Dredged Material Management Plan (DMMP)
EOEA No. 11669

Draft Environmental Impact Report (DEIR)

for New Bedford and Fairhaven Massachusetts

Office of Coastal Zone Management
City of New Bedford, MA
Town of Fairhaven, MA

April 30, 2002

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Prepared For:
Office of Coastal Zone Management
City of New Bedford, MA
Town of Fairhaven, MA

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New Bedford/Fairhaven Dredged Material Management Committee
MA Department of Environmental Protection
MA Department of Environmental Management
MA Division of Marine Fisheries
MA Board of Underwater Archaeology
US Army Corps of Engineers
National Marine Fisheries Service
US Environmental Protection Agency
US Fish and Wildlife Service

Any errors in the use of data, policy guidance and/or recommendations provided for this document are the sole responsibility of CZM.

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SECTION 1.0 - EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The New Bedford/Fairhaven Harbor Dredged Material Management Plan (DMMP) Draft Environmental Impact Report (DEIR) relies on the New Bedford/Fairhaven Harbor Plan to define, formally, local interest in dredging. The harbor planning process was designed to include exhaustive public participation and to ultimately reflect local consensus on harbor development priorities. Thus, while the DMMP provides technical assistance to the local discussion, the concerns, objectives and conclusions about dredging have been developed by the City and the Town. With the completion of the New Bedford/Fairhaven Harbor Plan, the DMMP can move forward with detailed technical assistance in the form of this DEIR in support of locally established objectives.

This summary of the New Bedford/Fairhaven Harbor DMMP DEIR presents an overview of the full report contents, lists the principal environmental impacts of the alternatives for dredged material management and identifies measures to be implemented to mitigate unavoidable environmental impacts.

1.1 Name and Location of Project

The project described in this DEIR is the New Bedford/Fairhaven Harbor 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 (CZM), 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.

1.2 Project Description

This DEIR includes 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 DEIR identifies two (2) proposed preferred alternatives for disposal of UDM, consisting of two Confined Aquatic Disposal (CAD) sites.

At this time, CZM is proposing two preferred alternatives, to gain public input into the disposal options proposed. Public comment will be invited on this DEIR in full compliance with the regulations implementing the Massachusetts Environmental Policy Act (MEPA). The proposed preferred alternatives will be evaluated by additional site specific analysis in the Final Environmental Impact Report (FEIR) subject to comments received on the DEIR.

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.

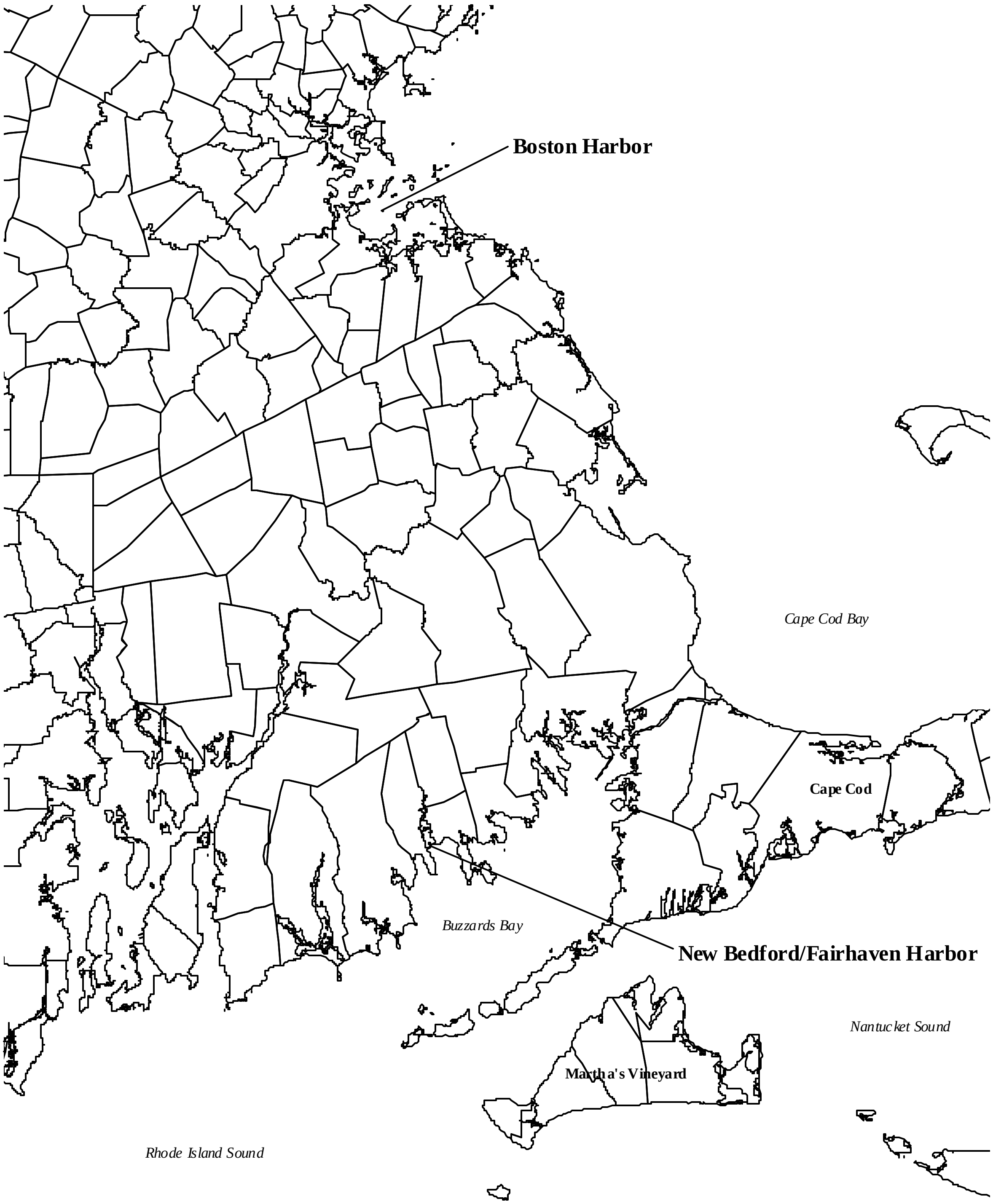

Figure 1-1: Location of New Bedford/Fairhaven Harbor (Base Map Source: MassGIS)

1.2.1 DEIR Development Process

The New Bedford/Fairhaven Harbor DMMP DEIR was developed in close coordination with a working group representing diverse local interests. This group, the New Bedford/Fairhaven Harbor Dredging Material Management Committee (DMMC), was appointed by the City and Town as an advisory body to the full Harbor Master Planning Committee. Six (6) presentations and two (2) screening meetings on the management of dredged material were held with the New Bedford/Fairhaven DMMC. All of the above meetings were publicly advertised and open to the public. In addition to the above, an additional meeting was held with the Harbor Forum stakeholders group. Further coordination with the Harbor Development Commission (HDC) is also reflected in the DMMP.

This project has also been coordinated very closely with State and Federal regulators with review jurisdiction over the disposal of UDM. Reviewing agencies have been involved at key project milestones, and their comments accordingly incorporated. This early coordination has been essential in developing the proposed preferred alternatives put forward in this report.

1.2.2 Public Comment Process

This DEIR represents a key milestone in the MEPA (Massachusetts Environmental Policy Act) review process for public comment. Upon notification of receipt of this DEIR by the Secretary of Environmental Affairs, in the *Environmental Monitor*, there will be a thirty-seven (37) day review period from the date of notification of the availability of the report. Comments on the New Bedford/Fairhaven Harbor DMMP should be directed to MEPA:

Secretary
Executive Office of Environmental Affairs
Attention MEPA Office
EOEA No. 11534
251 Causeway Street, Suite 900
Boston, MA 02114-2150

All comments made on the New Bedford/Fairhaven Harbor DMMP DEIR will be addressed in the FEIR, consistent with MEPA's purpose "to provide meaningful opportunities for the public review of potential environmental impacts" associated with the project. CZM will continue to coordinate closely with the City and Town in the development of the FEIR to provide opportunities for public involvement.

1.2.3 Purpose and Need

The purpose of the DMMP for New Bedford/Fairhaven Harbor is to identify, evaluate and permit, within the upland and aquatic Zones of Siting Feasibility (ZSFs) for New Bedford/Fairhaven Harbor (see Figures 1-2 and 1-3), dredged material disposal sites or management methods for the disposal, over the next ten (10) years, of UDM. 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.

Dredging Need

Based on dredging records collected in the Massachusetts Navigation and Dredging Management Study that was completed by the 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 for 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 twenty years has been estimated through surveys conducted by the USACE (1996) and Maguire (1997). The dredged material volumes were used to identify, plan and permit a disposal site(s) with sufficient long-term capacity to accommodate the needs for New Bedford/Fairhaven Harbor.

During the 1997 survey, all shoreline marina owners, municipalities, utilities, state and federal agencies were contacted via a mail-back questionnaire, with follow-up telephone calls to non-respondents. Marine users were asked to complete a questionnaire, denoting dredging footprints, volumes, and anticipated time schedule over the next twenty years. The total volume of sediment to be dredged from during that survey was estimated at 2,555,280 cy (2.6 million cy). This included the dredging needs of federal, state, local and private parties with channels, turning basins, or marinas within the harbor.

Accounting for recent developments in economic conditions, dredging need initially identified in Phase I for the twenty-year planning horizon, has been adjusted to establish baseline dredging demand for a ten-year period. The rationale for this adjustment is founded on the assumption that the ten-year period most accurately represents the volume of dredging that is likely to occur within the *Harbor Master Plan's* concurrent implementation time frame. The baseline dredging demand used in the New Bedford/Fairhaven Harbor DMMP is 960,000 cy. This number was adjusted downward from the 2.6 million cy identified in the dredging inventory as described above. The adjustment made reflects the lack of economic justification for federal participation (funding) to conduct the complete dredging of approximately 1,320,000 cy (1.3 million cy) of material for the main federal channel. After follow-up discussions with the USACE federal navigational maintenance dredging that is likely to go forward includes approximately 80,000 cy for the Fairhaven channel and 200,000 cy in the New Bedford channel. Coupled with the projected ten-year estimate of 680,000 cy of dredged material coming from private and public (non-federal) projects, unchanged from the original dredging inventory, a baseline dredging demand of 960,000 cy was established.

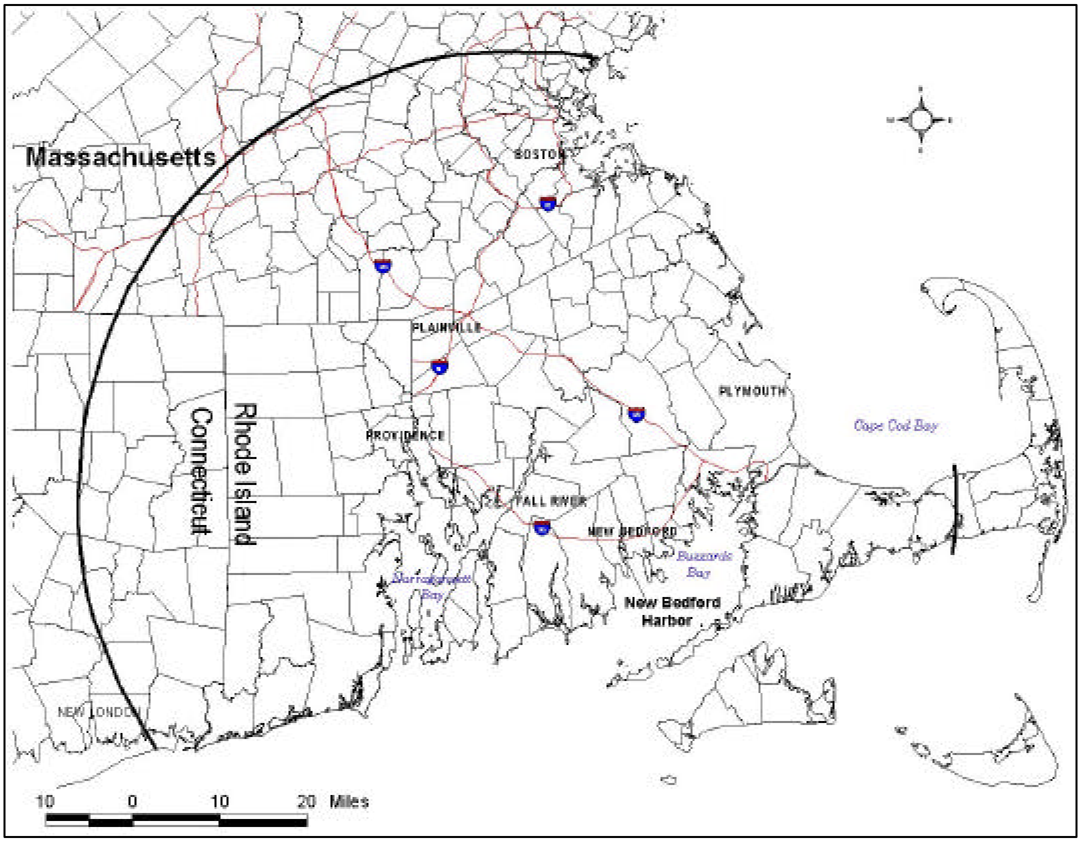

Figure 1-2: Upland Zone of Siting Feasibility (Base Map Source: MassGIS)

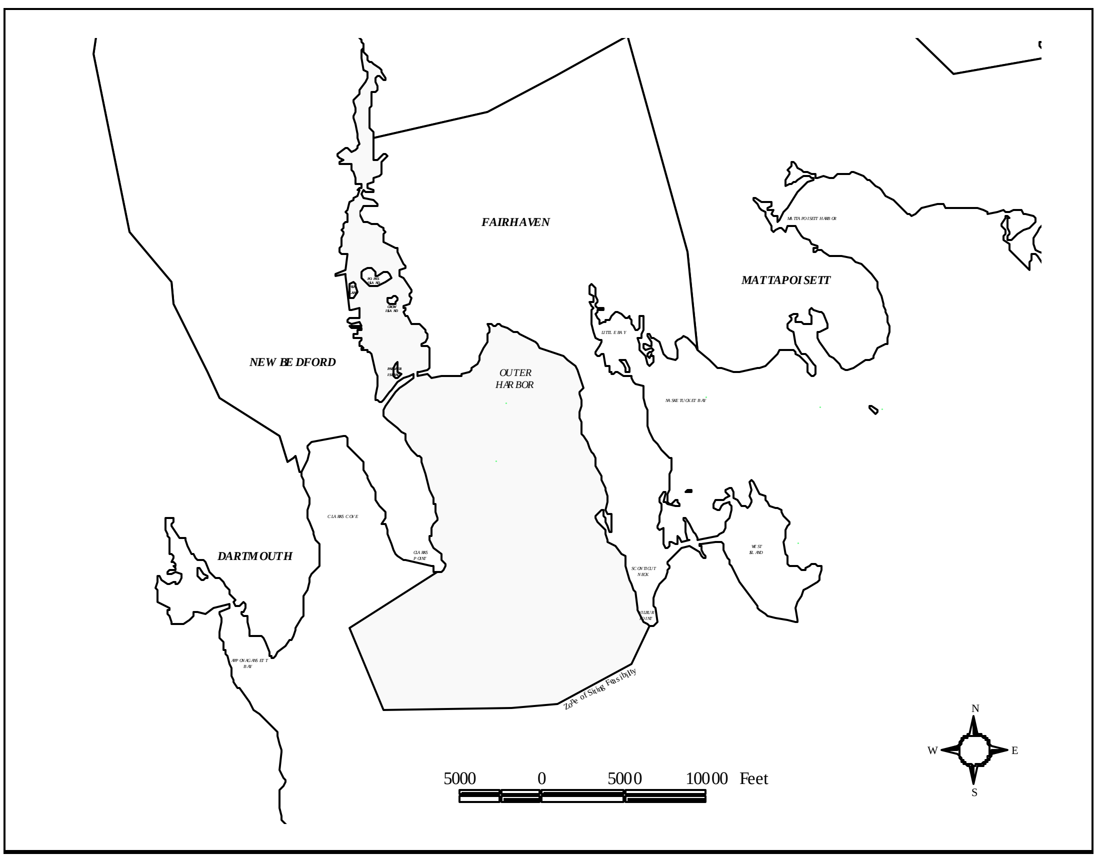

Figure 1-3: Aquatic Zone of Siting Feasibility (Base Map Source: MassGIS)

The remainder of the original volume will be carried forward and discussed in the context of the capacity of the Proposed Preferred Alternatives for conceptual future disposal plans (2011 – 2020) in Section 8. The City does not view this as curtailing New Bedford's ability to proceed, after the DMMP as an independent applicant under an unrelated action and associated Basic Project Purpose, for an additional range of disposal alternatives for future federal improvement work that accommodates additional City objectives (marine and transportation infrastructure development).

Sediment Quality

In order to evaluate the quality of potential sediment to be dredged from New Bedford/Fairhaven Harbor, as part of the DMMP, a preliminary determination of its suitability for open ocean disposal is offered in this DEIR. This preliminary determination is based upon a comparison of sediment chemistry results from samples taken within proposed 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).

Sediment chemistry data for the major dredging projects in the New Bedford/Fairhaven federal navigation areas were used to evaluate those specific project areas, but this data is also useful in assessing the suitability of sediments at nearby facilities that have expressed an interest in dredging. Those facilities that are distant from any sampling locations were assessed based on: historic sediment quality data (if any); proximity to pollution sources; and, general oceanographic conditions, i.e. is the site within a high or low energy environment.

Given the sediment chemistry reviewed, it is assumed that all sediments from New Bedford/Fairhaven would be unsuitable for ocean disposal at MBDS (Table 1-1). Sediments in the lower harbor channel and near Fish Island contain elevated concentrations of metals, Polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbon (PAH), 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 are 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.

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

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, 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.

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.

1.2.4 Alternative Disposal Sites

Universe of Sites

Possible geographical locations to implement upland and aquatic disposal alternatives for UDM were investigated within the upland and aquatic ZSFs defined for the New Bedford/Fairhaven Harbor DMMP. The logistical basis for each ZSF, described below, 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 follows.

Upland Universe

The Upland ZSF was established based upon a reasonable truck travel distance from New Bedford/Fairhaven Harbor. A 50-mile ZSF (Figure 1-2) was established because it is the maximum distance a truck could travel to and from the dewatering site in a normal eight-hour working day. This included the time for loading and offloading at the dewatering site and disposal site, respectively. The Upland ZSF includes: most of eastern and southeastern Massachusetts, extending as far west in central Massachusetts as I-495; the entire state of Rhode Island and a portion of eastern Connecticut. Commercial landfills within these states were also investigated.

All possible upland disposal sites, 1,123 total, were identified by locating areas that could physically accommodate the UDM volume estimated in the DMMP Phase I inventory report. The purpose of this effort was to identify the largest possible universe of potential sites for analysis. The locations evaluated for this effort included all existing landfills (commercial and private), other areas identified by previous upland evaluations (MWRA, Boston Harbor, etc.). In addition, a statewide announcement for interest from landowners to accept the UDM was conducted to complete the comprehensive search for possible sites within the Upland ZSF. No detailed environmental or socioeconomic assessments were performed at this level.

Aquatic Universe

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 (Figure 1-3). 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 were 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. Again, no detailed environmental or socioeconomic assessments were performed at this level.

<u>Screening Process</u>

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
- Application of site selection screening criteria
- Identification of preferred alternatives

Initial Screen for Feasibility

From the universe of potential sites, CZM applied a screen for feasibility and eliminated sites that were clearly not suitable for disposal of dredged material. Sites were screened out because of the surrounding land uses (for upland sites), lack of protection from erosive bottom currents (aquatic sites), lack of access for the disposal type, or insufficient capacity as discussed in Section 4.0. Alternative treatment technologies were evaluated for capabilities and logistical requirements of the process equipment, current and projected costs. Because new technologies are evolving, alternative treatment technologies are carried forward as an "open" category where practicable technologies will be assessed as they emerge. Sites that were not feasible disposal options were permanently eliminated from further consideration in this DEIR. Feasible sites were identified as Candidate Sites.

Application of Screening Criteria

In preparation for site selection screening, CZM developed site selection screening criteria based on the United States Army Corps of Engineers (USACE) Providence River Draft Environmental Impact

Statement (USACE, 1998). The development of these criteria was coordinated with local, state, and federal agencies for concurrence. Site selection criteria were the standards by which the candidate sites were evaluated.

Site selection criteria were distinguished as either "exclusionary" or "discretionary"**.** Exclusionary criteria reflect a state or federal prohibition on dredged material disposal. For example, Stellwagen National Marine Sanctuary regulations prohibit dredged material disposal within the sanctuary. Had any candidate sites been situated within sanctuary boundaries (none were), this exclusionary criterion would have prohibited further evaluation of that site. Discretionary criteria are those that determine, when applied as a group, which sites are least or best suited for dredged material disposal. For example, the potential impacts to finfish spawning or nursery habitat were evaluated under discretionary criteria: the presence of such habitat in a candidate site would not automatically exclude the site from further consideration, but would identify that site as less desirable than one in which such habitat was absent. The application of various discretionary criteria was the main component of the screening process, and it was the process by which sites were compared, using the quantitative, site-specific information and regional characterizations to make a qualitative decision – which site was "best".

To determine whether a given site included the exclusionary criteria and to determine how it compared to the discretionary criteria, site specific information was developed. Data sheets were developed for each candidate site, listing the environmental, social, political, and economic features of the site.

Candidate sites were screened under the exclusionary criteria. Those that failed were eliminated from further review. Sites that do not have features that are exclusionary became Potential Alternatives**.** Potential Alternatives were, then, reviewed using the discretionary criteria. Each Potential Alternative was assigned a relative ranking. Sites having significant limitations received low rankings; sites with fewer limitations received higher rankings.

The result of the screening process was a continuum of sites, from least to most appropriate for each disposal type evaluated. The least appropriate sites were categorized as reserve sites**,** and, as the name implies, were carried forward in reserve, but subjected to further analysis. More appropriate sites for dredged material disposal were categorized as Proposed Preferred Alternatives**.** Proposed preferred alternatives were presented to the City and federal agencies for comment. Results of the former, resulted in refining and the identification of the Preferred Alternatives Sites The DMMP Disposal Site screening process is shown in Figure 1-4.

The New Bedford/Fairhaven Harbor DMMP DEIR investigated the potential for the treatment of UDM with alternative treatment technologies to create material for beneficial uses, disposal in upland and aquatic locations. Additionally, the DMMP evaluated potential dewatering sites, critical to implementing alternative treatment technologies and upland disposal options. The following sections summarize the results of the alternative technology assessment, dewatering, upland and aquatic site screening.

Alternative Technology Assessment

Alternative treatment technologies involve the treatment of UDM, using one or more processes, to allow for reuse of the sediment in a safe manner in the upland environment or for unconfined open water disposal.

There are four general types of treatment technologies, categorized based on their effect on the contaminants of concern within the sediment:

- *Destruction*; the removal of contaminants from the sediment via physical, chemical or biological agents;
- *Separation*; the process of removing contaminants from the sediment resulting in a concentrated residual of contaminated sediment of significantly smaller volume;
- *Reduction*; the process of reducing the amount of contaminated dredged material that requires treatment by screening sediments into various particle sizes; and
- *Immobilization*; the fixing of contaminants in the dredged material which keeps the contaminants from being released to the environment.

Fourteen (14) classes of treatment technologies were evaluated within the four broad categories listed above, involving a comprehensive survey of technology vendors. The results of the alternative treatment technology assessment indicate that, at this time, alternative treatment technologies do not appear to be a practicable solution to the management of UDM from New Bedford/Fairhaven Harbor, primarily based upon cost effectiveness and market for materials.

However, alternative treatment technologies may prove viable for small projects, those that deal with unique and/or specific type(s) of contaminant(s), or as an element of a larger UDM management technique. Alternative treatment technologies are a rapidly growing and evolving field and it is very likely that as ongoing and future pilot and demonstration projects occur, the universe of technically viable, cost-competitive, and permittable alternatives may emerge.

For this reason, the DEIR carries forward all alternative treatment technologies as "potential future alternatives", and specifies the various general performance standards which alternative treatment technologies must meet to be considered as a practicable alternative (see Section 4.5 for a discussion of Beneficial Use Determination (BUD) process). This flexible approach will provide a baseline from which proponents of alternative treatment technologies can develop and present specific, detailed proposals, and will allow the state to focus its reviews on potentially practicable proposals. This approach is based on the Boston Harbor EIR/EIS. The DMMP will reevaluate, on a five year cycle, the feasibility of alternative treatment technologies for UDM in New Bedford/Fairhaven Harbor and other harbors throughout the Commonwealth.

CZM is aware that DEP is currently performing two major regulation reassessments that might affect the potential for alternative treatment technologies and/or beneficial use of dredged material. DEP is reassessing the BUD regulations and is expected to issue revised regulations in 2002. BUD revisions will be reviewed to determine whether they will have any significant impact on permittability. DEP's revision to its 401 WQC Dredging Regulations, to develop a set of comprehensive regulations for dredging and management of dredged material, anticipates going to public review/promulgation in late 2002 and will take into account planning, permitting, and implementation phases. Additionally, CZM is represented on the regulation revision workgroup and has been incorporating drafts of the regulations into the DEIR as guidance.

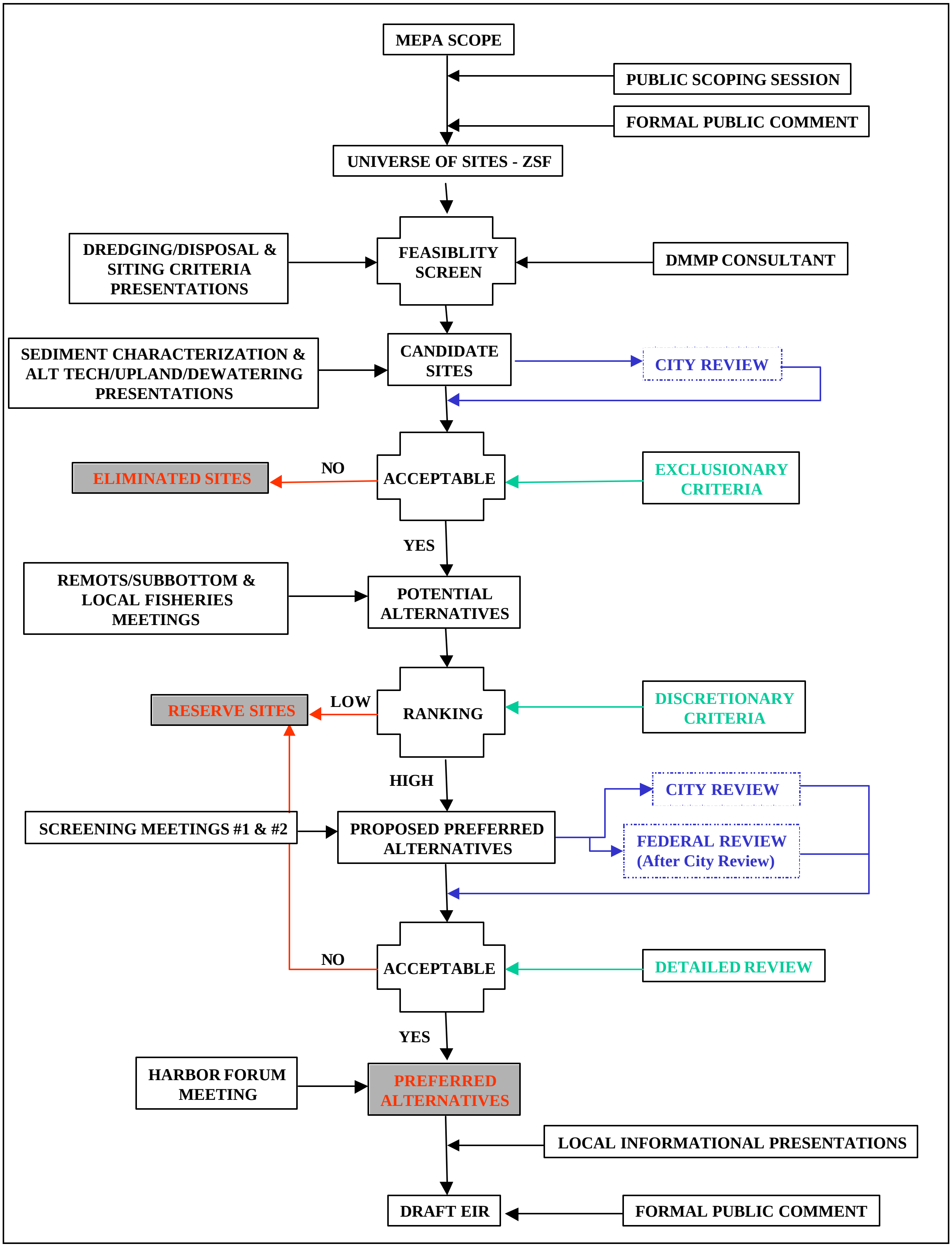

Figure 1-4: DMMP Disposal Site Screening Process

Dewatering Sites

All upland disposal/reuse and most alternative treatment technologies require a shore-front site of adequate size and availability to dewater dredged material prior to transport to an upland site. A total of ten (10) potential dewatering sites were identified along the commercial and industrial shorelines of New Bedford and Fairhaven. The universe of dewatering sites is shown in Figure 1-5.

As with the aquatic and upland sites, the ten (10) candidate dewatering sites were subjected to a two tier process involving the initial screening for exclusionary site factors and a second tier screening for discretionary factors. The exclusionary factors only apply to the harbor side site requirements, all other criteria are discretionary. The minimum site area required for a DMMP dewatering site was estimated to be 3.2 acres. This estimate was based on practical application of DEP policies and guidance, and a minimum project size of 10,000 cy. None of the ten (10) sites met all of the DMMP screening criteria, nor were the sites practicable for dewatering dredged material.

The USEPA is currently planning to transport dredged material to upland disposal locations that it will be remediating as part of the Superfund project. As part of this revised alternative, USEPA will be establishing a desanding facility in the Upper Harbor, where desanded material would be pumped, via a pipeline, to an enclosed sediment dewatering facility (to be built) along the western side on the Inner Harbor. Dewatered dredged material would then be loaded onto railway cars and transported to an upland disposal facility. While future potential opportunities to use this site by entities other than USEPA are unknown at the present time, an assessment of practicability for use as part of the DMMP will be included in the FEIR. However, based upon the costs and limited capacity available for upland disposal of DMMP material and logistical concerns (potential cross-contamination), this option is not expected to provide a cost-effective option for most of the UDM.

Upland Sites

Upland reuse and disposal alternatives involve the placement of UDM on land. The site can be an existing active or inactive landfill, or an undeveloped parcel of land. Dredged material can be used as daily cover or final cover for landfills, provided the material meets the physical and chemical specifications for such use. Dredged material placed on an undeveloped parcel of land could be managed as a monofill (landfill for dredged material only), or could be used as a fill or grading material that has a beneficial end use (e.g. ball fields, golf course), provided the physical and chemical properties of the dredged material permit such use. There are currently no regulations in Massachusetts which specifically apply to the disposal of dredged material in the upland environment, therefore the disposal of the material is guided by policy (COMM-94-007 and COMM-97-001) and regulated under the Commonwealth's Solid Waste Management Regulations (310 CMR 16.00 and 19.000).

The total universe of upland sites was subjected to an initial feasibility screen that evaluated the site for a minimum capacity 10,000 cubic yards, and its compliance with setback requirements specified in the Solid Waste Regulations. These factors dictated a minimum site size of twenty-five (25) acres. A total of 270 sites in the upland universe were smaller than 25 acres and were eliminated, leaving a total of 853 candidate disposal sites from an initial universe of 1,123 sites.

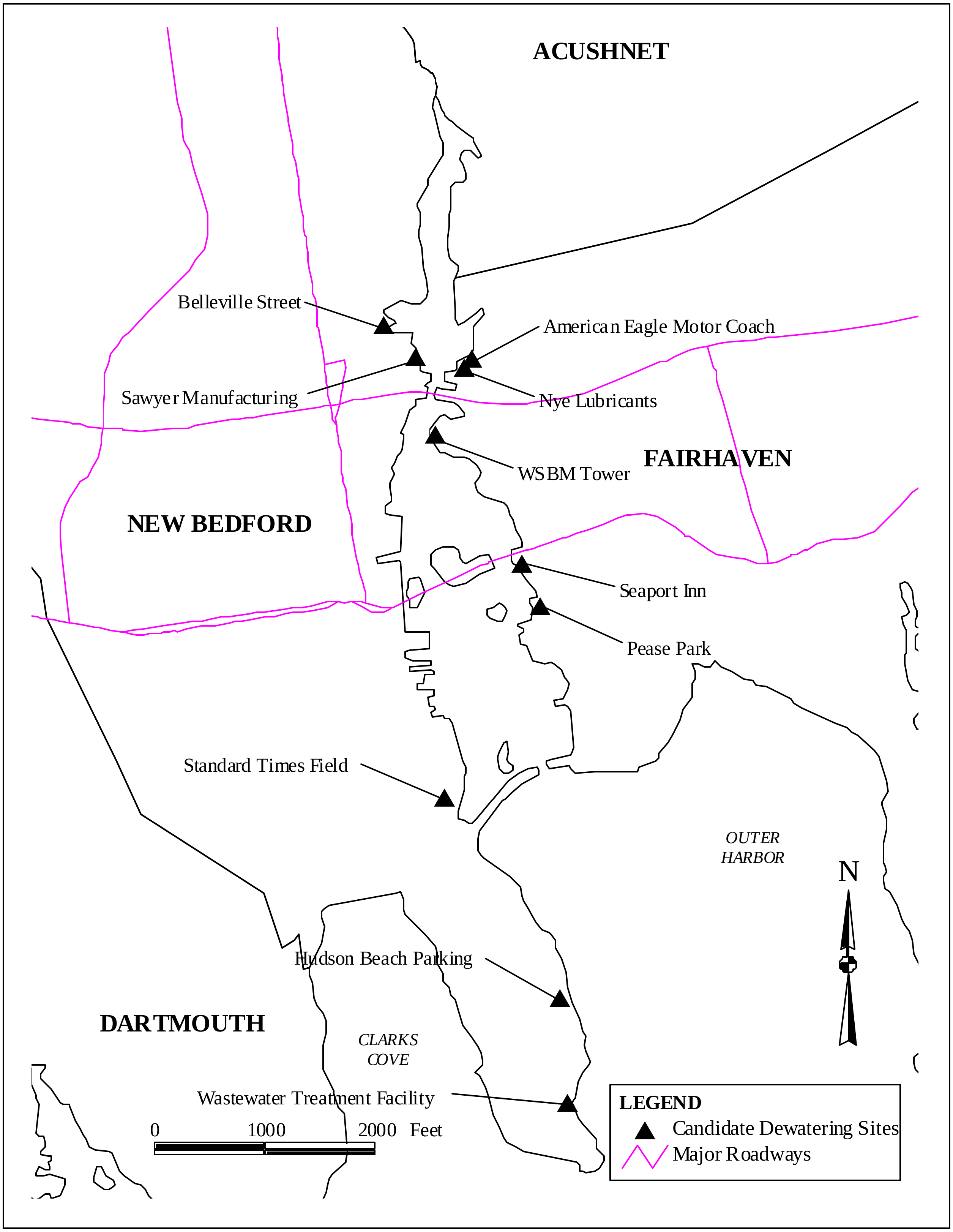

Figure 1-5: Candidate Dewatering Sites

The candidate sites were screened through a series of exclusionary criteria that examined factors that would essentially prohibit upland disposal based upon state or federal law or regulation. The close proximity to drinking water supplies, is an example of an exclusionary criteria which, would precludes the area from use as a disposal site. After applying the five exclusionary criteria (discussed in Section 4.7.2.1) 837 additional sites were eliminated, leaving 8 potential alternatives within the 50-mile ZSF, which were carried forward for further analysis (Figure 1-6).

As a result of the application of the discretionary criteria, it has been determined that none of the 8 potential upland disposal sites would be considered preferred alternatives for disposal of UDM from New Bedford/Fairhaven Harbor. Although some of the 8 sites have greater merit than others, none of the sites, either alone or in combination, satisfy the goals of the DMMP. There are several environmental, logistical, and cost constraints that make upland disposal an infeasible alternative. Among them are:

- 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 traditional open water disposal or CAD 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 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.

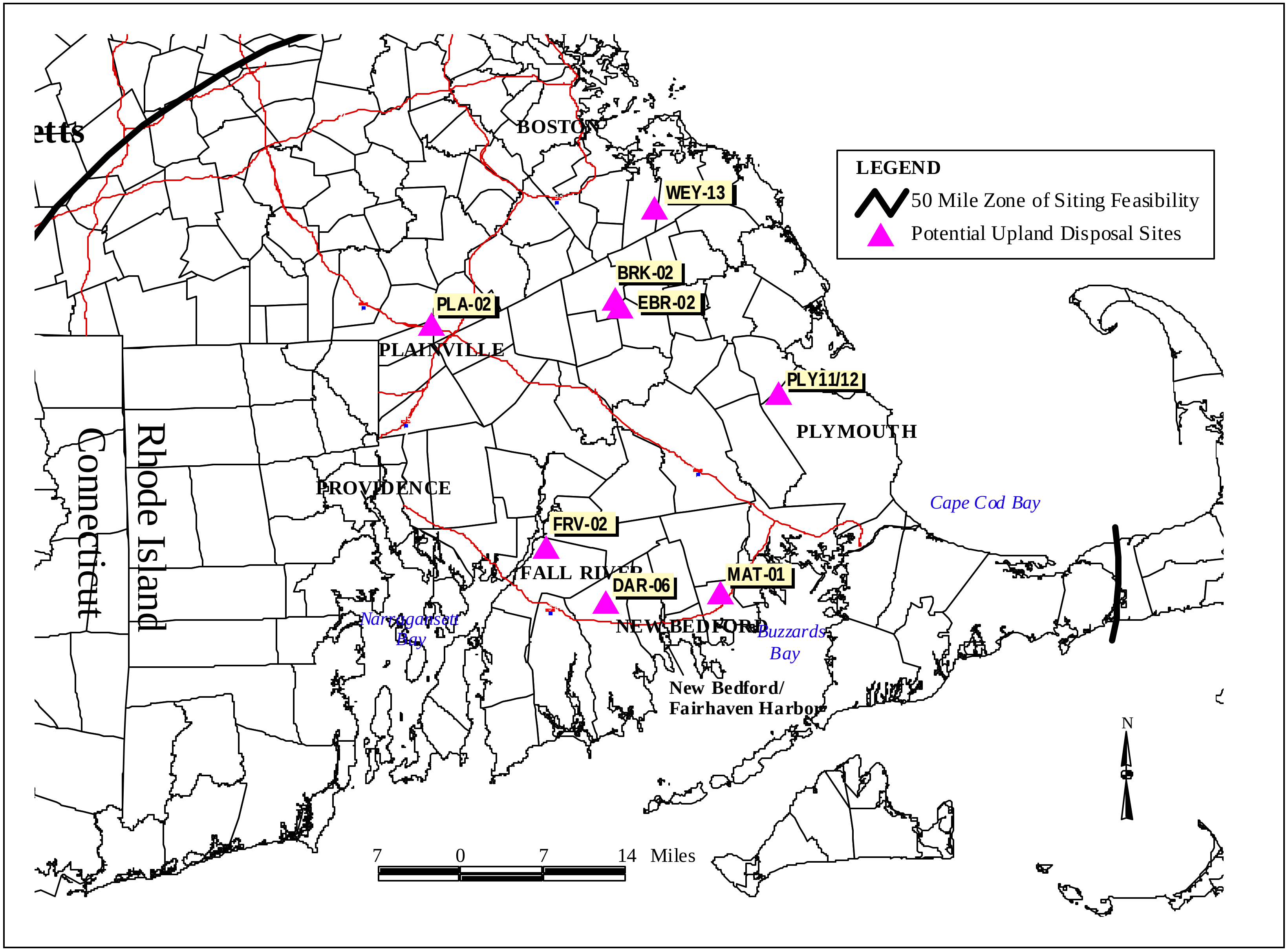

Figure 1-6: Potential Upland Disposal Sites

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 (Figure 1-7).

- Open water CAD site: CAD cell is constructed on the ocean bottom, or UDM is deposited in an existing depression in the ocean floor (Figure 1-8).

- 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 include port expansion and open space land creation (Figure 1-9).

- 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 (Figure 1-10).

A multi-step siting process was used to identify and screen aquatic disposal sites for UDM from New Bedford/Fairhaven Harbor. The first stage of the siting process was to define the range of disposal options by delineating a ZSF for New Bedford/Fairhaven Harbor (Figure 1-3). The technical description and rationale for delineation of the ZSF is fully described in Section 4.8.1. During Phase I of the DMMP, aquatic areas within 10 miles of the lower harbor were investigated to determine which areas may be suitable for dredged material disposal based on physical characteristics alone. For example, sites that are located in seafloor depressions were identified in the outer harbor and Buzzards Bay. Sites within and adjacent-to-channel in the outer, upper and lower harbors were also identified as were developed shorelines areas that had the physical potential for use as CDFs. Using this rationale, a total of 19 aquatic disposal sites within the New Bedford/Fairhaven Harbor and a portion of Buzzards Bay were identified.

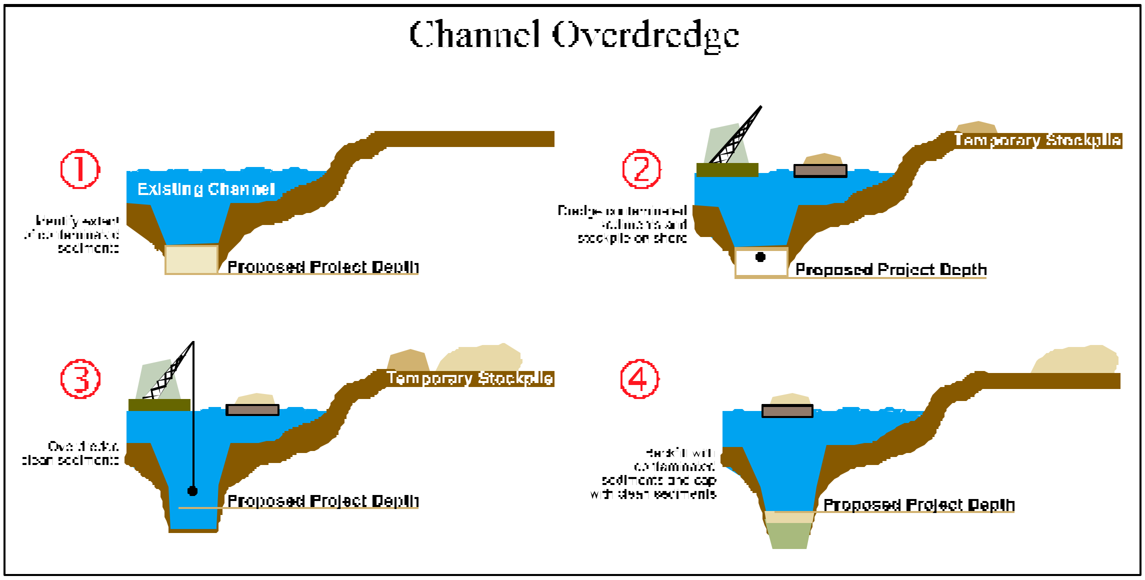

Figure 1-7: Schematic of Channel Overdredge (OD) method

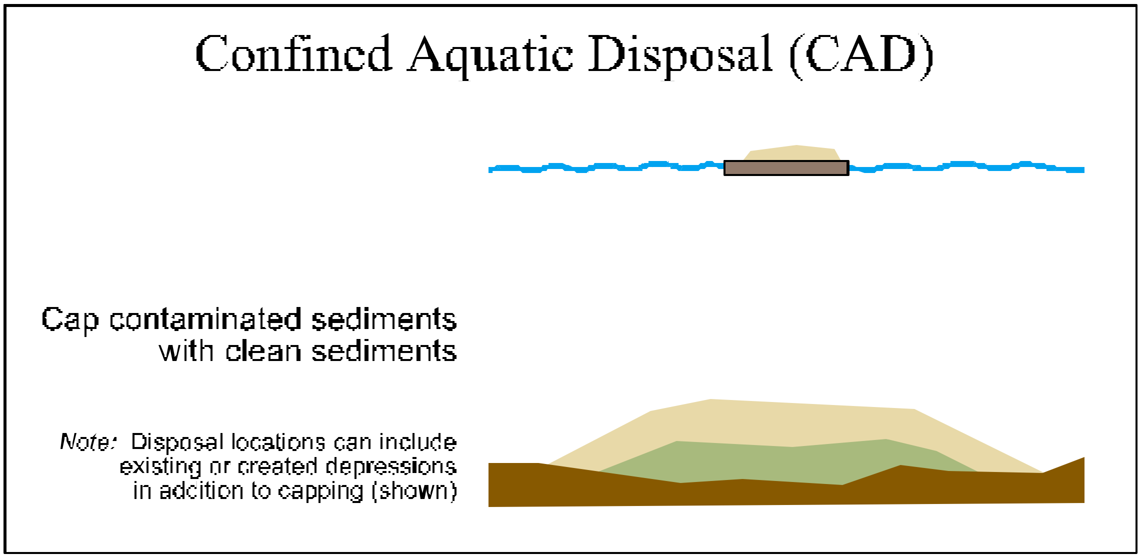

Figure 1-8: Schematic of Confined Aquatic Disposal (CAD) method

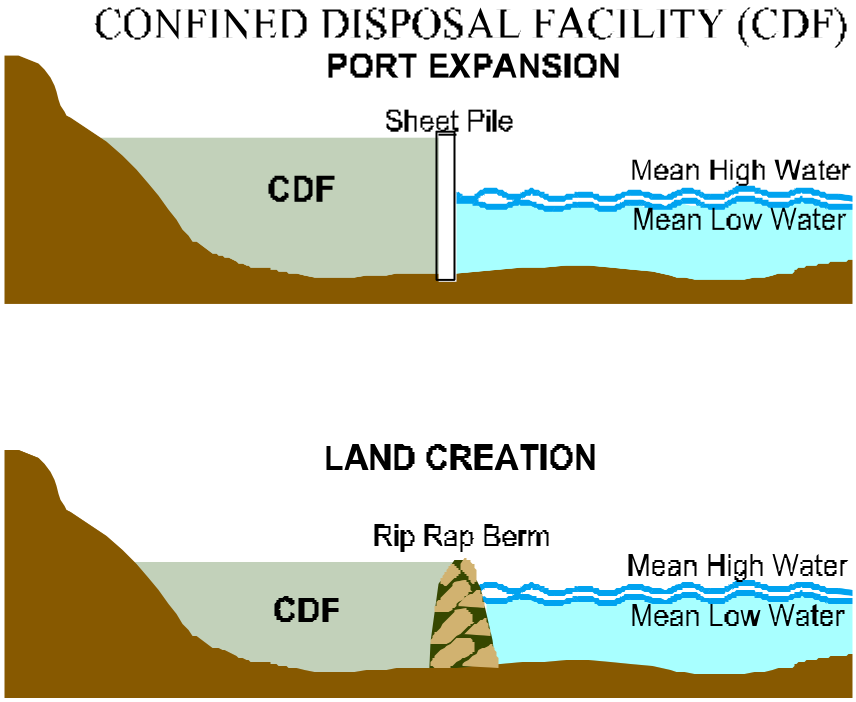

Figure 1-9: Schematic of the Confined Disposal Facility (CDF) method

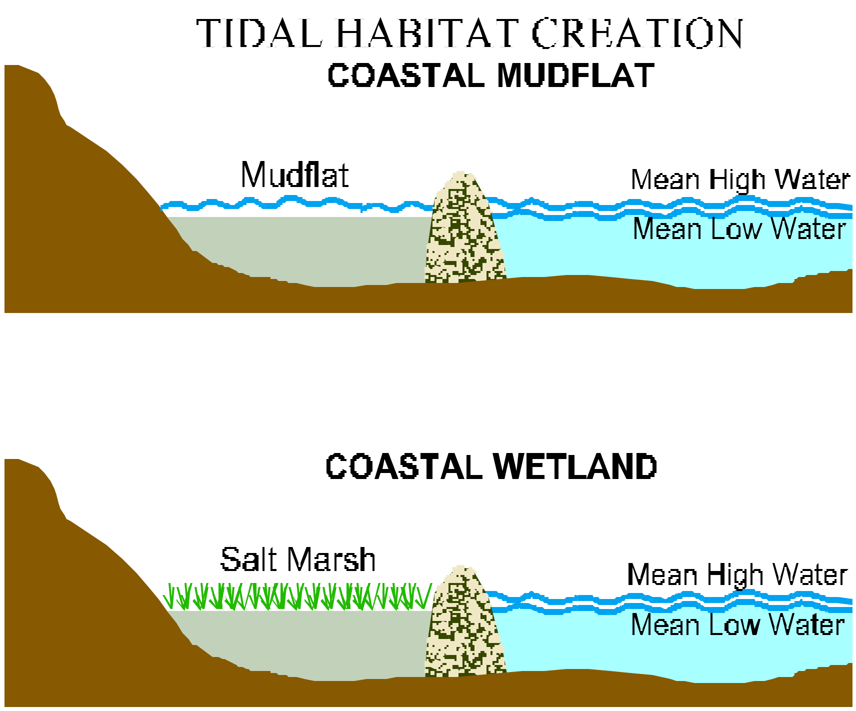

Figure 1-10: Schematic of the Tidal Habitat (TH) creation method.

After completion of the first phase of the DMMP, the New Bedford/Fairhaven Harbor ZSF was established. A line was drawn from Wilbur Point to Clarks Point across the outer harbor and all sites south of this line were eliminated (Figure 1-11). Sites south of the line were excluding for one or more of the following reasons: 1) sites further into Buzzards Bay have increased wind and wave exposure, therefore containment of UDM in a CAD or capped mound could be problematic; 2) gross sediment mapping of the seafloor (Moore, 1963) indicates that sites further into Buzzards Bay proper have sandy bottoms, which implies an erosional environment; and, 3) sites further in the bay have been less disturbed by man-made forces (dredging, dredged material disposal, wastewater disposal) than sites further inshore.

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 (Figure 1-12)

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. 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.

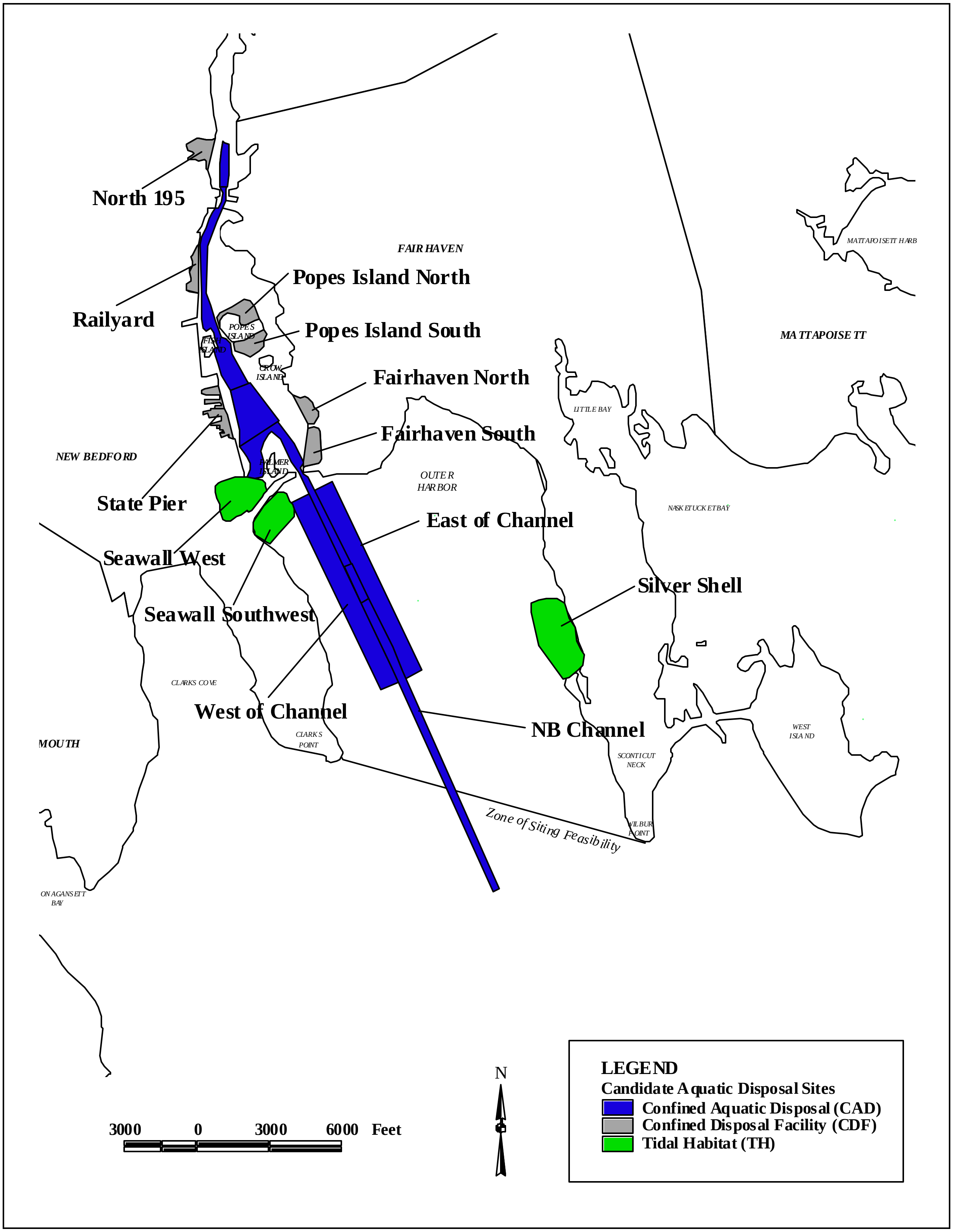

Figure 1-11: Original ZSF and Candidate Aquatic Disposal Sites

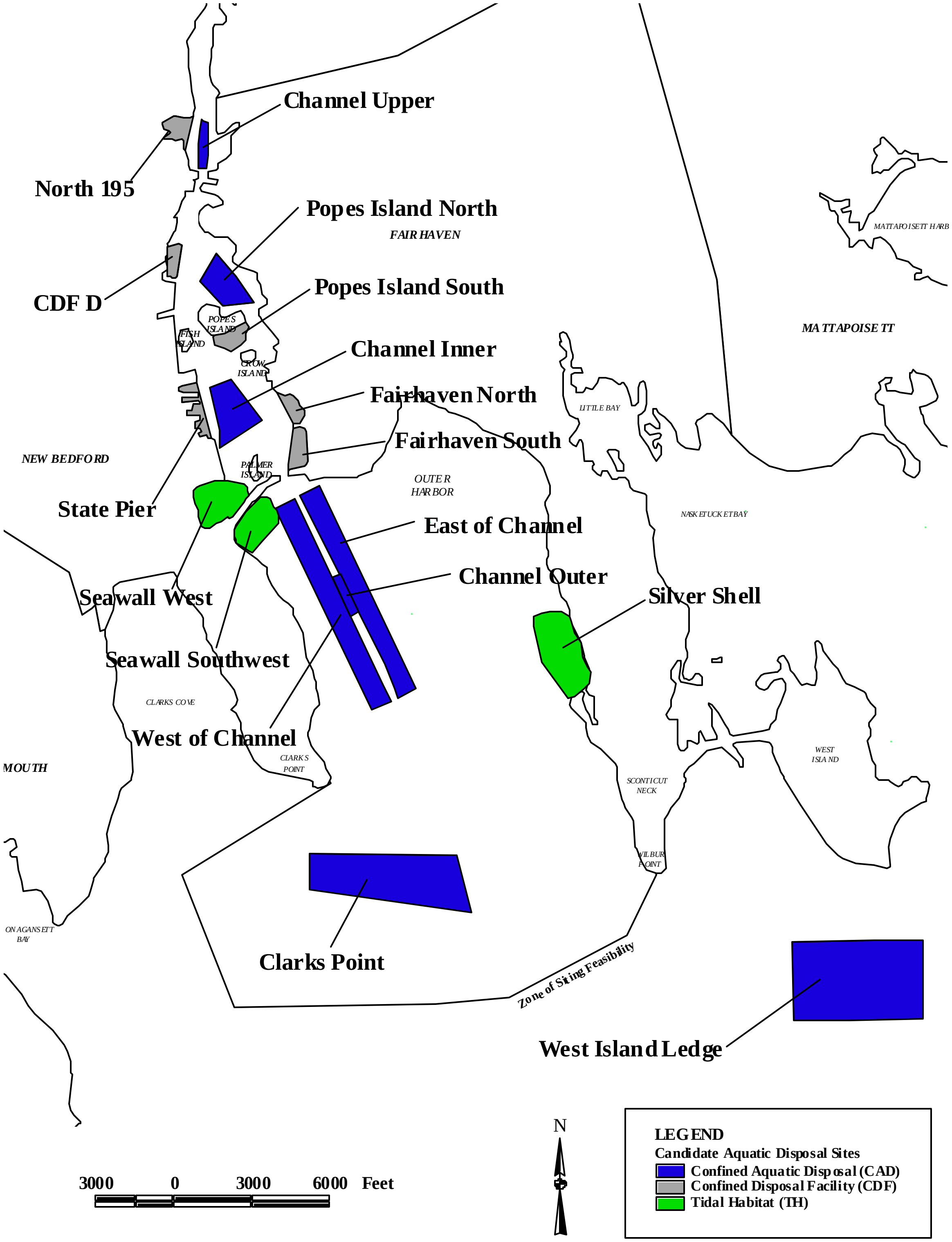

Figure 1-12: Expanded ZSF and Candidate Aquatic Disposal Sites

1.2.5 Identification of the Preferred Alternative

After evaluating and screening the physical, biological, jurisdictional, economic and other factors for the universe of aquatic disposal sites, two sites were selected as proposed preferred aquatic disposal areas (Table 1-2). These sites are Inner Channel and Popes Island North CADs. These sites (either alone or using sub-cell combinations) 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 (see Figure 1-13).

<u>Physical Attributes</u>

- *Capacity* - Of the two Proposed Preferred Aquatic Disposal Sites in New Bedford/Fairhaven Harbor, the Channel Inner and Popes Island North sites have adequate capacity to accommodate the estimated 960,000 cy of UDM. The amount of expected capacity in Popes Island North is almost three times that of the Channel Inner CAD.

- *Bottom Type* - The existing bottom type at both sites is soft silty sand or mud, which is similar to the type of dredged material that would be disposed of there.

- *Distance* - The sites are proximal to all dredging projects in New Bedford/Fairhaven Harbor. This increases the efficiency of dredging and disposal and decreases the chances of accidental spillage of UDM from barges.

- *Water Depth* - Water depth varies between the two sites from six feet below mean low water (Popes Island North) to 28 feet below mean low water (Channel Inner site), which is sufficient to accommodate the drafts of dredging equipment, however disposal at Popes Island North would require dredging an entrance channel.

- *Navigation* - One of the sites (Channel Inner) is located within the limits of New Bedford/Fairhaven Harbor Federal Channel. Commercial fishing ships also use the channel, which would require navigation coordination during construction and disposal to avoid disrupting the flow of vessels within the harbor. The sites would not infringe upon seawall docking areas.

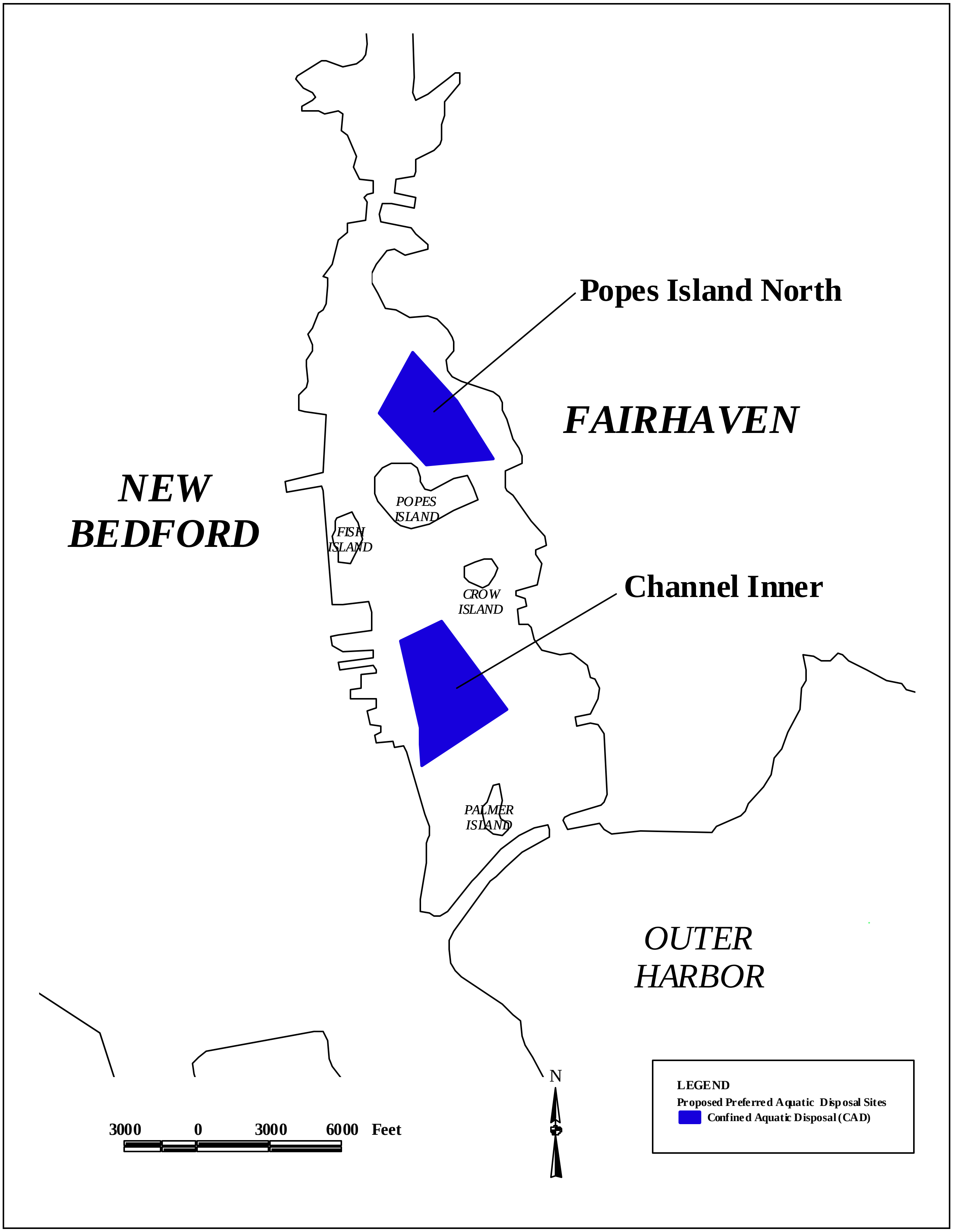

Figure 1-13: Proposed Preferred Aquatic Disposal Sites

Biological Attributes

- *Finfish* (Inner Harbor)- The two proposed preferred aquatic disposal sites are expected to have some nursery potential for ecologically and economically important finfish. The Channel Inner and Popes Island North CAD sites are closed to all finfishing activity.

- *Lobster* - The vicinity of the two proposed preferred aquatic disposal sites are closed for commercial harvest of lobster. The habitat, soft silty sand and mud, is not a preferred substrate for lobsters (located throughout the harbor) however, lobsters are expected to occur proximal to these sites.

- *Benthos* - Despite relatively high concentrations of metals, PAHs, and PCBs, the sediments of the aquatic disposal sites are well oxygenated and supportive of diverse and abundant benthic invertebrates. OSI values averaged 4 at both Channel Inner and Popes Island North sites.

- *Shellfish* - Quahogs, located throughout the harbor, are its most economically important shellfish species. Many beds are closed due to bacterial contamination as evidenced by high coliform counts. The Channel Inner and Popes Island North sites lie within prohibited harvest areas. Some areas of the Inner Harbor are used for seed stock and depuration programs. A portion of the Channel Inner site lies within the northern limits of a primary priority contaminated shellfish relay area.

- *Coastal Wetlands/Submerged Aquatic Vegetation* - The proposed preferred aquatic disposal sites are not located within or adjacent to a salt marsh, intertidal wetland, or an SAV bed. Salt marsh and intertidal areas lie northeasterly of Popes Island North and southwesterly of the Channel Inner site. The closest SAV bed lies to the southeast, outside of the Hurricane Barrier.

Economic Attributes

- *Recreational and Commercial Fishing* -The location of the proposed preferred alternative sites are not in conflict with recreational and commercial fishing as the Inner Harbor is closed to fishing all fishing as a result of Superfund material releases. However, coordination during disposal operations at the Channel Inner site would need to occur to avoid disruptions to vessels using the navigation channel.

- *Water Dependant Use* - Disposal at the proposed preferred alternative sites would not conflict with existing or proposed water dependant uses. Disposal would not result in any long-term changes to navigational conditions. The timing of disposal activies, in the winter, would minimize the potential for temporary impacts to recreational navigation.

Regulatory/Practicability/Human Attributes

- *Consistency with Harbor Plan* -The sites are not in conflict with the *Harbor Plan*. Both sites are consistent with its goal of maintenance and improvement dredging within the harbor. In particular, the use of the Popes Island North area as a CAD site would not preclude the future use designated in the *Harbor Plan* as a CDF with marine industrial as the proposed end use. area. Use of Popes Island North would also require coordination with the proposed plans to relocate the Route 6 bridge.

- *Historical and Archaeological Resources* - No known shipwrecks lie within the footprints of the proposed preferred aquatic disposal sites, although further investigation would be needed for verification. Because of their near shore locations, there is potential for encountering prehistoric artifacts from aboriginal inhabitants. The probability of finding and recovering historical or archaeological artifacts within the cells is hindered by years of accumulated sediment.

- *Practicability/Permitability* - Average unit costs for disposal would be approximately $34/cy, which is similar to the costs for other CAD pit sites, but higher than for CAD mound sites in the off shore areas. Unit cost is slightly lower for Popes Island North due to smaller footprint requirement as a result of greater depth to bedrock. Similar sites in Boston Harbor have been approved by the USACE and DEP and are currently being used and the project is nearing completion.

Potential Environmental Impacts and Mitigation Measures

The potential environmental impacts and proposed mitigation measures for each of the proposed preferred alternative aquatic disposal sites for the New Bedford/Fairhaven Harbor DMMP are summarized in Table 1-3. A detailed analysis of project impacts is included in Section 6.0 of this document. Sections 8.0, 9.0 and 10.0 include a discussion of construction/management issues and potential mitigation measures for the proposed preferred alternatives. Specific environmental features are contrasted with the “no action alternative”, the alternative of not undertaking the project, to provide a baseline for comparison. The no action alternative is described in Section 4.2. Both impacts and mitigation measures are grouped by screening criteria for the no action alternative and proposed preferred alternative disposal sites.

Table 1-2: Summary of Attributes of Proposed Preferred Alternative Sites

	Channel Inner CAD	Popes Island North CAD
Physical Attributes		
Capacity (cy)	1,222,575	3,226,108
Bottom Type	Mud	Mud
Distance (miles)	1.8	1.1
Water Depth (feet)	28	6
Navigation	Sufficient Depth for Navigation	Adjacent to Federal Channel; shallow depth (<7 feet)
Biological Attributes		
Fisheries	Moderate-High Nursery Potential	Some Nursery Potential
Lobster	Not a Preferred Substrate for Lobsters	Not a Preferred Substrate for Lobsters
Benthos (Mean OSI)	4	4
Benthos (Habitat Complexity)	10	1
Shellfish	Prohibited Harvest; (productive quahog beds throughout. A portion of this site lies within a primary priority shellfish contaminated relay area)	Prohibited Harvest; (productive quahog beds throughout)
Wetlands, SAV	None	None
Economic Attributes		
Recreational/Commercial Fishing	Closed to all Fishing Activity	Closed to all Fishing Activity
Water Dependant Use	Located in Navigation Channel	Not Located in Navigation Channel
Regulatory/Practicability/Human Attributes		
Consistency with Harbor Plan	Supports Harbor Master Plan	Supports Harbor Master Plan
Historic/Archeo-logical Resources	No known resources	No known resources
Cost ($ per cy)	$36	$40
Permitability	Potentially Permittable	Potentially Permittable

Table 1-3: Potential Environmental Impacts and Mitigation Measures Summary

AQUATIC SITES: Channel Inner and Popes Island North CAD Cells		
Environmental Feature	**No Action Alternative**	**Impact/Mitigation Measures**
Sediments	No Impact	Impact: Change in substrate conditions, from soft silt to sand. Mitigation: Recess final cap material elevation relative to existing elevation in order to encourage active sedimentation over cap if necessary.
Sediment Transport	No Impact	Impact: No permanent impact Mitigation: Avoid EPA hot spot area in Popes Island North vicinity until remediated
Water Quality	No Impact	Impact: Short term localized, degradation (e.g. increased turbidity and contaminant resuspension) due to dredged material disposal; Monitoring to ensure compliance with water quality standards Mitigation: Disposal only during favorable tidal conditions to minimize impacts. Implementation of CAD BMPs and Sample Water Quality Certificate.
Benthos	No Impact	Impact: Mortality of some benthic organisms. Change in substrate conditions will favor organisms that prefer sand. Mitigation: Recess final cap material elevation relative to existing elevation in order to encourage active natural sedimentation over cap, prompting natural recolonization of benthos, if necessary.
Shellfish	No Impact	Impact: Long-term impact to shellfish resources and footprint overlap with identified relay area. Mitigation: Avoid disposal under high turbidity conditions (e.g. unfavorable weather/tidal conditions) and use subcell disposal footprint at Channel Inner site that avoids relay area.
Lobsters	No Impact	Impact: Some mortality will occur during dredging and disposal. Benthic conditions will change, potentially influencing local lobster abundance and distribution. Mitigation: Per consultation with DMF and NMFS
Submerged Aquatic Vegetation	No Impact	Impact: No resources within disposal site vicinity Mitigation: None Required
Wetlands	No Impact	Impact: No impact to Federally designated wetlands. Impact to State-designated Land Under Ocean from cell construction and disposal activities Mitigation: Allow natural sedimentation of cap. Natural benthic recolonization expected.

Table 1-3: Potential Environmental Impacts and Mitigation Measures Summary *(continued)*

AQUATIC SITES: Channel Inner and Popes Island North CAD Cells		
Environmental Feature	**No Action Alternative**	**Impact/Mitigation Measures**
Finfish	No Impact	Impact: Seafloor habitat will be disturbed. Potential impact to early life history fishes. Mitigation: Time disposal activities to avoid peak spawning periods and other sensitive life stages.
Wildlife	No Impact	Impact: No impact to shorebird, waterfowl or seabird breeding habitat. No impact to shorebird foraging habitat. Minimal impact to waterfowl, and seabird foraging habitat. No impact to marine mammal and sea turtle breeding or foraging habitat. Mitigation: None Required
Endangered Species	No Impact	Impact: No impact to known endangered species habitat at disposal site Mitigation: None required
Lobstering	No Impact	Impact: Lobster habitat will be disturbed at the disposal sites. Lobstering is prohibited in Inner Harbor. Mitigation: Per consultation with DMF and NMFS.
Recreational Fishing	No Impact	Impact: Fish habitat in and near disposal cells will be affected during dredging and disposal. Recreational fishing is prohibited in the Inner Harbor. Mitigation: Construction activities to occur outside of peak fishing season.
Navigation and Shipping	Lack of disposal site may limit dredging activity which will lead to shallower water depths, affecting safe navigation and reducing moorings	Impact: Potential interference with commercial fishing and maritime vessel traffic. Mitigation: Timing of disposal and cell construction activities to avoid ship movements.
Land Use	Lack of disposal site may lead to loss of water-dependent uses, changing land use patterns, impose limitations on future economic diversification based on commercial shipping	Impact: No direct impacts; Positive indirect impacts resulting from maintenance of existing land use patterns and maintenance of options for future economic growth based on commercial shipping. Mitigation: None required
Consistency with Harbor Master Plan	Lack of disposal site is not consistent with Harbor Plan	Impact: Positive; disposal site is consistent with Harbor Plan objectives. Mitigation: None required

Table 1-3: Potential Environmental Impacts and Mitigation Measures Summary *(continued)*

AQUATIC SITES: Channel Inner and Popes Island North (continued)		
Environmental Feature	**No Action Alternative**	**Impact/Mitigation Measures**
Air Quality/Noise/Odor	No Impact	Impact: AQ - temporary diesel emissions;, potential volatilization of organic compounds; Noise - temporary increase in disposal site noise levels; some increase expected at nearby land side receptors; Odor- potential odor impact from hydrogen sulfide emanating from dredged material temporarily stockpiled on barges. Mitigation: AQ - use of properly operating equipment and participation in DEP's Voluntary Diesel Retrofit Program (VDRP), Noise- use of properly operating and mufflered equipment, operation during daylight hours; Odor- use lime to control objectionable odors emanating from dredged materials
Historic/Archaeological Resources	No Impact	Impact: Potential historic and archaeological resources to be further investigated; impacts to potential previously undiscovered historic shipwrecks unlikely due to previous dredging activities. Mitigation: Possible discovery, recovery and/or recordation
Recreation	No Impact	Impact: Recreational boaters temporarily diverted from area during cell construction and disposal operations, cell construction and disposal activities may drive fish from nearby recreational fishing areas Mitigation: None required

Disposal Costs

In the DEIR, disposal costs were calculated for each of the preferred alternative disposal sites. The average unit cost of disposal was calculated to range between $34 to $44 per cy (total cost ÷ UDM disposal volume) of UDM for subcells within both preferred alternative locations. An average value of $39 per cy was used for planning purposes in the DEIR. The cell construction unit cost calculated does not include the cost of dredging and transport of UDM from individual facilities. Nor does it include any sediment testing that may be required of individual project proponents using a DMMP disposal site.

To illustrate the relative costs of disposal types considered in the DMMP, estimated costs were calculated to dispose of 1,000 cy of UDM for New Bedford/Fairhaven Harbor for comparison purposes (Table 1-4). The range of unit costs calculated for the preferred alternative cells are less than the range of values calculated for upland disposal and reuse of between $60 cy for grading/shaping material to $117 for a new landfill to dispose of UDM (see Section 4.7). The aquatic and upland disposal and reuse unit costs are directly comparable, in that both values do not include dredging and are based upon disposal of volumes of UDM identified in areas of potential dredging.

Table 1-4: Disposal Cost Comparison example for 1,000 cy of UDM

DISPOSAL TYPE	UNIT COST[1] ($/cy)	ESTIMATED COST ($/1,000 cy)
Aquatic Disposal[2]	$39.00	$39,000
Upland Disposal and Reuse - Shaping/Grading[3]	$60.00	$60,000
Upland Disposal and Reuse - Monofill[3]	$117.00	$117,000
Alternative Treatment Technology[4]	$99.00	$99,000

Notes:

1. UDM disposal costs only; does not include cost of dredging or testing by individual facilities
2. Average unit cost of five subcells considered in DEIR.
3. Assumes reuse as grading/shaping material. Please note upland disposal of UDM may require amendment of between 2 to 3 parts soil to 1 part of UDM.
4. Alternative treatment technology unit cost is for Solidification/Stabilization, the only technology demonstrating potential feasibility for New Bedford/Fairhaven Harbor UDM (see Section 4.5.5)

CAD Cell Sequencing

In order to contrast the planning horizon UDM volumes requiring disposal with the preferred alternative disposal sites, cell capacity calculations were conducted to determine the extent of the predicted disposal volumes occupying the preferred alternative disposal sites (see Section 8.0 for full description of conceptual engineering conducted). By contrasting the ability of each disposal cell to accommodate planning horizon UDM volumes, the following two potential phasing sequences were developed:

Scenario 1

- ***Channel Inner Subcell 1*** - Five Year Planning Horizon
- ***Channel Inner Subcell 2*** - Ten Year Planning Horizon

Scenario 2

- ***Channel Inner Subcell 3*** - Five Year Planning Horizon
- ***Popes Island North Subcell 4*** - Ten Year Planning Horizon

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.

In the FEIR, detailed site specific data will be collected for the proposed preferred alternative sites. These data will be examined and revised cell capacities will be calculated based upon site-specific data and engineered designs. The results of the final design of the disposal cells will take into account the City and Town's cell phasing preference in developing the both the configuration of the final alternative disposal cell footprints and the phasing sequence proposed in the FEIR.

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 1-5 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 Section 7.0 of this DEIR.

1.2.6 Next Steps

The next key milestone in the DMMP Planning process is the development of the FEIR. After public and agency comments are received on this DEIR, and incorporated into the scope of the FEIR, the next phase of the DMMP will commence. The objective of study for the next phase for the New Bedford/Fairhaven Harbor DMMP is to collect, analyze, and report site-specific information regarding geological, hydrodynamic, and biological conditions at the preferred alternative site locations. Approval of these sites by federal and state regulators, the City of New Bedford, Town of Fairhaven and the general public requires the collection of additional environmental data to aid in the assessment of each site's suitability. In addition to the collection of site-specific environmental data, key management and policy issues will also be evaluated. Ongoing coordination with the USEPA and USACE will also explore potential beneficial use of clean material dredged for UDM capacity for use in harbor-wide wetlands restoration projects.

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 necessary to determine the nature of the material proposed for disposal.

Table 1-5: Potential local, state and federal permits and approvals

JURISDICTION	PERMIT/ APPROVAL	AGENCY	AQUATIC DISPOSAL
			CAD Cells
FEDERAL	***Section 10 Permit*** - Review of projects in navigable waters of the United States	Corps of Engineers	U
	Section 103 Permit - Approves transport of suitable dredged material to ocean disposal site	Corps of Engineers	U
	Section 404 Permit - Determines compliance with guidelines for discharges of dredged or fill materials into waters of the United States	Corps of Engineers	U
STATE	***MCZM Consistency Concurrence*** - Evaluation of a project's consistency with MCZM's policies and management principles	MA Coastal Zone Management	U
	MEPA Certification on DEIR and FEIR - Decisions of Secretary of Environmental Affairs on DEIR and FEIR and compliance with MEPA	MA Environmental Policy Act	U
	Chapter 91 License - Approves structures/activities below mean low water mark	DEP: Division of Wetlands & Waterways	U
	Water Quality Certification - Controls impacts to water quality and determines compliance with state water quality standards	DEP: Division of Wetlands & Waterways	U
LOCAL	***Wetlands Order of Conditions*** - Protection of Wetland Resource Area and compliance with WPA performance standards.	Local Conservation Commissions	U

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

CZM 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. This model may be appropriate to consider for New Bedford/Fairhaven Harbor.

It is important to note that (1) the final, approved management plan will 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 will occur until a management plan is developed, presented for public comment in the FEIR, and approved by the City, Town, state and federal regulatory agencies.

CAD Cell Best Management Practices

CZM 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.

Site-Specific Environmental Data

The expected impacts of the proposed preferred alternative disposal sites were evaluated in this 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. The following site-specific efforts will be undertaken in support of continuing the MEPA and/or permitting processes to develop final concept designs:

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

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SECTION 2.0 - INTRODUCTION

2.0 INTRODUCTION

2.1 DEIR Organization

The organization of the New Bedford/Fairhaven Harbor DMMP DEIR follows the framework established in MEPA to fully explore alternatives, and is organized into the following sections (see Figure 2-1).

Section 1.0 - Executive Summary, summarizes the report contents, lists the principal environmental impacts of the alternatives and identifies mitigation measures to be implemented to mitigate unavoidable environmental impacts. This section also indicates the steps that will be taken prior to developing a FEIR.

Section 2.0 - Introduction, presents the reader with the background of the DMMP planning process, MEPA procedural history and a summary of "scoping" and coordination involved in developing this DEIR. This section also highlights the process of how issues of concern, identified by public input and agency review, through the DMMP process have been identified and incorporated.

Section 3.0 - Purpose and Need, details the project's purpose, and discusses the need for the project, the relationship between the DMMP with the New Bedford/Fairhaven Harbor port planning process, and a discussion of sediment quality and quantity. This section identifies the planning volumes of UDM that will be used as the required capacity baseline for this DEIR.

Section 4.0 - Alternatives Analysis, outlines the application of the DMMP disposal site screening process and criteria. This section presents the evaluation of potential impacts and benefits associated with the candidate sites or alternative treatment methodologies. This section details the potential impacts on specific resources in the vicinity of the disposal sites and in the case of alternative technologies, potential side-stream impacts associated with the implementation of specific treatment options.

Section 5.0 - Affected Environment, is a detailed description of affected environments in the vicinity of the aquatic and upland candidate disposal sites. This section presents a discussion of environmental and cultural resources which will be affected by the alternatives for UDM disposal, providing a baseline against which the impacts of disposal alternatives described in Section 4.0 can be analyzed in Section 6.0.

Section 6.0 - Environmental Consequences, evaluates, in detail, the potential impacts associated with implementation of the preferred alternatives for upland and aquatic disposal. This section outlines the cultural and environmental impacts of proposed aquatic disposal CAD alternatives, Channel Inner and Popes Island North. Also contained in this Section is a discussion of secondary impacts from anticipated dredging projects for potential impacts to wetland resources.

Section 7.0 - Compliance with Regulatory Standards, is an overview of the current regulatory framework under which disposal of UDM occurs. This section describes the applicable regulations associated with implementing the Preferred Alternatives.

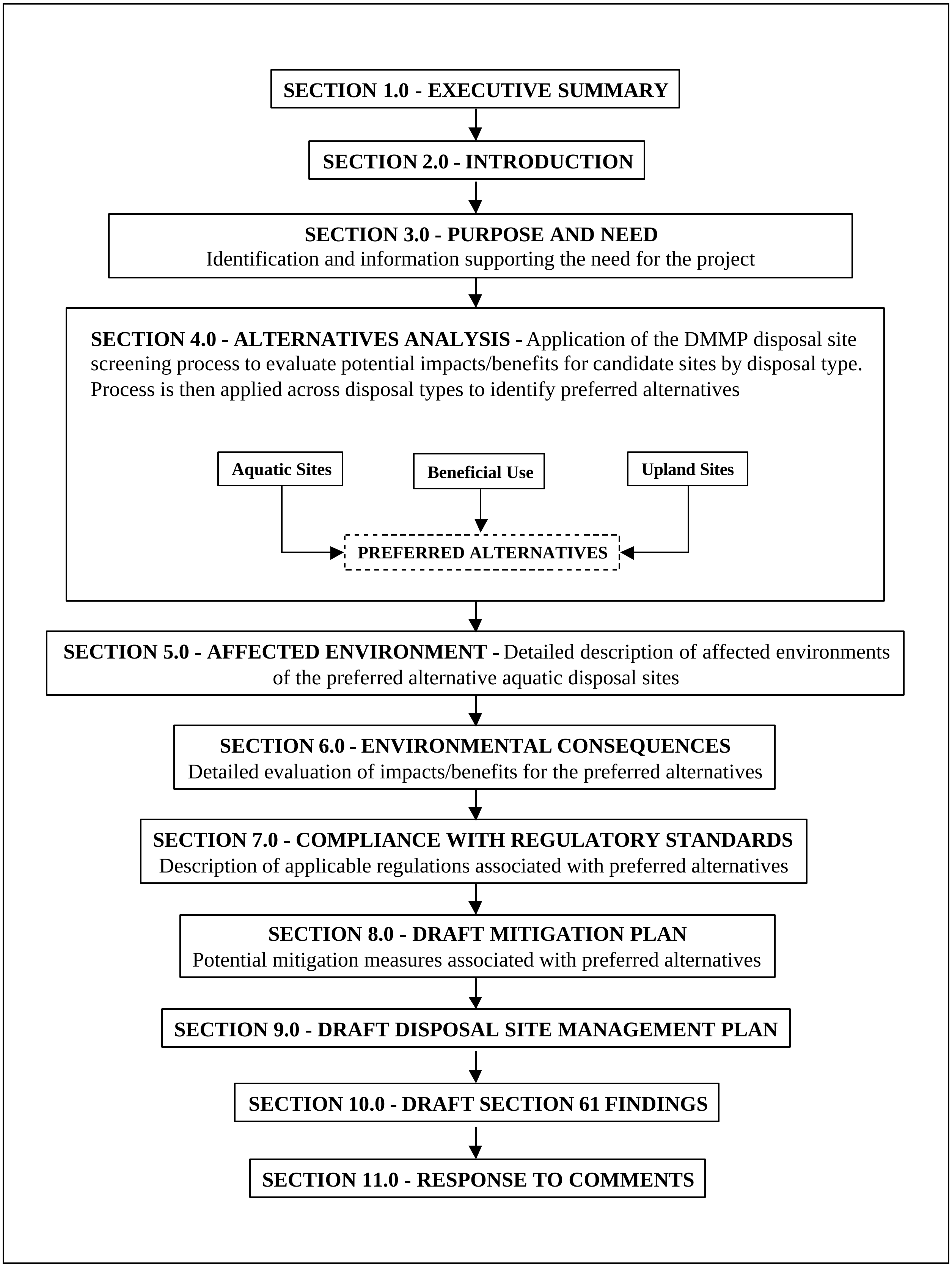


Figure 2-1: New Bedford/Fairhaven Harbor DMMP DEIR organizational chart

Section 8.0 - Draft Mitigation Measures, this section describes the basis for conceptual engineering, and includes a discussion of construction sequencing, and the associated measures to be taken to mitigate the negative impacts associated with implementation of the Preferred Alternatives. This section focuses on mitigating impacts to the upland, marine and human environments.

Section 9.0 - Draft Disposal Site Management Plan, discusses the issues of monitoring the Preferred Alternatives for long-term environmental impacts and the management of operations for each disposal site. Management options discussed include experiences in other jurisdictions, general liability issues, fees, financing and general operation.

Section 10.0 - Draft Section 61 Findings, are included as required by MEPA, to outline whether the implementation of the Preferred Alternatives are likely to cause either direct or indirect damage to the environment. This section makes findings describing potential environmental impacts confirming that all practicable measures have been taken to avoid or minimize potential damage to the environment.

Section 11.0 - Response to Comments, is a comment by comment response to correspondence received by the MEPA Office regarding the New Bedford/Fairhaven Harbor DMMP ENF. The DEIR contains a copy of each comment in a separate appendix. Comments within the MEPA scope are addressed and restated in this section, followed by a response. This section addresses all agency and public comments received.

The structure and content of the New Bedford/Fairhaven Harbor DMMP DEIR is directly controlled by three primary sets of regulations. At the state level, the MEPA Scope that identifies the information that must be evaluated as part of the site identification process. This outline will ensure that the requirements of the state's environmental policies are met. At the federal level, the DEIR is subject to the provisions of Section 404 of the Clean Water Act (Section 404), and to the National Environmental Policy Act (NEPA). The Section 404 and NEPA outlines will ensure meeting the requirements of federal environmental policies.

The first task, then, was to integrate the requirements of these three authorities. To do this, previous projects that have faced the same task were investigated. First, site selection processes used by the state to site the Cape Cod Disposal Site (MADEM Generic EIR, 1992), and by the USACE and Massport to site the disposal cells for the Boston Harbor Navigation Improvement Project (USACE & Massport Final EIR, 1996) were evaluated. Then, at the direction of the federal agencies, the process used more recently by the Corps of Engineers for the federal Providence River Navigation Project (USACE DEIR, 1998) was also examined. After extensive discussion with the state and federal agencies, the screening process chosen was modeled after the Providence River project, in large part because the federal agencies reviewing this DEIR have developed the Providence screening, and are therefore familiar with the logic of the document.

Thus, CZM is using the Providence River document (with some modification to format) as the template for the outline and the logic of the screening process, and is overlaying the MEPA Scope, creating the substance of the document.

2.2 New Bedford/Fairhaven Harbor

New Bedford/Fairhaven Harbor, is located on the west side of Buzzards Bay, at the mouth of the Acushnet River. The Harbor is located about 166 miles from New York via Long Island Sound and 83 miles from Boston via the Cape Cod Canal. A gated hurricane barrier across the lower harbor, completed in 1966, protects the New Bedford, Fairhaven and Acushnet area from tidal storms. The Harbor includes all the tidewater lying northerly of a line from Clarks Point at the southern extremity of New Bedford to Wilbur Point at the southern end of Fairhaven, and extends to the head of navigation on the Acushnet River at Acushnet. The outer harbor consists of the area south of the hurricane barrier at Palmer Island, and the inner harbor consists of the area north of the barrier to a short distance above the New Bedford/Fairhaven Bridge. (USACE 1996)

The federal navigation channel in New Bedford-Fairhaven Harbor consists of a main channel authorized extending from deep water in Buzzards Bay through the New Bedford-Fairhaven Bridge (U.S. Route 6); a channel extending from the lower maneuvering area along the upper waterfront to the vicinity of Fish Island and the swing bridge; a channel west of a line channelward of the Fairhaven Harbor lines from Pierce and Kilburn Wharf to the old causeway pier; and an anchorage area north of Palmer Island, off the Fairhaven main waterfront. (USACE 1996)

New Bedford/Fairhaven Harbor has a history of seafaring traditions that continue today with an active fishing fleet. New Bedford/Fairhaven Harbor hosts a wide variety of vessel traffic. The fishing fleet is the most important with more than two hundred (200) vessels operating out of the Harbor. The bulk of the vessels are steel hulled vessels fishing for groundfish and scallops supplying the nation with fish products. Maritime support industries in the Harbor include vessel maintenance and repair facilities, both dockside and/or at various facilities along the waterfront. Equipment and provisions purchased relative to the catching of these product such as food, ice, fuel, oils and many other products have a great impact upon the areas economy. (New Bedford HDC, 1999)

Harbor-related businesses in New Bedford and Fairhaven account for $671 million in worldwide sales and 3,700 local jobs. The seafood industry as a whole, core and support services, accounts for 97% of harbor sales worldwide, or $653 million. Additionally, other waterfront area businesses contribute and estimated $18 million in sales and nearly 600 jobs. Growth of the seafood industry over the next five years could result in an additional $59-155 million in sales and 140-410 new jobs. (New Bedford Harbor Plan, 2000)

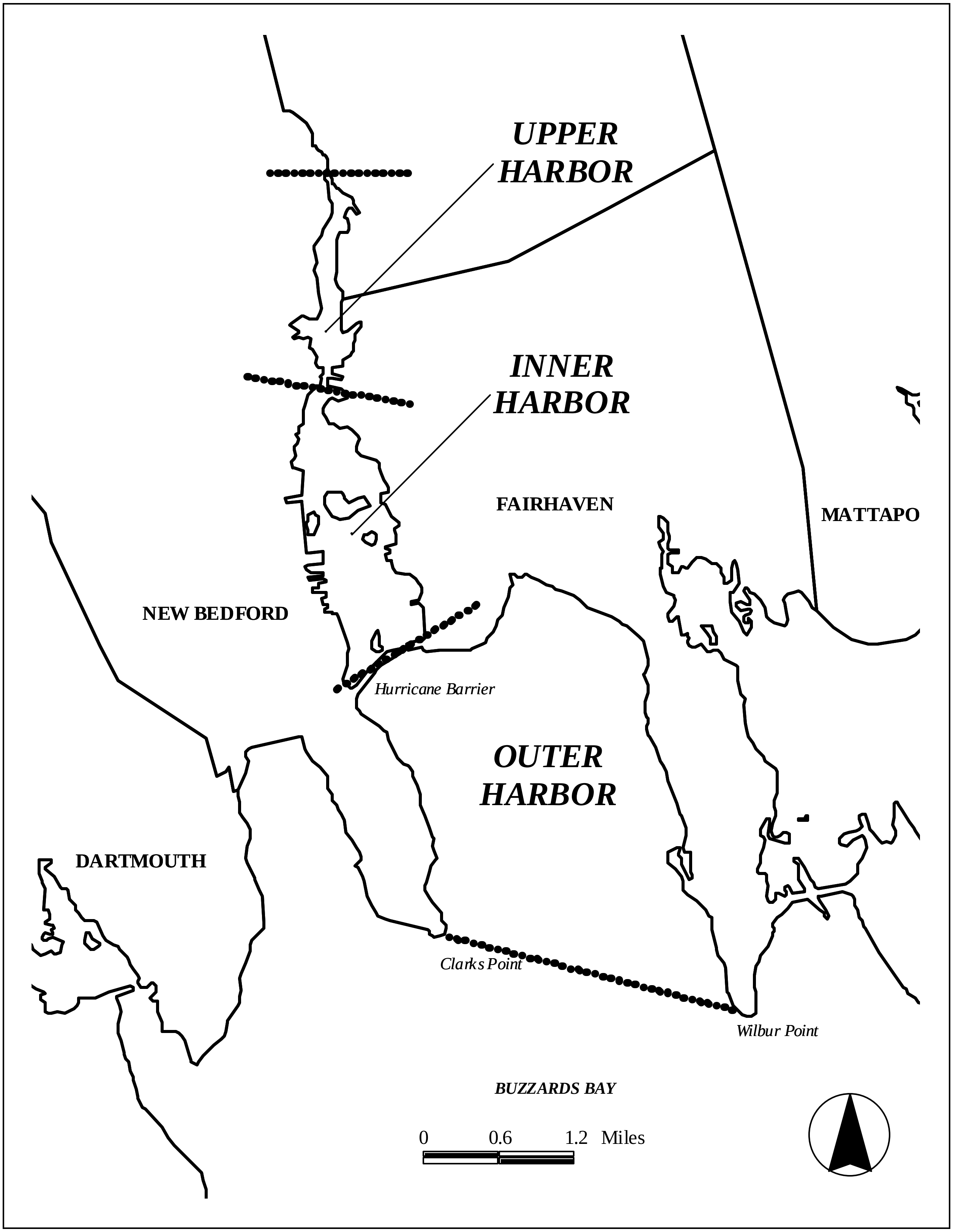


Figure 2-2: New Bedford/Fairhaven Harbor Upper, Inner and Outer Harbor Areas

2.3 Background of the CZM DMMP

The Executive Office of Environmental Affairs (EOEA), through its office of Coastal Zone Management (CZM), is providing technical assistance to the City of New Bedford and Town of Fairhaven in support of the harbor planning objectives through the development of a DMMP for New Bedford/Fairhaven Harbor dredged sediments. The DMMP has a ten year planning horizon. The development of this New Bedford/Fairhaven Harbor DMMP DEIR involved two project phases to address the critical issue of finding environmentally sound and cost effective disposal sites or methodologies for dredged material unsuitable for unconfined ocean disposal.

To develop the DMMP, CZM needed to do the following:

C Collect and analyze information on dredging needs, characteristics of the sediment, cultural and environmental resources and available alternatives for treatment, reuse, and disposal of dredged material from the New Bedford/Fairhaven Harbor area for use in support of on-going port planning initiatives;

C Identify and characterize the range of reasonable alternatives for dredged material reuse/disposal and establish a framework for comparison of the alternatives as guidance for compliance with MEPA.

Phase I of the DMMP, conducted in 1996 and 1997, included several discrete tasks, the purpose of which was to provide a baseline assessment of existing conditions related to dredging and dredged material disposal for New Bedford/Fairhaven. DMMP Phase I tasks were documented in a report (Maguire Group Inc., 1997a and b.) and included:

- Summary Report - a synopsis of dredging volumes, sediment quality and potential disposal alternatives for Gloucester, Salem, New Bedford/Fairhaven and Fall River Harbors;
- Dredging Inventory - an update of the US Army Corps of Engineers inventory of dredging demand for Gloucester, Salem, New Bedford/Fairhaven and Fall River Harbors;
- Bathymetric Surveys - a review and compilation of existing bathymetric survey information in Gloucester, Salem, New Bedford/Fairhaven and Fall River Harbors;
- Alternative Technologies - an inventory and assessment of available treatment technologies for contaminated dredged material;
- Natural Resource Inventory - an inventory of all known fish, shellfish and wildlife resources within Salem Sound and Gloucester, New Bedford/Fairhaven and Fall River Harbors;
- Aquatic and Near-Shore Disposal Site Analysis - an identification and description of potential confined aquatic disposal (CAD), confined disposal facility (CDF) and tidal habitat restoration sites within Salem, Gloucester, New Bedford and Fall River Harbors;
- Upland Disposal Site Inventory - an examination of upland and reuse options for contaminated dredged sediments;
- Due Diligence - an inventory and data description of pollution sources and historic sediment quality information in Salem, Gloucester, New Bedford/Fairhaven and Fall River Harbors;
- Preliminary Geotechnical Investigations - an inventory and assessment of existing geotechnical information within Salem, Gloucester, New Bedford/Fairhaven and Fall River Harbors; and
- Sampling Plans - develop sediment sampling and testing plan for Harbor dredging projects.

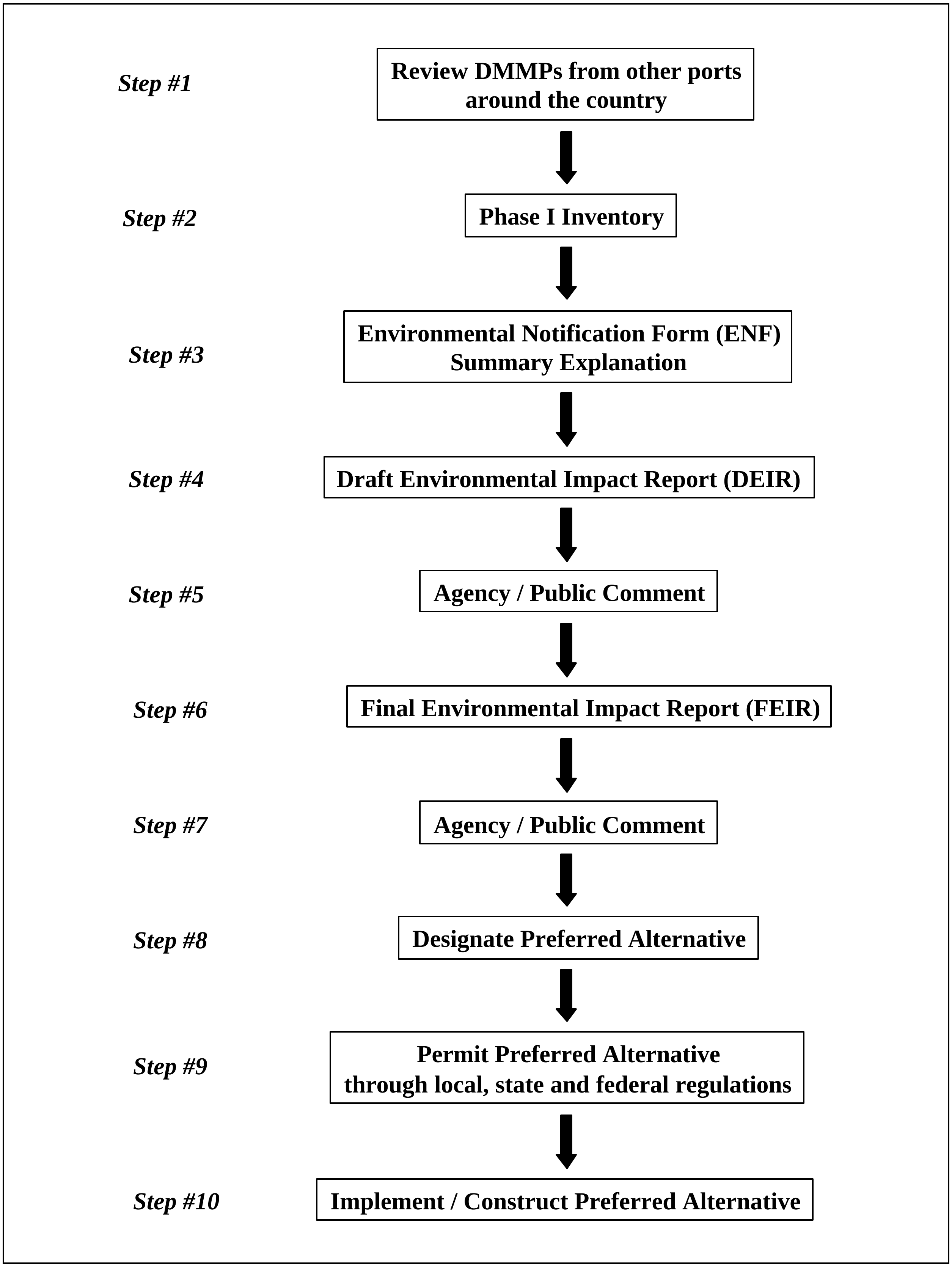


Figure 2-3: Overview of DMMP Planning Process

The DMMP Phase I information was used to identify baseline conditions and data gaps, and served as the basis for the preparation of the MEPA ENF for the New Bedford/Fairhaven Harbor DMMP.
Phase II of the DMMP has focused on conducting the field work, research, and analysis necessary to undertake a detailed assessment of the potential environmental impacts associated with the dredged material disposal alternative(s) identified through the DMMP process.

The purpose of the DMMP for New Bedford/Fairhaven Harbor is to identify, evaluate and permit, within the Zone of Siting Feasibility (ZSF) for New Bedford/Fairhaven Harbor, a dredged material disposal site(s) or methodology with sufficient capacity over the next twenty years to accept dredged material unsuitable for unconfined ocean disposal from public and private dredging projects.

The lack of a practicable cost-effective method for the disposal of UDM in an environmentally sound manner has been a long standing obstacle to the successful completion of dredging projects in New Bedford/Fairhaven Harbor. The disposal alternative siting process has been closely coordinated with the City of New Bedford and Town of /Fairhaven, through the Dredged Material Management Committee (DMMC).

Members of the DMMC were appointed by the City of New Bedford and Town of Fairhaven to serve in an advisory capacity to represent the interests of each community throughout the development of the DMMP. The DMMC was responsible for reviewing project related materials, holding informational sessions and communicating with the DMMP consulting team and Harbor Master Planning Committee. Members of the DMMC included staff from the City of New Bedford's Department of Public Works, Harbor Development Commission, business and economic development interests, Town of Fairhaven's Executive Secretary, a member of the fishing industry and the New Bedford/Fairhaven Harbor Master Planning Committee.

Coordination with local port planning interests has also been an important component of the development of the New Bedford/Fairhaven Harbor DMMP DEIR. The simultaneous development of both the DMMP and the New Bedford/Fairhaven Harbor Master Plan has aided the identification of the future dredging needs for the maintenance and improvement in navigation within New Bedford/Fairhaven Harbor and with the identification of potential sites for the disposal of UDM.

This New Bedford/Fairhaven Harbor DMMP DEIR identifies disposal alternatives with sufficient cumulative capacity to accept dredged material unsuitable for unconfined ocean disposal from public and private dredging projects for the twenty year planning horizon. The configuration of the final alternative or combination of alternatives will determine final capacity figures. Continued refinement of dredging need, regulatory analysis of the preferred alternatives, and integration of New Bedford/Fairhaven Harbor development priorities will ultimately determine the relationship between need and capacity. For the DEIR-level planning assessment, need is assumed to be the total projected twenty-year volume of dredged material. Accordingly, the DEIR anticipates that subject to field verification, sufficient capacity can be created to accommodate, at a minimum, all of New Bedford and Fairhaven's dredging needs over a ten-year period.

2.4 Massachusetts Environmental Policy Act (MEPA) Procedural History

The submission of the ENF for the New Bedford/Fairhaven DMMP on June 10, 1998, started the official MEPA review process for the DMMP (a copy of the ENF is included in Appendix A). On July 10, 1998, pursuant to the Massachusetts Environmental Policy Act (M.G.L. c. 30, ss. 61-62H) and the MEPA Regulations (301 CMR 11.00), the Secretary of the Executive Office of Environmental Affairs (EOEA) made the determination that the New Bedford/Fairhaven Harbor DMMP requires the preparation of an Environmental Impact Report (EIR). Because the project involves the potential alteration of more than ten acres of Land Under the Ocean (a resource area regulated under the Massachusetts Wetlands Protection Act, M.G.L. c. 131, s. 40) and involves the use of state agency funding through the Seaport Bond Bill (Chapter 28 of the Acts of 1996), the New Bedford/Fairhaven Harbor DMMPs exceeded the "categorical inclusion" threshold at Section 11.25(2) of the MEPA regulations in effect in June 1998, requiring by regulation the preparation of an EIR. (Under the current MEPA Regulations, promulgated in July 1998, the New Bedford/Fairhaven Harbor DMMP exceeds the 10-acre wetland resource area alteration "Mandatory EIR" threshold at 301 CMR 11.03(a)b. The Mandatory EIR thresholds contained in the July 1998 MEPA Regulations have replaced the Categorical Inclusion thresholds from previous versions of the MEPA regulations.)

2.5 Scoping and Coordination Summary

The MEPA public "scoping" meeting was held at City of New Bedford's Main Library on July 2, 1998. The meeting was conducted by a representative of the MEPA Unit of the EOEA. At the meeting, the New Bedford/Fairhaven Harbor DMMP, as described in the ENF, was presented and public comments were received by the MEPA Unit.

The Secretary's ENF Certificate of July 10, 1998 (included in the front matter of this DEIR), establishes the scope for this DEIR. In addition to the DEIR subject matter outline contained in Section 11.07 of the MEPA regulations, several major issues were emphasized as subjects to be addressed in this DEIR:

- Sediment quality and quantity analysis;
- Identification of disposal alternatives, including: alternative technologies and methodologies; upland reuse/disposal; and aquatic disposal;
- A complete description of the screening of disposal alternatives:
- Results of fisheries investigations and monitoring program;
- Effects on shore bird habitat;
- Results of cultural/historical/archaeological investigations;
- Characterization of proposed disposal sites;
- A description of the Preferred Alternative; and
- A proposed disposal site management plan.

2.5.1 Coordination with Harbor Planning Process

CZM, the City of New Bedford and Town of Fairhaven sponsored a series of local presentations with topics related to dredging and dredged material management. The purpose of the presentation series was to provide a mechanism for citizens with an interest in New Bedford/Fairhaven Harbor to provide input into the process of developing a preferred disposal alternative. CZM also attended a series of working meetings with the New Bedford/Fairhaven DMMC. The proposed disposal sites included in the ENF were a starting point, and the continuing input from the DMMC assisted CZM in identifying dredging projects and disposal sites that needed to be added, subtracted, or modified from the ENF listing of potential disposal sites.

The meetings also served the function of disseminating DMMP technical information as it became available, so that information could be reviewed as this DEIR was developed. Public presentations conducted included the following topics, as listed in Table 2-1 and described below.

Table 2-1: New Bedford/Fairhaven Harbor DMMP Presentations/Meetings

Presentation/Meeting	Date
Dredging and Disposal Technologies Video	November 1998
Siting Criteria and Process for Dredged Material Disposal	December 1, 1998
Sediment Characterization	February 25, 1998
Alternative Technologies/Upland/Dewatering Options	March 24, 1998
REMOTs / Sub-bottom	June 30, 1999
Local Fisheries Meeting	September 1, 1999
Screening Results Meeting #1	April 20, 2000
Screening Results Meeting #2	May 18, 2000
Harbor Forum	June 7, 2000

Dredging and Disposal Technologies - This video presentation, broadcast on local cable access channels, provided information on the basic elements of dredging, including potential dredging technologies that could be employed in New Bedford/Fairhaven projects, and dredged material disposal. Issues covered included: probable characteristics of dredged material; types of disposal options for dredged material; and management practices to minimize and mitigate environmental impacts. The goal of the video was to inform participants of the linkage between minimizing environmental impacts with the proper planning of dredged material disposal. (Shown on local cable public access channels first two weeks of November 1998)

Siting Criteria and Process for Dredged Material Disposal - In this presentation, the siting criteria were discussed, including avoidance of environmentally sensitive areas, compatibility with adjacent uses and minimizing exposure to important physical features. The linkage between developing comprehensive siting criteria and understanding regulatory requirements with potential locations for siting dredged material disposal within the harbor was developed. This workshop also focused on the idea that selecting potential sites for dredged material disposal should follow a logical process of using important features of the natural and built environment as a means of screening and, finally, choosing the best location to create a dredged material disposal site. This workshop provided an opportunity for local input on screening criteria and the development of Harbor-specific site screening factors. (December 1, 1998)

Sediment Characterization - The results of marine sediment tests performed under Phase I were presented. Sediment quality data were compared with criteria mandated by the USACE and USEPA. Dredged material that the federal agencies deem suitable for unconfined aquatic disposal, and the probable location of disposal sites and cost of disposal were addressed. Probable dredged material contaminants and degrees of unsuitability of sediment in the harbor were presented. The linkage between the volume of UDM and disposal site alternatives was developed in this workshop. (February 25, 1998)

Alternative Technologies/Upland/Dewatering Options- For this meeting the subcommittee discussed the specifics of the screening criteria for potential upland, alternative treatment technologies disposal and dewatering options. This meeting also involved discussion of the screening process. A goal of this meeting was to identify any additional criteria needed to address concerns or interests specific to New Bedford/Fairhaven. The Subcommittee discussed factors that were important from a local perspective. Another A goal of this meeting was to gain insight into candidates disposal and dewatering sites from the City that may not have been apparent to CZM. (March 24, 1998)

REMOTs/Sub-bottom Presentation - The meeting involved a presentation of data collected for candidate aquatic disposal sites. Further information on the sites presented was incorporated into the screening database. The screening criteria were discussed and finalized at this meeting to include the DMMC's concerns. At this meeting the results of the initial screen for feasibility were presented to the Subcommittee for input. This meeting also involved discussion of the screening process and criteria. A goal of this meeting was to provide an opportunity for the Committee to comment on the results of the feasibility screen and the steps necessary to develop preferred alternatives(June 30,1999).

Local Fisheries Meeting - A meeting was held with the New Bedford/Fairhaven Harbormasters to gather further local input on their understanding of New Bedford /Fairhaven Harbor and the surrounding water's (Buzzards Bay) marine environment (September 1, 1999)

Screening Results Meetings #1 & #2 - The proposed preferred alternatives were presented to the DMMC for review. These meetings were hands-on sessions, working with maps of the harbor and its various built and natural features. The use of computer overlays, facilitated the discussion at the presentation, depicting fisheries habitat, water depths, wind/wave exposure, areas of navigation and other data collected and compared it with the siting criteria developed in the Siting Criteria meeting. The intent of the meetings were to present results of the screening process to find a disposal site(s) of sufficient size, with minimal environmental impacts, for UDM. The DMMC provided input on the proposed preferred alternative presented. A goal of these meetings was to incorporate final comments from the Subcommittee before presenting the results of the screening process to the federal agencies. Sites that were placed on the reserve list were discussed in detail. The resultant proposed alternative sites were also discussed. (April 20, 2000 & May 18, 2000).

Harbor Forum Meeting - This presentation provided and overview of the DMMP screening process leading up to the identification of the proposed preferred alternatives. This meeting was attended by key harbor stakeholders to provide input into the DMMP planning process.

Local City Process - After the presentation of screening results to the DMMC, and incorporating comments, from the DMMC and the federal agencies, the DMMP information was presented by the Dredging Subcommittee Chairman in a series of informational sessions. The purpose of these informational meetings was to introduce the general public to the DMMP process, and to familiarize the public with the more technical information before this DEIR was published.

Additional coordination with the Harbor Planning process involved attendance at public milestone meetings and interaction with the project coordinator and consultants developing the New Bedford/Fairhaven Harbor Plan. Development of the New Bedford/Fairhaven Harbor DMMP DEIR also involved coordination with the ongoing Superfund project by attending several "linkage" and coordination meetings with key local, state and federal agencies and stakeholders. Documentation of the above public meetings can be found in Appendix B. The documentation includes meeting notes, presentation handouts and other items.

2.5.2 Coordination with Federal Agencies

The USACE has developed a method of coordinating the review and approval time-lines of the various federal resource agencies charged with reviewing major projects involving discharges of dredged or fill material in waters of the United States, regulated under Section 404 of the Clean Water Act or activities in tidal waters regulated under Section 10 of the Rivers and Harbors Act of 1899. Based upon the mapping overlay planning methodology developed by noted landscape architect Ian McHarg in the 1960s, the USACE's "Highway Methodology" provides a valuable tool for decision making in a coordinated fashion. This methodology integrates the planning and design of a project with the requirements of the USACE permit regulations. The USACE serves as the coordinator of comments from the federal agencies, including the USEPA, the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS).

Participation by the USACE in the earliest stages of project planning is a key provision of the Highway Methodology. The evaluation of alternatives to the project is key to the successful completion of the methodology. Alternatives analysis are based upon the determination of the project "purpose and need" (developed under the National Environmental Policy Act (NEPA)) and the "overall/basic project purpose" required under the EPA 404(b)(1) guidelines and used by the Corps in project permitting.

The 404(b)(1) guidelines establish pass/fail environmental tests, to be completed before a determination is made on the balancing of overall project benefits versus detriments. An USEPA/USACE's Memorandum of Agreement, signed in February 1990, mandates a three-step iterative process of avoidance, minimization and mitigation of adverse impacts to wetlands functions and values (USACE, New England Division, 1993).

Application of the Highway Methodology to the New Bedford/Fairhaven Harbor DMMP DEIR involved several key milestones including the USACE's concurrence with the DEIR Outline, Basic Project Purpose (BPP), and Aquatic and Upland Zones of Siting Feasibility (ZSFs). Documentation of the USACE's implementation of the Highway Methodology is presented in Appendix B which contains letters presenting the coordinated federal comments.

As part of the effort to coordinate closely with the federal agencies, a meeting to present draft screening results was held. This presentation was to representatives of all reviewing federal agencies, including representatives from USACE, USEPA, NMFS and USFWS, on August 23, 2000.

2.5.3 Coordination with State Agencies

Because of the array of permits required from the state to implement various disposal types and technologies proposed, DMMP planning has also required the close coordination with state regulatory agencies, particularly the Department of Environmental Protection (DEP), Division of Marine Fisheries (DMF) and Massachusetts Historical Commission (MHC). The broad reaching policy issues involved in the disposal of UDM have also been explored with these agencies, and will require continued coordination through the development of the FEIR. Close coordination with state agencies was essential to developing this DEIR. However, all statements and conclusions contain herein are the sole responsibility of CZM. State agencies will be reviewing and formally commenting to MEPA on the content and conclusion of the DEIR and FEIR pursuant to their regulatory oversight responsibilities.

2.5.3.1 Department of Environmental Protection

Since Massachusetts does not have comprehensive regulations for the disposal of dredged material, DEP Divisions with jurisdiction over UDM disposal including: Wetlands and Waterways, Water Pollution Control, Waste Site Cleanup and Solid Waste Management were approached at key DMMP milestones. DEP agencies reviewed and concurred with the site selection criteria developed to insure consistency with existing state regulations. Issues regarding upland and aquatic disposal and alternative technologies were discussed at numerous meetings, phone calls and e-mail correspondence. Representatives from DEP divisions also participated in the regulatory forum described above, to inform interested parties of requirements and expectations of the permitting process.

2.5.3.2 Division of Marine Fisheries

DMF participation in, and oversight of, investigations of marine resources conducted in support of the DMMP was invaluable to developing the detailed assessments provided in this DEIR. In its role "to maintain the diversity and abundance of marine habitats" (DMF mission statement), DMF has collected marine resource data for decades, and some of that data has been consulted in the New Bedford/Fairhaven DMMP analysis including *Massachusetts Designated Shellfish Growing Areas* (Produced February 10, 1999) and *Quahog Standing Crop Survey: New Bedford/Fairhaven Inner and Outer Harbors* (1999) were incorporated into the New Bedford/Fairhaven Harbor DMMP analysis.

The on-going coordination with DMF has played an integral role in data collection and identification of areas needing further study for the New Bedford/Fairhaven Harbor DMMP. This working relationship has involved participation of both CZM and DMF staff on data review and resource surveys and will continue through the development of the FEIR.

2.5.3.3 Massachusetts Board of Underwater Archaeological Resources

As the sole trustee of the Commonwealth's underwater heritage, the Massachusetts Board of Underwater Archaeological Resources (MBUAR) is committed to promoting and protecting the public's interests in these resources for recreational, economic, environmental, and historical purposes. Under Massachusetts General Law Chapter 6, sections 179-180, and Chapter 91, section 63, the Board is charged with the responsibility of encouraging the discovery and reporting, as well as the preservation and protection, of underwater archaeological resources. Because the Board's jurisdiction extends over the inland and coastal waters of the state, the siting of aquatic disposal alternatives has been sensitive to the MBUAR's charge. Ongoing communication and with the MBUAR will continue throughout the remainder of the New Bedford/Fairhaven Harbor DMMP planning process.

SECTION 3.0 - PURPOSE AND NEED

3.0 PURPOSE AND NEED

3.1 Project Purpose

The linkage between the need for dredging in New Bedford/Fairhaven Harbor and the regulatory challenges involved with the disposal of UDM, associated with dredging projects identified in the New Bedford/Fairhaven Harbor Plan, forms the basis for the New Bedford/Fairhaven Harbor DMMP. While this section describes dredging needs for New Bedford/Fairhaven Harbor, the focus of this DEIR is on disposal options for UDM. This section also characterizes the quality and quantity of dredged sediments for dredging projects, establishing the magnitude of UDM requiring disposal and the types of measures and site characteristics required for safe disposal of UDM.

As discussed in Section 2, the lack of a practicable cost-effective method for the disposal of UDM 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. The basic project purpose of the New Bedford/Fairhaven Harbor DMMP, is to identify, evaluate and permit, within the New Bedford/Fairhaven Harbor upland or aquatic Zones of Siting Feasibility (ZSFs) a site (or sites) or alternative treatment technology, for the disposal of UDM over a ten year planning horizon for both public and private dredging projects. The inability to find a practicable, environmentally sound, cost-effective method for disposal or management of UDM will restrict the maintenance and improvement of New Bedford/Fairhaven's waterways and ultimately, full implementation of the New Bedford/Fairhaven Harbor Plan.

3.2 Harbor Planning Context

The February 1996, passage of the Seaport Bond Bill, included a provision for funding assistance to the state's major commercial ports to conduct comprehensive harbor development and management plans. This "Four Ports Initiative," undertaken by Gloucester, Salem, New Bedford and Fall River with technical assistance from CZM, on behalf of the Secretary of the EOEA, is being closely coordinated with the DMMP. As part of the local harbor planning process, New Bedford/Fairhaven has developed a Harbor Plan to guide the development of the harbor for the five (immediate term) and ten (long term) year planning horizons, providing a framework for future decisions related to port development.

A Harbor Plan, approved by the Secretary of the EOEA, is a document having significant impact upon the viability of planning initiatives in the port. The plan allows New Bedford and Fairhaven to have greater flexibility in implementing a development strategy tailored to its individual needs and the City and Town's visions of economic development and environmental quality. The plan also identifies funding needs which are critical to its implementation. The development option put forward in the plan represents New Bedford and Fairhaven's mutual harbor planning goals and vision for the next ten years.

The preparation of the New Bedford/Fairhaven Harbor DMMP, also funded through the Seaport Bond Bill, has been coordinated with local planning efforts. Coordination with local harbor planning interests has been an important component of the development of this DEIR. The simultaneous preparation of the harbor plan and the DMMP has helped with the identification of New Bedford/Fairhaven Harbor's future dredging needs as well as potential sites for the disposal of UDM.

3.3 Project Need

This section describes the need for the New Bedford/Fairhaven Harbor DMMP in three primary areas: dredging history; future dredging needs; and, sediment quantity and quality.

3.3.1 Dredging

3.3.1.1 Dredging History

Based on dredging records collected in the Massachusetts Navigation and Dredging Management Study that was completed by the USACE for the State of Massachusetts (USACE 1995), a total of 7,028,465 cubic yards of material have been historically dredged from New Bedford/Fairhaven Harbor. Much of this volume was dredged prior for 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.

3.3.1.2 Dredging Inventory

The volume of sediment to be dredged from New Bedford/Fairhaven Harbor over the next twenty years was estimated through surveys conducted by the USACE (1996) and Maguire (1997).

The total volume of sediment to be dredged from New Bedford/Fairhaven Harbor over the next twenty years was estimated at 2,555,280 cy (2.6 million cy). This included the dredging needs of federal, state, local and private parties with channels, turning basins, or marinas within the harbor. This number also included a contingency of 20% that was added to account for any uncertainty in the volumes provided by the marine users and to accommodate any unplanned dredging projects that may arise in the future. However, the volumes presented in the sub-sections below are *without* the 20% contingency.

During the 1997 survey, all shoreline marina owners, municipalities, utilities, state and federal agencies were contacted via a mail-back questionnaire, with follow-up telephone calls to non-respondents. Marine users were asked to complete a questionnaire, denoting dredging footprints, volumes, and anticipated time schedule over the next 20 years.

The listing for New Bedford and Fairhaven included 18 facilities associated with the receipt or shipment of commodities in deep draft vessels, 17 facilities associated with commercial fishing, and 8 marinas and yacht clubs for recreational craft (ACE 1996). In terms of volume, the maintenance dredging of the federal channels in New Bedford and Fairhaven was forecasted to account for 84% of the total 20-year desired dredging volume identified. Six percent of the volume is from state and local dredging projects and 10% is from private marinas for a total of 16% from private and public non-federal projects.

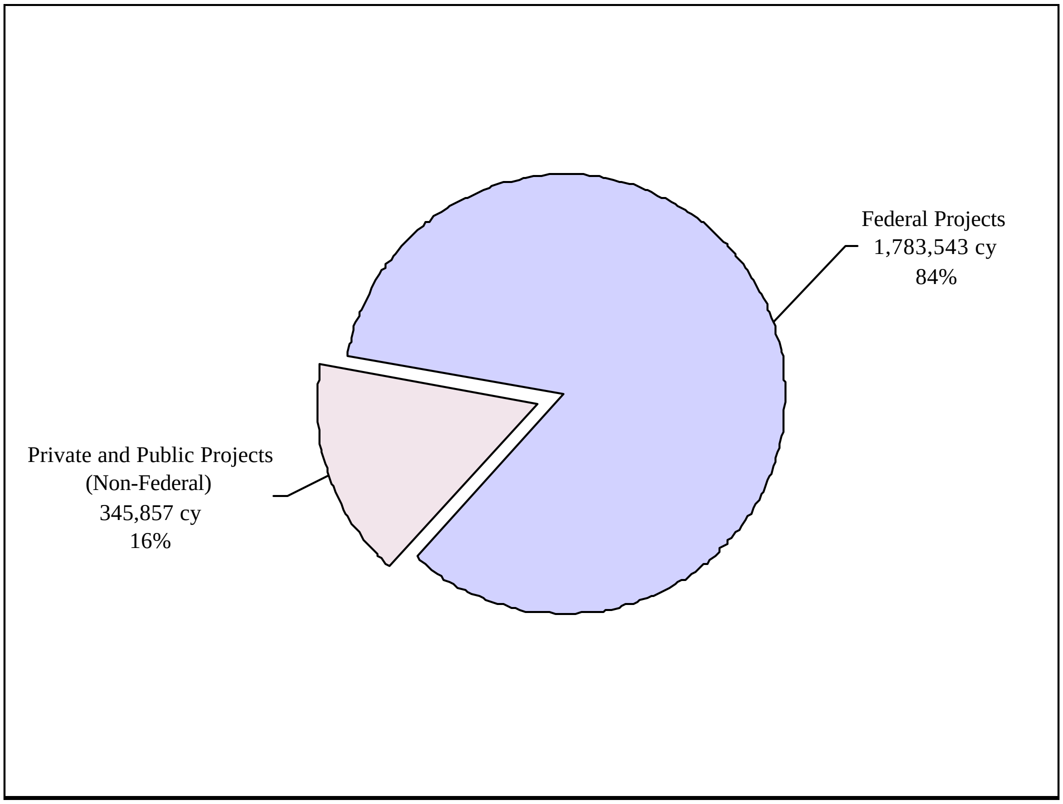


Figure 3-1: Twenty-year Dredging Volume Breakdown by Sponsor Type

New Bedford/Fairhaven Harbor contains 30 ft, 25 ft, 15 ft, and 10 ft federally authorized channels (Figure 3-2) which are currently shallower than their authorized depths. As shown in Table 3-2, the 30-ft. federal channel and maneuvering areas combined account for over 90% of the desired dredging in the federally authorized navigation areas. Approximately one-third, 400,000 cy, of this 1.2 million cy of desired dredging in the 30-ft channel/maneuvering area would occur in the outer harbor.

The 15 ft and 10 ft entrance channels to Fairhaven Harbor require approximately 8,000 cy of dredging. The 25 ft. anchorage area between the main channel and the Fairhaven channels requires about 80,000 cy of dredging. There are numerous areas that require maintenance dredging (Table 3-1) over the next 20 years. Among the largest projects are the Fish Terminal Wharf, U.S. Coast Guard, and the State Pier.

Table 3-1: Projected Twenty-Year Dredging Volumes for New Bedford/Fairhaven Harbor (based upon original dredging inventory conducted)

Inventory ID	Project Name	Volume (cy)	M or I	Volume Suitable	Volume Unsuitable	Dredging Year
NB1	Cape Island Express Line Pier	0				0
NB2	City South Terminal Wharf	0				0
NB3	Global Petroleum - Main Dock	0				0
NB4	Global Petroleum - Fuel Dock	0				0
NB5	City - Leonard's Wharf	0				0
NB6	City - Homer's Wharf	0				0
NB7	City - Coal Pocket Pier	0				0
NB8	City - Steamship Pier	0				0
NB9	State Pier	0				0
NB10	City - Pier 3 Fisherman's Wharf	3,333	M		3,333	5
NB11	New Bedford Seafood Corp.	0				0
NB12	Crystal Ice Co. Wharf	0				0
NB13	Maritime Terminal Wharf	30,000	M		30,000	5
NB14	Frionar USA Wharf	3,500	M		3,500	5
NB15	MA Towing Co.	0				0
NB16	City of New Bedford	0				0
NB17	Packer Marine	1,000	M		1,000	5
NB17	Packer Marine	1,500	I		1,500	5
NB18	Fish Terminal Wharf	10,000	M		10,000	5
NB19	Gear Locker Marina	8,000	M		8,000	5
NB19	Gear Locker Marina	8,000	I		8,000	5
NB20	The Olde NBYC	0				0
NB21	Bayline Marina Inc.	0				0
NB22	Popes Island Marina	0				0
NB23	Cozy Cove Marina	1,500	M		1,500	5
NB24	Seaport Marina	0				0
NB25	US Coast Guard	15,407	M		15,407	10
NB26	Linberg Marine Berth	5,000	M		5,000	5
NB26	Linberg Marine Berth	2,000	I		2,000	10
NB27	Acushnet Fish Co. Pier	11,000	M		11,000	10
NB28	DN Kelly & Son Wharf	61,000	M		61,000	5,10
NB29	Town of Fairhaven	3,524	M		3,524	5
NB30	Norlantic Diesel Fuel	16,500	M		16,500	5
NB31	Hathaway/Braley Wharf Co.	1,000	M		1,000	5
NB32	Fairhaven Shipyard/Marina W.	0				0
NB33	State Pier - to Fed. Channel	60,000	M		60,000	5
NB34	Ferry Pier	35,000	M		35,000	5
NB35	Fairhaven Boat Ramp-Town Pier	25,000	M		25,000	5
NB36	Federal Channel	1,318,136	M		1,318,136	5
NB36	Federal Channel	150,000	M		150,000	10
NB36	Federal Channel	150,000	M		150,000	15
NB36	Federal Channel	150,000	M		150,000	20
NB41	Nimiec Marine	26,000	M		26,000	10
NB42	Whaling City Marine	23,000	M		23,000	10
NB43	D.W. White Construction	10,000	M		10,000	10
TOTAL		2,129,400		0	2,129,400	
	CONTINGENCY (20%)				425,880	
TOTAL	WITH CONTINGENCY				**2,555,280**	
Notes:	M = maintenance					
	I = improvement					

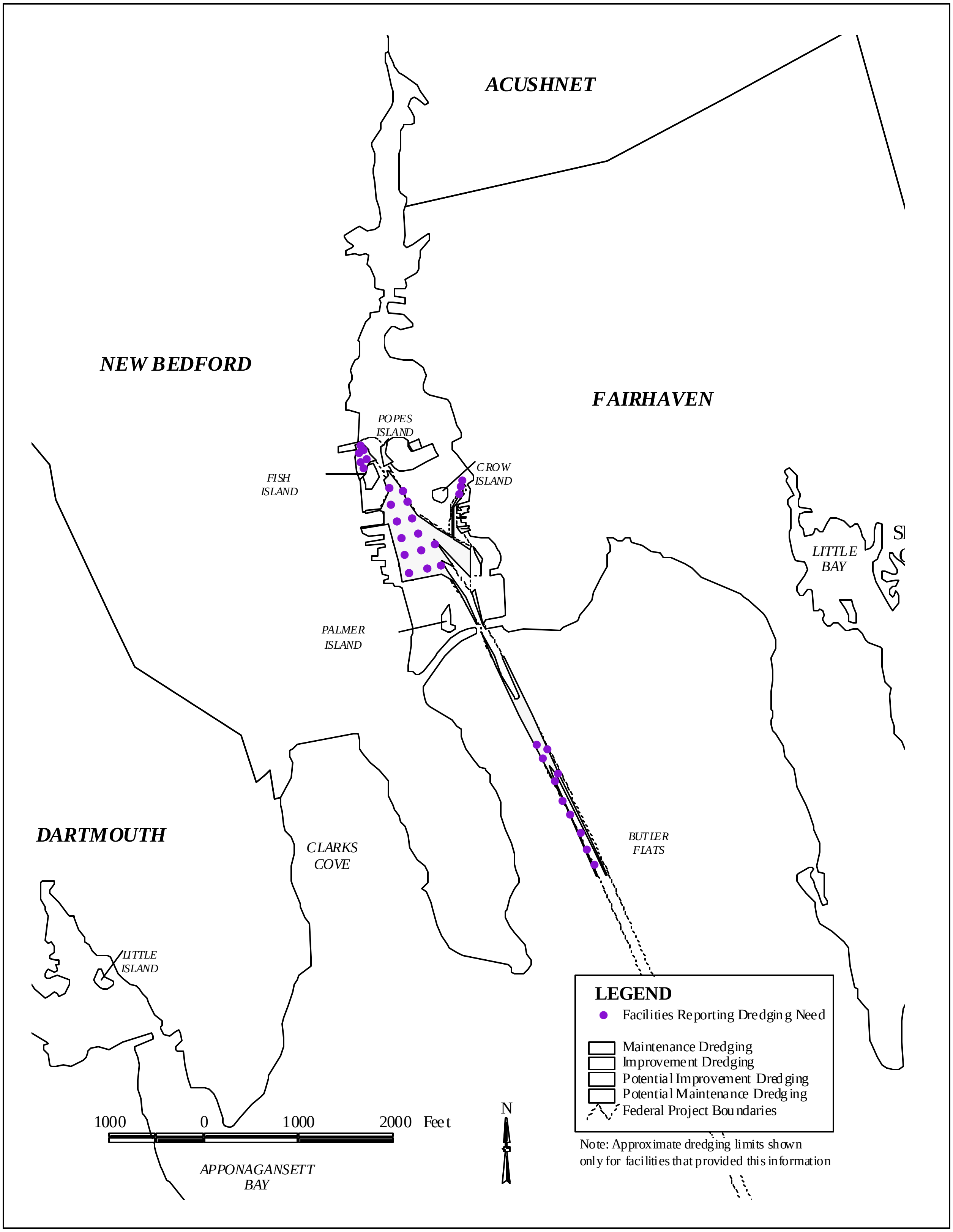


Figure 3-2: Federal Navigation Channels and Potential Long-Term Dredging Areas

In addition to investigating the need for dredging as it directly relates to navigation and economic development, the need for dredging as a result of the natural process of sediment entering New Bedford/Fairhaven Harbor was evaluated to ascertain future maintenance dredging needs not identified in the original dredging inventory. After a review of hydrographic surveys over the past several decades, since the hurricane barrier was constructed, it was estimated that the harbor is shoaling at an average rate of approximately 63 cy/acre/year (USACE, 1996), which equates to about 23,000 cy/year over the entire federal channel area in the lower harbor. This volume was added to the original estimate of maintenance dredging. This investigation also confirms that three additional maintenance dredging cycles would required to maintain authorized depths over a 20 year period involving about 150,000 cy of dredging per cycle if the project moves forward.

3.3.1.3 Baseline Dredging Demand

Accounting for recent developments in economic conditions, dredging need identified for the twenty-year planning horizon, has been adjusted to establish baseline dredging demand for a ten-year period. The rationale for this adjustment is founded on the assumption that the ten-year period most accurately represents the volume of dredging that is likely to occur within the *Harbor Master Plan's* concurrent implementation time frame. The baseline dredging demand used in the New Bedford/Fairhaven Harbor DMMP is 960,000 cy. This number was adjusted downward from the 2.6 million cy identified in the dredging inventory as described above. The adjustment made reflects the current lack of economic justification for federal participation (funding) to conduct the complete dredging of approximately 1,320,000 cy (1.3 million cy) of material for the main federal channel. After follow-up discussions with the USACE, federal navigational maintenance dredging that is likely to go forward includes approximately 80,000 cy for the Fairhaven channel and 200,000 cy in the New Bedford channel. Coupled with the projected ten-year estimate of 680,000 cy of dredged material coming from private and public (non-federal) projects, unchanged from the original dredging inventory, an estimated baseline dredging demand of 960,000 cy was established (Figure 3-3). This baseline dredging demand volume was used to identify, plan and permit a disposal site(s) with sufficient capacity to accommodate the needs for New Bedford/Fairhaven Harbor.

The remainder of the original volume will be carried forward and discussed in the context of the capacity of the Proposed Preferred Alternatives for conceptual future disposal plans (2011 – 2020) in Section 8. The City does not view this as curtailing New Bedford's ability to proceed, after the DMMP as an independent applicant under an unrelated action and associated Basic Project Purpose, for an additional range of disposal alternatives for future federal improvement work that accommodates additional City objectives (marine and transportation infrastructure development).

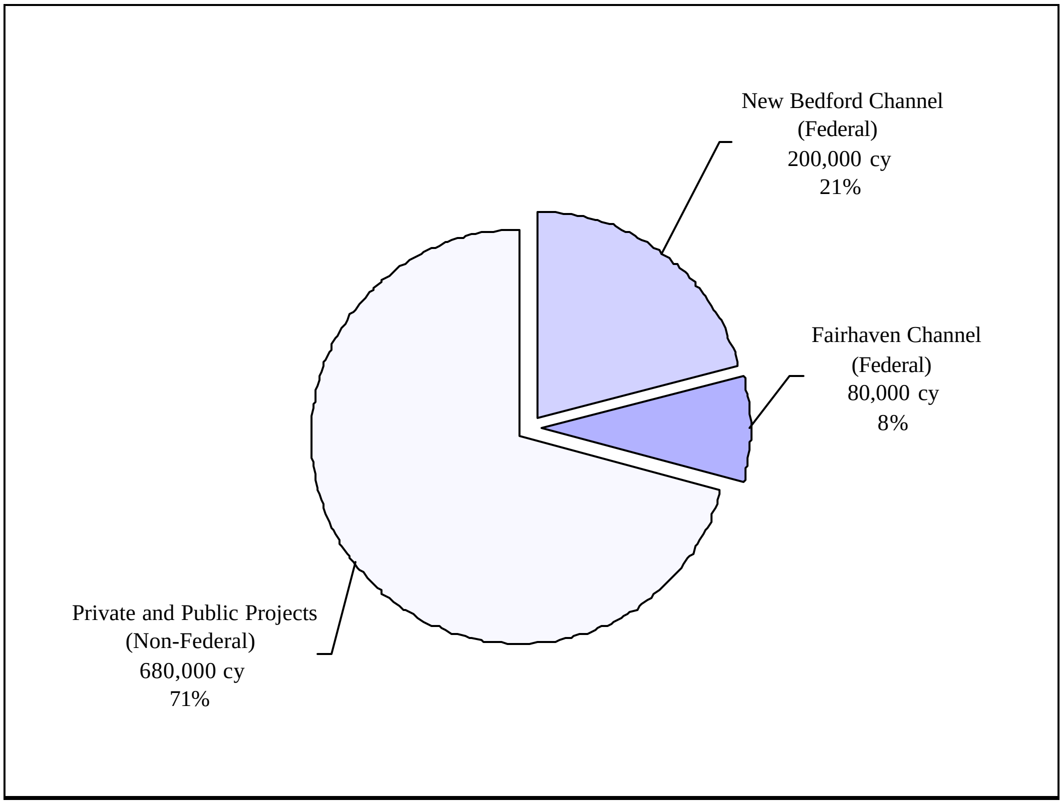


Figure 3-3: Ten-year Dredging Volume Breakdown by Sponsor Type

3.3.2 Sediment Quality and Quantity

3.3.2.1 Sediment Quality - Conformance with Regulatory Requirements

The evaluation of sediments proposed for dredging is conducted by federal and state regulatory agencies. The USEPA, USACE, NMFS, USFWS, DEP, and CZM, through an interagency agreement, are responsible for development and review of all sampling and testing for dredging and dredged material disposal in Massachusetts. At the state level, DEP and CZM review sampling and testing under the purview of the Coastal Zone Management Act (CZMA) and Section 401 of the Clean Water Act (CWA). The federal agencies jurisdiction comes from Section 404 of the CWA. Sampling and sediment testing for the New Bedford/Fairhaven DMMP DEIR followed published protocol of the USEPA and USACE. The protocol (USEPA/USACE, 1991) involves a tiered approach. Tier I involves a literature search on potential contaminant sources, history of dredging, natural harbor features and other factors.

Tier 1 - Identification of Potential Pollution Sources

The historical discharges of pollutants into the harbor have been well documented as part of USEPA's Superfund cleanup efforts (USEPA, 1998) and subsequent studies (Maguire, 1997; VHB, 1996). Due to the harbor's industrial nature, particularly in New Bedford, industrial pollutants such as metals and organic compounds have been discharged to the river. Those chemicals that have a strong affinity to sediments have settled to the harbor bottom. The water-soluble chemicals were likely flushed into the outer harbor and Buzzards Bay.

The major pollution sources in the harbor include: Aerovox, Revere Copper Products, Fairhaven Wastewater Treatment Plant, Cornell Dubilier Plant and the New Bedford Municipal Wastewater Treatment Plant (Figure 3-4). Of these, Aerovox and Cornell Dubilier have been implicated as Potentially Responsible Parties (PRP), in the discharge of PCB-laden chemicals to the harbor, which has caused significant environmental damage to water quality and biota in the harbor. The discovery of this contamination in the mid 1970s eventually led to the closure of fishing and shellfishing in the harbor and the investigation of means to remediate the most contaminated areas of the harbor. Since then, USEPA has worked to developed a remedy for the situation and has developed a plan to excavate the most contaminated sediments from the harbor and place these sediments in a series of confined disposal facilities (CDFs) (Figure 3-5). The USEPA is also currently exploring other non-CDF disposal alternatives.

While the Aerovox and Cornell Dubilier facilities were cited as major contributors of pollutants to the harbor, there were many other, small facilities that also discharged contaminants. Among these are combined sewer outfalls (CSOs) which discharge directly to the harbor. CSOs are pipes that carry a combination of sewage and stormwater. The utility infrastructure of much of New Bedford and Fairhaven is old and many CSOs still exist, although efforts are underway to separate the existing municipal sewer and stormwater systems.

Tier II - Physical and Chemical Analysis of Sediments

The first step of Tier II involves the physical analysis of samples (grain size, organic carbon content). These results are reported to the USACE, which, in turn determines which samples are to be composited for bulk chemical analysis. The only sediments that would not require further testing are those that consist of greater than 90% sand and/or are in areas of high currents and no major pollution sources as determined by USACE. In New Bedford/Fairhaven, there are no sediments that meet this criteria. The harbor is almost entirely a depositional area because of relatively slow currents and tidal action, and major pollution sources exist throughout the harbor.

After the bulk chemical analysis is complete, results are presented to the federal agencies for their review and evaluation. According to USEPA, if a substance is detected in sediments above "trace amounts", biological-effects testing (Tier III) is required to prove if sediments are suitable for unconfined ocean disposal. USEPA interprets "trace amount" as being any concentration that is above laboratory detection levels. If all substances are below trace levels, then no additional testing is required and sediments are deemed suitable for ocean disposal.

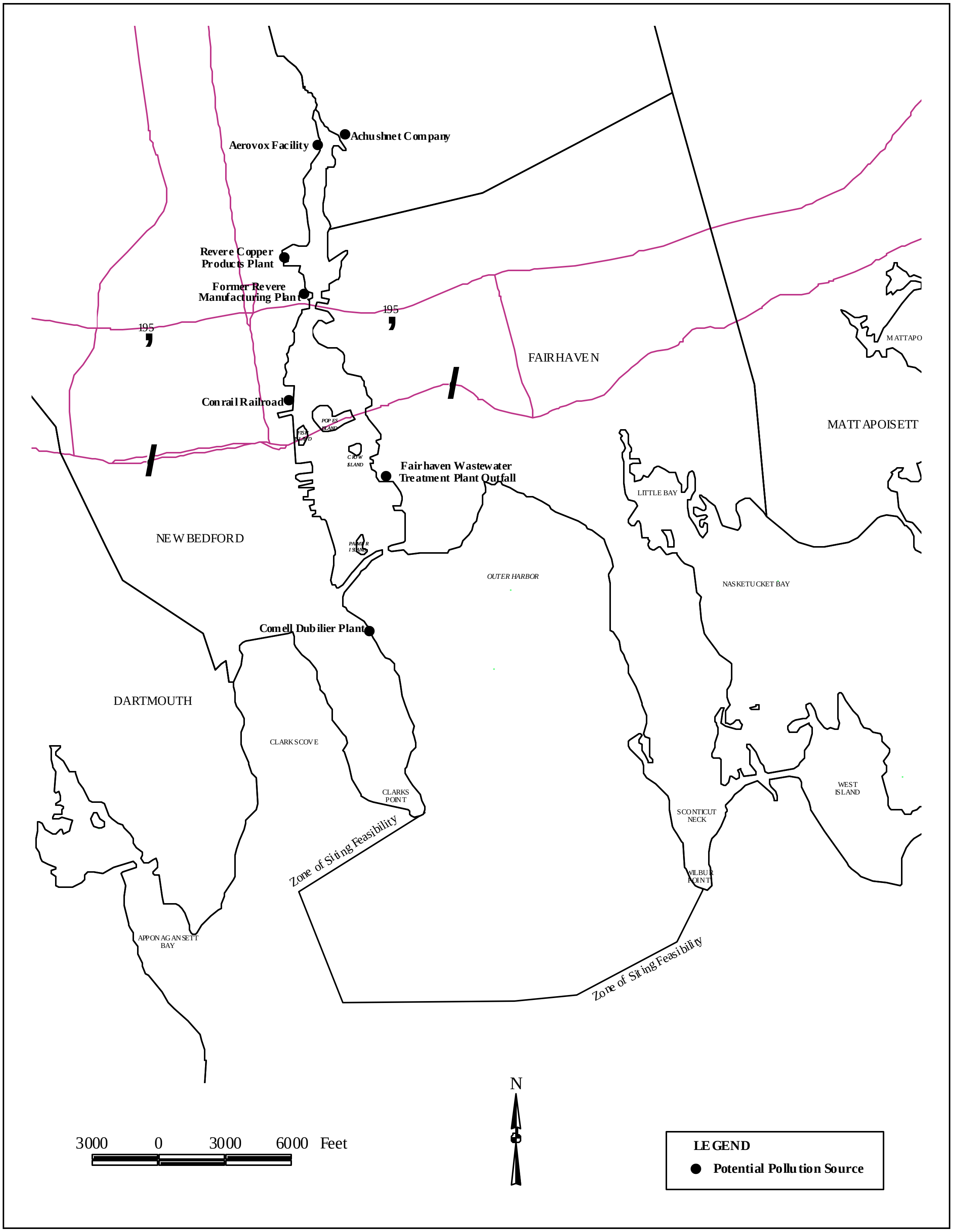


Figure 3-4: Potential Pollution Sources

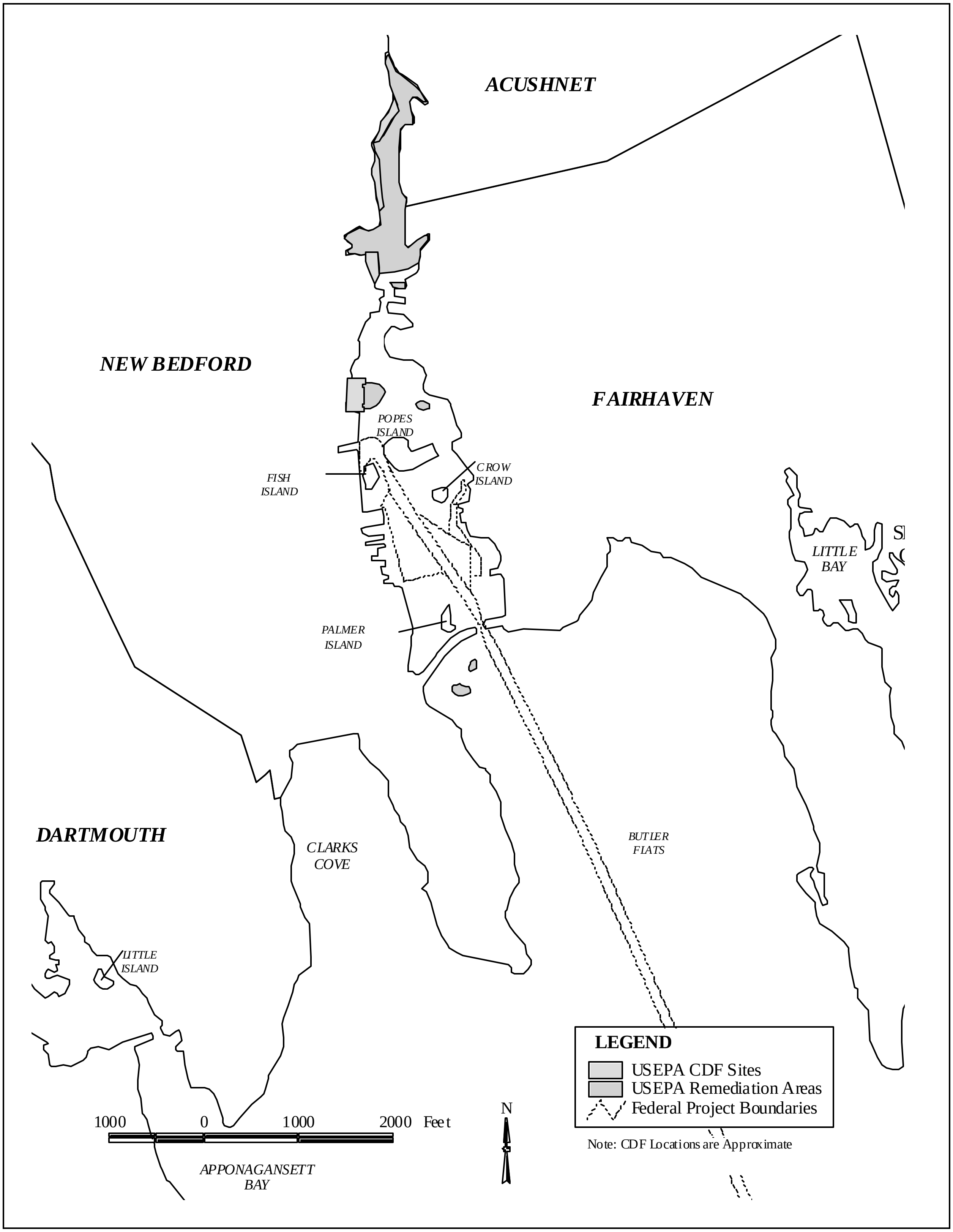


Figure 3-5: USEPA Remediation and Disposal Areas

The inventory of potential pollution sources and historic sediment quality data in and near New Bedford/Fairhaven Harbor in Tier I was used by the regulatory agencies to develop site-specific sampling and testing plans for the dredging of the federal navigation channels, maneuvering and anchorage areas. These areas were chosen for site-specific study because in total, they account for about 80% of the total anticipated dredged volume in the harbor over the next 10 years.

Sampling and testing plans are developed in a coordinated effort by USEPA, USACE, NMFS and USFWS with input from DEP. The sampling plans for New Bedford/Fairhaven Harbor were completed in the winter of 1998. Sampling and testing was conducted in the summer of 1998. A summary of the results is presented below and detailed results appear in Appendix D.

Surficial sediments in the lower harbor channel, maneuvering and anchorage areas are fine-grained, generally grey to black in color and anoxic, with some sulfur odor. These sediments consist of 90% silt or finer (clay) material.

Sediments just below the surface (2 ft. or below the sediment surface) in the lower harbor maneuvering are also composed of primarily silt and clay-size particles, however, inclusions of sand, gravel, and shell fragments do occur in some areas. Nevertheless, the sediment matrix of these sediments is primarily silt.

Sediments to be dredged within the outer harbor channel are also composed of organic silts, with small inclusions of sand.

Sediments were analyzed to determine metals, polycyclic aromatic hydrocarbon (PAH), pesticides, polychlorinated biphenyl (PCB), and dioxin/furan content. All these classes of chemical have been detected in previous samples in the harbor and have the potential to occur in the sediments due to the presence of several point and non-point pollution sources in the area.

For south shore sediments, there are two existing open water disposal options, the MBDS and Cape Cod Bay Disposal Site (CCDS). The MBDS is located about 70 miles northeast of New Bedford, accessible through the Cape Cod Canal (Figure 3-6). The CCDS is also accessible via the Canal, but it is closer to New Bedford, 45 miles, than MBDS (Figure 3-7). Although a direct comparison of chemistry test results to existing open water disposal site reference values is not strictly used to determine sediment suitability, chemistry results can be compared to reference values obtained from sediments near the open water sites. For New Bedford/Fairhaven Harbor and other south shore harbors, the nearest open water site is the CCDS and, therefore, disposal at CCDS would be preferred because of the shorter haul distance. However, the reference sites near MBDS are used here used as a benchmark for New Bedford sediments because the sediment chemistry data from MBDS is more comprehensive and reliable than data collected from the CCDS reference area. Generally, the sediment quality guidelines for CCDS are more strict than MBDS.

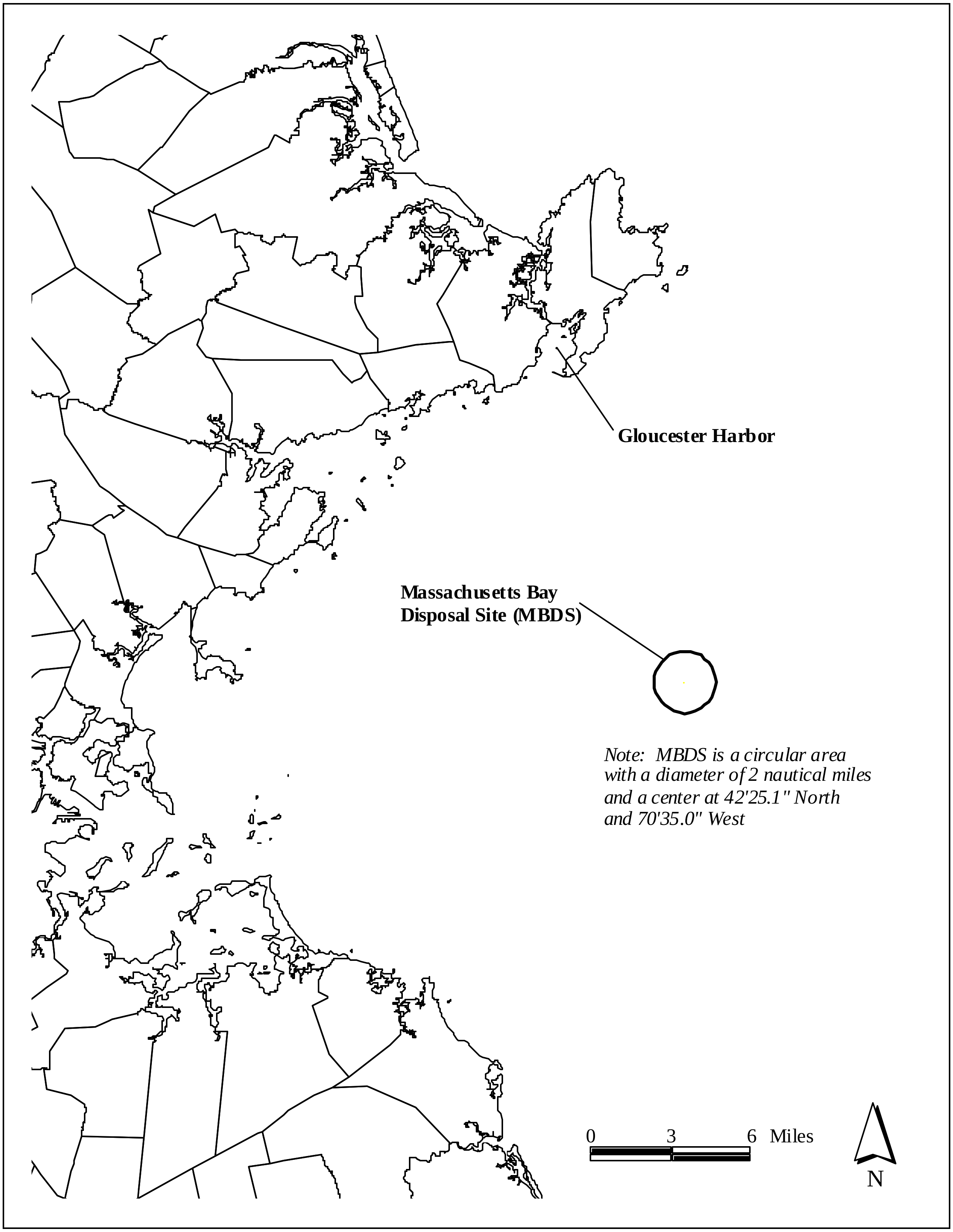


Figure 3-6: Approximate Location of Massachusetts Bay Disposal Site (MBDS)
(Base Map Source: MassGIS)

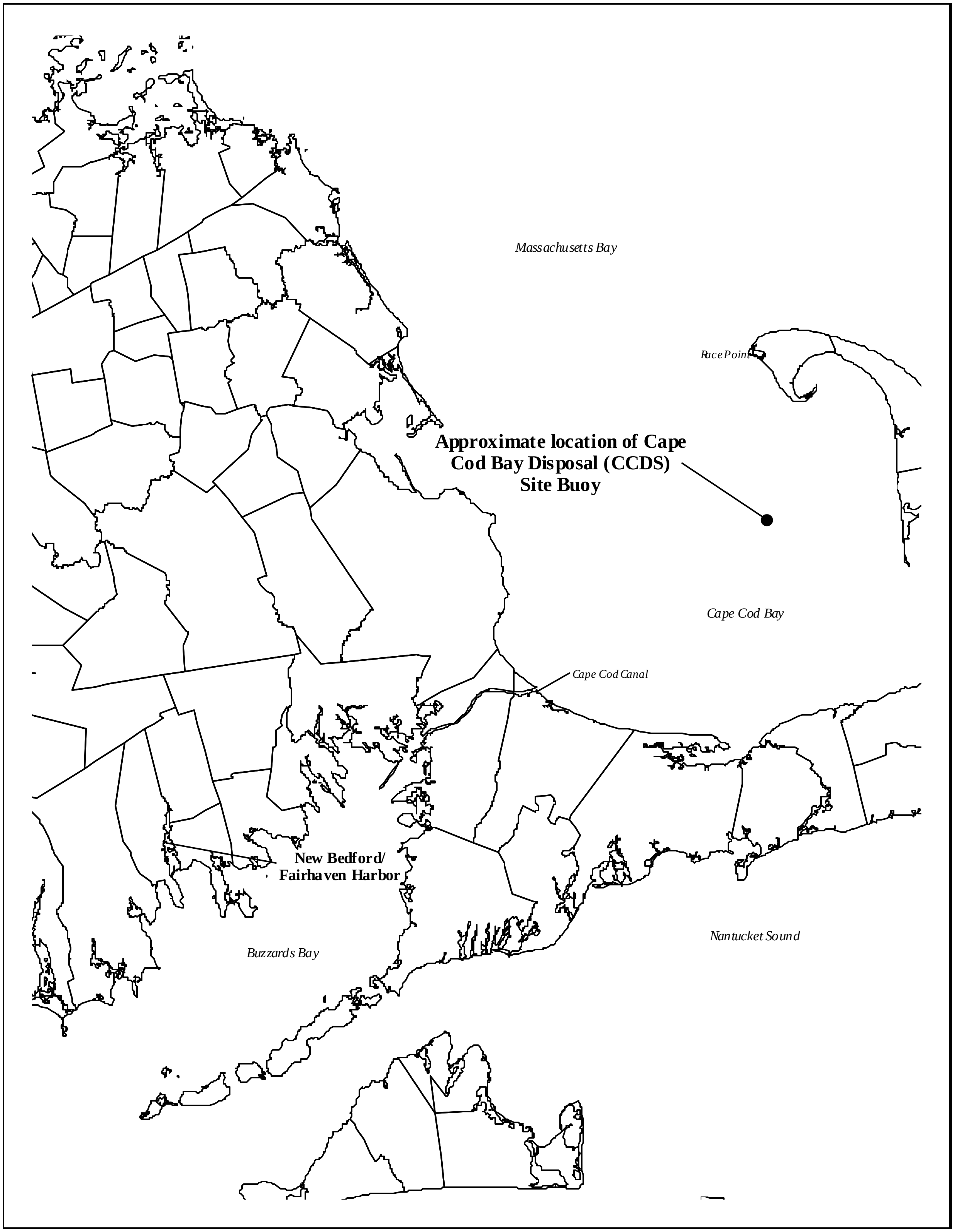


Figure 3-7: Approximate Location of Cape Cod Bay Disposal Site (CCDS) Buoy (Base Map Source: MassGIS)

Table 3-2 summarizes the mean (average) concentrations of the metals, PCBs and PAHs in sediments to be dredged from the New Bedford/Fairhaven Harbor channel, maneuvering and anchorage areas.

Table 3-2: Mean Sediment Chemical Concentrations for Federal Channel, Maneuvering and Anchorage Areas in New Bedford/Fairhaven Harbor.

Analyte	Units	Inner Harbor	Outer Harbor	Crow Island (Fairhaven Channel)	Fish Island	MBDS Reference
Copper	ppm	**512**	**127**	**260**	**850**	32
Lead	ppm	**155**	64	**72**	**215**	66
Total PCBs (Congeners)	ppm	6.7	2.5	2.1	11.8	ng
Total PAH	ppm	**11.7**	2.0	2.2	**14.5**	3.0
Total Dioxins/Furans	ppb	4.7	3.1	2.3	5.3	ng

Notes:
Bold denotes values greater than MBDS Reference
MBDS Reference values are mean plus 2 standard deviations
ng = no guideline
Concentrations are averages of samples collected from these areas

Of the eight metals studied, copper and lead are the most prevalent. Mean copper concentrations are four to twenty-seven times higher then the MBDS reference values. Highest concentrations are near Fish Island and in the lower harbor. Lead concentrations are also elevated, but are only abnormally high in the two aforementioned areas. Metals occur naturally in sediment at low concentrations, but point and non-point discharge sources contribute significant amounts of metals to the water and sediment. Most metals have a tendency, once entering the water, to adsorb suspended sediment particles which then settle to the harbor bottom. Potential sources of elevated copper in the harbor include the Revere Copper Products Plant in the upper estuary, other industrial facilities (Figure 3-4), wastewater treatment outfalls and combined sewer outfalls.

Total PAH concentrations exceed the MBDS reference in the Fish Island and lower harbor areas by four and five times, respectively. Polycyclic aromatic hydrocarbons (PAH) are a class of chemicals that are formed by the incomplete combustion of fuel. Sources of PAH include power generation, stormwater runoff, industrial discharge and dry deposition from the atmosphere.

Polychlorinated biphenyls (PCBs) are the main pollutant of concern in New Bedford/Fairhaven Harbor. Sediment concentrations are among the highest encountered in any US waterway. The focus of the Superfund project is the remediation of PCBs in the upper and lower harbor areas. In the upper harbor, sediments containing total PCB concentrations above 10 ppm are targeted for removal and placement in nearshore CDFs in New Bedford. In the lower harbor, sediments containing PCBs in excess of 50 ppm are slated for similar cleanup measures. These remediation areas and potential CDF disposal sites are depicted in Figure 3-5.

All sediments sampled for the DMMP had PCB concentrations below the cleanup levels. The highest concentrations were in the channel area around Fish Island (average 11.8 ppm). Concentrations in the lower harbor averaged 6.7 ppm, while the Fairhaven Channel and outer harbor channel sediments contain PCBs around 2 ppm.

PCBs were once used as cooling fluids in transformers and other electrical equipment. Since 1976, PCBs have been banned from manufacturing and use in the United States due to their potential acute and chronic effect on the environment. The sources of PCB contamination in the harbor are many, however, two past industrial facilities, Aerovox Inc. and Cornell Dubilier, have been implicated by USEPA as the primary sources.

In addition to the high PCB levels in sediment, dioxins and furans, a class of compounds similar in chemical structure and behavior to PCBs, have been found at elevated levels. Their spatial distribution mirrors that of the other contaminants discussed above, i.e. concentrations are highest near Fish Island and the inner harbor and less in the Fairhaven Channel and outer harbor. These compounds are present in Aroclor (PCB) mixtures. They can also be derived from atmospheric fallout from incineration of sewage sludge, and are common by-products of paper bleaching. The PCB discharges and atmospheric incineration are suspected as primary sources of dioxin/furan contamination in the harbor (Pruell, 1990).

Tier III - Biological Testing

In accordance with the EPA protocol discussed in the above section, Tier III biological-effects testing would be required if disposal at either the CCDS or MBDS is proposed. Any private or public dredging project that proposes disposal at either of the above sites must undergo biological testing to determine if sediments are suitable. The biological testing requirements (if any) for disposal at any of the preferred aquatic disposal sites within the Harbor, will be determined at a later date by the appropriate regulatory (state and federal) agencies to prove if sediments are suitable for ocean disposal if material from New Bedford or Fairhaven is proposed for open ocean disposal.

1) Suspended particulate phase bioassays;

This test is used to determine the short-term effect of dredging and disposal on sensitive water column organisms. If significant short-term effects are anticipated, then dredging and disposal management restrictions can be employed to minimize impacts.

2) Solid phase toxicity test;

Over a 10-day period, sensitive marine amphipods are exposed to test sediments to determine the acute toxicity (lethality) of the sediment.

3) Solid phase bioaccumulation test;

Sediment dwelling organisms are exposed to test sediments over a 28-day period to determine acute and chronic effects of the sediment. The tissues of surviving organisms are then analyzed for the chemicals of concern.

The results of the above tests are evaluated in accordance with the procedures in the USEPA/USACE protocol. This includes a human and ecological risk assessment conducted by USEPA.

Testing Summary

Testing requirements for the dredging projects proposing to use a DMMP CAD cell will be determined as one component of the management plan.

3.3.2.2 Sediment Quantity - Suitable versus Unsuitable Volumes

The determination of the suitability for sediments for ocean disposal is made by the federal agencies. Normally, the agencies require that biological-effects testing be conducted to make such a determination. For DMMP planning purposes, however, a preliminary determination of suitability is offered in this DEIR. This preliminary determination is based upon a comparison of sediment chemistry results from samples taken within proposed dredging projects and with results from MBDS reference sites and other sediment guidelines such as those developed by NOAA and the New England River Basins Commission (NERBC).

Sediment chemistry data presented in this section for the major dredging projects in the New Bedford/Fairhaven federal navigation areas were used to evaluate those specific project areas, but this data is also useful in assessing the suitability of sediments at nearby facilities that have expressed an interest in dredging. Those facilities that are distant from any sampling locations were assessed based on: historic sediment quality data (if any); proximity to pollution sources; and, general oceanographic conditions, i.e. is the site within a high or low energy environment.

Given the sediment chemistry data presented above, it is assumed that all sediments from New Bedford/Fairhaven would be unsuitable for ocean disposal at MBDS. Sediments in the lower harbor channel and near Fish Island contain elevated concentrations of metals, PCBs, PAH, 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 are also assumed to be unsuitable for ocean disposal.

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, 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.

Given the assumptions presented above, 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.

Table 3-3: 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

Table 3-4 portrays the timing estimates for disposal of UDM from New Bedford/Fairhaven Harbor. As shown, the majority of the UDM would be dredged in the first 5 years. These projects include primarily the private and public non-federal navigation areas. Dredging in the outyears would consist of the federal maintenance dredging projects.

Table 3-4: Ten Year Dredged Material Volume (cy) Breakdown in 5-Year Increments

Years 1-5	Years 6-10	Total
680,000	280,000	960,000

3.4 Harbor Plan Implementation

New development proposed in the Harbor Plan will strengthen New Bedford/Fairhaven Harbor as a tourism center. The Harbor Plan is designed to comprehensively integrate New Bedford and Fairhaven goals and objectives regarding tourism, public access, land and water transportation, commercial and industrial marine economic development, remediation of environmental impacts from infrastructure and past human-use impacts. The identification of the need for dredging to implement New Bedford/Fairhaven Harbor Plan recommendations and the characterization of a portion of the dredged material in the DMMP as UDM, underscores the importance of locating a cost-effective environmentally sound disposal option for UDM to help the City, Town and the Commonwealth meet the mission statement of the Harbor Plan. Identification of a practicable UDM disposal option will help attain both Communities' vision of maintaining a vibrant seaport, while preserving New Bedford and Fairhaven's maritime heritage, and furthering economic development.

The Harbor Plan also supports maintenance and improvement dredging activities as well as the concept of aquatic disposal of UDM. Selection of a disposal site for UDM, as a concept, is supported by the New Bedford/Fairhaven Harbor Plan, which recommends the pursuit of the maintenance and improvement dredging projects in the harbor and the establishment of one or more disposal sites for the UDM generated from these projects.

SECTION 4.0 - ALTERNATIVES ANALYSIS

4.0 ALTERNATIVES ANALYSIS

4.1 Introduction

This section of the New Bedford/Fairhaven DMMP DEIR presents the alternatives for the disposal or management of UDM as well as a comparative assessment of the environmental impacts of each alternative. Both state and federal laws guide the development of the alternatives analysis contained in this section of the DEIR. The two principal statutes are:

(1) Massachusetts Environmental Policy Act (MEPA), Massachusetts General Laws (MGL) Chapter 30, Sections 61 and 62A-H. MEPA is the environmental review statute of the Commonwealth, and is the law under which this DEIR is being prepared. MEPA provides an opportunity for public review of potential environmental impacts of projects for which state agency actions (e.g., permits, funding, or agency-sponsored projects) are required. Most important, MEPA functions as a vehicle to assist state agencies in using: "... all feasible means to avoid damage to the environment or, to the extent damage to the environment cannot be avoided, to minimize and mitigate damage to the environment to the maximum extent practicable." (MEPA, 1998)

MEPA requires an analysis of "reasonable alternatives and methods to avoid or minimize potential environmental impacts" (301 CMR 11.07(6)) and that all "feasible" alternatives be analyzed in an EIR. Feasible alternatives means those alternatives considered: "... in light of the objectives of the Proponent and the Mission of the Participating Agency, including relevant statutes, regulations, executive orders and other policy directives, and any applicable Federal, municipal, or regional plan formally adopted by an Agency or any Federal, municipal or regional governmental entity" (301 CMR 11.07(6)(f)).

(2) Clean Water Act (CWA), in particular the Section 404(b)(1) guidelines of the US Environmental Protection Agency (Title 40, Code of Federal Regulations (CFR), Part 230), require that "practicable" alternatives to a proposed discharge to waters of the United States be considered, including avoiding such discharges, and considering alternative aquatic sites that are potentially less damaging to the aquatic environment. The goal of the Section 404(b)(1) guidelines is to provide a framework for arriving at the Least Environmentally Damaging Practicable Alternative (LEDPA). While the alternative selected for implementation needs to be the least environmentally damaging, i.e. resulting in the least amount of human and natural environment impact of the alternatives studied, it also needs to be practicable. The term "practicable" means "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."

In consideration of the above, the alternatives for New Bedford/Fairhaven Harbor included in this section of the DEIR are those alternatives for the disposal and/or reuse of UDM.

4.2 No Action Alternative

Consideration of the no action alternative for the New Bedford/Fairhaven Harbor DMMP is required under the MEPA Regulations at 301 CMR 11.07(6)(f). The no action alternative is used to provide a future baseline against which the impact of the preferred alternative(s) is (are) measured, compared and contrasted. It is representative of future conditions in New Bedford/Fairhaven Harbor, without the changes or activities that would result from the implementation of the preferred alternative(s) for disposal of UDM.

The no action alternative assumes that dredging activities involving the removal of sediments that are unsuitable for unconfined open water disposal would not occur. It is estimated that approximately 960,000 cy of sediment to be dredged from New Bedford/Fairhaven Harbor over the next 10 years is unsuitable for unconfined open water disposal. Therefore, under the No Action alternative, this 960,000 cy of sediment would not be dredged.

Existing sedimentation rates in New Bedford/ Fairhaven Harbor would continue unabated and the navigation channels would slowly fill in. The USACE estimates that the federal navigation channels receive a net volume of 23,000 cy of sediment per year, which equates to approximately 0.5 inches within the channels (USACE, 1996). The approximately 30 dredging projects and activities which have been identified to continue economic growth in the Cities of New Bedford and Fairhaven in their Harbor Plans would not occur.

Specifically, for the New Bedford/Fairhaven Harbor DMMP, no aquatic or upland disposal sites for UDM would be constructed and future environmental impacts which would result from their construction and use would be avoided. If an aquatic disposal site is not constructed, temporary aquatic environmental impact such as impacts to benthic invertebrates or alterations to deep water environments would not occur (Section 6.2 Benthos). Furthermore, if a upland disposal site is not constructed, environmental concerns associated with oxidation/acidification, dust and odor nuisances and leaching of heavy metals and salts would not result.

4.3 Description of Disposal Alternatives

4.3.1 Aquatic Disposal Alternatives

The following describes several types of aquatic disposal methods considered for the disposal of dredged material. Generally speaking, the primary advantages of open water disposal over other disposal alternatives are typically the large disposal capacity, relatively short-term environmental impacts, and lower relative cost (Carey et al., 1999). The primary disadvantages of aquatic disposal include potential changes in benthic habitat quality and temporary water quality degradation, as well as complex logistics associated with certain types of aquatic disposal. The complexity of aquatic disposal is due to the interdependence, sequencing and timing of dredging, storage and disposal operations.

4.3.1.1 Confined Aquatic Disposal

Confined aquatic disposal (CAD) is the process where dredged material that is unsuitable for unconfined open water disposal is deposited into the marine environment within a confined area, and then covered with suitable material (Figure 4-1). There are basically two methods of constructing a CAD site. Most commonly, CAD sites are created by placing unsuitable material on the existing seabed, and then covering it with clean dredged material which is considered suitable for open-water disposal. The overlying layer is commonly referred to as a cap, typically constructed

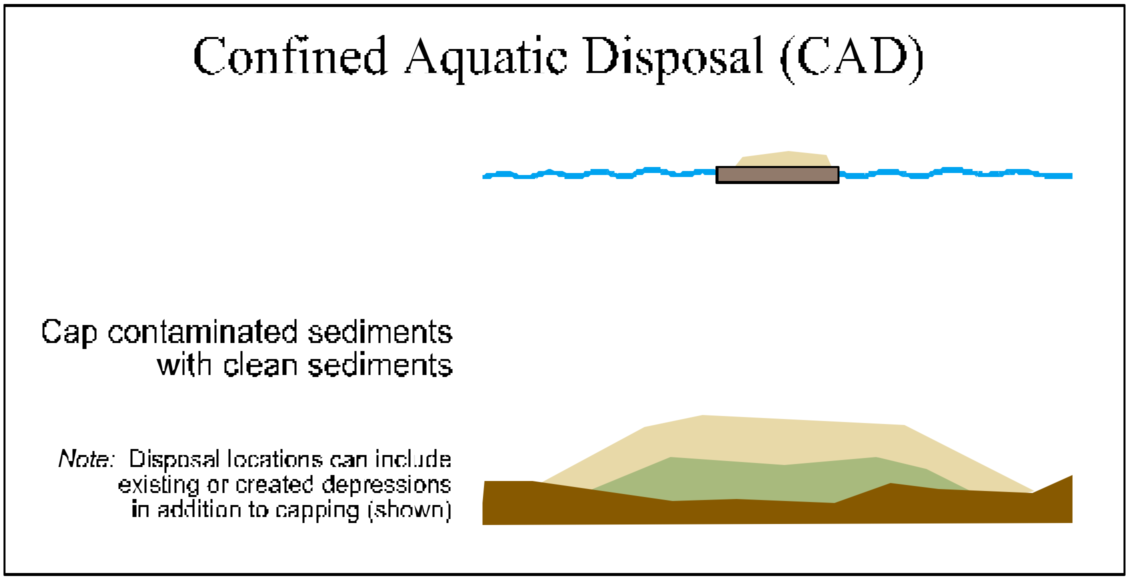


Figure 4-1: Schematic of Confined Aquatic Disposal (CAD) Mound Method

using either dredged silt or sand. This method has been used in open-water disposal sites in New England (e.g., DAMOS 1994), New York (SAIC 1998), and elsewhere, and requires that sufficient suitable material be available to provide complete capping of UDM. In exposed offshore regions in Buzzards Bay, sites with topography conducive to confinement were preferred, in water depths of at least 65.6 feet (20 meters) to maximize protection against storm-driven waves.

The second method of constructing a CAD site is to excavate a confined area, or pit, which is then filled with UDM and capped. In general, these sites can be created in shallower water, but require water depths in excess of 20 feet (6.1 m), so that dredges and barges which are used to create the pit can access the area. Two types of CAD pits are presented for possible use:

Overdredge (OD) - CAD sites located within an existing channel that are dredged below the proposed navigational depth, then filled with dredged material and capped to the proposed navigational depth (Figure 4-2);**Adjacent-to-Channel (ATC)** - CAD sites that are created along-side existing channels and/or anchorage areas.

The **OD** method was employed for the BHNIP (NAE and Massport 1995; DAMOS 1999). In this method, the pits are excavated in the channel, and then filled and capped up to or below the existing maintenance depth. If the overlying sediments in the channel are unsuitable, these are first removed and stockpiled. Dredging then continues into underlying suitable sediments, creating a pit below the designed channel depth. Suitable material is disposed of in an approved offshore disposal site (e.g. MBDS). UDM (including the stockpiled channel cover) is then deposited in the pit and covered with suitable material. In the BHNIP, the cap design was for three feet of sand, although alternative cap material can be considered. The selection of an appropriate cap material is dependent upon the environmental objectives of the CAD design, as well as the geotechnical properties of the sediment to be capped.

The **ATC** method is similar to the OD method, except that the pits are excavated in areas near, but outside, the project dredging area. The ATC can be dredged into existing bottom, but is limited only by the existing water depth rather than the maintenance depth of the channel. As with OD sites, if the overlying sediments prove to be unsuitable, the removed material also needs to be stockpiled for eventual deposition into the ATC pit.

The OD and ATC CAD alternatives have the advantages of locating the disposal site near an existing dredged area (the channel), causing only temporary disturbance of the bottom resulting in rapid biological recovery of the sea floor, and disposing of the material in an inner harbor area that is already impacted by human activity. When the OD site is located near the area being dredged, the additional advantages include (NAE and Massport 1995):

1) confinement of the disposal impacts to areas impacted by dredging;
2) sequestering the material near the point of origin; and,
3) compartmentalizing dredging and disposal operations.

Relative to the first type of CAD site in which no pre-dredging is required, the OD and ATC methods have the disadvantages of requiring additional dredging, longer project duration, greater material handling, larger disposal volumes (the material removed to create the pits), and increased costs. In addition, for OD sites, if the top-of-cap elevation is set as the channel depth, this method precludes future dredging of the channel to deeper design depths without first removing the previously deposited contaminated sediments. Where future navigational improvement projects are being contemplated, the OD top-of-cap elevation must include an adequate depth contingency to accommodate additional channel depth associated with planned future navigational improvement projects. One advantage of the ATC design is that there is no concern that the material will be disturbed by future maintenance dredging of existing navigational dredging projects.

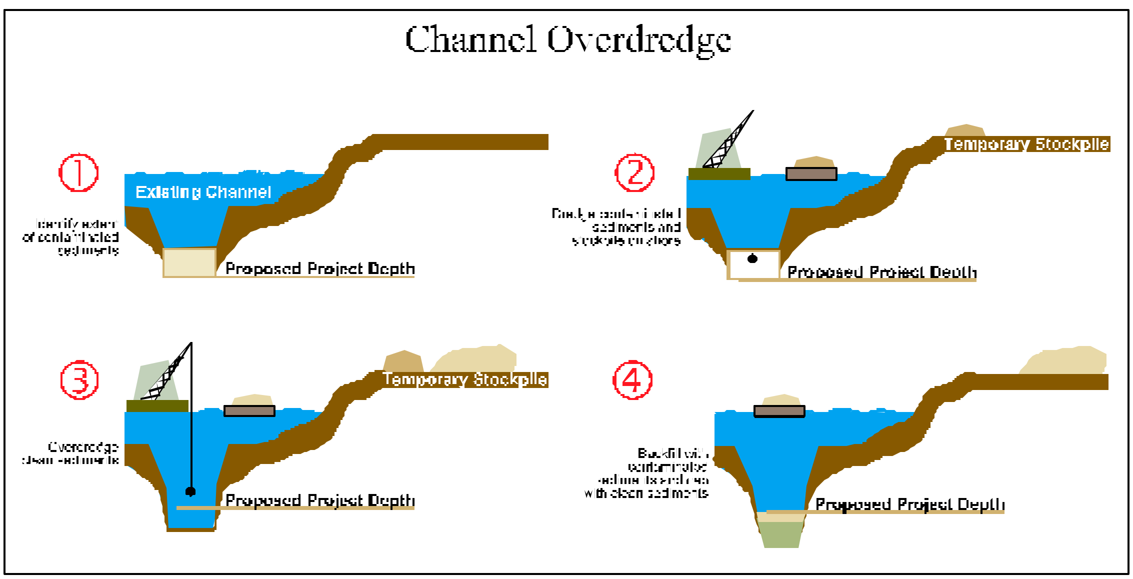


Figure 4-2: Schematic of Channel Overdredge (OD) Method

4.3.1.2 Confined Disposal Facility

UDM may also be disposed in confined disposal facilities (CDFs), illustrated in Figure 4-3. Creation of a CDF requires construction of confinement walls, typically steel sheet pile, or a confinement berm of earth or stone. Stone reinforcement (rip-rap) may be required on the seaward side of confinement walls and berms to protect them from wave action and tidal scouring. An impermeable liner and cap may also be required, depending on the chemical characteristics of the dredged material. The liner and cap may be made of impermeable soils, such as clay, synthetic materials such as high density polyethylene (HDPE), or some combination of these two. Leachate collection, treatment and disposal may be necessary for lined cells during the construction period to control rainwater infiltration until the cap can be placed over the cell. CDFs have the advantage of isolating UDM from the environment, while at the same time creating new land which can be put to constructive uses, such as port expansion, development, open space, parkland, or upland wildlife habitat. Alternatively, the CDF can be left as a subaqueous area, creating additional wetlands, as discussed in the section on Tidal Habitat, below. CDFs have the disadvantages of: permanently displacing existing tidal and subtidal habitat; being relatively expensive to construct; and, requiring periodic maintenance to ensure the long-term structural integrity of the CDF.

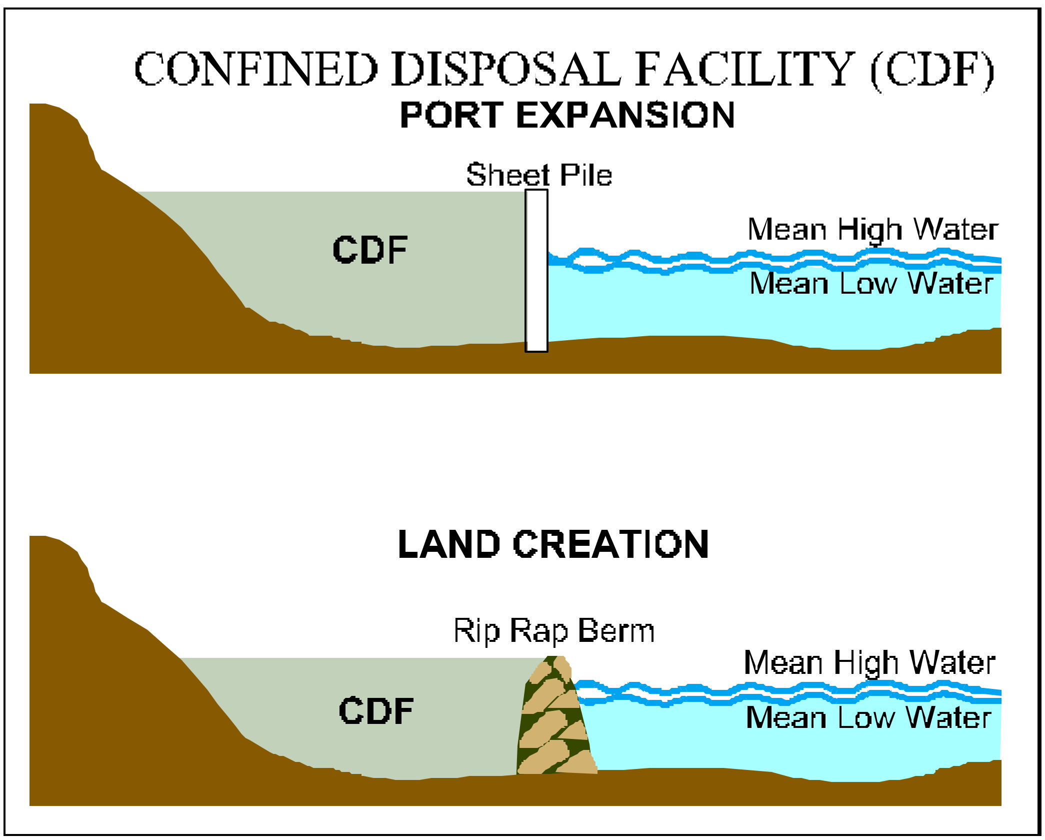


Figure 4-3: Schematic of the Confined Disposal Facility (CDF) Method

4.3.1.3 Tidal Habitat

A tidal habitat site is a special type of CDF, developed specifically for creation of tidal habitats such as mudflats and coastal wetlands (Figure 4-4). The tidal habitat method requires a cap of material that is chemically and physically able to support biological activity. The tidal habitat method requires creation of an impoundment to retain the dredged material and protect the newly created habitat from scouring currents and wave action. This is typically accomplished by building a berm or breakwater of stone, or of soil armored with stone, up to an elevation above high water. The berm would be penetrated by one or more culverts, enabling sea water to flow through the berm and equalize tide elevations on both sides. The area inside the berm can then be filled with dredged material. The surficial sediments that will be exposed to biological activity must be suitable material (similar to a CAD cap) in order to prevent bioaccumulation/biomagnification and bioturbation of
contaminants.

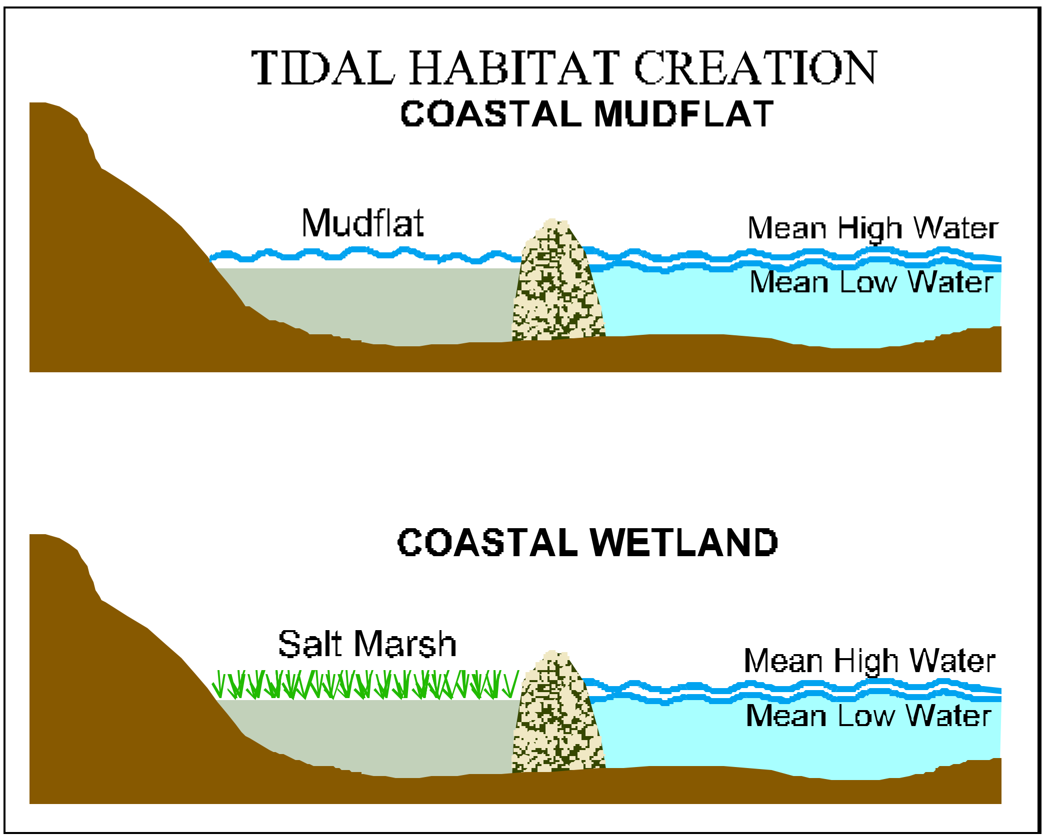


Figure 4-4: Schematic of the Tidal Habitat (TH) Creation Method

To create an intertidal mudflat, the area is filled to the elevation of mean sea level. This ensures that the surface will be covered with water at high tide and will be exposed at low tide. Tidal mudflats provide habitat for a wide range of invertebrate organisms, which, in turn, are an important source of food for shorebirds. To create tidal wetlands (i.e. salt marsh), the area is filled to an elevation that ensures that the surface will be flooded periodically, saturated most of the time, and exposed at low tide. Once the surface has stabilized, it is planted with species such as salt marsh cordgrass (*Spartina* *alterniflora*), salt meadow cordgrass (*Spartina patens*), and big cordgrass (*Spartina cynosuroides*). Salt marsh wetlands provide habitat for a wide range of invertebrate organisms, and are used as nurseries for many species of marine fish. These organisms are an important food source for shorebirds, waders and certain waterfowl.

Tidal habitat alternatives have the advantage of creating additional habitat in, or proximal to, densely developed urban areas (thereby restoring the functions and values of a natural coastline). They have the disadvantages of: displacing existing tidal and subtidal habitat; having low capacity relative to the total quantity of material to be dredged; being relatively expensive to construct; and requiring on-going monitoring and maintenance to ensure the integrity of confinement and the success of the created habitats.

4.3.2 Relationship of Alternative Treatment Technologies, Dewatering and Upland Disposal

Alternative treatment of marine sediment, dewatering and upland disposal are often components of a single logistical system for the handling/disposal of UDM. Depending on the characteristics of the sediment (its composition and mixture of contaminants), UDM must be handled, stored and transported several times before its ultimate disposal or use in the upland environment.

As illustrated in Figure 4-5, UDM first leaves the barge for storage, dewatering and/or treatment at a shore-side location. This location is referred to as a dewatering site. While at the dewatering site, the sediment will be placed in piles where the sediment will dry and the water will evaporate and run-off. This dewatering process may also be accelerated by use of mechanical devices such as a belt filter press. Sediment may be processed through a number of treatment methods to eliminate adverse

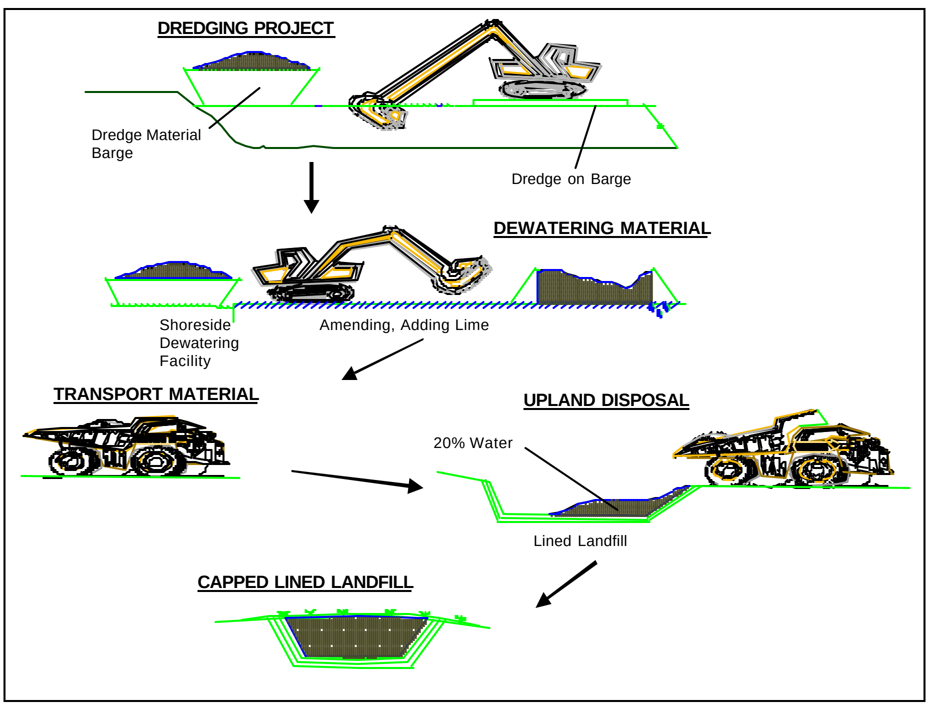


Figure 4-5: Upland Disposal Process

impacts from contaminants. Treatment may be as simple as adding other substances to the sediment to solidify or chemically stabilize the dredged material. Treatment may also be quite complex involving incineration or a series of other processes which in themselves create environmental impacts. For upland disposal, a range of locations is possible: from active landfills to vacant parcels that may be converted to environmentally sound disposal sites for UDM. Each of these components of a non-aquatic disposal system have alternative choices within them. There are numerous types of alternative treatment technologies; several shore-side locations as potential dewatering sites and many locations as potential disposal sites for UDM. The following sections address alternatives within each of these non-aquatic disposal system components.

4.3.3 Alternative Treatment Technologies

Alternative treatment technologies involve the treatment of contaminated sediment, using one or more processes, to allow for reuse of the sediment in a safe manner in the upland environment or for unconfined open water disposal. There are four general types of treatment technologies, categorized based on their effect on the contaminants of concern within the sediment:

1) *Destruction*: the removal of contaminants from the sediment via physical, chemical or biological agents;

2) *Separation*: the process of removing contaminants from the sediment resulting in a concentrated residual of contaminated sediment of significantly smaller volume;

3) *Reduction*: the process of reducing the amount of contaminated dredged material that requires treatment by screening sediments into various particle sizes; and,

4) *Immobilization*: the fixing of contaminants in the dredged material which keeps the contaminants from being released to the environment.

Destructive methods are generally the most complex and expensive forms of treatment. Some of the destructive methods assessed in the DMMP include: incineration, pyrolysis, solvent extraction, thermal desorption and vitrification. The costs for such technologies range from $161-420/cy (Maguire Group Inc., 1997a).

Separation of contaminants from the sediment can be accomplished by solvent extraction and other techniques. These processes result in a residual material that requires disposal and/or further treatment. The average cost for solvent extraction is $182/cy (Maguire Group Inc., 1997a).

The primary method of reduction used today is soil washing, a process where water is used to separate the sediments by particle size into a reusable bulk fraction, and a smaller fraction containing concentrated contaminants. Because organic contaminants are often sorbed (adhered) to the finer sediment particles such as silts and clays, separation of this fine soil fraction from the coarser, sandy sediments allows for the reuse of the sand and an overall reduction in the volume of UDM. The average cost for this technology is $89/cy (Maguire Group Inc., 1997a).

Immobilization techniques evaluated in the DMMP include chelation and solidification/stabilization. Costs for such processes range from $75-$90/cy (Maguire Group Inc., 1997a). Some of these processes, such as solidification/stabilization, can produce a material with sufficient structural bearing strength to allow for use as structural fill in construction projects.

4.3.4 Dewatering Alternatives

In order to implement an upland disposal or alternative treatment option, a shore front site with adequate land area to dewater the dredged material is required. A dewatering site (or sites) is necessary to provide an area to reduce the moisture content of dredged material, allowing it to be processed and transferred to an upland disposal site for final disposal or reuse.

The process to prepare dredged material for final upland disposal or reuse involves the following primary site functions: off-loading; material screening; lime treatment; soil amendment; and transfer to disposal/reuse site.

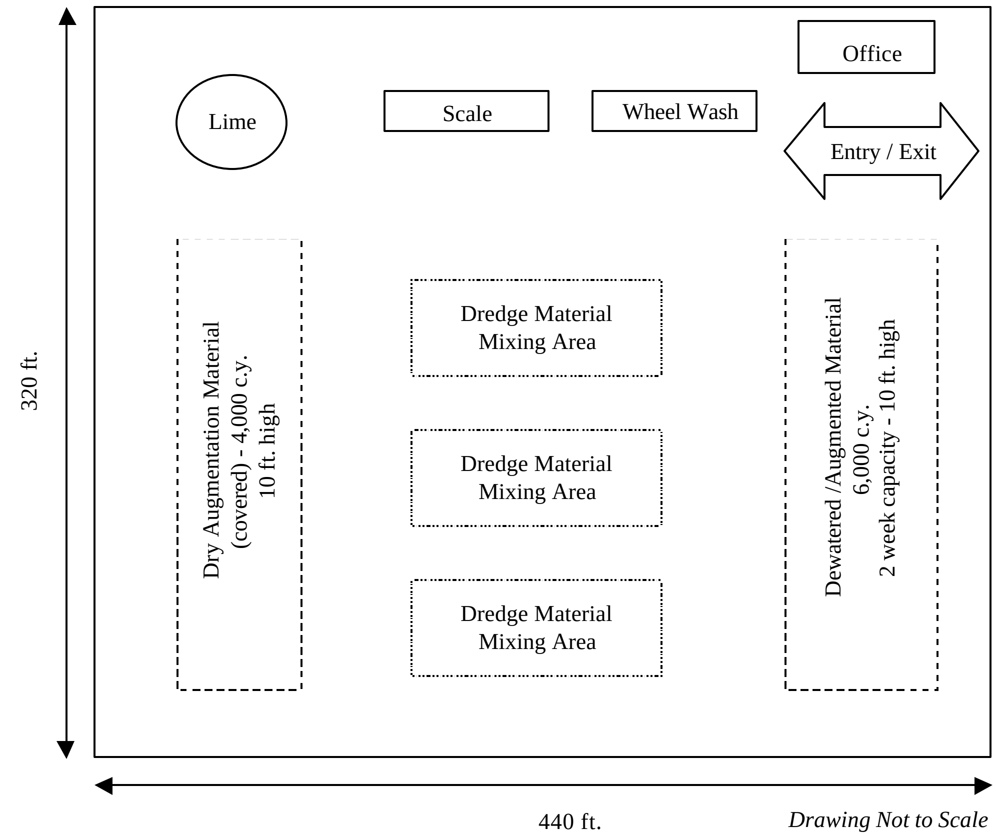
Off-loading of the dredged material requires that the barge be tied to a pier or seawall along the shore front. Front end loaders or cranes are used to unload the dredged material from the barge and place it on the site or in dump trucks which move the material to a specific location on the site. If the dredged material has a high water content, water-tight crane buckets and dump trucks may be required to minimize the uncontrolled discharge of sea water and suspended sediment into the water.

Material screening is often required to screen out large pieces of debris, such as piling fragments, fishing gear, and other debris typically encountered in an urban harbor environment. This material must be removed from the dredged material and disposed of separately.

Lime treatment is often required to reduce the moisture content of the dredged material and to control odors. Anaerobic decomposition results in the production of a strong, sulfur odor that may be controlled via lime additions to the dredged material. Dredged sediment with a high organic content has often undergone long term anaerobic (without oxygen) decomposition in the marine environment. Lime treatment also reduces the moisture content of the dredged material, and results in a material which is easier to handle and spread.

Soil amendment of the dredged material is often required to produce a final product that is suitable for various end uses. UDM is typically a fine grained, silty material. The removal of excess water from dredged material through active site management may add considerably to containment area storage volume especially in the case of fine-grained dredge material (USACE, 1983). Mixing or amending UDM with a coarser material such as sand improves the workability of the material. DEP has typically required that amendment of the dredged material be performed within the dewatering site; before UDM is transported upland.

Transport of the dredged material to the final disposal or reuse site is required. Truck transport is the most common method. Water transport via barge or alternative land transport such as rail is also possible, but less common. Space must be available within the dewatering site to allow for loading of the transport vehicles.



Site Area Required:
Approximately 3.2 acres

Process:
UDM is mixed with augmentation material and a drying agent (quick lime etc.) to create workable material to be transported off-site for upland disposal/reuse.

Assumptions:
10,000 c.y. to be removed, 50 c.y./hr.dredge production rate, 10 hr. work day, 6 days/week based upon Central Artery Project CO9A8 contract dredge rate using similar augmentation process.

Advantages:
Short schedule
Workable material in short duration

Disadvantages:
Cost of augmenting material to workable consistency
Labor intensive, multiple re-handling.
Smell - hydrogen sulfide escaping material, spray with lime to control odor
Weather dependent.

Figure 4-6: DMMP Dewatering Site Conceptual Layout

Ideally, the performance of all the above functions are conducted at one dewatering site, minimizing the number of times the material is transported and reducing overall costs.

Potential environmental impacts associated with dewatering may include pollution due to a release of contaminants in the effluent during dewatering operations. Dewatering of UDM material also has potential environmental advantages because the result of the process produces soil that can be considered for beneficial uses.

To determine the minimum area required to process dredged material for upland/reuse disposal from a 10,000 cy dredging project, dewatering site logistics and area requirements were investigated for the DMMP. The site area requirements developed included the application of lime to control sulfide reactivity, and amendment of the material as per DEP policy. The typical dewatering site requires adequate area for mixing, lime storage, augmenting material storage, truck scale and wheel wash, and approximately a one week storage capacity for dewatered material.

Assuming a facility through-put capacity of 400 cy per day, based upon a typical workday (50 cy per hour times 8 hours per day), a 3.2 acre site (approximately 320-feet by 440-feet) is required. Figure 4-6 illustrates a conceptual site layout and requirements for the facility. When mobilization and construction of containment structures (4 weeks), duration of dredging (5 weeks) and restoration of the site (3 weeks) are factored in, the total time required to process 10,000 cy of material is approximately 12 weeks, or 3 months.

The projected volume of UDM from New Bedford/Fairhaven Harbor in the first five year planning horizon is 680,000 cy. The theoretical 3.2 acre dewatering site could process the material for upland disposal/reuse in about 75 weeks (5 weeks for every 10,000 cy + 7 weeks mobilization/demobilization). The above numbers represent the best-case scenario; scheduling conflicts and weather delays will extend the processing time.

Seasonal dredging restrictions imposed to protect fish spawning would require dredging to be spread out over several years, given the limited throughput capability of a small dewatering site. Dredging in most areas is limited to the late fall and winter months, a 5-month (22-week) period. With one dewatering site, 3.2 acres in size, the maximum volume of dredging that can occur in any one dredging season is about 30,000 cy.

As part of the DMMP DEIR process of exploring potential dewatering site options, the screening process focused on a universe of potential sites within the municipal boundaries of New Bedford and Fairhaven. A total of 10 potential dewatering sites were identified. The sites were identified by examining aerial photographs and via windshield surveys conducted in 1998 and 1999. Also, meetings were held with local municipal officials to aid in the process of identifying vacant, open or undeveloped waterfront site as a potential location for dewatering.

4.3.5 Upland Disposal/Reuse Disposal Alternatives

Upland reuse disposal alternatives involve the placement of UDM on land. The land site can be an existing active or inactive landfill, or a raw parcel of land. Dredged material can be used as daily cover or final cover for landfills, provided the material meets the physical and chemical specifications for such use. Dredged material placed on a raw parcel of land could be managed as a landfill, or could be used as a grading material that has some end use (e.g. ball fields, golf course, etc.), provided the physical and chemical properties of the dredged material permit such use. There are currently no regulations in Massachusetts which specifically apply to the disposal of dredged material in the upland environment, therefore the disposal of the material is regulated under the Commonwealth's Solid Waste Management Regulations (310 CMR 16.00 and 19.000). Dredged material, when amended with other material such as Portland cement, can be used as structural fill in construction projects.

The environmental advantages of an upland reuse disposal alternative are threefold. First, the containment of UDM material into a well engineered and monitored situation. Second, a reclamation of the dredged material into a stable soil form can be utilized in engineered construction (i.e. port expansion, recreation and commerce) and, third, the creation of stable, fast land at the disposal site itself, with a final elevation of known geotechnical properties (USACE, 1983). The environmental disadvantages include the potential for leachate to contaminate the water supply and the large dewatering area that would be required for the volume of UDM proposed. Furthermore, the future land use of the site might be limited due to the classification of the UDM material.

The cost for upland disposal ranges from $62 - $333/cy for silty UDM that is not suitable as final cover for landfills. Clayey sediments that could be used as final cover material would be slightly less expensive to dispose of in a landfill.

Table 4-1, provides a descriptive summary of all disposal alternatives considered for UDM for New Bedford/Fairhaven Harbor.

Table 4-1: Disposal Types - General Summary Matrix

Disposal Type	Benefits	Drawbacks	Contaminant Pathways
CDF	Contaminated sediment sequestered from marine environment; creation of new land for port expansion, recreation, commerce, etc..	Permanent loss of subtidal and intertidal habitat; fine sediments may require extensive dewatering time, restricting use of the site for extended period.	Birds and small mammal can be temporarily exposed to contaminants in soil and potentially ingest contaminated organisms before cap placement.
CAD - In Channel	Contaminated sediment sequestered from marine environment; impact occurs within already disturbed area; relatively low cost	Technology of capping not perfected; limits potential future dredging depths; short-term water quality impacts; permanent change to bathymetry of disposal site	Suspended particulate matter released during disposal can affect water column
ATC-CAD	Contaminated sediment sequestered from marine environment; relatively low cost; close to channel dredging areas	Technology of capping not perfected; ATC areas may not be degraded, therefore high value bottom habitat can be impacted; short-term water quality impacts	Suspended particulate matter released during disposal can affect water column; potential change in substrate type.
CAD	Contaminated sediment sequestered from marine environment; relatively low cost;	Technology of capping not perfected; CAD areas may not be degraded, therefore bottom habitat can be impacted; benthos impacts, short-term water quality impacts; large volume of capping material required to cover mound	Suspended particulate matter released during disposal can affect water column; potential change in substrate type.
TH	Creation of salt marsh or tidal flats beneficial to water quality and wildlife.	Contaminated sediments cannot be used for habitat creation because of potential bioaccumulation/biomagnifi-cation/bioturbation of contaminants.	Benthic organism and plants living in contaminated sediments can transfer pollutants within food web.
Upland	Removal of contaminants from marine environment into a well engineered and monitored situation.	Large dewatering area required; air quality, noise, traffic impacts; high cost; future use of disposal site permanently affected due to classification of material as solid waste	Potential groundwater contamination from leachate; air quality impacts from fugitive dust and odor
Alternative Treatment Technology	Removal of contaminants rendering sediment potentially suitable for ocean disposal or beneficial reuse (tidal habitat creation)	Cost prohibitive, particularly for small projects. Residuals may require treatment. Potential air emissions.	Air and wastewater emissions from processes.

4.4 Disposal Site Screening Process

The disposal site screening process is designed to assess all possible alternatives through the sequential application of environmental, social and economic criteria. As sites with significant conflicts are removed from consideration, the assessment of remaining sites becomes more detailed. Ultimately, only those sites with minimal or no conflict with the criteria are subjected to intensive evaluation to determine which remaining sites best meet the goals of the New Bedford/Fairhaven Harbor DMMP.

A universe of disposal sites was developed during Phases I and II of the DMMP, including historic dredged material disposal sites recommended by the USACE as well as sites suggested by the New Bedford/Fairhaven Dredged Material Management Committee. These were evaluated in a tiered process. The result of this process is the identification of a range of practicable and reasonable disposal site alternatives. These sites, determined through the evaluation process described below, are evaluated in detail in this DEIR.

The types of disposal sites and methods identified through this process include: Adjacent to Channel (ATC), Channel Over Dredging, Confined Aquatic Disposal (CAD), Capping (CAP), Confined Disposal Facility (CDF) for land creation, Tidal Habitat Creation (mudflat or marsh), upland (reuse or disposal), and alternative treatment technologies.

The disposal site screening criteria described in this DEIR were developed independently, based on published federal and Massachusetts disposal siting criteria and conforming with the Providence River and Harbor Maintenance Dredging Project Draft Environmental Impact Statement (USACE, 1998). The evaluation factors used in the Providence River DEIS were reviewed by the USEPA, USFWS, NMFS and Massachusetts regulatory agencies to obtain their concurrence with the criteria that would be the basis for disposal site decisions. The evaluation factors were also reviewed by the Dredged Material Management Committee.

The disposal site screening process includes four categories of evaluation criteria: criteria for all sites, criteria for aquatic disposal sites, criteria for upland disposal sites, and criteria for beneficial uses. The process of site screening is generically illustrated in Figure 4-7. Each disposal alternative category listed above underwent this screening analysis, with some variation during one or more stages of the process to account for the unique issues associated with each type of alternative. The site screening process for these categories is described in Sections 4.5 through 4.8.

The screening criteria were applied in sequential phases to each of the two major disposal site option groups (i.e., upland and aquatic). The first phase of the screening process ("Feasibility Screen") was to eliminate sites that are clearly a poor choice for disposal of dredged material because of one or more of the following: the surrounding land uses (for upland sites), their inaccessibility relative to the type of disposal proposed, their inability to contain a sufficient volume of material. Sites that are not feasible disposal options are permanently eliminated from further consideration under the DMMP.

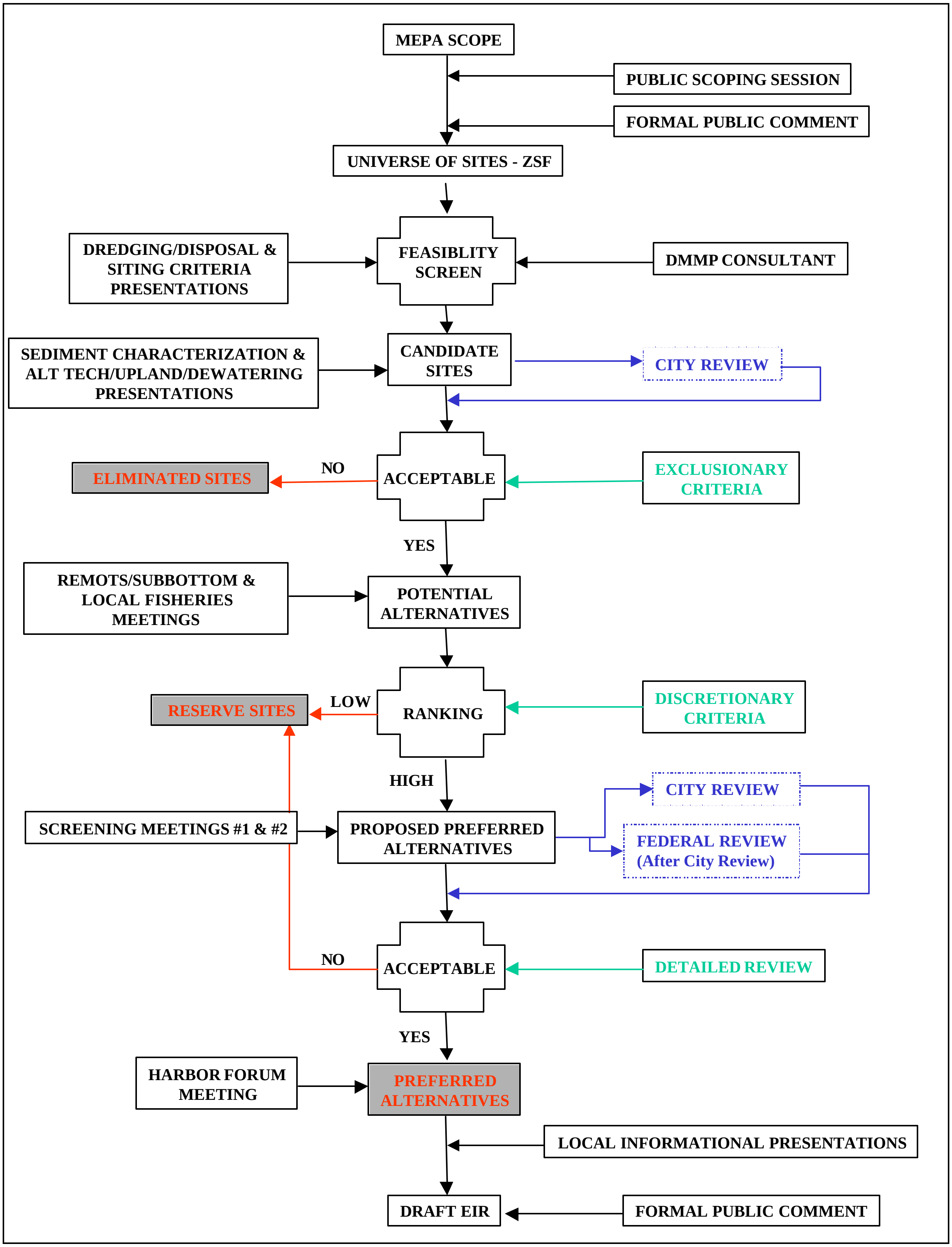


Figure 4-7: DMMP Disposal Site Screening Process

In order to facilitate involvement with the City, the Town and the Dredged Material Management Committee, and to provide a concise framework for evaluation and comparison of each disposal site, data sheets were developed which provided information from each site relative to the evaluation criteria. These data sheets were reviewed with the Committee during various phases of the screening process. Maps depicted the location of these sites and summary comparison matrices were also disseminated with the data sheets.

Sites that survived the feasibility screen, i.e. candidate sites, in addition to be being presented to the City, Town and the Dredged Material Management Committee, underwent exclusionary criteria analysis. For example, sites that were located in areas inhabited by federally or state-designated endangered species were eliminated from further consideration. In some cases, such as for the upland disposal analysis, exclusionary criteria significantly reduced the number of sites for further study. In other cases, such as for the aquatic disposal analysis, exclusionary criteria had no effect on the screening process. Where it was deemed useful and practicable, such as with the candidate aquatic sites, site-specific field investigation was conducted to better characterize and distinguish the sites. Those sites that survived this screen were deemed potential alternatives.

A series of discretionary criteria were applied to each of the potential alternatives. Each potential site was evaluated with respect to these criteria and the result was a ranking of sites. At this stage in the process, each of the sites had potential as a dredged material disposal site but some sites had attributes that clearly distinguished them from the other sites. These "higher ranking" sites were then elevated to "proposed preferred" status. These sites, and the process whereby they were selected, were presented to the City, Town and federal resource agencies for review. These sites also underwent more detailed field analysis and the result was the selection of a preferred alternative, which is the alternative that is evaluated for environmental impacts in Section 6.0 of this DEIR.

The following sections of this DEIR are divided to correspond with the four categories of disposal alternatives considered for the New Bedford/Fairhaven Harbor DMMP. Sections 4.5 through 4.8, describe the procedures, screening criteria and results of alternative treatment technology, dewatering, upland and aquatic disposal siting analyses.

4.5 Alternative Treatment Technology Alternatives

This section describes the available alternative technologies for treatment of UDM, the process for evaluating these technologies, the factors used in the evaluation, and the results of this evaluation with respect to applicability to the New Bedford/Faihaven DMMP. As discussed in Section 3.0, sediments tested and determined to be unsuitable for open ocean disposal, contain primarily metals and PAHs that exceed MBDS reference values. Alternative treatment technologies were evaluated in the context of their ability to 'treat' these constituents of the New Bedford/Faihaven Harbor UDM.

4.5.1 Screening Process

Alternative treatment technologies and their applicability to the DMMP were evaluated in Phase 1 of the DMMP (Maguire 1997a) and updated in this DEIR.

Data on the technologies were gathered from several sources including the USEPA, US Department of Defense, USACE, Environment Canada, and technology vendors. In addition, the findings of other dredging projects involving contaminated sediments were reviewed including the New Bedford Superfund studies, BHNIP various projects conducted by the Port Authority of New York and New Jersey, Boston Harbor projects, and several projects in European countries.

The inventory included technology description, treatment cost, and site demonstration information for 14 classes of treatment technologies including: chelation, chemical reduction/oxidation, dehalogenation, fungal remediation, incineration, in-situ bioremediation, pyrolysis, slurry bioreactor, solid-phase bioremediation, solidification/stabilization, solvent extraction, thermal desorption, and vitrification (see Appendix D). An overview of pretreatment, sidestream treatment, and residuals management options was also presented.

As part of this technology assessment, a survey of vendors was conducted to gather current information in several major comparative categories including: ability to treat various contaminant types, effects of sediment characteristics on the treatment process, potential role of the vendor in a sediment decontamination project, capabilities and logistical requirements of the process equipment, and information on current and projected costs. The results of the vendor survey allowed for a comparative evaluation of the technologies using standard criteria.

Regulations governing the recycling or reuse of treated sediment have yet to be promulgated in Massachusetts. The DEP is currently developing a Comprehensive Dredging Regulation and a set of regulations/policies/procedures for the management of non-municipal-solid-waste contaminated media, both targeted for completion in 2002. Currently, proposals for reuse and alternative treatment technologies are evaluated under 310 CMR 16.00 and 19.00 (Appendix J). A Beneficial Use Determination (BUD) process (Figure 4-8) as described in 310 CMR 19.060 determines the acceptability of treating contaminated media (including sediments). A Demonstration of Need (DON) for the treated product may also be needed to get approval from DEP (Figure 4-9). BUD and DON are currently two separate processes. BUD is the main permitting process for the use and distribution of the material.

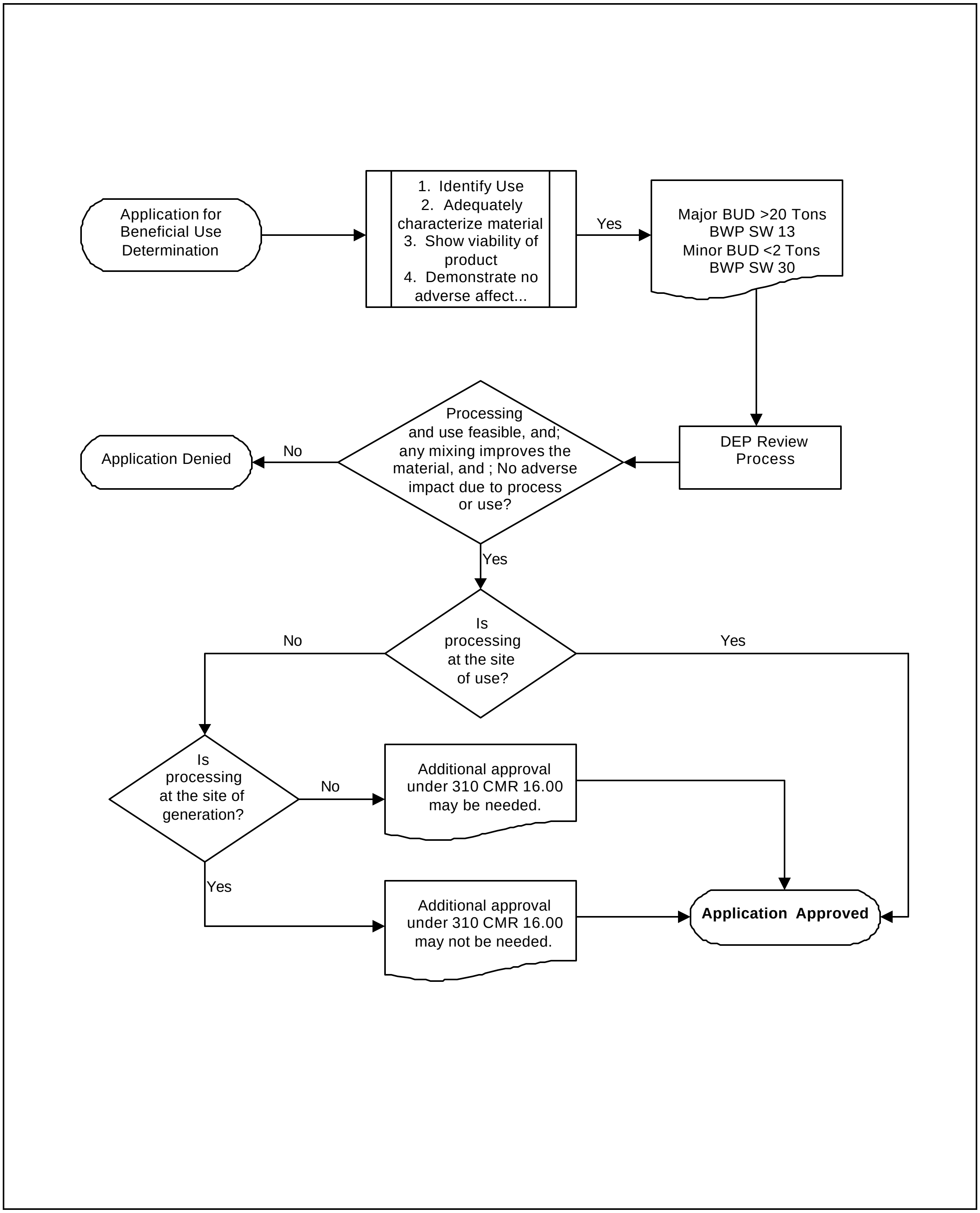


Figure 4-8: Beneficial Use Determination Process

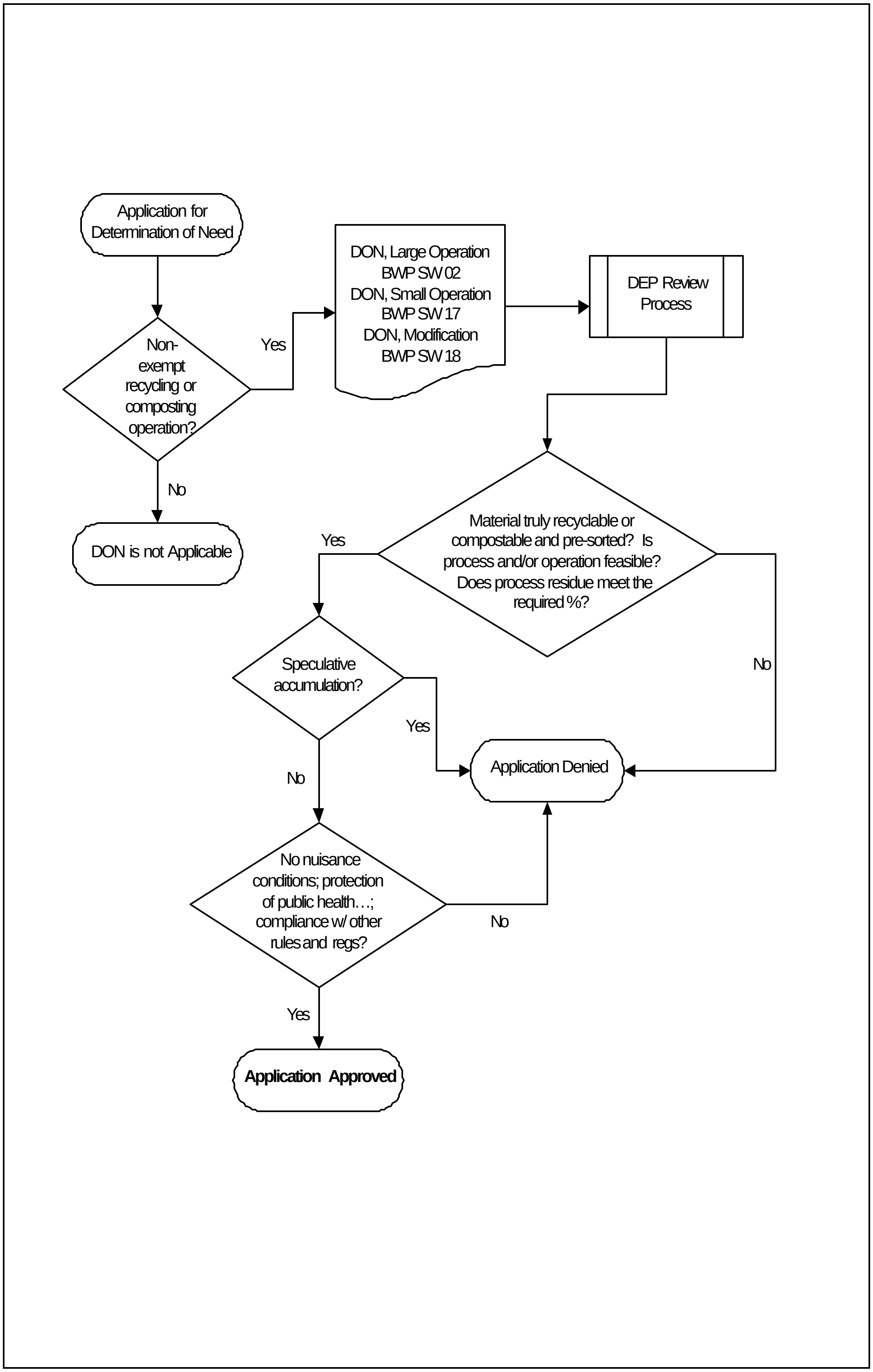


Figure 4-9: Determination of Need Process

The UDM that is treated must have a beneficial end use in order for approval to be granted. The product must be viable, i.e. there must be a practical and marketable use. Also, the product and the treatment process itself must be demonstrated to have no adverse effect on the environment.

4.5.2 Description of Treatment Technologies

This section describes existing sediment decontamination technologies. For each technology, distinct categories of the sediment decontamination process including: pretreatment technologies, treatment technologies, sidestream treatment technologies, and residuals management are also considered.

Pretreatment of the sediment typically involves removal of oversized materials and dewatering prior to treating the contaminated sediment.

Treatment of the sediment involves application of the primary decontamination process (e.g., physical, chemical, biological, and/or thermal) to reduce, destroy, or immobilize the target contaminants present in the sediments. Treatment may include use of a single technology or use of multiple technologies (i.e., treatment "train" or sequence) in order to address the widely-varying contamination and sediment types.

Sidestream treatment is often required for sidestream wastes (e.g., offgas, particulate emissions, and wastewater) generated during the primary sediment treatment process. These sidestream wastes typically require special handling, treatment, and/or disposal.

Residuals management involves the handling of treated solids from the primary sediment treatment process that may be acceptable for reuse or contain residual contamination which warrants special disposal.

The capabilities and costs of the treatment technology are the main consideration in the selection of a sediment decontamination method. Because sediments often contain a mixture of contaminants, the ability of a treatment technology to handle widely-varying contaminant and sediment types is very important. There are many technologies that will treat a specific contaminant in a relatively inexpensive manner, but require the addition of other technologies in a treatment train to handle a range of contaminants. Use of a treatment train increases the costs, handling requirements, potential environmental exposure, and complexity of sediment decontamination. On the other hand, some individual technologies may be more expensive, but can treat a full range of contaminants. Although the treatment process normally represents the major portion of the costs of sediment decontamination, the total costs including pretreatment, sidestream treatment, and residuals management must be considered when choosing between treatment alternatives. Public concerns about sidestream discharges, especially air emissions, can preclude the selection of certain treatment technologies. As mentioned in Section 2.1, the treatment technology information contained in this section was gathered from previously-published sources. All data on costs, treatment efficiencies, and reference sites were taken from the SEDTEC (Environment Canada, 1996) and VISITT (EPA, 1996) databases. For those technologies without costs or reference sites, no datum was available in VISITT or SEDTEC.

Table 4-2: Cost and Production Rates of Treatment Technologies

Technology	Treatment Rate (tons/hr)	Average Cost (per cubic yard)	# Technologies per Category
Chelation	16	$83	1
Chemical Reduction/Oxidation	172	$232	8
Dehalogenation	76	$263	15
Fungal Remediation	ND	$215	2
Incineration	10	$243	8
In-Situ Bioremediation	135	$42	22
Pyrolysis	9	$262	3
Slurry Bioreactor	17	$223	12
Soil Washing	32	$89	19
Solid-Phase Bioremediation	62	$62	51
Landfarming	ND	$48	2
Composting	40	$73	7
In-Vessel Bioremediation	1	$154	3
Solidification/Stabilization	40	$99	1
Thermal Desorption	27	$177	52
Vitrification	3	$462	17
Solvent Extraction	37	$182	21

ND = Not enough data
Source: SEDTEC 1996 and EPA 1996

Table 4-2 presents average values of the treatment rates and costs for the treatment technologies described in this section as well as the total number of vendors for each technology listed in the SEDTEC and VISITT databases. The average treatment costs range from $4/cy for phytoremediation to $462/cy for vitrification. The average cost for all of the technologies considered was $179/cy. These costs are strictly for comparative use and should be considered preliminary estimates only. Costs are subject to high variability based on the uncertainties associated with the widely-varying contaminant and sediment types, concentrations, and site-specific conditions.

4.5.2.1 Chelation

This process is a form of chemical stabilization that immobilizes metals. Chelation, or complexation, is the process of forming a stable bond or complex between a metal cation and a ligand (chelating agent). Chelating agents, or ligands, may form a single bond (monodentate) or multiple bonds (polydentate) with the target cation. The more bonds formed, the more stable the resulting complex and the greater degree of immobilization of the metal contaminant within the complex. Ethylenediaminetetraacetic acid (EDTA) is a commonly used polydentate chelating agent. Process efficiency is ion-specific depending upon the chelating agent, pH, and dosage.

The chelation process for metal immobilization may reduce the leachable metals adequately to meet the toxicity characteristic leaching procedure (TCLP) requirements. Treated sediments are the only residuals generated by the chelation process. Sidestream waste includes wastewater from dewatering of the treated sediments. Costs given by the vendor listed for chelation treatment are $83/cy.

4.5.2.2 Chemical Reduction/Oxidation

Chemical Reduction/Oxidation technology uses chemical additives to detoxify target contaminants by conversion into less toxic or immobile forms. Chemical oxidation processes work by transferring electrons from the contaminant to the oxidizing agent, which is reduced. Typical oxidizing agents include various forms of chlorine, potassium permanganate, hydrogen peroxide, persulfate, and ozone. These chemical oxidants may be catalyzed by the ultraviolet radiation or other transitional metal additives to enhance its oxidation potential by generation of free radicals.

Typical treatment efficiencies for selected organics may attain 90 to 95% removal. Sediment residuals contain excess chemical agents, reaction by-products including dissolved gases may require a post-treatment monitoring prior to backfill. Sidestream wastes include wastewater from dewatering of the treated sediments and offgas from the treatment vessel. Wastewater can be recycled into the extraction process. Costs for reduction/oxidation treatment range from $39 to $2,805 per cubic yard ($35 to $2,550 per ton) with an average cost of $232 per cubic yard ($211 per ton) (neglecting the highest value). In Europe, reduction/oxidation is only used as part of a soil washing train, after removal of fine particles.

Limitations include:

- Incomplete oxidation may lead to the formation of intermediate contaminants that are more toxic than the original;
- Dewatering is required after treatment;
- High organic content increases the required reagent dosage;
- Potential foaming and gas emissions of treated products; and,
- Presence of non-target compounds may react with the reagent additives to increase the treatment cost.

4.5.2.3 Dehalogenation

Dehalogenation is a process which destroys or removes some of the halogen atoms from halogenated aromatic compounds such as polychlorinated biphenyls (PCBs), dioxins, furans, and pesticides by substitution of bicarbonate or glycol for the halogen (usually chlorine) atoms. The two most common forms of dehalogenation are base-catalyzed decomposition and glycolate dehalogenation. Costs for dehalogenation range from $220 to $330 per cubic yard with an average of $263 per cubic yard.

4.5.2.4 Fungal Remediation

Fungal remediation is a particular subset of bioremediation that employs fungi rather than bacteria to degrade the contaminant. White rot fungus is the most commonly studied fungus because the enzymes secreted by the white rot fungus can degrade lignin, the complex organic building block of wood. White rot fungus has shown the ability to destroy complex organic compounds such as explosives, pesticides, PAHs, and PCBs. Although the potential of white rot fungus has been known for over 20 years, there have been few commercial applications of this remedial technology.

Treatment efficiencies of approximately 50% have been reported. Costs for the two vendors offering fungal remediation are $165 to $264 per cubic yard. Residuals include the treated sediments. No sidestream wastes are generated during this treatment process.

Limitations include:

- High contaminant concentrations may be toxic to the fungus;
- Minimum degradation concentration of contaminants may not meet the cleanup standard;
- Does not treat metals;
- Unknown how salt water will effect white rot fungus;
- Short life of cultured fungi may require frequent reactor replacement; and,
- Removal efficiencies of approximately 50% are considered too low to effectively treat contaminated sediments.

4.5.2.5 Incineration

Incineration is one of the most commonly-used remediation technologies. Incineration, or thermal oxidation, destroys contaminants using high temperatures in the presence of oxygen and is effective in destroying a wide range of organic contaminants. Currently in Massachusetts, incineration of wastes is not looked on favorably by the DEP, environmental groups, or the public. It would be very difficult to site an incineration facility in Massachusetts as evidenced by recent efforts to site a portable thermal oxidizer for treatment of 30,000 cy of soil near Logan Airport. Other efforts, such as the proposed incineration of PCB-laden sediments from New Bedford Harbor in the early 1990s were also thwarted due to potential air quality impacts. Treatment efficiency of the incineration process generally exceeds 99.99% and can be as high as 99.9999% when required for PCBs and dioxin. Costs for incineration range from $55 to $880 per cubic yard with an average cost of $243 per cubic yard. Incineration costs increase for PCBs and dioxins.

Limitations include:
- Requires a very low moisture content in sediments;
- Strict feedstock particle size limitations (1 - 2 inches maximum);
- Gaseous discharges are a major potential contaminant emission pathway;
- Heavy metals are not removed or destroyed and are more leachable after incineration;
- Metals can react with chlorine or sulfur to form more toxic compounds;
- Public opposition;
- Permitting difficulties; and,
- Large area required for equipment layout.

4.5.2.6 In-situ Bioremediation

In-situ bioremediation is a process in which indigenous or inoculated microorganisms (i.e., fungi, protozoa, bacteria, and other microbes) degrade organic contaminants found in the sediments. In the presence of sufficient oxygen, microorganisms may ultimately convert many organic contaminants to carbon dioxide, water, and microbial cell mass. In the absence of oxygen, the contaminants may be ultimately reduced to methane, carbon dioxide, and trace amounts of hydrogen gas. Sometimes contaminants may be degraded to intermediate products that may be equally, or more hazardous than the original contaminant. In-situ bioremediation processes have been successfully used to treat petroleum hydrocarbons, solvents, pesticides, and other organic chemicals.

Treatment efficiency of the in-situ bioremediation process generally exceeds 90% and can be as high as 99%. Costs for in-situ bioremediation range from $6 to $116 per cubic yard with an average cost of $42 per cubic yard.

Limitations include:
- Extended remediation times on the order of years to decades;
- High concentrations of heavy metals and contaminants may be toxic to microorganisms;
- Bioremediation slows at low temperatures;
- Not all organic compounds are biodegradable;
- Bioremediation rates are limited by the availability of PAHs, PCBs and pesticides in the sediments; and,
- Heterogenous geological conditions and low permeability soils (less than 10^{-5} cm/sec) are not favorable for in-situ bioremediation.

4.5.2.7 Pyrolysis

Pyrolysis involves the destruction of organic material in the absence of oxygen. The absence of oxygen allows separation of the waste into an organic fraction (gas) and an inorganic fraction (salts, metals, particulates) as char material. Pyrolysis is normally used to treat high levels of organics (e.g., semivolatile organic compounds and pesticides) that are not conducive to conventional incineration.
Treatment efficiency for the pyrolysis technology generally exceeds 99%. Costs for the two vendors offering pyrolysis are $248 and $275 per cubic yard. Major factors affecting this estimate are the condition and properties of the feed sediment (i.e., moisture, total contamination, and soil characterization.

Limitations include:
- Requires a very low moisture content (<1%) in sediments;
- Strict feedstock particle size limitations;
- Gaseous discharges are a major potential contaminant emission pathway;
- Heavy metals are not removed or destroyed, but are not more leachable after pyrolysis;
- Public opposition;
- Permitting difficulties; and,
- Site space limitations.

4.5.2.8 Slurry Bioreactor

A slurry bioreactor is a controlled biological treatment vessel where the contaminated sediments are treated in a slurry form at a low solids content. The sediment is mixed with water to a predetermined concentration dependent upon the concentration of the contaminants, the rate of biodegradation, and the physical nature of the sediments. Slurry bioreactors can treat a variety of organic contaminants including chlorinated and non-chlorinated volatile organics, PAHs, PCBs, and pesticides.

Typical treatment efficiencies of greater that 90% can be attained in a slurry bioreactor. Treatment costs range from $6 to $825 per cubic yard with an average cost of $223 per cubic yard. Treatment residuals include processed soils. Sidestream wastes include wastewater from dewatering the treated slurry and offgas from the treatment vessel.

Limitations include:
- Heavy metals at high concentrations can inhibit microbial degradation;
- Treatment and disposal of wastewater from slurry dewatering;
- Dewatering is required after treatment;
- Equipment operation and maintenance is intensive;
- Higher energy costs than solid-phase bioremediation;
- Organic destruction efficiencies are generally low at low concentrations; and,
- Low cleanup standards may be difficult to meet for recalcitrant organics.

4.5.2.9 Soil Washing

Soil washing refers to the process of using water to physically separate the sediments by particle size into a reusable bulk fraction and a smaller fraction containing concentrated contaminants. Since organic contaminants are often sorbed to the finer silt and clay particles, separation of this fine fraction from the sandy sediments allows reuse of the typically non-contaminated sands and accomplishes a volume reduction of the total contaminated sediment mass. It is also possible to add chelating agents, surfactants, acids, or bases to separate the contaminants from the sediment. Soil washing has the potential to treat a variety of contaminants including PAHs, PCBs, fuel oil, heavy metals, radionuclides, and pesticides.

Typical treatment efficiencies are greater than 90% for volatile organics, 70 to 95% for metals, and 40% to 90% for semivolatile organics. The cost of soil washing ranges from $20 to $220 per cubic yard with an average cost of $89 per cubic yard.

Limitations include:

- Soil washing is only marginally effective for sediments composed primarily of clays and silts;
- Maximum particle size typically 0.5 cm;
- Removal of fines from wastewater may require the addition of polymer flocculent;
- Treatment and disposal of wastewater from dewatering; and,
- Dewatering is required after treatment.

4.5.2.10 Solid-Phase Bioremediation

Biological degradation of contaminants is a naturally-occurring process. Bioremediation is the acceleration of the natural biodegradation processes by controlling moisture content, temperature, nutrients, oxygen, and pH to create the optimal environment. For purposes of this discussion, the varieties of solid-phase biological treatment processes have been divided into three categories based on level of engineering: landfarming, composting, and in-vessel bioremediation. Solid-phase biological treatment technologies are used primarily to treat VOCs and petroleum hydrocarbons. It is also possible to treat PAHs, PCBs, halogenated organic compounds, explosives and pesticides to some degree, especially in the more highly-engineered in-vessel systems.

Costs for all solid-phase bioremediation technologies range from $3 to $264 per cubic yard with an average cost of $62 per cubic yard. Solid-phase bioremediation is used on a production scale in Europe, especially in The Netherlands, Germany, and France.

4.5.2.11 Landfarming

Landfarming is the least engineered of the solid-phase bioremediation treatment processes. Landfarming consists of spreading the contaminated sediments over a large area of land and periodically tilling the sediments for aeration. Environmental conditions are controlled by watering (moisture content), fertilizing (nutrient concentration), tilling (oxygen concentration), and lime addition (pH) to accelerate natural bioremediation. Temperature cannot be regulated to a great extent, limiting the applicability of landfarming in cold climates. Since oxygen is added by tilling, the thickness of the spread contaminated sediments is limited to the tilling depth; therefore, a large area of land is required for landfarming. Landfarming may also incorporate the use of polyethylene liners to control leaching of contaminants.

Treatment efficiencies are highly variable but generally greater than 90% for contaminants amenable to aerobic bioremediation. The effectiveness in remediating petroleum hydrocarbons has been widely demonstrated. The costs for the two vendors offering landfarming are $44 and $52 per cubic yard.

Limitations of Landfarming include:

- Open landfarming may not be practical in regions of heavy annual rainfall precipitation and/or cold climate;
- Does not remediate inorganic contaminants;
- Inorganic contaminants may leach from contaminated sediments into ground;
- Ineffective for treatment of high molecular weight PAHs and highly chlorinated PCBs;
- Can generate odors;
- Of the solid-phase bioremediation treatment processes, landfarming offers the least control over environmental conditions;
- Of the solid-phase bioremediation treatment processes, landfarming offers the least control over collection of offgas;
- Of the solid-phase bioremediation treatment processes, landfarming requires the largest space; and,
- Of the solid-phase bioremediation treatment processes, landfarming requires the longest cleanup time.

4.5.2.12 Composting

Composting is the middle level of the engineering hierarchy of the solid-phase bioremediation treatment processes. The two major variations of the composting process discussed here are windrow and aerated static pile. The windrow is a pile typically 6-10 feet high, 15-20 feet wide and hundreds of feet long. Windrows are mechanically turned twice a week to once a year to aerate the pile, control the temperature, and create a more uniformly mixed material. Turning of the pile releases odors. Composting is completed in one month to a few years depending on the contaminants and the level of maintenance of the windrow.

Treatment efficiencies are highly variable but generally greater than 90% for contaminants amenable to aerobic bioremediation. The cost of composting ranges from $25 to $198 per cubic yard with an average cost of $73 per cubic yard.

Limitations of composting include:

- A large space is required;
- Questionable effectiveness for treatment of high molecular weight PAHs and highly chlorinated PCBs;
- Requires months of cleanup time;
- Can generate odors; and,
- Collection of offgas is difficult.

4.5.2.13 In-Vessel Bioremediation

In-vessel bioremediation is the most engineered of the solid-phase bioremediation treatment processes. In-vessel biological treatment is often referred to as in-vessel composting. Here it is discussed separately since it is possible to have anaerobic conditions. Treatment consists of placing the contaminated sediment mixture in engineered treatment enclosures with leachate collection systems and aeration equipment. In-vessel composting is completed in a couple of weeks and the pile is normally allowed to cure for an additional one to three months. In-vessel systems allow stricter environmental controls, faster composting times, odor collection and treatment, smaller area requirements, and can handle a wider variety of contaminants.

Typical treatment efficiencies range from 70 to 95%. Typical costs range from $33 to $220 per cubic yard ($30 to $200 per ton) with an median cost of $154 per cubic yard.

Limitations of In-Vessel Bioremediation include:
- Ineffective for remediating inorganic contaminants;
- Difficult to treat high molecular weight PAHs and highly chlorinated PCBs;
- Most expensive of the solid-phase bioremediation treatment processes; and,
- Emission controls for offgas may be required.

4.5.2.14 Solidification/Stabilization

Solidification/stabilization is effective at immobilizing contaminants and are among the most commonly used remediation technologies. Solidification/stabilization involves mixing reactive material with contaminated sediments to immobilize the contaminants. Contaminants are physically bound or enclosed within a stabilized mass (solidification), or undergo chemical reactions with the stabilizing agent to reduce their mobility (stabilization). Binding of the contaminants to the sediment reduces contaminant mobility via the leaching pathway. A typical treatment process includes homogenization of the feed material followed by mixing of solid or liquid reagents with the feed material in a pug mill. Three specific categories examined in this screening include asphalt, cement, and lime solidification/stabilization.

Solidification is the process of eliminating the free water in a semisolid by hydration with a setting agent or binder. Typical binder materials include cements, kiln dust, and pozzolans such as lime/fly ash. Binders used in Germany and France are bentonite and Portland cement. Solidification usually provides physical stabilization but not necessarily chemical stabilization. Physical stabilization refers to improved engineering properties such as bearing capacity, trafficability, and permeability. Although solidification/stabilization technologies are not generally applied to organic contaminants, physical stabilization can also immobilize contaminants since the contaminants tend to be bound to the fines, which are physically bound in the solidified matrix. Chemical stabilization is the alteration of the chemical form of the contaminants to make them resistant to aqueous leaching. The solubility of metals is reduced by formation of metal complexes, chelation bonds, or crystaline precipitates within the solid matrix with chemical additives and by controlling pH and alkalinity. Anions, which are more difficult to bind as insoluble compounds, may be immobilized by entrapment or microencapsulation. Chemical stabilization of organic compounds is not very reliable.

Results of reactions of binders to the contaminated sediment are not always predictable due to varying contaminant types and concentrations within the test material. Therefore, laboratory leach tests must be conducted on a sediment-specific basis.

Asphalt Batching

Asphalt batching is a commonly used technology in Massachusetts and has been proven effective in immobilizing TPH, VOC, and PAH compounds. Contaminated solids are blended with asphalt emulsions in a pug mill. The asphalt-emulsion-coated material is stockpiled and allowed to cure for approximately

2 weeks. Pretreatment requirements include dewatering and size classification by screening or crushing to less than 3-inch diameter. End product can be recycled as a stabilized base material for parking lots or roadways.

Cement Solidification/Stabilization

Cement solidification/stabilization involves mixing the contaminated sediments with Portland cement and other additives to form a solid block of stabilized waste material with high structural integrity. Siliceous materials such as fly ash may be added to stabilize a wider range of contaminants than cement alone. Cement solidification/stabilization is most effective for inorganic and metallic contaminants.

Lime Stabilization

Lime/fly ash pozzolanic processes combine the properties of lime and fly ash to produce low-strength cementation. Lime stabilization involves mixing the contaminated sediments with lime in a sufficient quantity to raise the pH to 12 or higher. Raising the pH results in chemical oxidation of the organic matter, destruction of bacteria, and reduction of odor. Lime stabilization is commonly used to treat wastewater sludge and is primarily effective for organic contaminants and microbial pathogens.

Typical treatment efficiency of the solidification/stabilization process ranges from 75% to 90%. Costs range from $48 to $330 per cubic yard with an average cost of $99 per cubic yard. Residuals produced from treatment are stabilized blocks of sediment material. Air emissions are the main sidestream waste produced during the treatment operation

Limitations include:
- May not be particularly effective for organic contaminants, particularly VOCs;
- Fine particles may bind to larger particles preventing effective bonding of the binder material;
- Inorganic salts may affect curing rates and reduce strength of stabilized product;
- Organic contaminants may volatilize due to heat generated during the reaction; and,
- High moisture content requires increased amounts of reagent.

<u>4.5.2.15 Solvent Extraction</u>

Solvent extraction is similar to soil washing in that the technology produces a volume reduction of the total contaminated material, however, solvent extraction focuses on extracting the contaminants from the sediments using organic solvents. Contaminated material volume reductions of 20 times or more are attainable. Solvent extraction is targeted primarily at organic contaminants including PCBs, PAHs, VOCs, petroleum hydrocarbons, and chlorinated solvents. This technology is not particularly applicable to inorganics; however, organically-bound metals can be extracted.

Treatment efficiencies for the solvent extraction process generally exceed 90% and are typically in the 98-99% range. The costs ranges from $21 to $567 per cubic yard with an average cost of $182 per cubic yard.

Limitations include:
- Less effective for sediments composed primarily of clays and silts;

- Not typically effective for removal of inorganic compounds;
- Treated soil may contain residual concentrations of solvent;
- Maximum particle size 0.5 cm;
- Treatment and disposal of wastewater from dewatering; and,
- Dewatering is required after treatment.

4.5.2.16 Thermal Desorption

The thermal desorption technology employs high temperature to volatilize organic contaminants. Thermal desorption technologies are divided into high temperature and low temperature categories. Thermal desorption is a removal process that applies to contaminants that are volatile at the process operating temperatures. Primary targets of treatment are organic contaminants including PAHs, VOCs, pesticides, and chlorinated solvents. This technology is not applicable to inorganic compounds; however, volatile metals, such as mercury, can be extracted.

High-Temperature Thermal Desorption

The high-temperature process uses temperatures between 600 °F and 1,000 °F. At these temperatures, a greater range of contaminants are volatilized including some metals (which may not be desirable).

Low-Temperature Thermal Desorption

The low-temperature process uses temperatures between 200 °F and 600 °F. The lower temperatures do not volatilize metals. Most commercial low-temperature thermal desorption units are of the rotary dryer or thermal screw design. Costs for thermal desorption range from $11 to $908 per cubic yard with an average cost of $177 per cubic yard.

Limitations include:

- Optimal moisture content less than 60%;
- Gaseous discharges are a major potential contaminant emission pathway;
- Feedstock particle size limited to 2 inches maximum;
- Tightly bound contaminants in clayey and silty sediments increase residence time requirements; and,
- Heavy metals are not removed or destroyed

4.5.2.17 Vitrification

Vitrification technology uses high temperatures, above 2,900 °F, to melt and convert contaminated sediments into oxide glasses, thus achieving destruction of organic contaminants and stabilization of inorganic contaminants. The resulting glass is nontoxic and suitable for landfilling as non-hazardous materials. Vitrification technology is applicable to all types of contaminants. Vitrification immobilizes inorganic contaminants in a solidified glass matrix and destroys organic contaminants with the high temperature involved in glass production.

The treatment efficiencies range approach 99% or greater for most target contaminants. Vitrification is one of the most expensive technologies; however, since vitrification can act as a stand-alone technology, the cost of vitrification can compete when a treatment train of other technologies is required. The cost of vitrification ranges from $66 to $1540 per cubic yard with an average cost of $462 per cubic yard.

Limitations include:

- Gaseous discharges are a major potential contaminant emission pathway;
- Creates a glass material that must be reused or disposed;
- More expensive than incineration; and,
- Molten product requires long cooling period.

4.5.3 Screening Factors

To evaluate alternative sediment decontamination technologies, a survey was performed of potential vendors of treatment systems. Potential vendors were identified from the VISITT and SEDTEC databases. Each vendor was provided with a sediment decontamination technology vendor questionnaire to complete either on-line or through the mail. A copy of the questionnaire is provided in Appendix D. The questionnaire was developed and administered in order to obtain information for a comparative analysis of treatment technologies. Results of this questionnaire allowed development of a consistent set of results including site conditions, sediment characteristics, target cleanup levels, treatment options, and cost elements to evaluate sediment decontamination processes and vendors.

The vendor questionnaire was divided into several major comparative categories including: Business Information, Ability to Treat, Effects of Sediment Characteristics, Vendor Involvement, Process Information, and Cost. These elements, as well as several practicability criteria were applied to each technology. In addition, DEP Solid Waste Management staff were consulted regarding specific case-studies and experience in the application of alternative treatment technologies to dredged material and other media within the Commonwealth (see Appendix K for DEP comments and Section 4.5.4 below for detailed screening).

4.5.3.1 Ability to Treat

The ability of the technology to treat the contaminants that may potentially be present in the dredged sediments such as metals, PAHs, PCBs, and TPH is a primary consideration in evaluating treatment technologies. The vendor was asked to categorize their technology for its ability to provide immobilization, removal, destruction, or no effect on the target contaminants. In addition, the typical treatment efficiencies and operating ranges (i.e., low and high contaminant levels) were to be identified. Specific individual contaminant exceptions within each of the four major contaminant groups were also to be identified in this section.

4.5.3.2 Effects of Sediment Characteristics

This category contains information about the sensitivity of the treatment technology to variations in the physical and chemical properties and characteristics of the dredged sediments. Requested information included the maximum particle size accepted by the treatment system and the optimal solids content recommended for the treatment system by the vendor. More detailed information was requested on the effects of specific sediment characteristics on the treatment technology. These characteristics included sandy, silty, clayey, low and high moisture content, low and high organic content, and high metals content. Choices provided for describing the effects of the sediment characteristics on the treatment technology included favorable, no effect, impedes, or unknown.

4.5.3.3 Process Information

This category contains information specific to the design and implementation of the vendor's technology. The most critical piece of information in this category is the current scale of development of the technology. Choices included laboratory, pilot, or full/commercial scale. The total number and site-specific references were requested of those vendors with full scale operations. Process-specific information requested included pretreatment requirements, treatment batch size and treatment time, maximum system throughput, residuals generated (e.g., liquid, solid, gas, none), and residual disposal requirements. In addition, any special site- or process-specific needs such as power, water, safety, or permits were to be identified in this section. Other process-specific information included mobilization and demobilization times and layout space required.

4.5.3.4 Cost

The capabilities and costs of the treatment technology, in combination with the time required to process a given volume of sediment (see throughput below), are a key consideration in the selection of a sediment decontamination method. The cost of sediment decontamination technologies is relatively high ranging from $70 to $170 per cubic yard. In comparison, contaminated sediments from the BHNIP will be disposed of in CAD cells within the footprint of the area to be dredged at an estimated disposal cost of $36 per cubic yard.

4.5.3.5 Throughput

The vendor survey found that the treatment technologies generally have low throughput ranging from 30 to 2,000 cy per day. The treatment technologies evaluated for the BHNIP were rejected partially because the low throughput would constrain the viability of the project. Throughput rates must be considered along with the number of days allowed for dredging and the volume of material to be dredged. In New Bedford/Faihaven Harbor, dredging is allowed only in the late fall and winter months to protect sensitive spawning activities. There are approximately 100 working days (Monday through Friday) in any one dredging season. For a project of 100,000 cy, 1,000 cy of sediment would need to be dredged each day. For smaller projects, slower throughput rates could be adequate, but for large projects, dredging rates of 5,000 - 10,000 cy per day are typical.

Ten of vendors reported throughput rates equal to or greater than 1,000 cubic yards per day, but the majority of processes have much lower throughput rates, in the hundreds of cubic yards per day range .

4.5.3.6 Demonstrated Success

The results of the vendor survey and pilot-scale testing for the Port of NY/NJ cast doubt on the assertion that technologies are not available and proven. The vendors surveyed reported an average of 32 reference sites for full-scale implementation, and approximately half of the vendors reported 5 or more full-scale implementations of their technology. However, the ability of a treatment system to handle widely-varying sediment and contaminant types remains a challenging issue.

4.5.3.7 Logistics

The availability of space, utilities, time, and other logistics are site-specific issues not addressed in this report other than to mention the importance of considering such issues.

4.5.3.8 Permitting Issues

Two issues make permitting of treatment facilities particularly difficult in Massachusetts: sidestreams and residuals management. Public concerns of sidestreams such as gaseous emissions can bring overwhelming opposition to the siting of a treatment facility. Residuals management is discussed separately below.

4.5.3.9 Residuals Management

The costs incurred while managing residuals can easily result in a treatment option that is not economical. In the best case, the residuals can potentially have a commercial value to help offset treatment costs. Based on the documents contained in Appendix C, it appears that there is limited applicability of the following residuals management options: landfill disposal, recycling as landfill cover, and recycling as asphalt material. In addition, the uncertainties associated with the reuse option will greatly limit its applicability until regulations/policies have been promulgated. Although 88% of the vendors claimed that the treated sediments could be reused, it appears based on discussions of specifics with the vendors that many of the potential reuse options remain ideas and not reality.

4.5.4 Screening Results

The results of the alternative treatment technology inventory (presented below) were used to evaluate the potential for application of these technologies to sediments to be dredged from the New Bedford/Faihaven Harbor.

The survey results are as follows:

- 77% of the technologies are at the full scale/commercial scale of development;
- Vendors offering full scale/commercial technologies have an average of 32 reference sites per vendor;
- Average throughput for all technologies is 754 cubic yards/day (838 tons/day);
- Average treatment costs for all technologies range from $70 to $167 per cubic yard; and,
- The top 4 factors affecting price are: 1) quantity of sediments, 2) moisture content, 3) target contaminant concentration, and 4) characteristics of sediments.

The following is a summary of the practicability of each technology for treating UDM from New Bedford/Faihaven Harbor. Table 4-3 summarizes each technology with respect to the screening factors described above.

Table 4-3: Summary of Treatment Technology Characteristics

Technology	Major Advantages	Major Disadvantages
Chelation	relatively moderate cost; excellent for metals treatment	not effective for organics
Chemical Reduction/Oxidation	effective for most organics and inorganics	cost, ineffective for some PAHs, potential toxic residuals
Dehalogenation	excellent removal efficiency for PCBs and chlorinated pesticides	cost, ineffective for metals and PAHs
Fungal Remediation	low technology requirements	low treatment efficiencies, cost
Incineration	high treatment efficiency	permitability, air emissions, cost
In-Situ Bioremediation	high treatment efficiency, relatively low cost	long treatment time, not effective for all organics
Pyrolysis	high treament efficiency	requires low moisture content, cost, permitability, air emissions
Slurry Bioreactor	effective for treating metals and organics, contained within vessels	cost, ineffective for some organics at low levels
Soil Washing	low technology, relatively low cost	not appropriate for silts and clays
Solid Phase Bioremediation	relatively low cost, low technology	slow process, large land area requirement
Landfarming	relatively low cost, low technology	slow process, large land area requirement, metals not treated
Composting	relatively low cost, low technology	slow process, large land area requirement, low effectiveness for PAHs
In-Vessel Bioremediation	good treatment efficiencies	not effective for inorganics or HMW PAHs, cost
Solidification/Stabilization	byproduct can be used as structural fill, relatively moderate cost, proven track-record for large UDM volumes	ineffective for some organics
Thermal Desorption	high treatment efficiency	requires low moisture content, cost, permitability, air emissions
Vitrification	high treatment efficiency	requires low moisture content, cost, permitability, air emissions
Solvent Extraction	effective in treating organics	not effective for metals, possible toxic residuals, not effective for silts/clays

4.5.4.1 Chelation

This process is used mainly as a means of controlling leaching of metals but it is not particularly effective on organic compounds or dredged material consisting of silts and clays (which make up a significant portion of the sediments to be dredged from New Bedford/Faihaven Harbor). Metals leaching, even in sediments containing relatively high metals levels, is typically not a problem in upland disposal. Also, chelation is not effective in treating organic contaminants such as PCBs and PAHs, which are prevalent in New Bedford/Faihaven Harbor sediments. Chelation is relatively inexpensive compared to other treatment technologies ($83/cy), but it requires extensive pretreatment and residuals management.

4.5.4.2 Chemical Reduction/Oxidation

This process is effective in removing inorganics and organics that are present in dredged material. Throughput (172 tons per hour) is relatively high compared to other technologies, however, it's cost is high ($232 per cy). For example, a typical marina dredging project containing 10,000 cy of UDM would cost about $2.3 million for treatment alone. Removal rates of 90 - 95% have been reported. Full scale operations have reported relatively low throughput rates of 200 tons/day.

4.5.4.3 Dehalogenation

Dehalogenation processes are engineered to destroy or remove some of the halogen atoms from halogenated aromatic compounds such as PCBs, dioxins, furans and some pesticides, thereby rendering them less toxic. However it is ineffective in the removal of heavy metals and PAHs from the sediment and its cost is high at $263 per cy.

4.5.4.4 Fungal Remediation

This remediation process are relatively inefficient in their remediation capacity (50% removal). The process also does not treat metals and its effectiveness in salt-water media is unknown. In addition, the average cost is $215 per cy.

4.5.4.5 Incineration

Incineration is one of the most commonly-used remediation technologies, however, there are several disadvantages to this technology, particularly the air emissions generated from the process. Public opposition to incineration has been strong. A small portable thermal oxidizer was proposed to treat 30,000 cy of on-site generated soils (contaminated with petroleum products only) at an isolated area over a mile from the nearest resident near Logan Airport. Public opposition was so strong that the proposal was withdrawn. Incineration was originally proposed as the solution for remediating 10,000 cy of contaminated sediment as part of the EPA's Superfund cleanup effort in the upper harbor. This area, labeled the "hot spot operable unit" contained PCB concentrations of greater than 4,000 ppm, which is over 400 times the concentrations encountered in the federal navigation channels in the lower and outer harbors. EPA's Record of Decision (ROD) declaring that incineration was the preferred remedy for remediation of the sediments was met with significant public opposition and EPA revoked the incineration idea in favor of dredging and disposal in shoreline CDFs (EPA, 1998)

There are several technical shortcomings as well: heavy metals are not destroyed and may become more leachable after incineration; the technology is not effective on high moisture content (like sediments); and, gaseous discharges are created as a new contaminant pathway. PCB incineration can create emissions of dioxins and furans, two groups of highly toxic compounds. The cost is also high at $243 per cy.

4.5.4.6 In-Situ Bioremediation

In-situ bioremediation technologies have been utilized in Massachusetts for treatment of oil and hazardous materials at contaminated upland sites and could potentially be used for contaminated sediment if the intent is to only remediate the sediments in-place. This is not the case for the DMMP as sediments need to be removed to provide safe navigation.

4.5.4.7 Pyrolysis

Pyrolysis is very similar to incineration discussed above, except that it is used to treat very high levels of organics that are not conducive to conventional incineration. Like incineration, low throughput rates and high unit costs as with incineration are encountered with the use of pyrolysis.

4.5.4.8 Slurry Bioreactor

This technology would require pre and post-treatment actions and extensive sidestream controls. Also, its effectiveness in treating low levels of organic contaminants is minimal. Treatment and disposal of wastewater from slurry dewatering is also required. The average cost of this treatment system is $223/cy.

4.5.4.9 Soil Washing

Soil washing is one of the most common methods for treatment of dredged material. It has been used in the United States and is extensively used in Europe. This technology involves two main stages; particle separation, and, washing by water. Other substances such as chelating agents, acids or surfactants can be added to the process to aid in contaminant removal. Despite its real world usage for large volumes of dredged material, soil washing is not effective in treating silt and clay sediments, which comprise the majority of sediments to be dredged from New Bedford/Faihaven Harbor. Sediments that contain a high sand fraction, such as areas of the eastern side of New Bedford/Faihaven Harbor, could benefit from this technology, but at a cost of $89 per cy.

4.5.4.10 Solid-Phase Bioremediation

This technology includes three basic categories of processes: landfarming, composting, and in-vessel bioremediation. Landfarming and composting require large areas of land to be effective, because the sediment requires thinning and spreading. Landfarming does not remediate metals and is ineffective for high molecular weight PAHs, which is one of the primary contaminant types in New Bedford/Faihaven Harbor sediments. The same limitations are noted for composting. At an average cost of $62/cy, this is the least complicated and least expensive of the treatment technologies.

In-vessel bioremediation is more than twice as expensive as landfarming or composting because it involves engineered treatment enclosures with leachate collection systems and aeration equipment. It too is not effective in remediating metals and is only marginally effective in treating high molecular weight PAHs.

4.5.4.11 Solidification/Stabilization

Solidification is effective at immobilizing inorganic contaminants and is one of the most commonly used remediation technologies. It has been used in New Jersey at several shoreline sites including a site in Elizabeth, where the treated dredged material is being used as structural fill for a new shopping mall.

Solidification/Stabilization technologies are potentially viable, however, the end product still needs to find an acceptable disposal site. That end product can be of a significantly higher volume than the original dredged material because of bulking and the amendments (fly ash, cement, bentonite, lime) that are required to immobilize the contaminants and/or control pH, odor, and sulfide reactivity.

The effectiveness of these processes in immobilizing organic contaminants has been inconsistent (EPA, 1990). The USACE performed laboratory tests of New Bedford Harbor sediments mixed with various solidifying agents at various ratios. It was found that solidification with portland cement reduced the total leaced amounts of total PCB, PCB Aroclors and most PCB congeners by factors of 10 to 100 times as compared to untreated sediment. However, leachability of metals such as copper nickel actually increased.

Solidification effectiveness was studied using PCB-contaminated sediments from the Great Lakes and was found to be ineffective in immobilizing PCBs (Garbaciak, 1994; D. Averett, communication)

Lime has been used as an additive to dredged material to control nuisance odors and sulfide reactivity in Massachusetts sediments that were dredged and then used as daily or intermediate cover at landfills. This was done on dredged sediments from the Central Artery/Tunnel project (Tanal, et. al., 1995).

Given the uncertainty of solidification/stabilization processes in immobilizing PCBs, project-specific laboratory or bench-scale tests would need to be conducted to determine the effectiveness of solidification/stabilization technologies in immobiling contaminants. These processes are also relatively inexpensive compared to other treatment technologies. Average cost is estimated at $99 per cy, although the unit cost at the aforementioned New Jersey mall site was $56 per cy (P. Dunlap, personal communication). Solidification/Stabilization technologies appear to be a potentialy viable treatment technologies. However, its applicability to the New Bedford/Fairhaven DMMP depends on: the sediment-specific effectiveness of contaminant immobilization; and, the demand for construction fill. Currently, there is no large-scale demand for fill material that cannot be supplied by upland sources. The costs for upland fill material are significantly less than that of solidified dredged material. If the demand for fill material increases over the next 20 years, and the supply of upland fill material decreases, then solidified/stabilized dredged material could become a marketable, cost-competitive commodity.

4.5.4.12 Solvent Extraction

This technology is similar to, and could be used in conjunction with, soil washing technologies to treat contaminated sediments. However, it has a slow production rate (37 tons/hr) and is expensive (average cost $192 per cy). Its effectiveness in treating organic contaminants such as PAHs, PCBs, petroleum hydrocarbons and chlorinated solvents is good, but only for coarse grained materials such as sand, however the majority of sediment to be dredged from the New Bedford/Faihaven Harbor is fine-grained (silts and clays).

This technology was evaluated as part of the Superfund remediation project in New Bedford. EPA determined that , while solvent extraction would have been an effective remedy, because it would provide the ultimate destruction of PCBs, its reliability and potential lack of qualified vendors were reasons why it was dismissed as the preferred alternative (EPA, 1990).

4.5.4.13 Thermal Desporption

Thermal desorption is very similar to incineration and pyrolysis and has many of the same characeristics That is it has a low throughput rate (27 tons/hr) and high cost ($177/cy) for operation. This technology is not effective in destroying inorganics, such as metals. Off-gas from the process needs to be treated before release to the atmosphere.

4.5.4.14 Vitrification

Vitrification is the most effective treatment system available for treating a media that contains a wide variety of contaminants, such as dredged material. Through exposure to 2,900EF heat, the soil/sediment is melted and converted into an oxide glass-like slag that would be suitable for landfilling. Vitrification, however, is one of the most expensive treatment technologies at an average cost of $462 per cy. Throughput rates are fairly high, with one full scale operation processing 1,500 tons/day.

4.5.5 *Summary of Alternative Treatment Technology Practicability*

Alternative treatment technologies, unto themselves, do not offer any practicable solution to the management of 2.6 million cy of UDM from New Bedford/Faihaven Harbor. This is due to several factors, most notably cost. But the costs for some technologies such as solidification and landfarming, even though comparable to the cost of CAD disposal, do not overcome the fact that there needs to be a permanent receiving site for the treated sediment. It is not known at this time, whether treatment of the UDM would be required for disposal at the proposed preferred upland sites; more tests need to be conducted. The rationale for deeming the alternative treatment technologies evaluated in the New Bedford/Faihaven DMMP DEIR impracticable are shown in Table 4-4.

Table 4-4: Reasons why alternative treatment technologies were deemed impracticable

Technology	Rationale
Chelation	Inability to treat PAHs and PCBs,sidestream wastes, high cost
Chemical Reduction/Oxidation	Inability to treat metals and PAHs, sidestream wastes, high cost
Dehalogenation	Inability to treat metals and PAHs, sidestream wastes, high cost
Fungal Remediation	Inability to treat metals, low removal efficiencies, high cost
Incineration	Inability to treat metals, sidestream wastes, high costs, permitting difficulties. Not recommended for PCBs (may produce dioxins)
In-Situ Bioremediation	Inability to treat certain PAHs and most PCBs, sidestream wastes, limited temp. range
Pyrolysis	Inability to treat metals, sidesteam wastes, low sediment moisture content required, high cost, permitting difficulties
Slurry Bioreactor	Inability to treat metals, sidestream wastes, dewatering required after treatment, high cost
Soil Washing	Marginally effective for clay and silt sediments, dewatering after treatment required, high cost
Solid-Phase Bioremediation	
Landfarming	Inability to treat metals and PAHs, not suited for cold climates, ineffective on PCBs, sidestream wastes, land intensive, long duration
Composting	Inability to treat metals, space intensive, sidestream wastes, questionable effectiveness PAHs and PCBs, high cost
In-Vessel Bioremediation	Inability to treat metals, sidestream wastes, questionable effectiveness high molecular weight PAHs and highly chlorinated PCBs , high costs
Solidification/Stabilization	Final product volume significantly larger than original dredged material, market demand, high costs. Stabilization of organic compounds is uncertain for PCBs.
Solvent Extraction	Inability to treat metals, sidestream wastes, dewatering after treatment required, low effectiveness for silt and clay sediments, high cost
Thermal Desorption	Inability to treat metals, sidestream wastes, low sediment moisture content required, long processing time for clay and silty sediments, high cost
Vitrification	Sidestream wastes, long processing time, extremely high cost

Dehalogenation, soil washing, slurry bioreactors and solvent extraction are effective forms of treatment that demonstrate feasibility for treatment of New Bedford/Faihaven Harbor UDM potentially contaminated with PCBs. However these treatment technologies are usually not suffiecient to treat other types of contaminants and would most likely require other forms of treatment. In addition, a receiving site, such as an industrial or commercial development that requires large quantities of construction fill, would need to identified. Also, the treated UDM must be competitively-priced with upland sources of fill material in order for the use of treatment technologies to be a practicable solution for the DMMP. Currently, the supply of upland fill material exceeds the demand for construction fill, and at a much lower price (approximately $20/cy) than that of even the lowest-priced treatment technology.

4.5.5.1 Potential Future Alternatives

Alternative treatment technologies may prove viable for small projects, those that deal with unique and/or specific type(s) of contaminant(s), or as an element of a larger UDM management technique. Alternative treatment technology is a rapidly growing and evolving field and it is very likely that as ongoing and future pilot and demonstration projects occur, the universe of technically viable, cost-competitive, and permittable alternatives will emerge.

For this reason, the DEIR carries forward all alternative treatment technologies as "potential future alternatives", and specifies the various general performance standards which an alternative treatment technologies must meet to be seriously considered as a practicable alternative. This flexible approach will provide a baseline from which proponents of alternative treatment technologies can develop and present specific, detailed proposals, and will allow the State to focus its reviews on potentially practicable proposals. This approach is based on the Boston Harbor EIR/EIS. The DMMP will reevaluate, on a five year cycle, the feasibility of alternative treatment technologies for UDM in New Bedford/Fairhaven Harbor and other harbors throughout the Commonwealth.

CZM is aware that DEP is currently performing two major regulation reassessments that might affect the potential for alternative treatment technologies and/or beneficial use of dredged material. DEP is reassessing the BUD regulations and is expected to issue revised regulations in 2002. BUD revisions will be reviewed to determine whether they will have any significant impact on permittability. DEP's revision to its 401 WQC Dredging Regulations, to develop a set of comprehensive regulations for dredging and management of dredged material, anticipates going to public review/promulgation in late 2002 and will take into account planning, permitting, and implementation phases. Additionally, CZM is represented on the regulation revision workgroup and has been incorporating drafts of the regulations into the DEIR as guidance.

4.6 Dewatering Site Selection

In order to consider upland disposal/reuse as a viable option for the disposal of dredged material, adequate land area is required to accommodate the process to prepare dredged material for final disposal or reuse. A site or series of sites is needed to process and dewater dredged material to reduce the moisture content before transfer to an upland disposal or reuse site. As part of the DMMP DEIR process of exploring potential disposal options, harbor-side and upland site requirements were examined for transferring dredged material from the marine environment to the upland environment for final disposal/reuse.

4.6.1 Screening Process

An initial windshield survey of waterfront accessible areas throughout the shorelines of New Bedford and Fairhaven was conducted to produce a list of potential dewatering sites. Dewatering site criteria such as size, topography and accessibility were the main factors considered during the initial windshield survey. The potential dewatering sites produced during the initial windshield survey were examined against specific screening factors so that feasible dewatering site alternatives could be identified. Input from local municipal officials and the New Bedford/Fairhaven Dredged Material Management Committee were also incorporated into the search for dewatering sites.

The DMMP dewatering screening process is a two tier process involving the first tier or initial screening of *exclusionary* site factors and a second tier screening of *discretionary* factors. The exclusionary factors only apply to the harbor-side site requirements, all other criteria are discretionary. The harbor-side requirements are exclusionary because, being the first link in the “dewatering/upland disposal process train”, dewatering is the limiting factor for consideration of upland disposal. Thus, if a harbor-side site meeting the minimum requirements for dewatering could not be located, then upland disposal options are not feasible.

4.6.2 Screening Factors

The exclusionary factors for first tier dewatering process screening are described below:

D-1. Proximity to Dredging Site - Located within the developed shoreline of New Bedford and Fairhaven. These shorelines extend into Buzzards Bay proper and this was deemed a reasonable hauling distance for a sediment-loaded barge (M. Habel, personal communication). This screening criteria also factors in the compatibility of existing shoreline land uses. Shoreside locations that are residential or recreational were eliminated because of incompatibility with the industrial nature of dredged material stockpiling and its associated impacts.

D-2. Pier Requirements - Pier or bulkhead with a minimum length of 120 feet. The harbor-side site adjacent to the pier must be adequately sized to provide an off-loading area and be capable of accommodating two way truck traffic. An area that does not have a pier/bulkhead was considered if construction of a temporary structure would be practicable.

D-3. Water Depth - The pier must have a minimum water depth of 12 feet during all tides. If an area is shallower than 12 feet, but has other positive attributes which could make it a suitable dewatering site, then the site may be considered. This would be possible only if minimal dredging is required to obtain the necessary water depth.

D-4. Dewatering Area - A minimum area of 3.2 acres is needed to provide for a diked dewatering facility for a 10,000 cy project (Figure 4-5). This includes adequate area to allow the treatment of effluent and/or connection to local sewer system.

Second tier discretionary screening factors include the following:

D-5. Timing/Availability - The site (or sites) must be available for the time frame required by the particular dredging project(s) to process dredged material.

D-6 - Access to Transportation Network - The site(s) should be located in an area that has adequate land-side access provided by the existing transportation network. Sites requiring minor upgrading, such as re-paving or constructing a temporary access road may be considered, provided the connecting transportation network is adequate to accommodate the trucking needs associated with the transportation of dredged material.

D-7. Haul Routes - Selected haul routes should avoid lateral or vertical obstructions or any other restrictions. Evaluation of sensitive receptors passed on the haul route should be considered. Other potential logistical problems/conflicts that might be encountered accessing a site should also be identified.

D-8. Present Habitat Types - Sites shall be evaluated for general vegetation cover, presence of wetlands, rare plant/wildlife habitat, and the surrounding landscape.

D-9. Existing Terrain (suitability to diking) - Site examination to determine potential for dike construction.

D-10. Flood Plains - National Flood Insurance Program, Flood Insurance Rate Maps will be consulted for each site to determine if a site is in or partially in a designated flood plain.

D-11. Agricultural Use - Determination of prime agricultural soils on the site.

D-12. Surrounding Land Use - Evaluation of adjacent ownership, present and projected land use. Sites located in industrial or commercial areas are preferred over sites in or adjacent to residential or recreational areas.

D-13. Odors/Dust/Noise Receptors - Evaluation of potential impacts and distance to sensitive receptors of odors, dust and noise from dewatering process methods selected. Sites at a distance from sensitive receptors are preferred over sites adjacent to sensitive receptors.

D-14. Consistency with Port Plan - Each proposed site was reviewed for consistency with the New Bedford/Fairhaven Harbor Plan, specifically to determine whether the site(s) enhance(s) the values articulated in the Plan and conform to projected site-specific uses. This criteria is only applicable to potential dewatering sites identified within the municipal boundaries of New Bedford or Fairhaven.

D-15. Local, Regional, State Plans - Evaluation of consistency with Local, Regional and State long-range plans.

D-16. Ability to Obtain Permits - Likelihood of local, state, and federal regulatory approval.

D-17. Cost - The cost of the construction, operation, and restoration of the site was calculated for comparative purposes.

4.6.3 Screening Results

A total of 10 candidate dewatering sites were identified (Figure 4-10), 5 in New Bedford and 5 in Fairhaven. All sites were subject to a windshield survey and review of existing information. Each dewatering site was evaluated against the evaluation factors listed above, and this information was recorded on data sheets (Figure 4-11) for each site. The dewatering site screening evaluation is summarized below.

4.6.3.1 Exclusionary Screening

A strict interpretation of the exclusionary screening criteria resulted in all candidate sites failing the screen (Table 4-5). Eight of the ten sites would require pier construction. The remaining two have piers that would need substantial upgrading. Five of the sites were less than 3.2 acres in size, thereby failing the minimum size criteria. Nine of the 10 sites have inadequate water depth and, therefore, would require dredging. Many of these sites are adjacent to sensitive marine resources (e.g. mud flats, salt marsh), therefore dredging to create shore side access would result in negative ecological impacts.

Since all sites failing the exclusionary screening criteria, another site, the Railyard site, was considered as a dewatering site. The Railyard Site is also the site of EPA's CDF "D" and was also considered as a potential CDF site for the New Bedford Harbor DMMP (see Section 4.8). Initially, it was thought that this site could potentially be used for two purposes: dewatering of DMMP sediments, and permanent storage of sediments from the Superfund remediation. After discussions with EPA, it was deemed that the use of the site for dewatering would present significant conflicts with EPA's CDF construction, operation and maintenance, therefore, the site was eliminated from further consideration.

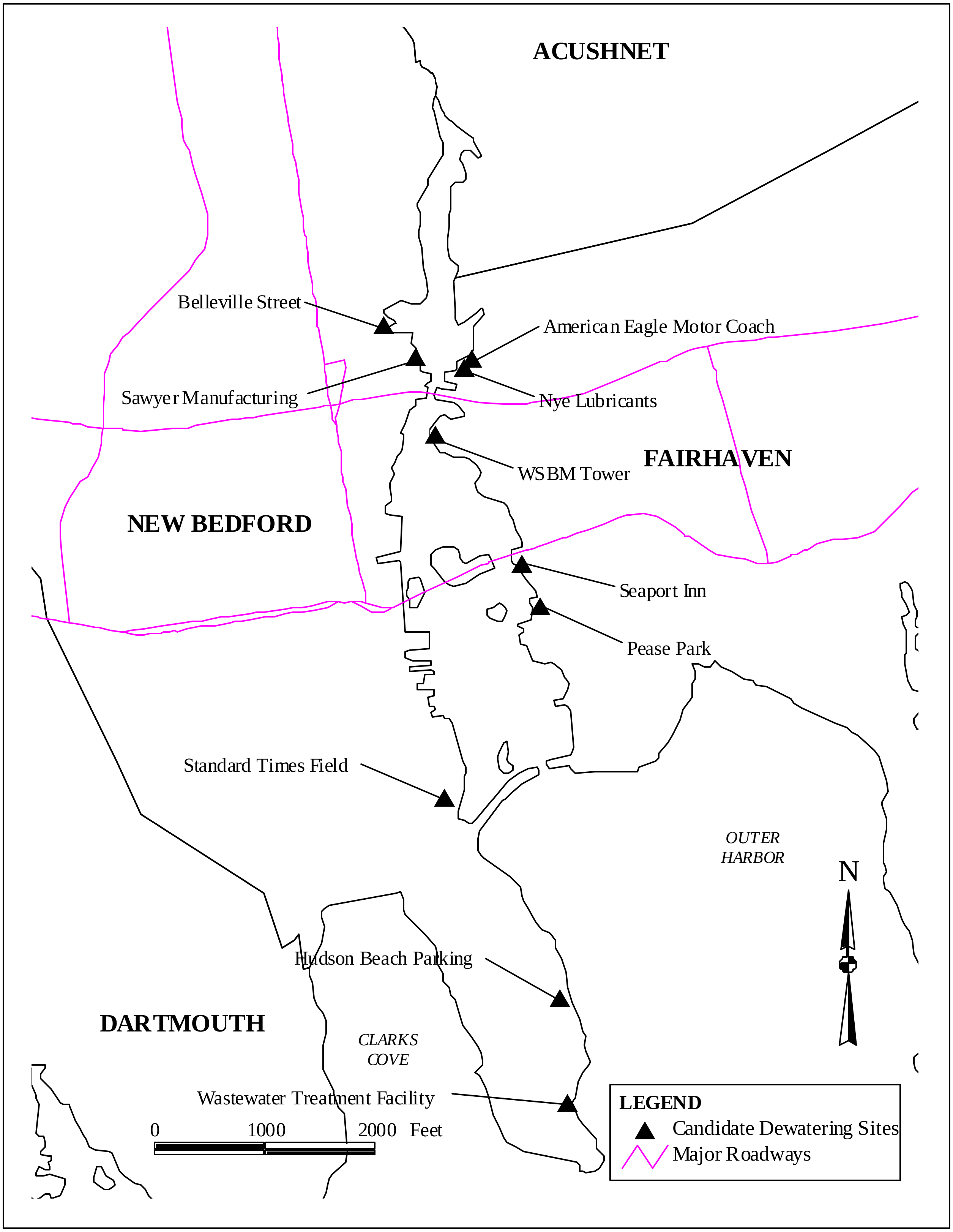


Figure 4-10: Candidate Dewatering Sites

DEWATERING SITE SCREENING

SITE LOCATION 1

HARBOR: SITE NAME:
CITY/TOWN: Lynn SITE ADDRESS:
GENERAL DESCRIPTION:

SITE CHARACTERISTICS

Proximity to Dredging Site (D-1):

Miles from Dredging Projects
Comments:

Pier Requirements (D-2):

Length (Feet)	Able to Accommodate Two Way Truck Traffic
Possible to create Pier:	

Water Depth (D-3):

Minimum Water Depth (Feet)
Possible to dredge to 12 feet:

Dewatering Area (D-4):

Area (Acres)	Dewatering Method
Comments:	

Timing / Availability (D-5):

Availability	Time Frame	Ownership

Access to Transportation (D-6):

Proximity to Highways (Miles)	Proximity to Rail (Miles)
Comments:	

Dredged Material Haul Route (D-7):

Restrictions /Obstructions	Sensitive Receptors
Comments:	

Figure 4-11: Dewatering Site Data Sheet Sample

Present Habitat Types (D-8):
Summary Type:

Successional Stage (D-8.a):	
Disturbance (degree) (D-8.b):	
Plant/Animal Diversity (D-8.c):	
Plant/Animal Integrity (D-8.d):	
Landscape Position (D-8.e):	
Wildlife Function/Use (D-8.f):	

Existing Terrain - suitability for diking (D-9):

Topographical Characteristics	Comments

Flood Plains (100 year) (D-10):

% Coverage	Comments

Agricultural Use (D-11):

Description	Comments

Surrounding Land (D-12):

Existing Land Use	Projected Land Use
Comments:	

Odor/Dust/Noise Receptors (D-13):

Name/Description	Distance	Comments

Consistency with Port Plan (D-14):

Consistency with Stated Goals	Relationship to Preferred Alternative
Comments:	

Local, Regional, State Plans (D-15):

Local	Regional	State
Comments:		

Ability to Obtain Permit (D-16):

Consistency with Federal Regulations	Consistency with State Regulations
Comments:	

Cost (D-17):

Construction	Operation	Restoration
Approx		

Figure 4-11: Dewatering Site Data Sheet Sample (continued)

4.6.3.2 Discretionary Screening

Each potential dewatering site was also evaluated relative to the discretionary screening criteria (Table 4-5). As all the sites have been eliminated based on the exclusionary screening alone, it is reasonable to focus on those sites with the largest available land because land size is one of the most critical attributes of a dewatering site. The Nye Lubricants Site (4) is a 4.9-acre, privately owned commercial/industrial site that is currently used as a parking lot. The site is located above the I-95 bridge in the upper harbor where water-side access is limited by shallow water (less than 6 ft) and the presence of low clearance bridges.

Standard Times Field (8) is a 20.7-acre site owned by the City of New Bedford. The site borders a salt marsh and is primarily open field. The City of New Haven has petitioned that this site not be used for disposal of dredged material.

Also owned by the City of New Bedford is the Wastewater Treatment Facility site. This site 17.2 acres in size and is currently used mostly as a parking lot, however, a park area has been recently constructed on the site. The water is shallow (less than 6 ft) and there is no pier so dredging and pier construction would be required.

The USEPA is currently planning to transport dredged material to upland disposal locations that it will be remediating as part of the Superfund project. As part of this revised alternative, USEPA will be establishing a desanding facility in the Upper Harbor, where desanded material would be pumped, via a pipeline, to an enclosed sediment dewatering facility (to be built) along the western side on the Inner Harbor. Dewatered dredged material would then be loaded onto railway cars and transported to an upland disposal facility. While future potential opportunities to use this site by entities other than USEPA are unknown at the present time, an assessment of practicability for use as part of the DMMP will be included in the FEIR. However, based upon the costs and limited capacity available for upland disposal of DMMP material and logistical concerns (potential cross-contamination), this option is not expected to provide a cost-effective option for most of the UDM.

Based on the analysis described above, there are no practicable dewatering sites available within New Bedford/Fairhaven Harbor for DMMP material. The lack of a dewatering site is a hindrance to any upland disposal or treatment technology as these two methods of disposal /treatment require dewatering as a necessary element in the process.

Table 4-5: New Bedford/Fairhaven Harbor potential dewatering site screening summary

Site	Pease Park	Seaport Inn	WSBM Tower	Nye Lubricants	American Eagle Motor Coach	Belleville Street	Sawyer Manufacturing	Standard Times Field	Hudson Beach Parking	Wastewater Treatment Facility
Map ID	1	2	3	4	5	6	7	8	9	10
EXCLUSIONARY CRTIERIA										
Distance	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pier	No	Yes	No	No	No	No	Yes	No	No	No
Depth	<6	6	<6	<6	<6	<6	15	<6	<6	<6
Area	0.9	0.6	1.0	4.9	3.1	10.8	1.8	20.7	2.8	17.2
DISCRETIONARY CRTIERIA										
Availability	Town	Private	Private	Private	Private	City Owned	Private	City Owned	City Owned	City Owned
Access	Good	Excellent	Good	Good	Good	Good	Good	Good	Good	Good
Hual Routes	Commerical /Residential Area	Adjacent to Route 6	Residential Area	Commerical /Industrial Area	Commerical /Industrial Area	Commerical /Residential Area	Commerical /Industrial Area	Commerical /Industrial Area	Commerical /Residential Area	Commerical /Residential Area
Habitat	Urban Park	Parking Lot	Salt Marsh	Parking Lot	Parking Lot	Disturbed	Parking Lot	Salt Marsh /Open Field	Parking Lot	Parking Lot
Terrain	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat
Flood Plains	AE	AE	VE	VE	VE	VE	VE	A0	AE	AE
Agricultural	No	No	No	No	No	No	No	No	No	No
Land Use	Commerical / Residential Area	Adjacent to Route 6	Residential Area	Commerical / Industrial Area	Commerical / Industrial Area	Commerical / Residential Area	Commerical / Industrial Area	Commerical / Industrial Area	Commerical / Residential Area	Commerical / Residential Area
Receptors	Yes	No	Yes	No	Yes	Yes	No	No	Yes	No
Port Plan	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	No Conflict	Conflict - Marine Industrial	No Conflict	No Conflict
Other Plans	No Conflict	No Conflict	Conflict	No Conflict	No Conflict	Conflict	Conflict	No Conflict	No Conflict	Conflict
Permits	unlikely	likely	unlikely	unlikely	unlikely	unlikely	likely	unlikely	unlikely	unlikely
Cost	$ 19,800	$ 13,200	$ 22,000	$ 107,800	$ 68,200	$ 237,600	$ 39,600	$ 455,400	$ 61,600	$ 378,400
Comments	Town Boat Ramp, Requires pier construction and dredging, small size	Private Development Plans, small size	Future Site of Marsh Island Recreation Site - Port Plan, Site requires pier construction and dredging	Recently Redevelped, limited access - bridges	Commercial Use - limited access - bridges, pier construction and dredging required	Adjacent to 195 CDF, Mudflat resources, plans to develop park, pier construction and dredging required	Adjacent to EPA CDF "C", limited access - bridges, small size, pier rehabilitation needed	City Prohibition on use of site as CDF - Mudflats resources, pier construction and dredging required	City Beach Parking, small size, pier construction and dredging required	Park recently developed, pier constrction and dredging required.

(red) - FAILED EXCLUSIONARY SCREENING
(yellow) - FAILED EXCLUSIONARY CRITERIA
(green) - PASSED EXCLUSIONARY CRITERIA

n/a - Not evaluated based upon results of exclusionary screening

4.7 Upland Disposal/Reuse Alternatives

4.7.1 Screening Process

The purpose of the upland disposal site screening process is to identify sites where disposal of dredged material would be feasible and be the least environmentally damaging to the natural and human environment. This was accomplished by employing a tiered screening process depicted in Figure 4-7. The screening follows the guidelines of 40 CFR Part 230, established under Section 404(b)(1) of the Clean Water Act (CWA) and complying with 310 CMR 16.00 (Site Suitability Regulations) for dredged materials classified as solid waste by DEP (MDPW, 1990).

The first tier involved the establishment of a Zone of Siting Feasibility (ZSF), which determined the general area that was to be studied for site selection. The ZSF was established based upon a reasonable truck travel distance from New Bedford/Fairhaven Harbor. A 50-mile ZSF (Figure 4-12) was established because it is the maximum distance a truck could travel to and from the dewatering site in a normal 8-hour working day. This included the time for loading and off-loading at the dewatering site and disposal site, respectively. The upland ZSF includes: all of southeastern Massachusetts; all of Rhode Island; and, much of eastern Connecticut.

The universe of upland sites was compiled from the following sources, including several previous siting studies that have been conducted for dredged material disposal and disposal/reuse of other materials:

- Boston Harbor Navigation Improvement Project
- Central Artery/Tunnel Project
- MWRA Residuals Management Facility Plan
- DEP Active Municipal Solid Waste Landfills and Active Demolition Landfills in Massachusetts
- DEP Inactive or Closed Solid Waste Landfills in Massachusetts
- Massachusetts Division of Capital Asset Management Inventory of State-Owned Properties
- Lists of active landfills in Connecticut and Rhode Island
- Meetings and conversations with local, state and federal agencies
- Requests for Expressions of Interest in major newspapers
- Requests for Expressions of Interest mailed to every municipality within the ZSF

This compilation resulted in a universe of 1,123 sites within the ZSF. These sites were then subjected to a feasibility screen, where sites that were smaller than the minimum size required to accommodate a certain volume of dredged material were eliminated.

The criteria for determining the minimum disposal site size was based upon two primary factors:
1) the minimum area required to accommodate 10,000 cy of dredged material; and, 2) setback distances for solid waste management facilities as specified in the Massachusetts DEP Solid Waste Management Regulations at 310 CMR 19.000. The 10,000 cy minimum volume was selected because it is the threshold for triggering environmental review under MEPA and it is a volume that is typical of smaller, marina dredging projects along the North Shore. A 500-foot buffer distance from the potential disposal area to adjacent properties was assumed as per DEP regulations.

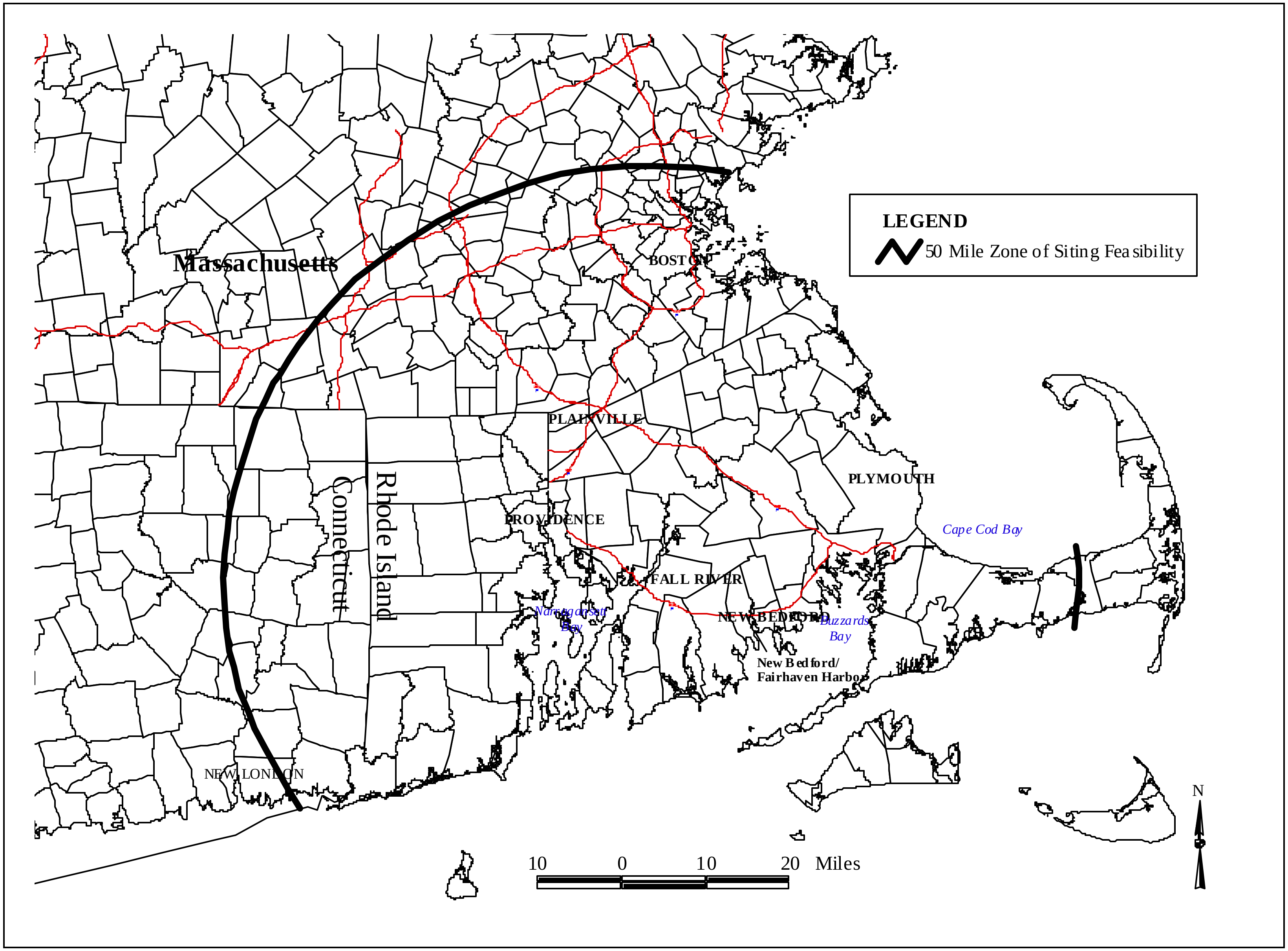


Figure 4-12: Upland Zone of Siting Feasibility

This resulted in a minimum disposal area of 25 acres. Any of the 1,123 sites less than 25 acres in size were eliminated. There were 270 sites eliminated based upon this criteria, leaving 853 remaining candidate sites.

The candidate sites were screened through a series of exclusionary criteria that examined factors that would essentially prohibit upland disposal based upon state or federal law or regulation. The close proximity to drinking water supplies, is an example of an exclusionary criteria which, would precludes the area from use as a disposal site. After applying the five exclusionary criteria (discussed in Section 4.7.2.1) 837 additional sites were eliminated, leaving 8 potential alternatives within the 50-mile ZSF, which were carried forward for further analysis.

The potential alternatives were then evaluated based upon a set of secondary or discretionary criteria, consisting of 15 factors that could affect the feasibility and potential impacts of a disposal site. These factors are shown in the upland site data sheets (Figure 4-13) and are described in Section 4.7.2.1.

Each of the potential alternative sites (Figure 4-14) were then compared, relative to one another, using the discretionary criteria. Finally, DEP policies and regulations related to waste disposal were applied to the set of potential alternatives to determine the relative feasibility of each site for accepting dredged material.

4.7.2 Screening Factors

In conclusion, after sites were eliminated based upon size and capacity in the feasibility screen , the candidate sites were then screened using a set of exclusionary criteria. The potential sites still remaining after these two initial screening processes were then evaluated using a set of discretionary criteria, which included the feasibility of obtaining approvals for these sites based upon existing DEP policies and regulations regarding waste management.

UPLAND DISPOSAL SITE SCREENING

SITE LOCATION

HARBOR: SITE NAME:
SITE COORDINATES:

PHYSICAL CHARACTERISTICS

Disposal Type(s):
Potential Capacity (cy x10^3):
Present Land Use:
Adjacent Land Use (U-15):
Physical Area of Impact (acres) (U-9):

Site Accessibility (U-8):

Route	Distance	Logistics
		[Including time of transport, road types, rehandling, and storage]
Trucking Limitations:		

Duration of Potential, Adverse Long-term Impacts (U-10):

Duration	Severity	Comments

Existing Terrain (U-12):

Topographical Characteristics	Comments
	[Including suitability for diking]

DESIGN CHARACTERISTICS

Ability to Obtain Permit (U-19):

Consistency with Federal Regulations	Consistency with State Regulations

Risk of Containment Facility Failure (U-16):

Geotechnical Stability	Foundation Stability	Comments

Consistency with Local, Regional, and State Plans (U-18):

Values	Site-specific Uses

Figure 4-13: Example of Upland Disposal Site Data Sheet

Estimated 20 year Cost (U-20):

Construction	Maintenance	Monitoring

EXCLUSIONARY USE FACTORS

Critical Habitat for Federal or State, Rare and Endangered Species (U-1):

Species	Designation (S/F)	Habitat Use	Seasonality
		[Breeding/Resident/ Migratory/Habitat]	

Historic/Archeological Sites or Districts (U-2):

Type of Site	Significance of Features

Drinking Water Supply – Groundwater (U-3):

Zone II	Sole Source Aquifer

Drinking Water Supply – Surfacewater (U-4):

More than 0.5 Miles Upgradient nearest source	Comments

National Seashore (U-5.a):

Name	Distance	Comments

Wilderness Area (U-5.b):

Name	Distance	Type	Comments

ACEC's (Areas of Critical Concern) (U-5.c):

Name	Distance	Type	Comments

Figure 4-13: Example of Upland Disposal Site Data Sheet (continued)

DISCRETIONARY USE FACTORS

Groundwater – General (U-6):

Depth to Groundwater	Comments

Surface Water - Rivers (U-7.a):

Name	Distance	Potential for Water Quality Degradation

Surface Water - Wetlands (U-7.b):

Name	Distance	Potential for Water Quality Degradation

Flood Plains (U-13):

Percent Coverage, 100 year	Comments

Agricultural Use (U-14):

Description	Comments

Odor/Dust/Noise Receptors (U-17):

Name/Description	Distance	Comments

BIOLOGICAL USE FACTORS

Present Habitat Types (U-11):

Summary Type:

Recovery Potential:

Successional Stage (U-11.a):
Disturbance (degree) (U-11.b):
Plant/Animal Diversity (U-11.c):
Plant/Animal Integrity (U-11.d):
Landscape Position (U-11.e):
Wildlife Function/Use (U-11.f):

Figure 4-13: Example of Upland Disposal Site Data Sheet (continued)

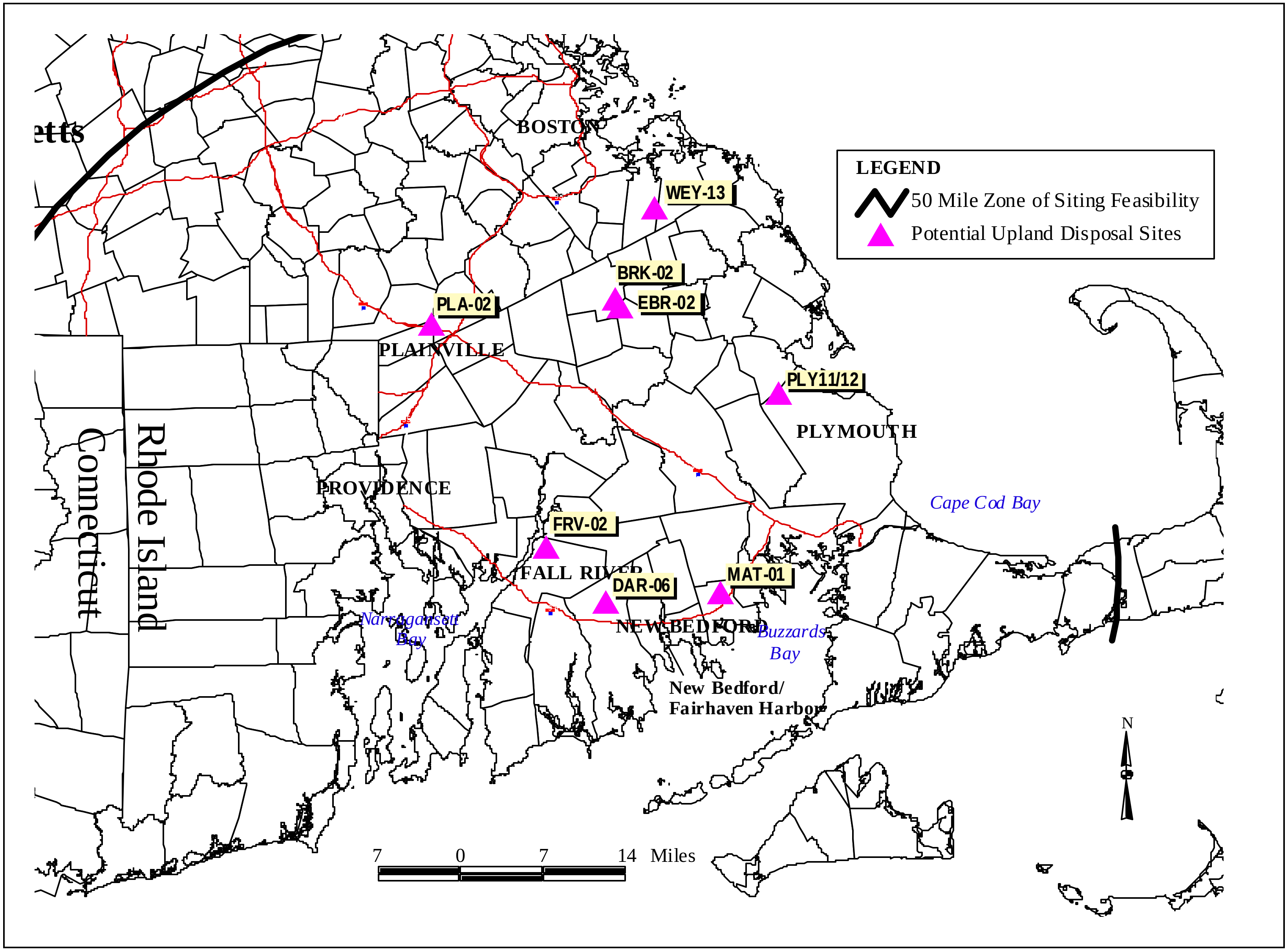


Figure 4-14: Potential Upland Disposal Sites

4.7.2.1 Exclusionary Factors

The following exclusionary factors were applied to those sites 25 acres in size or greater, i.e. the candidate disposal sites:

U-1. Threatened and Endangered Species - (Critical habitat or resource-use area for federal or state listed threatened or endangered species or species of special concern) **-** The locations of the sites identified in the initial screening were identified in the Massachusetts Natural Heritage Atlas which utilizes information from the USFWS to map and list these state and federal species.

U-2. Historic/Archeological Sites or Districts - The sites were evaluated for potential cultural resource constraints through consultation with the Massachusetts Historical Commission and review of any local, State or National designations for the site.

U-3. Drinking Water Supply - Groundwater - Sites were evaluated for proximity to an area with groundwater with Zone II designation and Sole Source Aquifer (SSA) designation. The Massachusetts Department of Environmental Protection created three zones to identify Wellhead Protection Areas which are designed to outline potable public groundwater sources. Sites with a Zone II designation can be defined as, the entire extent of the aquifer deposits which could fall within, and upgradient from, the production well's capture zone based on the predicted drawdown after 180-day drought conditions at the approved pumping rate (Massachusetts Department of Environmental Protection, 2000). A SSA is an aquifer designated by the United States EPA as the 'sole or principal source' of drinking water for a given aquifer service area and which is needed to supply 50% or more of the drinking water from that area and for which there are no reasonably available alternative sources if that aquifer became contaminated (United States Environmental Protection Agency, 2000).

U-4. Drinking Water Supply - Surface Water - Sites were evaluated for proximity to public drinking water supplies, location within one-half mile upgradient of a surface water supply, potential pollutant pathways to a water supply, and potential for water quality degradation.

U-5. Land Designation

U.5.a - National Seashore - Sites were evaluated for federal designation as a National Seashore. Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in a designated National Seashore area.

U.5.b - Wilderness Area - Sites were evaluated for federal designation as a Wilderness Area. Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in a designated Wilderness Area.

U.5.c - Area of Critical Environmental Concern (ACEC) - Sites were evaluated for state designation as an Area of Critical Environmental Concern (ACEC). ACECs are areas containing concentrations of highly significant environmental resources that has been formally designated by the Commonwealth's Secretary of Environmental Affairs for preservation and enhancement of the land's natural assets (Massachusetts Department of Environmental Management, 2000). Massachusetts Solid Waste Regulations, 310 CMR 19.000, prohibit placement of unsuitable material in an ACEC.

4.7.2.2 Discretionary Factors

The following discretionary factors were used to evaluate the 11 potential upland disposal sites that survived the exclusionary criteria screening process.

U-6. Groundwater - General - Evaluation of the types of aquifers in the vicinity and depth to groundwater at the site.

U-7. Surface Water Quality

> **U.7.a - Water Bodies and Rivers** - Evaluation of the sites' setback (distance of the site from the shoreline) from waterbodies and rivers.
> **U.7.b - Wetlands** - Evaluation of setback of sites from wetland resource areas.

U-8. Site Accessibility - Description of the most practical route to transport dredged material to the disposal site, including any potential logistical problems that might be encountered during use or construction of the proposed site. Sites should be directly accessible from a regional highway, have a rail or navigable waterway nearby, have a local access route that does not include lateral or vertical obstructions or restrictions, and have a local access route that does not pass by sensitive receptors.

U-9. Physical Area of Impact - Evaluation of the amount of land area in acres that would be directly affected by disposal activities.

U-10. Duration of Potential, Adverse Impacts - Estimation of recovery time based on the type of disposal and present site conditions.

U-11. Present Habitat Types

> **U-11.a - Successional Stage** - Evaluation of vegetation stage (e.g., forest, grass) and whether wetlands were present.
> **U-11.b - Degree of Disturbance** - Evaluation of the visual evidence of site disturbance, including physical disruptions such as land clearing or development; and ephemeral disturbances such as noise or temporary land usage.
> **U-11.c - Diversity of Plant and Animal Species** - Evaluation of the type and amount of vegetative cover to estimate species diversity, highlighting the presence of wetlands on or adjacent to the site, and considering influence of topography and soil types.
> **U-11.d - Integrity of Plant and Animal Communities** - An evaluation of the plant and animal community integrity by considering the degree of disturbance that the site and the surrounding landscape conditions, and their potential impact on the habitat and species of native flora and fauna at the site.
> **U-11.f - Wildlife Function** - Assessment of wildlife value by considering degree of disturbance and landscape position as well as the presence of breeding, feeding, resting/roosting areas, presence or connectivity to dispersal areas, presence of food and cover, and other wildlife attributes.

U-12. Existing Terrain (suitability for diking) - Determination of ability to construct a dike around disposed sediment in light of existing terrain.

U-13. Flood Plains - Determination whether site is within or partially within a designated floodplain, consulting National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs).

U-14. Agricultural Use - Determination of prime agricultural soils on or near the site.

U-15. Adjacent Land Use - Evaluation of adjacent ownership, present and projected land use.

U-16. Risk of Containment Facility Failure - Review of characteristics and engineering requirements for each site to assess the potential stability of material disposed of at the site.

U-17. Odors / Dust / Noise - Evaluation based on proximity of odors, dust and noise generated on-site to sensitive receptors such as residential areas, schools, cemeteries, etc.

U-18. Local, Regional, State Plans - Evaluation of consistency with local, regional and state long range plans.

U-19. Ability to Obtain Permits - Evaluation of likelihood of local, state, and federal regulatory approval.

U-20. Cost - Estimation of comparative costs for construction, maintenance, and monitoring of proposed sites.

Table 4-6: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Upland Disposal/Reuse

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
PRE-SCREENING		
Geographic Area	50-mile radius; Beyond MA state boundaries, only commercial opportunities were considered	Maximize proximity to dredging activity
Capacity	>10,000 c.y	Maximize capacity
INITIAL SCREENING (E)		
U-1. Rare and Endangered Species 310 CMR 19.00	Rare or endangered species habitat	Avoid rare or endangered species habitat
U-2. Historical/Archaeological Sites 310 CMR 19.00	Presence of Local, State, or National Historic Site	Avoid Local, State, or National Historic Sites
U-3. Drinking Water Supply - Groundwater 310 CMR 19.00	Proximity to Zone II and Sole Source Aquifer	Avoidance of Zone II and Sole Source Aquifer
U-4. Drinking Water Supply - Surface Water 310 CMR 19.00	Setback greater than ½ mile up gradient of water supply	Beyond ½ mile upgradient
U-5. Land Designation		
U-5.a - National Seashore **E** - 310 CMR 19.00	National Sea Shore Designation (Federal)	Avoid designated sites.
U-5.b - Wilderness Area **E** - 310 CMR 19.00	Wilderness Area Designation (Federal)	Avoid designated sites.
U-5.c - Area of Critical Environmental Concern(ACEC) **E** - 310 CMR 19.00	ACEC Designation (State)	Avoid designated sites.
SECOND TIER SCREENING (D)		
U-6. Groundwater - General **D**	Depth to groundwater	Maximize separation distance
U-7. Surface Water		
U-7.a - Water Bodies and Rivers **D**	Setback from river, water quality degradation	Protect river quality
U-7.b - Wetlands **D**	Setback from wetland, water quality degradation	Protect wetland quality
U-8. Site Accessibility **D**	Trucking limitations, length, time to transport, road types, re-handling, storage	Minimize disruptions Maximize efficiency Reduce risks of re-handling
U-9. Physical Area of Impact **D**	Size of area affected	Minimize area adversely affected
U-10. Potential Adverse Long-term Impacts **D**	Time, severity, recovery period	Minimize impacts

Table 4-6: Summary of Exclusionary (E) and Discretionary Screening Factors for Upland Disposal/Reuse (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
U-11. Present Habitat Types		
D ***U-11.a - Successional Stage***	Existing conditions	Long-term protection of advanced stage or climax communities and utility over pioneers
D ***U-11.b - Disturbance (degree)***	Existing conditions	Long-term protection of undisturbed sites or sites with least disturbance
D ***U-11.c - Plant/Animal Diversity***	Existing conditions	Long-term protection of sites with greatest diversity.
D ***U-11.d - Plant/Animal Integrity***	Existing conditions	Long-term protection of sites with stable populations of native, non-invasive and diverse flora and fauna
D ***U-11.e - Landscape Position***	Existing conditions	Assure long-term compatibility with adjacent environment types and land use
D ***U-11.f - Wildlife Function /Use***	Existing conditions	Long-term protection of sites which support the greatest number of critical life functions
U-12. Existing Terrain **D**	Existing terrain suitable for diking	Maximize long-term secure containment
U-13. Flood Plains **D**	Avoid impacting flood plain	Retain flood storage capacity
U-14. Agricultural Use **D**	Existence of prime agricultural soils/ agricultural use	Avoid impacting resources
U-15. Adjacent Land Use	Ownership, present and projected use	Maximize long-term retention of greenspace/retain long-term availability
U-16. Facility Failure **D**	Geotechnical stability, foundation stability	Maximize stability/containment of material
U-17. Odors / Dust / Noise **D**	Proximity to receptors of odors, dust and noise.	Maximize distance to receptors
U-18. Local, Regional, State Plans **D**	Consistency with applicable plans	Avoid conflict with long range plans
U-19. Ability to Obtain Permit **D**	Likelihood of obtaining local, state, and federal approvals	High probability of obtaining necessary approvals
U-20. Cost **D**	Estimated 20-year cost of construction, maintenance, monitoring	Minimize long-term costs.

4.7.3 Screening Results

Using the methodology and criteria described above, the initial screening narrowed the universe of sites. This initial screening of the Massachusetts sites was conducted using the following reference sources:

- Massachusetts Geological Information Systems (MassGIS),
- United States Geologic Survey Topographic Maps,
- Massachusetts National Heritage Atlas,
- Massachusetts Historic Commission maps,
- Bureau of Waste Site Cleanup Sites Transition and Reportable Releases Lists,
- Information gathered in previous reports and databases, and
- Information obtained about sites within the municipal limits of the harbors at meetings with town officials.

Over 1,000 sites within Massachusetts had exclusionary constraints, causing them to be eliminated. Table 4-7 summarizes the results of the initial screening.

The remaining 8 sites either did not have exclusionary constraints or were active commercial landfills or contaminated sediment treatment facilities and therefore could potentially be used as a disposal site for dredged material.

Because the 50-mile ZSF extended into Rhode Island and portions of Connecticut, active commercial landfills within these states were considered. Four commercial landfills were identified, two in each state. However, all are either prohibited from accepting out-of-state material or are not willing to accept dredged material due primarily to capacity constraints.

Table 4-7: DMMP Upland Disposal Site Exclusionary Screening Summary

Site Sources:	Active Landfills	BHNIP	CA/T	DCAM	Planning Depts.	Inactive Landfills	RMFP	UR Parcels	Total Sites
Candidate Sites	37	12	6	380	3	368	312	5	1,123
Sites Failing Exclusionary Criteria:									
Capacity/Status	25	4	0	11	0	162 (2)	67	1	270 (2)
Rare and Endangered Species	0	0	0	37	0 (1)	23	21	0	81 (1)
Zone II Aquifer	1	2	1	19	0	30	71	0	124
Sole Source Aquifer	2	0	1	4	0	17	15	0	39
Surface Water Source	0	0	0	2	0	9	5	0	16
National/Historical Monument	2 (1)	0	0	11	1	62 (1)	68	0	144 (2)
National Seashore	0	0	0	0	0	0	0	0	0
Wilderness Area	1	1 (1)	1	280	1 (1)	37 (1)	59	2	382 (3)
ACEC	0	2	0	31	0	15	14	2	64
21E Site	3 (1)	2	3	4	0 (1)	16 (1)	13	0	41 (3)
Screened by Agency Action	2	1	1	0	0	56	16	0	76
Sites Eliminated	35 (1)	10 (1)	6	378	2 (1)	362 (4)	309	5	1107 (7)
Potential Alternatives:									
in Massachusetts[4]	2	2	0	2	1	6	3	0	16
outside New Bedford ZSF									-8
within New Bedford ZSF									**8**

Notes:

1. Sites in parentheses failed the exclusionary screening, but were not eliminated because of their potential as disposal sites.
2. Some sites failed more than one criteria.
3. A site would fail due to capacity/status if: site is smaller than 25 acres, site has capacity less than 10,000 cu yd, site is too narrow to accommodate landfill construction, site has been developed (e.g. residences, industrial park, highway), landfill is closed and capped, landfill only accepts MSW, or site is no longer part of database that included it in this list.
4. Within the overlapping ZSFs of MA North Shore and South Shore Harbors.

Site Sources:

Active Landfills - Active MSW Landfills and Active Demolition Landfills in Massachusetts (DEP, April 1998), Connecticut Active Landfill Sites (CT DEP, February 1998), Rhode Island Licensed Solid Waste Landfills (RI DEM March 1996). Landfills Operating - 1997 (NH DES, November, 1997), and Maine: Operating Landfills (Maine DEP).
BHNIP - Boston Harbor, Massachusetts: Navigation Improvement Project and Berth Dredging Project (April 1994).
CA/T - Central Artery/Tunnel Project: Results of Upland Disposal Site Screening Study (November 1990).
DCAM - Massachusetts Division of Capital Assets Management (formerly Division of Capital Planning Operations) Sites.
Planning Depts. - Suggested during meetings with members of Salem Planning Office (December 8, 1998) and Gloucester Planning Office (December 15, 1998).
Inactive Landfills - Inactive or Closed Solid Waste Landfills in Massachusetts (DEP, April 1998).
RMFP - MWRA Residual Management Facilities Plan (MWRA, 1986 and Black and Veatch, 1987).
UR Parcels - Massachusetts Highway Department Uneconomic Remainder Parcels.

4.7.4 Potential Alternatives

The 8 potential upland sites in Table 4-7 have been identified based on the initial screening. Detailed information about each of these sites can be found on data sheets in Appendix C, however a summary of the general characteristics of each site is presented in Table 4-8, followed by a discussion of each site relative to the discretionary criteria.

Table 4-8: Potential Upland Disposal Site Characteristics

Site ID	Site Name	City	Present Site Usage	Distance from NB (mi)	Capacity (cy)	Cost ($/cy)
FRV-02	BFI Fall River Landfill	Fall River	active landfill	11	160, 000	$ 62
EBR-02	Northern Disposal BFI Landfill	E. Bridgewater	inactive landfill	30	711,100	$137
WEY-13	Bates Quarry	Weymouth	active quarry	37	189,600	$169
DAR-06	Cecil Smith Landfill	Dartmouth	inactive landfill	5	102,700	$200
MAT-01	Mattapoisett Landfill	Mattapoisett	inactive landfill	8	38,500	$214
PLA-02	Plainville Landfill	Plainville	inactive lined	24	172,800	$217
PLY-11/12	MHD ROW Parcel	Plymouth	undeveloped	25	124,400	$238
BRK-02	Brockton Landfill	Brockton	unlined inactive	30	42,500	$333

<u>4.7.4.1</u> <u>Detailed Screening of Potential Upland Disposal Sites</u>

Map analyses, file reviews, and site visits were used to acquire more detailed information for each potential upland disposal site identified during the initial screening. Detailed information about each of these sites was recorded on the data sheets (see example, Figure 4-13 and Appendix C). DMMP team members and representatives of local, state, and federal governments met and reviewed this information to review potential alternatives. Discretionary factors were discussed to determine the benefits and constraints of using each site.

The sites that survived the detailed screening are “Proposed Preferred Alternatives”. The discretionary evaluation criteria used during the second tier upland disposal site screening are outlined below, with more detailed discussion in section 4.7.2.

Existing Site Uses

Of the 8 potential sites, only one, FRV-02, is an active landfill. The landfill has recently received a permit to expand the facility to create an area capable of accepting about 882,000 cy of material. However, this capacity will be used for municipal solid waste from Fall River and surrounding towns. Approximately 160,000 cy of cover material is need as interim and final cap.

Four of the potential sites are inactive lined landfills. One site, Bates Quarry (WEY-13) is a 106-acre quarry located near Route 3 in Weymouth.. The remained site, PLY-11/12, is an 83-acre undeveloped, wooded parcel owned by the Commonwealth of Massachusetts as highway (Rt. 80) right-of-way.)

Groundwater

To avoid potential impacts to groundwater, sites located atop important groundwater resources were eliminated. Sites located within the Zone II (Zone of Contribution) of a public water supply well, within an Interim Wellhead Protection Area (IWPA), or within a Sole Source Aquifer failed the initial screening, in accordance with the Massachusetts Site Assignment Regulations for Solid Waste Facilities (310 CMR 16.00). None of the potential disposal sites are located above a Zone II, IWPA, or Sole Source Aquifer. The locations of potentially productive and other aquifers at or near the site were considered in the discretionary screening.

To further minimize the potential for the disposal of dredged materials to impact groundwater, the Site Assignment Regulations require that the disposal area be at least four feet above groundwater. At a site that has a shallower groundwater table, the disposal facility can be engineered so that there is at least 4 feet between the lower-most liner and the high level of groundwater.

As indicated above, any disposal facility used or built would be lined to keep any leachate from the dredged material from coming into contact with groundwater. Groundwater sampling via monitoring wells and laboratory analysis of the groundwater samples would be conducted to confirm that leaks into groundwater have not occurred.

Sites FRV-02, EBR-02 and PLA-12 are all lined landfills, therefore, groundwater protection measures are in place. The remaining five sites are either unlined landfills or undeveloped land that would need to be lined for acceptance of UDM. Shallow depth to groundwater (< 3ft.) has been mapped by MASSGIS at EBR-02, FRV-02 and BRK-02. The remaining sites either have deep depth to bedrock or no mapping information is available.

Surface Water and Wetlands

While disposal of dredged material into freshwater wetlands is not absolutely prohibited, it would be difficult to obtain a permit for such an activity. For this reason, candidate upland disposal sites that are wholly or in large part covered with wetlands were eliminated from further consideration. However, sites that contain a minimal amount of wetlands were not, because disposal site design could avoid impacts to the wetlands. However, sites that do not contain any nearby wetlands would obviously be preferred over sites that are adjacent to wetlands.

Wetlands were identified through the use of USGS. Topographic Maps and the National Wetlands Inventory (NWI) mapping developed by the USFWS. The NWI maps only identify and described relatively large wetlands (>5 acres), so other, smaller wetlands and vernal pools may be present at these sites. A site-specific field delineation would be required to define the regulatory limits of these wetlands.

All the potential disposal sites either contain or abut wetlands or waterbodies. The entire western perimeter of the BFI Landfill in East Bridgewater (EBR-02) is a shrub/scrub and forested wetland. The southwest quadrant of the Brockton Landfill (BRK-02) contains a forested shrub/scrub wetland. The Colbrook riverine system runs through DAR-06. Large swamps surround MAT-01 and PLY-11/12 contains many small pockets of open water/wetland and, potentially, vernal pools.

Site Accessibility

Most of the potential upland disposal sites are existing active or inactive landfills or quarries and, therefore, access to the sites have been improved over the years to accept trucks carrying solid waste or raw materials. Therefore, access is considered good for excellent for all potential sites except PLY-11/12. Because it is an undeveloped parcel, an access road or road system would need to be constructed. However, general access to the site is good because it is located directly off Rt. 80 in Plymouth.

In terms of distance from New Bedford/Fairhaven Harbor, DAR-06 and MAT-01 are closest (<10 miles away). The Fall River Landfill is only 11 miles away and is easily accessible via Interstate 495 and Rt. 24/79. The remaining sites are about 25-37 miles away.

Physical Area of Impact

The footprint of UDM disposal at the potential disposal sites was estimated based on the existing topography of the land and engineering criteria established in the Commonwealth's Solid Waste Management Regulations. Those sites that can receive dredged material over a smaller area are generally preferred over sites that need large areas to accommodate the same volume of material. Sites that contain natural or man-made depressions can accommodate material over a smaller area compare to level or mounded land. Therefore, the Bates Quarry (WEY-13) and PLY-11/12, which contain topographical depressions, are best suited for limiting physical impact area. Sites such as the Plainville Landfill (PLA-02), a landfill mound, and MAT-01, a drumlin, would require a larger area to accommodate the same volume of material.

Duration of Potential, Adverse Impacts

Long term adverse impacts would be greatest at sites that have undergone the least disturbance. All sites have some degree of disturbance, even the MHD right-of-way parcel (PLY-11/12) which contains several man-made depressions. The duration of potential adverse impacts will depend on the manner in which the site were to be engineered and proximity to sensitive resources (wetlands, waterbodies, archaeological sites). Such information would be obtained during the preliminary design phase, therefore, it would be difficult to assess the duration of impacts until this level of information is available.

Present Habitat Types

Sites within or near productive, diverse, and undisturbed habitats are least preferred over sites with habitats that have been disturbed. Sites within existing or inactive landfills or quarries have undergone habitat disturbance already and, therefore, are preferred over sites such as PLY-11/12, which are less disturbed and undeveloped parcels of land.

The inactive and active landfills and quarries contain disturbed land, however, several of the potential sites border sensitive ecological areas. Sites EBR-02, DAR-06, BRK-02, and MAT-01 contain, or are surrounded by, sizable wetland areas. Sites DAR-06 and MAT-01 are located near rare, threatened or endangered species habitat. While none of the sites are known to contain such habitat, site specific studies may need to be conducted for confirmation. In any event, the indirect effects of dredged material disposal at these sites would need to be evaluated.

Existing Terrain (suitability for diking)

A disposal site for UDM can be engineered for practically any site conditions. However sites that are level or sites with existing topography that could easily contain dredged material (e.g. quarries, borrow pits) are preferred. As such, the quarry sites, WEY-12 (Bates Quarry) and PLY-11/12, would be most effective in containing the dredged material because of the minimal need for dike/embankment creation. The existing landfills contain moderate to steep slopes, so additional side slope stabilization would need to be engineered.

Flood Plains

Sites that are located outside of the 100-year or 500-year floodplain are preferred over sites that are. Only three of the eight sites have significant floodplain constraints. BRK-02 is 60% covered by the Beaver Brook floodplain. EBR-02 and DAR-06 are 20% covered by floodplain. The rest of the sites either contain a small fraction (2% or less) or no floodplains.

Agricultural Use

None of the sites are currently used for significant agricultural purposes according to MASSGIS data. Sites that are landfills would likely not be used for agricultural purposes in the future because of potential contamination from the landfills. However, a small portion of the Cecil Smith Landfill (DAR-06) is cropland and cropland abuts to the north. Also, about 3% of the Brockton Landfill site (BRK-02) is cropland. Cropland exists about 200 ft west of the Mattapoissett Landfill (MAT-01).

Adjacent Land Use

Sites in industrial or commercial areas are preferred over those in residential, agricultural, or recreational areas. Of the eight sites, the Fall River Landfill (FRV-02) and Bates Quarry (WEY-13) have industrial and/or commercial land uses abutting their properties. FRV-02 abuts an airport and WEY-13 abuts a commercial/industrial area. However, residential areas are also nearby these two sites and FRV-02 abuts a state forest. The remaining six sites abut a mixture of land uses, primarily residential and open space.

Facility Foundation Conditions

Sites containing steep slopes and underlying swamp deposits have less desirable geotechnical stability and, therefore would require a greater degree of engineering in order to create a stable dredged material disposal deposit. Sites EBR-02 and BRK-02 contain 15% swamp deposits over their sites. Due to steep slopes associated with borrow pits at WEY-13 and PLY-11/12, the stability of placing dredged material on these slopes could be problematic. However, further site-specific investigation would be needed to determine facility foundation conditions and engineering measure would need to be employed to meet the minimum criteria set by MDEP.

Odors / Dust / Noise

Disposal sites that are close to residential, recreational, and tourist areas could negatively affect these areas by the odor, dust and noise created from a UDM disposal operation. All sites, except PLY-11/12, have been or are used for industrial-type activities such as landfilling or quarrying. Sensitive land uses in these areas have been previously exposed to odor/dust/noises associated with trucking and disposal of waste materials. In most cases, efforts have been made to minimize these impacts and if these sites were delegated for dredged material disposal, then similar measures would be employed. Site BRK-02 abuts a residential area and a cemetery, both of which could be impacted by odors, dust or noise. A campground and residents are located near the Plainville Landfill (PLA-02). Residential and conservation adjoin EBR-02. FRV-02 is located near a school.

Local, Regional, State Plans

Sites that, according to local, regional and state plans, are planned for continued use as disposal areas are preferred over sites that are not planned for use as disposal areas. Therefore, sites that are active landfills or quarries would be preferred over inactive sites or undeveloped land. Site PLY-11/12, which is currently undeveloped is not targeted for large-scale industrial activities, therefore its use as a disposal site would likely not be consistent with local, regional or state plans.

Ability to Obtain Permits

Because active landfills are currently operating with permits to dispose of certain materials (solid waste, ash), these sites would likely be the easiest for which to obtain the necessary state and local approvals (permits). It would be more difficult to obtain permits for inactive sites because these sites were likely closed for environmental reasons under RCRA. Undeveloped sites such as PLY-11/12 would likely be the most difficult to permit because of the stringent state and local regulations and policies for landfill siting.

The ability to obtain a permit for a quarry site (WEY-13) is unknown, because the use of abandoned quarries for disposal of UDM has not occurred in Massachusetts. One of the key permitting issues is groundwater contamination because the UDM would be placed below the groundwater table, thereby potentially introducing contaminants to the groundwater. The presence of water in the existing quarry would also pose further permitting issues.

Cost

Placing dredged sediments in the upland environment is a relatively expensive disposal option, with unit costs for the potential alternatives ranging from $67 to $333 per cubic yard (Table 4-5) . The least expensive is FRV-02 ($62/cy) and the most expensive is BRK-02 ($333/cy). The construction of a new facility is generally more expensive than using an active landfill, due to the extra costs required to site, permit, build, monitor, and close the landfill (see Appendix D for itemized costs). Economies of scale also make building a facility at a small site, with minimal capacity, cost more on a unit cost level than a larger facility. This is in part because the same siting and permitting process is required for all sites.

Historic and Archaeological Resources

Data from MASSGIS was reviewed to determine the presence/absence of known historic or archaeological sites within or near the potential upland disposal sites. The specific nature of the historic/archaeological sites was not investigated during this phase of the study. Sites that contain resources of historic or archaeological significance are least preferred, however the mere presence of artifacts may not render a site unpermitable. Sites on the National Register of Historic Places were eliminated during the exclusionary screening phase.

Several sites contain recorded historic and/or archaeological sites and many are in close proximity to such sites. Site FRV-02 contains an archaeological site within and abutting the site. There are two archaeological sites within 250 ft of EBR-02 and two historic sites within 0.25 miles. The Bates Quarry (WEY-13) is located within one-half mile of 18 historic sites, mostly on Pleasant St. to the west. Rabbit Hill Pond is an archaeological site which abuts PLA-02. There are two archaeological sites within 0.4 miles of PLY-11/12, one of which is the Parting Ways Cemetery. The Cecil Smith Landfill site contains an historic woodland settlement at Colebrook Swamp. In addition, an historic cemetery, Evergreen Cemetery, is within 0.35 miles of the site. An archaeological site is about 0.3 miles northwest of the Mattapoisett Landfill.

4.7.5 The Preferred Upland Disposal Sites

Upland disposal sites with respect to the discretionary criteria have been evaluated. As a result of the upland disposal site analysis, it has been determined that none of the 8 potential upland disposal sites would be considered preferred alternatives for disposal of UDM from New Bedford/Fairhaven Harbor. Although some of the 8 sites have greater merit than others, none of the sites, either alone or in combination, satisfy the goals of the DMMP. Additionally, all of the property owners were contacted and none expressed an interest in accommodating the DMMP UDM material. There are several environmental, logistical, and cost constraints that make upland disposal an infeasible alternative. Among them are:

1. 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.

2. The lowest cost for upland disposal is $62/cy. This is more costly than traditional open water disposal or CAD disposal. In addition, the $62/cy cost would be for disposal of only about 6% of the entire UDM volume.

3. 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 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.

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4.8 Aquatic Disposal Alternatives

Section 4.8 outlines the application of the DMMP disposal site screening process (Figure 4-7) and aquatic screening criteria to the universe of aquatic disposal alternatives. This section presents the evaluation of potential impacts and benefits associated with the identified aquatic sites and details the potential impacts on specific resources in the vicinity of the disposal sites.

4.8.1 Aquatic Disposal Site Screening Process

During Phase I of the DMMP, aquatic areas within 10 miles of the lower harbor were investigated to determine which areas may be suitable for dredged material disposal based on physical characteristics alone. For example, sites that are located in seafloor depressions were identified in the outer harbor and Buzzards Bay. Sites within and adjacent-to-channel in the outer, upper and lower harbors were also identified as were developed shorelines areas that had the physical potential for use as CDFs. Using this rationale, a total universe of 20 aquatic disposal sites within the New Bedford/Fairhaven Harbor and a portion of Buzzards Bay were originally identified (Figure 4-15).
After completion of the first phase of the DMMP, the New Bedford/Fairhaven Harbor ZSF was revised. A line was drawn from Wilbur Point to Clarks Point across the outer harbor and all sites south of this line were eliminated. This resulted in the original Phase II universe of 13 sites (Figure 4-16). The seven sites eliminated south of the line were excluded for one or more of the following reasons: 1) sites further into Buzzards Bay have increased wind and wave exposure, therefore containment of UDM in a CAD or capped mound could be problematic; 2) gross sediment mapping of the seafloor indicates that sites further into Buzzards Bay proper have sandy bottoms, which implies an erosional environment; and, 3) sites further in the bay have been less disturbed by man-made forces (dredging, dredged material disposal, wastewater disposal) than sites further inshore.

At the request of several federal regulatory agencies, the ZSF for Phase II was further 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 in the universe of sites considered in Phase II. Further changes to the Phase II universe of sites, as a result of coordination with state and local agencies included; revising the name and footprint of the Railyard site to correspond with CDF D under consideration by the USEPA and the City of New Bedford, segmentation of the NB Channel site into three segments, Channel Upper, Channel Inner and Channel Outer and the footprint and disposal type (from CDF to a CAD) for the Popes Island North site. These changes resulted in a net addition of four new sites considered, bringing the total revised Phase II universe to 17 candidate sites (Figure 4-17).

Exclusionary criteria, aimed at eliminating sites based on regulatory prohibition, were applied to the universe of 17 candidate sites. The specific criteria are explained in Section 4.8.2.1. None of the candidate sites failed the exclusionary criteria, therefore all 17 candidate disposal sites were carried forward as potential alternatives.

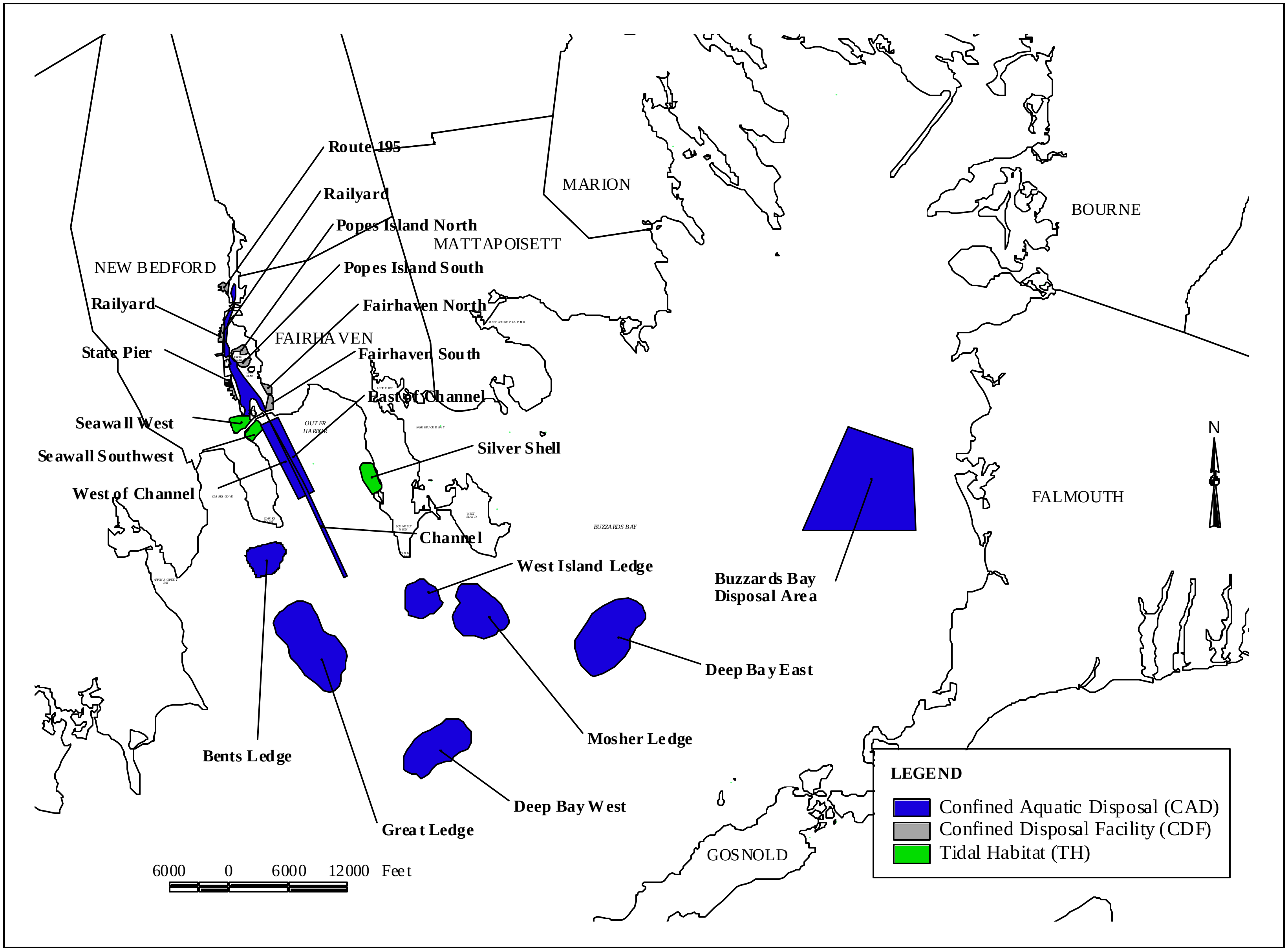


Figure 4-15: DMMP Phase One Universe of Aquatic Disposal Sites

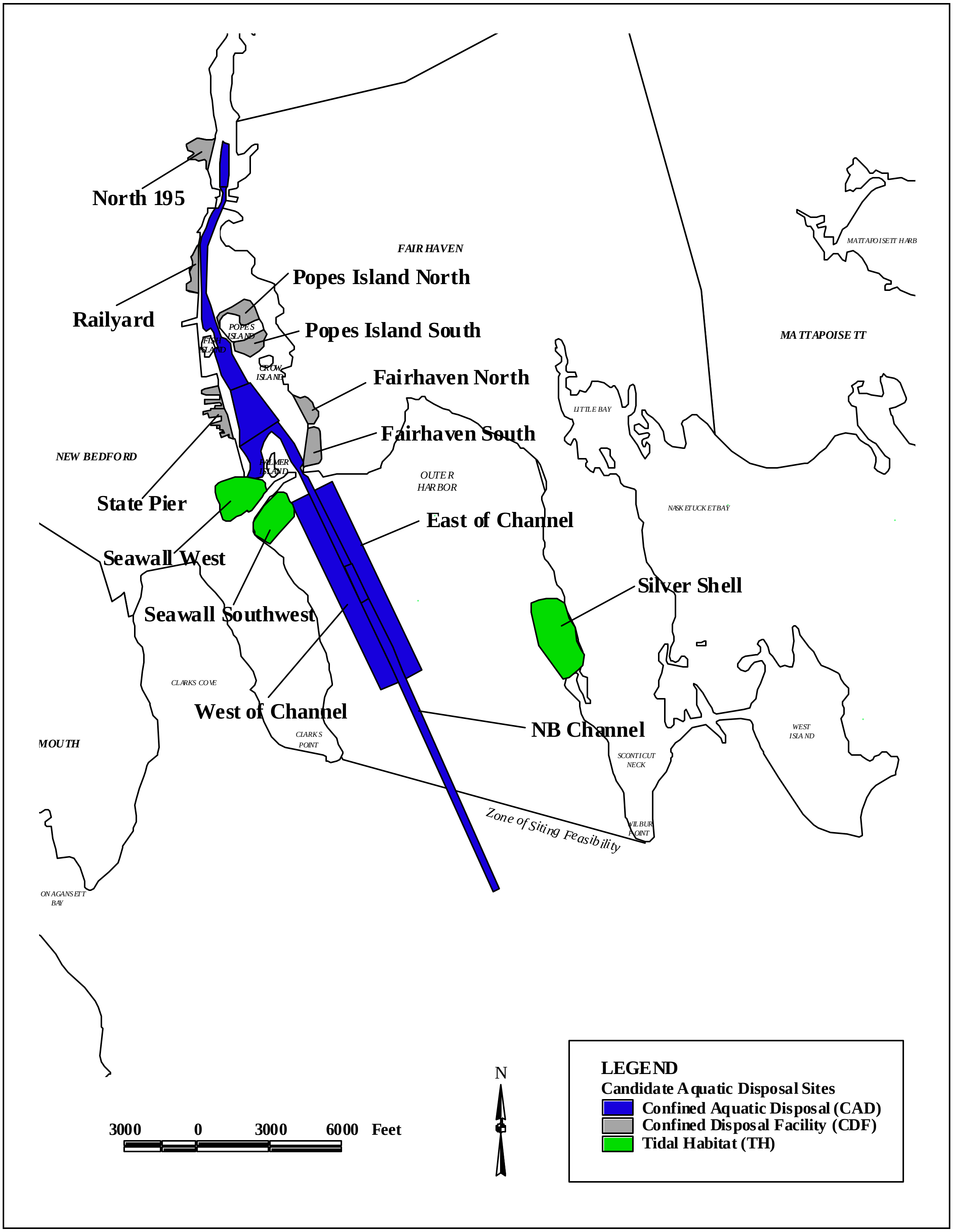


Figure 4-16: Original ZSF and Candidate Aquatic Disposal Sites

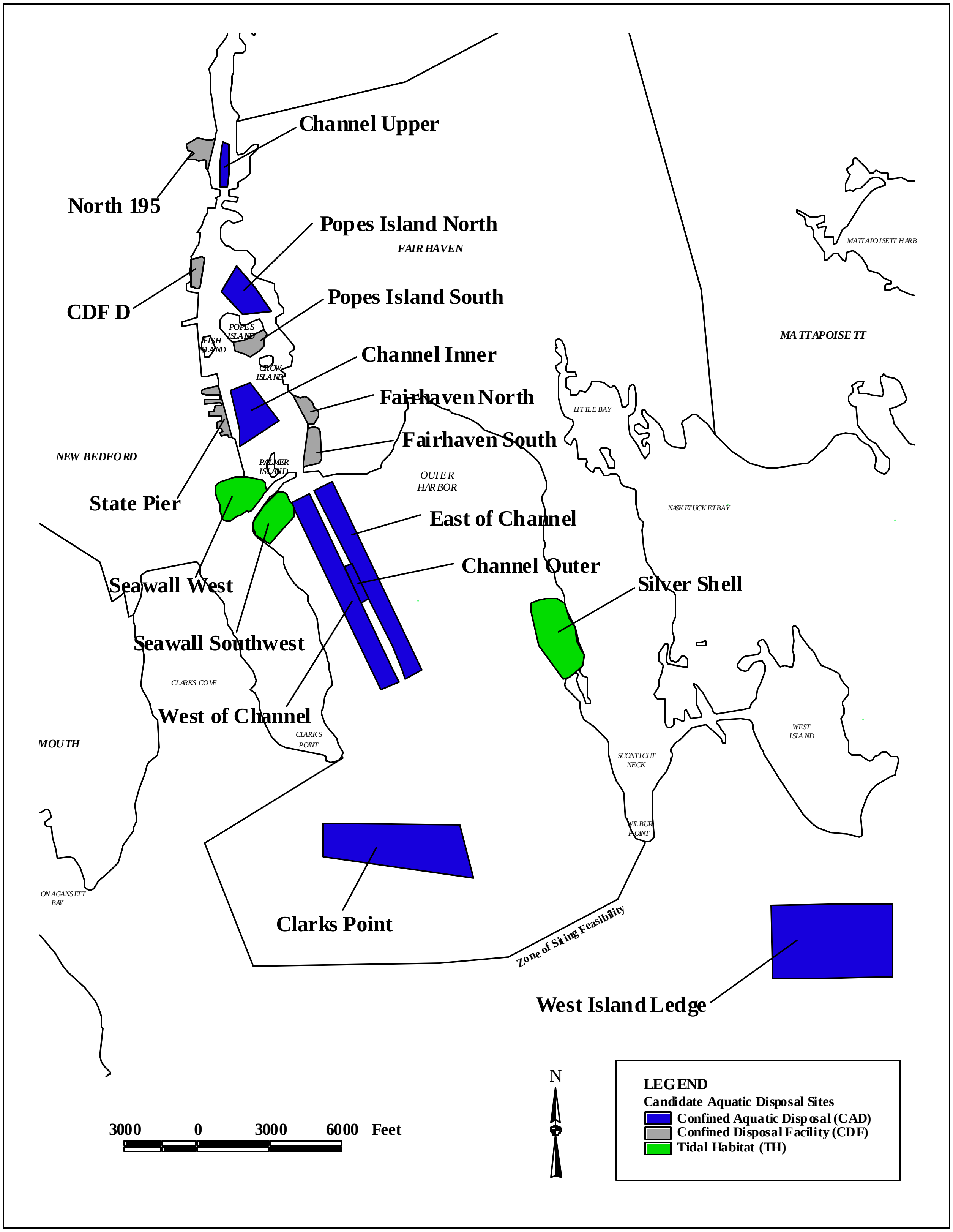


Figure 4-17: Expanded ZSF and Candidate Aquatic Disposal Sites

After, these 17 potential disposal sites were evaluated, two sites were selected as proposed preferred alternatives (Figure 4-18). Section 4.8.2 below describes the screening factors that were applied to the 17 potential sites that ultimately resulted in the identification of two proposed preferred alternatives. Section 4.8.3 then presents the screening results and the evaluation of each potential site with respect to the specific screening factors. Then the two proposed preferred alternatives are characterized in greater detail in Section 5.

4.8.2 Screening Factors

As discussed earlier, there are two general types of screening criteria, exclusionary and discretionary. Exclusionary criteria are those that would unequivocally prohibit disposal of UDM at a particular site. Exclusionary criteria have a basis in federal or state law. For example, locating a disposal site in an area occupied by an endangered species would be prohibited under the federal Endangered Species Act.

Discretionary criteria are those factors that are used to weigh the relative merits and drawbacks of sites. They do not prohibit use of a site for disposal of UDM, but they do, in total, allow for a comparative analysis of each site, or set of sites, so that a LEDPA can be selected. Discretionary criteria were grouped into the following functional areas: physical, jurisdictional, biological, economic and other.

The screening factors, the goal to be achieved by applying these factors, and the significance of these factors in protecting the environment are listed in Table 4-9 and described below. For each candidate site, a data sheet (Figure 4-19) was completed and distributed to city, state and local groups/agencies. The data sheets contain site specific data collected for the application of the screening criteria. Presentation of the data in this format was used to perform the screening analysis. Data sheets for all the aquatic disposal sites considered are contained in Appendix C.

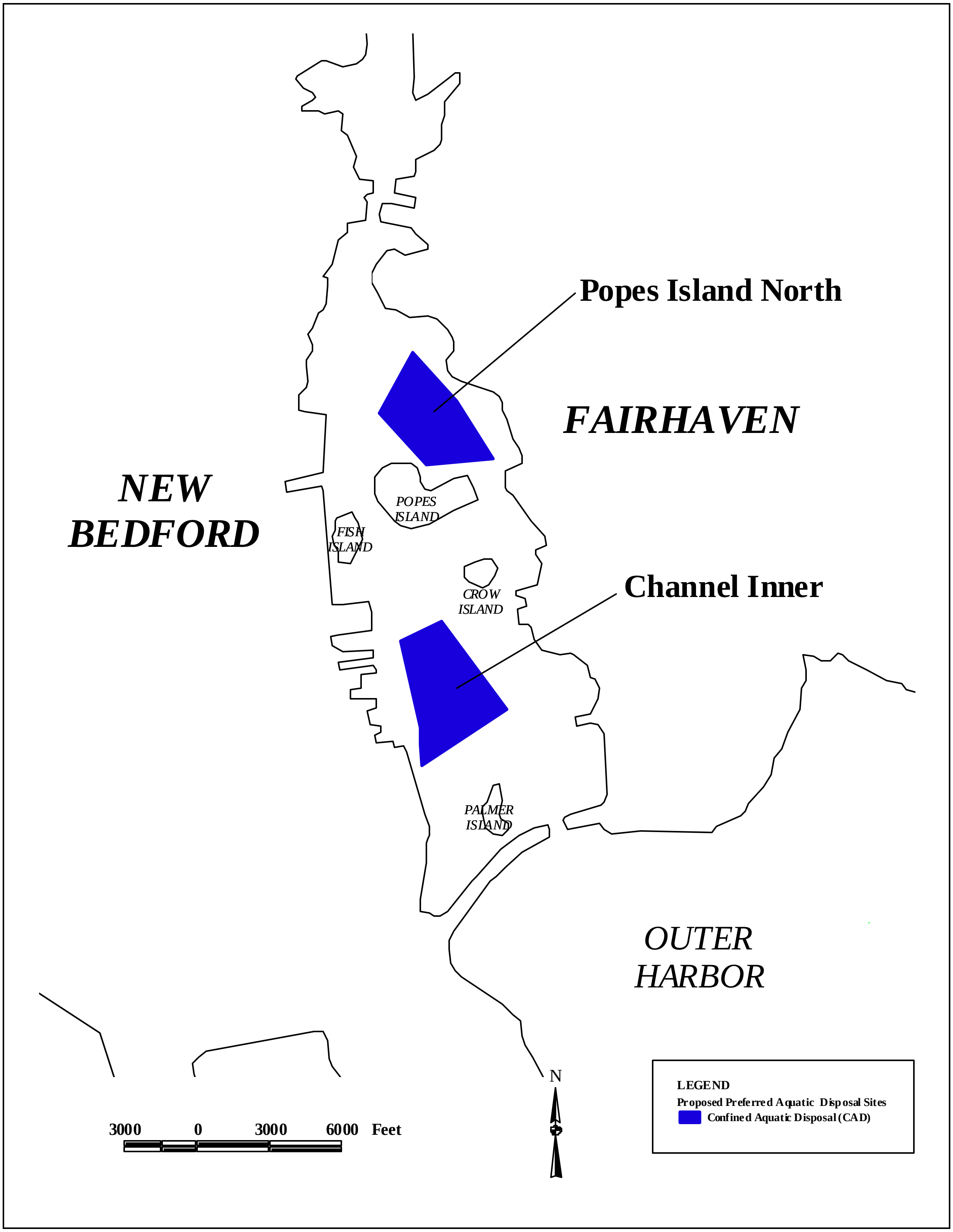


Figure 4-18: Proposed Preferred Disposal Sites

Site Name: **Harbor:**

GENERAL CHARACTERISTICS

Site Coordinates: **Longitude:** **Latitude:**

Disposal Type(s):

Total Potential Capacity (cubic yards):

Adjacent Land Use(s):

Provides Capacity For*:

	Local	Region
Area		
% Capacity		

** Based on conservative total volume estimate which assumed 100% unsuitable material plus 20% contingency.*

EXCLUSIONARY USE FACTORS

Critical Habitat for Federal or State, Rare or Endangered Species:

State Species: The natural Heritage and Endangered Species Program (MADFW) is not aware of any rare plants or exemplary communities in the area of this aquatic site.

Federal Species: NMFS indicates the endangered or threatened species that may be present in the project areas include: Northern right whale, Humpoack whale, Fin whale, Leatherback sea turtle, Loggerhead sea turtle, or Kemp's ridley sea turtle. USFWS indicates that with the exception of occasional transient bald eagles or peregrine falcons, no federally-listed or proposed threatened or endangered species under their jurisdiction are known in the project area.

Federal Marine Sanctuaries:

Name	Distance to Nearest				Comments
	(mi):		(km):		

ACEC's (Areas of Critical Concern):

Name	Distance to Nearest			
	(mi):		(km):	

Historic/Archeological Sites or Districts *:

Type of Site	Presence	Site Name	Distance to Nearest	
			(ft):	(m):

** Not listed on the National Register of Historic Places thus considered a Discretionary Factor.*

PHYSICAL CHARACTERISTICS

Physical Area of Impact (acres):

Average Depth	(ft):		(m):	

Site Accessibility:

Distance:	(mi):		(km):	
Logistics:				
Route:				

Figure 4-19: Example of Aquatic Disposal Site Data Sheet

Duration of Potential, Adverse Long-term Impacts:

Duration	Comments

Navigation/Anchorage:

Comments

Current Patterns, Water Circulation:

Type(s)	Data Source	Mean Surface Current	Mean Bottom Current

Comments:

Potential for Sediment Resuspension and Erosion:

Sedimentary Environment	Comments	Potential for Prop Wash

Ambient Sediment Conditions:

Grain Size	Existing Quality (based on visual observation)

Containment Characteristics:

Type	Concerns	Evaluation	Method

JURISDICTIONAL CONSIDERATIONS

Wetlands:

Present w/in 100 ft:	Distance to Nearest		Area of Overlap	
	(ft):	(m):	(ft^2):	(m^2):

Wetland type:

Essential Fish Habitat (EFH):

** This site has been designated as EFH by the NMFS. See EFH Appendix (1) for more detailed designation information.*

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

BIOLOGICAL USE FACTORS

Present Habitat Types:

Summary Type:

Impacts:

Recovery Potential:

Submerged Aquatic Vegetation:

Presence	Distance to Nearest		Area of Overlap		Type
	(ft):	(m):	(ft^2):	(m^2):	

Mudflats:

Presence	Distance to Nearest		Area of Overlap		Type
	(ft):	(m):	(ft^2):	(m^2):	

Benthic Habitat:

Dominant Habitat Type	
Quality	
Heterogeneity	
Benefits	
Impacts	

Summary SPI Data:

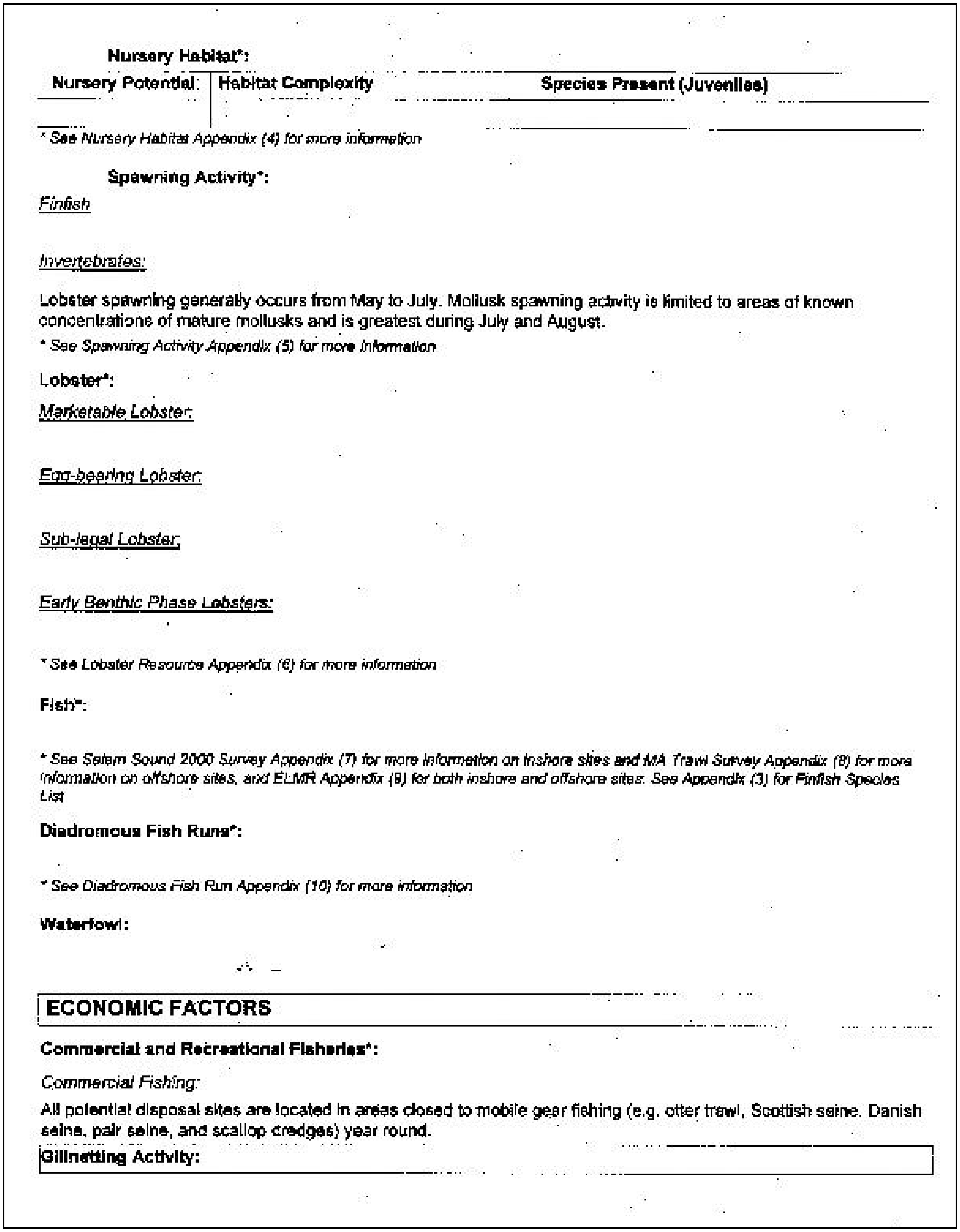
Mean OSI:
Minimum OSI:
Maximum OSI:
Mean RPD:
Methane Present:
Low Dissolved Oxygen:
Dominant Successional Stage:
Successional Stage(s) Present:

Shellfish Beds:

Presence	Distance to Nearest		Area of Overlap	
	(ft):	(m):	(ft^2):	(m^2):
Type				

** See Shellfish Resources Appendix (2) and Finfish/Invertebrate Species Lists Appendix (3) for more information*

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)



Nursery Habitat*:

Nursery Potential	Habitat Complexity	Species Present (Juveniles)

* See Nursery Habitat Appendix (4) for more information

Spawning Activity*:

Finfish

Invertebrates:

Lobster spawning generally occurs from May to July. Mollusk spawning activity is limited to areas of known concentrations of mature mollusks and is greatest during July and August.

* See Spawning Activity Appendix (5) for more information

Lobster*:

Marketable Lobster:

Egg-bearing Lobster:

Sub-legal Lobster:

Early Benthic Phase Lobsters:

* See Lobster Resource Appendix (6) for more information

Fish*:

* See Salem Sound 2000 Survey Appendix (7) for more information on inshore sites and MA Trawl Survey Appendix (8) for more information on offshore sites, and ELMR Appendix (9) for both inshore and offshore sites. See Appendix (3) for Finfish Species List

Diadromous Fish Runs*:

* See Diadromous Fish Run Appendix (10) for more information

Waterfowl:

ECONOMIC FACTORS

Commercial and Recreational Fisheries*:

Commercial Fishing:

All potential disposal sites are located in areas closed to mobile gear fishing (e.g. otter trawl, Scottish seine, Danish seine, pair seine, and scallop dredges) year round.

Gillnetting Activity:

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

Commercial Lobstering:

No restrictions within any of the Salem or Salem-Gloucester potential disposal sites. Lobster fishing represents the most valuable single-species fishery in Massachusetts waters.

Lobstering Activity:

Recreational Fishing:

Presence	Distance to Nearest		Area of Overlap	
	(ft):	(m):	(ft^2):	(m^2):
Species:			**Season:**	

* *See Commercial and Recreational Fisheries Appendix (11) for more information.*

Water-dependent Recreation:

Type(s

OTHER FACTORS

Ability to Obtain a Permit:

Mitigation Potential:

Consistancy with Port Plan:

Unit Cost of Construction (per cu. yd.) : $

Figure 4-19: Example of Aquatic Disposal Site Data Sheet (continued)

Table 4-9: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
Exclusionary Use Factors		
A-1. Rare and Endangered Species / Critical Habitat **E** - 16 USC 470 et seq. 16 USC 1531 et seq. MGL Chap. 131A 321 CMR 10.60	Amount and quality of habitat, species, time of year occupied	Protect habitat integrity, avoid disturbance during period of use/occupation
A-2. Federal Marine Sanctuaries **E** - 33 USC 1401	Type, distance, time of year restrictions	Meet Federal requirements
A-3. ACECs (Areas of Critical Environmental Concern) **E** - 301 CMR 12.00	Type, distance, time of year restrictions	Meet State requirements
A-4. Historic/Archeological Sites or Districts **E** - Only for designated sites 16 USC 469 MGL Chap. 40C 312 CMR 2.0 - 2.15 **D** - Non-designated sites	Type of site, presence, significance of features	Protect site integrity
Physical Characteristics		
A-5. Physical Area of Impact **D**	Size of area affected	Minimize area adversely affected
A-6. Depth **D**	Depth relative to environmental and navigational use	Protect navigation; maximize containment
A-7. Site Accessibility ***Route*** ***Distance*** ***Logistics*** **D**	 Navigation limitations Length, time to transport Re-handling, storage	 Minimize disruptions Maximize efficiency Reduce risks of Re-handling
A-8. Duration of Potential, Adverse Long-term Impacts **D**	Time, severity, recovery period	Avoid, minimize, mitigate
A-9. Navigation/Anchorage **D**	Amount, type, draft	Avoid, minimize, mitigate adverse impacts
A-10. Current Patterns, Water Circulation **D**	Current speed, transport direction	Avoid, minimize, mitigate adverse impacts
A-11. Potential for Sediment Resuspension and Erosion **D**	Wave heights, direction, fetch	Maximize long-term containment confidence

Table 4-9: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
A-12. Ambient Sediment Conditions **D**	Grain size, existing quality	Minimize adverse change to existing bottom
A-13. Containment Characteristics **D**	Currents, grain size, value of adjacent areas	Maximize long-term containment confidence
Jurisdictional Considerations		
A-14.a Wetlands - State Jurisdiction - Massachusetts Wetland Resource Areas including: Coastal or Barrier Beaches, Coastal Bank, Rocky Intertidal Shores, Salt Marshes, Land Containing Shellfish, Banks of or Land Under the Ocean, Ponds Streams, Rivers Lakes or Creeks that Underlie Anadramous/Catadromous Fish Runs **D**	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts
A-14.b - Wetlands - Federal Jurisdiction, ACOE Wetlands including: 404(b)1 Wetlands, Mudflats, Submerged Aquatic Vegetation **D**	Amount, type, benefits, impacts, recovery potential	Avoid, minimize, mitigate adverse impacts
A-14.c - Essential Fish Habitat (EFH) - based upon data from NMFS and DMF as well as DMMP sampling. **D**	New Bedford/Fairhaven Harbor is designated as EFH under Magnusson-Stevens Act	Avoid, minimize, mitigate adverse impacts

Table 4-9: Summary of Exclusionary (E) and Discretionary (D) Screening Factors for Aquatic Disposal (continued)

SCREENING FACTORS	EVALUATION CRITERIA	GOAL
Biological Use Factors		
A-15. Present Habitat Types		
D ***A-15.a - Submerged Aquatic Vegetation***	Amount, type, impacts, distance, recovery potential	Avoid, minimize, mitigate adverse impacts
D ***A-15b. - Mudflats***	Amount, type, impacts, distance, recovery potential	Avoid, minimize, mitigate adverse impacts
D ***A-15c.-Benthic Habitat***	Habitat type, quality, heterogeneity, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
D ***A-15.d - Shellfish beds***	Habitat type, quality, heterogeneity, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
D ***A-15.e - Nursery and Spawning Potential***	Amount, type, benefits, impacts, recovery potential, distance, time of year issues	Avoid, minimize, mitigate adverse impacts
D ***A-15f - Fish***	bundance, benefits, impacts, recovery potential, time of year issues	Avoid, minimize, mitigate adverse impacts
D ***A-15g - Waterfowl***	Amount, type, time of year issues	Avoid, minimize, mitigate adverse impacts
Economic Factors		
A-16. Commercial and Recreational Fisheries **D**	Amount, type, quality	Avoid or minimize loss and long-term impacts
A-17. Water-dependent Recreation **D**	Amount, type, quality	Maximize retention of opportunities
Regulatory/Practicability/Human Factors		
A-18. Ability to Obtain Permit **D**	Consistency with federal and state regulations	Meet all federal and state guidelines for permits
A-19. Mitigation Potential **D**	Amount, type of mitigation required/possible through site use.	Maximize potential for mitigation of existing degraded habitats
A-20. Consistency with Port Plan **D**	Values and site-specific uses in port plan	Maximize consistency with port plans
A-21. Cost **D**	Estimated 20-year cost of construction and maintenance, including monitoring	Minimize long-term costs

4.8.2.1 Exclusionary Criteria

A-1. Rare and Endangered Species (Critical habitat or resource-use area for federal or state listed threatened or endangered species or species of concern) - The locations of the sites identified in the initial screening were provided to the U.S. Fish and Wildlife Service and National Marine Fisheries Service for threatened and endangered species review. The locations were also provided to Massachusetts Department of Environmental Management for review of state listed species.

Disposal of UDM at a site located within a threatened or endangered species habitat would likely be prohibited under the federal Endangered Species Act.

A-2. Historic/Archeological Sites or Districts - The sites were evaluated for potential cultural resource constraints through consultation with the Massachusetts State Historic Preservation Office and review of positions of shipwrecks and artifacts of maritime history.

Disposal of UDM at a significant historic or archaeological site could be prohibited. However, the determination of significance would be made by the Massachusetts Historic Preservation Office in consultation with the Bureau of Underwater Archaeology. If a site is deemed not significant, or if mitigation measures such as recovery and recordation can be implemented, then the presence of an historical or archaeological resource may not exclude the site from accepting UDM.

A-3. Federal Marine Sanctuaries - Sites were evaluated by comparing their locations (and any potential drift of suspended material) to the boundaries of nearby National Marine Sanctuaries.

A-4. ACECs (Areas of Critical Environmental Concern) - Sites were evaluated by comparing their locations (and any potential drift of suspended material) to the boundaries of any ACECs identified by Mass GIS.

ACECs are areas designated by the Commonwealth as having unique environmental features. There are no ACECs within the New Bedford/Fairhaven ZSF. The nearest ACEC is the Black River Estuary and Pocassett River sites located approximately 15 miles east of New Bedford/Fairhaven Harbor in Bourne, MA.

4.8.2.2 Discretionary Criteria

A-5. Site Accessibility - Accessibility is determined by the following factors: Route; The most practical route for tugs and barges for transit to and from the dredging area and disposal site. Distance; The distance based on the practical route was calculated from the head of navigation of the proposed dredging project. Logistics; Any potential logistical problems that might be encountered in use or construction of the proposed site.

The site accessibility factors are important in maximizing dredging and disposal efficiency by minimizing disruption and sediment re-handling.

A-6. Physical Area of Impact - The amount of sea floor in acres that would be directly affected by disposal activities was estimated. A smaller footprint of disturbance is preferred over a larger footprint, therefore, sites that could be excavated to deeper depths would be preferred over sites that have excavation limitations due to presence of bedrock or other material that is difficult to dredge.

A-7. Duration of Potential, Adverse Long-term Impacts - Recovery time is a function of the type of disposal and site conditions (e.g. constructed, level bottom). The relative length of recovery is estimated in the following manner:

Short Term: sites with sediment size similar to material to be dredged with little or no construction required are most preferred.
Intermediate: sites with different grain size or construction required are less preferred.
Potential Long Term: sites with potential non-recoverable long term effects (e.g. altering fish migration routes) are least preferred.

A-8. Navigation/Anchorage - The proximity and depth relative to shipping lanes, designated channels and anchorages. Sites located within existing channels or anchorage areas would be less preferred over areas not utilized for navigation. Shallow areas, generally less than 20 ft. MLW, are least preferred due to potential access problems for excavation equipment.

A-9. Present Habitat Types

A-9.a - Wetlands - State Jurisdiction - Wetlands as defined in the Massachusetts Wetlands Protection Act (M.G.L Ch. 131, Section 40) and the DEP Wetland Regulations (310 CMR 10.00). Sites located within or near (and potentially impacting) the MA DEP Natural Resource Areas are less preferable than those outside of and distant from these resource areas. MA DEP Natural Resource Areas include: Coastal or Barrier Beaches, Coastal Bank, Rocky Intertidal Shores, Salt Marshes, Land Containing Shellfish, Banks of or Land Under the Ocean, Ponds, Streams, Rivers Lakes or Creeks that Underlie Anadromous/Catadromous Fish Runs.

A-9.b - Wetlands - Federal Jurisdiction - Wetlands as defined in the CWA. As listed in Section 404(b)(1) wetlands, mudflats, and submerged aquatic vegetation (SAV) are given special consideration. Mudflats are Special Aquatic Sites under CWA 4-1(b) guidelines and include any intertidal areas with organic material and grain size less than sand. Sites distal to these resources are preferred over sites within or proximal to these wetland resources.

A-9.c - Spawning/Nursery Habitat - Spawning or nursery habitats for finfish. Sites within or near these habitats, as identified by Massachusetts DMF and other sources, are discouraged.

A-9.d - Shellfish Beds - Sites within or near areas of shellfish concentration, as indicated by DMF and other available sources, are least preferred.

A-9.e - Benthic Habitat - Sites are preferred in areas where benthic community and overall habitat quality is poorest. Each site was evaluated through the use of REMOTS® sediment profile imaging. The REMOTS® data were used to assess the number of habitats present, the quality based on the Organism Sediment Index (OSI) of the benthic habitat and the general context of the site relative to other sites. In general the preference was to locate disposal sites in substrates that contain homogeneous, soft sediments with low OSI quality rather than hard sandy substrates or sites with multiple habitat types and high OSI quality.

A-9.f - Essential Fish Habitat (EFH) - The evaluation of EFH is based upon data provided by the NMFS and DMF as well as sampling conducted within New Bedford/Fairhaven Harbor for this DMMP EIR. All of New Bedford/Fairhaven Harbor is designated as EFH under the Magnusson-Stevens Act.

A-10. Avifauna - The presence, timing and concentration of avifauna. Through consultation with the Massachusetts Department of Fish and Wildlife, USFWS and literature sources, avifauna (i.e.: shorebirds, waterfowl, seabird habitat was reviewed. Sites furthest from known avifauna concentration areas, particularly nesting islands, are preferred.

A-11. Current Patterns, Water Circulation - Currents and water circulation patterns can affect the movement of deposited UDM. Sites are preferred in areas where currents, particularly bottom currents, are low so as to minimize the erosion potential to UDM or capping.

A-12. Exposure to Erosive Currents, and Storm Waves - The effect of currents, both tidal and storm-induced, can affect the movement of sediments. UDM disposal in areas where bottom currents from various hydrodynamic forces are low is preferred over areas of potential high velocity (i.e., erosive) currents. Erosion potential was evaluated based on coastal bathymetric charts, determination of fetch, local knowledge, and published information on grain size (Knebel et al., 1998).

A-13. Commercial and Recreational Fisheries - DMF reviewed proposed sites relative to existing data on commercial and recreational fisheries and evaluated local knowledge provided through the Harbor Committees. Areas that are not fished, commercially or recreationally, are preferred over those that are actively fished.

A-14. Water-dependent Recreation - These activities include: fishing, boating, scuba diving, swimming. Sites are preferred in areas with little or no recreational activity.

A-15. Ambient Sediment Conditions - Estimated sediment type will be recorded from REMOTS® data. Similar to A-9.e, areas where sediment is similar to that of the UDM to be placed there, (i.e. soft, silty and homogenous), are preferred over areas where ambient sediment is coarse-grained or mixed.

A-16. Depth - The existing depths of the disposal sites were obtained from bathymetric surveys or NOAA charts. Final depths after construction or fill were estimated from this available existing depth data. Sites located in shallow water, generally less than 20 feet, are less preferable than deeper sites, because of potential keel clearance of dredging/disposal equipment.

A-17. Containment Characteristics - The depth and bathymetry (existing or after construction) were evaluated to assess containment characteristics. Sites located within existing depressional areas, where "natural" bathymetric contours provide containment are preferred over level or sloping areas where containment would be more difficult.

A-18. Ability to Obtain Permit - Each proposed disposal site was reviewed for consistency with federal and state regulatory guidelines to determine potential for obtaining a permit under existing guidelines. Sites that have a higher potential for meeting all state and federal laws, policies and regulations are preferred.

A-19. Mitigation Potential - The characteristics of the proposed site (e.g. location, existing habitat, future uses) were evaluated for either loss of habitat, or conversely, potential to add habitat through site design. The feasibility of habitat restoration mitigation measures would be assessed if habitat loss was found to be likely. If habitat restoration was determined to be a possible solution, then the feasibility of mitigation activities would be evaluated. Sites that require the least amount of mitigation activities in terms of size, time, and cost are preferred.

A-20. Consistency with Port Plan - Each proposed disposal site was reviewed by the New Bedford/Fairhaven Harbor Dredging Subcommittee for consistency with the New Bedford Harbor Plan, specifically to determine whether the sites enhance the values articulated in the Port Plan and conform to projected site-specific uses. Sites that enhance the Port Plan recommendations are preferred over those that conflict with the Port Plan.

A-21. Cost - The cost of the construction, maintenance, and monitoring of each proposed site was estimated on a twenty-year planning cycle for comparative purposes. Sites that are least costly are preferred over sites that have higher costs.

4.8.3 Screening Results

As discussed earlier, 17 potential disposal sites were subjected to further screening. In order to distinguish among these sites, the screening factors described in Section 4.8.2 above, were applied. In many cases, groups of sites were compared because there were no significant differences in physical or biological characteristics between the individual sites.

The evaluation of the 17 potential disposal sites with respect to the discretionary screening factors is discussed below based on five general groupings: exclusionary, physical, jurisdictional, biological and economic factors.

The physical factors include: capacity, physical area of impact (A-6), site accessibility (A-5), navigation/anchorage (A-8), current patterns/water circulation (A-11), potential for sediment resuspension and erosion (A-12), ambient sediment conditions (A-15), depth (A-16), containment characteristics (A-17), and duration of potential adverse long-term impacts (A-7).

The exclusionary factors include: threatened and endangered species/critical habitat (A-1), federal marine sanctuaries (A-3), and ACECs (A-4). The biological factors are habitat types (A-9) and avifauna (A-10) and commercial and recreational fisheries (A-13) represent the economic factors.

Regulatory/Practicability/Human factors include: historical/archaeological sites or districts (A-2), water-dependent recreation (A-14), ability to obtain permit (A-18), mitigation potential (A-19), consistency with port plan (A-20), and cost (A-21).

4.8.3.1 Exclusionary Factors

Exclusionary criteria, aimed at eliminating sites based on regulatory prohibition, were applied to the universe of 17 candidate sites. None of the candidate sites failed the exclusionary criteria, therefore all 17 candidate disposal sites were carried forward as potential alternatives and the remaining four factor groupings were applied as described below.

4.8.3.2 Physical Factors

Site capacity was an important consideration as it determines whether a single site or multiple sites would be needed to confine the material requiring dredging (Maguire Group Inc., 1997a). There were two interdependent elements of site capacity: area and UDM thickness. For example, 400,000 cy of UDM would cover 400 acres to 1 foot in depth; 40 acres to 10 feet of depth; or 20 acres to 20 feet of depth. Given the anticipated volumes of UDM, the use of UDM for creation of land, wetland, or tidal mudflat would be most practical at water depths of less than 20 feet MLW. Bottom disposal in the relatively exposed Buzzards Bay may require depths greater than 20 feet for maximum protection against storm driven waves.

Tables 4-10 shows the potential capacities of each site to accept UDM. Of the 17 potential sites, nine (9) sites, West of Channel, East of Channel, Channel Inner, Popes Island North, Seawall Southwest, Seawall West, Silver Shell, West Island Ledge, and Clark's Point have the capacity to accept all of the UDM from New Bedford/Fairhaven Harbor over the next 10 years. The remaining aquatic disposal alternatives would have insufficient capacity to accommodate 100 percent of UDM. Therefore, if one of these sites were used, then another site would have to be used in conjunction to satisfy the capacity requirement.

Table 4-10: Characteristics of Potential Aquatic Disposal Sites in New Bedford/Fairhaven Harbor

Site Name	Type	Average Water Depth (Feet)	Size (Acres)	Potential Capacity[1] (x 1000 c.y.)	Distance To Project[2] (Miles)
West of Channel	CAD/ATC	18	162	6,214	3.3
East of Channel	CAD/ATC	16	140	4,396	3.3
Channel Inner	CAD/OD	28	60	1,223	1.8
Channel Outer	CAD/OD	24	12	364	3.3
Channel Upper	CAD/OD	10	14	454	0.5
Popes Island North	CAD	6	40	3,266	0.9
North 195	CDF	2	20	656	0.7
CDF D	CDF	4	14	442	0.6
Popes Island South	CDF	8	19	599	1.5
State Pier South	CDF	20	15	492	1.9
Seawall Southwest	CDF/TH	10	51	1,660	2.9
Seawall West	CDF/TH	3	61	1,976	2.5
Silver Shell	CDF/TH	5	102	3,298	5.3
Fairhaven North	CDF	5	10	225	2.2
Fairhaven South	CDF	4	21	694	2.4
West Island Ledge	CAD	25	349	14,090	8.7
Clark's Point	CAD	29	238	11,524	5.1

[1] These capacity calculations were based on the sum of maximum capacities estimated for candidate site sub-areas. All volumes are based on a 3:1 slope. Maximum capacity was calculated using the average basement depth (Maguire 1999).

[2] As measured from the center of the lower harbor

Site accessibility was considered with respect to the candidate sites. The two off-shore sites are more distant from the dredging projects than most sites within the Harbor with the exception of the Silver Shell CDF/TH. Off-shore disposal site distances range from 5.1 to 8.7 miles from the dredging areas. Sites within New Bedford/Fairhaven Harbor are within 0.6 to 5.3 miles from the dredging areas.

Sites located in New Bedford/Fairhaven Harbor are within and/or near existing navigation areas. West of Channel and East of Channel are CAD/ATC sites that are located adjacent to the federal navigation channel within the Outer Harbor. The Inner Harbor Channel Site is located adjacent to federal channels and commonly-used navigation areas for recreational vessels. All off-shore sites are outside of designated navigation channels.

Depths for the candidate sites ranged from 2 to 29 feet deep. The Outer Harbor and off-shore sites are considerably deeper than the Upper and Lower Harbor sites. The shallowest sites are near-shore or within the Upper Harbor where the depth to bottom is variable and can be as low as 2 feet in some locations. These shallow sites would have to be constructed as CDFs or excavated CADs.

The physical area of impact is an important factor in evaluating disposal sites. Because most of the biological activity in sediment is within the upper 2 feet, it is important to limit the disturbance to as small a footprint as possible. For example, a disposal area that is relatively small in area, with a large cell depth, is preferred over a site that is relatively large in area, but has a shallow cell depth.

The physical area of impact is a function of many variables: the volume of UDM, the type of disposal site (e.g.: CAD-mound, CAD-pit, CDF, TH), depth to bedrock, site configuration, side-slope, surrounding bathymetry, disposal timing and sequencing are all important factors. Because there are so many variables and assumptions involved in the calculation of physical impact area, the direct comparison of these values for each candidate sites would not be appropriate. Rather, the discriminating factor in determining physical area of impact, particularly for sites in the Harbor, is the depth to bedrock. Sub-bottom profile surveying was done to determine the depth to bedrock for New Bedford/Fairhaven Harbor sites. Sub-bottom profiling is a standard technique used for distinguishing and measuring various sediment layers that exist below the sediment/water interface. Sub-bottom systems are able to distinguish sediment layers by measuring differences in acoustic impedance between the layers. A sub-bottom system uses the energy reflected from these boundary layers to build an image of the existing environment.

Survey transects were run throughout the lower harbor and outer harbor potential sites (Figure 4-20). However, data from the lower harbor and some areas of the outer harbor channel were difficult to reliably contour because of the presence of gases within the shallow water survey area, potential sound loss due to layers of coarse glacial sediments and methane layers. An additional geophysical investigation was conducted to contour the Inner Harbor.

A marine seismic refraction survey consisting of a number of seismic lines, or “spreads”, designed to cover Inner Harbor locations was conducted (Figure 4-21). Small seismic charges were emplaced into the sediment of the harbor bottom to provide seismic energy. The sound returns as a result of the seismic shots were input into a model to determine the depth to bedrock in the sample areas (Appendix J).

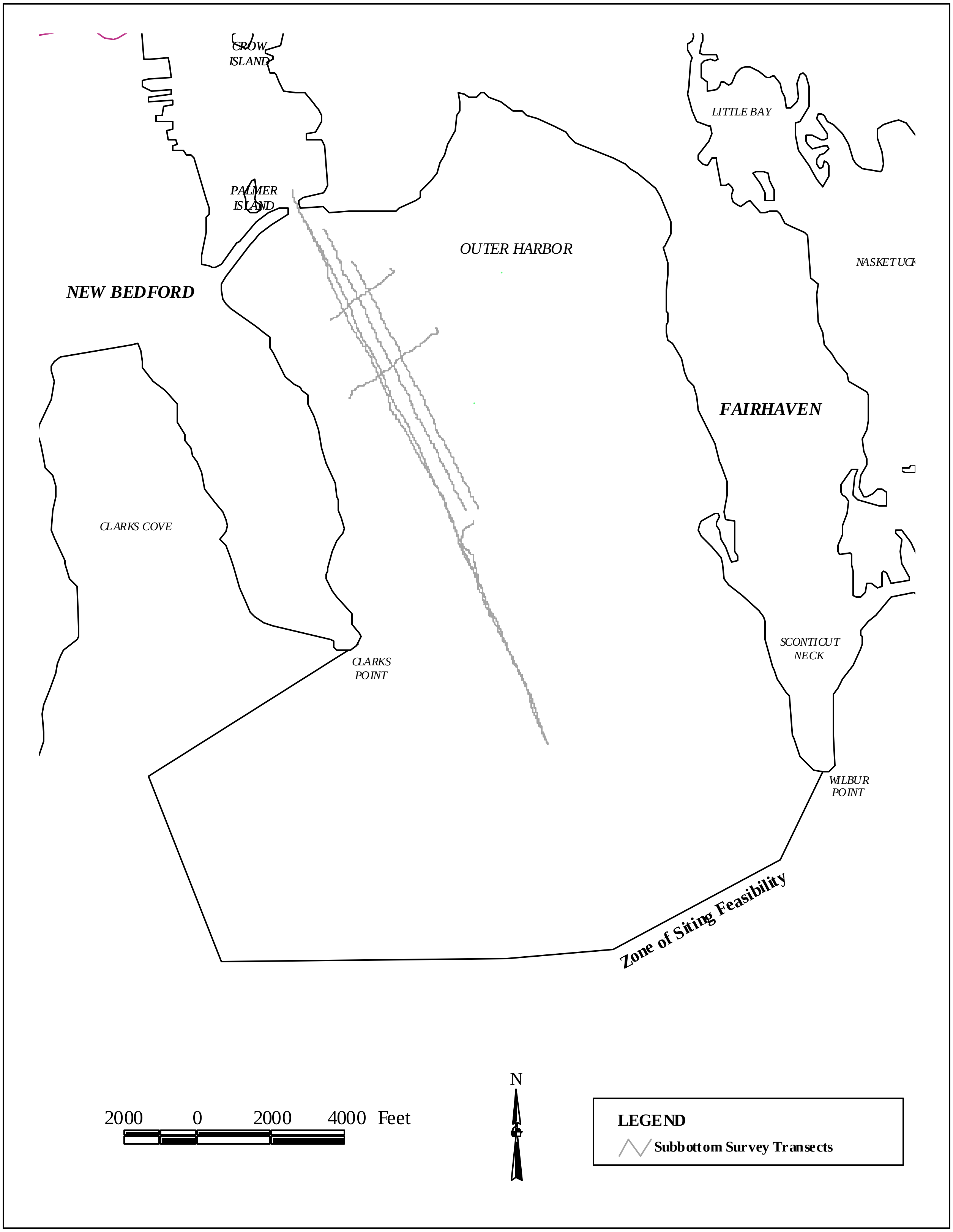


Figure 4-20: Outer Harbor Sub-bottom Survey Transects

Depth to bedrock varies within New Bedford/Fairhaven Inner and Outer Harbor areas (Figures 4-22 and

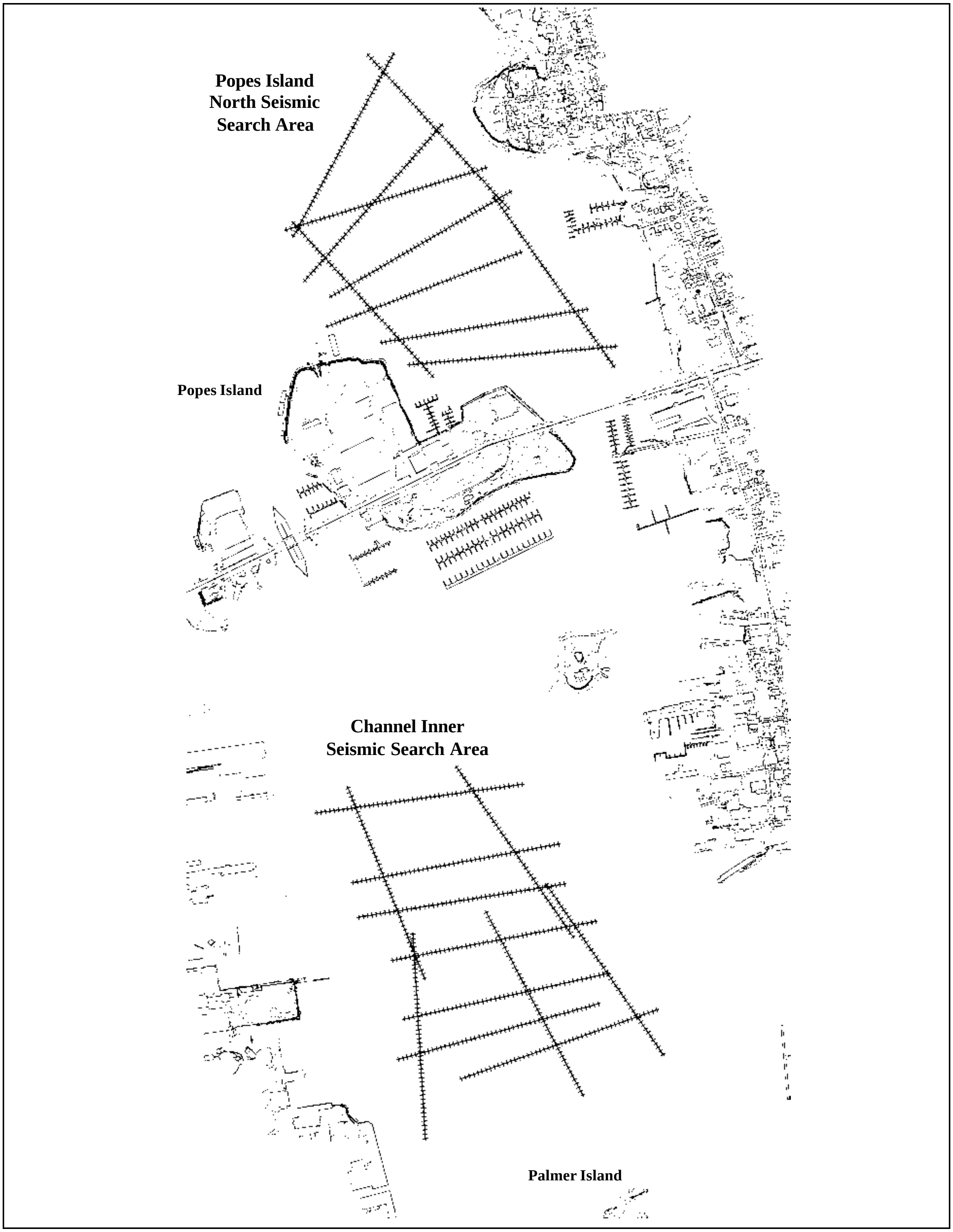


Figure 4-21: Inner Harbor Marine Seismic Refraction Spreads

4-23). Within the East of Channel CAD/ATC site, depth to bedrock ranges from 5 to 14 m below the sediment surface. The West of Channel ATC site in the Outer Harbor has slightly more sediment overburden, with average depth to bedrock from about 6 to 18 meters.

The CAD/OD areas in the Inner Harbor are considerably more shallow than the CAD/ATC areas within the Outer Harbor. Therefore 960,000 cy of UDM deposited in the New Bedford/Fairhaven Outer Harbor CAD sites would result in less physical area of impact than if that same volume of UDM were deposited in Inner or Lower Harbor CDF sites, because of the suspected inner harbor's relatively shallower depths to bedrock.

The channel and adjacent-to-channel CAD cells generally have deeper depth to bedrock than other areas of the Harbor channel and adjacent-to-channel sites where depth to bedrock was typically recorded at <3 feet below the sediment surface .

Available literature on the depth to bedrock at the off-shore West Island Ledge CAD site, suggests that bedrock may lie from 3-6 feet below the sediment surface. At Clark's Point Aquatic Disposal site, the depth to bedrock may be as deep as 9-12 feet. Therefore, the Clark's point disposal site would be expected to be constructed with a smaller footprint due to the deeper potential depth of the pit. Both sites have adequate capacity to accommodate the 2.6 million cy of UDM expected to be dredged from New Bedford/Fairhaven Harbor.

Currents have the potential to resuspend surficial sediments, which may be re-deposited in areas where the current velocity decreases. Generally speaking, fine grained sediments, such as silts and clays, are found in water with slow currents that often produce depositional areas. While coarse-grained sediments, such as sand and gravel, exist in areas where current speeds are relatively high and erosional areas are more likely. Areas of mixed fine and coarse-grained sediments are considered transitional areas or sediment reworking areas. Therefore, patterns of currents can be inferred from the mapping of sediment types provided by Moore (1963) and Summerhayes et. al. (1985) (Figure 4-24). This type of analysis, however, only offers a broad view of the hydrodynamic characteristics of the candidate sites. For instance, all of New Bedford Harbor and Buzzard's Bay in general are considered net depositional areas due to landward movement of water and its sediment load in the lower water column (CDM, 1989). However, data specific to the West Island Ledge offshore aquatic site (i.e. the presence of large grain sizes), suggests that this site specific location is an erosional environment.

In order to further define the sediment conditions from which we can infer current energy and to distinguish each site based upon sediment conditions, sediment profile imaging surveys were conducted at each of the candidate aquatic disposal sites. The composition of the existing sediments at the New Bedford/Fairhaven Harbor and off-shore sites is discussed below.

The existing character of the sediment was sampled during the DMMP Phase 1 Study (Maguire Group, 1997) and the habitat characterization study (SAIC, 1999a).

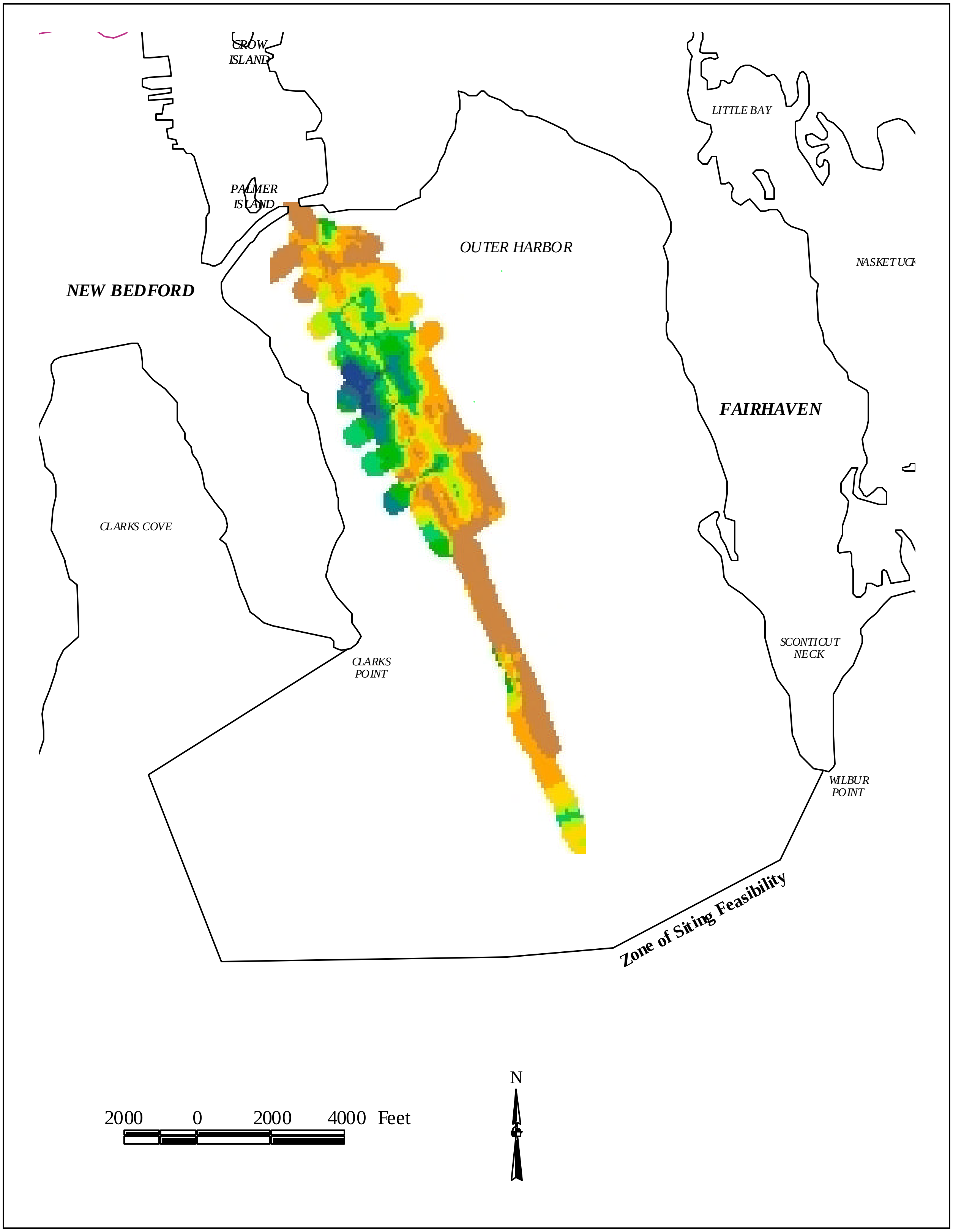


Figure 4-22: Outer Harbor Depth to Bedrock

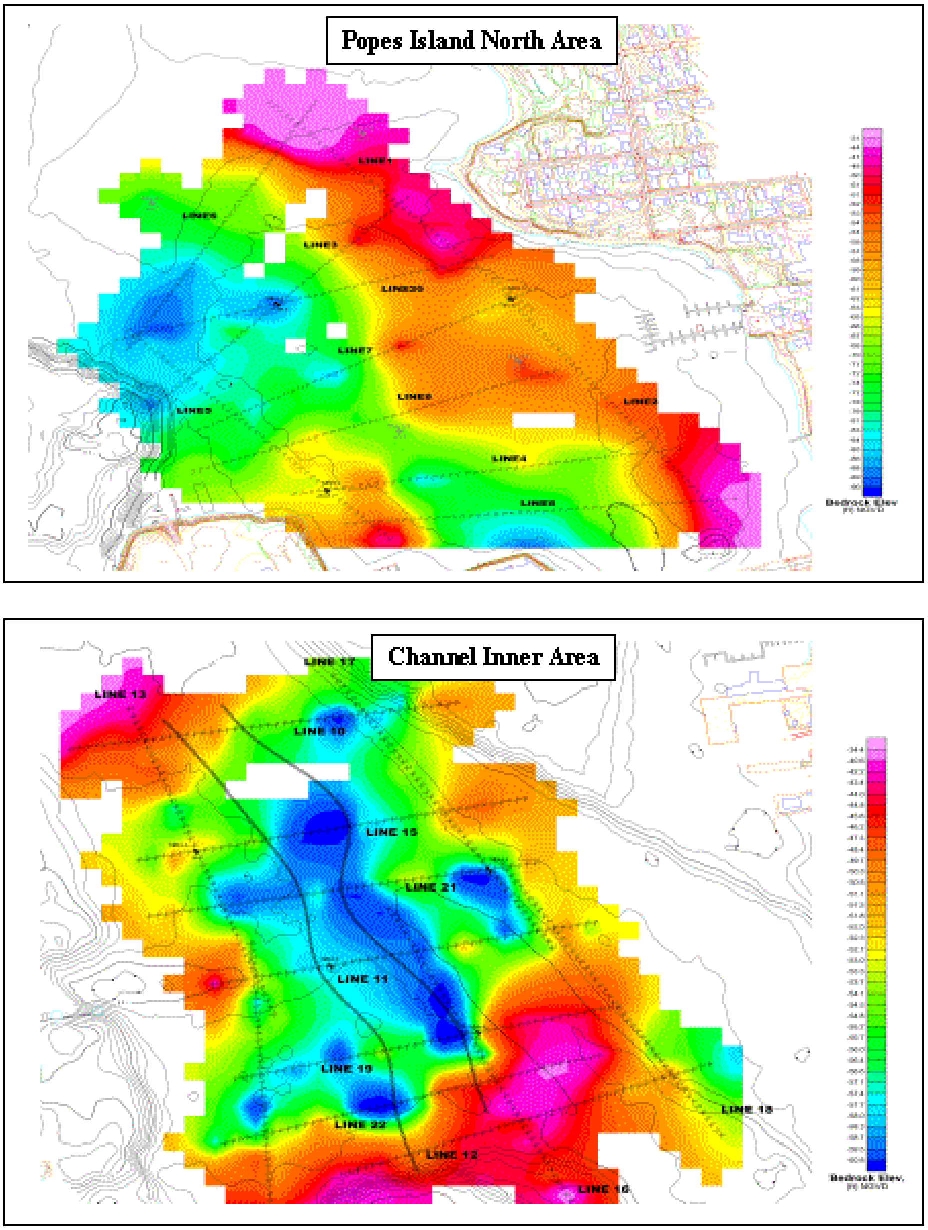


Figure 4-23: Inner Harbor Depth to Bedrock

Fine-grained sediments (>4 phi), such as silts and clays, dominate the New Bedford/Fairhaven Channel and Popes Island South potential alternative aquatic disposal sites in New Bedford/Fairhaven Harbor. This type of sediment suggests a low-energy, depositional environment. Very fine sand sediments (4-3 phi) were found within much of Seawall Southwest, Fairhaven South, and Pope's Island North sites. The west of Channel, State Pier, and Railyard sites were also predominantly fine-grained (>4 or 4-3 phi) but also contained areas of hard bottom (rocks). The East of Channel site had predominantly silt-clay (>4 phi) sediments, but medium and very coarse sand areas also exist. Largest grain-sizes (hard, medium to fine sand) with some pebbles and shells was found within the Silver Shell site. Other limited areas found within the alternative aquatic disposal sites, consisted of fine sand or bedrock. Off-shore sites are more variable, although they generally contain sediments that are more coarse grained than harbor sediments (Figure 4-24).

Other physical and biological parameters were evaluated using sediment profile imaging to provide further insight into the sediment character. The Redox Potential Discontinuity (RPD) is the depth of oxygenation into the sediment. It is determined via REMOTS® sampling which involves pushing a camera into the sediment and photographing the sediment profile. The abrupt change in color from lighter oxygenated sediments to darker hypoxic or anoxic sediment is known as the RPD. Higher RPD depths indicate more oxygen in the sediment. Many New Bedford/Fairhaven Harbor sites showed intermediate RPD depths (1-3 cm), indicating poor to fair sediment aeration, probably due to moderate to high levels of organic loading in New Bedford/Fairhaven Harbor. The highest RPD values (>3 cm) were measured from three images taken within NB-Channel and one image from East of Channel.

Due to poor camera penetration, the RPD could not be determined at a number of sampling locations within the harbor. Namely: the south end of the West of Channel Site; the north end of Silver Shell site; the north end of the State Pier site; the vicinity of the west end of the Seawall West site; the Seawall southwest site and the north end of East of Channel.

Sediment profile images could not be obtained from a number of sampling areas due to inhibition of camera penetration by rocks, shells, or other hard bottom substrate. Most of the images obtained from penetrable areas exhibited Stage I communities. The patterns of infaunal successional stages were consistent with the results of the RPD indices at these harbor sites. Only three images depicted evidence of Stage III organisms: one from NB Channel, one from East of Channel, and one from Pope's Island South site. Within the Outer Channel area, sediments were found to include mixtures of gravel, sand, and mud at various proportions. The highest proportion of fine-grained sediment (>75% silt-clay) was found within the shipping channel, while the area immediately west of the shipping channel had somewhat lower proportions of silt-clay. Outside of these areas, sediments generally contained less than 50% silt-clay. The vicinity of Station 139 in the Outer Shipping channel showed fine-grained sediments. Much of the area within the Outer Channel area therefore appears to be moderately depositional. An area where maximum sub-bottom capacity could be configured was chosen as a CAD site (Clark's Point CAD), because of significant depth to bedrock and because it was a sediment deposition zone.

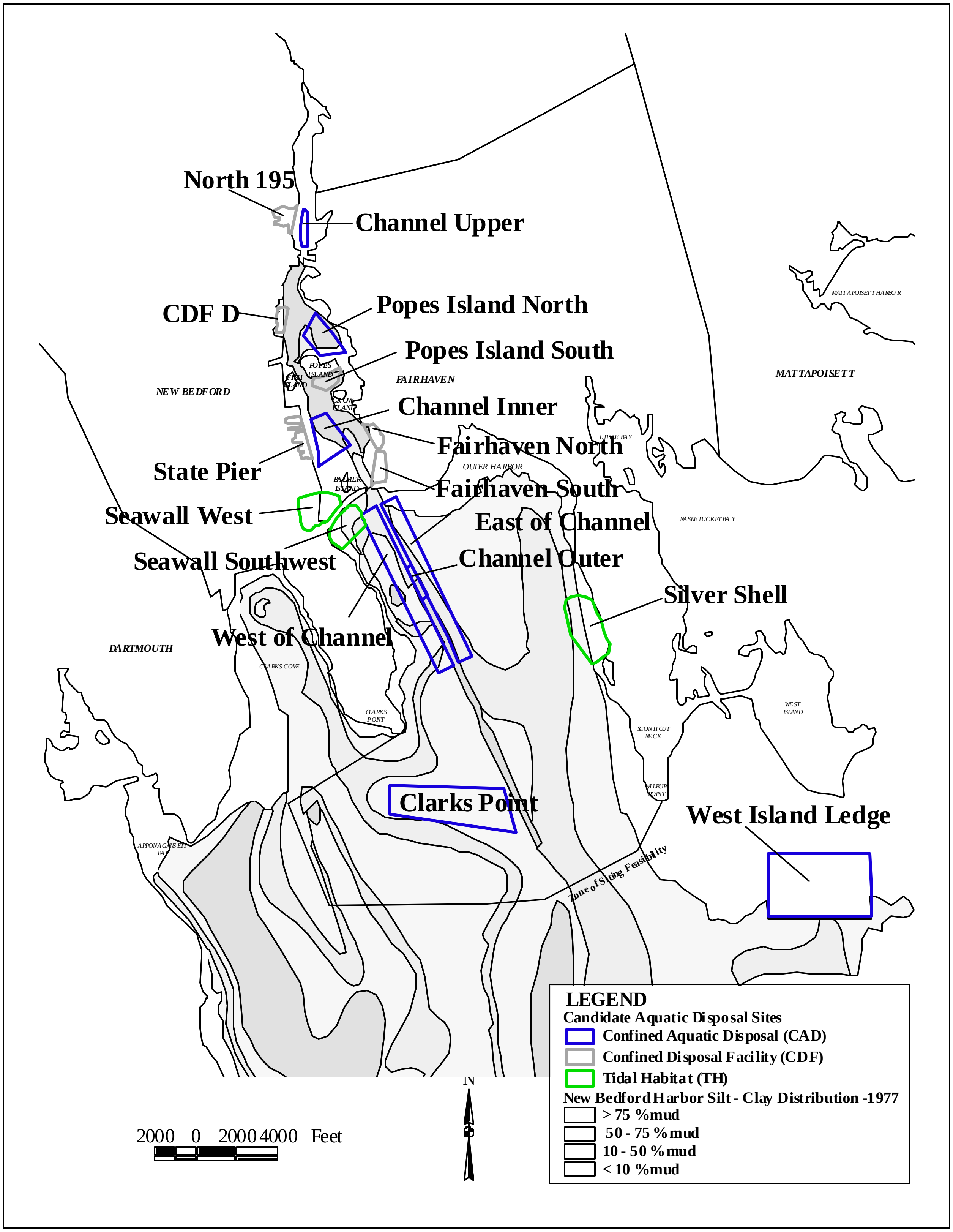


Figure 4-24: Silt-Clay Percentages of Surficial Sediments in Harbor and Buzzards Bay (Summerhayes et al, 1985)

The area offshore of New Bedford/Fairhaven in Buzzard's Bay is characterized by a wide variety of sediments, ranging from those dominated by silt and clay, to sand, gravel, and rocks. Data specific to the offshore disposal sites demonstrated this variability. Sediment samples collected from within the West Island Ledge disposal site boundaries were comprised of less than 10% silt-clay, Hard sand/rocky sediment environments typically are indicative of higher near-bottom energy regimes, and thus erosional sedimentary environments. Therefore the West Island Ledge site is believed to lie within an erosional area. Other areas off-shore are known to contain sandier sediments ranging from hard fine to medium sand and unconsolidated fine sand habitats.

4.8.3.3 Biological Factors

The biological characteristics of the candidate disposal sites are evaluated below. Various biological factors such as fisheries, benthos, and avifauna were examined independently, however, this analysis attempts to evaluate the *overall* ecosystem in and near each candidate disposal site. A variety of primary and secondary information sources were used. Information that was found to be pertinent to the differentiation of candidate disposal sites is featured in the screening analysis, while other information that is less valuable in this aquatic disposal screening application (but serves to characterize the resource on a large scale) is presented in Appendix E and F.

Benthic Invertebrate Community

No benthic invertebrate sampling was conducted to determine specific parameters (e.g., species richness, abundance, eveness, diversity, dominance, etc.) of the benthic invertebrate communities within New Bedford/Fairhaven Harbor. Sediment profile images were recorded at the candidate disposal sites to assess the overall health of the bottom (SAIC, 1999a), see Figures 4-27a and 4-27b. Sediment profile imaging is a benthic sampling technique in which a specialized camera is used to obtain undisturbed, vertical cross-section photographs (i.e. *in situ* profiles) of the upper 15 to 20 cm of the sea floor. This is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological sea floor characteristics. Measurements obtained from sediment-profile images can be used to characterize sediment types, evaluate benthic habitat quality, map disturbance gradients, and follow ecosystem recovery after disturbance abatement.

By photographing a cross-section of the upper 20 cm of sediment and overlying water, scientists can: view evidence of benthic invertebrate activity (i.e. worm holes, amphipod tubes); determine oxygenation status of the sediment; estimate the stage of ecological succession on the sea floor; and observe the presence/absence of methane gas which is an indicator of an organically enriched or stressed system.

Results of the New Bedford/Fairhaven Harbor sampling suggest that much of the harbor sediment substrate is inhabited by Stage I successional benthic macroinvertebrate assemblages (SAIC, 1999a). Stage I assemblages usually consist of dense aggregations of near-surface dwelling (pioneering), tube dwelling polychaetes (Rhoads and Germano, 1986). These areas also typically had a shallow RPD depth (Section 4.8.3).

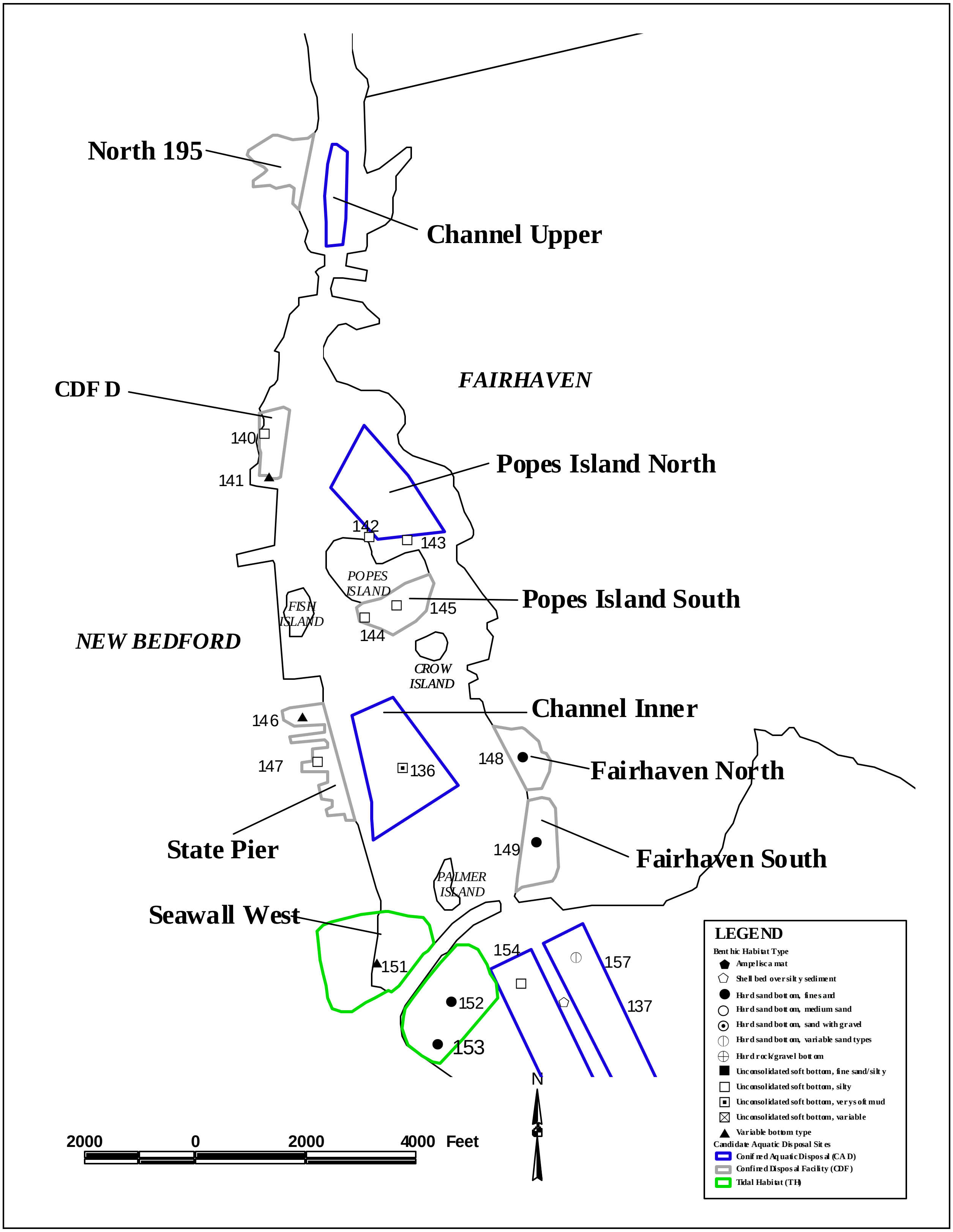


Figure 4-25: Benthic Habitat Type in Upper and Inner New Bedford/Fairhaven Harbor

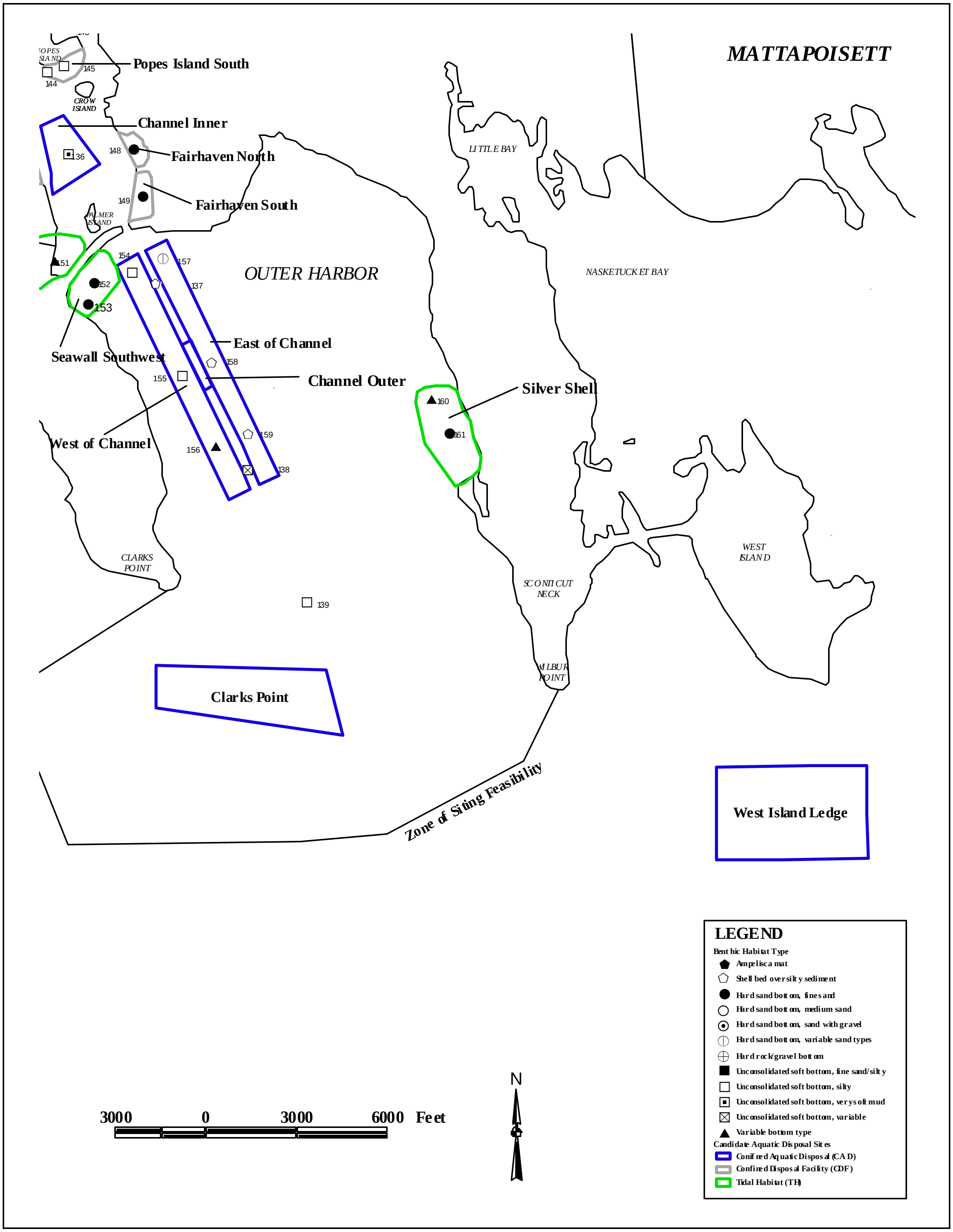


Figure 4-26: Benthic Habitat Types in the Outer Harbor

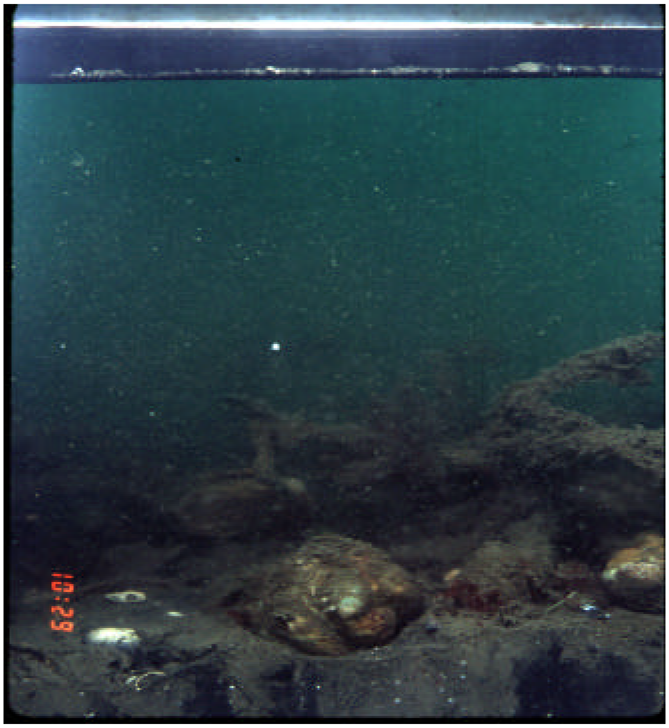


Figure 4-27a: Sediment profile image from station 158, East of Channel site, illustrating shell bed over silt sediment habitat.

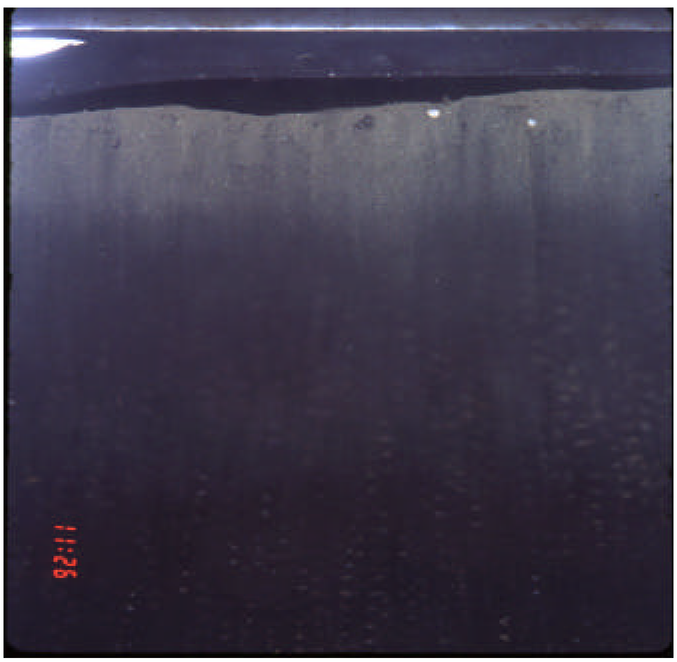


Figure 4-27b. Sediment profile image from station 136, Channel-Inner site exhibiting unconsolidated soft, silty sediment.

Stage II communities are characterized by mid-successional infaunal deposit feeders such as shallow-dwelling bivalves and tubicolous amphipods (Rhoads and Germano, 1986). No stage II benthic macroinvertebrate assemblages were encountered during sampling throughout the Upper, Lower, and Outer Harbor sediment sampling.

Stage III communities are characterized by the presence of high order (climax) successional infaunal invertebrates including deep burrowing bivalve molluscs. Very few Stage III benthic macroinvertebrate assemblages were encountered during sampling throughout the Upper, Lower, and Outer Harbor sediment sampling. Benthic communities at the New Bedford/Fairhaven Channel, Pope’s Island South, and East of Channel sites were found to be characteristic of Stage II communities (SAIC, 1999a).

The Organism-Sediment Index (OSI) is a value which defines overall benthic habitat quality by reflecting the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced (i.e., anaerobic) sediment at the sediment-water interface. Therefore, it is a good general summary of benthic habitat quality, which is an important parameter for disposal site selection. OSI values less than 0 indicate degraded habitat quality, values between 0 and +6 reflect intermediate quality (i.e., moderately degraded), and values greater than +6 are considered indicative of good or healthy benthic habitat quality (Rhoads and Germano, 1986).

Figures 4-28 and 4-29 show the OSI values for candidate disposal sites in New Bedford/Fairhaven Harbor, and off-shore candidate disposal sites, respectively. In New Bedford/Fairhaven Harbor, no OSI values less than 0 were recorded throughout the aquatic disposal sites. The lowest OSI value recorded (+2) was found within the unconsolidated silty soft bottom sediment of the Railyard CDF. Harbor sites had a range of moderate (0-6) to high (+6) OSI values. OSI values at the New Bedford Channel, Pope’s Island South, and East of Channel sites were high. OSI values at many sites could not be surveyed because of insufficient depth for the survey vessel, or other restrictions (e.g. RPD could not be determined) (SAIC, 1999a).

The REMOTS data suggests that habitat quality throughout much of the Upper and Lower Harbor is relatively poor compared to outer harbor and offshore areas. For instance, in the Upper and Lower Harbor areas, the lowest OSI values were recorded in the CDF D and Pope’s Island North site. Higher (>6) values are seen in some of the Outer Harbor areas such as the East Channel Station 159 and the Central New Bedford Channel Station No. 138. This finding is consistent with the sediment chemistry results for the harbor. Many contaminant concentrations are highest in the Inner Harbor (Summerhayes, 1985; USEPA, 1996b) and may be either acutely toxic to some invertebrates or may be an additive stress (along with temperature and salinity extremes, that act to limit the upstream distribution of some invertebrates in the Acushnet Estuary.

The high OSI values of the Outer Harbor reflect the widespread presence of Stage III organisms coupled with relatively deep apparent RPD depths at these sites (SAIC, 1999a). At the remainder of the New Bedford/Fairhaven sites (mainly those located in shallower, more protected water closer to shore such as Pope's Island south CDF, the Inner Harbor Channel CAD, and the State Pier CDF sites) OSI values were typically recorded from between +4 to +5. These OSI values are a result of intermediate RPD depths and the predominance of Stage I organisms. The general absence of bioturbating Stage III organisms coupled with possible high inputs of organic matter from runoff and local point sources at the sites within New Bedford/Fairhaven Harbor has resulted in somewhat shallower RPD depths. These factors are, in turn, reflected in the intermediate OSI values which are suggestive of moderately degraded benthic habitat quality. For many REMOTS ® sampling stations, the OSI values were indeterminate. If the RPD depth and/or infaunal successional stage for a particular image are indeterminate, then the OSI value cannot be calculated and is also indeterminate.(SAIC, 1999a).

Infaunal successional stages could not be reliably determined at some sites because the penetration of the camera prism was inhibited by rocks and/or hard sand. Because of this inhibition, no data was collected from REMOTS® Station Nos. 156 (within the west of channel site), 158 (within the east of channel site), 159 and 160 at Silver Shell site; 151 (seawall west), 152 and 153 (Seawall southwest) and 157 (east of channel, north end). At the majority of sites, Stage I was overwhelmingly the dominant successional stage. Stage III was observed in only 4 images out of 43 images taken: REMOTS ® station No. 159 (East of Channel, New Bedford Channel, Central (Station 148) and Pope's Island South).

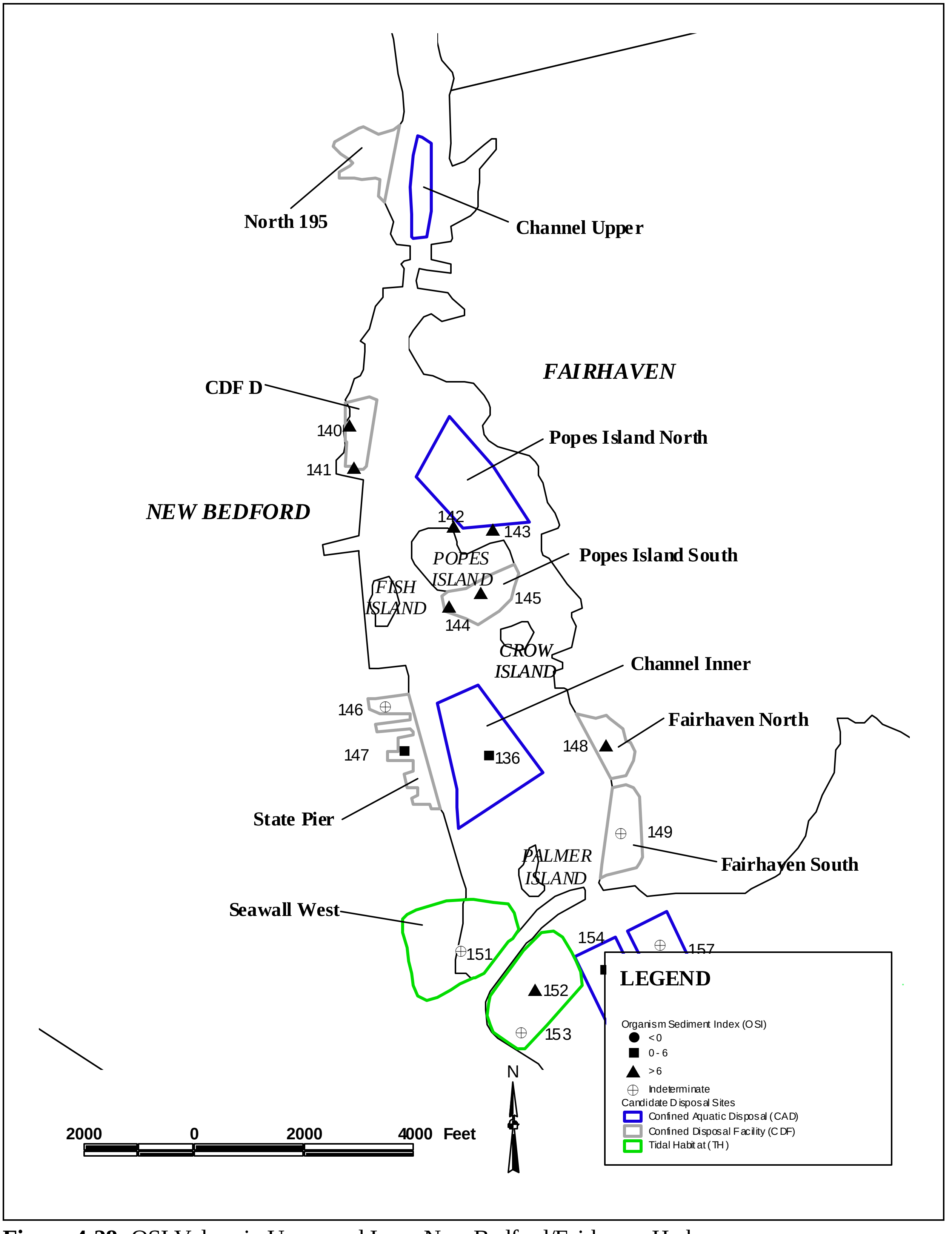


Figure 4-28: OSI Values in Upper and Inner New Bedford/Fairhaven Harbor

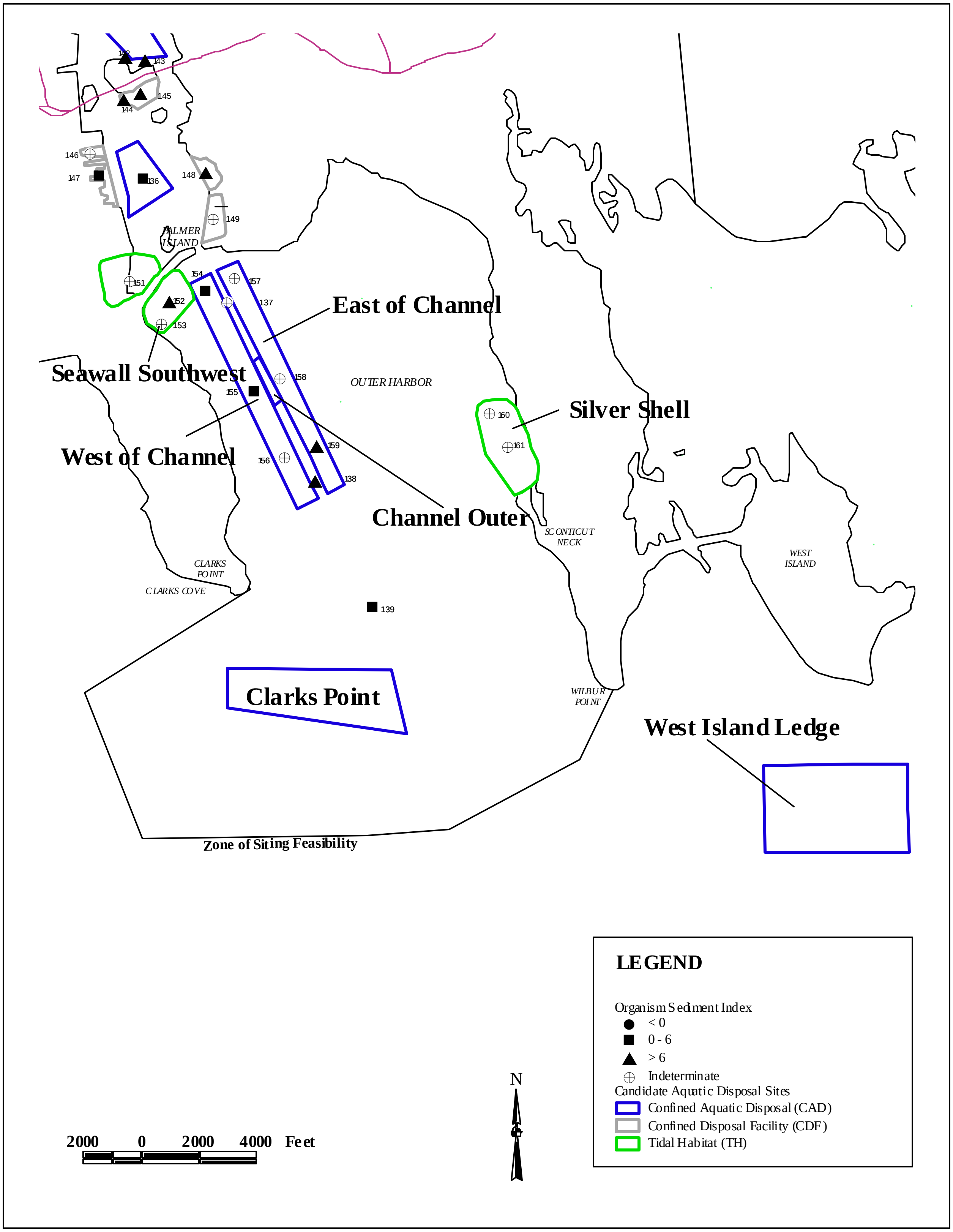


Figure 4-29: OSI Values for Outer Harbor

Shellfish

In Buzzard's Bay the primary shellfish fisheries are quahogs (*Mercenaria mercenaria*), bay scallops (*Aequipecten irradians*), soft-shelled clams (*Mya arenaria*), and oysters (*Crassostrea virginica*)(Figure 4-30). Quahogs are found throughout the harbor and Buzzards Bay and are the dominant shellfish species. All potential disposal sites lie within areas of quahog habitat, either confirmed or probable. Significant patches of the conch/quahog assemblage occur in the Outer Harbor in and near the East of Channel, West of Channel and Clark's Point sites. Portions of Popes Island North lie within both quahog and soft shell clam/oyster/quahog habitat. The quahog fishery is the largest reported fishery in Buzzard's Bay and typically exceeds all other shellfish harvest combined. The scallop industry is reportedly declining - the reason not decisively documented. The oyster industry has also declined over the years in New Bedford/Fairhaven Harbor due primarily to pollution and subsequent bed closures. Areas in New Bedford/Fairhaven Harbor have been seeded by other stock populations and new beds have formed within the harbor on artificial structures. Secondary shellfish fisheries in Buzzard's Bay include surf clams (*Spisula solidissima*) and mussels (*Mytilus edulis*)(Howes and Goehringer, 1996). A continued threat to the shellfish industry in New Bedford/ Fairhaven Harbor and the adjacent regions is contamination by enteric bacteria, as identified through fecal coliform concentrations greater than 14 colonies/100 ml.

In New Bedford/Fairhaven Harbor, quahogs are the major bivalve mollusk shellfish of economic importance. The quahog standing crop was determined by Whittaker (1999) in a recent study. This same study also identified ancillary species of mollusks inhabiting New Bedford/Fairhaven Harbor. The study showed that quahog density varied throughout both the Inner and Outer Harbors and significantly from the Inner Harbor to the Outer Harbor. Whittaker attributed the variances to several factors (e.g. fishing pressure, predation, substrate type, etc). For instance, intense fishing pressure in the Outer Harbor versus lack of fishing in the Inner Harbor was attributed to the variability of the quahog standing crops between the two areas. Other discrepancies were not easily explained by fishing pressure. For instance, among size distribution of the quahog, the large percentage of seed occurred within the Inner Harbor versus the Outer Harbor, despite higher pollutant concentrations in the Inner Harbor. Whittaker suggested the higher concentration of predators in the Outer Harbor may be responsible for low seed levels there. A quahog resources survey conducted in the Outer Harbor by NAI (1999) also found the quahog seed size class to have the lowest standing crop. In the NAI study, standing crop increased with a concurrent increase in size class (i.e. chowder standing crop > cherrystone > littlenecks > seed).

Sustainable Annual Quahog Yield

Whittaker (1999) predicted a continued decline in the quahog densities of "approved areas" within the Outer Harbor if present recruitment rates and market conditions remained the same or similar, and if harvesting continued at it's current rate. The average annual commercial landings currently reported for New Bedford/Fairhaven Harbor are almost equal to the potential harvest. This has caused a diminished catch per unit effort as indicated by Whittaker (1999). Whittaker also identified hydraulic harvesting as a potential impact to quahog settlement and growth due to the negative effects of sediment resuspension, subsequent deposition of silt and redistribution of the predominately mud substrate (Table 4-11).

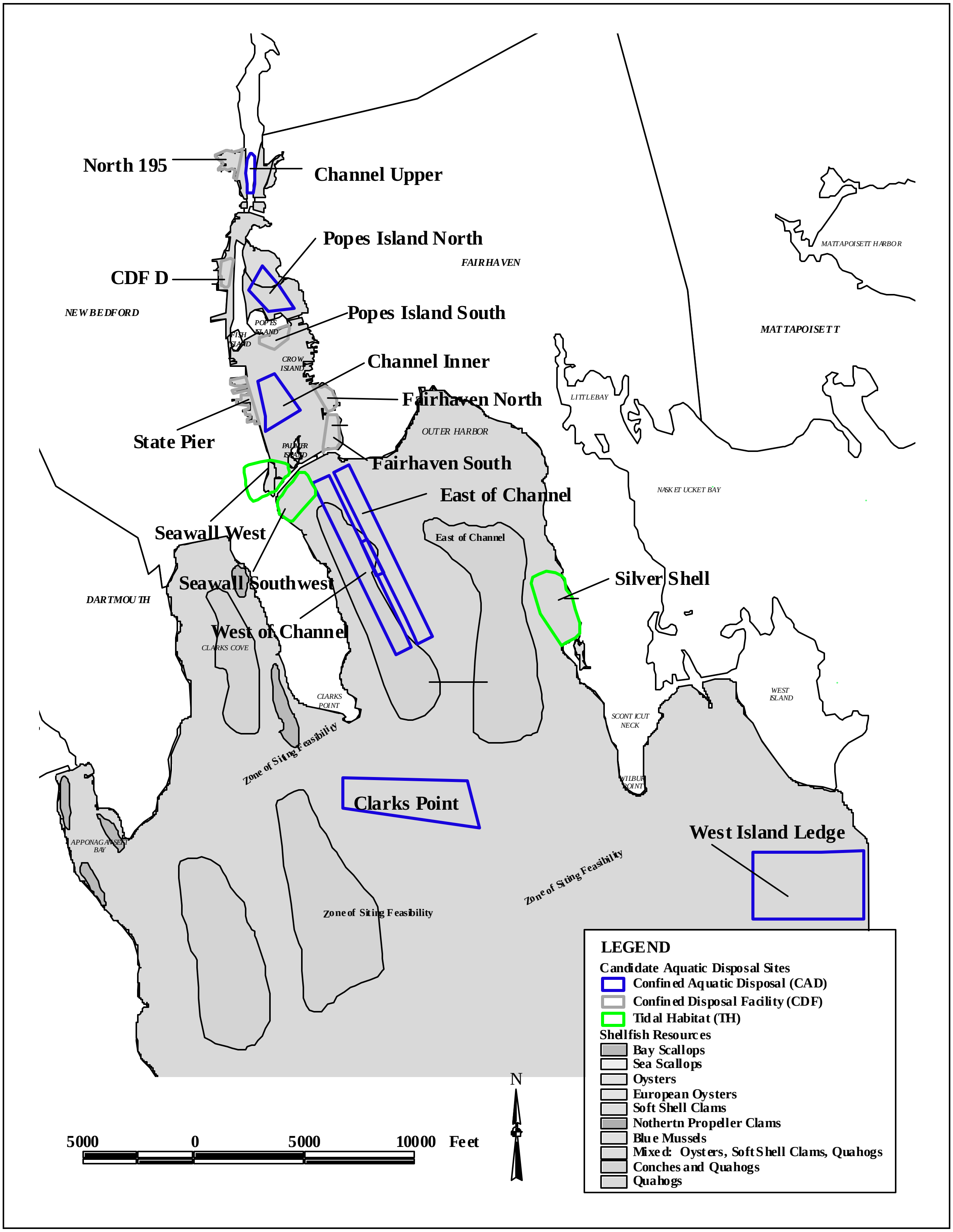


Figure 4-30: Shellfish Resources in the Harbor and Buzzards Bay

Table 4-11: Shellfish and Crustacea identified during quahog standing crop survey of New Bedford/Fairhaven Inner and Outer Harbors

Phylum	Class	Common Name	Scientific Name
Mollusca	***Gastropoda***	Channeled Whelk	*Busycon caniliculation*
		Knobbed Whelk	*Busycon carica*
		Oyster Drill	*Urosalpinx cinerea*
		Moon Snail	Unknown
		Periwinkle	*Littorina sp.*
		Slipper Shell	*Crepidula fornicata*
		Cockle	*Cyclocardia sp.*
	Bivalvia (Pelecypoda)	Quahog	*Mercenaria mercenaria*
		Soft-shell Clam	*Mya arenaria*
		Eastern Oyster	*Crassestrea virginica*
		Bay Scallop	*Argopecten irradians*
		Razor Clam	*Ensis directus*
		Ribbed Mussel	*Mytilus edulis*
		Ark	*Anadara sp.*
		Jingle	*Anomia simplex*
		Pitar	*Pitar morrhuanus*
Arthropoda	***Crustacea***	Barnacle	*Balanoides balanoides*
		Mantis Shrimp	*Squilla empusa*
		Blue Crab	*Callinectes sapidus*
		Mud Crab	*Neopanope rexana*
		Green Crab	*Carcinus maenas*
		Spider Crab	*Libinia emarginata*
		Lady Crab	*Ovalipes ocellatus*
		Hermit Crab	*Pagurus longicarpus*
Echinodermata	***Stelleroidea***	Common Starfish	*Asterias forbesi*
Annelida	***Polychaeta***	Polychaete Worm	*Nereis succinea*
		Ribbon Worm	*Cerebratulus sp.*
Porifera		Boring Sponge	*Cliona sp.*

Quahog Relay Potential

Between the hurricane barrier and the Fairhaven Bridge, the DMF has identified 3 additional areas as having contaminated quahog relay potential (Figure 4-31). They are: an area proximal to Crow Island, the eastern shoreline of Fairhaven between the hurricane barrier and the commercial piers, and Palmer's Cove. Palmer's Cove has been identified by the DMF as the primary area. Full designation of these areas as contaminated quahog relay potential areas is dependent on pending water quality findings of the sanitary survey and quahog tissue analysis.

Lobsters

Lobsters are abundant and the basis of productive fisheries in the New Bedford/Fairhaven Harbor and Buzzards Bay regions. Since lobsters are mobile and are found throughout the region, it is difficult to differentiate among disposal sites on the basis of their potential impact to adult lobsters. Surveys of the marine resources of the New Bedford/Fairhaven Harbor areas, while reporting on the overall importance of the lobster fishery to the area, do not specify which sites or areas are more productive than others. Given the abundance of lobsters throughout the region, dredged material disposal at any one limited site would probably not have a significant effect on the entire existing adult lobster population of the area. However, very young lobsters tend to be more stationary than older juvenile and adults. These lobsters, referred to as early benthic phase (EBP) lobsters, are more susceptible to dredged material disposal activities. Early benthic phase lobster survey data from New Bedford/Fairhaven Harbor was not available for this project.

Because the Inner Harbor is closed to all fishing, including lobstering, sites within the Inner Harbor would be preferred over sites in the Outer Harbor based on this criterion. Outer Harbor sediment is more variable, with areas of sand, gravel and shell litter that are not common in the Inner Harbor. Therefore, lobster habitat is favorable in the Outer Harbor.

On a regional basis, Buzzards Bay is a productive spawning area as evidenced by the percentage of gravid females caught in a 1987 study (31% of catch) when compared to other areas outside of Buzzards Bay: Cape Ann at 4.5%, Salem Sound (Beverly-Salem Area) at 1.8%, Boston Harbor at 1.7%, Cape Cod bay at 3.9% and Outer Cape area at 16.9% (Estrella and McKiernan 1988, 1989), Therefore, Buzzards Bay is an important spawning area and source of lobster larvae for Massachusetts Bay, via the Cape Cod canal (Howes and Goehringer, 1996).

Finfish

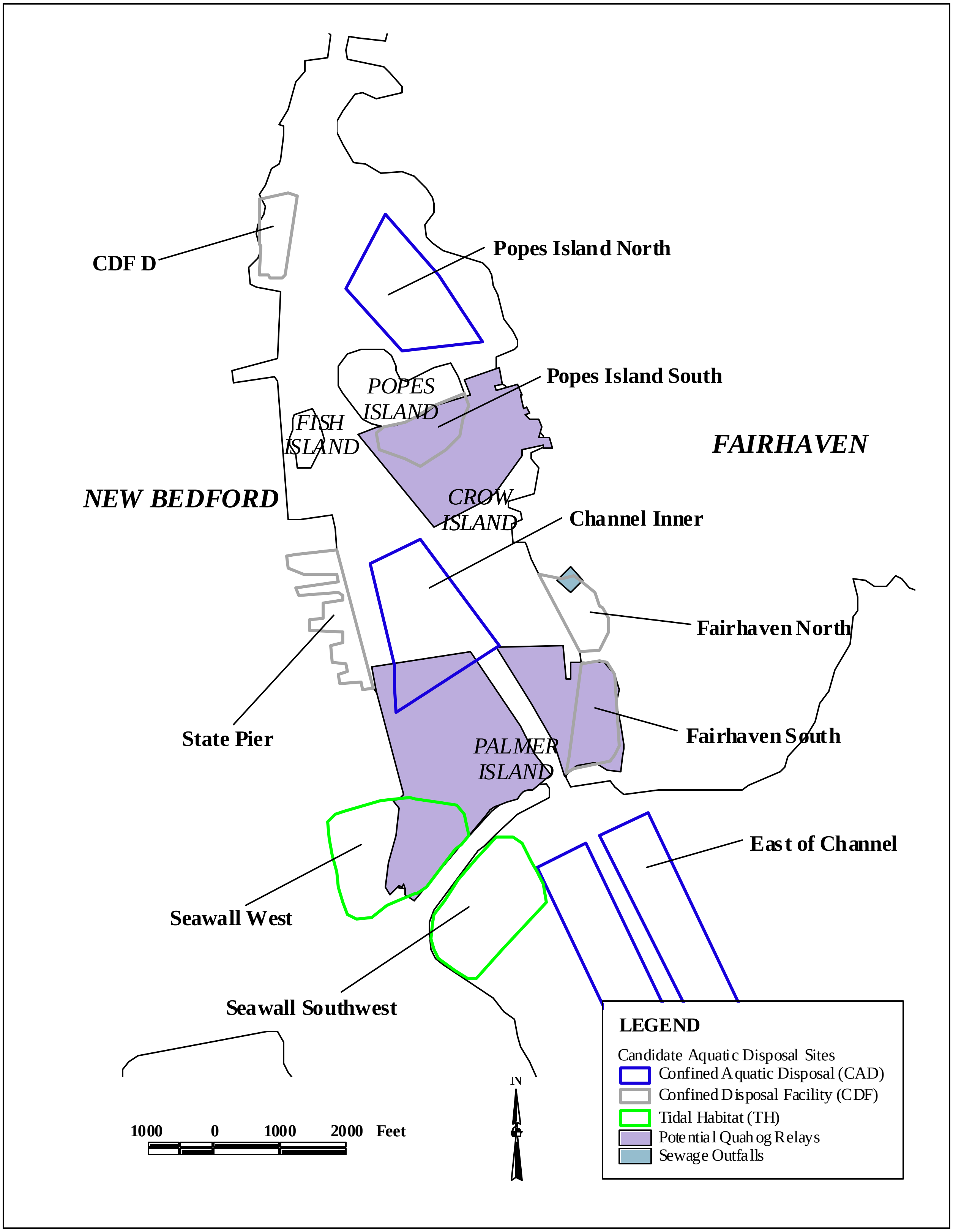


Figure 4-31: Potential Quahog Relay Areas

Adult finfish can avoid turbidity created by dredging and disposal events and return to a disposal site once operations have ceased and food organisms have returned to the area. However, larval and juvenile fish may not be able to avoid short-term dredge disposal impacts, as well as adults (Blaxter, 1969, 1974; Bannister, et al., 1974; May, 1974; McGurk, 1986; Black et al., 1988; Chambers et al., 1988; Newcombe and Jensen, 1996). Therefore, areas of known concentration of young fish should be avoided.

The following information is summarized below in an effort to characterize and distinguish among sites (or groups of sites) based on the following fisheries information:

- Essential Fish Habitat (EFH) Listings, Buzzards Bay and off-shore areas,
- Diadromous fish activity for New Bedford\Fairhaven Harbor,
- Summary of trawl survey data,
- Areas of commercial and recreational fishing,
- Evaluation of nursery potential by site; and,
- Comparison of spawning potential (offshore versus harbor sites).

Essential Fish Habitat

Under the Magnuson-Stevens Fishery Conservation and Management Act, (a.k.a. the Sustainable Fisheries Act, or SFA), an EFH is broadly defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity”. All of the candidate aquatic disposal sites are located within designated EFH. Therefore, the EFH regulatory criterion is not a discriminating factor in aquatic disposal site selection.

Diadromous Fish Activity

Five of the fish species listed as commercially important or as residents in Buzzards Bay are diadromous species that have been reported from the New Bedford\Fairhaven Harbor ZSF. They are alewife, American shad, blueback herring, rainbow smelt and American eel. Diadromous fish are those that at any particular life stage, regularly move between freshwater and saltwater, spending part of their life cycle in each environment. Diadromy is further divided into three categories to include anadromy, catadromy, and amphidromy. Anadromous fish move from marine waters to inland freshwaters to spawn. Catadromous fish move from freshwater to marine environments to spawn. Amphidromy is a term usually used to describe the movement of immature fish between either environment (Matthews, 1998). Anadromous and catadromous species are discussed below.

Anadromous Species

Four of the diadromous fish species reported from the New Bedford/Fairhaven ZSF, are Anadromous. They are the alewife, American shad, blueback herring, and rainbow smelt. Of the Anadromous fish, only the alewife and possibly the blueback herring have been reported to spawn within the Acushnet River (VHB, 1996). Alewife are known to spawn upriver at Saw Mill Pond (Howes and Goehringer, 1996).

Like other fish they migrate though New Bedford/Fairhaven Harbor with the warming of inland waters relative to offshore water. Therefore, migration begins in early March or April, depending on seasonal conditions, and continues into June. Other Anadromous fish runs were formerly present within the Acushnet River but have since been extirpated due to water quality impacts, upstream blockages and other human induced impacts (Howes and Goehringer, 1996).

On their spawning grounds, alewife and blueback herring broadcast eggs across the bottom of suitable substrate. Eggs are fertilized by the male broadcasting sperm over the eggs. Like other broadcast spawners, these species tend to have high fecundity. Egg production rates are reported to be between 60,000 and 300,000 eggs per year. An average mature female releases 125,000 to 150,000 eggs in a typical spawning run (Brady, 2000). Therefore, with the re-establishment of favorable conditions along the Acushnet River (e.g. the removal of dams and other barriers to fish passage, and water quality improvements) productive and successful fish runs could be restored to this drainage. Natural increases in Anadromous fish runs have been reported for other rivers in the south coastal drainage systems (Brady, 2000).

Catadromous Species

The American eel is the only catadromous fish species native to the Acushnet River drainage that passes through New Bedford/Fairhaven Harbor in destination to its breeding grounds, the Sargasso Sea (Howes and Goerhinger, 1996).

Summary of Finfish Sampling Studies

Numerous finfish sampling programs have been conducted in New Bedford/Fairhaven Harbor over the years by the DMF, and others employing both seine and trawling techniques. Table 4-12 summarizes the results of various sampling programs or surveys from 1972 to 1999. Due to the variation in sampling frequency, methods, location, and seasonality, no quantitative statistical comparisons could be made among all the various finfish surveys conducted to date. However, they do serve to characterize the ichthyofaunal composition within the harbor areas.

Most specific to the New Bedford/Fairhaven DMMP was a finfish sampling survey conducted by Normandeau in 1999. Five trawl and three beach seine samples were taken monthly in 1998 and 1999 at locations in and near some of the potential disposal sites (Figure 4-33). Three of the trawl stations were in the outer harbor (NT-1, NT-2 and NT-3) and two stations (NT-4 and NT-5) were in the inner harbor. Data from this study can be used to generally characterize the inner and outer harbor fish composition. However, due to the transitory nature of fish and the limited number of samples taken over a relatively short period of time, comparison of fish habitat relative to the potential disposal sites would be conjectural. The 1999 Normandeau study, combined with the other studies in Table 4-12 serve to characterize the type of fish that commonly occur in the inner and outer harbor areas.

Table 4-12: Summary of Finfish Sampling Conducted in New Bedford/Fairhaven Harbor, 1972-1990

Sample Date	Location as Reported	Sampling Methods	Target Sampling Subjects	Source	Results Summary
Feb - May, 1972	Within and between Acushnet River and Westport River estuaries	Net tows	Ichthyoplankton	Giovani, 1973	Larvae of nine taxa sampled: including sand lance, sculpin, winter flounder, Atlantic herring, Atlantic cod, pollack, tomcod, snakebelly gunnel, sea snail, rock gunnel, and four beard rockling
December, 1972 April 1973 December 1973	Lower and Inner Harbor	Trawls	Water column and demersal ichthyofauna	Hoff et al., 1973	Windowpane and winter flounder most abundant species sampled in December (higher catches in the Inner harbor). Eight species collected during sampling
December 1972	Outer Harbor	Trawls	Water column and demersal ichthyofauna	Hoff et al., 1973	Window pane and winter flounder most abundant species sampled in December. Six species collected during sampling
1976-1979	Eastern Buzzards Bay	Net tows	Eggs, larvae, and juveniles	DMF (Collins et al., 1981)	Peak egg densities found during summer; highest egg densities from Atlantic menhaden, scup, weakfish, cunner and yellowtail flounder. Larval densities peaked in June; highest densities being cunner and tautog
Summer 1987	Shallow water areas proximal to salt marshes within the harbor	Seine and bait trapping techniques	Water column finfish	Bellmer, 1988	Sixteen fish species captured; Atlantic silversides and two species of mummichog were the most abundant. Study also included analysis of stomach contents of mummichog and winter flounder

Table 4-12: Summary of Finfish Sampling Conducted in New Bedford/Fairhaven Harbor, 1972-1990 (continued)

Sample Date	Location as Reported	Sampling Methods	Target Sampling Subjects	Source	Results Summary
1990	New Bedford / Fairhaven Harbor: Upper, Inner and Outer Harbors		Winter Flounder	Battelle Memorial Institute	Age I and II winter flounder found year round throughout Acushnet River Estuary including Inner Harbor, and Outer Harbors and Upper Buzzards Bay suggesting spawning on shoals of these areas. Larger (age IV and V) flounder found in Outer Harbor and Upper Buzzard's Bay.
1990	New Bedford / Fairhaven Harbor: Upper, Inner and Outer Harbors		Ichthyofauna	EBASCO, 1990	Eight fish species identified as representative of five habitat zones within the Estuary and Harbor
1999	New Bedford / Fairhaven Inner and Outer Harbors	Trawls, beach seines	Icthyofauna	Normandeau, 1999	Five species dominant deep water, silversides dominate shallows.

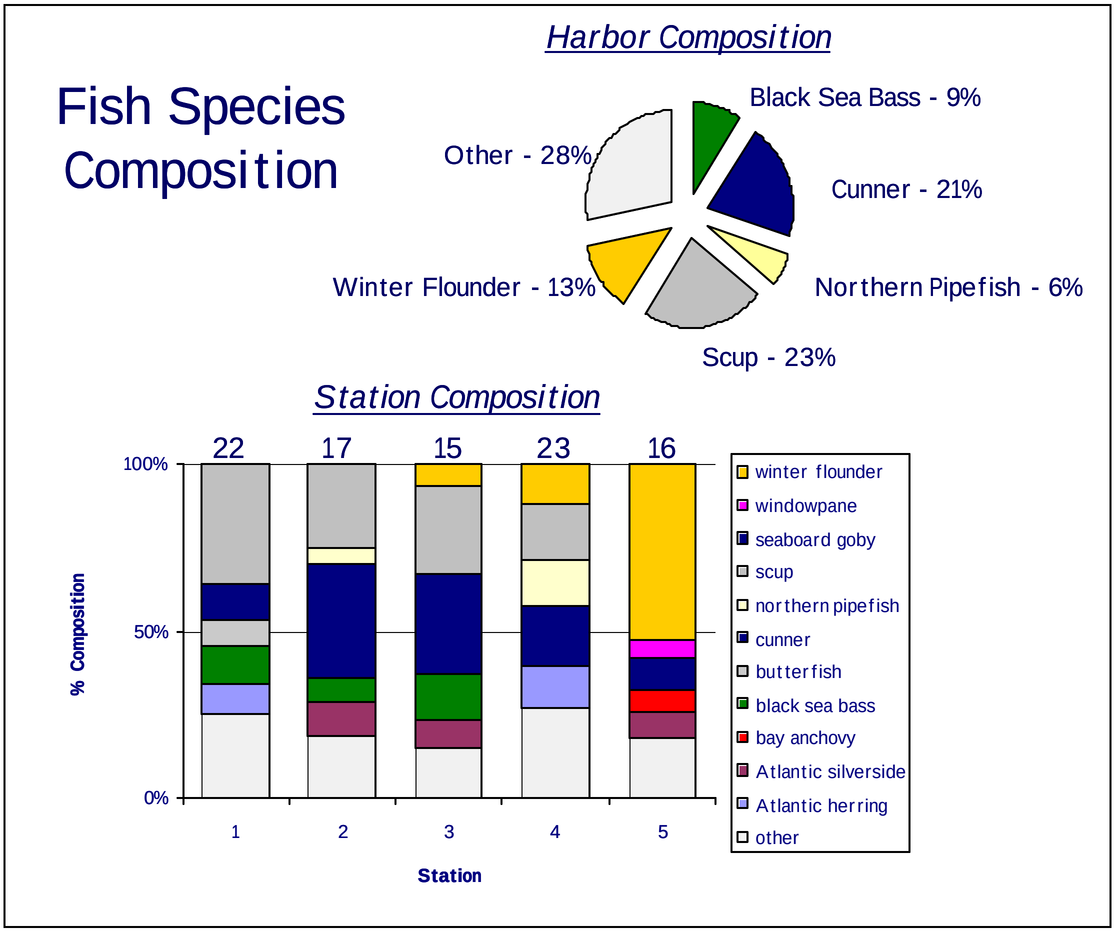


Figure 4-32: Fish Species Composition at 5 Trawl Stations in 1998/1999 (from Normandeau, 1999)

As shown in Figure 4-32, cunner, winter flounder, scup, black sea bass and northern pipefish were the dominant fish caught at the 1998-1999 trawl stations. Generally, cunner accounted for a higher percentage of fish species caught in the outer harbor versus the inner harbor. The highest relative abundance of winter flounder was caught at NT-5, near the Popes Island North potential disposal sites. However, overall catch-per-unit effort (CPUE) was lowest at this station. In general, the highest CPUE was recorded at the outer harbor stations.

In the beach seine samples, the Atlantic silverside was the most abundant fish, caught at all three stations. Striped killifish, cunner, mummichog, Atlantic menhaden, and winter flounder were also abundant at most stations.

The most abundant offshore (i.e. outside New Bedford/Fairhaven Harbor but within Buzzards Bay) finfish are scup, winter flounder, and butterfish. Bluefish, striped bass and Atlantic mackerel are reported as abundant on a seasonal basis using the bay in the summer and fall as nursery habitat (Howes and Goehringer, 1996).

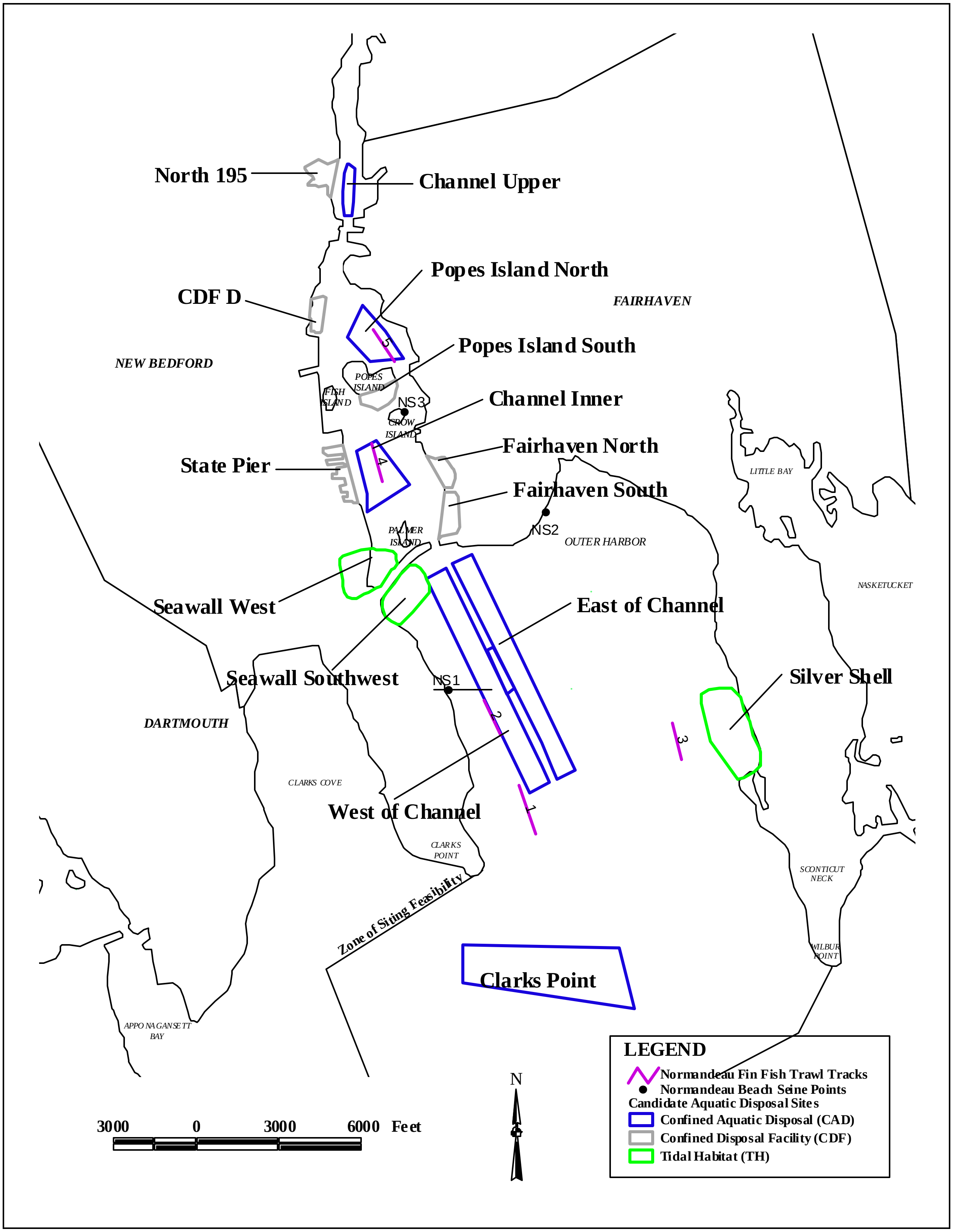


Figure 4-33: Beach Seine and Trawl Locations

Historically, shad, alewife, and blueback herring were of great economic importance for food and fertilizer within the watershed of Buzzards Bay. These species were typically reported as the dominant fish in Buzzards Bay from pre-1920's data sets (Howes and Goehringer, 1996). Today, the dominant fisheries in Buzzards Bay are centered around shellfishing (see previous subsection). However, ten fish species are reported to be of economic importance.

Evaluation of Finfish Nursery Potential by Site

Utilizing the information from the various available finfish surveys, as well as knowledge of the benthic habitat types within the harbor areas, and other literature, the potential for each candidate site as a nursery for finfish and large invertebrates was assessed. Dredged material 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 an important element of the screening analysis.

Table 4-13 summarizes the nursery potential of each site. Nursery potential is estimated using the following empirical formula from Wilbur (1999):

HABITAT COMPLEXITY + JUVENILE PRESENCE = NURSERY POTENTIAL (HIGH, MODERATE, LOW)

Habitat complexity, rated on a scale of 1-12, is highest where there is variation in substrate conditions. Juvenile presence (yes/no) is the dominant commercial, recreational and non-target organism collected in substantial numbers or apparent in similar habitat.

As shown in Table 4-13, the Channel and Silver Shell sites have high nursery potential. No data was available for off-shore sites (West Island Ledge and Clark’s Point). The high nursery potential at the Silver Shell site is a function of high benthic habitat complexity, presence of fine sand substrate and presence of SAV. Mummichog, cunner, and winter flounder are the dominant juvenile species present at the upper and lower Harbor sites. In addition to these species, black sea bass and scup are common juveniles at the Outer Harbor sites and off-shore at Clark’s Point. No data was available for the West Island Ledge site.

Submerged aquatic vegetation was present at the Silver Shell site. This site also had the highest benthic habitat complexity, and relatively better water quality in comparison to the Upper Harbor sites. These two factors combined, resulted in a high rating for finfish nursery potential. Sites in and adjacent to the channel within the Outer Harbor also have high potential as nurseries because of relatively high substrate complexity and relatively large catches of juvenile fishes.

Upper harbor sites consistently had the lowest potential as nurseries because of relatively low substrate complexity, no submerged SAV, poor water quality and relatively lower catches of demersal fishes.

No SAV beds were found within any of the Lower Harbor sites. Here, the substrate varies in complexity. Water quality at these sites was measurably better than the Upper Harbor sites but not as good as the Outer Harbor. Therefore, the Lower Harbor sites generally represented a transition (low to moderate) area for finfish nursery potential.

Table 4-13. Relative Nursery Values and Dominant Juvenile Fishes and Lobster for Candidate Disposal Sites

Disposal Site	Benthic Habitat Complexity	Juvenile Presence (ssp. collected with highest abundance)	Nursery Potential
UPPER HARBOR SITES			
North 195	NA	mummichog, cunner, winter flounder	N/A
Upper Channel	10	scup, black sea bass, cunner, winter flounder	Moderate-High
INNER HARBOR SITES			
CDF D	3	mummichog, cunner, winter flounder	Low-Moderate
Popes Island North	1	mummichog, cunner, winter flounder	Low-Moderate
Popes Island South	3	mummichog, cunner, winter flounder	Low-Moderate
Channel Inner	10	scup, black sea bass, cunner, winter flounder, northern pipefish	Moderate-High
State Pier	10	mummichog, cunner, winter flounder	Moderate
Fairhaven North	1	mummichog, cunner, winter flounder	Low-Moderate
Fairhaven South	4	mummichog, cunner, winter flounder	Moderate
Seawall West	5	mummichog, cunner, winter flounder	Moderate
OUTER HARBOR SITES			
Seawall Southwest	5	mummichog, cunner, winter flounder	Moderate
West of Channel	10	scup, black sea bass, cunner, winter flounder	High
East of Channel	10	scup, black sea bass, cunner, winter flounder	High
Channel Outer	10	scup, black sea bass, cunner, winter flounder	Moderate-High
Silver Shell	12	mummichog, cunner, winter flounder	High
BUZZARDS BAY SITES			
West Island Ledge	N/A	no data available	N/A
Clark's Point	N/A	scup, black sea bass, cunner, winter flounder	N/A

American lobster based on the presence of hard bottom (i.e. gravel/cobble)

Comparison of Finfish Spawning Potential in Off-shore versus Harbor Sites

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 fish species can spawn in both coastal and off-shore waters (i.e. winter flounder), while many species prefer only one of the two regions (Table 4-14).

Table 4-14: Summary of Distribution of Selected Fish Spawning Activity in New Bedford/ Fairhaven Harbor (Harbor Sites), and Buzzards Bay (Off-Shore Sites)

Common Name	**Harbor Sites**	**Off-Shore Sites**
Atlantic silversides (*Menidia menidia*)	X	
Striped killifish (*Fundulus majalis*)	X	
Atlantic Herring (*Clupea harengus*)		X
Cunner (*Tautogolabrous adspersus*)	X	
Black Sea Bass (*Centropristis striata*)		X
Mummichog (*Fundulus heteroclitus*)	X	
Northern pipefish (*Syngnathus fuscus*)	X	
Ocean pout (*Macroarces americanus*)	X	
Scup or "Porgy" (*Stenotomus chrysops*)		X
Winter flounder (*Pseudopleuronectes americanus*)	X	X
Atlantic Cod (*Gadus morhua*)		X
Haddock (*Melanogrammus aeglefinus*)		X
Windowpane Flounder (*Sopthalmus aquosus*)		X
Summer Flounder (*Paralicthys dentatus*)		X
Atlantic Butterfish (*Peprilus triacanthus*)	X	X
Atlantic Mackerel (*Scomber scombrus*)	X	

Whether a potential disposal site would lie in nearshore versus offshore waters is not necessarily a strong discriminating factor in disposal site selection and resultant impact to fish spawning because both off-shore and coastal water habitats support fish spawning. Of greater significance is the seasonality of spawning for the dominant fish and invertebrates. Dredging and disposal restrictions are imposed on Massachusetts harbors by MADEP to protect the spawning activities of the dominant species within certain regions of Massachusetts coastal waters. Table 4-15 lists the dominant fish and invertebrate species and their known spawning seasons in the Buzzard's Bay region including the Bay's harbors. As indicated in Table 4-15, spawning for most organisms occurs in the spring, summer and early fall. As such, dredging has historically been limited to the late fall and winter season to protect spawning activities of many species. The imposition of seasonal restrictions avoids impacts to sensitive eggs and larvae in the water column (pelagic) and on the sea floor (demersal).

Table 4-15: Spawning Seasons for Common Nearshore Invertebrate 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]
Windowpane flounder (*Scopthalmus aquosus*)	Feb - Nov (Peaks in May and Oct)[2]
Black sea bass (*Centropristis striata*)	May - October[2]
Scup (*Stenotomus chrysops*)	May - August[2]
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

However, there is overlap among the various fish species in their spawning seasons. Therefore, potential impact to all fish spawning activity may not be avoided through seasonal restrictions alone. Within the season, spawning can be spatially variable in the Buzzards Bay and 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 4-16 lists the special habitat requirements for spawning of managed fish species known to occur within New Bedford/Fairhaven Harbor and adjacent Buzzard's Bay waters.

Table 4-16: Spawning Requirements for some Common Managed Inshore Fish and Invertebrate Species known to Spawn in New Bedford/Fairhaven Harbor and Adjacent Waters of Buzzards Bay

Species Name	**Temp. (°C)**	**Salinity (‰)**	**Depth (m)**	**Substrate**
Atlantic cod (*Gadus morhua*)	<12	10 - 35	<110	surface waters
Haddock (*Melanogrammus aeglefinus*)	<10	34 - 35	50 - 90	surface waters
Winter flounder (*Pleuronectes americanus*)	<10	10 - 32	0.3 - 4.5 (inshore)	sand, muddy sand, mud, gravel
Windowpane flounder (*Sopthalmus aquosus*)	<20	n/a	<70	surface waters
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
Summer flounder (*Paralicthys dentatus*)	n/a	n/a	fall: 30 - 70; winter: 110; spring: 9 - 30	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

Coastal Wetlands and Submerged Habitats

Generally speaking, coastal wetlands include areas of submerged aquatic vegetation, salt ponds, salt marsh and tidal flats, and are subject to daily tidal action. Activities within or near these resources are regulated under the Massachusetts Wetlands Protection Act and Section 404 of the Clean Water Act. Coastal wetlands are productive habitat for wildlife, finfish and shellfish, and therefore, should be avoided to ensure protection. Disposal sites within or adjacent to these resources should be avoided.

Submerged Aquatic Vegetation Beds

SAV beds, which are found in shallow, clear waters, are extremely important habitats for fish and invertebrates. They are used as nurseries for various marine life, especially juvenile finfish, such as sticklebacks. SAV beds also filter pollutants and sediment from the water column and stabilize sediments in potentially erosive or reworking zones.

In the northeast, eelgrass is the primary SAV. Eelgrass is the preferred winter food of Brant (*Branta bernicula*), a marine goose. Eelgrass beds also provide habitat for a variety of marine organisms such as epiphytic algae and bryozoans, shellfish (e.g. bay scallops), shrimp and other invertebrates both sessile or motile (Gosner, 1978).

Direct impact, i.e. loss of the resource, would occur if a disposal site were located within the resource area, however indirect impacts from the suspended sediment plume, created by disposal or excavation of a CAD pit, can occur if the resource is nearby and down-drift of the disposal area. Based on previous studies in similar marine environments, the area of impact from disposal is estimated at approximately 300 feet from the disposal activity (see Section 6 for details), therefore disposal sites that are located at least 300 feet from a coastal wetland or SAV beds are more desirable.

Eelgrass beds were identified from aerial photographs of the New Bedford/Fairhaven area, and from other literature sources (Howes and Goehringer, 1996; Costello, 1997; NOAA/MACZM, 1998). The major eelgrass areas occur on the eastern shore of Fairhaven Harbor, just north of the hurricane barrier in the Lower Harbor and in the subtidal areas around Popes Island. The known stands of eelgrass around Popes Island are proximal to the Popes Island North, Popes Island North 2; Popes Island North 3 and Popes Island South candidate aquatic disposal sites. Figure 4-34 depicts the known eelgrass resources in the New Bedford/Fairhaven harbor areas.

Costa (1988) found stands of eelgrass beds at water depths between 0.9-3.0 m below mean low water. Therefore, this submerged aquatic vegetation is characteristic of shallow, nearshore areas, and would not be expected to be found in or proximal to the candidate offshore aquatic disposal sites.

Intertidal Flats

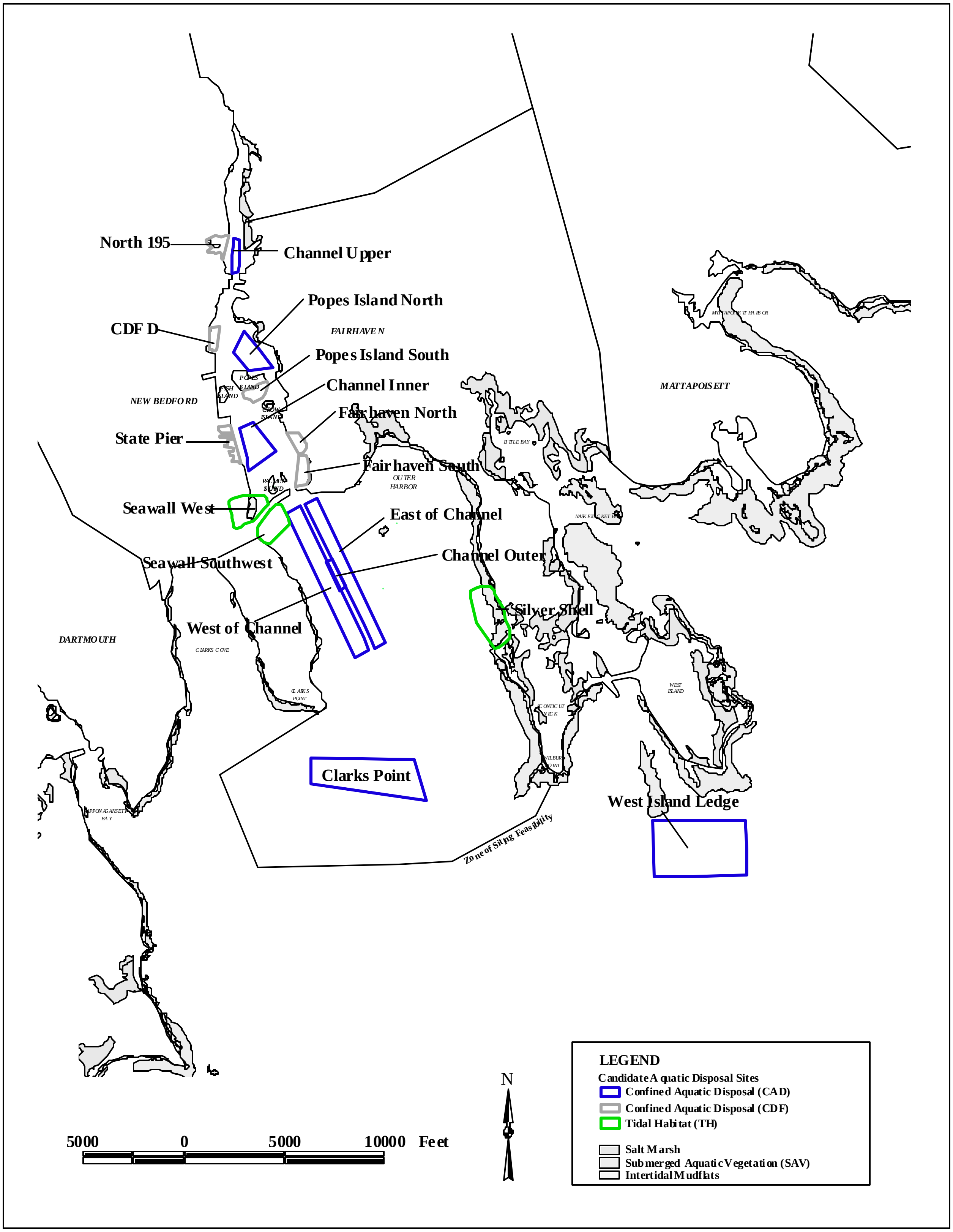


Figure 4-34: Submerged Aquatic Vegetation, Intertidal Areas and Candidate Sites

The most extensive intertidal flats exist in the southeast corner of the Lower Harbor just north of the seawall, on the northern end of the Outer Harbor in Priests Cove, and on the eastern side of the Outer Harbor south of Silver Shell beach (Figure 4-34).

Salt Marsh

No extensive salt marshes exist along the open coastlines of Clark's Point on the western side of the Outer Harbor in New Bedford. However, significant expanses of salt marsh lie on the eastern side of the Outer Harbor in Fairhaven, specifically, on the north end of the Outer Harbor in Priests Cove and on the east side of the Outer Harbor, south of Silver Shell Beach. Elsewhere, salt marsh lies within the Upper Harbor just south of the Interstate 195 bridge (Figure 4-34).

Herpetofauna

Reptiles found in the study area include sea turtles and the terrestrial semi-aquatic diamond-back terrapin (*Malaclemys t. terrapin*). Sea turtles, which do not breed in or near Massachusetts, are oceanic animals, feeding on jellyfish and are present mainly in summer (See Section 5.3.5.3). They are not dependent on the bottom and would not be affected by any localized change in bottom conditions. Turtles are sparse in distribution and could readily avoid any local, temporary changes in water conditions brought about by disposal operations. Although sea turtles are more likely to be found near one of the open ocean sites rather than within New Bedford/Fairhaven Harbor, their presence should not be a determining factor in site selection. Federally listed species that have been recorded in Buzzards Bay waters are: the threatened loggerhead (*Caretta caretta*), the endangered Kemp's Ridley (*Lepidochelys kempii*) and the endangered leatherback (*Dermochelys coriacea*).

The diamond-back terrapin is a terrestrial, semi-aquatic species that inhabits coastal areas. Massachusetts is the northern range limit of the diamond-back terrapin. Massachusetts populations are local and may be limited to Wellfleet on Cape Cod (Klemens, 1993).

Avifauna

Disposal at candidate sites that are contiguous with the shoreline or islands could impact some shorebirds or alter their habitat (Table 4-17). Shorebird habitat consists mainly of intertidal beaches and tidal flats although rocky coasts are preferred by some species. The confined disposal facility sites: north 195, Railyard, and Fairhaven north in New Bedford/Fairhaven Harbor are located in intertidal areas and disposal of UDM there could cause a temporary loss of shorebird habitat. Disposal at Seawall west, Silvershell, and Seawall southwest would create intertidal habitat and therefore increase habitat for shorebirds. No disposal of UDM is proposed in rocky intertidal zone habitat, therefore there would be no impact to shorebirds that inhabit these areas. No principal waterbird colonies were identified in New Bedford/Fairhaven Harbor by Veit and Petersen (1993). At the off-shore aquatic disposal sites, disposal activity may temporarily displace seabirds or waterfowl feeding proximal to the disposal site.

Table 4-17: Bird Species Reported to Frequent the Coastal Environments of Southeastern Massachusetts including New Bedford/Fairhaven Harbor and Vicinity

Species name	*Scientific Name*	Habitat	Status	Source
Common Loon	*Gavia immer*	Open waters	C/W, MA SC	1
Red-throated Loon	*Gavia stellata*	Open waters	U/W	1
Horned Grebe	*Podiceps auritus*	Open waters	U/W	2
Red-necked Grebe	*Podiceps grisegena*	Open waters	U/W	2
Gannet	*Morus bassanus*	Open waters	U/W	2
Double-crested Cormorant	*Phalacrocorax auritus*	Open waters	N/C	1
Great Cormorant	*Phalacrocorax carbo*	Open waters	U/W	1
Great Blue Heron	*Ardea herodius*	Intertidal	N/C/W	1
Great Egret	*Ardea albus*	Intertidal	N/C	1
Snowy Egret	*Egretta thula*	Intertidal	N/C	1
Green-backed Heron	*Butorides virescens*	Intertidal	N/C	1
Black-crowned Night Heron	*Nycticorax nycticorax*	Intertidal	N/U	1
American Bittern	*Botarus lentiginosus*	Intertidal	U, MA E	1
Mute Swan	*Cygnus olor*	Open waters	N/C/W	1
Canada Goose	*Branta canadensis*	Open waters	N/C/W	1
American Brant	*Branta bernicla*	Open waters	C/W	1
Mallard	*Anas platyrhynchos*	Open waters	N/C/W	1
Black Duck	*Anas rubripes*	Intertidal	N/C/W	1
Blue-winged Teal	*Anas discors*	Intertidal	N/U	2
Red-breasted Merganser	*Mergus serrator*	Open waters	C/W	1
Common Goldeneye	*Bucephala clangula*	Open waters	C/W	1
Bufflehead Duck	*Bucephalis albeola*	Open waters	C/W	1
Oldsquaw	*Clangula hyemalis*	Open waters	C/W	1
King Eider	*Somateria spectabilis*	Open waters	U/W	1
Common Eider	*Somateria mollissima*	Open waters	C/W	1
Greater Scaup	*Aythya marila*	Open waters	C/W	1
Canvasback	*Aythya valisineria*	Open waters	C/W	1
Black Scoter	*Melanitta nigra*	Open waters	C/W	1
Surf Scoter	*Melanitta perspicillata*	Open waters	C/W	1
White-winged Scoter	*Melanitta deglandi*	Open waters	C/W	1
Osprey	*Pandion haliaetus*	Intertidal	N/C	1
Northern Harrier	*Circus cyaneus*	Intertidal	N/C/W, MA T	1
American Kestrel	*Falco sparverius*	Intertidal	C/W	1
Clapper Rail	*Rallus longirostris*	Intertidal	N/U/W	1
King Rail	*Rallus elegans*	Intertidal	U, MA T	1
Killdeer	*Charadrius vociferus*	Intertidal	U	1
Semipalmated Plover	*Charadrius semipalmatus*	Intertidal	N/C	1
Piping Plover	*Charadrius melodus*	Intertidal	N/C; MA, US T	1
Black-bellied Plover	*Pluvialis squatarola*	Intertidal	N/C	1
Willet	*Catoptrophorus semipalmatus*	Intertidal	N/C	1

Species name	***Scientific Name***	**Habitat**	**Status**	**Source**
Spotted Sandpiper	*Actitus macularia*	Intertidal	N/C	1
Greater Yellowlegs	*Tringa melanoleuca*	Intertidal	C	3
Least Sandpiper	*Calidris minutilla*	Intertidal	C	1
Semipalmated Sandpiper	*Calidris pusilla*	Intertidal	C	1
Sanderling	*Calidris alba*	Intertidal	C	1
Herring Gull	*Larus argentatus*	Intertidal	N/C/W	1
Great Black-backed Gull	*Larus marinus*	Intertidal	N/C/W	1
Ring-billed Gull	*Larus delawarensis*	Intertidal	C/W	3
Common Tern	*Sterna hirundo*	Intertidal	N/C, MA SC	1
Least Tern	*Sterna antillarum*	Intertidal	N/U, MA SC	1
Roseate Tern	*Sterna dougallii*	Intertidal	N/U, MA E	1
Belted Kingfisher	*Ceryle alcyon*	Intertidal	C	1
American Crow	*Corvus brachyrhyncos*	Intertidal	C/W	3
Fish Crow	*Corvus ossifragus*	Intertidal	U/W	2
European Starling	*Sturnus vulgaris*	Intertidal, manmade structures	C/W	2
Saltmarsh Sharp-tailed Sparrow	*Ammodramus cuadacutus*	Intertidal	C	1, 3
Seaside Sparrow	*Ammodramus maritimus*	Intertidal	C	3
Song Sparrow	*Melospiza melodia*	Intertidal	C	2
Red-Winged Blackbird	*Agelatus phoeniceous*	Intertidal	C	3
Eastern Meadowlark	*Sturnella magna*	Intertidal	C	3
Common Grackle	*Quiscalus quiscula*	Intertidal	C	2
House Sparrow	*Passer domesticus*	Intertidal, manmade structures	C	2

C= Common; U= Uncommon; W = Winters in Buzzards Bay; MA SC, T and E = Massachusetts Special Concern, Threatened, and Endangered

Sources: 1 = Howes and Goerhinger (1996); 2 = Veit and Petersen (1993); 3 = Reinert and Mello (1995)

Note: Environmental aberrations such as storms and abnormal concentrations of bait fish (e.g. sand lance and sea herring) have resulted in the congregation of otherwise normally pelagic birds not listed above (i.e.: Cory's Shearwaters, Greater Shearwaters) in Buzzards Bay.

Mammals

As discussed in Section 5.3.5.2, numerous species of whale, dolphin, and porpoise are found in Massachusetts coastal waters. The highest concentrations occur in and around Stellwagen Bank, 12 to 30 nautical miles off the eastern shore of Massachusetts and far from any potential disposal sites in New Bedford/Fairhaven Harbor. One mammal which is commonly seen in Massachusetts harbors from late September to late May is the harbor seal, *Phoca vitulina*. Seals typically emerge from the water to rest on sheltered and undisturbed rock ledges or boulder beaches. No UDM disposal is proposed for these areas.

None of the candidate disposal sites are located in a specific marine mammal habitat and all local species are mobile enough to avoid any areas of temporary turbidity caused by disposal operations. Therefore, marine mammal presence/absence is not a discriminating siting criteria.

Endangered, Threatened, or Special Concern Species

The Massachusetts Natural Heritage Atlas indicates that there a several estimated habitat of state-listed rare wildlife in or adjacent to the New Bedford/Fairhaven ZSF (Figure 4-37). The nearest estimated habitat of rare wetland species is the tidal marsh on the south end of Silver Shell Beach located along the eastern side of the Outer Harbor on Sconticut Neck. This habitat overlaps the southern portion of the Silver Shell Tidal Habitat potential disposal site. Another notable habitat is the marsh along the eastern perimeter of West Island, which is approximately one-half mile north of the West Island Ledge potential aquatic disposal site.

Due to lack of certain topographic, bathymetric or oceanographic features that concentrate prey, Buzzards Bay is not a significant or suitable habitat for cetaceans (Howes and Goehringer, 1996). Therefore, the marine endangered species occurring in the open ocean waters off the coast of Massachusetts are not expected to occur near the off-shore aquatic disposal sites, and practically never within the harbors. The listed species are mobile and can avoid any temporary impacts from UDM disposal. Therefore, impacts to endangered wildlife species are not a factor in screening aquatic disposal sites.

4.8.3.4 Economic Factors

Areas of Recreational and Commercial Fishing

A series of meetings with local fishermen, both commercial and recreational, were held to discuss the regional fisheries resources of the New Bedford/Fairhaven area. At these meetings, they were asked to map the major commercial finfishing and lobstering areas and to denote which months commercial and finfishing for specific species were practiced. Data collected by the DMF was also consulted.

Recreational Fishing

Among the more commonly fished recreational finfish species in New Bedford/Fairhaven Harbor are winter flounder, tautog, striped bass, and bluefish. Although these species can be found in almost any area of New Bedford/Fairhaven Harbor, there are certain areas that are most frequently fished (Figure 4-34). Some of these areas are fished because of their easy land-side access (shore sites), while others are fished because environmental conditions favor aggregation of the species. The hurricane barrier, jetties along Clark’s point, Fort Phoenix and other areas around the Inner and Outer harbors are reportedly favored shore localities for recreational sport fishing for striped bass, bluefish, tautog, and scup (NBHTC, 1996). Therefore, the Silver Shell TH, Seawall Southwest, Fairhaven North and South sites, or the Pope’s Island sites may be proximal to preferred shoreside recreational fishing areas.

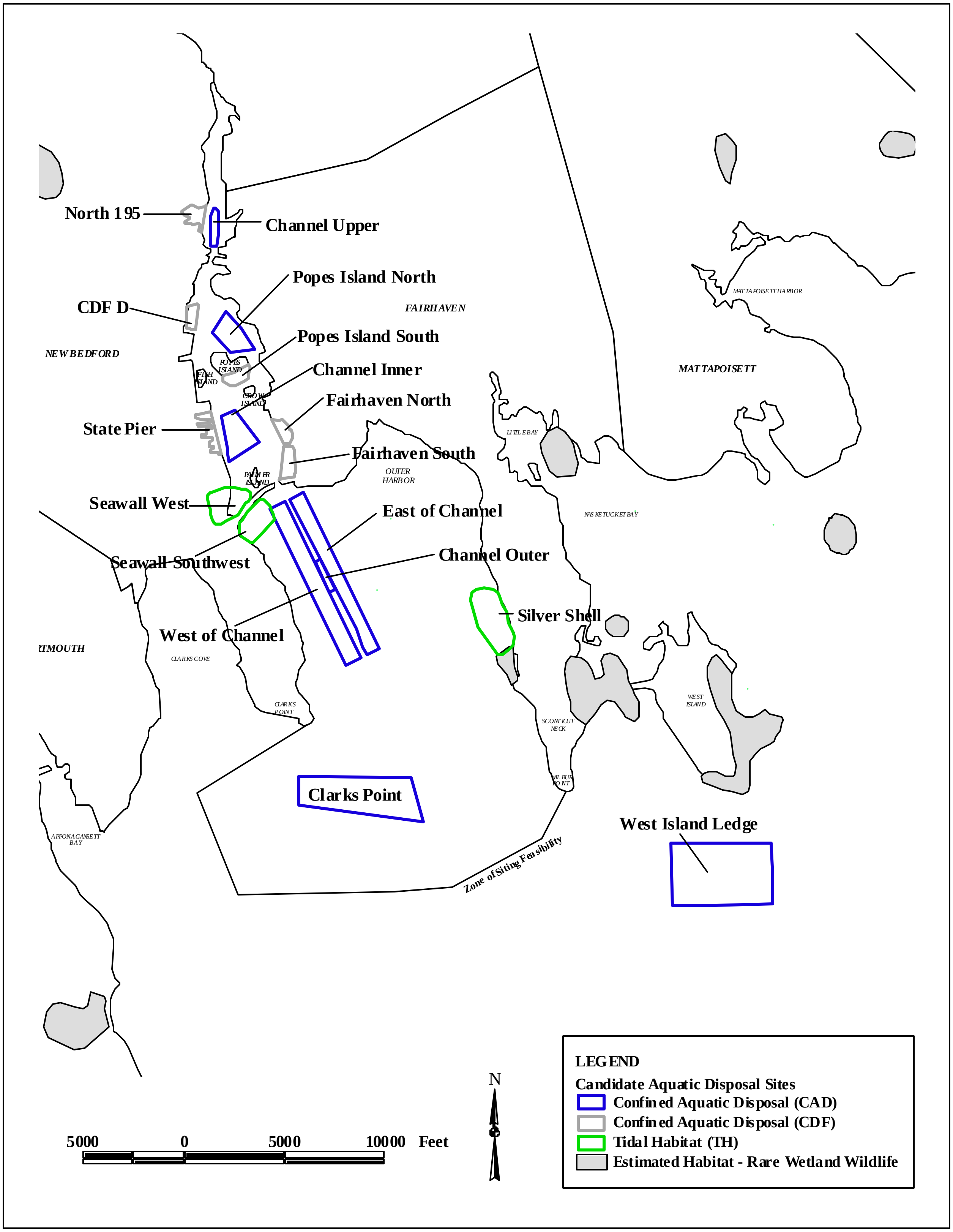


Figure 4-35: Estimate Rare Wetland Wildlife Habitat

Offshore, DMF mapping depicts recreational fishing areas concentrated around the shallow, rocky areas near the center of the Outer Harbor, near Egg Island and Little Egg Island, and the Butler Flats Lighthouse (Figure 4-36). Fish species found to inhabit areas proximal to the offshore aquatic disposal sites were identified in the DMF groundfish bottom trawl sampling surveys conducted from 1978 to 1996. The closest aquatic disposal site to favored offshore recreational fishing areas is the Clark's Point aquatic disposal site located approximately 1,600 feet south of the end of Clark's Point. The waters off of Clark's Point is a favored fishing area for striped bass, bluefish, and scup (NBHTC, 1996). In addition, DMF sampling revealed that winter flounder and tautog are the most abundant fish species at this location. Abundances of these two species were found to be greater here than at any other aquatic disposal site within the New Bedford\Fairhaven Harbor ZSF.

Commercial Fishing

The Inner Harbor has been closed to commercial fishing since 1979 due to PCB contamination. The Outer Harbor is also closed to the harvesting of lobsters, eels, flounders, scup and tautog. Therefore, commercial finfishing, using gill nets, and lobstering is practiced outside the harbor in Buzzards Bay (Figure 4-37). The commercial fishing done by the New Bedford fleet is concentrated on offshore sites, however, commercial fishing for finfish and lobster is practiced in Buzzards Bay.

Shellfishing, however, is concentrated in Buzzards Bay. Among the most important commercial fish in Buzzards Bay are scup, Atlantic menhanden, striped bass, winter flounder, and bluefish. Quahogs represent the largest commercial shellfish industry in Buzzards Bay, with commercial catch exceeding the catch of all other species (soft shell clam, oyster, bay scallops, surf clams, mussels) combined (Howes and Goehringer, 1996). Lobstering is restricted from most areas of New Bedford/Fairhaven Harbor. However, lobstering is permitted in adjacent Buzzards Bay, south of a line drawn from Hursett Rock off Mishaum point in Dartmouth, east to Rocky Point on West Island in Fair Haven. Lobstering occurs primarily from May to November (Estrella and Glenn, 2000), which typically lies outside of the DEP-designated dredge window. Deeper waters are more commonly fished from late spring/summer to winter. In their comprehensive ecological profile of Buzzards Bay in 1996, Howes and Goehringer reported lobster landings within Buzzards Bay to have remained relatively stable for the prior ten-year period. The catch per three day trap set for Buzzards Bay waters for marketable lobster, egg-bearing lobster, and sublegal lobster were higher than statewide catch rates in 1997.

Because of their mobility and natural changes in environmental conditions from season to season and year to year, the location of good lobster grounds can vary at any time, therefore, the use of adult lobster habitat as a criteria for disposal site screening is not definitive. However, the anecdotal information given above does indicate some general differences in lobstering between local areas in the region. Lobstering is practiced in deeper waters nearly year-round including fall and winter months, when dredging and disposal would occur. Coastal lobstering is most intensive from May to November (Estrella and Glenn, 2000).

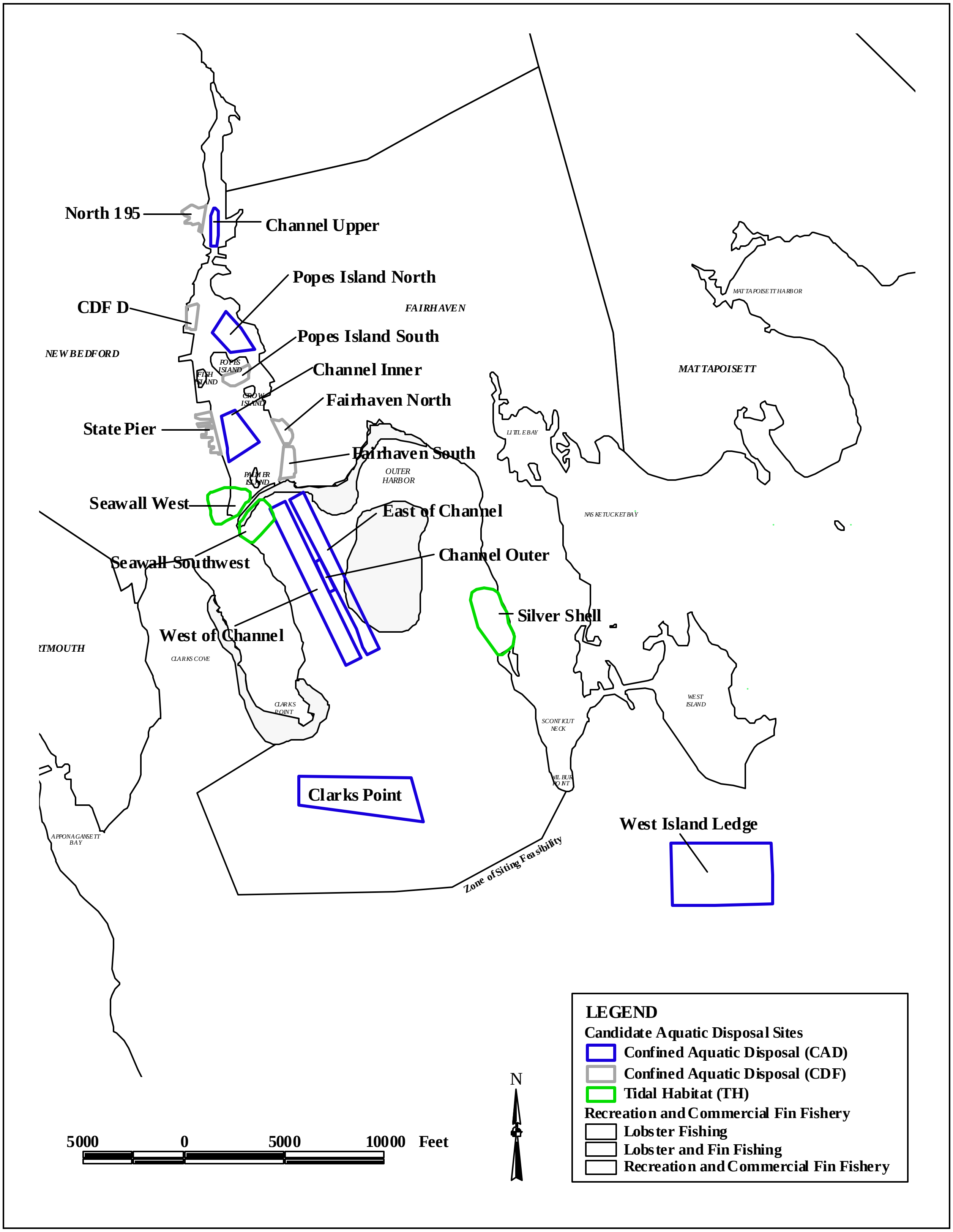


Figure 4-36: Recreational Fishing Areas

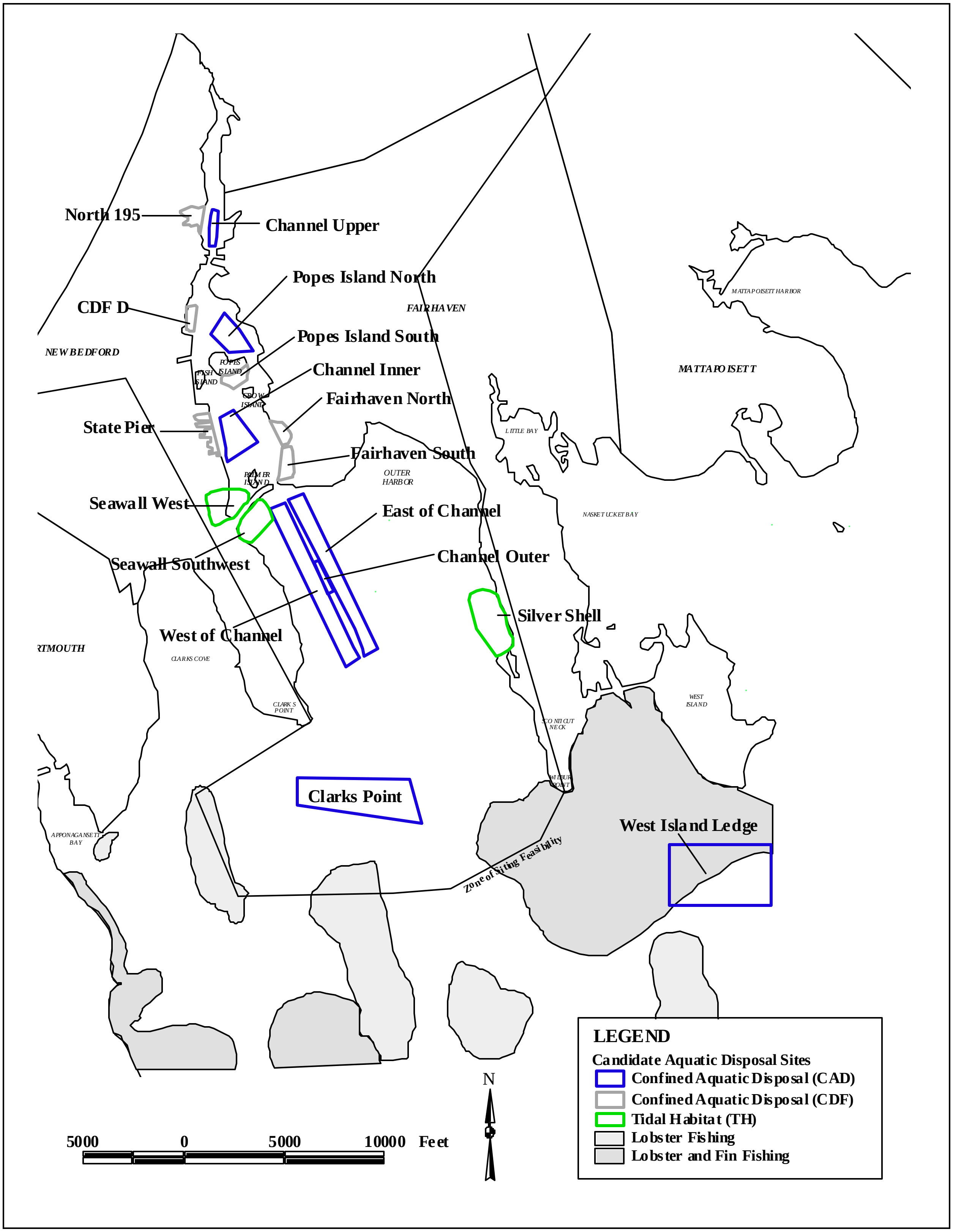


Figure 4-37: Commercial Fishing Areas

4.8.3.5 Regulatory/Practicability/Human Factors

In addition to the physical and biological characteristics of the candidate disposal sites, other factors are important in the screening process. First, the site must be permitable under existing state and federal laws, regulations and policies. Also, the site selection must be consistent with the New Bedford/Fairhaven Harbor Plan and must be amenable to the needs of the public at large. The presence of historic or archaeological artifacts, their preservation and/or documentation, is also a factor in disposal site screening. Cost is also an important factor, as it affects the practicability of using a particular disposal site. These considerations comprise the "practicability" portion of the LEDPA concept under Section 404 of the CWA.

Site permitability is related to the avoidance, minimization and mitigation of impacts associated with the site. In short, sites that avoid sensitive biological resources are more permitable than those which directly affect these resources. If impacts to biological resources are unavoidable, then means to minimize these impacts would need to be employed. Finally, if an impact occurs, even after minimization measures are employed, then mitigation would be required. The analysis of the candidate disposal sites follows this hierarchy (avoidance, minimization, mitigation) where sites that avoid impacts to natural resources are preferred over those that do not. Likewise, those sites in which unavoidable impacts can be minimized or mitigated, are preferred over sites where impacts cannot be minimized or mitigated.

One aspect of permitability is the "anti-degradation" provisions of Section 404 of the CWA. These provisions essentially favor dredged material disposal at sites that are already disturbed, as opposed to sites where no human-induced disturbance has occurred. The determination of permitability is not definitively made until a formal permit application has been made to the USACE. However, numerous meetings were held with the USACE, USEPA, NMFS, and USFWS during the DMMP process, and the permittability of the candidate sites, among other items, was discussed at these meetings.

Shipwrecks

Research was conducted to determine the potential for encountering shipwrecks or archaeologically sensitive sites within the candidate disposal sites. This was done using existing literature sources; no field investigations were conducted.

The research revealed a total of 81 historically significant small and large vessels lost within the New Bedford/Fairhaven Harbors and Buzzards Bay, although there are likely others that are not available in the historical record. Exact locations for only two vessels were available and these shipwreck sites are very distant from all potential aquatic disposal sites. Most shipwreck locations cited in contemporary newspapers were quite general, such as "lost off New Bedford".

The Department of the Interior states that shipwrecks over fifty years old are considered eligible for the National Register of Historic Places. Sixty-one of the shipwrecks identified during the study fit this definition. The recorded locations and dates of the two known shipwrecks were accepted, although it is recognized that the information for either site might be inaccurate.

However, the approximate number of significant shipwreck sites in the study area is considered accurate enough to support an initial screening of the candidate disposal sites.

Neither of the two known shipwreck locations are within or near candidate aquatic disposal sites. Given the large number of recorded and unrecorded wrecks within the ZSF, any of the candidate disposal sites could contain shipwrecks. Therefore, any aquatic alternatives explored in the FEIR will include a site specific archaeological survey.

The potential for Native American archaeological sites within the ZSF is highest near the existing coastline, therefore, all but the two off-shore sites would have the greatest potential for archaeological remains. Since little is known of the prehistoric Indians of the study area, any remains, whether a village, fish processing site, or sunken canoe, would be of great importance.

Sub-bottom profiling data indicate that the area has an irregular bed rock which is typically covered by 0-12 feet of glacially deposited medium sand, silt and clay sediment. Remains of any archaeological sites would be extremely hard to locate under the sediment. Field investigation to verify the presence/absence of historical and archaeological resources within the preferred disposal site will be conducted at a later date.

Compatibility with the Harbor Plan

The selection of a disposal site for UDM, as a concept, is supported by the New Bedford/Fairhaven Harbor Plan, which recommends the pursuit of the maintenance and improvement dredging projects in the harbor (Refer to Section 3) and a disposal site for the UDM generated from these projects. The Harbor Plan also supports maintenance and improvement dredging activities as well as the concept of aquatic disposal of UDM. In fact, the Harbor Plan specifically identifies CDFs for the Railyard area and Popes Island North as integral elements of proposed marine industrial expansion.

Costs

To estimate the potential cost of aquatic disposal options, cost estimates (per cubic yard) from a variety of recent dredging studies were compared. Estimates are available from the BHNIP, New Bedford Harbor Cleanup Plan, Salem PD, EPA Assessment and Remediation of Contaminated Sediments (ARCs) program, projects in New York and New Jersey, and the US Navy EIS on Homeporting for the Seawolf Submarine. Recognizing that site specific cost estimates for the preferred alternative will not be discussed until Section 5, the mean of estimates from the BHNIP was determined most applicable for comparing aquatic disposal alternatives in the DMMP. Table 4-18 compares the costs associated with aquatic disposal options considered in the New Bedford/Fairhaven Harbor DMMP DEIR.

Table 4-18: Aquatic Disposal Cost Comparison

Disposal Type	Cost per Cubic Yard	
	Range	Mean
CAD - pit	**$35 -55**	$45
CDF[1] (above mean high water)	$38 - 61	$50
CDF/TH (± mean low water)	$45 - 241	$142
CAD - mound	$16 - 33	$24

1 - Unit cost does not include decking/structures required for CDFs intended to be used as maritime commercial/industrial facilities

The highest aquatic disposal cost is for CDF/TH. Costs associated with creation of habitat are relatively high because engineering is complex, marine structures are often needed to create the proper hydrologic environment, and manual labor is needed for planting. Most significantly, projects involving tidal habitat creation typically do not involve very large volumes of dredged material, therefore, the unit cost for disposal is often high. Additionally, the unit cost for CDFs intended for maritime commercial/industrial uses, are widely variable due to use-specific support and decking requirements, potentially resulting in a unit cost beyond the upper limits of the CDF/TH unit cost.

Conversely, CAD disposal in a mound configuration is the least expensive method of disposal because it involves less sophisticated engineering and no manual labor. Development of a CAD pit and subsequent disposal of UDM would cost approximately $40/cy, based upon recent bid estimates from contractors for the BHNIP project. Large volumes of UDM can be disposed in open water in relatively short periods of time, thereby reducing costs significantly.

CDF costs are generally higher than CAD options but lower than TH. For the CDF or TH options, an engineered structure composed of sheet pile or stone is needed to contain the material, adding to construction costs. Geotechnical analysis of the UDM before and after placement in the CDF is required and, if an end use that requires structural stability is intended, more detailed geotechnical studies are typically required.

4.8.4 The Proposed Preferred Aquatic Disposal Sites

After evaluating and screening the physical, biological, jurisdictional, economic and other factors for the universe of aquatic disposal sites, two sites were selected as proposed preferred aquatic disposal areas. These sites are the Channel Inner and Popes Island North sites (Figure 4-38). These sites (either alone or in combination) have the potential to accommodate the total volume of UDM identified for New Bedford/Fairhaven Harbor. The following sections summarize the key attributes of the proposed preferred alternatives sites as they relate to the screening criteria.

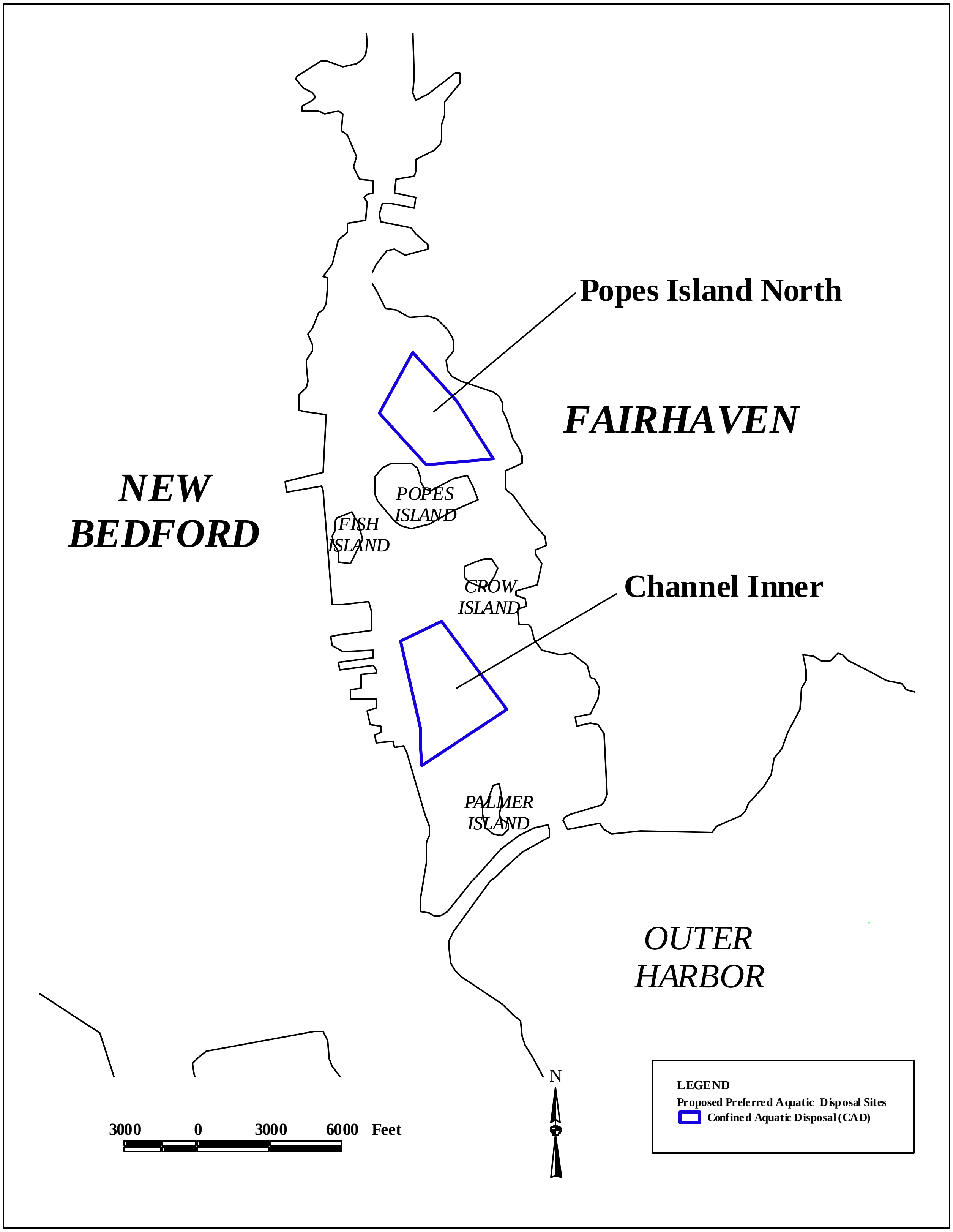


Figure 4-38: Proposed Preferred Disposal Sites

As mentioned earlier in this DEIR, sites with the potential for significant adverse impacts to natural resources, cultural resources/activities or conflicts with Harbor Plan initiatives were removed from consideration as preferred alternatives. The potential sites that were screened out were removed from consideration because of location in areas of high fisheries productivity and commercial fishing activity, proximity to resources, long travel distances, and limited disposal capacity. The site-specific rationale for screening out the remaining aquatic disposal candidates sites is summarized in Table 4-19. Site attributes are summarized in Table 4-20.

Table 4-19: Reasons Why Candidate Sites Placed on Reserve Status

Site Name	Rationale
Upper Harbor Sites	
Channel Upper	Low capacity, restricted access (bridge)
North 195	Intertidal Impacts; eliminated from consideration as a CDF as part of EPA ROD II
CDF D	Site of ROD II CDF "D"
Fairhaven North	Southern portion conflicts with existing marina, need to extend sewer outfall, low capacity
Inner Harbor Sites	
Fairhaven South	Intertidal impacts
Popes Island South	Conflicts with existing marina use, cost implications
State Pier	Northern portion actively used for fishing fleet
Seawall West	Intertidal impacts, city prohibition for use as CDF
Outer Harbor Sites	
Seawall Southwest	Heavy armor required, complex engineering considerations
Silver Shell TH	Inability to create habitat with net increase in value
Channel-Outer	Open shellfish harvest area, fishing impacts, limited capacity
East of Channel	Open shellfish harvest area, fishing impacts
West of Channel	Open shellfish harvest area, fishing impacts
Offshore	
West Island Ledge	Erosional environment, grain size and bathymetry present difficulties in sequestering material
Clark's Point	Sewer outfalls, fish resources

4.8.4.1 Physical Attributes

- *Capacity* - Of the two Proposed Preferred Aquatic Disposal Sites in New Bedford/Fairhaven Harbor, the Channel Inner and Popes Island North sites have adequate capacity to accommodate the estimated 960,000 cy of UDM. The amount of expected capacity in Popes Island North is almost three times that of the Channel Inner CAD.

- *Bottom Type* - The existing bottom type at both sites is soft silty sand or mud, which is similar to the type of dredged material that would be disposed of there.

- *Distance* - The sites are proximal to all dredging projects in New Bedford/Fairhaven Harbor. This increases the efficiency of dredging and disposal and decreases the chances of accidental spillage of UDM from barges.

- *Water Depth* - Water depth varies between the two sites from six feet below mean low water (Popes Island North) to 28 feet below mean low water (Channel Inner site), which is sufficient to accommodate the drafts of dredging equipment, however disposal at Popes Island North would require dredging a small entrance channel, 12 feet deep and 250 feet long
- *Navigation* - One of the sites (Channel Inner) is located within the limits of New Bedford/Fairhaven Harbor Federal Channel. Commercial fishing ships also use the channel, which would require navigation coordination during construction and disposal to avoid disrupting the flow of vessels within the harbor. The sites would not infringe upon seawall docking areas.

4.8.4.2 Biological Attributes

- *Finfish* (Inner Harbor)- The two proposed preferred aquatic disposal sites are expected to have some nursery potential for ecologically and economically important finfish. The Channel Inner and Popes Island North CAD sites are closed to all finfishing activity.

- *Lobster* - The vicinity of the two proposed preferred aquatic disposal sites are closed for commercial harvest of lobster. The habitat, soft silty sand and mud, is not a preferred substrate for lobsters (located throughout the harbor) however, lobsters are expected to occur proximal to these sites.

- *Benthos* - Despite relatively high concentrations of metals, PAHs, and PCBs, the sediments of the aquatic disposal sites are well oxygenated and supportive of diverse and abundant benthic invertebrates. OSI values averaged 4 at both Channel Inner and Popes Island North sites.

- *Shellfish* - Quahogs, located throughout the harbor, are its most economically important shellfish species. Many beds are closed due to bacterial contamination as evidenced by high coliform counts. The Channel Inner and Popes Island North sites lie within prohibited harvest areas. Some areas of the Inner Harbor are used for seed stock and depuration programs. A portion of the Channel Inner site lies within the northern limits of a primary priority contaminated shellfish relay area.

- *Coastal Wetlands/Submerged Aquatic Vegetation* - The proposed preferred aquatic disposal sites are not located within or adjacent to a salt marsh, intertidal wetland, or an SAV bed. Salt marsh and intertidal areas lie northeasterly of Popes Island North and southwesterly of the Channel Inner site. The closest SAV bed lies to the southeast, outside of the Hurricane Barrier.

4.8.4.3 Economic Attributes

- *Recreational and Commercial Fishing* -The location of the proposed preferred alternative sites are not in conflict with recreational and commercial fishing as the Inner Harbor is closed to fishing all fishing as a result of Superfund material releases. However, coordination during disposal operations at the Channel Inner site would need to occur to avoid disruptions to vessels using the navigation channel.

- *Water Dependant Use* - Disposal at the proposed preferred alternative sites would not conflict with existing or proposed water dependant uses. Disposal would not result in any long-term changes to navigational conditions. The timing of disposal activies, in the winter, would minimize the potential for temporary impacts to recreational navigation.

4.8.4.4 Regulatory/Practicability/Human Attributes

- *Consistency with Harbor Plan* -The sites are not in conflict with the *Harbor Plan*. Both sites are consistent with its goal of maintenance and improvement dredging within the harbor. In particular, the use of the Popes Island North area as a CAD site would not preclude the future use designated in the *Harbor Plan* as a CDF with marine industrial as the proposed end use. area. Use of Popes Island North would also require coordination with the proposed plans to relocate the Route 6 bridge.

- *Historical and Archaeological Resources* - No known shipwrecks lie within the footprints of the proposed preferred aquatic disposal sites, although further investigation would be needed for verification. Because of their near shore locations, there is potential for encountering prehistoric artifacts from aboriginal inhabitants. The probability of finding and recovering historical or archaeological artifacts within the cells is hindered by years of accumulated sediment.

- *Practicability/Permitability* - Average unit costs for disposal would be approximately $34/cy, which is similar to the costs for other CAD pit sites, but higher than for CAD mound sites in the off shore areas. Unit cost is slightly lower for Popes Island North due to smaller footprint requirement as a result of greater depth to bedrock. Similar sites in Boston Harbor have been approved by the USACE and DEP and are currently being used and the project is nearing completion.

Table 4-20: Summary of Attributes of Proposed Preferred Alternative Sites

	Channel Inner CAD	**Popes Island North CAD**
Physical Attributes		
Capacity (cy)	1,222,575	3,226,108
Bottom Type	Mud	Mud
Distance (miles)	1.8	1.1
Water Depth (feet)	28	6
Navigation	Sufficient Depth for Navigation	Adjacent to Federal Channel; shallow depth (<7 feet)
Biological Attributes		
Fisheries	Moderate-High Nursery Potential	Some Nursery Potential
Lobster	Not a Preferred Substrate for Lobsters	Not a Preferred Substrate for Lobsters
Benthos (Mean OSI)	4	4
Benthos (Habitat Complexity)	10	1
Shellfish	Prohibited Harvest; (productive quahog beds throughout. A portion of this site lies within a primary priority shellfish contaminated relay area)	Prohibited Harvest; (productive quahog beds throughout)
Wetlands, SAV	None	None
Economic Attributes		
Recreational/Commercial Fishing	Closed to all Fishing Activity	Closed to all Fishing Activity
Water Dependant Use	Located in Navigation Channel	Not Located in Navigation Channel
Regulatory/Practicability/Human Attributes		
Consistency with Harbor Plan	Supports Harbor Master Plan	Supports Harbor Master Plan
Historic/Archeo-logical Resources	No known resources	No known resources
Cost ($ per cy)	$36	$40
Permitability	Potentially Permittable	Potentially Permittable

SECTION 5.0 - AFFECTED ENVIRONMENT

5.0 AFFECTED ENVIRONMENT

This section of the DEIR describes the environmental and human resource characteristics of the proposed preferred aquatic disposal sites. Documentation of existing conditions provides a baseline against which the impacts of the two proposed preferred aquatic disposal alternatives, described in Section 4, can be analyzed. Potential impacts will be discussed further in Section 6. The preferred disposal sites are:

1. New Bedford Channel - Inner CAD/OD
2. Popes Island North CAD

In this section, the environmental and human aspects of these sites are characterized and their surroundings are described.

5.1 Location and Hydrography

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 (Figure 5-1). 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 which extends from Clark's Point in New Bedford, east to Wilbur Point in Fairhaven (Figure 5-2). 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 lies the community of Clark's 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.

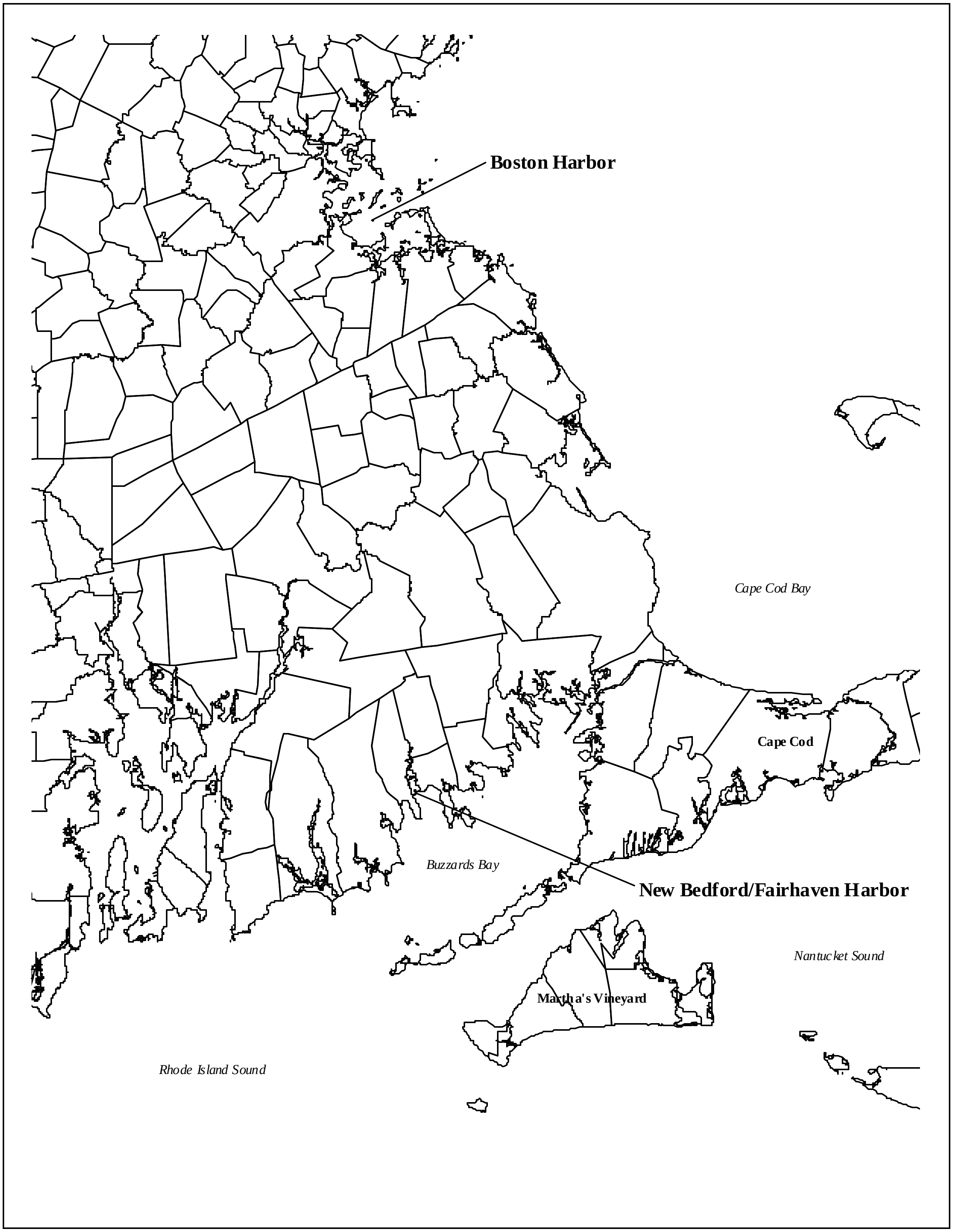


Figure 5-1: Location of New Bedford/Fairhaven Harbor (Base Map Source: MassGIS)

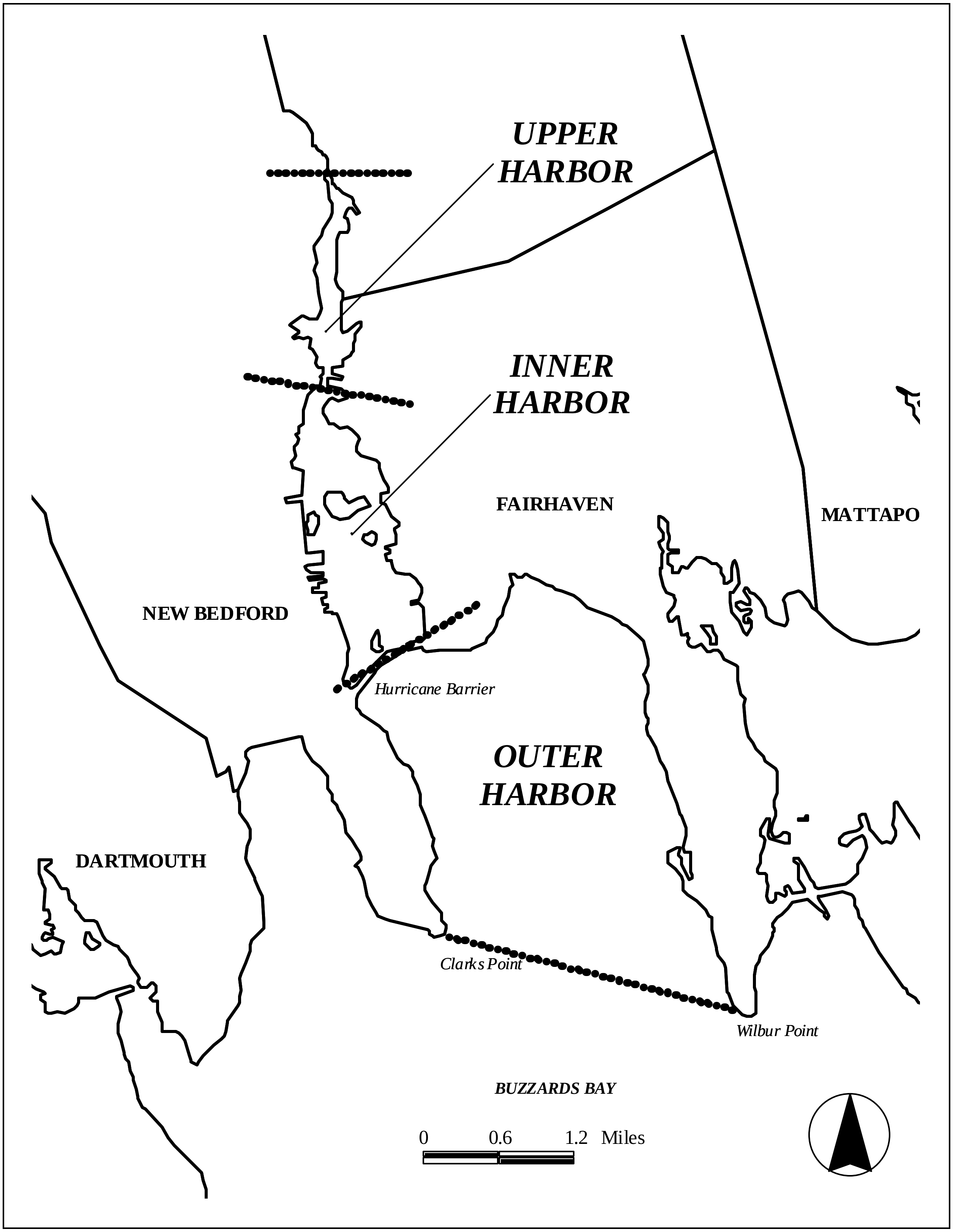


Figure 5-2: New Bedford/Fairhaven Harbor Upper, Inner and Outer Harbor Areas

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.

The main federal navigation channel leading into New Bedford/Fairhaven Harbor (the Entrance Channel) is authorized to a depth of 30 feet. 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 5-3).

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 (Figure 5-3).

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.

5.2 Regulatory Environment

Disposal of dredged material and UDM in the aquatic environment of New Bedford/Fairhaven Harbor falls under the jurisdiction of several federal and state environmental programs. The principal federal jurisdiction is Sections 401 and 404 of the CWA, which regulates the disposal of dredged material and UDM in open water landward of the baseline of the territorial sea. Because the candidate aquatic disposal sites are landward of the territorial sea baseline, they are not regulated by Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) (a.k.a. Ocean Dumping Act).

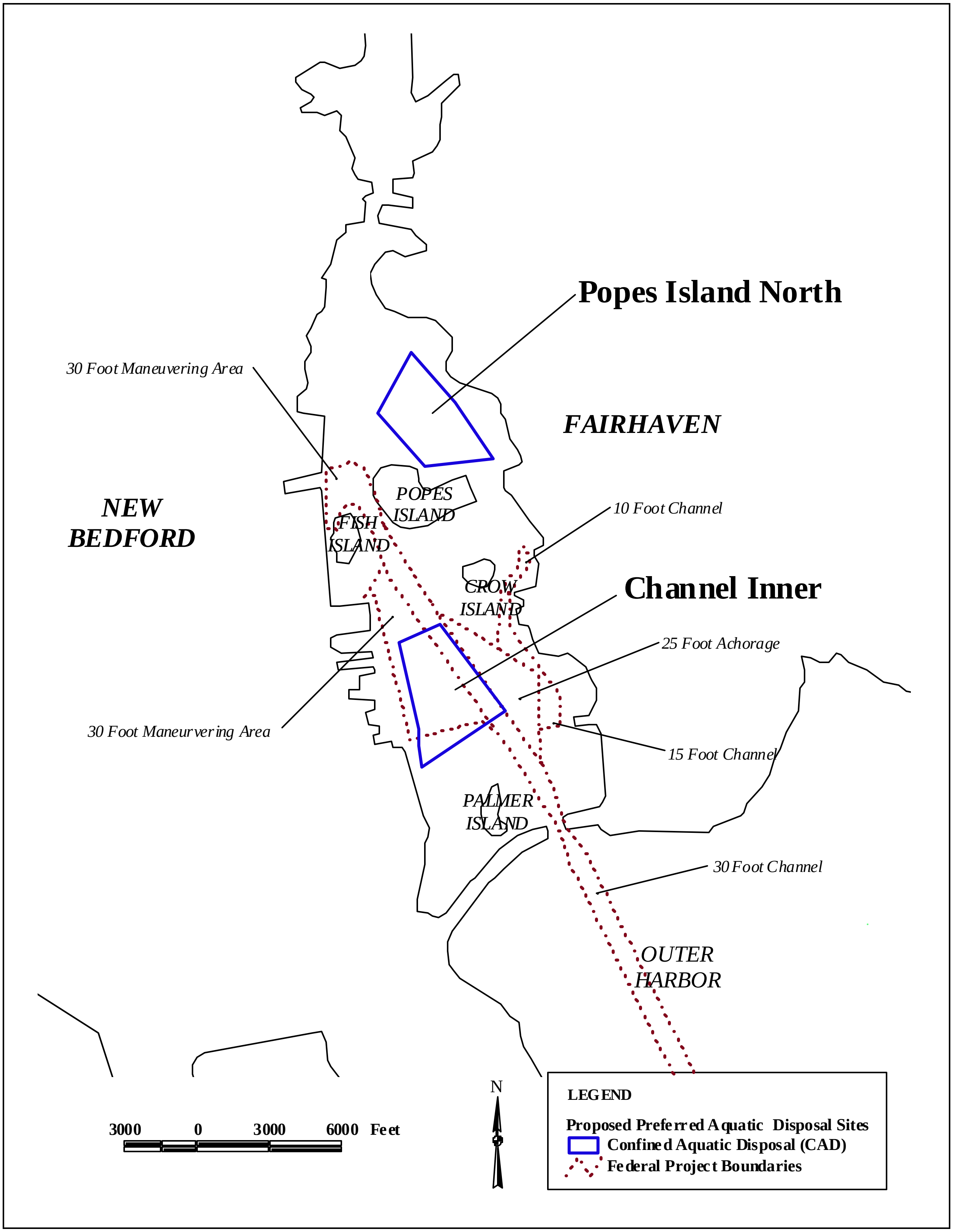


Figure 5-3: Federal Navigation Channels

The Section 401 Water Quality Certification program is administered by the DEP. A Water Quality Certificate must be issued for the disposal of dredged material and UDM within the limits of state waters, which extend from the shoreline seaward for three miles, or to the territorial sea baseline.

Other state regulatory programs include the Public Waterfront Act (Chapter 91 of the Massachusetts General Laws or MGL) and the Wetlands Protection Act, which govern dredged material and UDM disposal activities in the aquatic environment.

5.3 Marine Resource Characterization

Existing information pertinent to New Bedford/Fairhaven Harbor was collected and reviewed to characterize general sedimentary environments in the vicinity of New Bedford/Fairhaven Harbor. Recent fisheries information collected and surveys conducted for this project (NAI, 1999), were used in the characterization of existing fisheries and habitat resources of the region. Natural resources mapping prepared by the DEP (i.e.: eelgrass) and data provided by the Massachusetts Geographic Information System (MassGIS) office (i.e.: wetland resources) were also used.

Site-specific field studies were performed at each of the candidate sites to collect Sediment Profile Images (SPI) using the REMOTS® camera system (Rhoads and Germano, 1982;1986). These sediment-profile images provide valuable site-specific information on sediment types and biological activity.

Sediments to be dredged from within the channel were tested in 1997 to determine their suitability for unconfined aquatic disposal. The physical and chemical characteristics of the sediments at aquatic disposal sites were also determined.

A sub-bottom profile survey was conducted to determine the depth to bedrock in New Bedford/Fairhaven Harbor. This information was needed to estimate the potential capacity of the proposed CAD sites in the Harbor.

5.3.1 Sediments and Water Quality

Data regarding sediments (physical characterization, transport and circulation), and sediment quality was obtained from various regional and site specific studies including the following:

- Habitat characterization of the DMMP Candidate Aquatic Disposal Sites report to MACZM (Maguire Group, 1999);
- New Bedford Harbor Long Term Monitoring Assessment Report: Baseline Sampling. Research Report No. 600/R-96/097 (U.S.EPA,1996).
- Phase 2 Facilities Plan Effluent Outfall, City of New Bedford, MA (Camp, Dresser, & McKee, Inc. 1989)
- Overview of the New Bedford Harbor Physical/Chemical Modeling Program (EBASCO Services, Inc., 1991).

Water quality and water quality classification information was obtained from the following sources:

- Massachusetts Division of Marine Fisheries Designated Shellfish Growing Areas (MADMF, 1999)
- The DMMP, Phase I (Maguire Group, 1997).
- Ecological Profile of Buzzards Bay (Howes and Goerhinger, 1996).
- Feasibility Study of Remedial Activities for the Estuary and Lower Harbor/Bay (EBASCO, 1990).
- Buzzards Bay Project and Buzzards Bay Coalition (Costa, J., Howes, B., and E. Gunn, 1996; Howes, B., T. Williams and M. Rasmussen, 1999).

5.3.1.1 Physical Characterization of Existing Sediments

In general, fine-grained unconsolidated sediments overlaying till and bedrock were found throughout the New Bedford/Fairhaven Harbor as reported by Summerhayes, et al.(1985) (Figure 5-4). This type of sediment suggests a low-energy, depositional environment which is typical of protected coastal embayments with limited freshwater inflow and a moderate tidal influence. Others report a layer of glacially deposited sand and gravel atop the bedrock with a layer of organic silt covering the sand and gravel (EBASCO Services, 1988). Tests on composite grain samples taken from the upper two feet (0.6 meters) of sediment revealed that sediment from within and near the potential dredged material sites were predominantly within the silt to clay grain size range (Maguire Group 1997).

Laboratory analysis of sediment by the U.S.EPA (1996) using wet-sieving and pipette analytical techniques revealed that sediments from the relatively shallow Upper Harbor are composed primarily of fine-grained particle sizes with a high (40-80%) silt/clay content. However, localized areas of varying sediment composition were also identified, such as sandy shoal areas along the banks of the Acushnet River and gravelly bottom areas within scours produced by relatively faster currents beneath the Coggeshall Street Bridge. In the Lower Harbor, sediment grain size distribution appeared to be a function of water depth. In relatively shallow areas (<10 feet or <3m water depth), the sediments contain high (40 to >80%) silt/clay content. These areas occur along the northeast and southwest shorelines. In relatively deeper water areas (>32 feet or >10m water depth), the sediments contain a predominantly sand content (60 to >80%). Examples of these areas are the vicinity of and below the Coggeshall Street Bridge, and along the New Bedford reach of the navigation channel within the Lower Harbor.

The Channel Inner site was found to be a depositional sedimentary environment composed of very soft muddy sediments with methane bubbles. The REMOTS® sampling station within the Channel Inner site contained a Stage I community with an average RPD of 2 inches (SAIC, 1999).

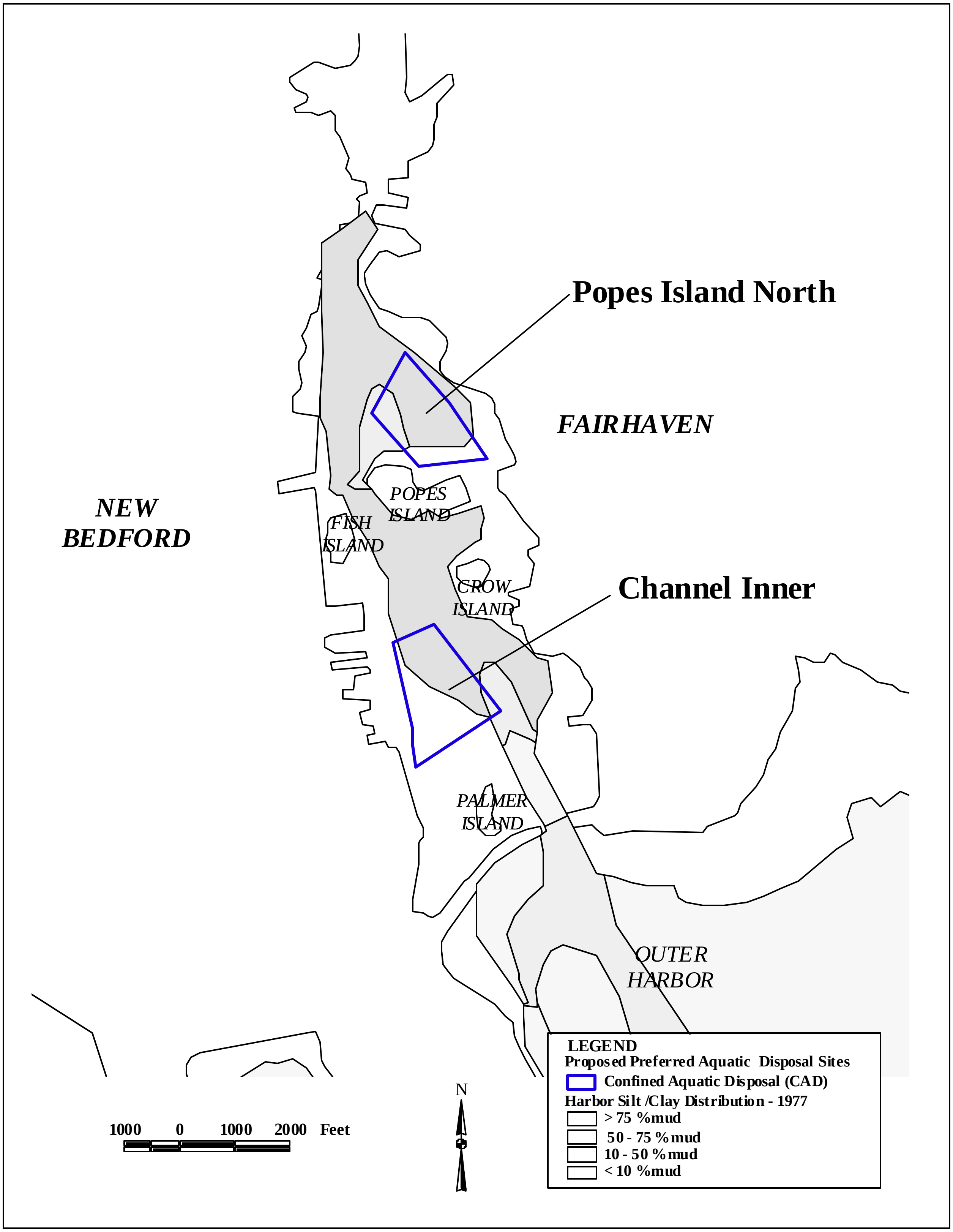


Figure 5-4: New Bedford/Fairhaven Harbor Sediment Size Distribution

The Popes Island North site in the Upper Harbor was found to be a depositional environment also, with homogenous soft silty sediments with little or no shell hash. The REMOTS sampling station within this site contained a Stage I community with an RPD between 1.19 to 2.31 inches (Figure 5-5). Lower RPD values and a Stage I designation are normally indicative of high-disturbance/degradation regimes in which the disturbance or degradation results in impact to habitat integrity (SAIC, 1999).

The Organism-Sediment index (OSI) is a metric which defines overall benthic habitat quality by assigning ranks and/or values to the depth of the apparent redox layer, successional stage of infauna, the presence/absence of methane gas in the sediment, and the presence/absence of reduced (i.e. anaerobic) sediment at the sediment-water interface. OSI values range from 1 through 10, with higher values representing stronger benthic habitat quality. The OSI value for the Popes Island North site was four (4), and the Channel Inner site was also four (4). A more detailed discussion of habitat conditions is presented in Section 5.3.2.2.

5.3.1.2 Sediment Transport/Circulation at the Proposed Preferred Disposal Sites

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 is 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 OBS (optical backscatter) 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 (refer to section 6.1.2). 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 meters). Spring tide range is reported to be 4.6 feet (1.4meters). In the Outer Harbor, the tidal range is reported to be from 1.41 feet (0.43meters) to 5.05 feet (1.54 meters) with a mean of 4.65 feet (1.42 meters)(ACOE, 1990). Flushing of the harbor was determined to take 2 days under winter conditions, and 8 days under summer conditions (Bellmer, 1988). Table 5-1 shows the effects during various time segments of the average tidal cycle.

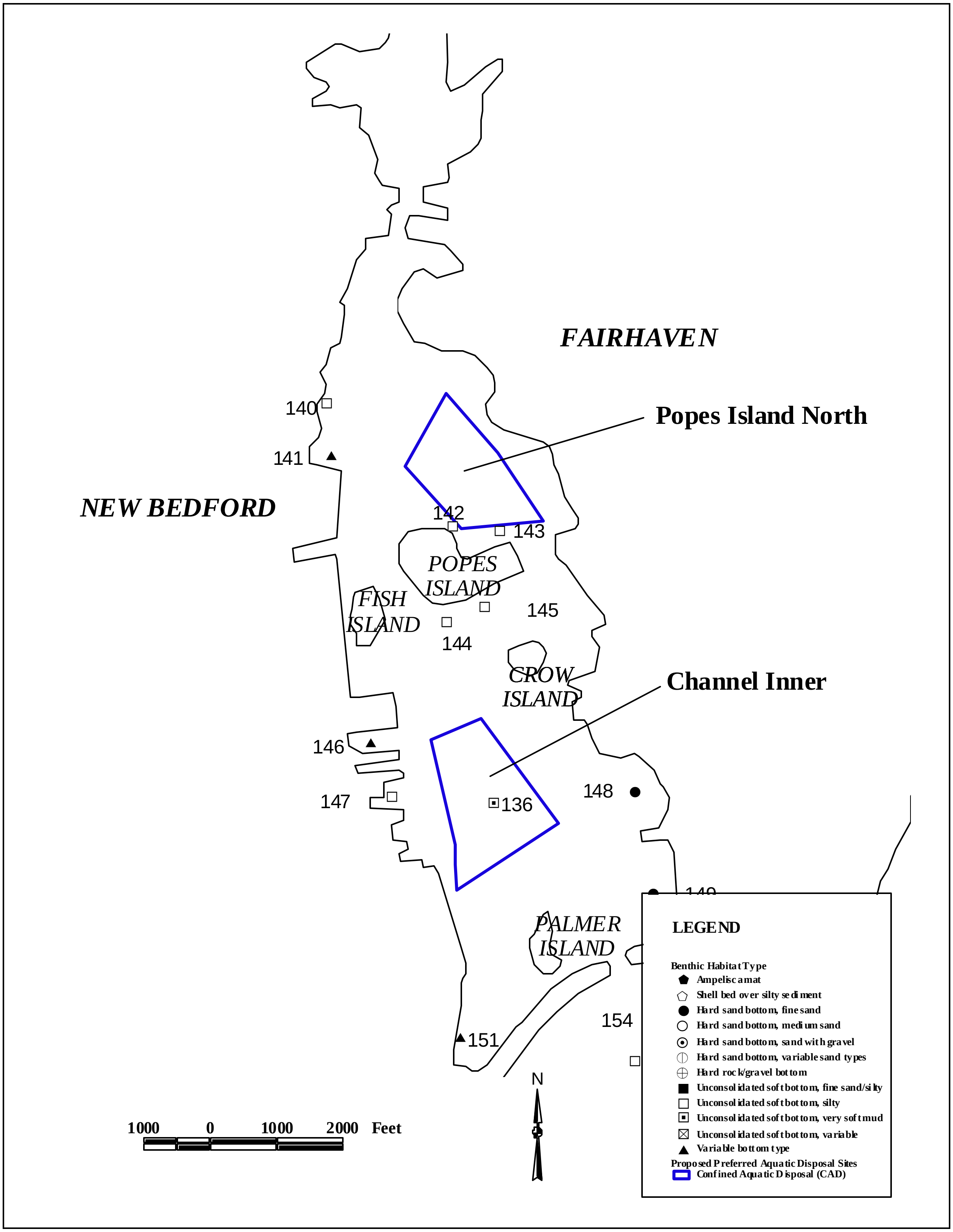


Figure 5-5: Benthic Habitat Type for Proposed Preferred Aquatic Disposal Sites

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 (ACOE, 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 (Table 5-1) 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 5-1: 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

5.3.1.3 Water Quality

Historically, waters of New Bedford/Fairhaven Harbor were utilized for the disposal of raw industrial and domestic sewage, as was typical of many tidal bays and estuaries in Massachusetts (Jerome et al, 1967; 1969). Pollution and the subsequent reduction in water quality have been a contributing factor to the disappearance of important commercial and recreational finfish species, as well as the closure or restriction of harvesting from shellfish beds in other Massachusetts ports (Costa, J., Howes, B., and E. Gunn, 1996; Howes, B., T. Williams and M. Rasmussen, 1999).

Water Quality Classification

The MADEP has established Water Quality Classifications for the Commonwealth's surface waters, as listed below. The Popes Island and New Bedford Channel Inner Proposed Aquatic Disposal sites are located within an area designated as SB (Figure 5-6). Class SB waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. The Inner Harbor is also a designated combined sewer outfall (CSO) area and a designated Restricted Shellfish Area, defined below.

In addition to the classification system for surface waters, the Commonwealth has also denoted specific subcategories of use assigned to water segments that may effect the application of criteria or specific anti-degradation provisions of 314 CMR 4.05. Those restrictions pertinent to the siting of a disposal site for UDM from New Bedford/Fairhaven Harbor include:

Shellfishing – open shellfishing areas are designated as "(O)" and restricted shellfishing areas are designated as "(R)." These waters are subject to more stringent regulation in accordance with the rules and regulations of the DMF pursuant to M.G.L. c. 130 § 75. These include applicable criteria of the National Shellfishing Sanitation Program. Three "Shellfish Contaminated Relay Areas", priority Areas Nos. 1, 2, and 3, respectively (1 being the highest priority) as designated by the DMF are located within the Lower Harbor area of New Bedford/Fairhaven Harbor (Whittaker, personal communication). The primary area is located in the southwestern corner of the Lower Harbor. It is bounded by the Hurricane Barrier to the south, the eastern limit of the New Bedford Channel to the east, and the New Bedford Commercial Wharves to the west. It extends north along the harbor to a point proximal to the Edison Light Company Wharf. A portion of the New Bedford Channel - Inner Proposed Preferred Aquatic Disposal site lies within the northern limit of Priority area No. 1.

CSO – These waters are identified as impacted by the discharge of combined sewer overflows in the classification tables in 314 CMR 4.06(3). Overflow events may be allowed by the permitting authority without variance or partial use designation. New Bedford/Fairhaven Inner Harbor (including Upper and Lower segments) is designated a CSO area. CSOs occur along the western side of the Upper and Lower Harbors in the vicinity of the commercial wharves and along the eastern side of the harbor in the vicinity of the Fairhaven commercial wharves. The Fairhaven Wastewater Treatment Plant sewage outfall pipe is also located at the east side of the Lower Harbor, just south of the Fairhaven commercial wharves.

Currently, treated wastewater is discharged via two outfall pipes located at the seaward limit of the Outer harbor. The first pipe, a 60 inch diameter cast iron pipe is located approximately 3,300 feet (1000 meters) southeast of Clark's Point. The second pipe is used as an auxiliary pipe. It is a 72-inch diameter prestressed concrete pipe that is located alongside the primary pipe and extends approximately 1,000 feet (303 meters) southeast of Clark's Point (CDM, 1990).

Water Quality Sampling

Physical and chemical water quality parameters were measured within the various Harbor regions and adjacent Buzzards Bay during various harbor studies. Water quality measurements have been taken in several locations within the New Bedford/Fairhaven Harbor. New Bedford/Fairhaven site-specific data from NAI (1999), EBASCO (1990) and Howes and Goehringer (1996) are summarized herein. Basic water column physical data (temperature, salinity, dissolved oxygen, turbidity) was taken from the Feasibility Study of Remedial Alternatives for the Estuary and Lower Harbor/Bay (EBASCO, 1990). Chemical data was also obtained from EBASCO (1990). Information provided in Howes and Goehringer was used to portray expected phytoplankton conditions in New Bedford/Fairhaven harbor since New Bedford/Fairhaven Harbor is hydrologically connected to Buzzards Bay. Figure 5-6 indicates state water quality classification areas.

Physical Parameters

Generally, as one moves from oceanic water areas landward toward and into enclosed coastal waters, one can expect greater turbidity, wider temperature ranges, higher nutrient concentrations and more variable salinity (Hiscock, 1986). In New Bedford/Fairhaven Harbor, water temperature, salinity and dissolved oxygen (DO) were collected during finfish sampling efforts (seining and trawling) from June 1998 through May 1999 (NAI, 1999) (refer to Section 5.2.4 Finfish). During the finfish sampling study, water quality sampling conducted at each seine and trawl sample stations revealed that monthly mean water temperature followed a predictable seasonal pattern (Figure 5-7). Water temperatures were generally highest in August (seine: 22.1 to 22.5 ^{o} C; trawl: 21.8 to 25.5 ^{o}C) and lowest in January (seine: 1.6 ^{o} C; trawl: 2.5 ^{o}C). Salinity did not vary appreciably during the months sampled or by location among the harbor sampling sites. In the seine, monthly mean salinity ranged from 25.0 ppt at one seine station (NS1 - at the Outer Harbor at Ferry Dock) in October, to 31.4 ppt at a trawl station (NT1 - at the seaward end of the Outer Harbor) in November.

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 (‰) during the diurnal tidal cycle; results that are comparable to those obtained during the finfish sampling (NAI, 1999).

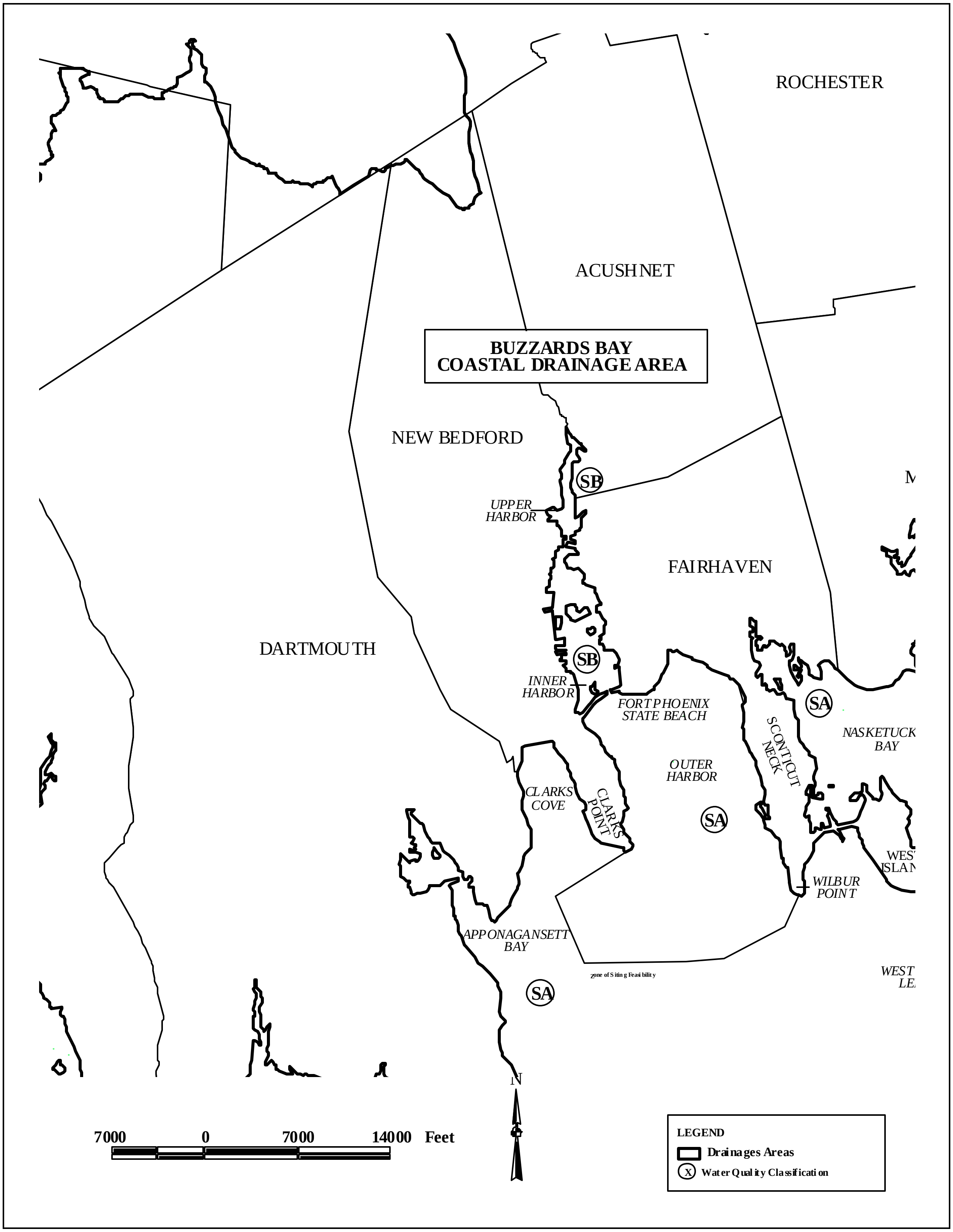


Figure 5-6: Water Quality Classification Areas

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 °C. to 23.5 °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 (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) (USACOE, 1990).

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 at one seine station(NS3 - located northeast of Crow Island in the Lower Harbor) in October to 13.5 mg/l at one trawl station (NT4 - 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 form suspended sediment in areas relatively exposed to tidal or storm induced wave energy.

Chemical Parameters

Batelle Oceanic Sciences (BOS, 1990) determined mean PCB concentrations from 18 sampling locations through the study area. This study found PCB concentrations in water samples to range from 5 to 7,635 ng/l (refer to Table 5-2). Concentrations were highest within the Upper Harbor, just south of the Wood Street Bridge, and decreased downstream to the lowest values in Buzzards Bay.
Filterable and total PCB was also determined from the surface water collected at the Coggeshall Street Bridge and Hurricane Barrier during the New Bedford Harbor Superfund Pilot Study (USACOE, 1990). PCB was reported in the surface water at a concentration of 607 ng/l during ebb tide at the Coggeshall Street Bridge and 114 ng/l at the Hurricane Barrier. These findings corroborate those reported by BOS in EBASCO (1990) and represent levels that exceed the national marine water criteria of 30 ng/l.

Three heavy metals, Cadmium (Cd), Copper (Cu), Lead (Pb), were also measured at these two locations during this water quality characterization study. According to the methods section of the report, both total and filterable concentrations were determined. However one data set is reported and the phase (i.e: total vs. filterable) is not specified. The reported results are likely to be the dissolved fraction determined as a product of the total minus filterable fractions (i.e. total - filterable = dissolved). The values for the three metal elements as reported are 0.20 ug/l, 3.4 ug/l and 6.5 ug/l, respectively, for the Coggeshall Street Bridge location and 0.11 ug/l, 2.3 ug/l, and 2.9 ug/l, respectively at the Hurricane Barrier (USACOE, 1990).Values reported for cadmium are below the mean of 9.5 ug/l presented in Manahan (1991) for trace metal concentrations in waters of the United States. Those reported for copper are below the mean of 15 ug/l, and those of lead below the mean of 23 ug/l (Manahan, 1991).

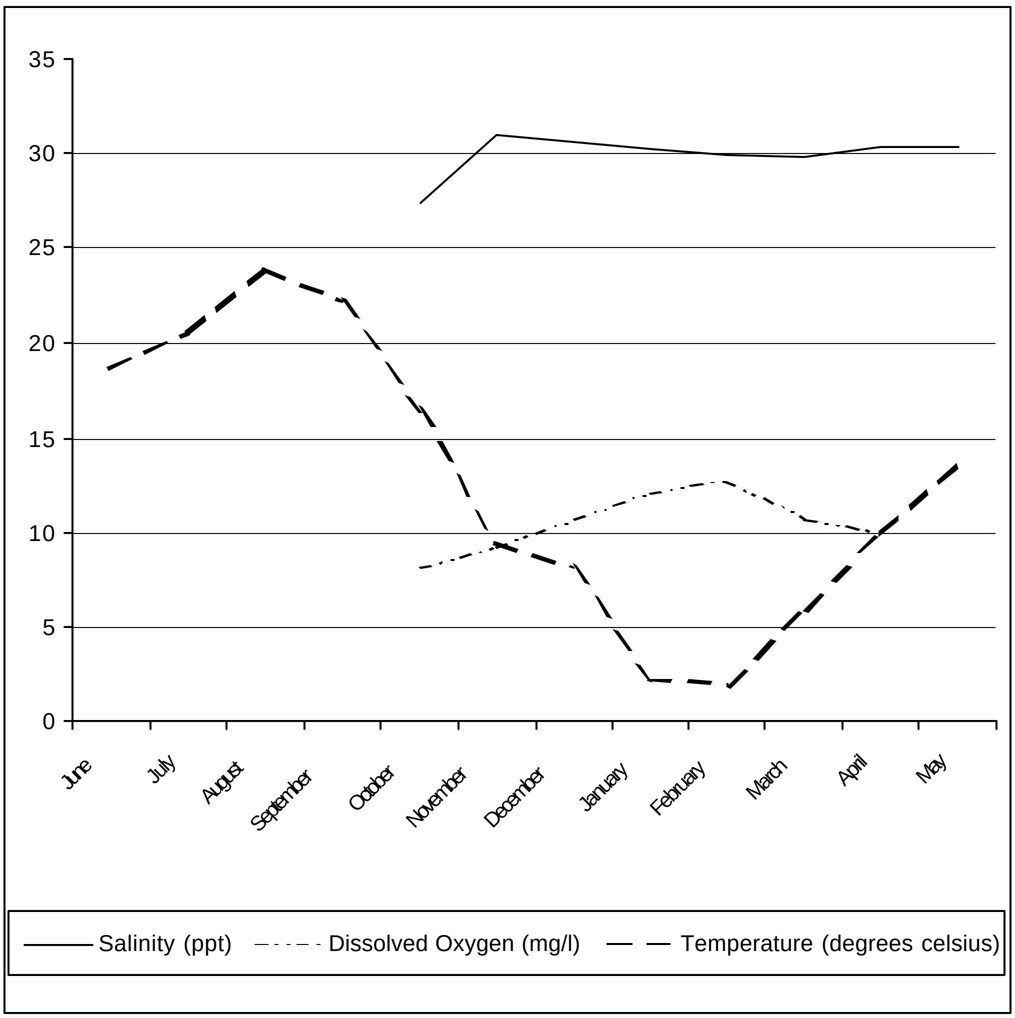


Figure 5-7. Mean Salinity, Dissolved Oxygen and Temperature at Stations NS1-3 and NT1-5 in New Bedford/Fairhaven Harbor (NAI 1999)

Table 5-2: Results of Surface Water PCB sampling throughout New Bedford/Fairhaven Harbor and Buzzards Bay in 1987

Sampling Station No.	Sampling Location	Concentration (ng/l)[1]
1	Upper Harbor: Acushnet River just south of Wood St. Bridge	7635
2	Upper Harbor: North of Coggeshall Street Bridge	1021
3	Upper Harbor: South of Coggeshall Street Bridge	269
4	Upper Harbor: Middle	209
5	Lower Harbor: West of Popes Island	170
6	Lower Harbor: Northeast of Popes Island **(Closest sampling station to Popes Island CAD Site)**	318
7	Lower Harbor: North-central	93
8	Lower Harbor/Outer harbor Interface	142
9	Lower Harbor East **(Closest sampling station to Channel Inner Site)**	91
10	@ Hurricane Barrier entrance	111
11	West Side of Outer Harbor	90
12	Outer Harbor Channel - North End	46
13	East Side Outer Harbor	15
14	Outer Harbor Channel - Middle	26
15	Outer Harbor Channel - South End	14
16	Clark's Point Sewer Outfall	25
17	Clark's Cove	12
18	Buzzards Bay	5

Source: Batelle Oceanic Sciences (BOS)**.** *In*: EBASCO (1990).
[1] ng/l = nanograms per liter or parts per trillion
Notes: Highlighted values exceed Alternate Water Quality Concentrations (chronic effects on aquatic life at 30 ppt.) The decreasing concentrations in water from estuary to Lower Harbor and Buzzards Bay correlate with the decrease in sediment concentrations in the same direction.

Biological Parameters

Chlorophyll *a* concentrations range from 10 mg/m^3 in nutrient enriched embayments of Buzzards Bay to 1 - 2 mg/m^3 at the mouth of the bay (Howes and Goehringer, 1996). The western shore of New Bedford/Fairhaven Harbor is a likely source of nutrient input as reflected by the relatively high annual primary production rates of 360 g C m^{-2} $year^{-1}$ as compared to the eastern shore of the harbor (106 g C m^{-2} $year^{-1}$) or baywide (230 g C m^{-2} $year^{-1}$). High temporal and spatial variability in chlorophyll concentration is characteristic of shallow near shore embayments, caused by fluctuations in riverine inflow, wind-driven turbulence, or patchy nutrient distribution. The first and largest bloom typically occurs in late winter to early spring with the warming of surface waters and the introduction of nutrients from freshwater inflow. In New Bedford/Fairhaven Harbor, seasonal patterns and bloom conditions similar to those reported for other estuaries within the same ecoregion (i.e.: Atlantic temperate climates) are expected. Seasonal variation in phytoplankton production are illustrated by chlorophyll *a* concentrations in surface water. Therefore, the western side of the Outer Harbor is more susceptible to nuisance algal blooms than other areas of the Outer Harbor. The Upper and Lower Harbors are also susceptible for this same factor but with the added disadvantage of reduced tidal flushing compared to the Outer Harbor. Nevertheless, nuisance algal blooms (e.g. red tides) historically have not had a significant impact on biological resources in Buzzards Bay to date (Howes and Goehringer, 1996).

5.3.1.4 Sediment Quality

Sources of potential contamination within New Bedford/Fairhaven Harbor were evaluated during the Due Diligence review in Phase I of the Dredged Material Management Plan (Maguire, 1997). As part of the Due Diligence review, a database search of existing local, state, and federal environmental files for reported releases of regulated substances (e.g. oil, hazardous chemicals) was conducted. The results of this review revealed thirteen (13) reported hazardous or other regulated material release incidents for New Bedford/Fairhaven Harbor. However, details regarding the identity, quantity and exact location of release for some incidents are incomplete. Available details regarding these releases (as recorded on the incident reports) are provided in Table 5-3.

The shoreline of New Bedford/Fairhaven Harbor is a dense mix of residential, commercial and industrial land uses (Maguire Group Inc., 1997). Within this developed area, there are 23 facilities permitted to discharge wastewater under the National Pollutant Discharge Elimination System (NPDES) within the New Bedford/Fairhaven Harbor area. The remaining sites are classified as a minor discharge source and are also located throughout the harbor's commercial areas. Existing and historical combined sewer outfalls or CSOs (see above) have also likely contributed pollutants to the Inner and Outer Harbors as well. Collectively, all these point sources have resulted in the discharge of heavy metals, PCBs, PAHs, and nutrients to the harbor. These contaminants are all detectable in the harbor's sediment (Figure 5-8).

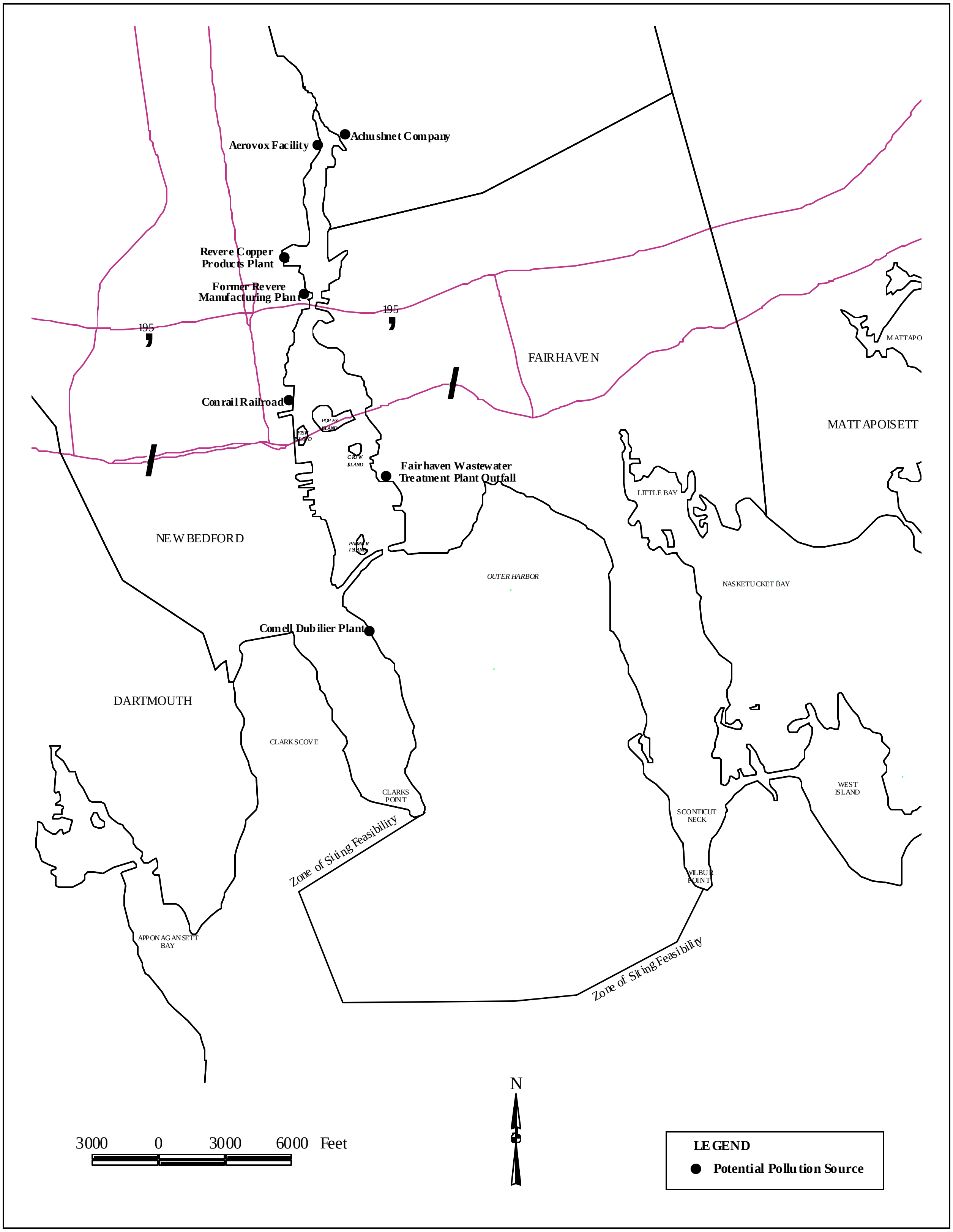


Figure 5-8: Primary Pollution Sources

Table 5-3: Reported Releases of Hazardous and Other Regulated Materials within New Bedford/Fairhaven Harbor from 1990 to 1997.

State or Federal Incident ID #	Location as Reported	Report Date	Material	Quantity	Units
3149	State Pier	7/17/90	unknown	251-500	gallons
2399	Fish Pier/ Leonard's Wharf	2/25/91	Diesel Fuel	10-50	gallons
2257	New Bedford Harbor	8/10/91	no. 2 fuel oil	unkown	unknown
2919	Seafood Coop	2/16/92	no. 2 fuel oil	1001-5000	gallons
2835	Palmer's Cove	3/8/92	Petroleum	unknown	gallons
3138	Steamship Pier	3/24/92	Petroleum	unknown	gallons
3136	State Pier No. 3	4/7/92	Petroleum	unknown	unknown
1733	Near Steamship Pier	4/28/92	Diesel Oil	100	gallons
3137	State Pier	8/12/92	Petroleum	unknown	unknown
3142	Pier 3	11/27/92	Petroleum	unknown	unknown
3166	North of State Pier	8/14/93	Waste Oil	1-10	Drums
2386	Fairhaven Bridge, Rt. 6	2/14/94	Oil	55	gallons
1424	North Terminal, New Bedford Harbor	6/7/96	Oil	Sheen: 1/4 x 1/4	miles

Source: Maguire Group, 1997

Sediment quality testing conducted in New Bedford/Fairhaven Inner Harbor Federal Channel in 1997, confirmed the presence of heavy metals (total copper, cadmium, lead, and total PAHs and PCBs in excess of Massachusetts Bay Disposal Site Reference Criteria.) These results were anticipated due to the proximity of adjacent waterfront pollution sources, and the historic sediment contamination in this area (Maguire Group 1997). Table 5-4 lists the average sediment contaminant concentration within each proposed preferred aquatic disposal site.

Table 5-4: Selected Surficial Sediment Chemistry Sampling Results
New Bedford/Fairhaven Harbor

Parameter	Units	Channel Inner CAD	Popes Island North CAD	Sampling Depth as Reported	Data Source	MBDS Reference
% Fines (silt/clay)	%	66.9 - 91.2	N/A	0 - 4 ft	MGI (1998)	88%
Arsenic	mg/kg	6 - 10	N/A	0 - 4 ft	MGI (1998)	28.7
Cadmium	mg/kg	0.39 - **5.7**	N/A	0 - 4 ft	MGI (1998)	2.74
Chromium	mg/kg	37 - **250**	N/A	0 - 4 ft	MGI (1998)	152
Copper	mg/kg	**200 - 540**	**101 - 500**	0 - 4 ft; 0 - 2 cm at Popes Island North 2	MGI (1998); USEPA (1996) for Popes Island North 2	31.7
Mercury	mg/kg	**0.54 - 1.3**	N/A	0 - 4 ft	MGI (1998)	0.277
Nickel	mg/kg	11 - 33	N/A	0 - 4 ft	MGI (1998)	40.5
Lead	mg/kg	**78 - 160**	N/A	0 - 4 ft	MGI (1998)	66.3
Zinc	mg/kg	140 - **380**	N/A	0 - 4 ft	MGI (1998)	146
Total Metals (Cadmium, Chromium, Copper, and Lead)	mg/kg	N/A	0-500 in center embayment, 500-100 around outer perimeter	0-6 in	EBASCO (1990)	ng
Total PAHs	ug/kg	68.1 - **9010**	N/A	0 - 4 ft	MGI (1998)	2,996
Total PCBs	mg/kg	<1 @ NW corner; 10-50 @ SW corner	0-500 in center embayment	0-6 in	EBASCO (1990)	ng

ng = no guideline
N/A = Not Available - Site specific data to be collected for the FEIR
*numbers in **bold** are above MBDS reference*

Potential sources of pollutants remain in the harbor watershed, due to the number of high risk industries within the commercially developed areas surrounding the harbor. For instance, the known one hundred (100) state hazardous waste sites within the New Bedford/Fairhaven Harbor watershed have been responsible for the release of PCBs, petroleum hydrocarbons, volatile organic compounds, and heavy metals to the soil, surfacewater, groundwater, and sediment media around the harbor. These sites include numerous gasoline filling stations, automotive service stations, fuel companies; autobody repair shops, and various manufacturing and industrial facilities.

5.3.1.5 Harbor Superfund Project

The Acushnet River watershed is the most urbanized area in the Buzzards Bay drainage basin and New Bedford/Fairhaven Harbor is the most contaminated area in the drainage basin (USEPA 1999). The harbor is contaminated with metals and organic compounds, including polyhlorinated biphenyls, commonly known as PCBs. Because of the high concentrations of PCBs in the sediment, the harbor was listed as a Superfund site in 1982.

The New Bedford Harbor Superfund Site is an 18,000 acre urban estuary reaching from the upper Acushnet River into Buzzards Bay (Figure 5-9). The cleanup of the Superfund site has been divided into three phases or "operable units": the hot spots, the upper and lower harbor and the outer harbor areas (Buzzards Bay area) (USEPA 1999). At the present time, there are no further plans to deal with sediments contaminated by chemicals other than PCBs (USEPA 1999).

In the late 1930s and early 1940s, two electronic parts manufacturers occupied empty textile mill buildings on the waterfront in New Bedford (Aerovox Corporation in 1939 and Cornell-Dubilier in 1941). These companies used PCBs in the manufacture of capacitors and discharged waste directly into the surrounding waters until the late 1970s, when the use of PCBs was banned by the EPA (USEPA 1999). As a result, the harbor is contaminated in varying degrees for at least 6 miles, from the upper Acushnet River into Buzzards Bay (USEPA 2002).

Other industries also released metals and organic compounds into the harbor. The impact of the development of the watershed combined with the construction of the hurricane barrier have effected sedimentation patterns, increased water residence times and altered water circulation patterns, permanently altering the ecology of the harbor.

In 1994, five of the most contaminated areas containing PCB-contaminated sediment (14,000 cy) were removed from the Acushnet River by the USACE (USEPA 2000). The hot spot sediments were ultimately disposed of at an offsite TSCA permitted facility in New York State (USEPA 2000). The USEPA, in September 1998, selected a dredging and shoreline containment method (CDFs) for approximately 450,000 cy of contaminated sediment, north of the hurricane barrier (USEPA 2000). Currently, the USEPA is now exploring another alternative, the upland disposal of the remaining Superfund material. The EPA will conduct additional investigations of the outer harbor (Buzzards Bay area) to determine if cleanup actions are necessary in the outer harbor.

Based upon many years of research and analysis of sediment contaminants, the USEPA has determined that presence of PCBs in the harbor poses threats to ecological and public health (see Section 5.3.12). As part of the remedy to restore the health of the harbor, target cleanup levels (TCL) were established for various portions of the harbor. The TCL for PCBs in the Lower Harbor has been set at 50 ppm. Evaluation of material to be dredged as part of the DMMP, while not suitable for open ocean disposal was also determined to be below the TCL and is therefore not Superfund material. Detailed discussion of sediment tested for the DMMP is included in Section 3.3.2.

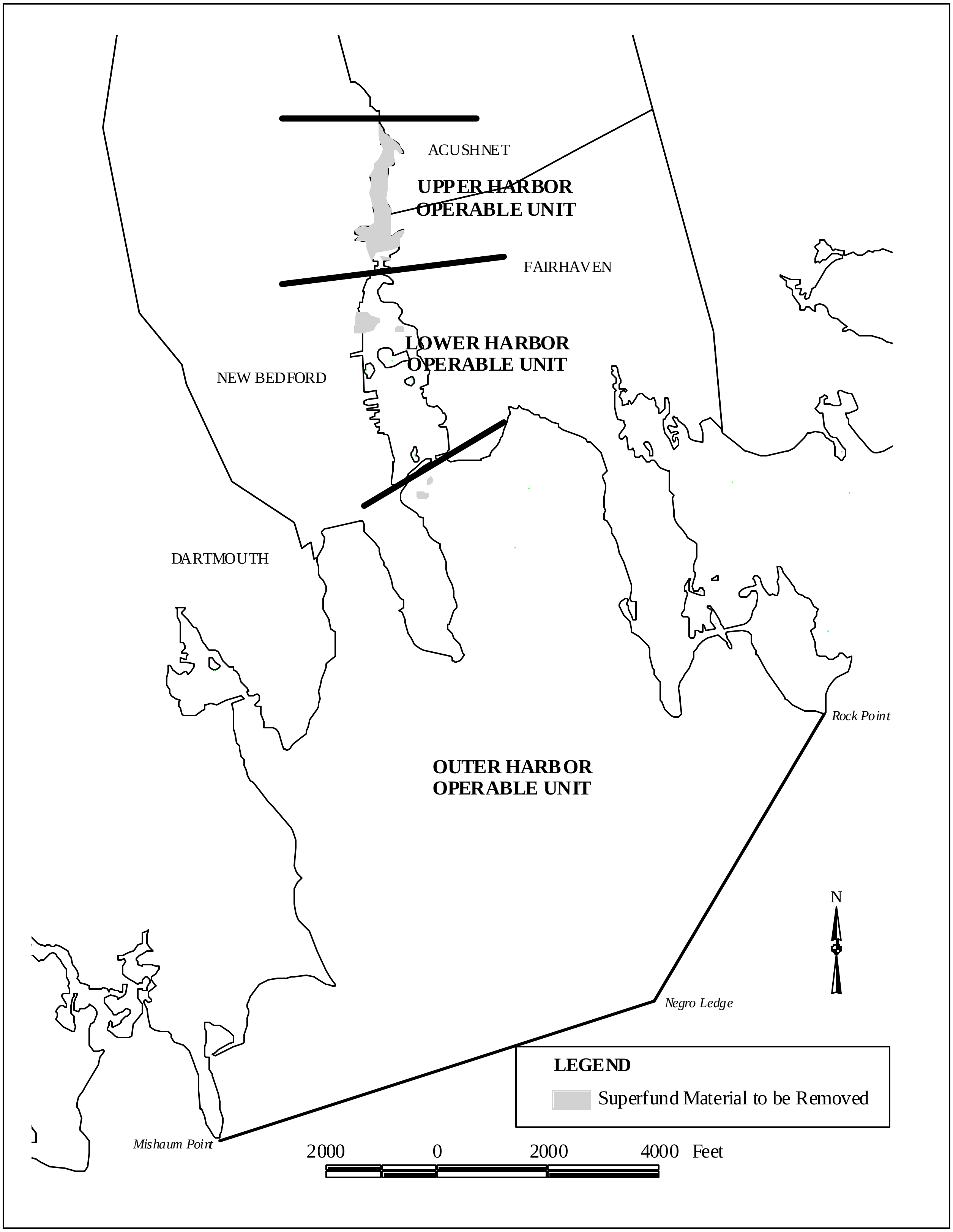


Figure 5-9: Harbor Superfund Project

5.3.2 Benthos

5.3.2.1 General

The term benthos refers to the community of organisms living in or on top of the sediments. For the purposes of this report, the term does not include finfish, although some finfish may live on the bottom (e.g. winter flounder). Benthic organisms include those valued for human consumption such as lobsters, clams, mussels, as well as many non-commercial species such as segmented worms, other bivalves, and various crabs.

The benthos of New Bedford/Fairhaven Harbor is discussed in four categories. First, the overall benthic habitat is described based on a REMOTS® survey (Valente, 1999) done in 1998 for this project. Second, the benthic invertebrate communities of the Upper, Lower and Outer Harbors are described. Third, the commercially and recreationally harvestable mollusks are discussed based on surveys conducted as part of DMF and other studies. Information regarding benthic invertebrates and benthic invertebrate habitat include the following sources:

- Habitat characterization of the DMMP Candidate Aquatic Disposal Sites report to MACZM (Valente, 1999);
- Massachusetts Division of Marine Fisheries Designated Shellfish Growing Areas (MADMF, 1999)
- The DMMP, Phase I (Maguire Group, 1997).
- Ecological Profile of Buzzards Bay (Howes and Goerhinger, 1996).
- Quahog Standing Crop Survey - New Bedford Inner and Outer harbors. Commonwealth of Massachusetts. Division of marine Fisheries (Whittaker, 1996).
- Dredged Material Management Plan Quahog Resources Survey for New Bedford and Fall River (NAI, 1999).

5.3.2.2 Benthic Habitat Conditions

In an effort to gain some general information on benthic habitat conditions at the candidate aquatic disposal sites Valente, et. al., (1999) conducted REMOTS® sediment-profile imaging surveys. The REMOTS® system uses a specialized camera to photograph a vertical cross-section of the seafloor to a depth of 15 to 20 cm. Data obtained from the photographs include sediment type, presence of macrofauna, presence of methane bubbles, and depth of oxidized sediments. The depth of oxidized sediments is apparent in the photographs as the boundary between colored surface sediment and underlying gray to black sediment, called the apparent redox potential discontinuity (RPD). The depth of the RPD is increased by the presence of bioturbating macrofauna. The foregoing parameters can be used to determine habitat type and infaunal successional stages, and to calculate an Organism-Sediment Index (OSI), an indicator of habitat quality of soft-bottom benthic environments. OSI values of less than 0 indicate degraded habitat quality, values of from 0 to +6 reflect intermediate quality, and values greater than +6 are indicative of good quality or healthy benthic habitats. During REMOTS® sampling, various sampling locations were chosen including stations within or adjacent to the current Proposed Preferred Aquatic Disposal Sites (Figure 5-10).

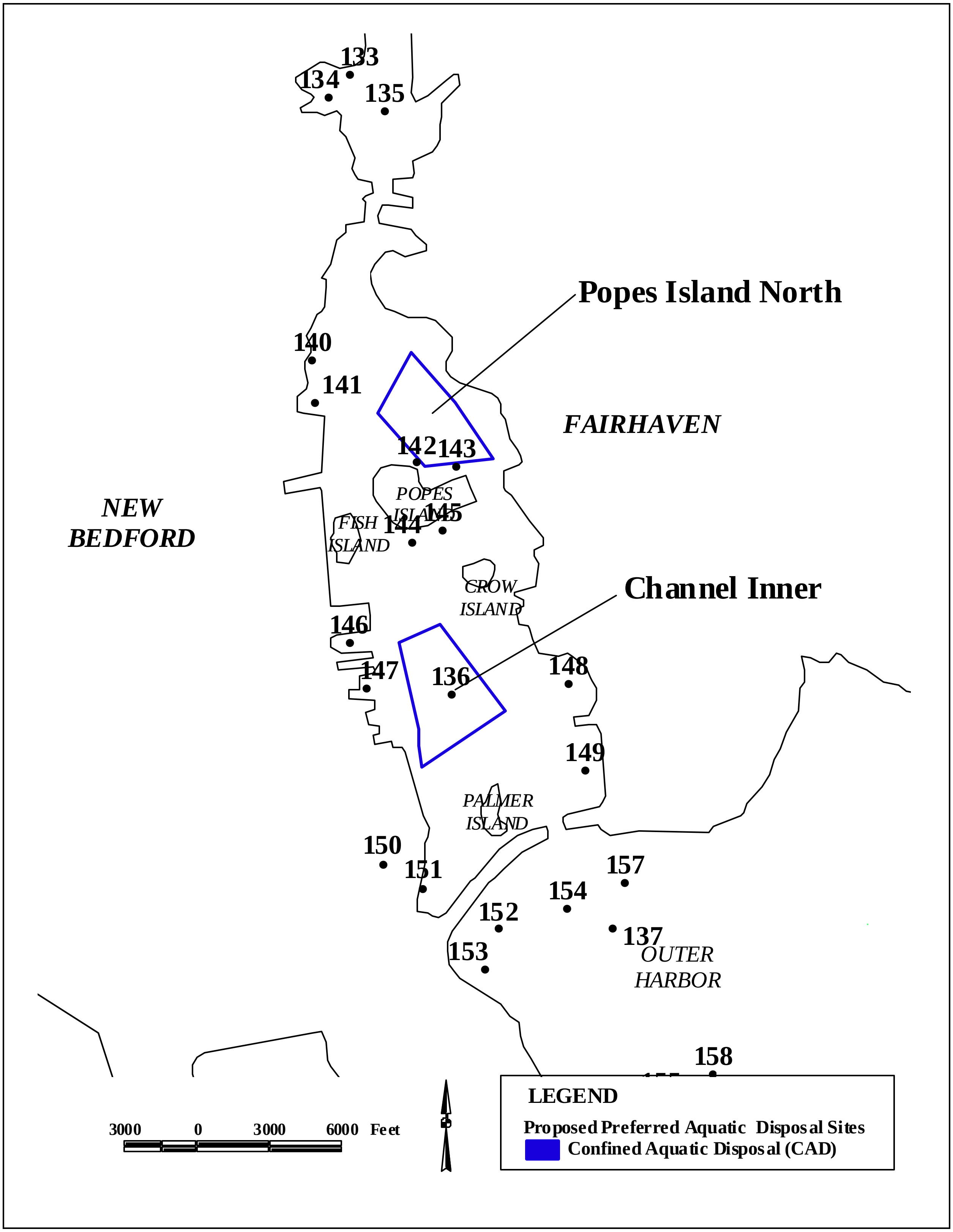


Figure 5-10: REMOTS Sediment Profile Images

Delineation of the Proposed Preferred Aquatic Disposal sites was conducted after REMOTS® sampling. One REMOTS® station was located at the Channel Inner site, (Station 136: two replicates), and two REMOTS® sampling sites were located proximal to the Popes Island North Site; one on the west end of the site (Station 142: four replicates) and one on the east end of the site (Station 143: four replicates). The results of the REMOTS® imaging obtained at each sampling station within or proximal to the Proposed Preferred Aquatic Disposal Sites are presented in Table 5-5.

The images indicate that the Channel Inner site is characterized by unconsolidated, fine-grained sediment having a grain size major mode of >4 phi (i.e., silt-clay). This resulted in the habitat type being classified as "UN.SF". The predominance of fine-grained sediment, and the geographical location of the site indicates that this is a depositional sedimentary environment.

The mean depth RPD depth ranged from 1.94 cm at Popes Island North to 2.1 cm at Channel Inner. These are moderate RPD values indicative of limited sediment aeration. The change in optical reflectance (i.e., color contrast) between the light-colored, aerobic surface sediment and the underlying dark, anoxic sediment is distinct in each image (Figures 5-11a-b). The black color of the underlying sediment suggests a high inventory of sulfides and high sediment oxygen demand, possibly related to elevated levels of organic loading within the Inner Harbor.

The REMOTS® infaunal successional stage was consistently determined to be Stage I images obtained from each REMOTS® sampling station within or proximal to the sites. The Stage I designation is due to the presence of small, opportunistic, tubicolous polychaetes at the sediment surface. Stage III organisms were evident in only one Channel Inner image. Both Stage I and Stage III organisms can co-exist and are known to exploit the fine-grained, organic-rich, soft mud which characterizes the sites. The presence of larger-bodied, Stage III infauna helps to explain the relatively well-developed RPD depths at the Channel Inner Site (compared to RPD values of <2 at the northern limits of the Inner Harbor). The feeding and burrowing activities of Stage III deposit feeders (bioturbation) result in increased sediment aeration and hence deeper RPD depths.

Mean OSI values at Popes Island North and Channel Inner were 4, indicative of moderately degraded habitat conditions. Stage I organisms were the dominant benthic type at these sites.

Table 5-5: Results of the REMOTS® Imaging Obtained at Sampling Stations within or Proximal to the Proposed Preferred Aquatic Disposal Sites

Proposed Preferred Aquatic Disposal Site	REMOTS® Station Nos.	Dominant Benthic Invertebrate Successional Stage	Median Grain Size	Mean RPD (cm)	Mean OSI	Dominant Habitat Type/ quality
Channel Inner	136	Stage I	>4 f	2.1	4	UN.SF/ moderately degraded, recently disturbed
Popes Island CAD	142 (West End) 143 (East End)	Stage I	4 to 3 f	1.94	4	UN.SI/ moderately degraded, recently disturbed

Key:
- RPD: Redox Potential Discontinuity (Refer to Text for Definition)
- OSI: Organism-Sediment Index (Refer to Text for Definition)
- UN.SI Silty Soft Bottom
- SH.SI Shell Bed over silt
- UN.SF Muddy Soft Bottom

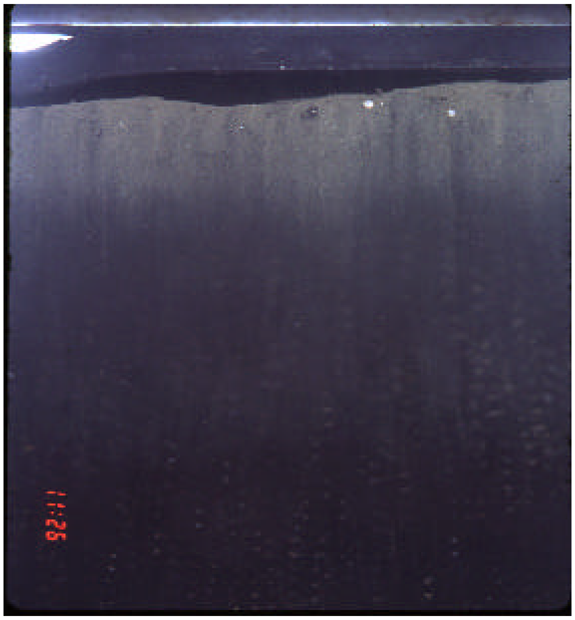


Figure 5-11a. Sediment Profile Image from Station 136 at Channel Inner Site.

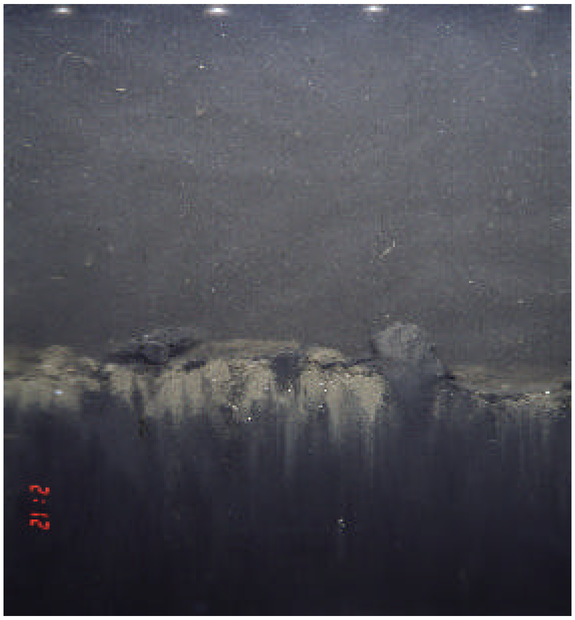


Figure 5-11b. Sediment Profile Image from Station 143 at Popes Island North Site.

5.3.2.3 Benthic Invertebrates

The benthic invertebrate fauna of the Massachusetts coast south of Cape Cod are characteristic of the Atlantic temperate biogeographical region, which has warmer temperatures and longer summer warming, and therefore a larger annual temperature range, than waters north of Cape Cod (the boreal ecoregion). Waters from Cape Cod south to Cape Hatteras, North Carolina lie within the Virginia Province of the American Atlantic Temperature Region. Many boreal species reach the southern limit of their range at Cape Cod, and it is there that many temperate species reach their northern range limit (Gosner, 1978).

Comprehensive benthic invertebrate sampling was not done, *per se*, at any of the candidate disposal sites. However, previous studies in the region (USEPA, 1996) contain some information on the abundance and type of benthos in New Bedford Harbor. Still other ancillary information was generated during other studies conducted for this project. For instance, REMOTS® sampling, conducted within New Bedford Harbor as part of this project, revealed general habitat conditions within or proximal to various candidate aquatic disposal sites within the ZSF, including the vicinity of the proposed preferred aquatic sites. The REMOTS® sampling survey did not identify or quantify the species of benthic fauna in New Bedford Harbor, rather, it provided evidence on the ecological roles of the present species, so that conclusions on community structure could be made (Refer to Section 5.3.2.2 - Benthic Habitat Conditions). Further site specific benthic investigation will be conducted within the preferred site footprints and this information will be included in the FEIR.

Based on information obtained from Mass GIS databases and information collected from ancillary studies for this project (e.g. habitat characterization via REMOTS® sediment profile imaging), various economically important benthic invertebrate species are expected to occur within New Bedford Harbor and, therefore, warrant attention for potential environmental impacts associated with UDM disposal in the Harbor (Table 5-6).

Table 5-6: Important Invertebrate Species of Economic Importance Warranting Attention in New Bedford Harbor from UDM Disposal Impacts

Common Name	***Scientific Name***
Quahog	*Mercenaria mercenaria*
Soft-shelled Clam	*Mya arenaria*
Bay Scallop	*Aequipecten irradians*
American lobster	*Homarus americanus*
Channeled Whelk (Conch)	*Busycon canaliculatum*

Source: Howes and Goehringer (1996)

The results of previous benthic invertebrate studies conducted in New Bedford Harbor by USEPA (1996) illustrate the composition of the benthic invertebrate community among the Upper, Lower and Outer Harbor areas. The Upper harbor is dominated by three species of invertebrates which are (in order of abundance): the marine polychaete worm *Streblospio benedicti* the dwarf surf clam, *Mulina lateralis*, and the gem shell *Gemma gemma*. The benthic community in many areas of this harbor segment is characterized by low evenness (i.e., unequal distribution of total individuals among the species present in the population) and low species richness (i.e., low total number of species when compared to other benthic invertebrate communities within the same faunal region)(USEPA, 1996). An average of 20 species per sampling station were identified in the Upper Harbor during systematic benthic invertebrate sampling. The Upper Harbor benthic invertebrate community was also found to be disturbed, using the EMAP Benthic Index metric (USEPA, 1995). The average EMAP benthic index of the Upper Harbor was found to be -5.7. A negative value indicates a disturbed community (either by natural or anthropogenic stresses). By comparison, a value of -2.7 was reported for the lowest 1 percentile of all sites measured in the Virginian Province. Based on the data collected, the USEPA (1996) study determined that the Upper Harbor benthic invertebrate community was highly impacted.

The benthic invertebrate community of the Lower Harbor segment is dominated by five invertebrate species which are (in order of abundance): the dwarf surf clam, *Mulina lateralis*; the marine polychaete worm *Streblospio benedicti*; an unidentified oligochaete; a capitellid threadworm polychaete *Mediomastus ambiseta* and the commercially important quahog, *Mercenaria mercenaria*. Species richness was comparatively higher in the Lower Harbor than the Upper Harbor with an average of 31 species identified per station in the Lower Harbor. Furthermore, the average EMAP benthic index (-1.4) suggested the Lower Harbor community to be impacted, but to a lesser degree than the Upper Harbor. However, within the Lower harbor, the benthic community within the limits of the Popes Island North Proposed Preferred Aquatic Disposal site was found to have a low index of community health (< -2.7). The EMAP Benthic Index for the Channel Inner site was determined to be moderate (i.e., between -2.7 and 0.0)(USEPA, 1996).

The Outer harbor had the highest species richness (an average of 72 species per station), the highest number of dominant species (16), and a positive average benthic EMAP index value (1.9), suggesting that the benthic invertebrate community was ecologically healthy. The assemblage of dominant species in the Outer Harbor represented additional taxa of marine invertebrates, some of which were not represented in the Lower and Upper Harbor communities. Examples include the gastropod molluscs, *Haminoea solitaria, Crepidula fornicata, Odostomia seminuda*; the cirratulid polychaete *Tharyx acutus*; the nephytid polychaete *Nephyts incisa*; the spionid polychaete *Scololepis texana*; the syllid polychaete *Parapionosyllis longicirrata*; and various pelecypod molluscs. Results of the ecological parameters measured in the USEPA (1996) study are summarized in Table 5-7.

Table 5-7: Ecological Parameters of the Upper, Lower, and Outer New Bedford Harbor Benthic Invertebrate Communities

Parameter	Parameter Level	Upper Harbor	Lower Harbor	Outer Harbor	Comments
Total benthic abundance	Species	Highly variable among individual grab samples			
Average total abundance	Species	3,612	2,435	2,295	Values are similar
Species richness	Population	lowest (20 ± 7 species per station)	intermediate (31 ± 14 species per station)	highest (72 ± 21 species per station)	Difference in values is statistically significant
Number of dominant species	Population	3	5	16	# of dominant spp. = those spp. that collectively account for 75% of total abundance for each benthic community
Average benthic EMAP index value	Community	-5.7 (-2.5 to -0.2)	-1.4 (-4.3 to -0.3)	1.9 (-0.2 to 4.8)	-2.7 reported for lowest 1 percentile in Virginian Province
Summation		Community highly impacted	Community impacted, but to lesser extent than Upper Harbor	Community healthy, as evidenced by high species richness and positive EMAP index	Ecological health of benthic invertebrate communities improves along a gradient from Upper Harbor to Outer Harbor

Average total abundance = count of each animal of every species, summed for all grabs taken from each benthic community

Source: (USEPA, 1996)

5.3.2.4 Commercially and Recreationally Harvestable Mollusks

DMF Mapping of New Bedford Harbor Shellfish

In Buzzards Bay, the primary shellfish fisheries are quahogs, scallops, soft-shelled clams, and conch. According to results presented in the 1996 Quahog Standing Crop Survey - New Bedford Inner and Outer harbors of the Commonwealth of Massachusetts, Whittaker (1996) concluded that the New Bedford/Fairhaven Harbor area and vicinity supports a substantial commercial quahog fishery. Quahogs are found throughout New Bedford Harbor and Buzzards Bay and are the dominant commercially and recreationally harvested shellfish species (Figure 5-12). However, all of New Bedford/Fairhaven Harbor waters north of the hurricane barrier are closed to shellfishing (DMF, 1999).

Despite this restriction, existing shellfish beds may still provide seed for cleaner areas, or could become fishable areas if pollutant concentrations were to be reduced in the future. Three such areas have been identified by the DMF for New Bedford/Fairhaven Harbor. They are identified as Shellfish Contaminated Relay Areas Nos. 1, 2, and 3, corresponding to Primary, Secondary, and Tertiary areas of priority respectively (Figure 5-13).

Priority Area No. 1 lies adjacent to the Seawall along the southwestern (New Bedford) shoreline of the lower harbor and extends easterly to the New Main navigation channel. It is bounded to the south by the Hurricane barrier and to the northerly to an area approximately equal to the end of the seawall. The northeastern corner of this relay area overlaps the southeastern corner of the Channel Inner Site.

Whittaker (1999) sampled the New Bedford Harbor and Acushnet River estuary complex in order to identify important shellfish resource areas. In the Whittaker report, sampling areas for shellfish overlapped potential dredge material disposal sites. For instance, at the sampling station (I-3) that overlaps the Popes Island North disposal site, samples of benthic biota were found to support a significant percentage (i.e., greater than 30%) of the cherrystone size class of the quahog, and a significant percentage (i.e., greater than 20%) of the littleneck size class of the quahog. The soft-shell clam was also found to be abundant at this location. Also, at the sampling location (I-5) that overlaps the Channel Inner dredge disposal site, samples of benthic biota were found to support a significant percentage (i.e., greater than 30%) of the cherrystone size class of the quahog, and a significant percentage (i.e., greater than 20%) of the littleneck size class of the quahog.

Priority Area No. 2 lies adjacent to the east side of the lower harbor along the Fairhaven waterfront from the hurricane barrier north to the Fairhaven Shipyard. It extends westerly to the main navigation channel. This priority area does not overlap any of the proposed preferred aquatic disposal sites.

Priority Area No. 3 lies adjacent to the south shore of Popes Island. It extends southerly to a point just south of Crows Island. It is bounded to the west by the New Bedford Reach of the main navigation channel and tp the east by the Fairhaven shoreline. This priority area does not overlap any of the proposed preferred aquatic disposal sites. Portions of the Popes Island North site lie within both quahog and mixed soft shell clam/oyster/quahog habitat, but outside of any Shellfish Contaminated Relay Areas.

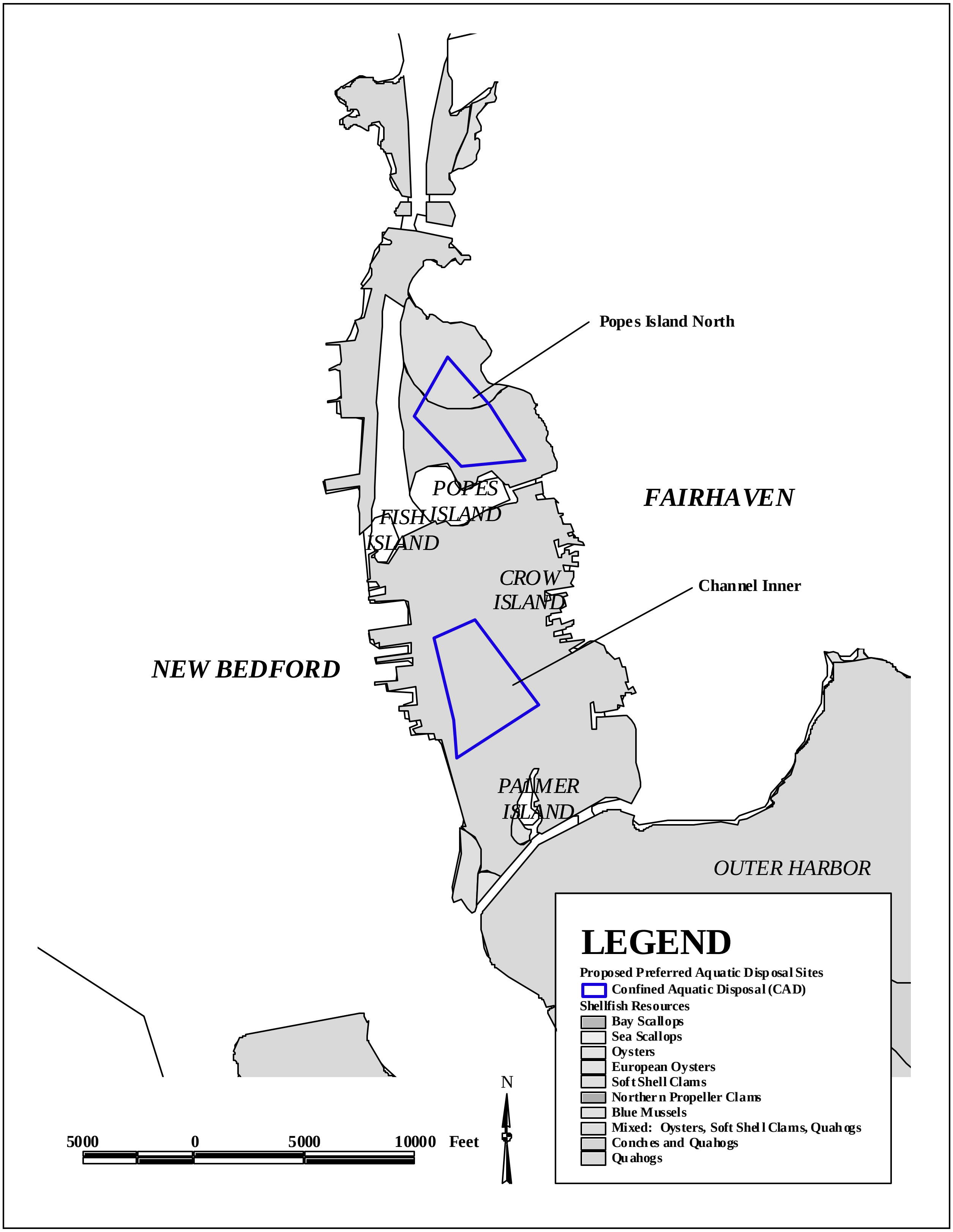


Figure 5-12: Shellfish Resources in New Bedford/Fairhaven Harbor

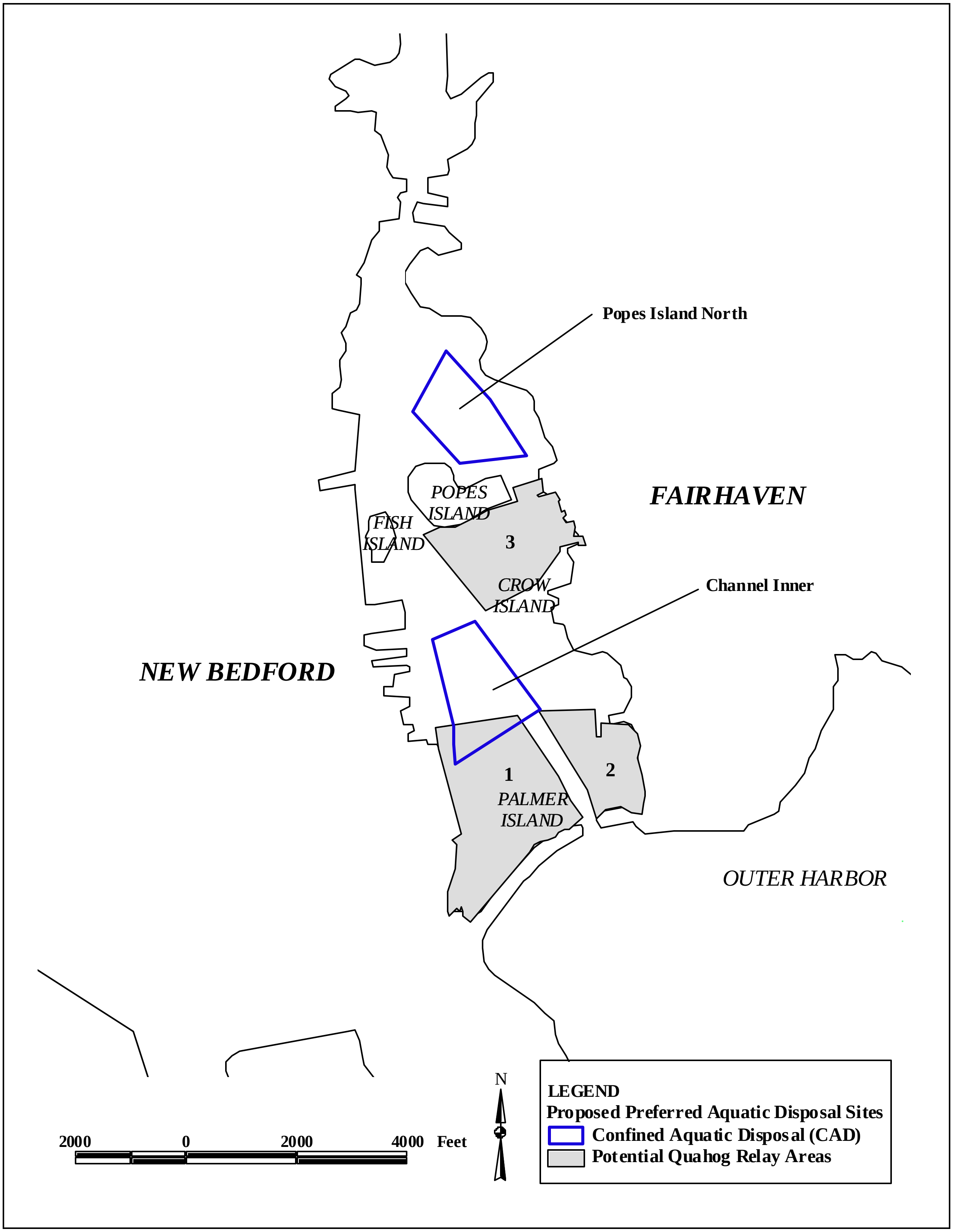


Figure 5-13: Potential Quahog Relay Areas

Sustainable Annual Quahog Yield

Whittaker (1999) predicted a continued decline in the quahog densities of “approved areas” within the Outer Harbor if present recruitment rates and market conditions remained the same or similar, and if harvesting continued at it’s current rate. The average annual commercial landings currently reported for New Bedford/Fairhaven Harbor are almost equal to the potential harvest. This has caused a diminished catch per unit effort as indicated by Whittaker (1999). A contaminated relay program administered by DMF has also contributed to the reduction of the harbor’s quahog standing crop. Whittaker also identified hydraulic harvesting as a potential impact to quahog settlement and growth due to the negative effects of sediment resuspension, subsequent deposition of silt and redistribution of the predominately mud substrate. Both Proposed Preferred Aquatic Disposal Sites overlap known quahog habitat. Sedimentation plumes generated during disposal may have a negative impact on larval dispersal, recruitment and development within these areas and within nearby approved harvesting areas.

The results of a Quahog resources survey for New Bedford and Fall River (NAI, 1999) revealed quahog densities similar to those reported in an earlier study (DeAlteris et. al., 1998) for tong sampling ($0.3/m^2$) and dredge sampling ($4.1/m^2$). Higher densities were found in Taunton River then in New Bedford. A trend of decreasing densities of smaller class sizes, especially the seed class, with distance down river was identified for the Taunton River, which was interpreted as an indication that upriver locations provide better habitat for seed quahogs.

Other Surveys

The results of the REMOTS® sampling did not identify benthic invertebrates to species level but did identify the successional stage of the benthic community. Within the area of the Lower Harbor sites (Channel -Inner and Popes Island North), REMOTS® sampling stations consistently revealed Stage I benthic community assemblages dominated by marine polychaetes. *Mulinia* shells were also noted at the Channel Inner site. An unidentified shell hash was found at the REMOTS® sampling station No. 143, on the east side of the Popes Island North site.

<u>5.3.2.5</u> <u>Lobsters</u>

Because all of the Harbor is closed to all fishing, including lobstering, the two Inner Harbor sites would have the lowest impact to lobster fishing of the New Bedford/Fairhaven Harbor region. Lobsters are abundant and the basis of productive fisheries in the New Bedford/Fairhaven Harbor and Buzzard’s Bay regions. Since lobsters are mobile and are found throughout the region, it is difficult to differentiate among the Proposed Preferred Aquatic Disposal sites on the basis of their potential impact to adult lobsters. Surveys of the marine resources of the New Bedford/Fairhaven Harbor areas, while reporting on the overall importance of the lobster fishery to the area, do not specify which sites or areas are more productive than others. However, very young lobsters tend to be more stationary than older juvenile and adults. These lobsters, referred to as early benthic phase (EBP) lobsters, are more susceptible to dredged material disposal activities.

Although early benthic phase lobster survey data from New Bedford/Fairhaven Harbor was not available for this project, their preferred substrate is known to be hard substrate such as cobble and boulder areas (Palma et. al., 1998). Sediment profile images obtained from the Popes Island North site revealed soft, unconsolidated silty habitat, while images from the New Bedford Channel Inner site revealed unconsolidated soft-bottom silt or soft mud. Therefore primary EBP lobster habitat does not appear to occur within the Proposed Preferred Aquatic Disposal sites. Primary EBP lobster habitat most likely occurs around known rock reefs and other hard bottom substrates located in the Outer Harbor and further seaward into Buzzard's Bay (Figure 5-14). Considering lobster preferred habitat and habitat characteristics in the Lower Harbor, the lobster population in New Bedford's inner harbor is not substantial.

5.3.3 Finfish

Because of the mobility of fish, the characterization of fish species within a specific area, such as the Proposed Preferred Aquatic Disposal sites is difficult. However, several studies give insight into the types, patterns, and behavior of the dominant fish species in the Buzzards Bay region and New Bedford/Fairhaven Harbor. This information, coupled with what is known about environmental conditions at the Proposed Preferred Aquatic Disposal sites (e.g. substrate type, water quality, water depth), allows for a reasonable characterization of finfish at and near the preferred aquatic disposal sites.

This Section discusses the following aspects of finfish activity in the Buzzards Bay Region and New Bedford Harbor:

C Regional Finfish Profile (Buzzards Bay);
C Summary of New Bedford Harbor boat trawl and beach seine survey data (June 1998 - May 1999);

- Diadromous fish activity;
- Nursery Potential;
- Fish Spawning Potential; and,
- Commercial and Recreational Fishing.

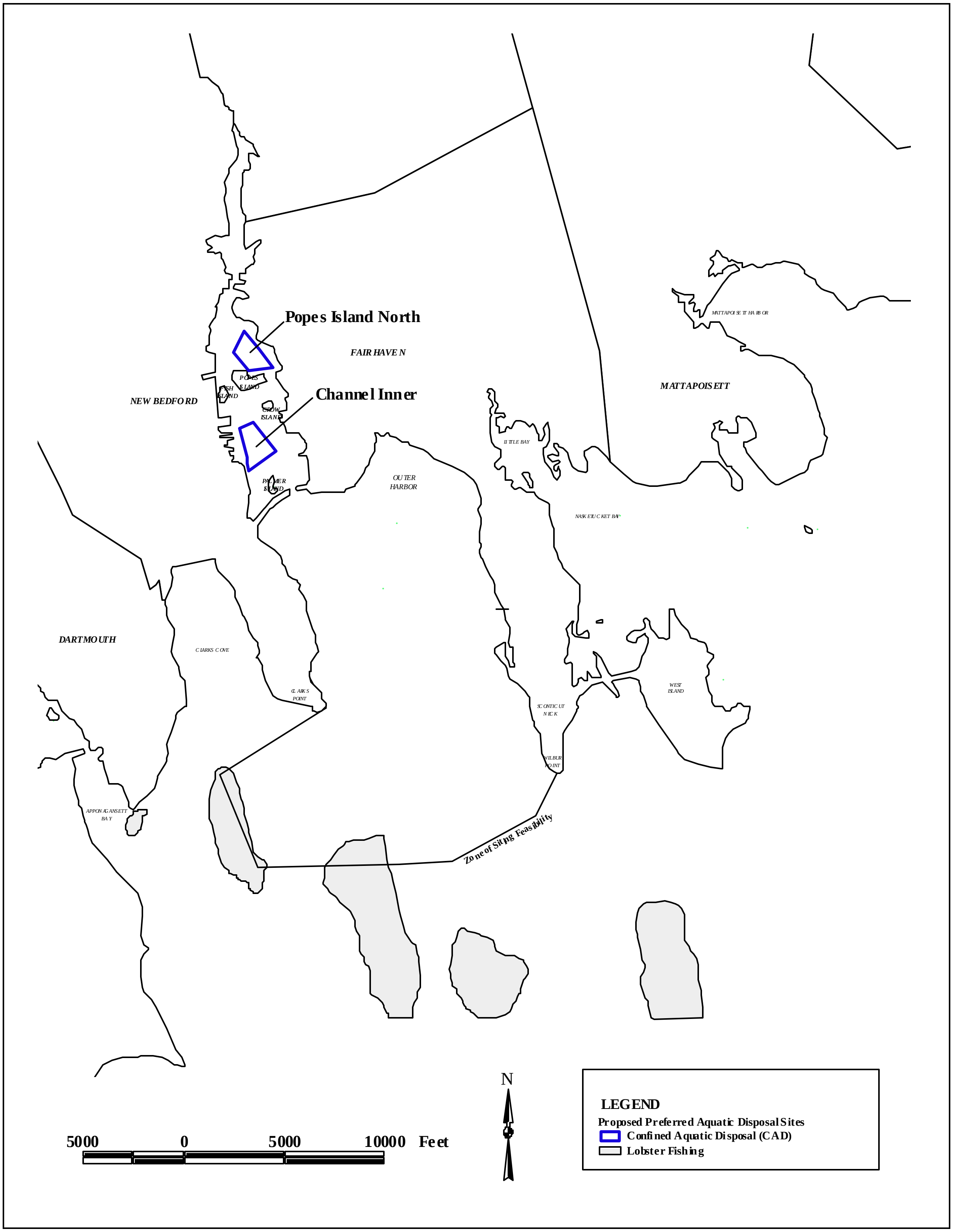


Figure 5-14: Lobster Fishing Areas

5.3.3.1 Regional Finfish Profile (Buzzards Bay)

As with the invertebrate fauna, the marine fish of New Bedford/Fairhaven Harbor are part of the Atlantic temperate biogeographical region. This region is characterized by moderate temperatures and longer summer warming, and therefore a wider annual temperature range than waters north of Cape Cod (the boreal region). Many northern species of fish reach the southern limit of their range at Cape Cod, and many southern species reach their northern range limit there as well.

Nearshore and deeper-water finfish populations within New Bedford/Fairhaven Harbor and vicinity have been the subject of various studies (Fiske et al. 1968; Giovani, 1973; Hoff and Ibara, 1977; Bellmer, 1988; EBASCO, 1990) the findings of which are summarized in the New Bedford Harbor Historic Overview Natural Resources Uses Status Report (VHB, 1996). Most studies reflect a subset of the finfish community reported for Buzzard's Bay by Stone et al. (1994). Howes and Goehringer (1996) reported 16 dominant fish species (Table 5-8) to inhabit Buzzard's Bay waters or associated salt marshes in the bay. Most of these species are also typical of New Bedford Outer Harbor waters, and many frequent the Inner Harbor as well. These species are identified as resident or non-resident (migratory) in Table 5-8.

Table 5-8: Dominant Fish Species Identified in Buzzards Bay (Howes and Goehringer, 1996)

Residents		**Non-residents**	
Common Name	**ScientificName**	**Common Name**	**Scientific Name**
Atlantic silverside	*Menidia menidia*	Alewife	*Alosa pseudoharengus*
Sheepshead minnow	*Cyprinidon variegatus*	Blueback herring	*Alosa aestivalis*
Atlantic herring	*Clupea harengus*	Atlantic menhaden	*Brevoortia tyrannus*
Winter flounder	*Pleuronectes americanus*	Tautog	*Tautoga onitis*
Mummichog	*Fundulus heteroclitus*	Black sea bass	*Centropristis striata*
Striped killifish	*Fundulus majalis*	Bluefish	*Pomatomus saltatrix*
Four-spined stickleback	*Apeltes quadracus*	Butterfish	*Peprilus triacanthus*
Scup	*Stenotomus chrysops*	Striped bass	*Morone saxatilis*

5.3.3.2 New Bedford Finfish Data

A complete record of finfish population trends in New Bedford Harbor is lacking due to prohibition of net fishing in the harbor waters nearly a century ago. The ban on net fishing eliminated catch records for this resource. Therefore, the MACZM and Normandeau Associates Inc (NAI) conducted a 12 month sampling study in New Bedford/Fairhaven Harbor waters between 1998 and 1999 to characterize the finfish population within the harbor during the cycle of seasons. The study consisted of the collection and analysis of seine and trawl samples collected from within the Inner and Outer Harbors. This sampling effort was coordinated with the Massachusetts Division of Marine Fisheries in order to be consistent with previous studies conducted by Fiske et al.(1968) and other previous sampling activities conducted in adjacent Buzzards Bay waters.

In the NAI study, all fish collected at each seine and trawl sample (Figure 5-15) were identified to species, counted, and measured for both total length to the nearest mm, and biomass to the nearest gram. 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 5-15). 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. The resources were calculated as a Catch Per Unit Effort (CPUE) based on the number of fish per haul. 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 comprised (16%), mummichog (9%), cunner (7%), and winter flounder (6%) of the fishes captured in nearshore New Bedford Harbor (Table 5-9).

CPUE of Atlantic silversides generally rose throughout the summer to a peak in abundance in August (Figure 5-16), 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 were 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 are 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 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, 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.

Table 5-9: 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 %**	**All Stations Combined (NS1-4) %**
Atlantic Silverside	45.2	33.4	54.1	43.6
Striped killifish	11.1	19.1	14.0	16.0
Cunner	--	10.2	5.8	7.5
Mummichog	--	17.9	--	8.7
Atlantic Menhaden	11.2	--	--	--
Black sea bass	--	6.8	--	--
Winter flounder	--	--	11.7	6.3
Northern kingfish	--	--	3.2	--
Northern puffer	6.3	--	--	--
Bluefish	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

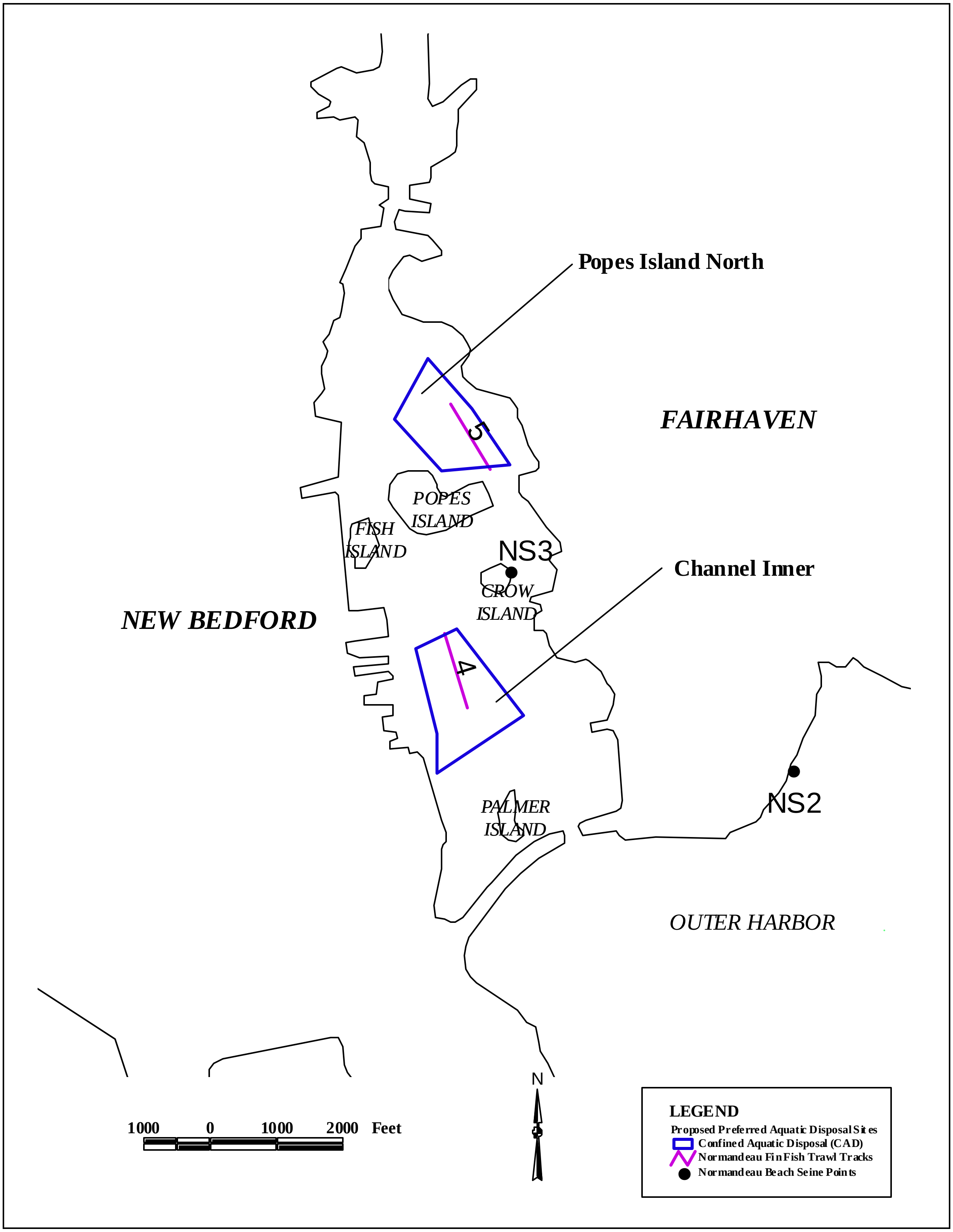


Figure 5-15: Beach Seine and Trawl Stations

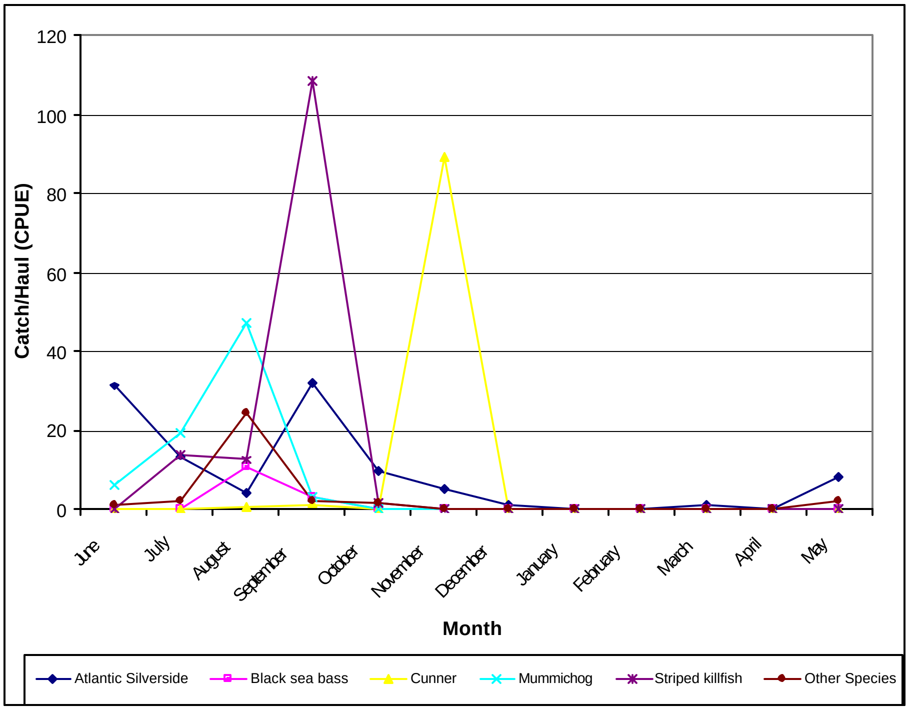


Figure 5-16: Geometric Mean Catch Per Unit Effort for Seine Samples in New Bedford/Fairhaven Harbor (NAI, 1999).

Trawl Samples

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 5-15. 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 light house 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% (NAI, 1999) (Figure 5-16). 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).

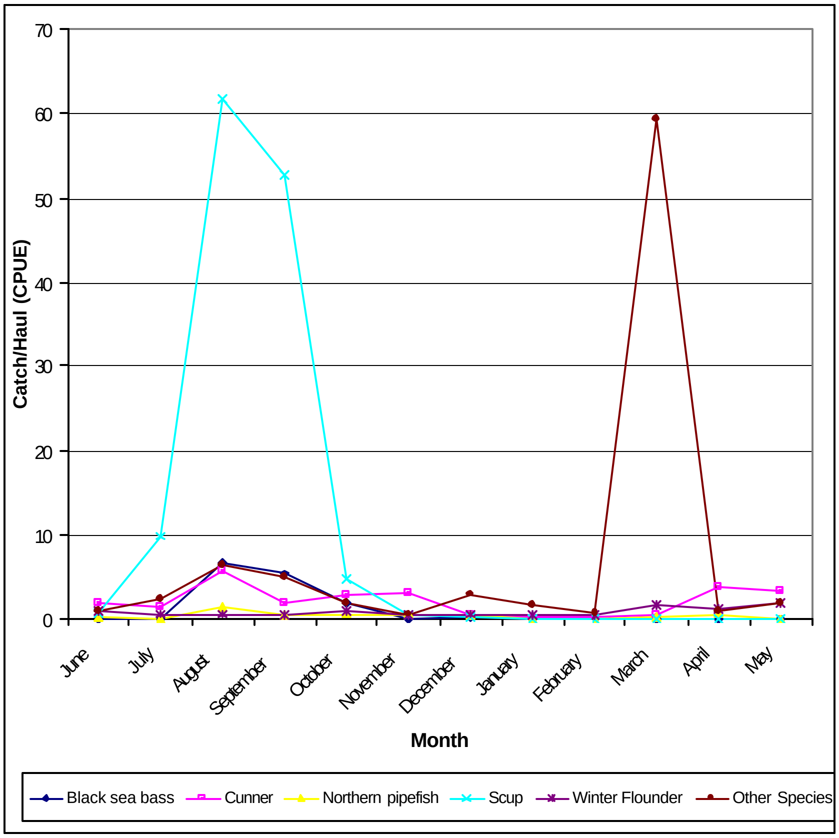


Figure 5-17: Geometric Mean Catch Per Unit Effort for Trawl Samples at Stations in New Bedford/Fairhaven Harbor.

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 (Figure 5-17). Highest CPUE occurred in August with scup dominating the catch. Recruitment of yong-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 station in CPUE, and the sample consisted mainly of scup (Table 5-10). Black sea bass, cunner and northern pipefish 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 5-10: Percent of fish caught in trawl samples taken in New Bedford Harbor from June 1998 through May 1999.

Species	Station NT1 %	Station NT2 %	Station NT3 %	Station NT4 %	Station NT5 %	All Stations combined (NT1-5) %
Atlantic herring	8.6	--	--	12.6	--	--
Atlantic silversides	--	10.3	8.7	--	8.1	--
Bay anchovy	--	--	--	--	6.5	--
Black sea bass	11.3	7.1	13.1	--	--	9.1
Butterfish	8.6	--	--	--	--	--
Cunner	10.7	34.0	30.1	18.2	--	20.8
Northern pipefish	--	4.6	--	13.4	--	6.0
Seaboard goby	--	--	--	--	9.5	--
Scup	35.3	25.3	26.8	17.3	--	23.4
Windowpane flounder	--	--	--	--	5.7	--
Winter flounder	--	--	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% 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 were 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 through May, and catches comprised of both one year and older fish.

Located in the Inner Harbor, east of the New Bedford Docks was sampling station NT4, which was highest in CPUE for all stations. The high ranking was in part related to the large captures of Atlantic herring in March. Cunner were 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, which was located in the Inner Harbor 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.
The fish species sampled in 1999 are typical of nearshore environments within Buzzards Bay.
For instance, the most common species sampled by Hoff and Ibara (1977) were also common in the NAI study. In addition, the most common fish captured in the NAI study were the silverside (*Menidia menidia*) and the mummichog (*Fundulus heteroclitus*). These results were similar to the monthly pattern of abundance reported for the Slocum River estuary (Hoff and Ibara, 1977), which is located approximately 10 km SW of New Bedford/Fairhaven Harbor. Findings reported for a similar study in the Westport River (Fiske et al, 1968) were similar to the findings reported in the NAI study for New Bedford (NAI, 1999). One species, the cunner (*Tautogolabrus adspersus*), is repeatedly observed in both the nearshore and deeper-water sampling efforts of various studies.

5.3.3.3 Diadromous Fish Activity

Four species (alewife, American shad, blueback herring, rainbow smelt) are diadromous in the Buzzards Bay area. Anadromous fish are those that migrate from the sea to breed in fresh water. Diadromous fish are those that, at any particular life stage, regularly move between freshwater and saltwater, spending part of their life cycle in each environment. 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 Buzzard Bay waters are the Blueback herring, striped bass (*Morone saxatalis*), white perches (*Morone americana*), and rainbow smelts (*Osmerus mordax*).

Recent finfish sampling in New Bedford Harbor has provided current data on diadromous fish activity within the New Bedford Harbor/Acushnet River estuary (NAI, 1999). Alewife were found to appear in trawl samples collected from the harbor in September, but were 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 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).

5.3.3.4 Nursery Potential

Certain intertidal and subtidal habitats are favorable for finfish nurseries because 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 important 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 large scale development and 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. Those that do survive migration to deeper warm waters in the winter, and 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 marsh residents. Typically, these fish will live several years and winter by burrowing or clinging to the bottom of creeks and marsh pools in brackish waters (Howes and Goehringer, 1996). All 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 all 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 disposal. 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 potential pathway to 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 is estimated using the following empirical formula (Wilbur, 1999):

HABITAT COMPLEXITY + JUVENILE PRESENCE = NURSERY POTENTIAL (HIGH, MODERATE, LOW)

Habitat complexity (1-12) is highest where there is variation in substrate conditions and greatest vertical structure. Juvenile presence (yes/no) is the dominant commercial, recreational and non-target organism collected in substantial numbers or apparent in similar habitat.

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.

5.3.3.5 Spawning Potential

Spawning periods for the most common fish and invertebrates within a given area are commonly used as a model for assessing overall marine fish spawning potential for that area. In fact, dredging is often limited to the times of year of decreased spawning, which is typically winter to spring. Many local surveys have identified important habitat associations (sand and cobble, eelgrass) that appear to be essential for the reproduction and development of fishes and invertebrates. Spawning potential within and proximal to the Proposed Preferred Aquatic Disposal Sites was estimated during this assessment based on available information obtained on substrate types, complexity, and water quality. The New Bedford Channel Inner and Popes Island North sites were determined to provide suitable spawning habitat for several fish species. Spawning activity at these sites is highest from May to September, and diadromous fish runs are present at particular times of the year.

New Bedford may support spawning winter flounder, since young of the year juveniles were found to co-dominate catches per unit effort during recent sampling (NAI, 1999), and the substrate types (mud to sand or gravel), depths (0.3 - 4.5m), temperature (3 - 5ºC), and salinity (10-32 ‰) regimes required by this species for spawning (Pereira, et al., 1999) occur within the harbor.

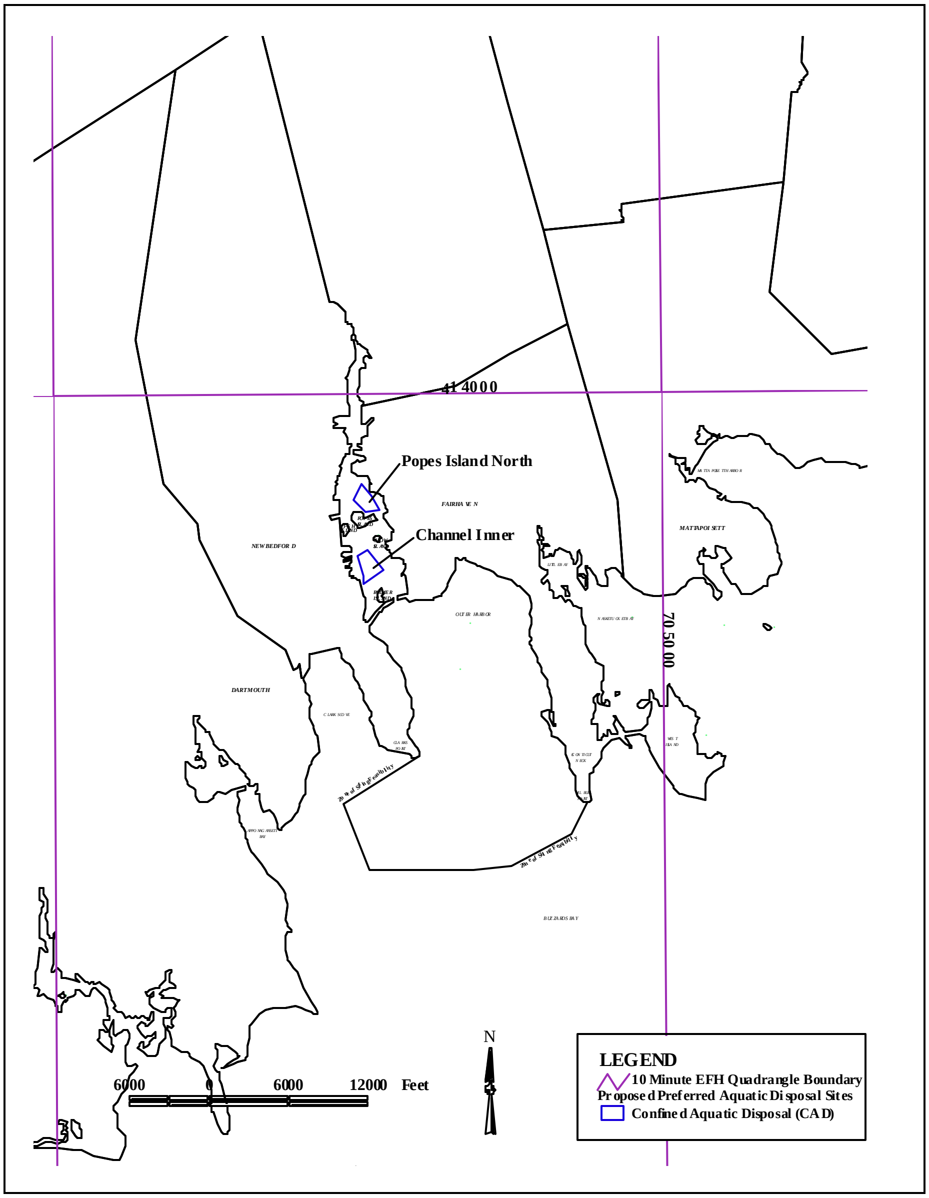
The seasonality of spawning for the dominant fish and invertebrates is an important factor in planning UDM disposal. For instance, dredging and disposal restrictions are imposed by DEP for Massachusetts coastal waters to protect the spawning activities of dominant finfish species within the region. Spawning for most of these organisms occurs in the spring, summer and early fall. As such, dredging has historically been limited to the late fall and winter season to protect spawning activities. The imposition of seasonal restrictions avoids impacts to sensitive eggs and larvae within the water column (pelagic) and on the seafloor (demersal).

Essential Fish Habitat (EFH)

The Magnuson-Stevens Act of 1976 (the Act) was passed in order to promote 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 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. 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 mapped and superimposed with ten minute by ten minute square coordinate grids (ten minute grid). New Bedford/Fairhaven Harbor lies within portions one 10'x10' grid areas designated as EFH for the New England Groundfish Management Plans (Figure 5-18).

All economically important fish species in which NFMS has determined will find suitable habitat within the ten minute grid are listed as EFH species. The habitat within a given ten minute grid must be essential to one or more life stages of the species, for the species to be listed as EFH to that coordinate. Within the designated grid for New Bedford/Fairhaven Harbor (including portions of Buzzards Bay), EFH for 20 species are designated within the established ten minute grid (Table 5-11). As part of the DMMP an EFH Assessment was conducted and is included in Appendix F.



10'' x 10'' Square Square Coordinates:

Boundary	***North***	***East***	***South***	***West***
Coordinate	41E/ 40.0'' N	70E/ 50.0'' W	41E/ 30.0'' N	71E/ 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 Barney''s 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.

Figure 5-18: EFH Ten Minute Grid for New Bedford/Fairhaven Harbor (NOAA,NMFS**)**

Table 5-11: New Bedford/Fairhaven Harbor EFH Designated Species

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
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: NOAA, NMFS

5.3.3.6 Commercial and Recreational Fish Harvest

Commercial gill net fishing and lobstering is practiced outside New Bedford/Fairhaven Harbor in Buzzards Bay and distant off-shore areas such as the Nantucket and Georges Fishing Banks. Since the Proposed Preferred Aquatic Disposal Sites lie within New Bedford/Fairhaven Harbor, both of the aquatic disposal sites are within areas closed to mobile gear fishing (e.g. trawls, seines, dredges). New Bedford/Fairhaven Harbor is important to commercial fishing as a landing port. Fish landings for New Bedford, MA in comparison to Massachusetts statewide landings are provided in Table 5-12. Approximately 99% of the total poundage of scallops landed in Massachusetts ports in 1999 were landed in New Bedford. About ninety-one (90.8%) percent of all window pane flounder poundage landed in Massachusetts came into New Bedford Harbor in 1999. Eighty percent (80%) of all winter flounder landed in Massachusetts came into New Bedford Harbor. A majority of the total yellow-tailed flounder (70.6%) and monkfish (66.5%) landed in Massachusetts in 1999 occurred in New Bedford. Most of the landings are from offshore fishing grounds.

Lobstering is practiced in deeper waters nearly year-round, including fall and winter months when dredging and disposal would occur. Coastal lobstering is most intensive from May to November (Estrella and Glenn, 2000). Because of their mobility and natural changes in environmental conditions from season to season and year to year, the location of good lobster grounds can vary at any time. However, the anecdotal information given above does indicate some general differences in lobstering between in-shore and off-shore areas.

Summarized below are dominant finfish species observed in Buzzards Bay waters, including New Bedford harbor. The description includes a short narrative of the species habits and whether or not the fish species is a significant commercial resource, recreational resource, or both.

Scup (*Stenotomus chrysops*)

Scup, also known as "porgy" are residents and typically the most abundant finfish throughout the summer and into the early fall. They are most common in the Lower and Outer Harbors (EBASCO, 1990). These fish are both an important recreational and commercial resource in the region and are prey for cod, bluefish, and weakfish (Steimle, et al., 1999a). During the winter these fish migrate to deeper warmer waters and return to in-shore regions (estuaries) in the spring to spawn. Peak spawning usually occurs in June (Bigelow and Schroeder, 1953). These fish are primarily bottom feeders existing on small crustaceans, worms, mollusks, squid and occasionally small fish (Steimle, et al., 1999a). Scup appear to be temperature sensitive; sudden decreases in temperature occurring in late fall have been identified as a major contributor in mortality in bays and estuaries in the embayment (Clayton et al., 1978). Results of finfish sampling conducted in New Bedford Harbor (NAI, 1999) revealed that scup typically appear within the harbor from June to December, with peak densities occurring from late July through early September. As bottom feeders, scup may be indirectly impacted by the loss of their benthic invertebrate prey during UDM dredging, CAD excavation, UDM disposal, and final CAD capping. Dredging and disposal activities within the Lower and Outer Harbors may disrupt spawning and subsequent young of year may be susceptible to physical disturbances related to sediment disposal at a Lower Harbor CAD site. As a result, local scup densities may decline in the vicinity of the disturbance areas.

Alewife (*Alosa pseudoharengus*)

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. During migratory movements, they may be common throughout all the major regions of the New Bedford/Fairhaven Harbor (EBASCO, 1990). 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 Harbor was greatest in September (NAI, 1999). Turbidity produced during UDM dredging, CAD excavation, UDM disposal, and final CAD capping may block the migratory movements of alewife within the Acushnet River. These fish may also be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters. As a result, seasonal alewife densities may temporarily decline within the river. Although alewife is not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in alewife densities may impact the populations of these predator species.

Blueback herring (*Alosa aestivalis*)

Blueback herring are closely related to alewives and, like alewife, are also anadromous, usually entering the brackish 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 species of fish, most notably the bluefish and the striped bass. Turbidity produced during UDM dredging, CAD excavation, UDM disposal, and final CAD capping may block or disrupt the migratory movements of blueback herring within the Acushnet River. These fish may also be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters. Turbidity plumes within the water column may also impact the visual-based feeding efficiency of this species, since their prey consists of various organisms that inhabit the water column. Although blueback herring is not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in blueback herring densities may impact the populations of these predator species.

Atlantic menhaden (*Brevoortia tyrannus*)

Atlantic menhaden are a commercially important resource, primarily used for fish meal and oils rather than direct human consumption. These non-residents spawn both at sea and inshore waters generally between April and October (Howes and Goehringer, 1996). Sampling within New Bedford Harbor (NAI, 1999) revealed menhaden to be most abundant in August. The diet of these fish is predominantly phytoplankton, smaller crustaceans, and various larvae (Howes and Goehringer, 1996). These fish are also an important prey species for most carnivorous marine fish. Since this species spawns in both inshore and of shore waters, offshore populations of menhaden may avoid the disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, inshore populations may be subjected to the same impacts as described for blueback herring. Although menhaden are not an important recreational or commercial finfish species, it is a prey item for some commercially and recreationally important finfish. Therefore, a decrease in menhaden densities may impact the populations of these predator species.

Striped bass (*Morone saxatalis*)

Striped bass are another anadromous fish which typically spawn in Chesapeake Bay waters. These fish typically migrate up from their spawning waters and inhabit the inshore areas including brackish rivers. These non-residents, like bluefish, are very aggressive feeders. Their diet consists of fish and invertebrates such as squid, herring smelts, menhaden, alewives, shrimp, lobsters, crabs, and polychaetes. Striped bass usually are summertime residents of the embayment. However, reports of the fish overwintering in some of the rivers of southern Massachusetts have been reported. The striped bass are one of the most important recreational species in the Buzzards Bay waters. They are most abundant in New Bedford Harbor in July and October (NAI, 1999).

As a highly mobile species, striped bass may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, given their propensity for spawning in estuarine habitats, this species may be subjected to physical impairment (e.g., turbidity-induced clogged gills resulting in suffocation, or abrasion of sensitive epithelial tissue) as they pass through turbid waters to and from spawning areas. Avoidance of the disturbance areas, failed spawning, and loss of individuals due to physical impairment could impact the local population of this species, thereby, effecting the local recreational and commercial harvest of this species for the year.

Winter flounder (*Pleuronectes americanus*)

Winter flounder are considered residents of the embayment and are both a commercially and recreationally significant resource, even after serious declines in the populations (Howes and Goehringer, 1996). The reason(s) for decline in the population is still unclear, however, the fishes' habit of burrowing into the sediments increases its potential exposure to many pollutants compared to other species that live within the water column. The habit of burrowing is thought to result in a higher incidence of fin rot and hepatic carcinomas in pollutant impacted areas (Landahl, et al., 1990; Johnson, et al., 1992). The fish are believed to return to the estuaries of their origin for spawning (Saila, 1961). Young winter flounder tend to remain within the embayments during their first year and move out into more open waters during the summer months, returning to the inshore areas in the fall. Actual spawning usually occurs in February and March. Peak abundances captured per sampling effort within New Bedford Harbor were recorded in May and June (NAI, 1999). The diet of the winter flounder is primarily comprised of worms, bivalves, crustaceans, snails and mollusks (Pereira, 1999).

This species may be the most susceptible to direct impacts associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping due to their demersal life styles. Compared to pelagic finfish, demersal fish species such as winter flounder are more susceptible to UDM dredging and disposal since most dredging related disturbance occurs near the bottom. The demersal eggs of the winter flounder are highly susceptible to impacts of dredging as compared to species with planktonic eggs. 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. The cumulative effects of UDM dredging, CAD excavation, UDM disposal, and final CAD capping may have a substantial impact to the winter flounder population of the New Bedford/Fairhaven Harbor. To the extent that winter flounder from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Black sea bass (*Centropristis striata*)

Black sea bass is considered a non-resident species in New Bedford/Fairhaven Harbor, migrating to the Harbor and Buzzards Bay waters in the summer, then retreating to warmer, deeper waters in winter (Howes and Goehringer, 1996). The juveniles are born as females and after the first spawn transform to males, they utilize the Buzzards Bay waters as a nursery ground, appearing in New Bedford harbor from August to December, with peak densities occurring in either August or September. The immature black sea bass are bottom feeders existing mainly on mysids in shallow areas, while the adult black sea bass diet consists of crustaceans, mollusks and fish (Steimle, et. al., 1999b). The adult fish are sought after by both commercial and recreational fishermen.

Black sea bass may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, black sea bass densities may decline in the vicinity of the disturbance areas. To the extent that black sea bass from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, this decline may be reflected in the commercial or recreational harvest of the region.

Tautog (*Tautoga onitis*)

Tautog is identified as a non-resident species and is recreationally important. This fish was found to inhabit New Bedford waters from May to October, with peak densities occurring in May and in October. This behavior most likely corresponds to periods of movement in and out of the harbor, since this species is known to migrate to shallow inshore waters from deeper waters in the spring. The tautog diet consists of crustaceans, mollusks, lobsters, worms and mussels (Howes and Goehringer, 1996). Tautog may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, tautog densities may decline in the vicinity of the disturbance areas. To the extent that tautog from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Butterfish (*Peprilus triacanthus*)

Butterfish are common to the mid-Atlantic region, and Buzzards Bay provides an important nursery area for the species. The juvenile butterfish grow quickly and migrate to deeper waters usually in late fall only to return to the shallow inshore areas in April. The diet of the non-resident butterfish consist of copepods, small fish, jellyfish and various marine polychaete worms (Cross, et al., 1999). Commercially, butterfish are harvested and they are another important prey source for many upper level predators such as bluefish and striped bass. Historically, the butterfish has been documented as an important species for Buzzards Bay (Howes and Goehringer, 1996). Due to the migratory nature and the schooling behavior of these fish, variable year-to-year statistics are available (Howes and Goehringer, 1996). Butterfish may avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping. However, as bottom feeders, this species may be indirectly impacted by the loss of their benthic invertebrate prey during UDM management activities. In response to the loss or decline of their invertebrate prey, butterfish densities may decline in the vicinity of the disturbance areas. To the extent that butterfish from New Bedford/Fairhaven Harbor fail to recruit to other areas of Buzzards Bay, the regional recreational and commercial harvest of this species may also be impacted.

Bluefish (*Pomatomus saltatrix*)

Bluefish are migratory non-residents of Buzzards Bay and are very important both commercially and recreationally to the embayment. Bluefish spawn offshore and enter Buzzards Bay waters as juveniles. Bluefish appear in New Bedford Harbor waters from July through September with peak densities typically occurring in August (NAI, 1999). Bluefish feed voraciously, sight feeding on almost anything in the water column, especially such favorite prey such as silversides, clupeids, striped bass, and bay anchovy (Fahay, 1999). Historically, this fish has been a documented staple for the Buzzards Bay region for over 100 years (Howes and Goehringer, 1996). Since they are dependent on sight feeding and are highly mobile, bluefish will likely avoid disturbance areas associated with UDM dredging, CAD excavation, UDM disposal, and final CAD capping, resulting in lowered local abundance of this species.

Table 5-12: Fish Landings (lbs) for New Bedford/Fairhaven Harbor and Massachusetts Statewide from May-December, 1999 (x1000)

Fish Species	Pounds Landed in New Bedford	Pounds Landed in Massachusetts (Statewide - All Ports Combined)	% of State Total Landed in New Bedford
Cod	3,634	11,721	31
Haddock	869	3,533	24.6
Yellow-tailed Flounder	3,468	4,915	70.6
White Hake	83	1,539	5.4
American Plaice	705	2,402	29.3
Winter Flounder	5,157	6,426	80.2
Witch Flounder	486	1,590	30.6
Window Pane	59	65	90.8
Silver Hake	106	3,996	2.6
Monk Fish	10,642	15,990	66.5
Scallop	11,440	11,547	99.1

Source: NMFS (1999)

5.3.4 Coastal Wetlands, Submerged Aquatic Vegetation and Intertidal Flats

The following subsections discuss coastal wetlands, submerged aquatic vegetation and intertidal flats, their presence within and near the preferred disposal sites, their ecological importance, and their regulatory status under the Massachusetts Wetlands Protection and Federal Clean Water Act.

5.3.4.1 Coastal Wetlands

The Massachusetts Wetland Protection Act, 310 CMR 10.21 through 10.37, regulates coastal wetlands including numerous submerged and intertidal resource areas. Salt marshes are areas with the most stringent protection under the Act (See Section 7.1.3). In addition, the following resources are regulated under the Act: Land Under Ocean; Coastal Beaches; Coastal Dunes; Barrier Beaches; Coastal Banks; Rocky Intertidal Shores; Salt Marshes; Land Under Salt Ponds; Land Containing Shellfish; Banks of or Land Under the Ocean, Ponds, Streams, Rivers, Lakes or Creeks that Underlie Anadromous/Catadromous Fish Runs; and, Estimated Habitats of Rare Wildlife (for coastal wetlands).

The Wetland Protection Act regulations define a salt marsh as "a coastal wetland that extends up to the high tide line, that is, the highest spring tide of the year, and is characterized by plants that are well adapted to or prefer living in, saline soils. Typically dominant plants within salt marshes are salt meadow cord grass (*Spartina patens*) and/or salt marsh cord grass (*Spartina alterniflora*)".

Salt marshes are also protected under federal law because they are wetlands; one of the "special aquatic sites" designated in the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230, Subpart E). The regulations describe possible impacts on these sites from dredged disposal, and the applicant for a dredging permit must demonstrate compliance with guidelines for avoiding adverse impacts to these areas before a permit can be issued. (See Section 7.2.5.3).

Salt marshes are located on the eastern shoreline of the Inner Harbor, just north of Popes Island. The Popes Island North site is approximately 570 feet from this marsh (Figure 5-19). The closest salt marsh to the Channel Inner is located over 5,000 feet to the north. This marsh is over one mile away from the East of Channel site.

Typical tidal areas of New England are generally formed in low energy areas such as behind protective barriers and circulation-restricted coves and bays. Typical New England salt water marshes are divided into two distinctive zones: Low marsh, which is dominated by the salt marsh cordgrass, *Spartina alterniflora*; and the High marsh, dominated by the salt marsh hay, *Spartina patens*, and the spike grass, *Distichlis spicata* (Howes and Goehringer, 1996). These zones are mostly delineated by the flooding frequency and duration of the flooding. Accordingly, low marsh environment is located between mean low water and mean high water, while the high marsh region is from high mean water to seasonal high waters elevations both vernal and autumn.

5.3.4.2 Submerged Aquatic Vegetation

Vegetated shallows (a.k.a. submerged aquatic vegetation) are regulated by DEP as "Land Under Ocean", and are also Special Aquatic Sites protected by the federal 404(b)(1) guidelines, where they are defined as "permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation". In marine settings of Buzzards Bay, eelgrass (*Zostera marina*) is the most common form of SAV, typically forming extensive beds. Eelgrass beds increase species diversity and productivity by providing substrate shelter and food for a variety of marine fish and invertebrates (Levington, 1982). They also stabilize marine sediments (reduce erosion and resuspension within the water column) by reducing wave energy. The formation of eelgrass beds are also the first step in saltmarsh succession (Gosner, 1978).

Eelgrass beds in New Bedford/Fairhaven Harbor were mapped by the DEP in 1997 from aerial photographs (Costello, 1997) (Figure 5-19). Extensive submerged aquatic vegetation (eelgrass beds) of New Bedford/Fairhaven Harbor occur primarily along the eastern shoreline of the Outer Harbor and west of and proximal to Little Egg Island in the middle of the Outer Harbor off of Fort Phoenix Beach. There is no mapped SAV within the Inner Harbor in the vicinity of either the Channel Inner or Popes Island North site.

5.3.4.3 Intertidal Habitats

The only areas other than wetlands and vegetated shallows, which are specifically protected under the 404(b)(1) guidelines and found in the New Bedford/Fairhaven coastal area, are mud flats. These are defined as follows in the federal guidelines:

> *"Mud flats are broad flat areas along the sea coast and along coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems. Wind and wave action may resuspend bottom sediments. Coastal mud flats are exposed at extremely low tides and inundated at high tides with the water table at or near the surface of the substrate. The substrate of mud flats contains organic material and particles smaller in size than sand. They are either unvegetated or vegetated only by algal mats."*

This definition differs from the state's definition of tidal flats principally in that mud flats are composed only of fine-grained material, whereas tidal flats may also include intertidal sand bars. Mud flats contain biota such as clams and marine polychaete worms, and may provide foraging and nursery areas for fish and foraging habitat for shorebirds.

Tidal flats (either mud flats or sand bars) generally occur along the various embayments along the Fairhaven (east) side of the Acushnet River south to and including the Upper and Inner Harbors. Specifically, within the Inner Harbor segment, either mud flats or sand bars occur along the south side of the marshes located just south of I-195, along the Fairhaven shore east of Popes Island, along the north side of Crow Island, within the southwest corner of the Inner Harbor segment west of Palmer's Island, east of Palmer's Island adjacent to the main navigation Channel, and on the southeast corner of Inner Harbor just north of the Hurricane Barrier.

Within the Outer Harbor, either mud flats or sand bars occur within the various embayment areas and other localized areas around the Outer Harbor perimeter. Most notably along a majority of the western shore, with in Priests Cove and adjacent portions of the northern shoreline to the east, and along the western shoreline most extensively from Silver Shell Beach, south to Wilbur Point. Available mapping for New Bedford/Fairhaven Harbor depicts the nearest tidal flats to the Channel Inner site lie within 1,700 feet to the south. Tidal flats are located 285 feet east of the Popes Island North site (Figure 5-19).

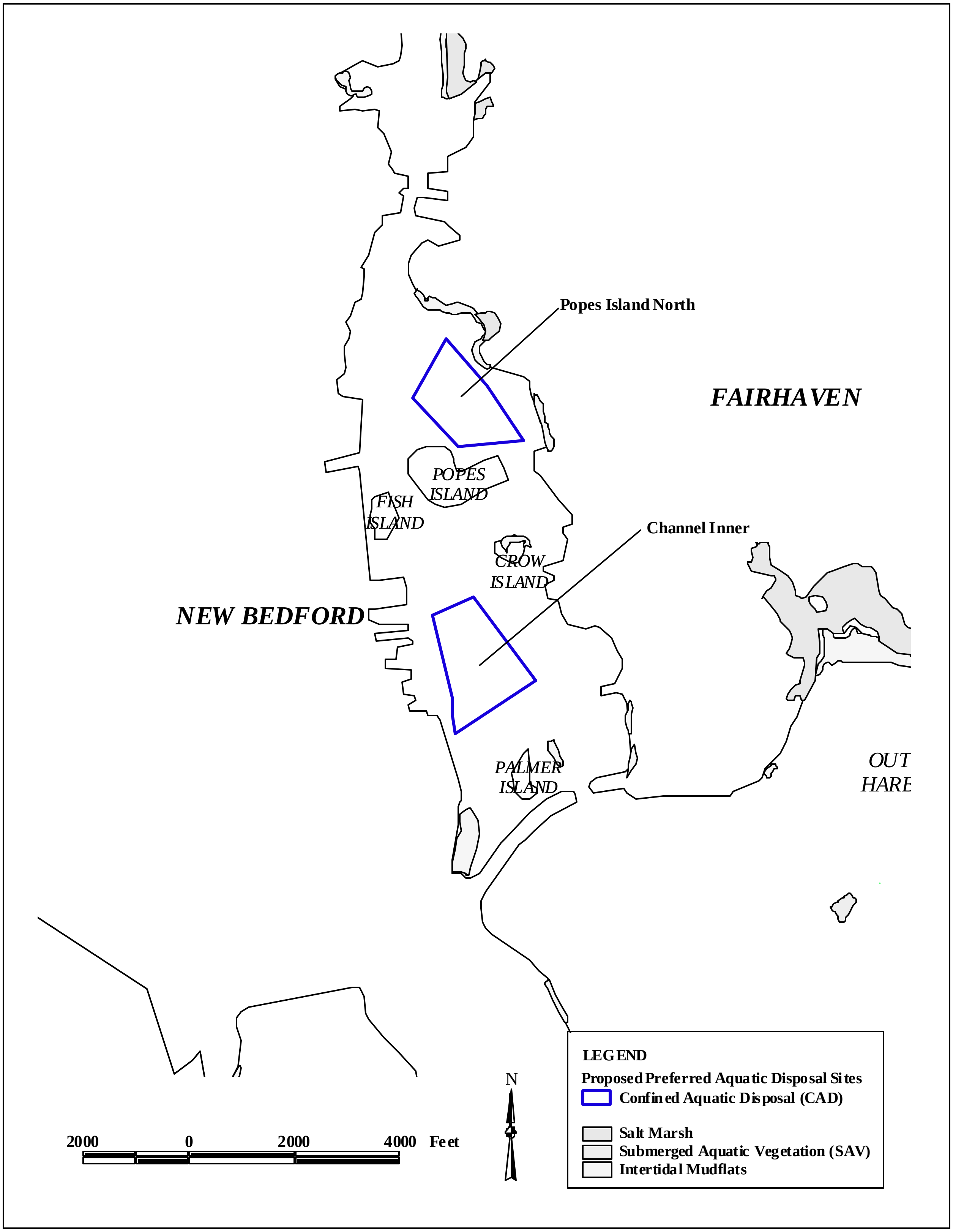


Figure 5-19: Submerged Aquatic Vegetation, Salt Marsh and Intertidal Mud Flats

5.3.5 Wildlife

The coastal waters and various coastal habitats within and proximal to New Bedford and Fairhaven including the Outer Harbor area are inhabited by various waterfowl, seabirds and shorebirds. The various species found within these habitats exhibit seasonal variations in occurrence, abundance, and habitat usage. The areas within the harbor and immediately offshore are not known to support any significant concentrations of marine mammals or reptiles. All wildlife in the area is mobile and should avoid any areas of disturbance.

5.3.5.1 Avian Habitats

In the New Bedford and Fairhaven areas, beaches and tidal flats provide potential shorebird and seabird breeding or foraging habitat. The eelgrass and intertidal flat areas with the Harbor (Figure 5-19) provide habitat for diving ducks, shorebirds, and seabirds. A general discussion of the waterfowl, shorebird, and seabird habitats of the Harbor is presented below.

Waterfowl

Diving ducks (Family Anatidae, Subfamily Anatinae, Tribes Aythyini and Mergini) can be found in Massachusetts embayments, including New Bedford/Fairhaven Harbor at any time of year, however most species are typically absent from May to September (Forster, 1994). Species richness and total abundance is greatest by late November when many farther north breeding sea ducks have arrived in the waters of eastern Massachusetts as winter residents. The total abundance may fluctuate throughout late fall to mid-winter months with the arrival and departure of somewhat transient loose flocks and individuals. Species richness and total abundance usually increases once again in late winter to early spring as the wintering waterfowl begin to stage for their flights to northern breeding grounds (Leahy, 1994).

The abundance of wintering waterfowl during diurnal cycles is usually greatest in nearshore (littoral) waters during mid to high-tide. The various species of waterfowl found within New Bedford/Fairhaven Harbor during the winter months include representatives of the herbivore (e.g. Brant, *Branta bernicla*), piscivore (e.g. Red-breasted Merganser, *Mergus serrator*), and molluscivore (e.g. Common Eider, *Somateria mollissima*) feeding guilds. During low tide, many of the deepwater (diving) species such as the seaducks and mergansers (Tribe Mergini) move out to deeper, off-shore waters (Leahy, 1994). Surface feeding ducks (Tribe Anatini) are found within New Bedford/Fairhaven Harbor, foraging in littoral waters for aquatic vegetation and invertebrates (e.g. Black Duck, *Anas rubripes;* American Widgeon, *Anas americana*, etc.).

Other waterfowl to be expected within New Bedford/Fairhaven Harbor other than ducks include the loons (Family Gaviidae), grebes (Family Podicipedidae) and cormorants (Family Phalacrocoracidae). In the Buzzards Bay region, including New Bedford/Fairhaven Harbor, loons and grebes are mainly absent as summer residents, but tend to be rare to locally common winter residents (Viet and Petersen, 1993). The species of loons (e.g. Common -*Gavia immer* and Red-throated -*G. stellata*) and grebes (e.g.: Horned, *Podiceps auritus* and Red-necked, *Podiceps grisegena*) reported by Forster (1994) to winter in coastal eastern Massachusetts embayments (including New Bedford/Fairhaven Harbor) feed mainly on fish by diving in open waters (Terres, 1980).

Of the cormorants, Double-crested Cormorants (*Phalacrocorax auritus*) are most abundant during the summer months, while Great Cormorants (*Phalacrocorax carbo*) appear in the harbor in winter months. Nearshore (littoral) and off-shore waters are used for feeding. Both species of cormorant feed primarily on fish (such as sculpins, haddock, cod, flounders, and herrings) but crustaceans such as spider crabs and shrimp may also be consumed (Terres, 1980). Food is caught by diving in open water areas. However, the harbor's reefs and rocky promontories are used by these species for roosting and sunning.

Since the Proposed Preferred Aquatic Disposal sites have been sited in areas outside of extensive eelgrass, shellfish and finfish concentration areas, these disposal sites would not have a significant impact to waterfowl populations within the harbor.

Shorebirds

Shorebirds are also expected to frequent New Bedford/Fairhaven Harbor. Numerous species of shorebirds such as the plovers (Family Charadriidae), and sandpipers (Family Scolopacidae) can be expected to frequent the intertidal flats of New Bedford/Fairhaven Harbor throughout the seasons. Typically, species richness and abundance of shorebirds is generally greatest on exposed mudflats and sandy beaches at low tide during autumn migration (late summer to early fall) with peak occurrences for various species varying throughout this time period (Forster, 1994). Although many species of shorebirds frequent mudflat habitat for feeding, some prefer pebbly or cobbly beaches (e.g. Ruddy Turnstone, *Arenaria interpres*) and others prefer rocky coast (i.e. Purple Sandpiper, *Calidris maritima*).

Shorebirds feed mainly on marine polychaetes, amphipods, and even mollusks (Terres, 1980) on tidal flats, intertidal rocks, and shallow subtidal bottoms (Levinton, 1982). These food sources tend to be more easily accessible to the birds during low tides, therefore diurnal cycles of abundance and species richness will be greatest during low tides. Sandpipers and plovers feed on surface-dwelling invertebrates such as amphipods and marine worms by gleaning from the surface or turning over stones. Larger shorebirds, such as dowitchers, whimbrels and willets, probe the soft substrata using their long bills (Levinton, 1982).

Since the Proposed Preferred Aquatic Disposal sites have been sited in areas outside of rocky coast areas, extensive mudflats and sandy beach areas as well as salt marsh, the disposal sites would not have a significant impact to shorebird populations within the harbor.

Colonial Nesting Waterbirds

Coastal seabirds such as the gull and terns (Family Laridae), pelagic seabirds such as the shearwater and petrels (Family Procellariidae), and wading birds such as herons and their allies (Family Ardeidae) nest colonially within Buzzards Bay. However no sites identified as "Principal Waterbird Colonies on the Massachusetts Coast" were identified by Veit and Petersen (1993) within New Bedford/Fairhaven Harbor. Therefore the Proposed Preferred Aquatic Disposal sites would not have an impact to these known principal nesting seabird colonies of Massachusetts.

5.3.5.2 Marine Mammals

Marine mammals found in the waters in and around Stellwagen, Nantucket and Georges Banks located east of New Bedford/Fairhaven Harbor, include thirteen species of cetaceans (whales and porpoises), and two species of seals (NOAA, 1993)(Table 5-13). Although five of the whale species are endangered, some, especially the large and conspicuous humpback (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*), have become locally common enough in those offshore waters to support a whale-watching industry operating from among the various Massachusetts ports located proximal to these offshore banks (i.e Salem, Gloucester, Newburyport, Plymouth, Provincetown, Nantucket, etc.). In fact, as of the end of 1998, the industry produced revenues of $20,000,000 per year and brought 860,000 people annually to Stellwagen Bank to view whales (Boston *Globe*, January 11, 1999). Most of the marine mammal species may be expected to be found occasionally in the ocean waters closer to Gloucester, Provincetown, or Nantucket but rarely, if ever, within the harbors. An exception to this is the

harbor seal *(Phoca vitulina*), which from late September to late May is commonly seen resting on sheltered and undisturbed rocky ledges in harbors, bays and estuaries from Maine to southern New England (Weiss, 1995).

5.3.5.3 Reptiles

The only marine reptiles found in the project region are sea turtles and the Northern Diamond Back Terrapin (*Malaclemys t. terrapin*). Although five species of sea turtles have been recorded in southern New England waters, only two, the leatherback (*Dermochelys coriacea*) and the Atlantic ridley (*Lepidochelys kempi*), are seen with any regularity (Payne 1991). The leatherback, the largest living reptile, may grow to 11 feet in length and weigh up to 1900 pounds. Leatherbacks breed in Central and South America and are most frequently sighted off Massachusetts from June through September. The Atlantic or Kemp's ridley is the most commonly reported turtle from Buzzard's Bay (Payne, 1991), but most of the sightings are of stranded juveniles. Individuals of this warm-water species breed in Mexico, and regularly drift or swim north as juveniles. Some become trapped in Cape Cod Bay as temperatures fall, where they are killed by the cold. They are not an important part of the fauna of Buzzard's Bay.

Among the remaining three species of turtles reported for the area, loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and the Atlantic hawksbill (*Eretmochelys imbricata*) are rarely found within southern New England waters. On the rare occasion when the Atlantic hawksbill is found in southern New England waters, it is usually found far offshore. Sightings of these three species within Buzzard's Bay are usually wandering juveniles that do not survive the winter (Weiss, 1995). Since Buzzard's Bay lies outside the normal range of most sea turtles, none of the Proposed Preferred Aquatic Disposal sites will have a negative impact on the status of marine reptile populations in the region.

Terrapins inhabit tidal creeks, bays and marshes from Cape Cod, south along the Atlantic coast to the Florida Keys, then westward along the Gulf Coast including most of the Texas coastline (Klemens, 1993). Its distribution in southern New England outside of Connecticut is very localized, with populations in Massachusetts reportedly occurring in Wellfleet on Cape Cod. Given the extent of development and disturbance in the New Bedford/Fairhaven Harbor, the project areas are unlikely to support populations of this species.

Table 5-13: Marine mammals found in the waters over and around Offshore Fishing Banks in Massachusetts (NOAA, 1993)

Common Name	Scientific Name	Remarks
Humpback whale	*Megaptera novaeangliae*	March-November, offshore, near bank
Northern right whale	*Eubalaena glacialis*	Late winter - July
Fin whale	*Balaenoptera physalus*	Peak April - October, offshore
Sei whale	*Balaenoptera borealis*	Very rare
Blue whale	*Balaenoptera musculus*	Very rare
Minke whale	*Balaenoptera acutorostrata*	Peak spring - late summer/early fall
Pilot whale	*Globicephala* spp.	(2 species)
Killer whale	*Orcinus orca*	Peak mid-July through September
White-sided dolphin	*Lagenorhynchus acutus*	Common all year
White-beaked dolphin	*Lagenorhynchus albirostris*	Rare, April - November
Harbor porpoise	*Phocaena phocaena*	Peak in spring
Bottlenose dolphin	*Tursiops truncatus*	Late summer/fall, offshore
Common dolphin	*Delphinus delphis*	Occasional, fall/winter, offshore
Harbor seal	*Phoca vitulina*	Common, nearshore
Gray seal	*Halichoerus grypus*	Abundant in Canada, rare in Massachusetts

5.3.5.4 Endangered Species

The Massachusetts Natural Heritage Atlas does not indicate any estimated habitat of state-listed Endangered, Threatened or Special Concern species in or adjacent to the marine waters of the New Bedford/Fairhaven area. It does not indicate any priority sites of rare species habitats or exemplary natural communities in this area.

Of the marine mammals and reptiles reported on in Sections 5.3.5.2 and 5.3.5.3, five whales and two turtles are federally listed as endangered. These include the humpback whale, fin whale, sei whale, blue whale, northern right whale, leatherback turtle and the Atlantic or Kemp's ridley turtle. These species, if they attain enough numbers to have centers of concentration at all, are found mainly at offshore upwelling sites like Stellwagen, Nantucket and Georges Banks outside of Buzzards Bay and offshore from Massachusetts Ports.

5.3.6 Historical and Archaeological Resources

5.3.6.1 General

The Port of New Bedford is rich in maritime history. Native Americans used the harbor extensively for fishing (Reiss, 1998), with the marine resources sustaining thousands of people (Howe and Goerhinger, 1996). The first European settlers to the region were Quakers and Baptists who purchased the New Bedford Harbor area from the Native Americans in 1654. It was soon settled by more colonists who established shipbuilding as an important local industry by the mid-1700s. During the American Revolution, New Bedford was raided by the British and many buildings and other structures were burned. By the mid-1800's, New Bedford had developed into the largest American whaling port. Other industries emerged including textiles, and metal products.

It's importance as a commercial fishing port has not diminished. It is currently the largest commercial fishing port in New England. It's maritime history is preserved in many museums and exhibits in the region. Because of New Bedford's long maritime historical significance, a reconnaissance survey of the potential shipwrecks and aboriginal (Native American) sites in the Harbor was conducted.

As requested by the Massachusetts Board of Underwater Archaeological Resources, a reconnaissance survey was conducted to identify the potential for historical (shipwrecks) and archaeological (aboriginal) sites for the New Bedford/Fairhaven DMMP. Excerpts from the survey appear in Sections 5.3.6.2 and 5.3.6.3, below, with the full survey report in Appendix H.

5.3.6.2 Historical Shipwrecks

To determine significance for each shipwreck the Department of the Interior's definition of eligibility for the National Register of Historic Places (i.e. generally sites over fifty years old) was used as guidance. However, most of the shipwrecks were over one hundred years old. Because the recording of shipwrecks was not done in a thorough and programmed manner in the 19th and early 20th century, the information for any particular site might be inaccurate. However, the approximate number of significant shipwreck sites in the New Bedford/Fairhaven study area is accurate enough to allow the determination that pre-dredging/disposal planning is recommended.

The survey-level historical research located a total of 22 shipwrecks located in the New Bedford/Fairhaven area and an additional fifty-nine in Buzzards Bay. Of the total number of known shipwrecks, the exact location of only two shipwreck sites could be determined within the harbor. The names of these two known shipwreck sites were not determined during the field reconnaissance. The location of the remaining sites in relation to the Proposed Preferred Aquatic Disposal sites cannot be determined. Despite this factor, sixty-three sites would fit the Department of the Interior's eligibility for the National Register of Historic Places (Reiss, 1998).

Two sunken vessels are depicted within the New Bedford/Fairhaven Harbor on the NOAA navigation charts of the harbor. One is located north of Fort Phoenix between the hurricane barrier and the first wharf depicted on the eastern (Fairhaven) shoreline upstream of the barrier. Another is depicted along the western (New Bedford) shoreline north of Fish Island.

In addition to those vessels found in the historical records, we must assume many others were lost in the study area and not recorded. Before radios and radar, vessels were surely lost with all hands on the numerous ledges in the area during storms and fogs. Others could only record them as missing at sea, whether they had just left the harbor, were returning after a long voyage, or were blown in while trying to sail past the shore. No one would know what happened to them. They would include small and large fishing boats, coasters, and transoceanic merchant men and warships.

Besides those vessels lost while underway, a number would have been lost at their moorings or abandoned in shallow water, such as the abandoned 1800s fishing vessel seen at low tide on the western shore of Manchester Harbor and the 1690s Hart's Cove shallop in Newcastle, New Hampshire. Some of the shipwrecks would have been salvaged shortly after wrecking or more recently.

Since we know so little of the early vessels, onboard fishing processes, or life aboard the early merchant vessels, the remains of any historic ship or boat would be archaeologically and historically significant on a local, regional, and national level.

Historic shipwreck sites are known to exist in the study area and are relatively easy to detect. The number of vessel losses found in this study is smaller than the total losses that would be located with a complete study, but the results found are indicative of a large number of probable shipwreck sites within or proximal to the Harbor. The lack of complete recorded evidence is typical for any locality along the New England shore. Until recently the loss of a vessel, even with the loss of life, was not considered newsworthy enough for the ubiquitous 4-page weekly newspaper in the 1700s and 1800s. State and federal government compilations of vessel losses, which are incomplete, date only from the very late 1800s. In addition, the parameters of this study only included some primary research with mostly the inspection of secondary compilations of data from the primary sources. The data located in this study indicate that there is a probability of encountering the remains of an historic vessel in or near the Proposed Preferred Aquatic Disposal sites. However, because this area was dredged for the creation of the Federal Channel, the remains of a shipwreck may have already been removed, wholly or in part.

Field surveys of the sites and vicinity will be conducted to ascertain if any shipwrecks or shipwreck debris is present. See Appendix H for a detailed scope of work.

5.3.6.3 Archaeological Sites

Prehistoric Indians (Native Americans) used the harbor for fishing and the shoreline for residences. The harbor was the access to the bountiful food offered by the sea. Indians were known to collect many types of shellfish which were smoked, dried, stored and traded for winter food. They used small dugout and bark canoes for fishing and hunting mammals, and for transportation along the shore and to nearby islands (Reiss, 1998).

In most areas of New England, seasonal Indian dwelling sites are typically found near a beach and a fresh water source with a southeast exposure to the sea. In addition, shell middens, created by Indians processing bivalves, are often found in similar areas without the need of running fresh water (Bourque, 1980, IV-45-49 & Reiss, 1989, 12). Since the last ice age, the net sea level change has placed the coastline of 6,000 BP under approximately 25 feet (7.62 meters) of water in the Cape Ann area (Bourque, 1980, IV-229).

Since little is known of the prehistoric Indians of the study area, any remains, whether a village, fish processing site, or sunken canoe, would be of great importance. However, previous sub-bottom profiling data indicate that the area has an irregular bedrock surface which is typically covered by 0-30 feet (0 to 9.1 meters) of glacially deposited medium sand and some organic and clay sediment.

Remains of any sites would be extremely hard to locate under the sediment in the survey area. Remote sensing surveys will generally not indicate a prehistoric site in this type of topography. Locating prehistoric Indian sites would require archaeological trenching of each proposed impact area. Spot inspection by archaeological divers, while investigating remote sensing targets of possible historic remains, would be useful, but probably not productive.

5.3.7 Navigation and Shipping

The federal navigation projects in New Bedford/Fairhaven Harbor consists of a main channel extending from deep water in Buzzards Bay through the New Bedford-Fairhaven Bridge (U.S. Route 6); a channel extending from the lower maneuvering area along the upper waterfront to the vicinity of Fish Island and the swing bridge; a channel west of a line channel ward of the Fairhaven Harbor lines from Pierce and Kilburn Wharf to the old causeway pier; and an anchorage area north of Palmer Island, off the Fairhaven main waterfront. (USACE 1996)

The entrance to New Bedford/Fairhaven Harbor lies easterly of Clark Point and westerly of Wilbur Point in Buzzards Bay, leading to the Outer Harbor. Entrance to the Outer Harbor is via the main Federal Channel, Entrance Channel and Fort Phoenix Reaches, which begin respectively, at points 3.8 nautical miles (nm) and 1.5 nm southerly of the Hurricane Barrier. Both of these reaches are 350 feet wide with a depth to MLW of 30 feet (Figure 5-2).

Table 5-14: New Bedford Harbor Main Channel Reaches

Name of Reach	Width (feet)	Length (nautical miles)	Depth to MLW (feet)
Entrance Channel	350	2.3	30
Fort Phoenix	350	1.5	30
New Bedford	350-400	0.7	30

Source: Buzzards Bay Navigational Chart, NOAA - 1979

The entrance to the Inner Harbor, through the Hurricane Barrier, is via the New Bedford Reach of the Federal Channel with a depth to MLW of 30 feet, with a width ranging between 350 and 400 feet for a length of 0.7 nm (Figure 5-2). Easterly of the New Bedford Reach on the Fairhaven side of the harbor, is an anchorage area with a depth to MLW of 25 feet and two channels with depths of 15 feet and 10 feet. The 15 foot channel is between 150-400 feet wide, westerly of a line 50 feet channelward of Fairhaven

Harbor lines from Peirce and Kilburn Wharf to Old South Wharf, thence, 10 feet deep, 150 feet wide to a point 1,000 feet south of the old causeway pier. On the westerly and northerly portions of the New Bedford Reach, are two 30 foot maneuvering areas for the State Pier and North Terminal areas(USACE, 1986).

Restrictions to navigation in New Bedford/Fairhaven Harbor include two swing bridges and the Hurricane Barrier. The Coggeshall Street Bridge, just north of the Route I-195 bridge has a vertical restriction of 4 feet at MHW. The Route 6 bridge, connecting New Bedford and Fairhaven across Popes Island, has a vertical restriction of 6.3 feet at MHW. A horizontal restriction of 150 feet exists in the Hurricane Barrier.

Although vessel movement data are not available for fishing or recreational vessel traffic both type of vessels contribute to harbor traffic. To gain a sense of the potential amount of activity associated with these types of vessels, New Bedford/Fairhaven Harbor is home to a recreational boating fleet of over 950 vessels and a commercial fishing fleet of approximately 265 vessels. (New Bedford/Fairhaven Harbor Plan, 1999).

In addition to the vessel movements associated with fisheries industry activity in New Bedford/Fairhaven Harbor, other maritime commerce activities generate vessel trips that need to be accounted for when considering aquatic disposal options. In 1998, a total of 2,505 inbound trips and 2,514 outbound trips within New Bedford/Fairhaven Harbor, or a total of 5,019 vessel movements, were reported. Approximately 70% of both the inbound and outbound traffic was attributable to tanker traffic, with the remainder of trips being generated by passenger and dry cargo vessels and tow or tug boats (USACE, 1998). Table 5-15 shows inbound and outbound vessel traffic for self propelled and non-self propelled vessels.

Table 5-15: New Bedford/Fairhaven Harbor Vessel Trips, 1998

	Self Propelled Vessels			**Non-Self Propelled Vessels**		**Total**
Vessel Type	**Passenger & Dry Cargo**	**Tanker**	**Tow or Tug**	**Dry Cargo**	**Tanker**	
Inbound	756	4	882	173	690	2,505
Outbound	757	4	881	173	699	2,514
Totals	1,513	8	1,763	346	1,389	5,019

Source: USACE, Waterborne Commerce of the United States, 1998

5.3.8 Land Use

Land use at the closest landward point to the Proposed Preferred Aquatic Disposal sites, is a mixture of undeveloped, residential, commercial and industrial usage (Figure 5-2). Land usage at the closest landward point to the New Bedford Channel Inner site is The New Bedford Gas and Edison Light Company Wharf with adjacent commercial or industrial uses along South, Cape and Hassey Streets in New Bedford. Land usage at the closest landward point to the Popes Island site is Popes Island itself, which is developed with a Marine Park and radio communication towers. Land usage at the closest landward point to the West of Channel Site is a mixture of residential, institutional, commercial, and industrial usage. The nearest land use to the East of Channel Site is a public park (Fort Phoenix Beach State Reservation) and. Egg island, a tiny undeveloped island surrounded by rocky shoals.

5.3.9 Air Quality and Noise

5.3.9.1 Air Quality

Background air quality in New Bedford Harbor has been estimated using monitoring data reported by the DEP to the USEPA Aerometric Information Retrieval System (AIRS). Although the DEP does not operate any air pollution monitors within or near New Bedford.

The USEPA mandates monitoring of the following six criteria air pollutants: nitrogen dioxide (NO_2), particulate matter with diameters less than or equal to 10 microns (PM_{10}), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), and lead. Ambient Air Quality Standards (AAQS) have been established for each of these pollutants to protect the public health and welfare, with a margin of safety. PM_{10}, O_3, and NO_2 emissions are those associated with operation of heavy equipment used in UDM disposal operations. Ozone is not a pollutant emitted by heavy equipment, but is formed in the atmosphere when "precursor" elements and compounds such as nitric oxides, hydrocarbons (e.g. from unburned fossil fuels) and oxygen are combined in the presence of sunlight.

A geographic area that meets or exceeds an AAQS is called an attainment area for that air pollutant standard. An area that does not meet an air standard is called a non-attainment area for that standard. The entire state of Massachusetts is in attainment of all criteria air pollutant standards except for ozone, for which it is classified as in serious non-attainment. A summary of existing air quality data for Bristol county is as follows:

Nitrogen Dioxide (NO_2)**:** The nearest monitoring station for this pollutant is in Easton, MA. From 1998-2000 there were no violations of the annual standard of 0.053 ppm. Annual measurements ranged from 0.006 to 0.009 ppm.

Particulate Matter 10-Microns (PM_{10}): At a monitoring station in New Bedford, readings of 14.3 to 17.8 ppm (annual average) were recorded. This is well below the standard of 50 g/m3.

Sulfur Dioxide (SO_2): The nearest monitoring station for sulfur dioxide is in Fall River. From 1995-2000 there were no exceedances of the EPA standards. Annual means during this period were 0.004 to 0.005 ppm, which is well below the annual standard of 0.03 ppm.

Ozone (O_3): The nearest monitoring station for ozone is in Fairhaven. Exceedances of the 1-hour standard of 0.12 ppm occurred twice in 1995 and 1999 and one each in 1996 and 1997. Statewide, Massachusetts continues to be in non-attainment of the O_3 standard.

Carbon Monoxide (CO): The nearest monitoring station for CO is in East Providence, RI. No violations of the 1-hour or 8-hour standards were recorded from 1995 to the present.

Lead (Pb): The closest monitoring station for lead is in Boston. Since 1995 there have been no exceedances of EPA's lead standard.

Overall, the existing air quality in the New Bedford/Fairhaven area is good and is in compliance with all state and federal air quality standards except for ozone. Statewide non-attainment for the ozone standard requires that Massachusetts continue to make progress on implementing a State Implementation Plan (SIP) for attaining the standard.

5.3.9.2 Noise

New Bedford/Fairhaven Harbor is a heavily commercialized port, and as such nearshore areas in these communities exhibit noise levels typical of commercial environments. Industrial noises, such as that associated with operation of a seafood processing plant or traffic noise from shipping and commerce, all contribute to the existing noise environment. Generally speaking, the Outer Harbor is much quieter especially in the vicinity of recreational areas, such as Fort Phoenix Beach State Reservation at the far southwestern corner of the Town of Fairhaven, and in the vicinity of residential areas, such as the Harbor View, Pope Beach and Silver Shell Beach neighborhoods of Fairhaven.

5.3.10 Recreational Resources

Recreational resources in New Bedford/Fairhaven Harbor are abundant, and reflect a wide range of passive and recreational activities. Predominant among the recreational uses of the harbor are boating and sailing, swimming, and fishing.

There are several recreational marina, boat yards and yacht clubs located in New Bedford/Fairhaven Harbor. In addition, numerous single point moorings are located just south of Popes Island and along the Fairhaven shoreline in the Lower Harbor. In addition, several dockside restaurants are located within the Harbor.

Recreational fishing is a significant activity, with winter flounder, cod, mackerel, bluefish, scup and seabass and striped bass the most important recreational species. Section 5.3.3.6 provides a more complete description of recreational fishing within the Harbor.

Public parks abutting New Bedford/Fairhaven Harbor include Fort Phoenix Park, a state-owned reservation located in the southwest corner of Fairhaven at the eastern end of the hurricane barrier. This park provides public beach access and picnic areas. A marine park is located on the southern side of Popes Island. Smaller municipal parks are also located along the waterfront on the western side of the harbor, such as the one located just north of the hurricane barrier in New Bedford. These small municipal parks generally contain neighborhood playgrounds. Private beach areas most likely service the communities of Harbor View, Pope Beach and Silver Shell Beach neighborhoods of Fairhaven.

5.3.11 Economic Environment

New Bedford Harbor has shaped the identities and economies of both the City New Bedford and Town of Fairhaven for over 150 years. Today New Bedford/Fairhaven is one of the nation's preeminent fishing ports, ranked first in 1996, among east cost ports, and second nationally based upon the value of product landed. New Bedford harbor is home to one of the largest commercial fishing fleets in the Northeast Seaboard region, recording the greatest tonnage of commercial caught fish for 5 species (cod, yellowtail flounder, winter flounder, windowpane flounder, and monkfish).

The harbor's seafood processing industry has grown in size and sophistication in recent years and is a nationally and internationally established industry center. Marine service and vessel repair industries, centered in Fairhaven, have an established reputation all along the east coast and have diversified to capture markets associated with recreational vessels. With over 950 recreational boat slips, the New Bedford/Fairhaven Harbor is an important center for recreational boating and has potential for expansion. And with the recent establishment of New Bedford Whaling Historical National Park, the harbor's history and cultural heritage is gaining increased visibility and recognition nationally, resulting growing tourism visitation (Harbor Master Plan, 1999).

The dominant sectors of the New Bedford/Fairhaven Harbor economy have evolved over the centuries from a whaling port, to a harbor dominated by industrial manufacturing, to its present state as a predominant fishing port. Harbor-related businesses are estimated to account for 3,700 jobs in the local area contributing $671 million in sales to the local economy (Table 5-16). The "core" seafood industries, harvesting vessels and dealers/processors, contribute over 90% of the sales and approximately 70% of the jobs for harbor-related businesses. The New Bedford/Fairhaven Harbor Plan identifies the following key economic sectors of harbor-related businesses:

- *Fishing Industry* - Accounting for 45% of Massachusetts' employment in the harvesting sector.

- *Seafood Processing/Wholesaling* - Seafood processors in the harbor have been successful in diversifying sources of supply both nationally and internationally to overcome local shortages of product.

- *Seafood Auction* - The existing display auction has been successful in its first two years, with over 50% of New Bedford's total volume of groundfish landed being sold at the auction.

- *Waterborne Freight* - To improve this struggling sector, future strategies need to be developed to regain the economic benefits of handling ocean freight.

- *Commercial Recreation and Tourism* - Measures to increase capturing tourists need to be implemented to capitalize on the New Bedford Whaling National Park and drawing visitors to the waterfront (Harbor Master Plan, 1999)

Table 5-16: New Bedford/Fairhaven Harbor Economic Summary Data

	Approximate # of Jobs	Estimated $ Generated
Seafood Industries	2,600	$609,000,000
Other Harbor-Related Industries	1,100	$62,000,000
Totals	3,700	$671,000,000

Source: New Bedford/Fairhaven Harbor Plan, 1999

To quantify the total value in dollars of other maritime commercial activities, data for imports and exports were reviewed. Total imports for 1999, in New Bedford/Fairhaven Harbor were valued at $27,157,467, representing an increase of greater than ten fold over import values from 1998. Even with an increase in total export weight between 1998, and 1999, export values for New Bedford/Fairhaven Harbor in 1999, corresponding with a decrease of 21% over 1998, exhibited a total value of $2,310,707. The composite increase in total imports and exports is approximately 488% between 1998, and 1999, for a total value of $29,468,174 in 1999 (US Maritime Administration, 2000). Table 5-17 illustrates total weights and total values of imports and exports for 1998, and 1999.

Table 5-17: Imports and Exports for New Bedford/Fairhaven Harbor, 1998, and 1999

Year	Total Weight (Kilograms)	Total Weight (Short Tons)	Total Value (US Dollars)
Imports			
1999	113,446,440	125,074	$27,157,467
1998	50,749,426	55,951	$2,073,272
Exports			
1999	342,580	378	$2,310,707
1998	54,393	60	$2,940,354
Total Imports and Exports			
1999	113,789,020	125,452	$29,468,174
1998	50,803,819	56,011	$5,013,626

Source: US Maritime Administration, 2000

To quantify the annual volume of commodities freight traffic for New Bedford/Fairhaven Harbor, a ten year average was calculated. The annual average was determined to be 512,500 short tons (Table 5-18). The 1998 breakdown of commodities by category indicates that petroleum and crude materials represent approximately 98% of the volume of commodities freight for New Bedford/Fairhaven Harbor with chemicals, food and farm product and manufacture equipment comprising the remaining 2% of total volume. Table 5-19 indicates the freight traffic by commodities category and Figure 5-20 illustrates the percentage breakdown of Commodities Freight by percentage of total volume (USACE, 1998).

Table 5-18 : Ten Year Annual Commodities Freight Totals

Year	Commodities Freight Totals (Short Tons)
1989	456,000
1990	406,000
1991	503,000
1992	484,000
1993	503,000
1994	601,000
1995	570,000
1996	516,000
1997	554,000
1998	533,000
10 Year Average	512,500

Source: USACE, Waterborne Commerce of the United States, 1998

Table 5-19: Freight Traffic Breakdown, 1998

Commodities	Freight Traffic (Short Tons - 1,000s)
Petroleum, and Petroleum Products	304
Chemicals, and Related Products	6
Crude Materials, Inedible Except Fuels	219
Food and Farm Products	0
Manufactured Equipment, Machinery and Products	3
1998 Total	533

Note: Food and Farm Products category was less than 500 tons, 1998 total reflects rounding

Source: USACE, Waterborne Commerce of the United States, 1998

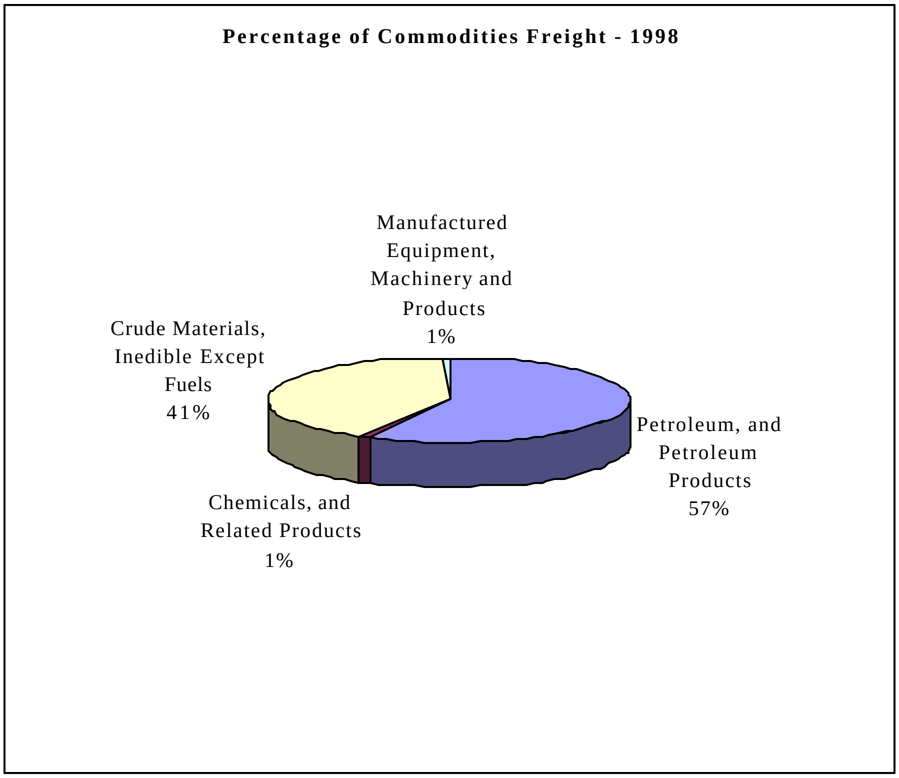


Figure 5-20: Percentage Breakdown of Freight Commodities for New Bedford/Fairhaven Harbor, 1998.

In January of 1999, DMF estimated the total values of New Bedford/Fairhaven Harbor's quahog resources. The value to fisherman calculated reflects the dollar values paid to shell fishermen. The consumer market value of the standing crop was obtained by applying an economic multiplier. The total value of New Bedford/Fairhaven Harbor's standing quahog crop to shell fishermen was calculated to be $17,004,228 (Table 5-20) with a total consumer market value of $76,519,027 (DMF, 1999).

Table 5-20: Economic Value of Quahogs for New Bedford/Fairhaven Harbor (Inner and Outer)

Harbor Segment	Value to Fisherman	Consumer Market Value
Inner Harbor	$11,503,725	$51,766,763
Outer Harbor	$5,500,503	$24,752,264
Total	$17,004,228	$76,519,027

Source: DMF, Quahog Standing Crop Survey, 1999

The City of New Bedford has been working to develop the Harbor as a destination for the cruise industry in conjunction with the City's growing tourist industry. American Cruise Lines's *American Eagle,* a brand new luxury liner, will make nine visits to the Harbor in the Summer of 2000. The addition of waterborne tourism to the harbor, will help diversify the use of the waterfront, while maintaining a viable seafood industry(New Bedford, 2000).

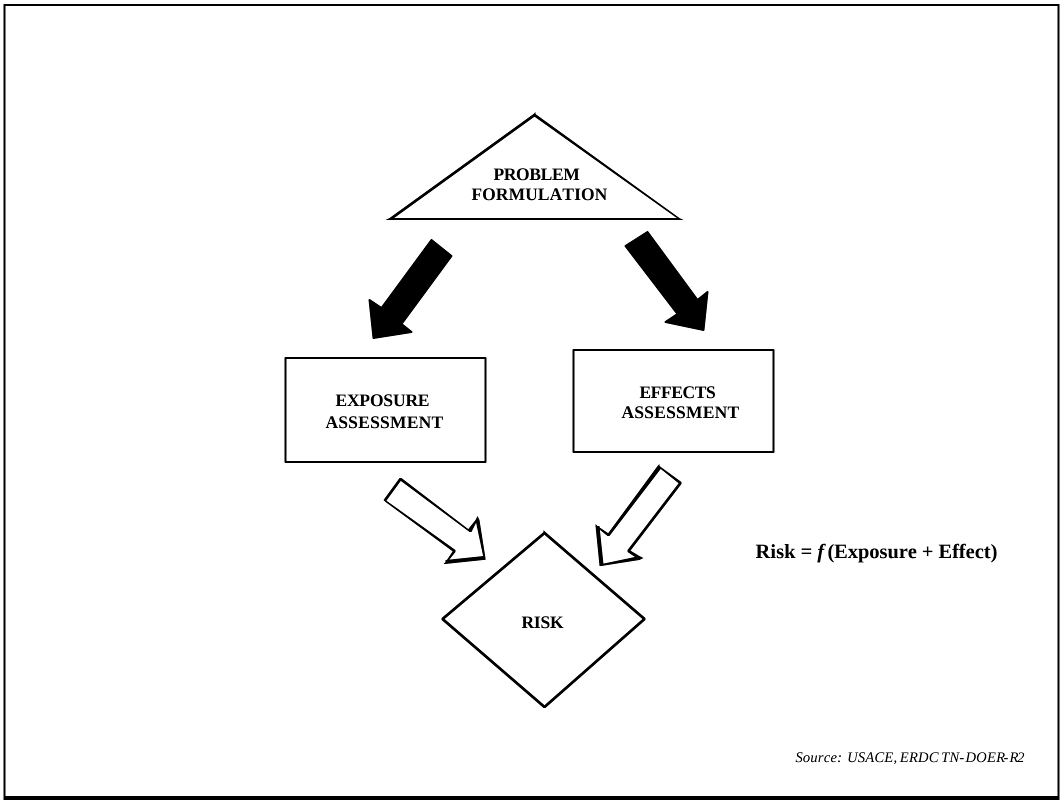


Figure 5-21: USEPA Risk Assessment Paradigm

5.3.12 Risk Assessment Synopsis

Risk assessment is basically a problem formulation to evaluate risk as a function of exposure to the environment and on human health (Figure 5-21). The evaluation and determination of potential dredging and disposal impacts on both environmental and human resources are useful planning tools when evaluating alternative disposal locations. As part of developing a remedy to address the environmental release described below, the USEPA conducted risk assessments associated with the New Bedford/Fairhaven Harbor Superfund project to evaluate associated ecological and human health impacts. A literature search was conducted as part of the DMMP to summarize past risk assessments conducted to establish a baseline for comparative purposes.

5.3.12.1 Problem Formulation

From the late 1940s until 1977, manufacturers in New Bedford discharged industrial wastes containing PCBs into New Bedford/Fairhaven Harbor and nearby coastal environments, resulting in widespread, severe contamination of the sediments, water column and biota of the Harbor estuary and parts of Buzzards Bay. Previous environmental studies conducted indicate the widespread contamination by polychlorinated biphenyl (PCBs) and other heavy metals such as copper, cadmium and lead. See studies by Hoff D.J. et al., 1973, Kolek and R. Ceurvels, 1981, McMullin, T.A., 1976, Nemerow, N.L., 1978, Sittig, M., 1975, Summerhayes, C.P et al., 1977, and Teal, J. and M. Teal, 1969. In 1979, due to the contamination of PCBs and other heavy metals, large areas of New Bedford/Fairhaven Harbor were closed to fishing. The justification for closing the fishing industry in the harbor was to reduce the potential for human exposure to PCBs.

In July 1982, under the direction of the Comprehensive Environmental Response, Compensation and Liability Act (or Superfund) (42 USC§9601 et seq.), the USEPA added New Bedford/Fairhaven Harbor to its Interim National Priorities List (NPL).

5.3.12.2 Ecological Risk Exposure Synopsis

The USEPA conducted an ecological risk assessment for New Bedford Harbor. The findings of the assessment confirmed extensive PCB contamination of water, sediments, and biota in the harbor, with sediment concentrations reported in excess of 100,000 parts per million (ppm) in the area of maximum contamination (EBASCO 1990).

An exposure assessment was performed by USEPA to identify representative organisms within New Bedford/Fairhaven Harbor that may be or have been exposed to PCBs and other metals. For the purposes of accumulating results at various (simulated) points in time, the transportation model used divides the estuary and harbor into five zones. These zones are based in part on natural and manmade structures and on the initial contaminant concentrations detected in the sediment.

The models used by the USEPA to evaluate risk to aquatic biota included a joint probability analysis. One distribution analysis represents contaminant levels in various zones of the harbor, while the other distribution represents the sensitivity of biota to contaminants (EBASCO, 1990). The two probability distributions were combined to present a comprehensive probabilistic evaluation of risk. These models were supplemented by: 1) comparisons of PCB levels in the harbor to USEPA water quality criteria (AWQC), 2) an evaluation of site-specific toxicity tests; and, 3) the examination of data on the structure of faunal communities in the harbor (EBASCO, 1990).

In conclusion, the analysis conducted by the USEPA to assess ecological risk and exposure associated with PCB contamination in the harbor indicated that levels in Zones 1, 2 and 3 have the potential to strongly impact individual biota in the harbor, as well as the overall integrity of the harbor as an integrated functioning unit (EBASCO, 1990). This impact may take the form of numerical changes at the population level, changes in community composition and ultimately ecosystem stability. For Zone 4, ecosystem level disruptions are less strongly indicated but are still likely. The results of numerous site-specific and laboratory studies indicate that New Bedford/Fairhaven Harbor is an ecosystem under stress and there is a high probability that PCBs are a significant contributing factor to the integrity of the harbor as an integrated functioning ecosystem (USEPA, 1998).

Proposed Preferred Alternatives

The proposed preferred alternatives within Zone 3 (Popes Island North) and Zone 4 (Channel Inner) are located in areas identified as posing ecological risks as a result of contamination by Superfund material located within the harbor. Popes Island North CAD site is located in an area identified with the potential to strongly impact the overall integrity of the harbor. The Channel Inner site is located in an area that was identified as an area likely posing ecological risks (Figure 5-22).

5.3.12.3 Human Health Exposure Synopsis

In addition to the ecological risk assessment conducted by the USEPA, a baseline public health risk assessment to estimate the probability and magnitude of potential carcinogenic and non-carcinogenic adverse health effects related to the release of Superfund contaminants as described above into New Bedford/Fairhaven Harbor. The USEPA's evaluation considered PCBs and other metals that could potentially contribute to adverse health effects. A baseline assumption of the evaluation was that contaminant concentrations would not change significantly over a ten-year period. Quantitative and qualitative estimates of the likelihood of adverse human health effects through several pathways were made. The following pathways were considered to assess the potential exposure to hazardous substances; ingestion of contaminated seafood, direct contact with contaminated shoreline sediment and incidental ingestion of contaminated shoreline sediment by children. Two other pathways deemed not to result in significant adverse health effects, included exposure while swimming and inhalation of airborne PCBs near the harbor (USEPA, 1998).

Conservative factors, where the true risk is unlikely to be greater than the risk predicted, were applied by USEPA to evaluate cancer risk. A health hazard index was also developed to evaluate the pathways for non- carcinogenic adverse health effects. Estimated risks from seafood consumption, skin contact and ingestion of sediment were evaluated. The greatest risk pathway identified was through the consumption of local seafood. For more detailed information the reader is encouraged to review the more detailed account of the baseline health risk assessment in "EBASCO 1989" (USEPA, 1998).

Proposed Preferred Alternatives

The areas of the Channel Inner and Popes Island North CAD sites under consideration in the DMMP are located in the portion of the harbor corresponding with Area 1 (from the Wood Street bridge southerly to the Hurricane Barrier) of the USEPA risk assessment. This area also corresponds with the area of New Bedford/Fairhaven Harbor that is closed to all fishing and swimming activities.

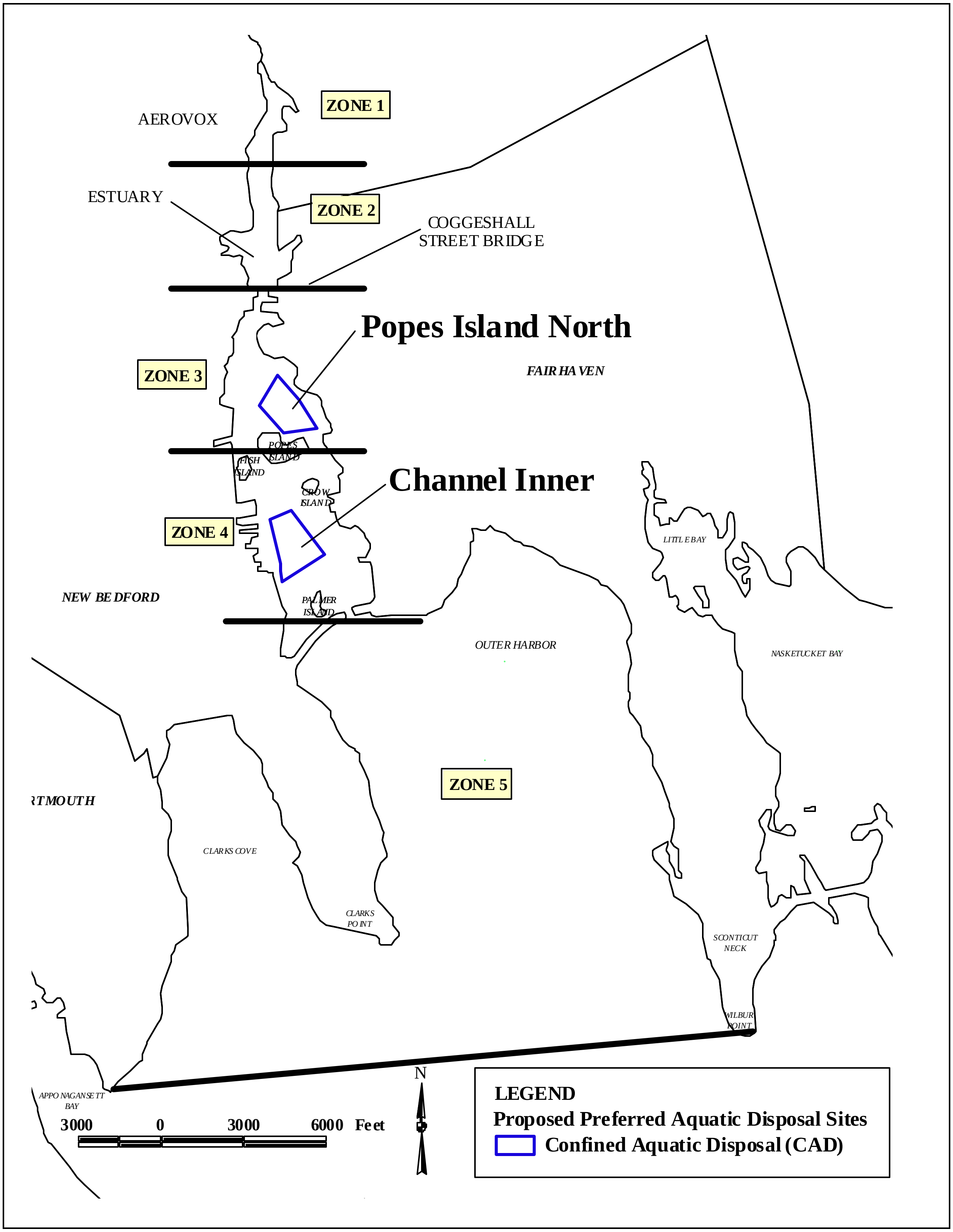


Figure 5-22: Exposure Zones Evaluated by the USEPA for Ecological Risk (EBASCO, 1990)

5.3.13 Environmental Justice

The draft Environmental Justice Policy of the EOEA asserts, defines environmental justice as "... all people have the right to be protected from environmental pollution and to a clean and healthful environment." It is EOEA's policy of the Executive Office of Environmental Affairs that environmental justice include the equal protection and meaningful involvement of all people with respect to the development, implementation and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. This policy is implemented through regulatory and resource agencies of the Commonwealth.

The need for environmental justice has been most widely recognized in communities of color and in low-income communities. The EOEA utilizes specific indicators based on social/economic, sensitivity/vulnerability and environmental data. Under the draft guidelines of the EOEA, a region that has fifteen (15) percent or more of the population as non-white and low income (U.S. Census Bureau) qualifies the municipality as an Environmental Justice Community. Other criteria presented include sensitivity/vulnerability measures such as low birth weight, incidence of cancer, and incidence of lung and bronchus. Based on U.S. Census Bureau data, the following analysis of the City of New Bedford and the Town of Fairhaven are provided below (Table 5-21).

Table 5-21: Environmental Justice Criteria Analysis for New Bedford and Fairhaven

	New Bedford	Fairhaven
Total Population*	99,922	16,132
Population - non white (17.8% MA avg.)*	12,164 (12.2%)	376 (2.3%)
Population - low income Household Income <$10,000^^	16,430 of 97,908 (16.8%)	1,032 households of 15,825 (6.5%)
Population - foreign-born^	20,865 of 99,922 (21%)	873 of 16,132 (5.4%)
Population - non-English speaking^	9,573 of 92,402 (10.4%)	170 of 15,180 (1%)
Incidence of low birth weight (7.1% MA avg.)^^	94 of 1,267 (7.4%)	10 of 139 (7.1%)
Incidence of all newly diagnosed cancer types for 1994 to 1998**	2,571 (obs) of 2,695 (exp)	536 (obs) of 483 (exp)
Incidence of lung and bronchus for 1994 to 1998**	372 (obs) of 393 (exp)	79 (obs) of 72 (exp)

References:

*1990 U.S. Census Data - long form (STF 3)
^ Poverty Level Based on Income in 1989
^^Massachusetts Births 1999
**Cancer Incidence in Massachusetts 1994-1998
n/a: Data not available for Fairhaven from U.S. Census Data

The boundaries of the two aquatic proposed preferred alternatives are physically located within the jurisdictional waters of the City of New Bedford and the Town of Fairhaven in New Bedford/Fairhaven Harbor. Thus, the environmental justice policy of MEPA is considered for these municipalities as potential environmental justice communities.

Based on the data presented in Table 5-21 and the EOEA guidelines, portions of both communities qualify for status as environmental justice communities. Additionally, the EPA has classified parts of both municipalities as environmental justice communities as verified by the EPA, New England Office. Specifically, several census blocks in New Bedford scored higher for environmental criteria than Fairhaven but Fairhaven had at least one census block that did score on the environmental justice criteria for EPA (M. Barry, personal communication, October 26, 2001). Table 5-20 indicates that the household income below $10,000 (poverty level) exceeded the 15% threshold of the EOEA for New Bedford but not for Fairhaven. However, the non-white population did not exceed the state average in either municipality. In New Bedford, the number of non-white population is 12.2%. Low birth weight and cancer rates are at or above state average.

SECTION 6.0 - ENVIRONMENTAL CONSEQUENCES

6.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED PREFERRED AQUATIC DISPOSAL SITES

A detailed evaluation of the environmental and human resource impacts and benefits associated with the implementation of the two proposed preferred aquatic disposal sites (Figure 6-1) was undertaken, and is presented in this section. Where impacts or benefits associated with the disposal of UDM is common to both proposed preferred aquatic disposal sites, they are referred to as the proposed preferred aquatic disposal sites collectively. Where impacts or benefits associated with the disposal of UDM varies among the two proposed preferred aquatic disposal sites, the impact or benefit associated with each specific site is discussed. In addition, at the end of each subsection (e.g. 6.1 Sediments and Water Quality), a summary of the impacts that would occur/not occur as a result of the no action alternative are also presented.

Both of the proposed preferred aquatic disposal sites are CAD sites (Channel Inner and Popes Island North). A simplified sketch of CAD disposal types is shown in Figure 6-2. It is important to note that impacts could occur at several stages in the dredging and disposal process and, therefore, are evaluated as such in the ensuing sections. For CAD cells, there are potential impacts associated with the creation of the sites themselves, i.e. the excavation of sediment needed to create the disposal cells. Once the cells are created, then the impact of dredged material disposal into the cells is considered. Finally, the capping of the UDM with a sandy sediment, which would level the harbor bottom to its pre-existing depth, is evaluated. This final step is seen as the long-term effect of disposal, i.e. the effect of the presence of a patch of clean, sandy substrate in a harbor predominantly composed of soft silt and mud.

As discussed in Section 9.0 of this DEIR, the planned operation and management of the disposal site will have a bearing on the temporal and spatial aspects of impact. Currently, it is envisioned that either of the two disposal sites 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 sites, placement of the UDM within the sites, and capping of the sites would likely occur within a period of less than six months. This period would be the time when *temporary* impacts could occur. After the cap is placed atop the UDM, then the potential impacts would be considered *long term*. The expected impacts of the project were evaluated based upon the following: site-specific information gathered during the DMMP process; previous studies of New Bedford/Fairhaven Harbor and the Buzzard's Bay region; studies done at other New England ports (e.g. Boston, Salem and Gloucester Harbors) and disposal sites, and laboratory studies of the effects of dredging and related activities. It is recognized that additional site-specific information is needed to complete the MEPA process and subsequent federal and state permitting.

The following site-specific efforts will be undertaken in support of continuing the MEPA and/or permitting processes:

- Geotechnical borings to confirm depth to bedrock and determine 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
- Physical and chemical analysis of surficial sediments

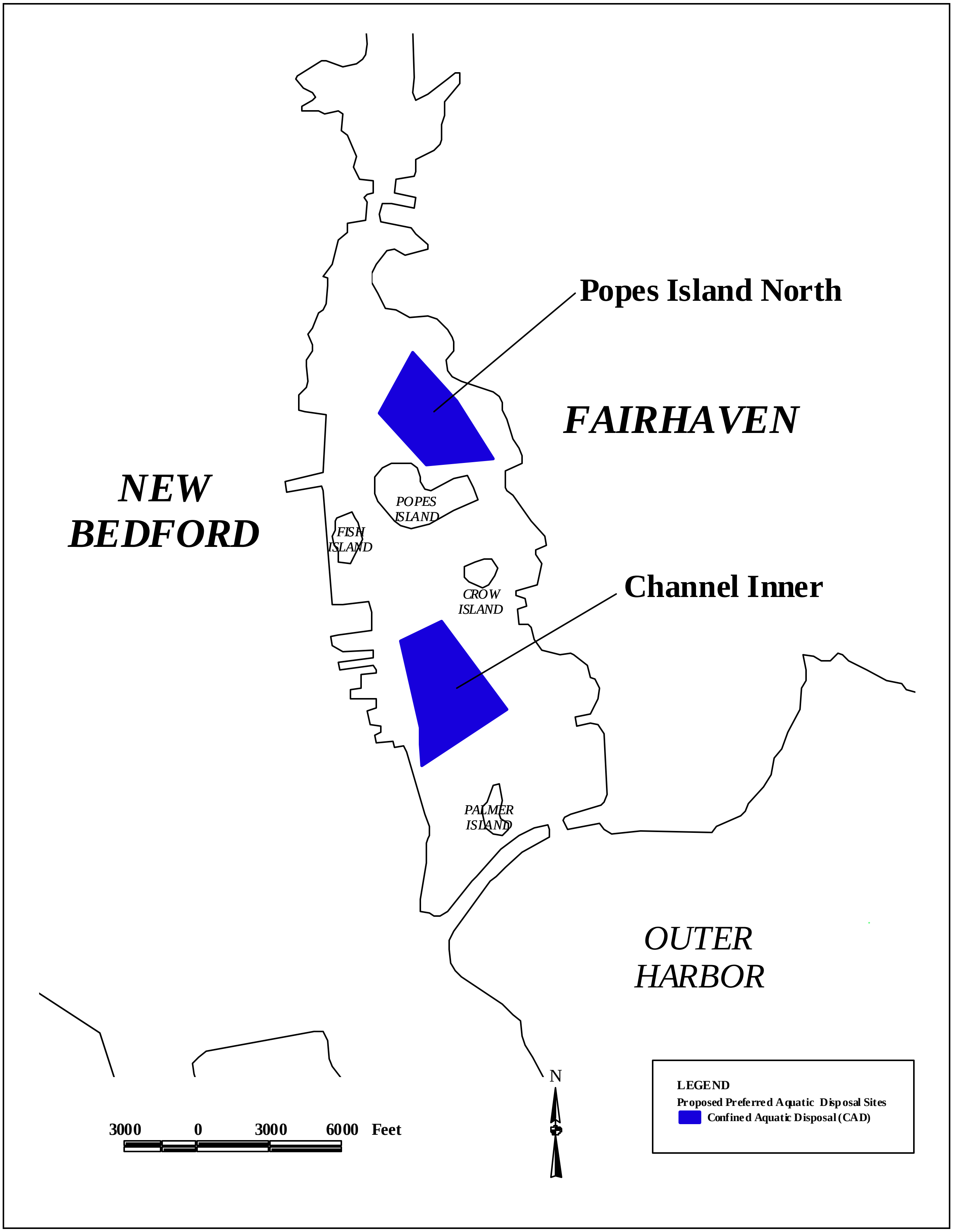


Figure 6-1: Proposed Preferred Disposal Sites

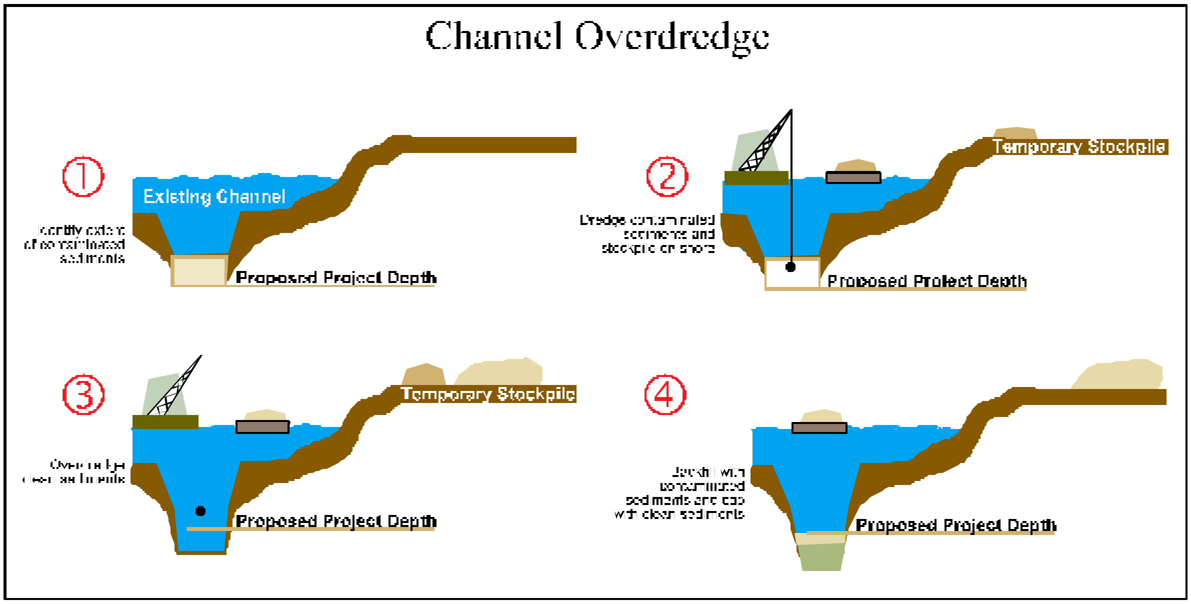


Figure 6-2: Schematic of Typical CAD Disposal Within an Existing Channel.

Depending on the actual volume of dredging to be conducted, either one or a combination of the two proposed preferred aquatic disposal sites could potentially be used to accommodate the actual volume of UDM dredged.

6.1 Sediments and Water Quality

6.1.1 Existing Sediments in the Vicinity of the Disposal Sites

Dredging and UDM disposal is intrinsically a high disturbance process with respect to existing sediments. The primary, potential repercussions of CAD excavation, UDM disposal, and subsequent capping of disposed sediments include the mortality of resident benthic organisms (especially sessile organisms), and the alteration of the existing sediment composition at the disposal site. The long-term sediment character is dependent upon the grain size of the final sediments at the surface cap relative to the pre-existing sediments, and the influence of re-colonizing benthic biota (Section 6.2.1). The expected type of sediment at the surface of the disposal sites is discussed further in this section.

The final character of the sediments overlying the disposal sites will be dependent upon the construction of the disposal sites. CAD sites are typically capped with a coarse-grained material (sand) because coarser grained sediment provides better resistance against resuspension, and stronger armoring capabilities. Because the existing sediment at the proposed preferred aquatic disposal sites is predominantly fine-grained, capping will alter the existing sediment type for a period of time. There is insufficient information to accurately predict the long term nature of the surficial sediments at the proposed disposal sites. However, rough estimates of shoaling rates in the federal channel areas of New Bedford/Fairhaven Harbor indicate that sedimentation occurs at a rate of approximately 0.5 in/year. This sedimentation rate is based upon the average amount of sediment accumulated in the harbor channels as derived from a comparison of historical bathymetric surveys (USACE, 1996). The specific shoaling rate of the proposed preferred aquatic disposal sites is not known at this time, but will be evaluated as part of the final EIR.

Sedimentation rates in and around CADs will be increased if the final topography of the CAD cells is recessed below the existing bottom. Active sedimentation will likely fill the disposal site so that the surface sediments may eventually reflect the composition of the fine-grained sediment naturally deposited in the area. For example, CAD cells have been constructed at the bottom of the existing dredged navigation channel in the Mystic River (Boston Harbor) in the past few years. Consolidation of the sediments in the CAD cells resulted in a recessed topography that resulted in faster sedimentation at the top of the cells, as compared to the surrounding area (USACE, 1999). At the surface of a coarse-grained cap, it is unlikely that species that prefer unconsolidated fine-grained sediments will recolonize as quickly or thoroughly. Thus, some change in species composition could result through capping with sand. Nonetheless, sand-capped mounds in other projects have been recolonized successfully (SAIC, 1998), albeit by different species of organisms than those that had inhabited the previous fine-grained sediment.

The sediment profile sample stations within the proposed preferred aquatic disposal sites showed RPD values of –4 cm, suggesting moderate sediment aeration either through tidal flushing, bioturbation by Stage III organisms (subsurface deposit-feeders), or a combination of these two factors. The mean OSI was +4 in the vicinity of the Popes Island North site and the Channel Inner site. OSI values less than +6 typically indicate a disturbed benthos (ENSR, 2001). Excavation of these areas, disposal of UDM, and final capping will disrupt the sediment profiles and the organism-sediment relationships that have helped create them. The increased sedimentation rates into the recessed CAD cap may create a temporary situation in which accumulating organic sediments initially increase oxygen demand. This occurs since the former benthic invertebrate community has been eliminated through excavation, disposal, and capping and is no longer available to process the input of organic material entering the recessed CAD cap. As a result, an increase in heterotrophic bacteria could be expected, as the bacteria decomposes the organic matter consuming oxygen during the process. Therefore, CAD excavation, UDM disposal, and capping would be expected to result in a shallower RPD depth, and lower OSI values across the CAD cap.

Recolonization of the CAD caps will eventually re-oxygenate the sediment-water interface. Recolonization may begin as soon as a few days following the cessation of disturbance. However, data collected from the Boston Harbor Navigational Improvement Project (BHNIP, 2001) CAD sites and vicinity suggests that a significant improvement over present bottom habitat conditions (i.e., pre-disturbance) following UDM disposal and final capping may not be readily apparent, especially if other disturbance factors are responsible for sediment resuspension (e.g., physical bottom instability, prop wash, bow waves). In the BHNIP, the deepest RPD depth measured in one CAD cell was 1.08 cm and the OSI values ranged from +2 - +3, three years after final capping, compared to an RPD depth of 2.44 cm and an OSI range of +2 to +6 in an adjacent reference site, which was undisturbed by UDM management activities. However, sediment grain size at the surface of the recessed CAD cap had returned to a silt over clay composition, comparable to that of adjacent reference sites outside of the disturbance area. At another CAD site in the BHNIP, re-oxygenation of the sediment-water interface on the cap surface was delayed by cell wall sloughing and subsequent sediment resuspension. The high oxygen demand of the organic mud fraction was apparently responsible for creating anoxic conditions which formed following sloughing events (ENSR, 2001). Eventually, as sedimentation of the recessed CAD cap matches existing ambient sediment topography, and recolonization progresses to later successional stages, the benthos would return to pre-disturbance conditions. Recolonization of the CAD sites by benthic invertebrate biota and progression through community successional stages is discussed in Section 6.2.1.

6.1.2 Sediment Transport/Circulation in the Vicinity of the Disposal Sites

The circulation of water in coastal embayments such as New Bedford/Fairhaven Harbor is influenced by a complex combination of forces produced by tidal fluctuations, wind, and density gradients. Factors such as wave height, geomorphology, and water-column stratification influence harbor current velocities, localized circulation patterns, and sediment transport. These factors are of particular concern in the siting and management of UDM disposal, since they will influence the long-term integrity of the cap material and the ability to isolate the disposed sediments from the aquatic environment at the CAD sites. The following discussion of potential impacts to sediment transport conditions from UDM disposal is based on analysis of historical hydrodynamic data collected from New Bedford/Fairhaven Harbor (see Section 5.3). A more accurate and complete understanding and prediction of impacts will be possible once site-specific circulation field studies of tidal currents and waves have been conducted as part of the Final EIR.

Hydrodynamic data collected within New Bedford/Fairhaven Harbor suggests that the areas in the vicinity of the preferred disposal sites are low energy, depositional areas. In depositional areas, fine-grained sediments accumulate and tend to be stable for long periods of time. Disposal sites located in these areas should effectively contain UDM in properly designed facilities. In contrast, boulders, rock outcrops, and coarse-grained sediments are typically detected in erosional or non-depositional areas. Erosional forces, due to a combined action of tidal currents and waves, may transport sediment away from disposal sites. Ensuring the confinement of sediments over time is difficult in turbulent environments, therefore locating disposal sites in low energy containment areas is of primary importance (Summerhayes, et al., 1985).

Given the level of information available, it is difficult to assess the potential site-specific impact of storm-induced circulation patterns within New Bedford/Fairhaven Harbor. Sites located in shallower regions may be more exposed to the effects of current scouring than those located at greater water depth which are relatively protected from meteorological conditions and surface wave-action. If storm-induced erosion does occur, the effects appear to be temporary as the sediment data from the proposed preferred aquatic disposal sites suggests a long-term depositional environment. In addition, the placement of a sand cap will reduce the potential for sediment resuspension over the CAD sites. Both sites are located in protected coastal embayments and are less likely to be exposed to significant storm-induced conditions because of the protection provided by surrounding land masses and the Hurricane Barrier.

Water column depth at the disposal sites may play an important role in determining localized current velocities. Bottom currents experience increasing friction as they approach the sediment boundary layer. Given this phenomena, CAD sites located at greater depth will be exposed to lower current velocities and less potential sediment resuspension forces than CAD sites at shallower depths. Coarser grained material also has the effect of greater frictional and gravitational forces holding the grains on the seabed. Thus a greater critical shear stress would be required to resuspend coarse-grain cap material than fine-grained silty sediments.

Hydrodynamic conditions may also be influenced by the construction of the containment cell created to disposal of UDM. In the case of Boston Harbor, an overdredged channel site was created which was moderately recessed from the surrounding channel sediments. The effect of this recessed pit was reduced water column mixing with surrounding waters, and active sedimentation within the pits (USACE, 1999).

Navigational channels often experience some degree of reduced mixing via stratification due to temperature or salinity gradients. Bottom sediments within navigational channels can experience hypoxic or anoxic dissolved oxygen (DO) conditions due to the reduced vertical mixing and higher BOD from the accumulation of organic material. Reduced circulation may be beneficial from the standpoint of cap integrity (if required) since resuspension is less likely, but by the same effect, this localized condition may also contribute to reduced water quality (see next section). Site specific effects of currents on sediment transport in the vicinity of the proposed preferred alternatives will be reviewed for the FEIR.

6.1.3 Water Quality in the Vicinity of the Disposal Sites

6.1.3.1 Physical and Biological (Pathogenic) Water Quality Parameters

From prior overdredging projects, evidence suggests that the impact to water quality from UDM management is short-term (USACE, 1996; USACE, 2001). Handling of the material during excavation, disposal, and final capping may result in impact to physical water quality parameters such as a localized decrease in DO, pH, light penetration, and increase in TSS concentrations. Conditions typically return to ambient conditions within hours to days, depending on the amount and composition of the disposed material. For example, at the New London Disposal Site (NLDS), DO levels have been shown to return to pre-disposal concentrations from 15 minutes to 2 hours after disposal (U.S. Navy, 1979). NOAA (1977) reported that the DO content in the bottom waters at the NLDS dropped to about 48 percent of saturation and returned to ambient (84 percent) within 40 minutes. However, surface and middle waters were hardly affected. Therefore, it is likely that short-term negative impacts on water quality, particularly DO, would be greatest at the bottom of the water column.

Lee et al. (1977) reported that the greatest drop in DO in a Galveston, Texas disposal project was 1.7 mg/l, but at no time did the level drop below 5.0 mg/l. This is the concentration at which many marine organisms become stressed. Therefore, the short-term decrease of DO in the water column, at the scale and magnitude measured for other dredge projects, should not significantly impact mobile marine organisms. However, following excavation of the CAD pit, bottom water within the recessed CAD could become hypoxic or anoxic. Since most of the benthic community at this point would have been removed via excavation of the CAD, the temporary formation of hypoxic or anoxic CAD cell bottom waters is not considered to significantly impact marine organisms locally, in the area outside of the CAD site footprint.

Following disposal of UDM and upon final capping and closure of the CAD site, the CAD surface may remain slightly recessed to allow natural sedimentation processes to occur. Natural sedimentation would return the CAD surface sediment texture to pre-disturbance ambient texture. However, this recession may trap organic particles causing high bacterial decomposition and resultant decomposition, a process which consumes oxygen. Hypoxic conditions may persist in the area of these recessed CAD caps until bioturbation by the benthic invertebrate community and tidal flushing restores dissolved oxygen to pre-disturbance conditions. Hypoxic conditions would first favor re-colonization by organisms which have adapted to low oxygen environments. In extreme situations, these areas could remain azoic for some time, as re-colonization is delayed by anoxia (Section 6.2.1).

Total suspended solids may increase dramatically due to fine material in the water column. Material from a plume may extend short distances from the disposal site. A reduction in DO is typical as common constituents of sediments are oxidized and organic material is metabolized by microbial activity at the sediment-water interface. In addition, high, suspended, solid concentrations have the effect of attenuating ambient light at shallower depths. Therefore, the turbidity plumes produced by UDM excavation, CAD site excavation, UDM disposal, and subsequent capping may impact local primary productivity by rapidly decreasing diatom production with depth (Gallagher and Keay, 1998). Rapid mortality of ambient diatom populations may result in a measurable increase in oxygen demand, as heterotrophic bacteria begin to decompose the dead diatoms consuming oxygen in the process.

Water quality was extensively monitored in Boston Harbor during both dredging and disposal activities associated with the Boston Harbor Navigation Improvement Project (BHNIP) and Berth Dredging Project in Boston, Massachusetts (ENSR, 1997). Monitoring results collected from the BHNIP showed that the suspended sediment plume was limited to an area within 300 feet of the dredging and disposal activity. In New Bedford/Fairhaven Harbor, the scale and magnitude of this impact is small in relation to the area of the Lower Harbor environment where the CAD sites are located. For instance, a three hundred foot turbidity plume that has formed around a release point within the CAD site would impact a fraction (approximately <20%) of the CAD site area.

During the BHNIP, no increases in TSS were measured at the reference area 1,000 feet from the dredge. Although, short-term spikes were noted during passage of larger working vessels such as tugboats, tankers and bulk carriers. There were no apparent differences in DO between the monitoring stations and the reference areas. All of the contaminants measured were below chronic aquatic toxicity levels except for mercury, which measured above chronic but below acute aquatic toxicity values during a limited number of monitoring events. Bioassay data also suggested there was no difference in impacts between the area dredged and a reference area.

The final results from Phase 1 of the BHNIP showed that the project met the Water Quality Certification compliance standards during the operations, and data collected during Phase 2 of the monitoring has suggested similar results (S. Wolfe, personal communication).

There has been no dredging/disposal water quality monitoring in New Bedford/Fairhaven Harbor associated with the DMMP to date. In addition, there is currently insufficient oceanographic data to predict water TSS effects. As a result, the evidence from Boston Harbor (Figure 6-3) monitoring was used to estimate short-term impacts to water quality and aquatic resources in New Bedford/Fairhaven Harbor. Figure 6-4 illustrates the predicted 300-foot area of turbidity, from a hypothetical release point, as applied to the proposed preferred aquatic disposal sites. Within this 300-foot plume, measurable yet temporary decreases in DO could occur. Turbidity would increase significantly but would return quickly to pre-disposal conditions.

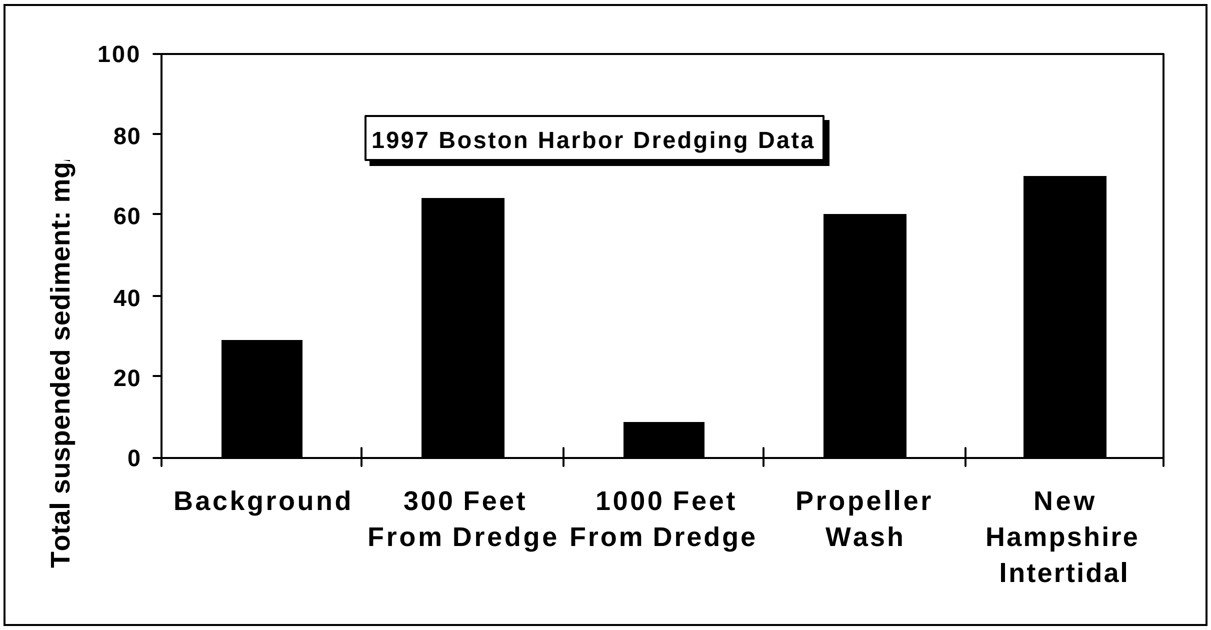


Figure 6-3: Total Suspended Sediment Measurements from Boston Harbor Dredging Operations.

During disposal of the UDM at the CAD site, sediment contaminants could be released into the water column, causing a temporary increase in water column pollutant concentrations (Section 6.1.3.2). However, this short term impact would be off-set by the long term benefit of eliminating a direct pathway of contaminants into the food chain. This is accomplished through reduction of exposure of benthic invertebrates to unconfined contaminated sediments. Contaminated sediments left in place is a source of exposure to benthic marine invertebrates and demersal finfish species via direct exposure and via ingestion of contaminated sediment, pore water and prey. Bioturbation can result in the mobilization or deposition of higher concentrations of contaminants than what may occur beneath the sediment surface (Aller and Yingst, 1978). To address site specific short term water quality impacts, additional site-specific studies, including oceanographic field studies to support water quality monitoring, will be done at a later date. Results of these studies will be presented in the FEIR.

A concern relative to long-term impacts to water quality was raised during the BHNIP. To ensure acceptable water quality, successful capping needs to be employed. Successful capping (defined as the placement of a discrete layer of three feet of sand over the entire surface of the cell) initially proved more difficult than first anticipated during the BHNIP. Although, most of the CAD cell was covered with a highly variable thickness of sand, the southern end had little or no cap material (USACE, 1999). Initial modeling suggested that tidal currents would influence the positioning of disposal barges to compensate for the anticipated transport of released capping material downcurrent. However, it was discovered during the monitoring phase of the project that the dredged material dumped from the barges fell directly to the bottom (USACE, 1999), accounting for the minimal cap material placement at the southern end of the cell. Therefore, preliminary estimates of sand transport due to prevailing currents were overestimated.

It was also determined that density differences between sand and fluidized UDM may have resulted in a mixing of sand cap material and UDM. This mixing phenomena was mitigated during Phase 2 of the project by allowing more time for UDM consolidation. Sediment that slumped from weakened cell walls may have contributed some of the fine-grained/coarse-grained mixture. Other construction measures, as recommended in USACE (1999), were employed during Phase 2. The result was a successful capping of UDM that satisfied DEP's water quality concerns (see DEP June 13, 2000 letter to USACE in Appendix B).

The BHNIP demonstrated the need for operational control during capping in order to ensure an even distribution of capping material over the CAD site, which includes the incorporation of real-time position tracking during sand placement. Similar operational control during capping would be enacted at the New Bedford/Fairhaven Harbor to ensure that a successful capping operation is conducted and short- and long-term adverse water quality impacts are avoided or minimized. For instance, the use of operational controls during capping (e.g., moving the scows around the cells while capping) and incorporation of real-time position tracking during sand placement would avoid errant capping efforts which could result in an uneven spatial coverage and variable cap thickness similar to the situation that occurred in the BHNIP. Deployment of one or more of the variety of monitoring strategies (e.g., single- and multi-beam bathymetry, sub-bottom profiling, sidescan sonar, coring, video, cone penetrometer) would be required to confirm cap coverage and thickness in order to avoid discrepancies in real-time versus model-predicted cap deposition and coverage.

The long-term impacts to water quality associated with UDM management would be avoided. By constructing CAD cells, basin bathymetry is not impacted because the final cap elevation is designed to match existing sediment elevations. Creating a recessed sand cap rather than an elevated mound would encourage sediment deposition rather than erosion. Avoiding creation of a raised sediment cap would prevent alterations of currents and flow regime, thereby, preventing erosion of the sand cap and exposure of the underlying contaminated sediments to the overlying water column. Long-term nutrient enrichment (a potential source of eutrophication to surface waters) would be avoided by using nutrient poor sand for the CAD cap. The nutrient concentrations of the sand cap could be verified by analytical testing of samples collected from the sand at the source. Impacts to water quality by total coliform and other microbial pathogens would not be considered a long-term impact because the Lower Harbor CAD sites lie in areas that are already closed to direct shellfish harvesting (i.e., without depuration) due to elevated coliform concentrations. Pathogens, alone (i.e., without accompanying sediment), are rapidly assimilated or neutralized by the estuarine system. Aside from potential human health impacts, pathogens typically pose little impact to the biota of the system (Wilson, 1988). Human health impacts would be avoided or minimized by the existing ban on finfishing and shellfish harvest in the harbor and the posted health advisories.

The technical specifications of the BHNIP have been compiled in Section 8.0 of this document. CAD Best Management Practices (BMPs), measures employed to reduce negative impacts, and a sample Water Quality Certification have been included to establish an operational framework and guidelines to ensure the DMMP proceeds in an environmentally sound fashion (Appendices L and M).

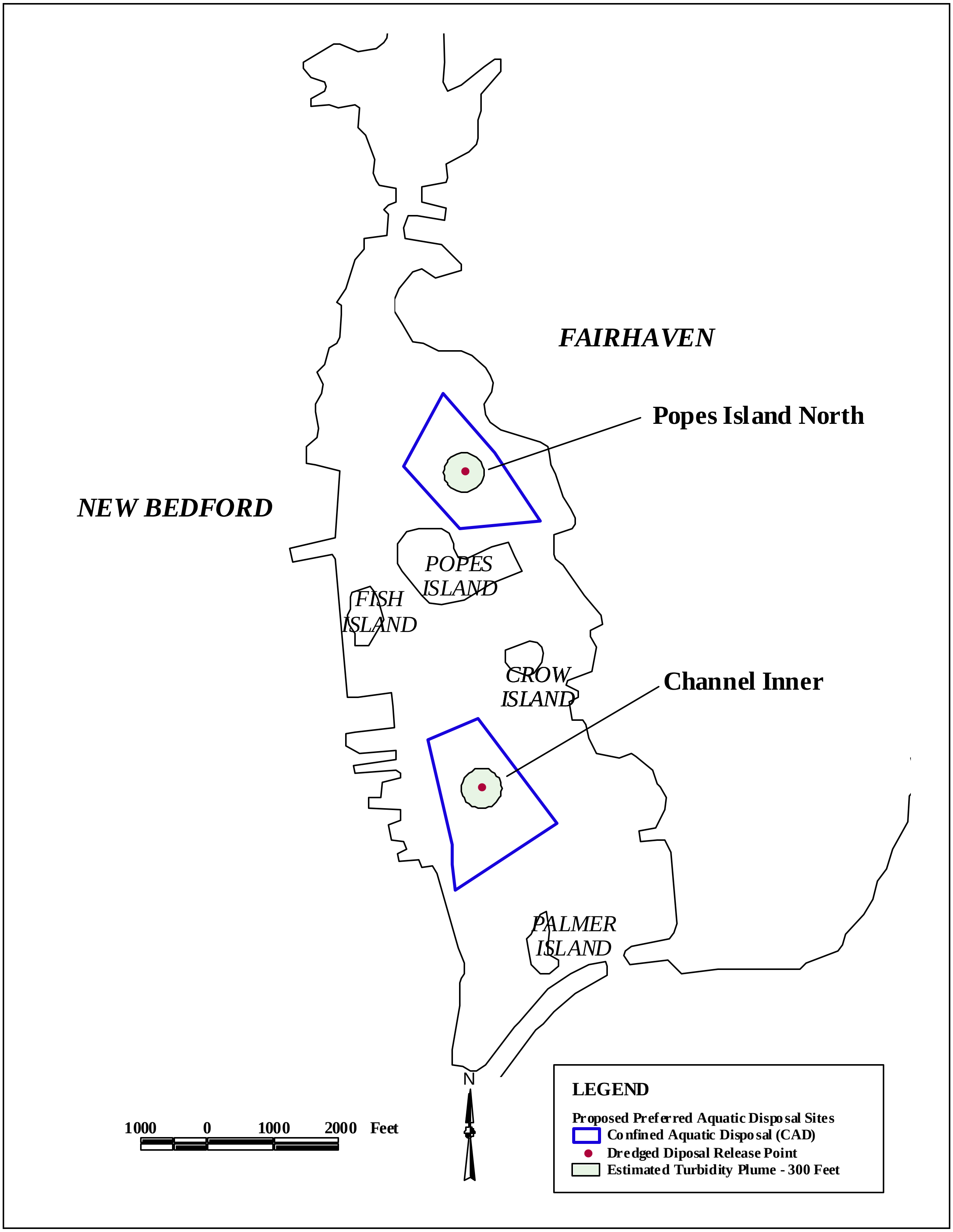


Figure 6-4: Estimated Turbidity Plume in Vicinity of Proposed Preferred CAD Sites

6.1.3.2 Pollutant Transport Modeling

A series of preliminary pollutant transport and fate simulations have been performed to estimate the water quality impacts in the water column from the proposed DMMP disposal operations for the New Bedford/Fairhaven Harbor (Appendix K). WQMAP (a proprietary model) was used to estimate the water column concentrations of pollutants of interest: various metals (mercury, lead, cadmium, arsenic, chromium, copper, nickel, zinc), polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH). The model simulated the fate and transport of the disposal materials at the proposed Popes Island North and Channel Inner CAD sites. Two different disposal release scenarios were set up and run. The instantaneous release simulated acute conditions and the continuous release simulated chronic conditions.

None of the constituents were found to exceed the USEPA water quality criteria under the tested scenarios with one exception. The concentration of copper at the time of instantaneous release was 20 (Channel Inner) to 33 times (Popes Island North) greater than the acute criteria. However, the concentrations decreased with time and quickly fell below the limit. With a continuous release, the pollutant levels increased with time. None of the constituents reached the chronic water quality limit, except copper. At the 29th simulation day, the copper concentration was almost four times the limit at the Popes Island North site release. The pollutant level at the same day was predicted to be three to five times smaller for the Channel Inner site release.

The size and strength of modeled pollutant plume varied depending on the release location. The same amount of released material at the Channel Inner site resulted in smaller concentrations in the water column than at the other site. The reason was that larger currents were calculated by the hydrodynamic modeling (BFHYDRO) component of the analysis at the Channel Inner site than at the Popes Island North site. The pollutant plume also varied with time. For an instantaneous release, the plume decreased in size and strength. The location of the maximum concentration changed in space. On the other hand, for a continuous release the size and intensity of the plume gradually increased. The plume varied at time scales of semi-diurnal tides. The maximum concentration was always observed at the release site.

The water quality impact results presented in the model are based on the sediment chemical measurements from a site north of Fish Island (FI-A). FI-A data indicated the highest pollutant concentrations and was chosen as a conservative estimate. The FI-A site was chosen, as it represented the most polluted site of the 16 sites sampled as part of the DMMP, providing an overall conservative estimate of pollutant loading (Table 6-1).

The water quality impacts for mercury, cadmium, arsenic, nickel and PCBs constituents were estimated by scaling the simulation results from the FI-A site measurements. The loading rate is proportional to the elutriate concentration. The pollutant simulation is two-dimensional and only non-linear process involved in the simulation is the diffusive term that is proportional to the second order derivative of a mass. However, the temporal scale for the diffusivity is much longer than the mass advection by the ambient current. Therefore, a simple linear scaling is reasonable.

The initial concentration for mercury based on the maximum elutriate concentration of 1.34 μg/L, for example, is 0.26 μg/L at the Popes Island North site and 0.16 μg/L at the Inner Harbor site. These values are still below the acute criteria of 1.8 μg/L. The other pollutant concentrations are estimated in a similar manner and are far below either the acute or chronic water quality limits (Tables 6-2 and 6-3).

Table 6-1: Comparison of Maximum Elutriate Concentrations (μg/L) at the FI-A Site

Constituent	FI-A	Maximum/station
Mercury	0.72	1.34/LH-6
Lead	162.00*	
Cadmium	5.50	5.81/LHC
Arsenic	6.66	9.19/LHA
Chromium	335.27*	
Copper	866.02*	
Nickel	28.60	29.17/LHC
Zinc	444.38*	
PCBs	0.0276	0.0734/FI-B
TPH	3795.00*	

Note: Numbers with stars represent that the FI-A site has the largest concentration among the measurements at all 16 stations.

Table 6-2: Initial Concentration (μg/L) at each CAD Site Estimated by a Scaling

Constituent	Popes Island North CAD	Channel Inner CAD	Acute Water Quality Criteria
Mercury	0.26	0.16	1.8
Cadmium	1.06	0.65	42
Arsenic	1.67	1.02	69
Nickel	5.29	3.22	74
PCBs	0.03	0.02	

Note: The acute criterion for PCBs is not available.

Table 6-3: Maximum Water Column Concentration (µg/L) at 29th Simulation Day

Constituent	Popes Island North CAD	Channel Inner CAD	Chronic Water Quality Criteria
Mercury	0.02	0.006	0.94
Cadmium	0.08	0.03	9.3
Arsenic	0.12	0.04	36
Nickel	0.39	0.13	8.2
PCBs	0.00	0.00	0.03

Note: Estimated by a scaling

The size and strength of modeled pollutant plume varied with the location of release. With a release at the Channel Inner CAD site, the simulation resulted in smaller concentration in water column than at the other site. This may be due to the fact that the larger currents exist at the Channel Inner site than north of Popes Island. The plume also varied with time. For an instantaneous release, the plume quickly decreased not only in size but also in strength. On the other hand, the size and strength of the plume for a continuous release increased gradually at a large time scale and varied at a scale of the semi-diurnal tide.

Figures 6-5 through 6-8 graphically illustrate some of the WQMAP model output for New Bedford/Fairhaven Inner Harbor for selected parameters. The graphic examples show results of both an instantaneous (short-term) and a continuous release (long-term) of harbor UDM. Short-term model results for six and twelve hours from a release for mercury concentrations are shown in Figures 6-5 and 6-6. Long-term model results for a continuous release at twenty-nine days are shown in Figure 6-7 and 6-8 for ebb and flood tides. For more detail on WQMAP preliminary modeling please see Appendix K.

The fate and transport of the pollutant component simulated in this work is based on a hypothetical loading of 3,000 cy of dredged material per day. In the FEIR, loading will be refined and scaled based upon site specific data and conditions to obtain a more accurate estimate of pollutant concentrations, specifically copper.

6.1.3.3 Establishment of a Mixing Zone

DEP is charged protecting the public health and enhancing the quality and value of the water resources of the Commonwealth under the Clean Water Act. The objective is the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. To meet these requirements the Department has adopted the Massachusetts Surface Water Quality Standards which designate the most sensitive uses for which the various waters of the Commonwealth shall be enhanced, maintained and protected. The standards prescribe the minimum water quality criteria required to sustain the designated uses and contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges.

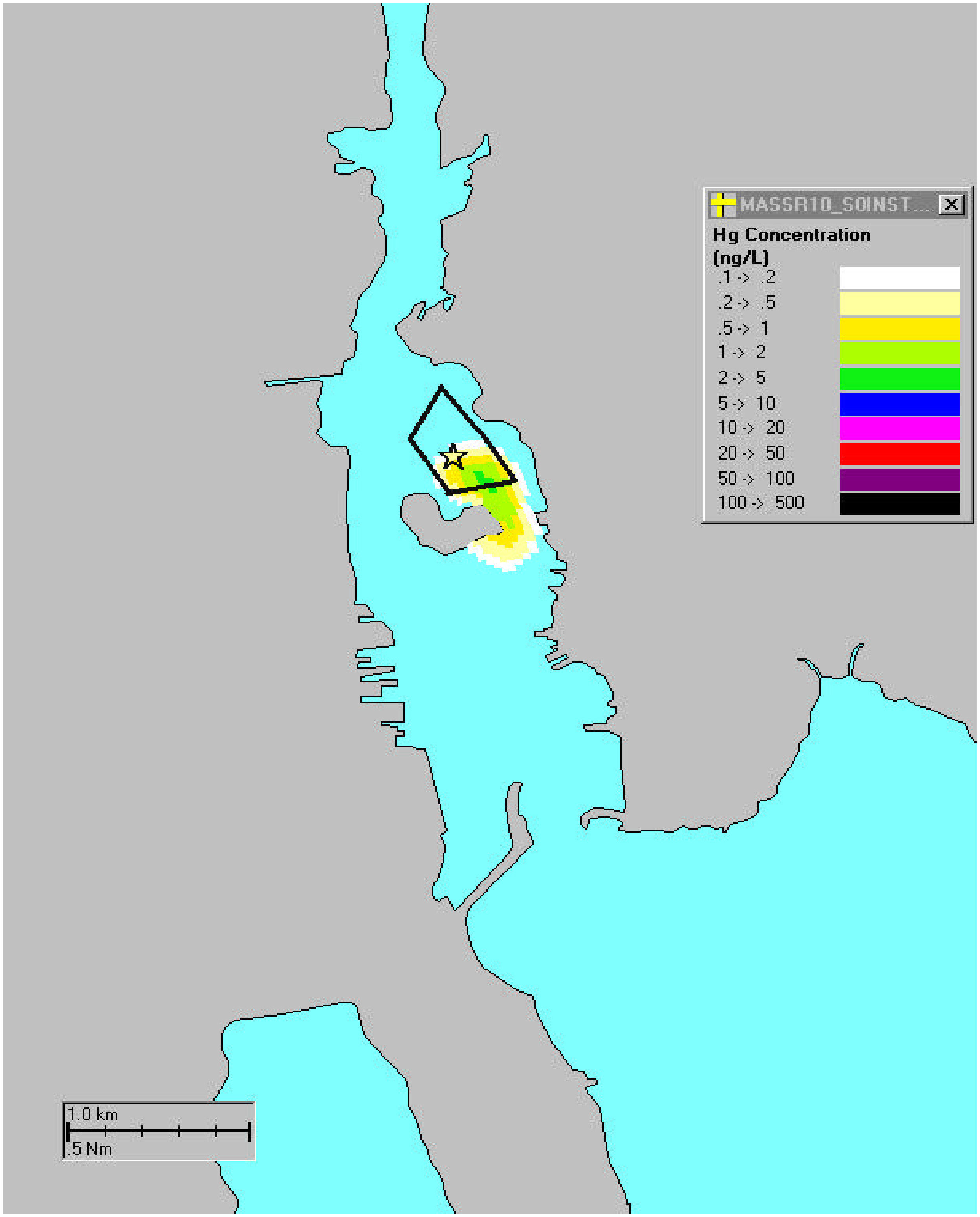


Figure 6-5: Six-Hour Modeled Mercury (Hg) Concentration at Popes Island North CAD

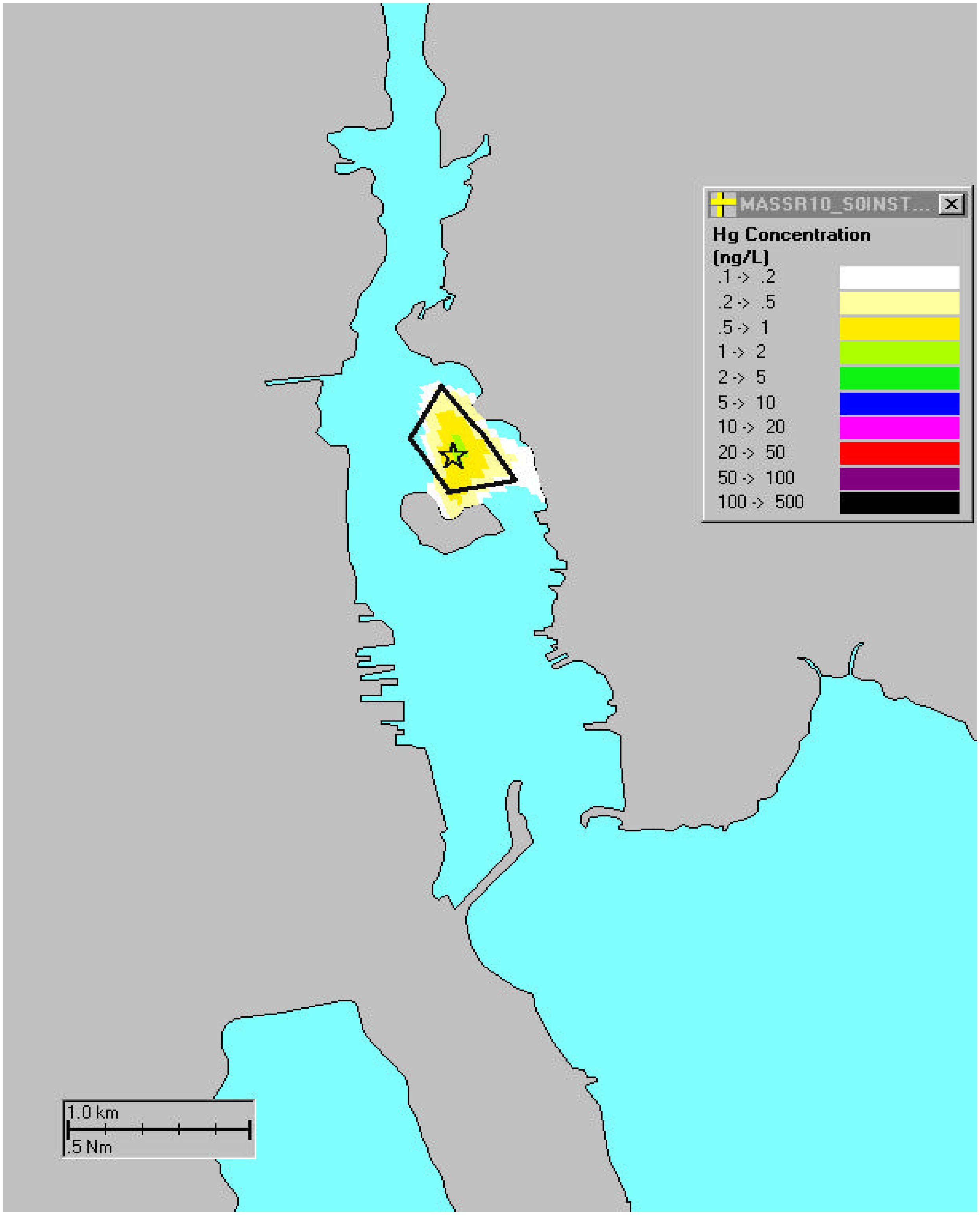


Figure 6-6: Twelve- Hour Modeled Mercury (Hg) Concentration at Popes Island North CAD

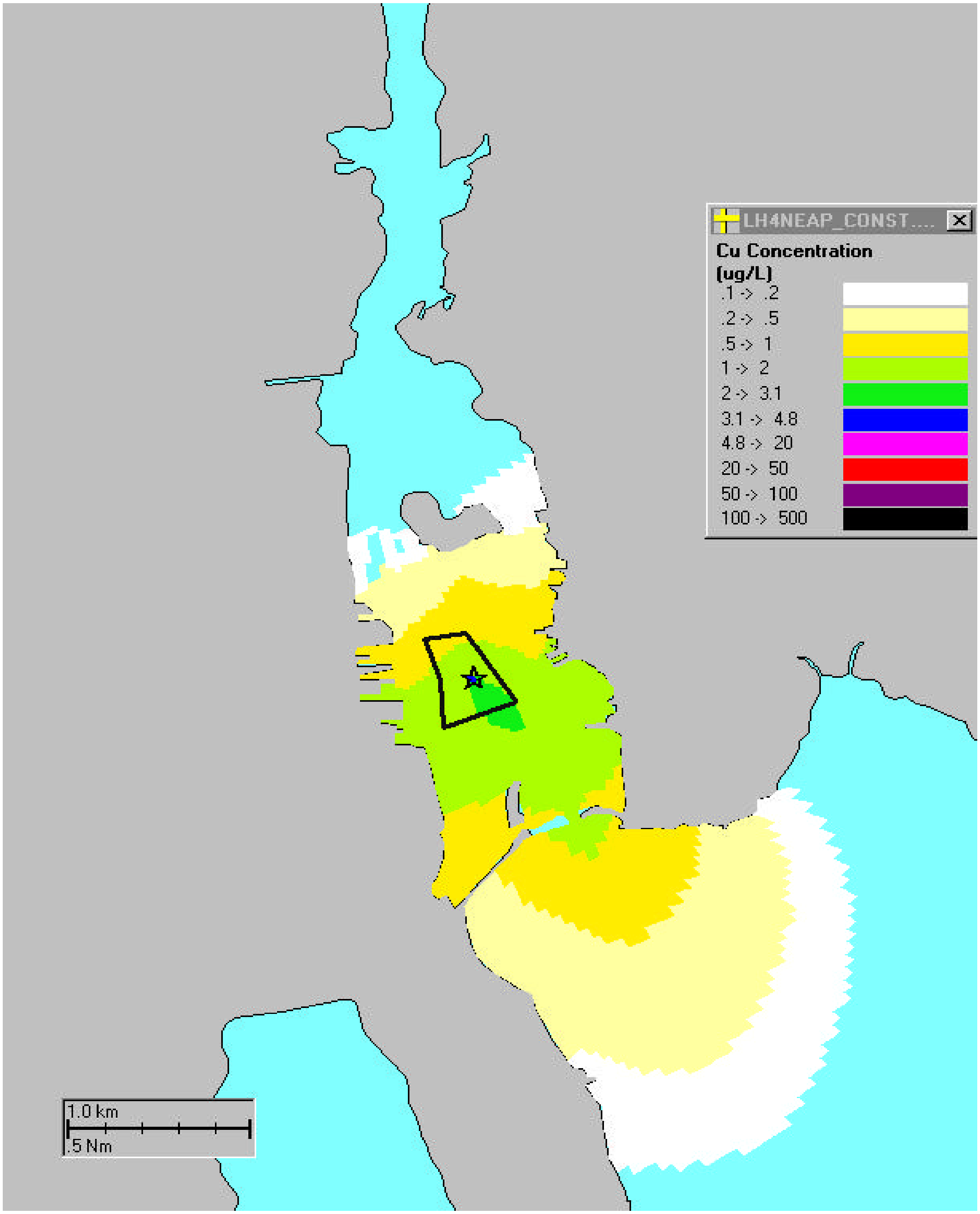


Figure 6-7: Twenty-Nine Day Continuous Modeled Copper (Cu) Release at Channel Inner CAD (Ebb Tide)

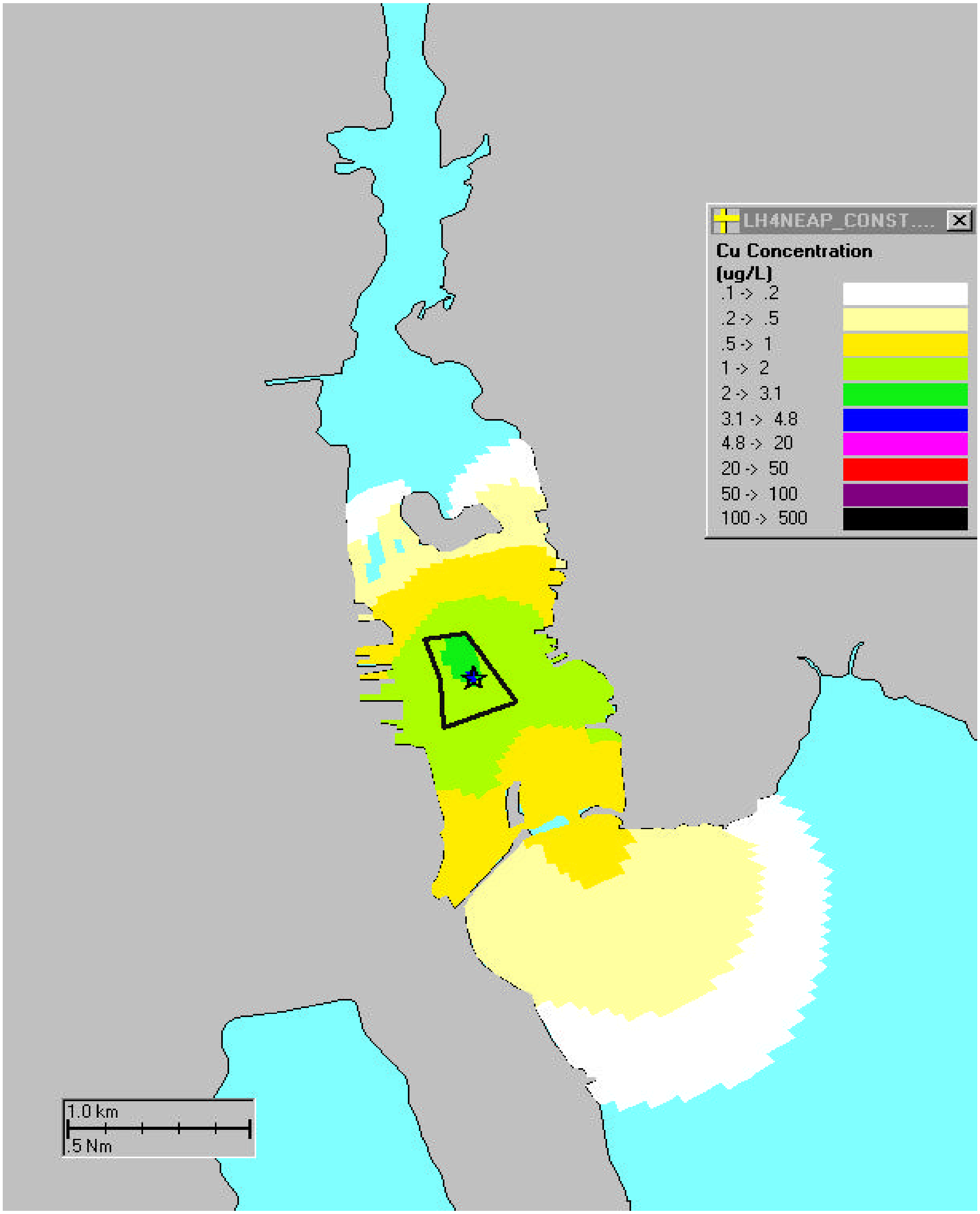


Figure 6-8: Twenty-Nine Day Continuous Modeled Copper (Cu) Release at Channel Inner CAD (Flood Tide)

In applying these standards the DEP may recognize a limited area or volume of a water body as a mixing zone for the initial dilution of a discharge. Waters within a mixing zone may fail to meet specific water quality criteria provided; the location, design and operation of the discharge shall minimize impacts on aquatic life and other beneficial uses, does not interfere with the migration or free movement of fish or other aquatic life, provides safe and adequate passage for swimming and drifting organisms with no deleterious effects on their populations and does not create nuisance conditions, accumulate pollutants in sediments or biota in toxic amounts or otherwise diminish the existing or designated uses of the segment disproportionately (314 CMR 4.03(2) a-c).

The use of either proposed preferred alternative sites would involve the disposal of more than 5,000 cubic yards of dredged material requiring a major dredge project certification (BRP WW 07) from DEP, Division of Wetlands and Waterways. The application will require a description of the proposed activity, detailed plan view and section, sediment analysis, and description of the characteristics of the proposed disposal site. The DEP may then put conditions on the dredging and disposal process designed to ensure compliance with water quality standards. A key method used to meet the standards is the establishment of a mixing zone, recognizing a limited area or volume of a waterbody as a zone for the initial dilution of a discharge. The limits of the mixing zone will be determined during the permitting process. With the establishment of a mixing no long-term detrimental water quality impacts would be expected.

6.1.4 No Action

If the proposed preferred aquatic disposal sites and vicinity were not to be used for disposal, existing water quality and sediment transport conditions at and near the site would remain unchanged.

6.2 Benthos

6.2.1 Benthic Invertebrates

Benthic invertebrate data, which are site-specific to the proposed preferred aquatic disposal sites, were obtained by the REMOTS® sediment-penetrating camera. This information is used to augment the discussion of environmental consequences to benthic organisms, which is based on various studies of how disturbances impact benthic invertebrate biota in the northeastern United States (Kaplan et al., 1975; McCall, 1977; Pearson and Rosenberg, 1978; Rhoads and Germano, 1982; Rhoads and Germano, 1986). The REMOTS® stations within the proposed preferred aquatic disposal sites in New Bedford/Fairhaven Harbor are as follows: Station 136 was located within the Channel Inner site, and Stations 142 and 143 were located within the vicinity of the Popes Island North site (Figure 6-9). The OSI (See Section 5.3.2.2) for these proposed preferred aquatic disposal sites indicates moderate overall benthic habitat quality at the Channel Inner site (Figure 6-9). The OSI values at the Popes Island North site were relatively high (>6) indicating good benthic habitat quality. The REMOTS® data provided for Pope's Island North represent a best case scenario, since deeper waters within the center of the CAD site may yield lower OSI values due to an expected decrease in benthic invertebrate abundance with depth (Gallagher and Grassle, 1989).

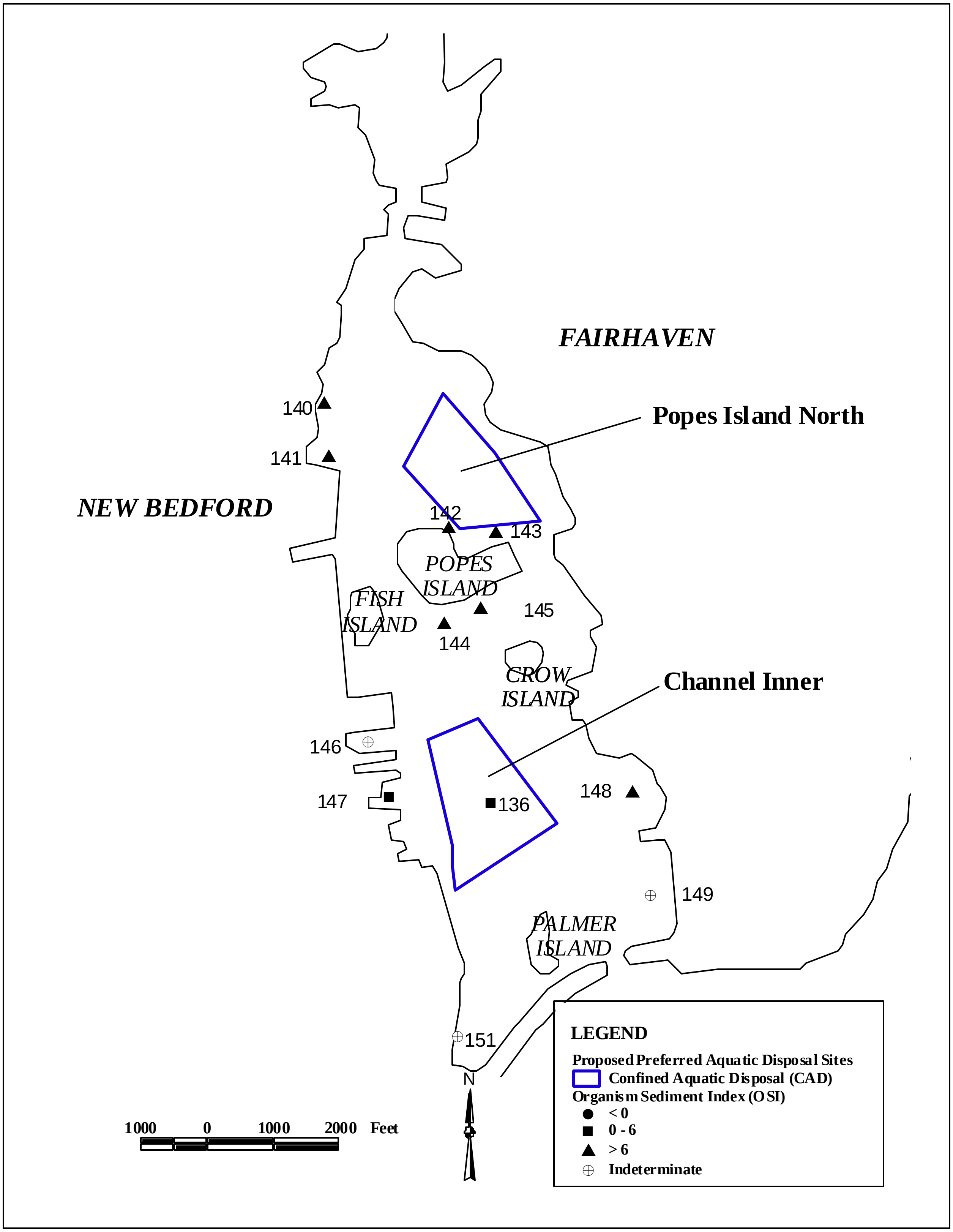


Figure 6-9: OSI Values for the Proposed Preferred Sites

Direct impacts to the benthic habitats and their organisms would occur as a result of the disposal site cell excavation, disposal of UDM and placement of capping material. All these events are expected to result in temporary and reversible impacts to the benthos at the proposed preferred aquatic disposal sites. Excavation of the CAD sites would result in mortality for many of the organisms residing on the bottom. Many of the larger, more mobile benthic megainvertebrates, such as crabs, would be able to flee the disturbed area. Following cell excavation, colonization of the substrate along the cell walls and bottom is expected via larval recruitment and emigration of benthic organisms from the surrounding area (Santos and Simon, 1980). However, the rate of recolonization is difficult to estimate because little effort has been made to study the recolonization of subaqueous pits. It is reasonable to assume that some recolonization of the CAD site following capping would occur. However, the type and abundance of benthos would depend on both abiotic and biotic factors as discussed by Gallagher and Keay (1998). Abiotic factors include physical substrate conditions, water temperature, dissolved oxygen content, and salinity. Biotic factors include succession, recruitment, competition, and biogeography.

As UDM is placed within the excavated pits, direct impact to the benthos would likely occur. Sessile marine invertebrates are not expected to survive burial. Some motile marine organisms would be buried and unable to survive, while others such as burrowing specialists, may survive. Vertical migration of motile benthic invertebrates (particularly crustaceans, polychaetes and molluscs), following burial has been demonstrated by Maurer et al., (1982a,b), and Nichols et al. (1978). These studies showed that burrowing organisms can survive repeated burial events by vertically migrating to the sediment surface. Survival rates depended primarily on burial depth. For example, in the Nichols et al. (1978) study, organisms were able to burrow upwards through 28 cm (11 in). However, it is reasonable to assume that repeated burial would weaken most benthic, motile organisms, resulting in direct or indirect (e.g., easier predation) mortality, since most disposal events would result in greater than 28 cm (11 in) deposition of UDM. In fact, the target thickness of capping materials may range from 30 to 90 cm (one to three feet).

Both the excavation and disposal events are likely to result in adverse impacts to pioneering benthic invertebrates. This is due to constant perturbation of the substrate by continuous dredged material disposal discharges. However, as discussed below, these impacts would be temporary. The long-term effect of having CAD cells in New Bedford/Fairhaven Harbor on the benthos is more important. The clean sand cap of the CAD cells would provide new substrate for recolonization by benthic invertebrate organisms and would prevent exposure of the benthos to contaminated sediments, resulting in a long-term benefit. The recolonization of the clean CAD cap would likely progress in successive stages, with dominant species varying over time. Although exact community assemblages are hard to predict to species level, the life history attributes and functional organism-sediment relationships are typically predictable. A typical recolonization scenario of the sand cap is discussed below based largely on recolonization studies described by Pearson and Rosenberg, (1978); Rhoads et al., (1978); and Rhoads and Germano (1982). There would be a change in substrate texture and conditions as a result of the placement of the sand cap atop the UDM. As suggested by the Boston Harbor CAD cell project, the cap would consist of primarily sand. However some silt may be introduced into the cap from slumping of the excavation walls and/or from active sedimentation occurring within the harbor (USACE, 1999). The result would be a primarily coarse-grained substrate with a small fraction of silt/clay. Typically, the surface of the cap would lie at an elevation below that of the surrounding sediment surface in order to allow natural sedimentation to occur within the recess of the CAD site, thereby replicating the surrounding sediment texture.

The specific nature of the benthic recovery process would largely depend on the timing of the disposal operation, local habitat characteristics, and which species exist in the surrounding areas to form source populations for recolonization. Typically, the first colonizing species to arrive to a recently disturbed area are “opportunistic” (Stage I) tubiculous polychaetes or oligochaetes. The spionid polychaetes (*Streblospio benedicti*, *Polydora ligni*) and the various capitellid polychaetes (*Capitella* spp.) are typical pioneers species that could be expected to recolonize the sand cap within days of final capping (McCall, 1977). The spionid polychaete (*Streblospio benedicti*) is most likely to be the first to appear since it is the most abundant polychaeate found in both the Upper and Lower Harbors (USEPA, 1996b).

Various meiofauna may also dominate (especially free-living nematodes) because they may be extremely abundant within the sediments of the region (Weiss, 1995). Refer to Wieser (1960) for a quantitative study of the meiofuana in the benthic communities of Buzzard’s Bay. Regardless of total macrobenthic densities during the initial stages of recolonization would likely be high and species diversity low (Grassle and Grassle, 1974; Kaplan et al., 1975; McCall, 1977; Zajac and Whitlatch, 1982; Jones, 1986). This situation may act to enhance the food supply of bottom feeding finfish species such as winter flounder (Rhoads et al., 1978).

The pioneer species occupy the sediment-water interface. Since colonization begins at the sediment surface, the feeding and bioturbation zone is shallow. However, the colonization of an azoic soft bottom habitat by Stage I pioneers, often facilitates succession by colonization of additional organisms (Gallagher, et al., 1983). Eventually, the Stage I pioneering benthic invertebrate community is succeeded by a transitional (Stage II) community, which may include deeper burrowing organisms employing additional feeding strategies. The predicted Stage II community is typically characterized by an apparently diverse assemblage of tubicolous amphipods, molluscs, and polychaetes, with most species feeding at or near the surface (Rhoads and Germano, 1986). Some late Stage II communities may also be inhabited by “conveyor-belt species” (species that feed head-down in the sediment surface) although they do not dominate at this stage. In the New Bedford /Fairhaven Lower Harbor, the mactrid pelecypod (*Mulina lateralis*) and the venerid pelecypod (*Mercenaria mercenaria*) are the dominant molluscs, while the spionid (*Streblospio benedicti*) and the capitellid (*Mediomastus ambiseta*) are the dominant polychaetes of the Stage II communities (USEPA, 1996). These organisms will likely provide a source population for further colonization of the CAD site.

In a Stage III equilibrium community, all benthic invertebrate functional groups are represented. That is, the species partition their niche by varying feeding depth, employing different feeding techniques, and represent various feeding guilds (e.g., planktivores, predators, detritivores). Rhoads and Germano (1996) reported that various maldanid, pectinariid, and orbinid polychaetes; caudate holothuroideans; protobranch bivalves; and some infaunal ophiuroids typically dominate the Stage III community. Some Stage I organisms may persist in the Stage III communities.

At this stage of succession, bioturbation and bioirrigation of a deeper sediment layer and higher rates of organic carbon consumption typically prevents anoxic and hypoxic conditions from occurring at the sediment-water interface, down to a 20 centimeter or deeper depth. As the benthic invertebrate community succeeds to Stage III equilibria, the prey availability to finfish may decrease. Stage III benthic invertebrate organisms typically do not exhibit significant seasonal changes in abundance or biomass.

The species that colonize the sand cap would most likely be the same as those from the surrounding benthic invertebrate community. At the Central Long Island Sound Disposal Site (CLISDS), Rhoads et al.

(undated) observed that a sand cap, with trace silt, was colonized by the same organisms (polychaetes and bivalves primarily) as a nearby site that consisted of a silt cap. This suggests that larval recruitment and emigration from surrounding areas was the major factor in recolonization. This implies that the colonization of the sand cap at the proposed preferred aquatic disposal sites, would initially consist of organisms that live in the surrounding area. However, successive colonizing species may be typical of those known to prefer sandier habitat since there is evidence that supports the notion that benthic invertebrate community assemblages are a function of particle size (Kaplan, et al., 1975; Etter and Grassle, 1992). Species preferring sandier substrates may dominate until natural sedimentation of the recessed cell restores the sediment surface to that of the surrounding sediment. The exact species composition of the community is not as important as the functionality of the organism-sediment relationships that form during the successional stages (Rhoads and Germano, 1986).

Additional information would be needed to better predict the benthic impacts on a species level at the proposed preferred aquatic disposal sites. First, the CAD-site specific benthic taxa would need to be identified and their abundance and distribution assessed. This could be done at a later date and the results included in the FEIR. Also, the chemical and physical nature of the existing substrate should be assessed to compare existing conditions with post-cap conditions, to address the influence of pollution as a possible disturbance factor. The progression of successional stages of benthic invertebrate colonization following final capping could be assessed via additional REMOTS® surveillance.

Despite the changes in the benthic invertebrate community, potential impact within the proposed preferred aquatic disposal sites would not be significant for the harbor or region as a whole. The recolonization of the cleaner surface sediments of the cap is expected. However, the duration of succession to a Stage III equilibrium community is not known. The duration of succession to a Stage III community depends on the frequency, degree, and magnitude of other disturbance factors (from both natural and anthropogenic sources) operating on the benthic community.

6.2.2 Commercially and Recreationally Harvestable Mollusks

The proposed preferred aquatic disposal sites do not contain any known commercially or recreationally active shellfish beds. This is due to their proximity to contaminated water or sediment, or due to their proximity to navigation lanes. However, suitable shellfish habitat exists within both sites. The northern (upstream) side of Popes Island North CAD site will impact approximately 13 acres of known oyster, soft shell clam and quahog habitat. The remaining 35 acres of the site will impact habitat suitable for quahog in the same manner (Figure 6-10). This impact would occur initially during excavation of the site, and will continue through UDM disposal, and final capping and cessation of DMMP activities. Impacts would occur mainly as direct removal of individuals and habitat (i.e, during dredging and during excavation of the CAD cells).

Likewise, construction, operation, and final capping of the New Bedford Channel Inner site will impact approximately 60 acres of known quahog habitat (Figure 6-10). Impacts would be similar in magnitude and duration (i.e, during the dredging, disposal, and final capping of UDM) to the Popes Island North CAD site. Of the 60 acres of the impacted quahog habitat that would be impacted at the Channel Inner site, approximately 11 acres are designated by the DMF as "Shellfish Contaminated Relay Area No. 1" (Figure 6-11). Contaminated relay areas are designated as potential harvest sites with subsequent depuration. The northeastern corner of Shellfish Contaminated Relay Area No. 1 would receive direct impacts from construction, operation, and final capping of the Channel Inner CAD site.

Following final capping and closure of the CAD site, shellfish habitat would return. However, should the areas of the CAD cells become anoxic following capping, and sulfidic conditions develop at the sediment-water interface, larval settlement of shellfish may be delayed until oxic conditions are re-established. Given that recolonization 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 recolonize the area. However, recolonization of the benthic environment by invertebrates is expected to occur in successional stages (Stages I, II, III). Stage I organisms (typically polychaete or oligochaete annelids) will recolonize first, followed by succession to Stage II and Stage III. Higher trophic level benthos such as most bivalve molluscs are typically part of the later stages (Rhoads et al., 1978). Monitoring will be needed to track the progress of recovery. Providing seed stock to the area could speed recovery.

6.2.3 Lobsters

All of New Bedford/Fairhaven Harbor is closed to the commercial harvest of lobster. Therefore, data on lobster distribution and abundance within the Acushnet River Estuary is not available from commercial lobstering data sources (V. Malkoski, Personal Communication). No surveys of early benthic phase (EBP) or juvenile lobsters were conducted in New Bedford/Fairhaven Harbor. Predictions regarding impact to this resource at the proposed preferred aquatic disposal sites were made based on the limited information obtained during finfish sampling in the harbor (NAI, 1999) and based on the limited information obtained during REMOTS® surveys of the benthic habitat at stations within the proposed CAD sites.

The proposed preferred aquatic disposal sites (Channel Inner, and Popes Island North) lie within closed fisheries areas. Therefore, disposal of UDM within these sites would not have a significant impact on the lobster fishery of New Bedford/Fairhaven Harbor, unless these areas contained a high density of early benthic phase lobsters, or gravid females that may disperse into the Outer Harbor and adjacent regions. No lobsters were caught during 12 months of seine and trawl fish sampling in the Inner or Outer Harbors of New Bedford.

Adult lobsters will likely be able to avoid dredging and disposal activities. If the lobsters are buried during disposal, they will be able to vertically migrate to the sediment surface, as will other strong burrowers (Maurer et al., 1982b; Nichols et al., 1978). Although the soft silt/mud substrate conditions which dominate the harbor are not preferred habitat for adult lobster (Hudon, 1987; Wahle and Steneck, 1991) dense lobster habitation can occur in muddy substrates (Berrill and Stewart, 1973; Berrill, 1974; Botero and Atema, 1982). For instance, the results of recent sampling within Gloucester Harbor, Massachusetts (NAI, 1999) indicate that adult and juvenile lobster will use the habitat of soft-bottom environments. Because of the abundance of lobster in the immediate area, emigration of lobsters from outside the disturbed area is expected. Such movement has been recorded at disposal sites in New England, including the NLDS (NOAA, 1975).

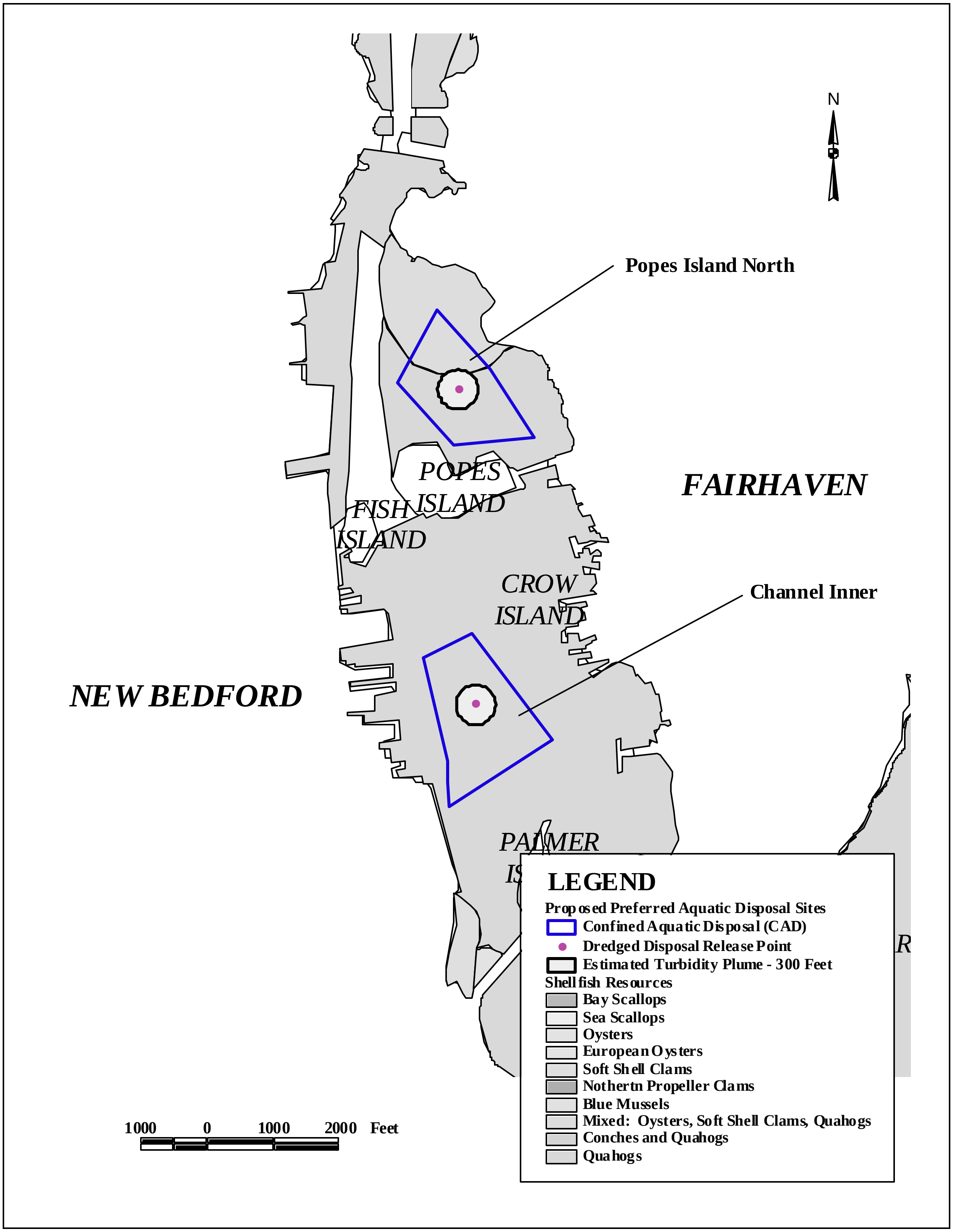


Figure 6-10: Shellfish Resources at the Proposed Preferred Sites

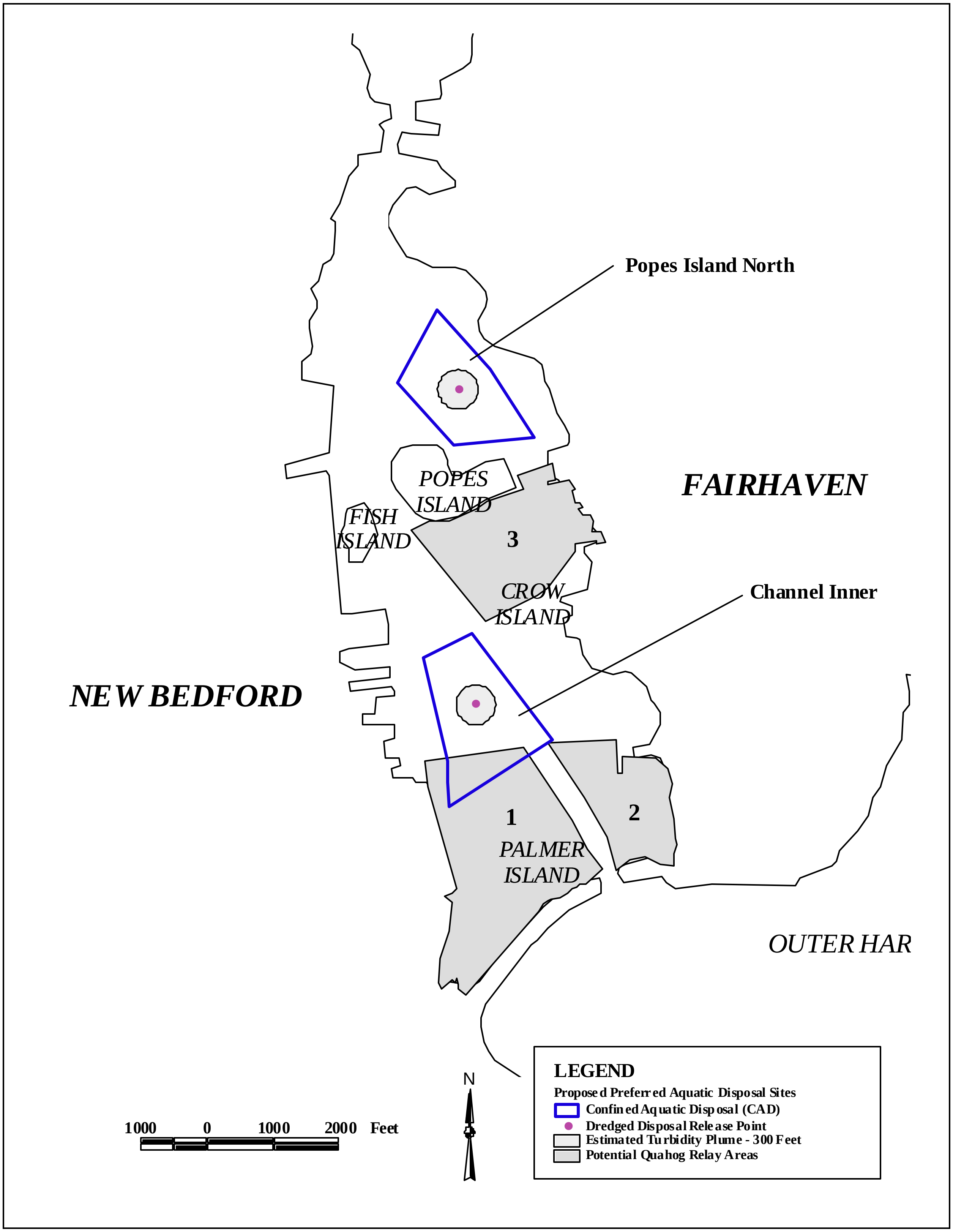


Figure 6-11: Potential Quahog Relay Areas at the Proposed Preferred Sites

The lobster habitat in the vicinity of Popes Island has not been surveyed. Therefore, it is not known if this area supports a population of early benthic phase or adult lobsters. Lobsters prefer a complex benthic substrate containing cobbles, boulders, or rocky reefs in which to seek out crevices and holes for cover. In the absence of hard substrate structures, they are capable of excavating a burrow in the sediment. However, most benthic habitat that supports a substantial lobster population has some rock structure mixed in with the softer sediment. Within these benthic habitats, lobsters will excavate burrows beneath or alongside the rock substrate.

Results of REMOTS® imaging obtained at sampling stations within or proximal to the preferred alternative sites, show that the habitat within the Popes Island North CAD site contains a silty, soft bottom. The habitat of the Channel Inner site contained a muddy soft bottom. These substrate types are not likely to support a substantial lobster population, and is the least preferred habitat by lobster for colonization and settlement. Should some lobsters inhabit the area, creation of a CAD, disposal of UDM, and capping would directly impact these individuals through physical disturbance. Regardless of the benthic habitat adult lobsters, should they occur in the area of the CAD sites, would leave or avoid the disturbance. However, as reported for the 12-mile Sewage Sludge Dumping site in the New York Bight, pre-disturbance lobster abundance would most likely rebound following cessation of UDM disposal and final capping (Wilk et al., 1995). Therefore, no substantial impact to lobster habitat would occur as a result of CAD construction, operation, and final capping.

6.2.4 No Action

If there is no action, sediments will remain in their present condition. The nature of the benthos would not be expected to change in any predictable way. Contaminants within the sediment would continue to impact the benthic invertebrate community, particularly in the Upper and Lower Harbors. The invertebrate community of the various harbor areas would be expected to exhibit a similar assemblage as that described by USEPA (1996). The Upper Harbor areas would continue to exhibit a high abundance of opportunists, low evenness, and low species diversity presumably due to impact from point and non-point pollution. The benthic invertebrate community of the Lower Harbor would continue to exhibit a greater diversity than the Upper Harbor, but the community would still show signs of impact. The Outer Harbor would continue to exhibit a higher species richness but opportunistic species would still dominate the community assemblage. The Outer Harbor represents an even distribution of dominant species when compared to the benthic invertebrate communities of the Upper and Lower Harbors.

6.3 Finfish

Little is known about the specific fishery resources at each proposed Preferred Aquatic Disposal site. However, the fishery of the Harbor, in general, has been characterized from various studies (Howes and Goehringer, 1996; Normandeau Associates, Inc., 1999). The Channel Inner site provides moderate to high nursery potential for scup, cunner, black sea bass, winter flounder and northern pipefish. The Popes Island North site provides low to moderate nursery potential for mummichog, cunner and winter flounder.

Dredged material disposal will have the greatest impact on fishes which are dependent on the bottom. Little to no impact will occur to pelagic fishes, since they are very mobile and can readily avoid the temporary areas of turbidity in the water column. Also, many fish popular with sport fishermen, such as black sea bass, striped bass, and tautog are found mainly near shoal, rocky areas and ledges, rather than the muddy channel and adjacent-to-channel areas proposed for dredge disposal.

Short-term impacts to fish in the upper to mid-water column at the proposed Preferred Aquatic Disposal sites would occur during excavation of the CAD pits, the disposal of UDM, and the construction of the sand cap. Most short-term impacts are associated with suspended sediment or turbidity plumes created during excavation, disposal, and capping. Increased barge activity can also have short term impacts to fisheries by invoking avoidance response. Various behavioral effects and some sublethal effects (physical stresses) can be considered short-term impacts, since fish behavior could return to normal and the sublethal effects could be reversed or eliminated following disturbance (Newcombe and Jensen, 1996). Some fish, especially highly mobile, migratory or pelagic species, are capable of fleeing the area during these events and would return once these activities cease. Although these impacts are unavoidable, they are short-term in nature (minutes or hours).

Moderate to severe sublethal effects, lethal or paralethal effects may be irreversible and long lasting. They may be associated with habitat degradation, reduced growth rate, delayed hatching, increased predation, and various levels of mortality (Newcombe and Jensen, 1996). These effects may be incurred via direct burial by sediment, exposure to suspended sediment, or via major alterations of their habitat that results in substantial changes to food source, water quality, flow regime, or biotic interactions (Karr, 1991).

Efforts were made during the site selection process to avoid high quality fish habitat (e.g., spawning shoals, rock reefs). Generation of suspended sediment plumes is harder to avoid in an environment such as a tidally influenced estuary. The severity of the effect of the suspended sediment on fish is a function of sediment concentration, duration of exposure, concentration of contaminants within the sediment, particle size, and particle morphology (Newcombe and Jensen, 1996). The susceptibility of various fish species to these potential ill effects is a function of one or more of the following: their taxonomic group, natural history, life history phase, and health status prior to exposure.

Winter flounder, one of the most important fishery species in the area, are bottom spawners with demersal eggs that stick to bottom substrate. Although they have pelagic larvae, winter flounder live on the bottom for most of their life cycle. They spawn during February and March in Massachusetts waters, and the eggs hatch in about 15 to 18 days (Bigelow and Schroeder, 1953). There could be an adverse impact on spawning and egg development from dredge disposal unless disposal is restricted during this time, which is typically February through May.

Being demersal fish, winter flounder would be most susceptible to direct impact during UDM disposal. The egg, embryonic, and larval stages of winter flounder (and most other fish) are most susceptible to mortality and injury (Blaxter, 1969, 1974; Bannister et al., 1974; McGurk, 1986; Black et al., 1988; Chambers et al., 1988). Eggs are found in bottom habitats with sand, mud, and gravel substrates where water temperatures are less than 10°C (50 °F), salinities range between 10 and 30 ‰ and water depths are less than 5 meters (16 feet). Larvae typically inhabit open water and benthic habitats in areas where the sea surface water temperatures are less than 15°C and the salinity ranges from 4 to 30 ‰. Juveniles are also found in bottom habitats with a substrate of mud or fine-grained sand. They typically occupy waters from

0.1 to 10 meters (0.3 to 33 feet) deep, and areas where the water temperature is below 28°C (82 °F) and where the salinity is between 5 and 33 ‰. Adults have similar benthic habitat substrate requirements. They are typically found in waters 6 meters (20 feet) deep, at temperatures below 15°C (59 °F), and within waters with a salinity between 5.5 and 36 ‰ (Pereira et al., 1999).

Scup could also be susceptible to direct impact during UDM disposal. Eggs and larvae are found in the water column from mixing to seawater salinity zones. Eggs appear from May to August in waters with temperatures between 13-23 °C (55-73 °F) and salinity greater than 15 ‰. Larvae have similar temperature and salinity requirements. Due to their relative immobility, eggs and larvae would not be able to escape the suffocating effects of burial during UDM disposal. Therefore, eggs and larvae are most susceptible to UDM disposal. Juvenile scup, although more mobile, are found in demersal waters in bays and estuaries during the summer and spring. They frequent areas where the substrate is composed of various sands, mud, mussel and eelgrass bed types. Scup require water temperatures > 7 °C (> 45 °F) and a salinity greater than 15 ‰ (Steimle et al., 1999a). Therefore, they would be expected to occur within the disposal areas and may be impacted by UDM disposal.

Black sea bass juveniles enter estuarine waters upon development from larval stages. They can be found at varying depths from the surface down to 38 meters (125 feet). Black sea bass are typically found around the edges of salt marshes and channels, preferring a rough bottom substrate such as shellfish, sponge or eelgrass beds, and nearshore patches of man-made objects. Adults tend to congregate around rock jetties, rocky bottom substrate areas, and areas underlain by sand and shell fragments (Steimle et al., 1999b). In areas where these substrates would be covered during UDM disposal, impact to black sea bass juveniles can be expected.

Flounder and other demersal fish species may benefit shortly after disposal ceases and the site is capped. Bigelow and Schroeder (1953) report that winter flounder are most often caught on muddy sand, but may be found on a variety of bottom types. Flounder typically spawn on a sandy bottom substrate. Since the sediments at the proposed Preferred Aquatic Disposal sites lack sandy areas, the area may become more attractive for these fish if the site is capped with sand or sand with some silt. Over time, the silt fraction may accumulate in the shallow depression of the CAD site and the substrate may revert back to its original soft-bottom condition. In addition, the formerly contaminated sediments that originally comprised the benthic substrate of the CAD cell would be replaced with clean sediments, following operation of the CAD site. The newer, cleaner sediments may encourage settlement and formation of more robust benthic invertebrate communities in an area where they were formerly impacted by degraded sediment. The abundance of early colonizing invertebrates at the sediment surface are readily available to demersal predators and may benefit the various groundfish, including winter flounder, that inhabit the harbor. Given the geographic range and distribution of finfish within the harbor, the temporal and spatial scale of disturbance and resultant potential impact to finfish associated with UDM management is insignificant.

6.3.1 No Action

If there is no action, fisheries will remain as at present, with the exception of changes not related to dredge or disposal of UDM, such as those caused by natural cycles or over-fishing.

6.4 Wetlands

6.4.1 Coastal Wetlands

As reported in Section 5.2.5.1, there are no federally designated coastal wetlands or salt marshes within the vicinity of the proposed preferred aquatic disposal sites, nor within the three hundred foot zone of influence of the disposal site. Therefore, there will be no effect on these resources in the Harbor (Figure 6-12).

However, the entire area within the footprints of the proposed preferred aquatic disposal sites lie within wetlands regulated by the Commonwealth of Massachusetts. The proposed preferred aquatic disposal sites overlap state-regulated wetlands areas classified as “Land Under Ocean” and “Land Containing Shellfish” according to the DEP wetland regulations under the Massachusetts Wetlands Protection Act (310 CMR 10.00). The activities related to UDM management may diminish the fish and shellfish habitat, production export, and wildlife habitat functions and values provided by these wetland resource areas in ways discussed in the respective sections of this document (e.g., Section 6.2 - Benthos, Section 6.3 - Finfish, and Section 6.5 - Wildlife). The areal extent of the impact is approximately 60 acres for Popes Island North CAD Cell site, and approximately 40 acres for the Channel Inner CAD Cell site. Activities within these wetland areas are subject to regulation under 310 CMR 10.25 for Land Under Ocean, 310 CMR 10.34 Land Containing Shellfish, and procedures established under 310 CMR 10.37 for protection of rare vertebrate or invertebrate species (Section 7.1.1).

6.4.2 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV), consisting mostly of eelgrass beds in this area, are not located within the vicinity of the proposed preferred aquatic disposal sites or their three hundred foot zone of influence. The nearest recorded eelgrass bed to any of the proposed preferred aquatic disposal sites is located approximately 0.45 miles east of the main navigation channel, outside of the Hurricane Barrier. One of the many functions and values of eelgrass beds is that they filter suspended sediments from the water column by reducing current and wave energy. Potential impacts of dredging and disposal, depend on many environmental conditions including current speed and direction, tides, UDM disposal volume, sediment water content, and other factors. However, as the nearest bed lies well beyond the expected 300 foot turbidity zone and outside of the Hurricane Barrier, no negative impacts to SAV are expected.

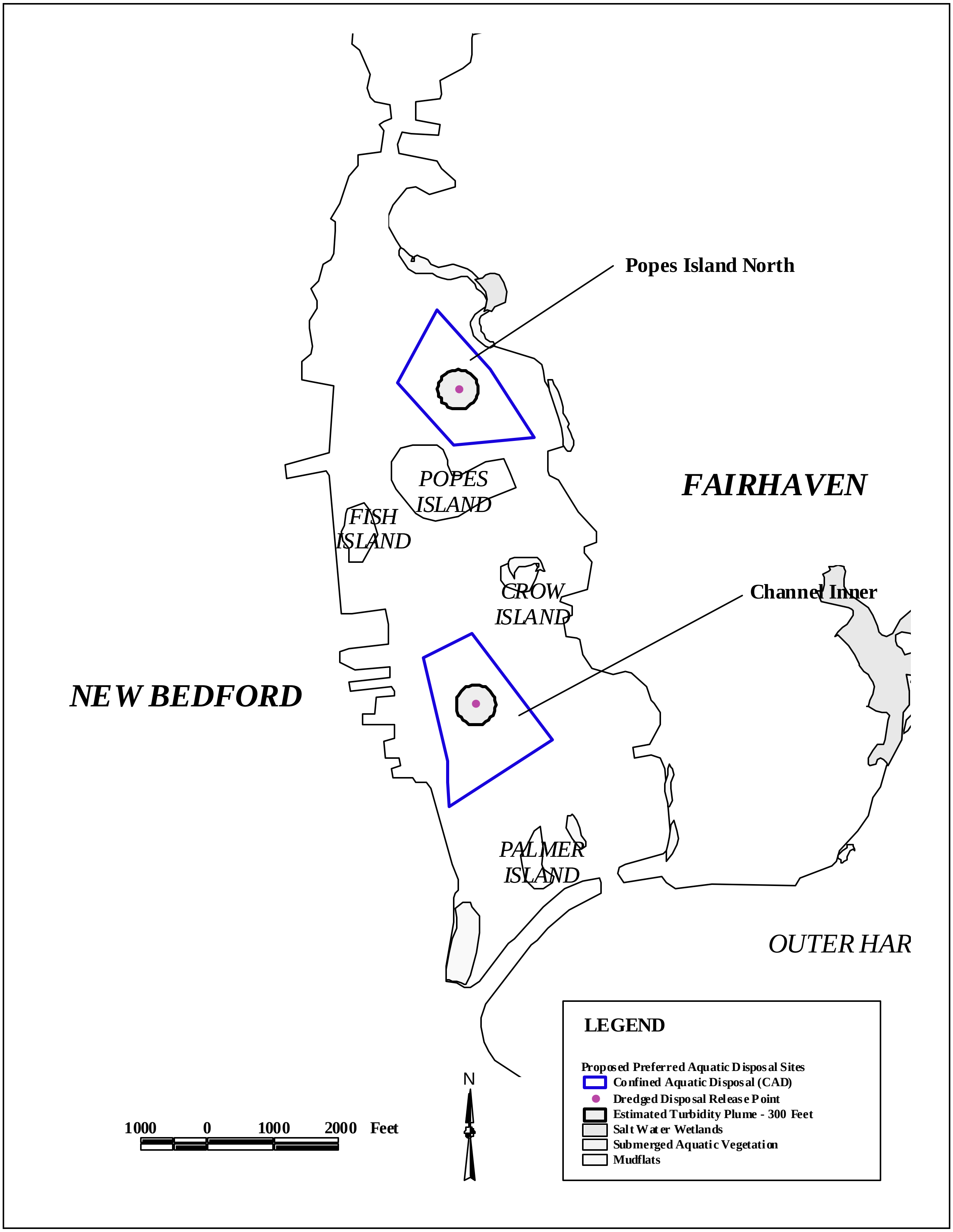


Figure 6-12: Coastal Resources in the Vicinity of the Proposed Preferred Aquatic Disposal Sites

6.4.3 Intertidal Habitats

The closest mudflats to the proposed Preferred Aquatic Disposal sites lie within 0.05 miles northeast of the Popes Island North site and approximately 0.3 miles south of the New Bedford Channel Inner site. These mud flats also lie beyond the expected influence of dredging and disposal, based upon the hypothetical release point. In the FEIR, detailed dredged material release points will be identified for the Popes Island North site that will not be closer than 300 feet from the eastern cell edge, to ensure a minimum 250 foot buffer to intertidal habitat. By maintaining the buffer, no adverse effects to the mudflats in the vicinity of Popes Island North are expected.

6.4.4 No Action

If the proposed preferred aquatic disposal sites and vicinity were not to be used as a disposal site, existing wetland resource areas at and near the site would remain unchanged.

6.5 Wildlife

6.5.1 Avifauna

Tidal flats are important shorebird feeding habitat. Since no tidal flats are located in close proximity to the preferred alternative disposal sites, impacts to shorebird habitat from suspended sediments or covering of feeding areas via siltation will be negligible. No loss of shorebird breeding habitat (e.g., salt marsh, sand or cobble beach) will occur from either dredging or disposal of UDM within either of the proposed preferred aquatic disposal sites. The Pope's Island North site has limited intertidal habitat adjacent to the northern shoreline of Pope's Island because the shoreline at this location has been altered by construction of a seawall with a steep, almost vertical slope. Construction of this abrupt edge has limited the formation of intertidal habitat to compressed vertical zones on the seaward side of this edge. Since this narrow intertidal zone lies outside the footprint of the proposed CAD cell, no intertidal habitat would not be lost through construction of the Pope's Island North CAD site.

Depending on the species, seabirds such as gulls and terns forage in a variety of marine habitats such as the open water surface, along beaches, on tidal flats, within salt marshes, or within a combination of these habitats. Certain species are well adapted to human activity and may forage in urban environments. No loss of seabird foraging or breeding habitat will occur during dredging. However, dredging of marine sediments may cause temporary suspension of benthic invertebrate macrofauna in the upper water column. Here the invertebrates may be eaten by gulls or terns. Benthic invertebrate macrofauna may also be gleaned by gulls from excavated sediment temporarily stored on scows.

The various species of waterfowl (loons, grebes, ducks, etc.) that frequent New Bedford/Fairhaven Harbor reach their greatest concentrations in winter. They tend to congregate in areas of abundant food supply proximal to shellfish beds, and areas where marine fish congregate such as rocks, ledges and reefs. The dredging and disposal of marine sediment will result in the loss of some shellfish habitat but will have minimal impact to reefs and other submerged structures. Fish concentrations will avoid the temporary disturbances to the water columns during dredging and disposal of marine sediments. Therefore loss of waterfowl foraging habitat is expected to be negligible. No loss of waterfowl breeding habitat will occur since all dredging and disposal will occur in open water areas.

6.5.2 Reptiles

Sea turtles, the only marine reptiles of the area, are not an important part of the fauna in the New Bedford/Fairhaven area and are rarely seen in the harbor. Any effect on the water column from dredge disposal will not extend to the open ocean where these animals live, therefore none of the preferred alternative disposal scenarios will affect marine reptiles.

6.5.3 Marine Mammals

As discussed in Section 5.3.5.2, the marine mammals of the region, with the exception of the harbor seal, are unlikely to be found in the vicinity of the proposed preferred aquatic disposal sites and therefore should not be affected by dredging and disposal activities. Furthermore, the sheltered and undisturbed rocky ledges preferred by harbor seals will not be impacted by disposal operations. In addition, seals are very mobile and easily able to avoid the limited area of the harbor impacted by disposal. The fish on which they feed will tend to be most abundant near the rocks and ledges where sport fishing is most productive, rather than at the muddy bottom of the preferred disposal site.

6.5.4 Endangered Species

As discussed in Section 5.3.5.4, five whales and two turtles, federally listed as endangered, occur in the ocean outside of New Bedford/Fairhaven Harbor and Buzzard's Bay. These species rarely (whales especially) occur within New Bedford/Fairhaven Harbor, or close enough to be affected by any indirect impacts of the project, such as turbidity or release of contaminants. Therefore, the project will have no impact on any endangered or threatened species.

6.5.5 No Action

If there is no action, the wildlife resources of the area, including endangered species, would not be affected.

6.6 Historic and Archaeological Resources

The proposed preferred aquatic disposal sites would be constructed entirely under water in New Bedford/Fairhaven Harbor. This fact, combined with the distance to the nearest significant land-based historic resources, such as Fort Phoenix Beach State Reservation to the northeast of the East of Channel Aquatic Disposal Site, will result in no impacts to shore-side historic resources in New Bedford/Fairhaven.

However, there is potential for impacts to yet undiscovered underwater historical and archaeological resources, as discussed below.

6.6.1 Historical Shipwrecks

The nearest known shipwrecks (currently unidentified at this stage of the investigation), lie outside of the footprints and associated zone of influence of the proposed preferred aquatic disposal sites in New Bedford/Fairhaven Harbor. However, the historical record of shipwrecks in New Bedford/Fairhaven Harbor is not complete. As a result, there is potential for as yet undiscovered historic shipwrecks to occur anywhere in New Bedford/Fairhaven Harbor, including the proposed preferred aquatic disposal sites. Because much of the Lower Harbor has been previously dredged (for maintenance of the navigation channels and maneuvering areas), the likelihood of encountering the remains of shipwrecks during future dredging, is lessened. Nevertheless, a field survey has been proposed to determine if there are shipwreck remains at the proposed preferred aquatic disposal sites. See Appendix H for details.

6.6.2 Archaeological Resources

New Bedford/Fairhaven Harbor has a long maritime history and the Harbor is considered to be an area of archaeological sensitivity. The proposed Preferred Aquatic Disposal sites are not located in the vicinity of any known archaeological resource in New Bedford/Fairhaven Harbor, although there is limited information on Native American sites within or proximal to the Harbor. Because of this paucity of information, and the fact that the proposed preferred aquatic disposal sites are near-shore and may have once been above sea level, there is a possibility of previous Native American activity in the area.

Remains of any sites would be extremely hard to locate under the sediment in the survey area. Remote sensing surveys will generally not indicate a prehistoric site in this type of topography. Locating prehistoric Native American sites would require archaeological trenching of each proposed impact area.

6.6.3 No Action

If the preferred aquatic disposal site in New Bedford/Fairhaven Harbor is not constructed, there would be no further disturbance of the site and therefore no impacts to extant underwater historic or archaeological resources. Any shipwrecks or colonial or aboriginal artifacts, if present at the site, would not be discovered, recovered, recorded, or preserved.

6.7 Navigation and Shipping

As detailed in Section 5.3.7, existing commercial navigation in the harbor is largely divided into three primary categories:1) traffic related to commercial fishing, 2) fish processing industry and, 3) other maritime vessels and recreational boats. Construction and use of the proposed preferred alternative sites will pose minimal impacts to existing navigation and shipping in the harbor, provided disposal activities are managed and coordinated closely with New Bedford and Fairhaven's Harbormasters. Issuance of navigational advisories will help place infrequent maritime harbor visitors on notice of disposal activities. Additionally, because disposal will only take place for one season during each planning horizon, opportunity for adequate public notice to frequent harbor users will be provided.

Use of the Channel Inner site will also result in increased traffic through the Hurricane Barrier associated with UDM delivery from Outer Harbor dredging projects. Because of its location within the navigation channel, the Channel Inner site could interfere with safe navigation. This could be mitigated by placement of buoys around the work area and notifications to mariners through Coast Guard advisories. As noted above, close coordination with Harbormasters will be essential to maintaining the smooth flow of vessel traffic within the Inner Harbor.

The nature of the construction of CAD disposal cells will not result in any reduction of navigable depth in New Bedford/Fairhaven Harbor. The three foot thick sand caps proposed for all of the disposal cells of the CAD preferred alternative sites will maintain existing bottom depths and not protrude into the water column any higher than existing conditions. After the completion of disposal activities for each planning horizon, navigational and shipping conditions in the vicinity of the disposal cells will return to preexisting conditions.

The presence of a CAD at Popes Island should not negatively affect long-term navigation. The federal navigation channel's northern terminus is east of the existing Popes Island and would not be encroached upon by the CAD. Small craft should be able to maneuver over the CAD to access deeper water east of Popes Island. However, temporary impacts during construction and dumping could be experienced, requiring coordination to minimize conflicts in movements.

6.7.1 No Action

If the preferred aquatic disposal site in New Bedford/Fairhaven Harbor is not constructed and UDM from dredging projects in the Harbor is not able to be disposed of cost-effectively, maintenance and planned improvement dredging projects may not be undertaken. Historical rates of sediment accumulation will continue and navigation channels, anchorage areas, turning basins, marine terminals, marinas and boat ramps in the harbor would gradually silt in. Navigation would become increasingly difficult in the harbor, compromising economic development.

6.8 Land Use

There would be no direct or indirect permanent impacts to land use in New Bedford/Fairhaven Harbor as a result of construction or UDM disposal activities at the proposed preferred aquatic disposal sites. These sites are aquatic sites, constructed entirely under water and therefore not visible from near shore areas.

Shoreline land use in the vicinity of the proposed preferred aquatic disposal sites is a mixture of residential, commercial, and industrial. Dredging and disposal, would involve the use of heavy machinery such as cranes and barges, therefore, residential areas may bear temporary noise impacts during a typical 8-hour working day.

Although there are nearby recreational areas (e.g. municipal parks and various marinas), these are most active in the warm-weather months when dredging and disposal would cease. Therefore, the activities at these sites would be only minimally negatively affected.

Indirect impacts from the construction of the proposed preferred aquatic disposal sites are expected to be positive. The presence of a cost-effective solution to disposal of UDM from harbor dredging projects will help to maintain the economic viability of the existing marine facilities and associated recreational and commercial land uses along the New Bedford/Fairhaven Harbor shoreline.

Construction of the Proposed Preferred Aquatic Disposal sites in New Bedford/Fairhaven Harbor is consistent with the stated goals of the New Bedford/Fairhaven Harbor Plan. The presence of the proposed disposal site will encourage the anticipated public and private dredging projects in the harbor to be undertaken and will provide a cost-effective, local disposal option for the UDM from those dredging projects. The New Bedford/Fairhaven Harbor Plan encourages the finding a solution for the disposal of UDM associated with the public and private dredging projects identified in the Harbor Plan.

6.8.1 No Action

If the preferred aquatic disposal site is not constructed, the existing industrial land use in the vicinity of the disposal site will likely remain unchanged for the foreseeable future. Over the long term, if planned private and public dredging projects in New Bedford/Fairhaven Harbor are not undertaken due to the lack of a cost-effective disposal option for UDM, then water-side land use patterns along the New Bedford/Fairhaven shorefront may change (e.g. industrial/commercial land use may decline due to reduced access to shipping ports). Access to recreational boat slips may also decrease.

6.9 Air Quality / Noise

6.9.1 Air Quality

Air quality impacts from the construction of the CAD cells and UDM disposal activities at the Proposed Preferred Aquatic Disposal sites in New Bedford/Fairhaven Harbor are expected to be minor, and temporary in nature. Impacts will result from the operation of heavy construction equipment, such as dredges and tugboat engines, and from the potential release of volatile organic compounds and the escape of odors from temporary storage of UDM on barges.

During construction, operation of the clamshell dredge will result in emissions from the diesel engine of the dredge. Among the chemicals emitted will be nitrogen oxide ($NO_{x)}$ and Volatile Organic Compounds (VOCs), two EPA Priority Pollutants that are precursor of ozone. Emissions of these pollutants would be minimized through the use of proper emission controls on the diesel engine, the use of equipment that complies with emission standards, and by the temporary nature of the activity. All dredging equipment will be equipped with proper air pollution control equipment and mufflers as required by DEP regulations.

A study done by the U.S. Navy (1995) estimated the total emissions of VOC and NO_x from a 1.1 million cy dredging and disposal project that was completed within one dredging season (approximately 4 months). It was forecast that 0.9 tons of VOC and 6 tons of NO_x would be emitted from the various construction equipment (barges, tugs, cranes). Similar emissions would result from the dredging and disposal in New Bedford/Fairhaven, but these emissions would be distributed over a 20-year period.

To construct the proposed aquatic disposal site, silts from the harbor bottom must be dredged and temporarily stored on barges or on land until this material is disposed of in the CAD cell. This material is assumed to be unsuitable for unconfined ocean disposal. The construction process for the CAD cell is illustrated in Figure 6-2. Depending on the location of the temporary stockpile and the length of time it is necessary to stockpile the material, minor air quality impacts may result.

Odors, occurring primarily as a result of the anaerobic decomposition of organic materials in the dredged sediments, may pose objectionable impacts. This can be controlled, if necessary, with the mixing of lime (which neutralizes odors) into the UDM. Volatilization of organic compounds in the UDM may occur if the temporary stockpiling occurs over a period of time sufficient to result in the drying of the UDM. A covering of water over the UDM prevents the volatilization of organic compounds in the UDM. Overall, volatilization is not expected to be a concern as the duration of the temporary stockpiling activities is expected to be minimal, preventing the complete drying of the UDM stockpiles.

Other factors that determine the degree of air quality and odor impacts include temperature (colder temperatures slow bacteria growth on dredge material and lessen odor impacts), wind direction, and proximity of residential areas.

6.9.2 Noise

CAD cell construction and UDM disposal activities will result in temporary and localized minor noise impacts at the Proposed Preferred Aquatic Disposal sites nearby waterfront residential and recreational locations. Given the mixture of abutting industrial and residential land use, this potential impact is considered relatively minor since local residents are somewhat accustomed to sounds of harbor commerce. The use of construction and dredging equipment that is properly equipped with mufflers, and by conducting CAD cell construction and UDM disposal activities during daytime hours, these impacts will be reduced or minimized.

6.9.3 No Action

If the preferred aquatic disposal site is not constructed in New Bedford/Fairhaven Harbor, there will be no additional temporary air quality, odor and noise impacts in the vicinity of the disposal site.

6.10 Recreational Resources

The nearest shoreline recreational areas include Fort Phoenix Beach State Reservation located approximately 0.5 miles to the south. Other recreational resources include various marinas located throughout the Inner Harbor. Construction of the proposed preferred aquatic disposal sites in New Bedford/Fairhaven Harbor will not directly impact these recreational resources. Indirect impacts may include temporarily increases in noise but harbor dredging and disposal would not directly impact recreational fishing.

Recreational boaters are numerous in New Bedford/Fairhaven Harbor. Recreational impacts will be limited because of seasonal restriction on dredging and disposal, and the boaters may need to potentially avoid the dredge and dump scows during activities at the proposed disposal sites and seek alternate routes to navigation channels.

6.10.1 No Action

If the preferred aquatic disposal sites in New Bedford/Fairhaven Harbor are not constructed, there will be no direct impacts to recreational resources in the harbor. However, over time, the lack of a cost-effective disposal site for the disposal of unsuitable dredge material from dredging projects in the harbor may result in the loss of moorings at harbor mooring areas and slips at local marinas or access to public boat ramps, impacting recreational boaters in the area.

6.11 Economic Environment

As New Bedford/Fairhaven Harbor enters the next century, economic development activity for the harbor is expected to center on seafood/ maritime industries, tourism and recreational activities. The Harbor Plan envisions a harbor that balances the fishing and tourism industries to mutually complement each other. The proposed expansion of terminal/berthing areas for commercial fishing activities is coupled with plans to improve recreational activities, facilities and improve public access along the waterfront. Implementation of the specifics of the Harbor Plan will require an immediate investment of $12 million dollars, of which $7 is already secured. This investment is expected to leverage the creation of 700-800 private sector jobs and $50-$60 million dollars in private investment (Harbor Plan, 1999).

The improved marketing and condition of the harbor envisioned in the plan is also projected to attract an additional 120,000 visitors, a 60% increase, with gross receipts of approximately $4 million. Additional need for 200 recreational slips is also expected. Based upon the preliminary success of the quick start ferry terminal, the plans vision of capturing the wholesale business to support the ferry service could support 125-150 full time jobs and between $50-75 million in new wholesale business (Harbor Plan, 1999).

Table 6-4: Immediate-Term - 5 Year Plan and Additional Near Term 5-Year Plan Implementation Costs

Investments	Estimated Cost
Immediate-Term - 5 Year Plan	
Freight Ferry	$4 million
Charter Excursion Dock/Related Improvements	$2 million
Fishing Pier Extensions	$2.7-3.6 million
Pier and Wharf Repairs	$2.2 million
Water Taxi Dock	$75K
Standard Times Field Infrastructure	$525K
Fairhaven Pease Park Boat Ramp/Taxi Dock	$125K
TOTAL	$12 million
Funding Already Committed	$12 million
Additional Near Term - 5 Year Plan	
Route 18 Enhancement	$15 million
Maintenance Dredging (users/driveways)	$20 million
TOTAL	$35 million
Funding Already Committed	$15-33 million

Source: New Bedford/Fairhaven Harbor Plan, 1999

In addition to the investments being made to implement the Harbor Plan, the proposed remedy to address PCB contamination is expected to be over $141 million (Table 6-5) and proposed projects by the New Bedford Harbor Trustee Council are over $9 million (Table 6-6).

Table 6-5: Superfund Costs - Estimated Cost of the 1996 Proposed Remedy

ACTIVITY	COST
I. DIRECT COSTS	
Dredging	$22,320,348
Dewater/Water Treatment	$27,123,051
CDF Construction	$27,121,318
Air Monitoring	$2,148,800
Total Direct Cost (TDC)	***$78,713,517***
II. INDIRECT COSTS	
Health and Safety (Level D Protection)	$3,935,676
Legal, Administration, Permitting	$7,871,352
Engineering	$7,871,352
Services During Construction	$7,871,352
Turnkey Contractor Fee	$11,807,028
Total Indirect Costs (TIC)	***$39,356,759***
TOTAL COSTS	
Subtotal TDC+TIC	$118,070,276
Contingency (20%)	***$23,614,055***
Total Capital Cost	**$141,684,331**

Source: USEPA - ROD II, 1998

Compatibility with the Harbor Plan

Furthermore, the selection of a disposal site for UDM, as a concept, is supported by the New Bedford/Fairhaven Harbor Plan, which recommends the pursuit of the maintenance and improvement dredging projects in the harbor and a disposal site for the UDM generated from these projects. As the figures in Table 6-4 illustrate, the Harbor Plan supports maintenance and improvement dredging activities and therefore recognizes the need for an environmentally sound, cost-effective UDM disposal alternative.

Table 6-6: New Bedford Harbor Trustee Council

Proposed Restoration Projects	Proposed Funding Level
Acushnet River Valley Conservation Project	$964,000
Buzzards Bay Keeper	$150,000
Community Rowing Boathouse (study and equipment)	$275,000
Marsh Island Salt Marsh Restoration	$750,000
Artificial Reef	$500,000
Educational Exhibit on PCBs impacts	$150,000
Marine Fish Stock Enhancement	$1,950,000
Salt Marsh Creation	$750,000
Nonquitt Salt Marsh Restoration	$150,000
Popes Beach Land Purchase (North)	$55,000
Popes Beach Land Purchase (South)	$145,000
Regional Shellfish Grow-Out Up-Well System	$500,000
Restoration and Management of Tern Populations	$1,232,000
Riverside Auto Wrecking Land Acquisition	$675,000
Upper Harbor CDF Natural Resource Habitat Enhancements	$25,000
Upper Sconticut Neck Shellfish/Sewer Installation (study and reserve)	$700,000
Winsegansett Field Station	$360,000
Total Proposed Funding Level	**$9,331,000**

Source: Federal Register Vol. 65., No. 145/July 27, 2000/Notices/pgs. 46146-46152

With the construction of a CAD site, there will be impacts to harvestable or potentially harvestable shellfish (mainly quahog) which may require mitigation. Consultation with DMF has been ongoing and will continue into the next phase of the New Bedford DMMP. Mitigation could take the form of monetary compensation to shell fishermen who harvest these areas.

6.11.1 No Action

If a disposal option for UDM is not identified, dredging projects essential to maintaining the fishing and maritime industries in New Bedford/Fairhaven Harbor could be significantly delayed with negative economic impacts upon the City of New Bedford and Town of Fairhaven. No action would limit the ability to implement the Harbor Plan's vision of maintaining and developing the harbor as an asset for the communities and region and compromise the fishing and maritime industries ability to remain competitive, and in New Bedford/Fairhaven Harbor.

6.12 Risk Effects Synopsis

6.12.1 Ecological Risk Effects Synopsis

The USEPA found that aquatic organisms are at risk due to exposure to waterborne PCBs in New Bedford/Fairhaven Harbor as a result of the Superfund release. The mean PCB concentrations in Zones 3 and 4 exceed the chronic AWQC at the time of the assessment, and the joint probability analysis indicates that there is significant likelihood that chronic effects would be realized in at least some species inhabiting New Bedford Harbor (USEPA 1990).

The risk probabilities for all major taxonomic groups were found to decline moving towards the outer harbor; though, marine fish may still be substantially impacted in Zone 5. PCB levels in gonadal tissues of winter flounder collected by the USEPA from Zone 3 exceed levels shown to result in reproductive impairment and other effects in marine fish. However, in Zone 4, the likelihood that chronic effects would be realized in typical crustaceans and mollusks was predicted to be less than ten percent. Furthermore the study concluded, PCB levels in organisms from lower trophic levels may either induce toxicological effect or impact predator species (USEPA, 1990).

Risk due to exposure to PCBs is also largely dependent on location of the organisms in the harbor, and may be a function of migratory behavior or reproductive habits (USEPA, 1990). Foraging behavior and prey preferences can also influence the degree of exposure encountered by a particular organism. The effects of chemical stress on an ecosystem can potentially affect such interspecific ecological interactions as competition, predation, and disease resistance. These effects can alter a population's birth and death rates resulting in long-term changes in numerical abundance (Ricklefs, 1979).

The risk assessment conducted by USEPA supports the conclusion that aquatic organisms (particularly marine fish) have been at a significant risk due to exposure to PCBs in the harbor. Concentrations of dissolved PCBs in the area of maximum concentration (> 4,000 ppm) and in all areas of the Inner Harbor were sufficiently elevated to result in a significant likelihood of chronic effects to indigenous biota. Results of this analysis suggest that although metals such as copper, cadmium and lead may be having some impact on the harbor ecosystem, the effects attributable to these contaminants are overshadowed by the presence of PCBs at much more harmful levels (USEPA, 1990).

Proposed Preferred Alternatives

Based upon the results of the preliminary pollutant transport modeling, the release of PCBs above water quality standards are not expected as a result of DMMP disposal operations. Therefore, the use of either the Channel Inner or Popes Island North sites are not expected to result in any ecological risk beyond that identified by the USEPA and what the harbor has already been exposed. Additionally, the removal and sequestering of harbor-bottom UDM, associated with dredging projects and disposal site footprints and ultimate disposal cell capping should also help to improve the harbor's overall long-term ecological conditions by further isolating sediments with PCBs. Additionally, the use of CAD BMPs and monitoring, will further reduce the potential for negative short- and long-term impacts to ecological health associated with DMMP CAD disposal.

6.12.2 Human Health Effects Synopsis

The assessment conducted by USEPA applied cancer potency factors to determine excess lifetime cancer risks associated with the PCBs historically discharged into New Bedford/Fairhaven Harbor. Using a threshold of a one in a million probability (1×10^{-6}), that is, an individual is not likely to have greater than a one in a million chance of developing cancer over 70 years as a result of Superfund site related exposure, the calculated total carcinogenic risk from PCBs in the areas of Popes Island North and Channel Inner CAD sites was 2.2×10^{-2}. This rate exceeded both the USEPA's thresholds for level of concern (1×10^{-6}) and 1 in 10,000 (1×10^{-4}) for remedial action. As part of the remedy to minimize human health effects resulting from the presence of Superfund material in New Bedford/Fairhaven Harbor, the USEPA established a target cleanup level (TCL) for PCBs of 50 ppm for the area of the Inner Harbor (USEPA, 1990).

Proposed Preferred Alternatives

The range of PCBs mapped by the USEPA for the Channel Inner site fall between less than one ppm to less than 50 ppm, and is not targeted for any remedial activity. A small portion of the Popes Island North site overlaps with an area known to exceed the TCL and has been targeted for remediation (Figure 6-13). Because the Superfund material in the vicinity of the Popes Island North site is expected to be remediated prior to any potential use for DMMP disposal activities, no conflicts are expected. However, CZM will continue its ongoing coordination with USEPA if this portion of the site is to be used for DMMP disposal and dredging operations. Either of the proposed preferred alternative sites would not be expected to involve the dredging or disposal of material above the TCL, and therefore no additional risk to public health associated with the DMMP would be expected.

The use of either the Channel Inner or Popes Island North sites are not expected to result in any human health risk beyond that identified by the USEPA and already posed by the harbor. Additionally, the removal and sequestering of harbor-bottom UDM, associated with dredging projects and disposal site footprints and ultimate disposal cell capping should also help to improve the harbor's overall long-term conditions by further isolating sediments with PCBs from impacting human health. Additionally, the use of CAD BMPs and monitoring, will further reduce the potential for negative short- and long-term impacts to human health associated with DMMP CAD disposal.

6.12.3 No Action

If the preferred aquatic disposal sites are not constructed in New Bedford/Fairhaven Harbor, there would be no additional risk to aquatic organisms or human health above existing conditions due to the exposure of waterborne PCBs in the vicinity of the disposal site.

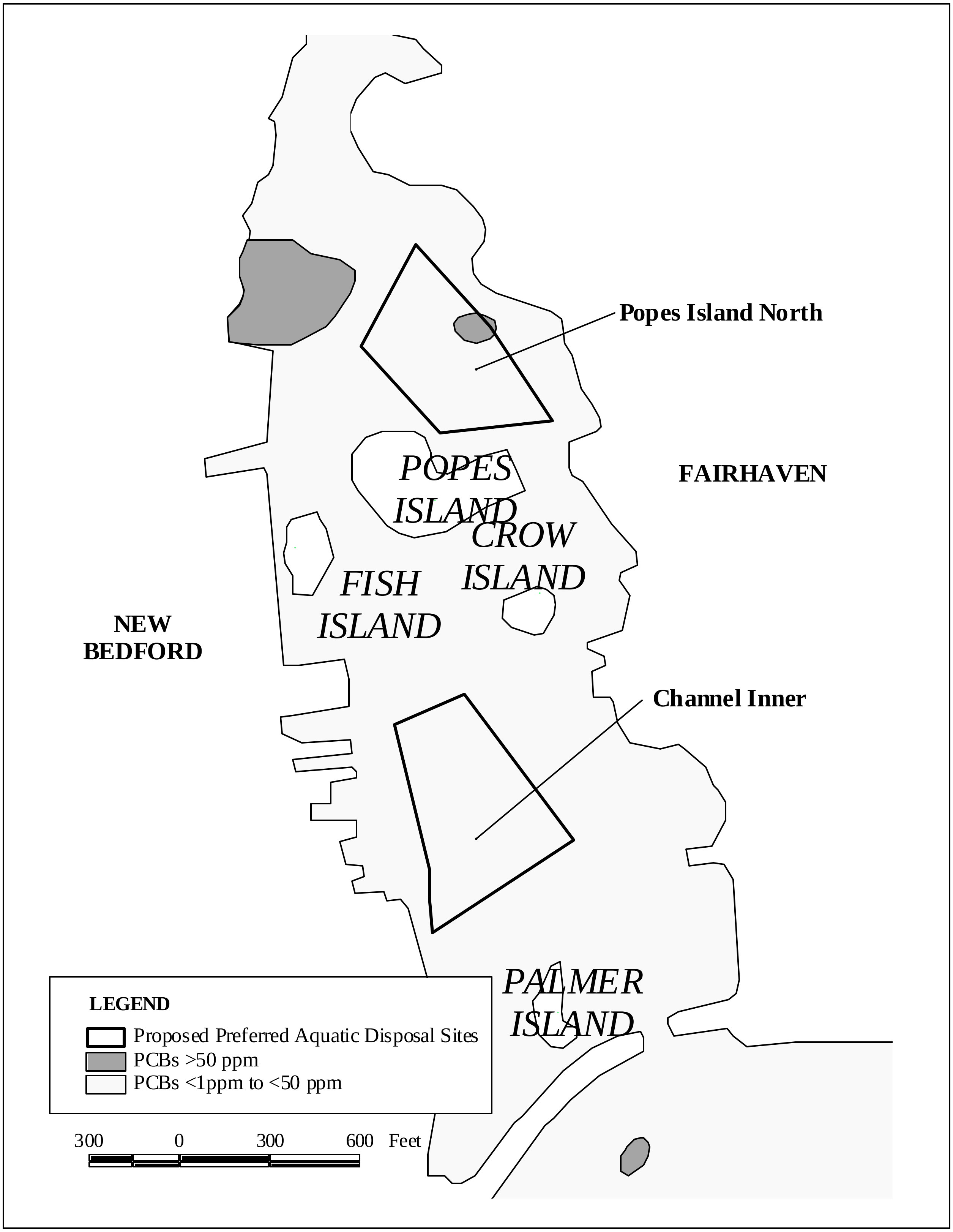


Figure 6-13: PCB Concentrations from Superfund Project (USEPA, 1998)

6.13 Environmental Justice

This study recognizes that the proposed preferred aquatic disposal sites are within environmental justice communities. However, the proposed preferred aquatic disposal sites are expected to result in temporary and reversible impacts to the benthos. Since all of New Bedford Harbor is closed to fishing, Channel Inner and Popes Island North sites will not adversely impact subsistence fishers.

The proposed preferred aquatic disposal sites will not negatively impact these environmental justice communities. The economic benefits of the DMMP to New Bedford and Fairhaven will be positive due to the increase in harbor activity. As reflected in the New Bedford/Fairhaven Harbor Plan, the fishing industry and seafood processing/wholesaling, currently account for an estimate $671 million in sales and 3,700 jobs within the local area (See Table 5-15). An improved coastal environment will generate more revenue and jobs for the community at large. Additionally, the *Harbor Plan* supports maintenance and improvement dredging activities as well as the concept of aquatic disposal of UDM.

6.13.1 No Action

If a disposal option for UDM is not identified, dredging projects essential to maintaining the fishing and maritime industries in New Bedford/Fairhaven Harbor could be significantly delayed with negative economic impacts upon the City of New Bedford and Town of Fairhaven. No action would limit the ability to implement the Harbor Plan's vision of maintaining and developing the harbor as an asset for the communities and region and compromise the fishing and maritime industries ability to remain competitive, and in New Bedford/Fairhaven Harbor.

SECTION 7.0 - REGULATORY COMPLIANCE

7.0 COMPLIANCE WITH REGULATORY STANDARDS AND REQUIREMENTS

This section includes a description of the primary regulations associated with the implementation of the preferred alternative aquatic disposal sites. Compliance with state and federal standards and regulations for aquatic disposal are discussed as they relate to the preferred alternatives. The preferred alternatives for New Bedford/Fairhaven Harbor include two disposal sites. The sites proposed in the DEIR are: Channel Inner (CAD) and Popes Island North (CAD). Each of the following sections describes the relationship of the standards and requirements discussed as they relate to CAD disposal.

7.1 Compliance with State Standards/Regulations

7.1.1 Wetlands Protection Act and Regulations (310 CMR 10.00)

The proposed aquatic disposal sites, Channel Inner (CAD), and Popes Island North (CAD) are all located in resource areas protected by the Massachusetts Wetlands Protection Act (WPA), specifically Land Under the Ocean (LUO). The Channel Inner and Popes Island North sites also lie within Designated Port Areas (DPAs). The WPA is administered on the local level by the Conservation Commission, which implements the Massachusetts Wetlands Regulations at 310 CMR 10.00.

CAD Disposal - A Notice of Intent (NOI) application to the New Bedford and Fairhaven Conservation Commissions will be required for proposed CAD disposal activities at the Popes Island North sites, as the current configuration lie in both jurisdictions. Channel Inner CAD preferred alternative is entirely within the jurisdiction of one commission, New Bedford. Orders of Conditions (OOC) need to be issued by the appropriate Conservation Commission(s) to permit the work for each of the above three alternatives.

7.1.1.1 Designated Port Areas

The Wetlands Regulations at 310 CMR 10.26 state that LUO in DPAs is likely to be significant to marine fisheries, storm damage prevention and flood control. LUO in DPAs often serves to provide support for coastal engineering structures such as seawalls and bulkheads, which have replaced natural protection for upland areas from storm damage and flooding. Projects affecting LUO in DPAs should not result in alteration of wave and current patterns so as to affect the stability of such structures. Portions of the preferred alternative sites Channel Inner and Popes Island North are located within New Bedford/Fairhaven Harbor's DPA (Figure 7-1).

CAD Disposal - Construction of Channel Inner is not expected to result in adverse effects on marine fisheries caused by changes in water circulation. The bottom elevation at the Channel Inner site following construction of the disposal site, disposal activities and final placement of capping materials, will not be higher than the existing bottom elevation, and will likely be slightly recessed compared to existing bottom elevations. The effect of this recessed pit is expected to be reduced water column mixing with surrounding waters, and active sedimentation within the pit. In addition, the location of the CAD site within the main navigation channel will also minimize localized changes in water circulation. Navigational channels often experience some degree of reduced mixing via stratification due to temperature or salinity gradients.

Water column depth at the CAD disposal sites may play an important role in determining localized current velocities. Current velocities typically behave in a logarithmic relationship with water column depth. Therefore, currents further from the surface experience increasing frictional retardation, particularly as currents approach the sediment boundary layer. Given this phenomena, the CAD preferred alternative sites will be exposed to smaller current velocities and less potential sediment resuspension forces than sites at shallower depths. Coarser grained cohesive material also has the effect of greater frictional and gravitational forces holding the grains on the seabed. Thus a greater critical shear stress would be required to resuspend coarse grain cap material than fine grain silty sediments.

Reduced circulation may be beneficial from the standpoint of cap integrity since resuspension is less likely, but by the same effect this localized condition may also contribute to reduced water quality. Typically, the impact to water quality from dredged material disposal is short-term. These impacts typically include localized degradation in dissolved oxygen (DO), total suspended solids (TSS), pH, light penetration, and contaminant concentrations. Conditions typically return to ambient conditions within hours to days, depending on the amount, composition, and frequency of the disposed material. Total suspended solids may increase dramatically due to the entrainment of fine material in the water column. A plume typically forms whereby material may be advected short distances from the disposal site. A reduction in DO is typical as common constituents of sediments are oxidized and organic material is metabolized by microbial activity at the sediment-water interface. High suspended solid concentrations have the effect of attenuating ambient light, thereby reducing penetration. Finally, contaminants sorbed to sediment particles may be dissolved by the aquatic environment through physical disturbance of the material as the sediment stream is released from the scow.

Detailed modeling of dredged material disposal events will be performed for the FEIR to more conclusively determine short term local water quality impacts associated with CAD options. The preferred alternative sites have been located so as to provide a sufficient distance to the nearest coastal engineering structure. No impact on the stability of the harbor bottom that would affect the support of the nearby coastal engineering structures is expected, and therefore no adverse effect on any structure's ability to serve a storm damage prevention or flood control functions in the area.

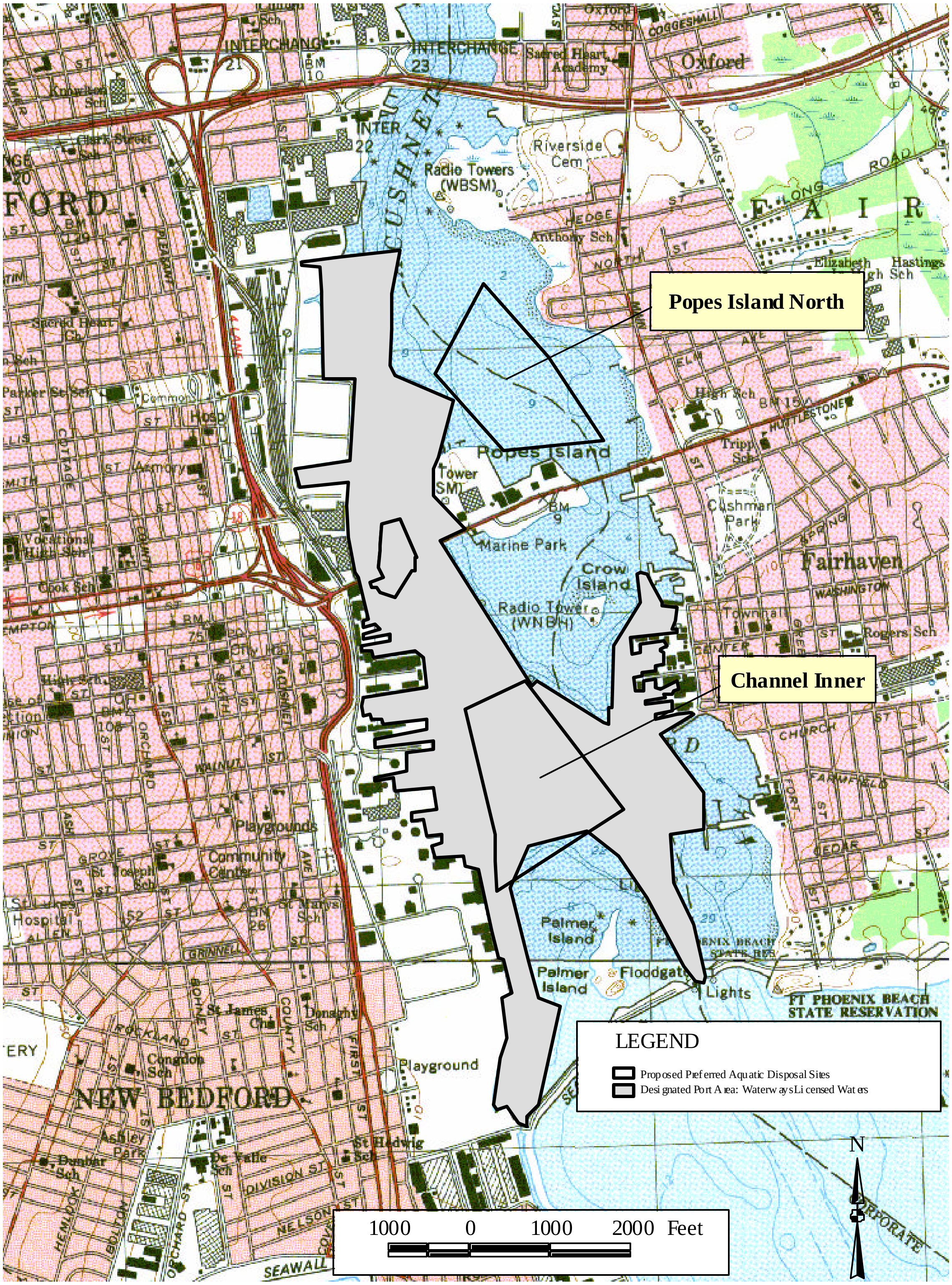


Figure 7-1: Relationship of Preferred Alternatives with DPA

7.1.1.2 Land Under the Ocean

Land Under the Ocean (LUO) is defined as "*... land extending from the mean low water line seaward to the boundary of a municipality's jurisdiction and includes land under estuaries*", within the Wetlands Regulations at 310 CMR 10.25(2). LUO is significant to the protection of marine fisheries and projects which affect LUO shall not cause adverse effects by altering the bottom topography so as to increase storm damage or erosion of coastal beaches, banks, dunes, of marshes. They must, among other things, also have no adverse effects on marine fisheries or wildlife habitat caused by alterations in water circulation, destruction of eelgrass beds, alterations in the distribution of sediment grain size, changes in water quality, or alterations of shallow submerged lands with high densities of polychaetes, mollusks, or macrophytic algae.

As described above, the aquatic preferred alternative sites are expected to have no adverse effect on marine fisheries caused by localized alterations in water circulation or changes in water quality. The sites are not located in existing eelgrass beds.

CAD Disposal - Any impacts to benthic organisms at the CAD disposal sites will be temporary and reversible. Immediately after disposal, the sites will be devoid of benthic populations, because the benthos will have been removed by overdredging or buried under disposed sediments. However, most benthic species are capable of rapid dispersal and colonization by means of planktonic larvae, and will quickly recolonize disturbed areas.

7.1.1.3 Land Containing Shellfish

Land Containing Shellfish (LCS) is defined as "*... land under the ocean, tidal flats, rocky intertidal shores, slat marshes or land under salt ponds when any such land contains shellfish*", within the Wetlands Regulations at 310 CMR 10.34(2). LCS is found to be significant to the protection of marine fisheries, when such areas have been identified and mapped by the local conservation commission or by DEP in consultation with DMF. Documentation required for this designation includes recording the density of shellfish, size of the area and the historical and current importance of the area to commercial and recreational fishing.

CAD Disposal - The preferred alternative disposal sites are all located within areas that have been designated as areas of LCS as specified in the Wetlands Protection Act and Regulations. As described above, the preferred CAD alternative disposal sites are not expected to have an adverse permanent effect on marine fisheries caused by localized alterations in water circulation, alterations in relief elevation, sediment grain size or changes in water quality. Implementation of either of the preferred CAD disposal alternatives will require mitigation for impacts to LCS (to be developed with regulatory agencies).

7.1.2 Water Quality Certification (314 CMR 9.00)

The federal Clean Water Act gives states the authority to review projects that must obtain federal licenses or permits and result in a discharge to state waters, and requires a 401 Water Quality Certification to ensure that the project complies with state water quality standards and other appropriate requirements of state law. As a project which will require disposal of more than 5,000 cubic yards of dredged material, the DMMP will require a major dredge project certification (BRP WW 07) from the Department of Environmental Protection, Division of Wetlands and Waterways. The application will require a description of the proposed activity, detailed plan view and section, sediment analysis, and description of the characteristics of the proposed disposal site. The DEP may then put conditions on the dredging and disposal process designed to ensure compliance with water quality standards.

Per the provisions of 314 CMR 9.06(1), no discharge of dredged material will be allowed if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic environment than the proposed discharge. As documented in this DEIR, the proposed preferred alternative aquatic disposal sites in New Bedford/Fairhaven Harbor are the least environmentally damaging practicable alternative for the aquatic disposal of UDM from the dredging projects identified in the harbor.

Per the requirements of 314 CMR 9.06(2), the proposed discharge of dredged material will not be permitted unless the "appropriate and practical steps" are taken to minimize potential adverse impacts to land under water. The discharge of UDM and subsequent capping of the material at the CAD preferred alternative disposal sites in New Bedford/Fairhaven Harbor will result in the cleanup and capping of contaminated sediments at the site, and will result in a cleaner harbor bottom.

Per the requirements of 314 CMR 9.06(3), no discharge of dredged material will be allowed in Outstanding Resource Waters. The Proposed Preferred Alternative aquatic disposal sites in New Bedford/Fairhaven Harbor are not located in Outstanding Resource Waters, as the water quality classification of the Inner Harbor is Class SB, due to the presence of combined sewer overflows and is a restricted shellfishing area. The classification of the Outer Harbor, east of the New Bedford/Fairhaven boundary is SA and open to shellfishing (314 CMR 4.06, Table 28).

Finally, no discharge of dredged material will be allowed, per the provisions of 314 CMR 9.06(7), where the discharge meets the criteria for evaluation as specified above, but would result in "substantial adverse impacts" to the physical, chemical or biological integrity of surface waters of the Commonwealth. As described in this DEIR, disposal of UDM at the preferred alternative disposal sites in New Bedford/Fairhaven Harbor will not result in substantial adverse impacts to surface waters in the Harbor.

7.1.3 MGL Chapter 91 (Public Waterfront Act) and Waterways Regulations (310 CMR 9.00)

Dredging activities to create a subaqueous disposal site for UDM, involving the subaqueous placement of unconsolidated material below the mean low water mark, requires a waterways permit, under the provisions of the Waterways Regulations at 310 CMR 9.05(2). Regulatory requirements for a Waterways permit are less stringent than those for a Waterways License, required for activities involving fill or structures in tidelands. Dredging activities for purposes such as navigation channels, boat basins, and other water-dependent purposes, and the subaqueous placement of unconsolidated material from those dredging projects below the mean low water mark, are considered a water-dependent project, under the provisions of 310 CMR 9.12(2)(a).

Waterways permits are issued only if certain requirements specified in the Waterways Regulations at 310 CMR 9.31 to 9.40 are met. Section 9.31 states that no permit shall be issued unless the project serves a “proper public purpose which provides greater public benefit than detriment to the rights of the public” in tidelands. As a water-dependent use project, the construction and use of the proposed preferred sites in New Bedford/Fairhaven Harbor are presumed to meet this standard.

Because the proposed alternative sites require Waterways permits, the provisions of 310 CMR 9.32, Categorical Restrictions on Fill and Structures, do not apply. As required under section 9.33, Environmental Protection Standards, construction and use of the proposed aquatic sites will comply with the applicable environmental regulatory programs of the Commonwealth, including: MEPA; the Wetlands Protection Act; the Massachusetts Clean Waters Act (MGL c. 21, s. 26-53 and the regulations for Water Quality Certifications, 314 CMR 9.00); Marine Fisheries Laws (MGL Chapter 130); and the Underwater Archaeological Resources Act (MGL c. 91 and c. 6, s. 179-180 and 310 CMR 22.00).

The preferred alternative sites are not located on private tidelands or filled Commonwealth tidelands and do not need to be deemed in compliance with the Zoning Ordinance. The preferred alternative disposal sites for New Bedford/Fairhaven Harbor conform to the provisions of Harbor Plan, in that the construction and use of the sites for the disposal of UDM from the dredging projects in Harbor supports the stated goals of the Harbor Plan to encourage identified maintenance and improvement dredging projects. The provisions of 310 CMR 9.34, Conformance with Municipal Zoning and Harbor Plans, are met by construction and use of the sites.

The provisions 310 CMR 9.35, Standards to Preserve Water-Related Public Rights, are applicable to the proposed alternative sites in the Harbor. Construction and use of the disposal sites will not significantly interfere with existing navigation. Use of the sites will also not significantly interfere with the public rights of free passage over the water, nor will it interfere with access to any city landings, easements or any other form of public access to New Bedford/Fairhaven Harbor. Use of the preferred alternative sites will not significantly interfere with the public rights of fishing and fowling, and being a subaqueous site, will not interfere with on-foot passage, swimming or boating around the site.

Section 9.36, Standards to Protect Water-Dependent Uses, also applies to a portion of the preferred alternative sites in New Bedford/Fairhaven Harbor. Construction and use of the preferred alternative will result in the preservation of the availability and suitability of tidelands in New Bedford/Fairhaven Harbor which are reserved as locations for maritime industrial uses and other water-dependent uses in the Harbor. The sites are located so that there will be no interference with private access to littoral property from New Bedford/Fairhaven Harbor, or to approach the harbor from the private property. Use of the disposal sites will not result in disruption to existing water-dependent uses in New Bedford/Fairhaven Harbor, nor will it displace any existing water-dependent uses. The preferred alternative does not include fill or structures for nonwater-dependent or water-dependent non-industrial uses which preempt any water-dependent industrial use within the New Bedford/Fairhaven Harbor DPA.

The provisions of section 9.37, Engineering and Construction Standards, will be met through the development of a sound engineering design for the aquatic preferred alternative disposal site. Construction and use of the proposed aquatic sites will not interfere with the ability to perform future maintenance dredging of the federal channel.

The preferred alternative disposal sites are neither a Recreational Boating Facility nor a Marina, Boatyard or Boat Ramp, therefore the provisions of 310 CMR 9.39 and 9.39 do not apply.

Finally, the provisions of Section 9.40, Standards for Dredging and Dredged Material Disposal, also apply to the proposed alternative disposal sites in New Bedford/Fairhaven Harbor. As two of the sites are located partially within the Harbor DPA, the prohibition on dredging to a mean low water depth greater than 20 feet in 310 CMR 9.40(1)(a) does not apply. The project also serves a commercial navigation purpose of federal and state significance, allowing the maintenance dredging of the main federal channel. The sites have been located so as to avoid shellfish beds to the extent possible, significant fisheries resources, and submerged aquatic vegetation such as eelgrass beds. Dredging activities necessary to construct the disposal sites will comply with the operational requirements specified in section 9.40(3), in that the depth of the disposal sites will be that necessary to accommodate the anticipated volume of UDM from New Bedford/Fairhaven Harbor, therefore accommodating the navigational dredging needs of the harbor users.

Operational procedures will be established for use of the aquatic disposal sites which will meet the intent of the requirements specified in section 9.40(4), Operational Requirements for Dredged Material Disposal and 9.40(5), Supervision of Dredging and Disposal Activity. Section 9.0 of this DEIR outlines the monitoring and management measures to be implemented to confirm compliance with permit standards and long-term sequestering of UDM for the preferred alternative sites.

7.1.4 Coastal Zone Management (301 CMR 21.00)

This project will be required to complete a federal consistency certification for review by CZM, describing the project and demonstrating consistency with CZM's program policies and management principles. The CZM Program Plan establishes program policies which embody coastal policy for the Commonwealth of Massachusetts. Recognition of these statements as Massachusetts coastal policy is formalized in

Memoranda of Understanding (MOU) between CZM and state environmental agencies. Projects subject to federal consistency review must be consistent with CZM program policies. CZM enforces its program policies through existing Massachusetts statutes and their implementing regulations.

In addition, the federally-approved CZM Program Plan lists management principles. These policy statements are not currently enforceable through existing state statutes and regulations. They are published as guidance to proponents of activities in the Coastal Zone, representing CZM's preferred policy direction.

Program policies cover issue areas such as Water Quality (Section 7.1.4.1), Habitat (Section 7.1.4.2), Protected Areas (Section 7.1.4.3), Coastal Hazards (Section 7.1.4.4), Port and Harbor Infrastructure (Section 7.1.4.5), Public Access (Section 7.1.4.6), Energy (Section 7.1.4.7), Ocean Resources (Section 7.1.4.8), and Growth Management (Section 7.1.4.9). Construction and use of the preferred alternative aquatic disposal sites within New Bedford/Fairhaven Harbor involve the CZM policies on Water Quality and Habitat.

7.1.4.1 Water Quality

Water Quality Policy #1 - Ensure that point-source discharges in or affecting the coastal zone are consistent with federally approved state effluent limitations and water quality standards.

Water Quality Policy #2 - Ensure that nonpoint pollution controls promote the attainment of state surface water quality standards in the coastal zone.

Water Quality Policy #3 - Ensure that activities in or affecting the coastal zone conform to applicable state and federal requirements governing subsurface waste discharges.

Conformance: Use of the aquatic preferred alternative disposal sites in New Bedford/Fairhaven Harbor will be consistent with the Water Quality Policies. Disposal of UDM at a subaqueous site is not considered to be a subsurface discharge of waste.

7.1.4.2 Habitat

Habitat Policy #1 - Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and fresh water wetlands for their important role as natural habitats.

Habitat Policy #2 - Restore degraded or former wetland resources in coastal areas and ensure that activities in coastal areas do not further wetland degradation but instead take advantage of opportunities to engage in wetland restoration.

Conformance: The proposed preferred sites have been located in areas of New Bedford/Fairhaven Harbor which avoids most of the protected coastal resource areas, including subtidal resources such as eelgrass beds, to the greatest extent practicable. There are no nearby salt marshes, dunes, beaches or barrier beaches, salt ponds or freshwater wetlands which would be affected by use of the disposal sites.

However, direct impacts to shellfish beds in the vicinity would result from the disposal of UDM. The effects of the preferred alternative to quahogs, soft shell clams and oyster habitat would be temporary because of the relatively strong recolonization rate of these species, especially if seed stock is used in the rehabilitation of the resource. Monitoring the success of the rehabilitation would be necessary during the recovery period (Section 6.2.6).

7.1.4.3 Protected Areas

Protected Areas Policy #1 - Preserve, restore, and enhance complexes of coastal resources of regional or statewide significance through the Areas of Critical Environmental Concern program.

Protected Areas Policy #2 - Protect state and locally designated scenic rivers and state classified scenic rivers in the coastal zone.

Protected Areas Policy #3 - Ensure that proposed developments in or near designated or registered historic districts or sites respect the preservation intent of the designation and that potential adverse effects are minimized.

Conformance: Per the requirements of 314 CMR 9.06(3), no discharge of dredged material will be allowed in Outstanding Resource Waters. The Proposed Preferred Alternative aquatic disposal sites in New Bedford/Fairhaven Harbor are not located in Outstanding Resource Waters, as the water quality classification of the Inner Harbor is Class SB, due to the presence of combined sewer overflows and is a restricted shellfishing area.

7.1.4.4 Coastal Hazards

Coastal Hazards Policy #1 - Preserve, protect, restore, and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes, and land under the ocean.

Coastal Hazards Policy #2 - Ensure construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Approve permits for flood or erosion control projects only when it has been determined that there will be no significant adverse effects on the project site or adjacent or downcoast areas.

Coastal Hazards Policy #3 - Ensure that state and federally funded public works projects proposed for location within the coastal zone will:

- not exacerbate existing hazards or damage natural buffers or other natural resources,
- be reasonably safe from flood and erosion related damage, and
- not promote growth and development in hazard-prone or buffer areas, especially in Velocity zones and ACECs, and
- not be used on Coastal Barrier Resource Units for new or substantial

reconstruction of structures in a manner inconsistent with the Coastal Barrier Resource/Improvement Acts.

Coastal Hazards Policy #4 - Prioritize public funds for acquisition of hazardous coastal areas for conservation or recreation use, and relocation of structures out of coastal high hazard areas, giving due consideration to the effects of coastal hazards at the location to the use and manageability of the area.

Conformance: To ensure that construction in the harbor will minimize interference with the water circulation and sediment transport, the bottom elevation at the Channel Inner site following construction of the disposal site, disposal activities and final placement of capping materials, will not be higher than the existing bottom elevation. This proposed construction will likely be slightly recessed compared to existing bottom elevations. The effect of this recessed pit is expected to be reduced water column mixing with surrounding waters, and active sedimentation within the pit. In addition, the location of the CAD site within the main navigation channel will also minimize localized changes in water circulation. The preferred alternative sites have been located so as to provide a sufficient distance to the nearest coastal engineering structure. No impact on the stability of the harbor bottom that would affect the support of the nearby coastal engineering structures is expected, and therefore no adverse effect on any structure's ability to serve a storm damage prevention or flood control functions in the area.

7.1.4.5 Port and Harbor Infrastructure

Ports Policy #1 - Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity and public health.

Ports Policy #2 - Obtain the widest possible public benefit from channel dredging, ensuring that designated ports and developed harbors are given highest priority in the allocation of federal and state dredging funds. Ensure that this dredging is consistent with marine environment policies.

Ports Policy #3 - Preserve and enhance the capacity of Designated Port Areas (DPAs) to accommodate water-dependent industrial uses, and prevent the exclusion of such uses from tidelands and any other DPA lands over which a state agency exerts control by virtue of ownership, regulatory authority, or other legal jurisdiction.

Ports Management Principle #1 - Encourage, through technical and financial assistance, expansion of water dependent uses in designated ports and developed harbors, re-development of urban waterfronts, and expansion of visual access.

Conformance: The majority of the Channel Inner preferred alternative site is located within New Bedford/Fairhaven Harbor's DPA (Figure 7-1). Typically, the impact to water quality from dredged material is short-term. Conditions return to ambient conditions within hours to days, depending on the amount, composition, and frequency of the disposed material.

7.1.4.6 Public Access

Public Access Policy #1 - Ensure that developments proposed near existing public recreation sites minimize their adverse effects.

Public Access Management Principle #1 - Improve public access to coastal recreation facilities and alleviate auto traffic and parking problems through improvements in public transportation. Link existing coastal recreation sites to each other or to nearby coastal inland facilities via trails for bicyclists, hikers, and equestrians, and via rivers for boaters.

Public Access Management Principle #2 - Increase capacity of existing recreation areas by facilitating multiple use and by improving management, maintenance and public support facilities. Resolve conflicting uses whenever possible through improved management rather than through exclusion of uses.

Public Access Management Principle #3 - Provide technical assistance to developers of private recreational facilities and sites that increase public access to the shoreline

Public Access Management Principle #4 - Expand existing recreation facilities and acquire and develop new public areas for coastal recreational activities. Give highest priority to expansions or new acquisitions in regions of high need or limited site availability. Assure that both transportation access and the recreational facilities are compatible with social and environmental characteristics of surrounding communities.

Conformance: Construction and use of the disposal sites will not significantly interfere with existing navigation. Use of the sites will also not significantly interfere with the public rights of free passage over the water, nor will it interfere with access to any city landings, easements or any other form of public access to New Bedford/Fairhaven Harbor. Use of the preferred alternative sites will not significantly interfere with the public rights of fishing and fowling, and being a subaqueous site, will not interfere with on-foot passage, swimming or boating around the site.

7.1.4.7 Energy Policy

Energy Policy #1 - For coastally dependent energy facilities, consider siting in alternative coastal locations. For non-coastally dependent energy facilities, consider siting in areas outside of the coastal zone. Weigh the environmental and safety impacts of locating proposed energy facilities at alternative sites.

Energy Management Principle #1 -Encourage energy conservation and the use of alternative sources such as solar and wind power in order to assist in meeting the energy needs of the Commonwealth.

Conformance: The proposed preferred sites are not coastally dependent energy facilities and do not require a power source.

7.1.4.8 Ocean Resources

Ocean Resources Policy #1 - Support the development of environmentally sustainable aquaculture, both for commercial and enhancement (public shellfish stocking) purposes. Ensure that the review process regulating aquaculture facility sites (and access routes to those areas) protects ecologically significant resources (salt marshes, dunes, beaches, barrier beaches, and salt ponds) and minimizes adverse impacts upon the coastal and marine environment.

Ocean Resources Policy #2 - Extraction of marine minerals will be considered in areas of state jurisdiction, except where prohibited by the MA Ocean Sanctuaries Act, where and when the protection of fisheries, air and marine water quality, marine resources, navigation and recreation can be assured.

Ocean Resources Policy #3 - Accommodate offshore sand and gravel mining needs in areas and in ways that will not adversely affect shorelines areas due to alteration of wave direction and dynamics, marine resources and navigation. Mining of sand and gravel, when and where permitted, will be primarily for the purpose of beach nourishment.

Conformance: The preferred alternative disposal sites are all located within areas that have been designated as areas of LCS as specified in the Wetlands Protection Act and Regulations. As described above, the preferred CAD alternative disposal sites are not expected to have an adverse permanent effect on marine fisheries caused by localized alterations in water circulation, alterations in relief elevation, sediment grain size or changes in water quality. Implementation of either of the preferred CAD disposal alternatives will require mitigation for impacts to LCS (to be developed with regulatory agencies).

7.1.4.9 Growth Management

Growth Management Principle #1 - Encourage, through technical assistance and review of publicly funded development, compatibility of proposed development with local community character and scenic resources.

Growth Management Principle #2 - Ensure that state and federally funded transportation and wastewater projects primarily serve existing developed areas, assigning highest priority to projects that meet the needs of urban and community development centers.

Growth Management Principle #3 - Encourage the revitalization and enhancement of existing development centers in the coastal zone through technical assistance and federal and state financial support for residential, commercial and industrial development.

Conformance: The proposed preferred sites have been located in areas of New Bedford/Fairhaven

Harbor to support the vision of the Harbor Plan to maintain and develop the harbor as an asset for the communities and region.

7.2 Compliance with Federal Regulations/Standards - Aquatic Disposal

7.2.1 Clean Water Act Section 404(b)(1) Analysis

The Code of Federal Regulations at 40 CFR 230 specifies guidelines for implementing the policies of Section 404(b)(1) of the federal Clean Water Act. The guidelines apply to discharges of dredged or fill materials into navigable waters, and their purpose is to restore and maintain the chemical, physical, and biological integrity of waters of the United States. The guidelines are divided into Subparts A through I. Subpart A is a general discussion of the guidelines. Compliance with more specific requirements is discussed below.

7.2.1.1 Subpart B - Compliance with the Guidelines

(a) The discharge shall not be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

The Alternatives Analysis in Section 4.0 of this DEIR establishes that the preferred alternative are the least environmentally damaging of the alternatives considered.

(b) No discharge shall be permitted if it contributes to the violation of a state water quality standard, violates any applicable toxic effluent standard or prohibition under Section 307 of the Act, jeopardizes the continued existence of endangered or threatened species, or violates any requirement to protect any federally-designated marine sanctuary.

The proposed discharge shall not violate any of these requirements, as discussed in Section 6.1.2.3 (Water Quality) and Section 6.1.7 (Endangered or Threatened Species). The proposed discharge sites are more than 60 miles, via sea, from the closest point of the nearest marine sanctuary, Stellwagen Bank, and will have no effect on it.

(c) No discharge shall be permitted which will cause or contribute to significant degradation of the waters of the United States. This discharge will not cause such degradation, as explained in discussions of the Subparts C through F.

(d) No discharge shall be permitted unless appropriate and practicable steps have been taken to minimize adverse impacts. Steps which will be taken to minimize these impacts are listed in the discussion of Subpart H.

7.2.1.2 Subpart C - Potential Impacts on Physical/Chemical Characteristics of the Aquatic Ecosystem

The discharge will not have a significant impact on physical and chemical characteristics of the ecosystem, as discussed in Section 6.2.1. Within this section, impacts on sediments are discussed in 6.2.1.1; impacts on suspended particulates/turbidity and water column impacts are in 6.2.1.3; and current patterns and water circulation in 6.2.1.2. The discharge will have no impact on normal water fluctuations, because the proposed disposal locations are in an open area where they will not interfere with tidal circulation. Since the discharge will not affect circulation and is not near an area where fresh and salt water mix, it will therefore not affect salinity gradients.

7.2.1.3 Subpart D - Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

The disposal sites will have no impact on threatened and endangered species, as discussed in Section 6.2.6.4. There are no benthic endangered species in the area which could be covered or otherwise directly killed, and no habitat for these species occurs in any area influenced by the disposal.

The CAD disposal sites will not permanently affect fish, crustaceans, mollusks, or other organisms in the aquatic food web. Any benthic organisms affected by disposal will be replaced by recolonizing organisms with aquatic larvae brought in by currents. The dredged material will be capped by clean sediments and therefore the recolonizing organisms will not be affected by toxins or heavy metals.

Other wildlife such as mammals, birds, reptiles, and amphibians will not be affected by the disposal sites. The subsurface open water disposal will not affect their habitat, and any turbidity during disposal will be temporary. Wildlife impacts are further discussed in Section 6.2.6.

7.2.1.4 Subpart E - Potential Impacts on Special Aquatic Sites

Sanctuaries and refuges. The proposed disposal sites are not in the vicinity of any designated sanctuaries or refuges.

Wetlands. The disposal sites, being in open water removed from shore, will not affect any wetlands, as defined in these guidelines.

Mud flats. The proposed disposal sites are all subtidal and will not affect any intertidal mud flats.

Vegetated shallows. Although eelgrass beds do exist in Upper Harbor, they are far enough away from the proposed disposal sites so that they will not be affected.

The other two special aquatic sites, coral reefs and riffle and pool complexes, are found only in tropical and subtropical seas and in freshwater streams, respectively, and are not a factor in this project area.

7.2.1.5 Subpart F - Potential Effects on Human Use Characteristics

As a subaqueous disposal site, this project will have no effect on municipal and private water supplies. The proposed disposal sites are not in an area of concentration or important migration or spawning areas for species important in recreational or commercial fisheries. Any impacts associated with CAD disposal to the water column or substrate will be temporary and will have no effect on fisheries. Fishery impacts are further discussed in Sections 6.2.3 and 6.2.4.

Water-related recreation activities will not be affected by disposal. Even if disposal is conducted in the limited period of the year when recreational activities take place (which is not proposed), turbidity from disposal, the most probable impact, will be temporary and limited in scope.

The disposal of UDM at the proposed CAD disposal sites will have no permanent aesthetic impacts because the subsurface disposal sites will not be visible. Temporary changes in appearance of the water will last no longer than the actual disposal operation.

There are no parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves which could be affected by disposal at the proposed sites.

7.2.1.6 Subpart G - Evaluation and Testing

Thorough testing of sediments proposed for dredging from New Bedford/Fairhaven Harbor has been initiated and will be completed in accordance with all regulatory requirements. This includes physical and bulk chemistry testing, bioaccumulation tests, and evaluation of sediment transport and circulation in the vicinity of disposal sites. These results of the chemical and physical testing performed to date are presented in Sections 3.3.2, 4.8.2, 5.2.2, and 6.2.2 of this DEIR.

7.2.1.7 Subpart H - Actions to Minimize Adverse Effects

The following actions, among those listed in Subpart H of the Guidelines, will be taken to minimize averse effects from disposal:

- Confining the discharge to minimize smothering of organisms;
- Designing the discharge to avoid a disruption of periodic water inundation patterns;
- Disposal of dredged material in such a manner that physicochemical conditions are maintained and the potency and availability of pollutants are reduced;
- Selecting discharge methods and disposal sites where the potential for erosion, slumping, or leaching of materials into the surrounding aquatic ecosystem will be reduced;
- Capping in-place contaminated material with clean material or selectively discharging the most contaminated material first to be capped with the remaining material;
- Avoiding changes in water current or circulation patterns which would interfere with the movement of animals;
- Avoiding sites having unique habitat or other value, including habitat of threatened or endangered species;
- Timing discharge to avoid spawning or migration seasons and other biologically critical time periods;

7.2.2 Rivers and Harbors Act of 1899, Section 10

Section 10 of the Rivers and Harbors Act of 1899, authorizes the USACOE to regulate virtually all obstructions to navigation within navigable waters the United States. This section defines navigable waters as *"those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past or may be susceptible to use to transport interstate or foreign commerce"*. Because all the dredging projects identified in New Bedford/Fairhaven Harbor are located in navigable waters, they will require a Section 10 permit from the USACE.

7.2.3 Marine Protection, Research and Sanctuaries Act (MPRSA)

The Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972, also known as the Ocean Dumping Act, requires obtaining a permit for discharging some wastes (such as dredged material) and prohibits disposal of others (including radioactive wastes, chemical and biological warfare wastes). Three primary sections of the MPRSA apply to dredging projects:

(1) Section 102 - This section empowers the USEPA to establish the criteria for evaluating all dredged material for open ocean disposal. Section 102 also authorizes USEPA to designate ocean dredged material disposal sites such as CCDS and MBDS.

(2) Section 103 - USACOE has the authority issue Section 103 permits, with concurrence from the USEPA, to dispose of dredged material in the open ocean. The permitting process includes public notice, public hearings, compliance with USEPA criteria, and the use of designated disposal sites, when possible.

(3) Section 104 - The USEPA and the USACOE have the authority to place conditions upon any aspect of ocean disposal operations to minimize negative environmental impacts. Typical conditions are imposed on the type and volume of dredged material, timing and location of disposal, and surveillance and monitoring of disposal activities.

The preferred alternative disposal sites for New Bedford/Fairhaven Harbor will not require approval under the MPRSA. However, projects including the transportation and disposal of dredged material, CAD disposal options, to either CCDS or MBDS will require testing and approval under the MPRSA.

7.2.4 Endangered Species Act - Section 7

The Endangered Species Act of 1973, protects federally listed and proposed threatened and endangered species. Section 7 of the Act requires the consultation with USFWS and NMFs and a opinion statement. This project is being coordinated with NMFS and the USFWS to determine whether any endangered or threatened species under their jurisdiction may be affected by use of the preferred alternative disposal sites in New Bedford/Fairhaven Harbor. To date, staff of NMFS and USFWS have participated in the review of the preliminary upland, aquatic and dewatering site screening processes and have indicated their concurrence with the results of the screening. As the final preferred alternative is selected in the FEIR, CZM will continue to coordinate with both NMFS and USFWS staff in the Section 7 consultation process.

7.2.5 Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

The MSFCMA authorizes the NMFS to establish Essential Fish Habitat (EFH) areas. The general purpose of the act is to conserve productive fisheries that provide recreational and commercial benefit. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" and all of New Bedford/Fairhaven Harbor is classified as EFH.

Under section 305(b) of the Act, coordination between federal agencies is required for any work proposed within an EFH. The intent and procedures of the Act are very similar to the Endangered Species Act (ESA). CZM has been coordinating with NMFS and USFWS in accordance with Section 7 of the ESA as well as the MSFCMA. Correspondence is included in Appendix B.

7.2.6 Executive Orders 11988 and 11990

Executive Order 11988 directs federal agencies to avoid long and short term adverse impacts associated with the occupancy and modification of floodplains. Because their construction would not result in any reduction in flood storage, the two proposed CAD alternatives would be consistent with this policy.

Executive Order 11990 directs federal agencies to avoid the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid new construction in wetland areas wherever there is a practicable alternative. Where avoidance is not practicable, agencies must take actions to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agencies' responsibilities. Implementation of the CAD alternatives will not involve the long term modification of wetlands.

SECTION 8.0 - CAD ENGINEERING AND CONSTRUCTION

8.0 CAD ENGINEERING AND CONSTRUCTION

This section describes the basis for conceptual engineering for CAD disposal of New Bedford/Fairhaven Harbor UDM and a description of potential construction sequencing associated with the implementation of the aquatic preferred alternative, as identified in this DEIR. Included in the discussion of the construction measures are the steps necessary to minimize negative environmental impacts associated with the disposal of UDM in the marine environment.

8.1 Conceptual Engineering

In order to evaluate the practicability of the preferred alternative, conceptual engineering of potential CAD pit aquatic disposal cells needed to be conducted. Inherent in this exercise is a set of assumptions based upon the level of data collected. The results of this exercise are not intended to provide a specific final design. The results of the conceptual engineering exercise are for illustrative purposes only, final CAD cell designs and specifics will be refined further in the FEIR.

8.1.1 Planning Horizon UDM Volumes

To calculate the disposal capacity based upon engineering principles, conceptual engineering drawings were developed for each of the proposed preferred alternatives. Calculations were conducted to evaluate the ability of the general site area, in its current site configuration, to accommodate the volume of UDM identified in the New Bedford/Fairhaven Harbor DMMP. Table 8-1 indicates the projected volumes for each of the DMMP's five-year planning horizons. Of the over 960,000 cubic yards of UDM identified to be dredged, over 70% of this expected volume is projected to occur within the first five-year planning horizon.

Table 8-1: UDM Disposal Volumes by Planning Horizon

Planning Horizon	**Years 1-5**	**Years 6-10**	**Total**
UDM Totals	680,000	280,000	960,000

8.1.2 Cell Capacity Calculation

In order to contrast the planning horizon UDM volumes requiring disposal with the preferred alternative disposal sites identified in Section 4.0, site capacity calculations were conducted to determine the extent of the predicted disposal volumes occupying the preferred alternative disposal sites. The footprints of the preferred alternative disposal sites identified through the site screening process for the Harbor were used to determine the areal extent of the Cell Footprint. Assuming a 3 to 1 side slope within the disposal cell, the area of the Cell Bottom was calculated.

To calculate the total gross capacity for the disposal cells, volumes were determined by using an average end area calculation method. The Cell Footprints and Cell Bottom areas were averaged and then multiplied by the cell depth. Accounting for potential variability in both surface and depth to bedrock contours and limitations of existing data, three feet were subtracted from the average depth to bedrock determined for each site. This assumption resulted in a conservative value for cell depth. For conceptual engineering and planning purposes, the maximum capacity values take into account the variability of seafloor elevations and depth to bedrock to the extent practicable based upon the level of data available for the sites. The maximum cell capacities were then adjusted further to accommodate a three (3) foot thick cap. The cap volume was calculated by multiplying the Cell Footprint Area by three (3) feet. To determine the UDM Capacity for each cell, the cap volume calculated was subtracted from the maximum capacity value for each cell. The gross capacity for Channel Inner was determined to be 1,222,575 cy and Popes Island North was calculated to be 3,266,108 cy.

8.1.3 UDM Volume versus Potential Capacity

The calculated gross capacities of both the Channel Inner and Popes Island North CAD sites, exceeds the ten-year UDM total of 960,000 cubic yards. The Channel Inner site would be expected to meet the entire demand for dredged material disposal, using 79% of the cell's total capacity. Due primarily to the greater depth to bedrock found in the area north of Popes Island, the Popes Island North CAD site is projected to have a total capacity of over three million cubic yards and would only use 29% of its capacity to accommodate the projected UDM to be dredged in the Harbor.

Table 8-2: UDM Volume versus Potential Capacity

	Channel Inner	Popes Island North
UDM Capacity (cy)	1,222,575	3,266,108
Ten-Year UDM Volume	960,000	960,000
Surplus Capacity	262,575	2,306,108
Percent Capacity Used	78.5%	70.8%

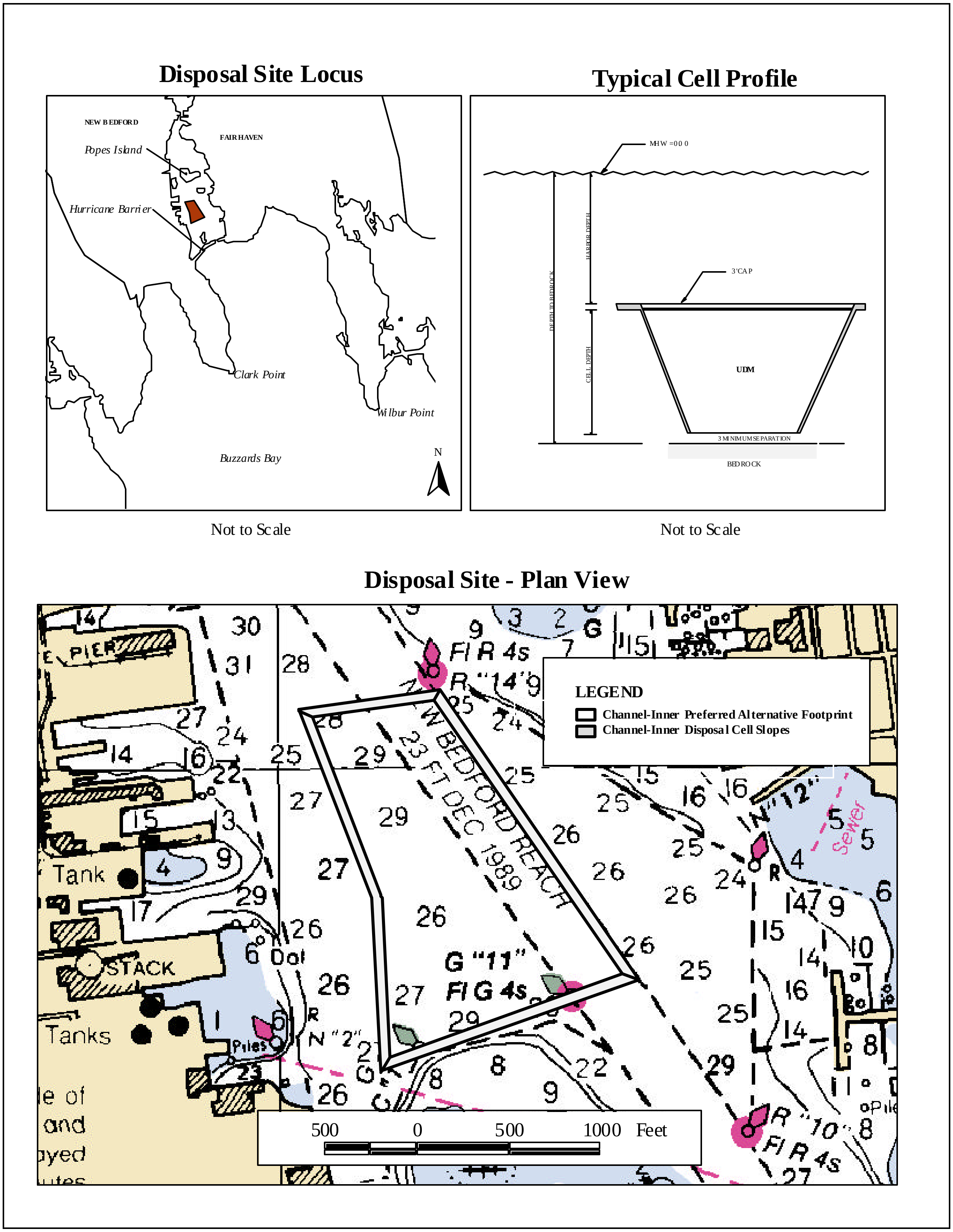


Figure 8-1: Conceptual Engineering for Channel Inner CAD Site

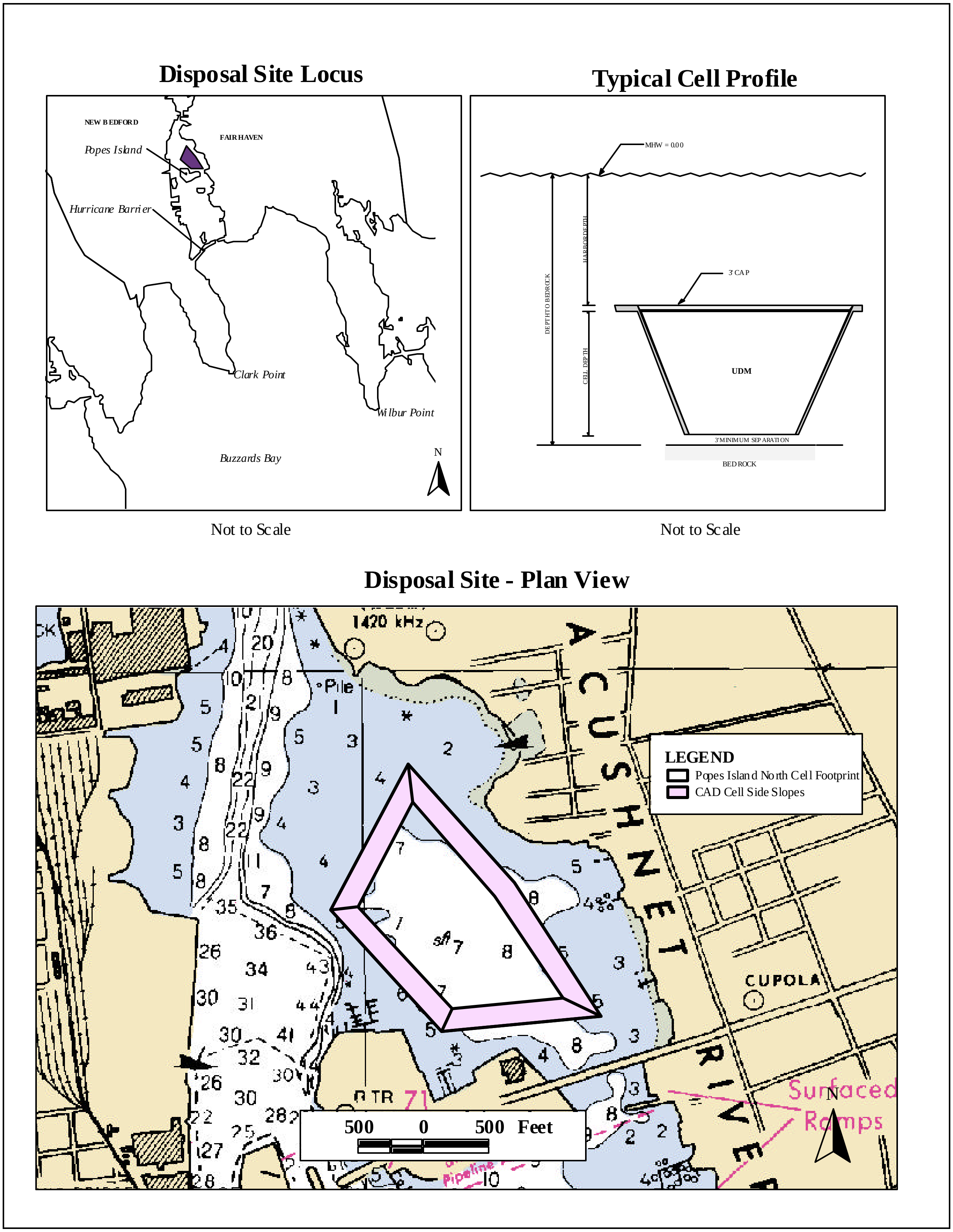


Figure 8-2: Conceptual Engineering for Popes Island North CAD Cell

8.1.4 Disposal Cell Phasing Scenarios

The final phase of the conceptual engineering exercise is the contrasting of calculated subcell capacities with planning horizon UDM volumes to develop potential disposal phasing scenarios. Two possible scenarios are presented (Figures 8-3 and 8-4). Scenario 1 involves the use of two subcells (Subcells1 and 2) at the Channel Inner site while Scenario 2 uses portions of both the Channel Inner and Popes Island North site footprints. Under Scenario 2, the northern portion of the Channel Inner site (Subcell 3) is configured to avoid the potential quahog relay area to the south and uses the Popes Island North site (Subcell 4) to meet the baseline dredging demand disposal needs.

To account for possible additional UDM, an assumption was made that the footprints of Channel Inner and Popes Island North subcells would be UDM (three feet thick). This additional UDM, was subtracted from the UDM Capacity subcell volume calculated above to determine an Adjusted UDM Capacity. Table 8-3 shows the results of this adjustment.

Table 8-3: UDM Capacity Adjustment for Subcell Scenarios

Scenario	UDM Capacity (cy)	UDM Footprint Adjustment (cy)	Adjusted UDM Capacity (cy)
Scenario 1 - Channel Inner Only			
Subcell 1	832,281	142,677	689,604
Subcell 2	343,651	58,912	284,739
Scenario 2 - Channel Inner and Popes Island North			
Subcell 3	1,153,606	161,942	991,664
Subcell 4	1,342,453	105,555	1,236,898

By contrasting the ability of each disposal subcell to accommodate planning horizon UDM volumes with the adjusted UDM capacities (Table 8-3), three of the subcells considered would be able to accommodate either the 0-5 year volume (680,000 cy) or the 6-10 year volume (280,000 cy). However, Channel Inner's Subcell 2, does not have adequate capacity within the Channel Inner footprint to accommodate the 6-10 year volume. As a result of the above findings the following two potential phasing scenarios were developed to coincide with the baseline dredging demand identified by planning horizon.

Scenario 1
- Subcell 1 - 0-5 Year Horizon
- Subcell 2 - 6-10 Year Horizon

Scenario 2
- Subcell 3 - 0-5 Year Horizon
- Subcell 4 - 6-10 Year Horizon

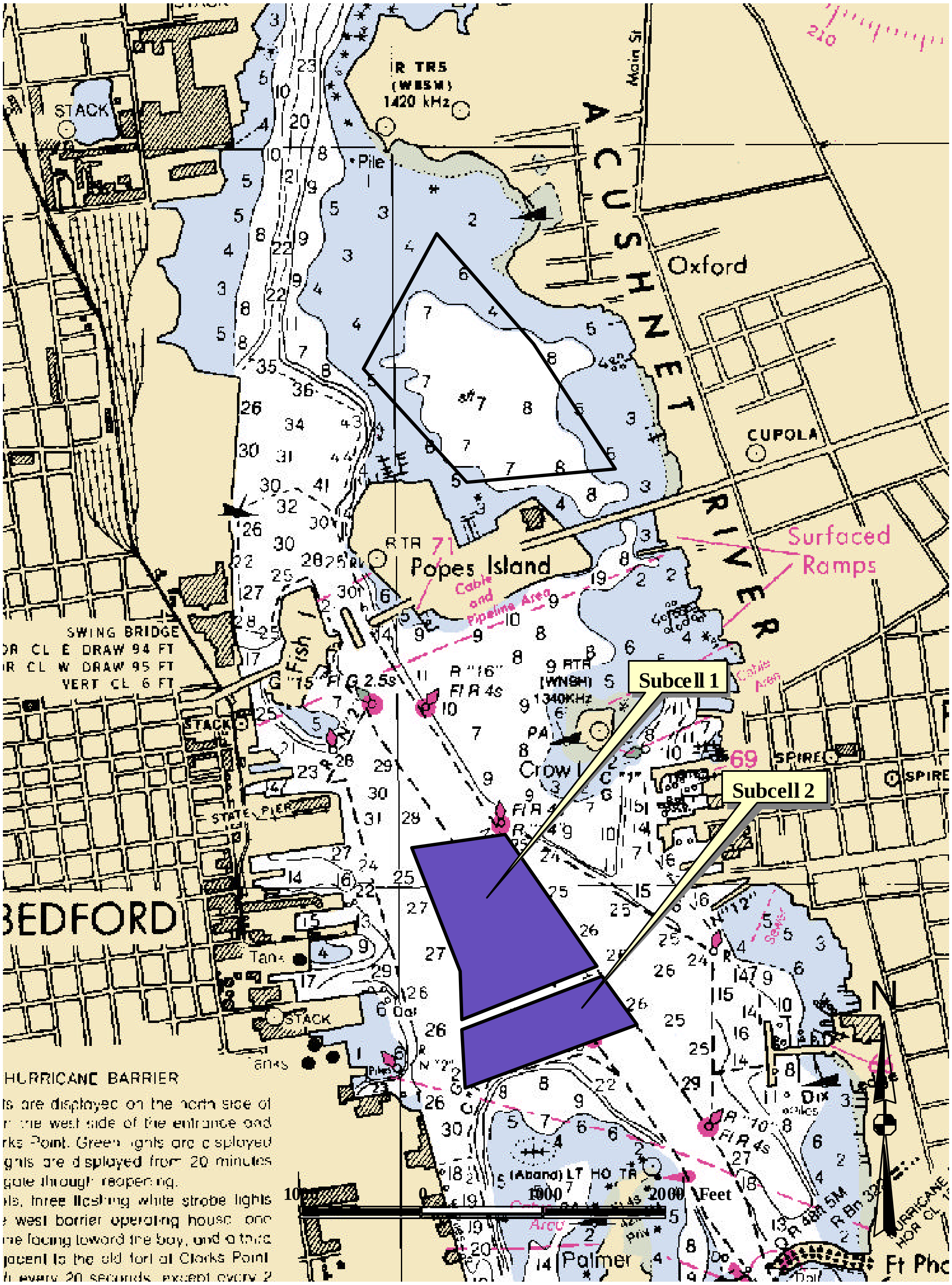


Figure 8-3: Scenario 1 Subcell Phasing

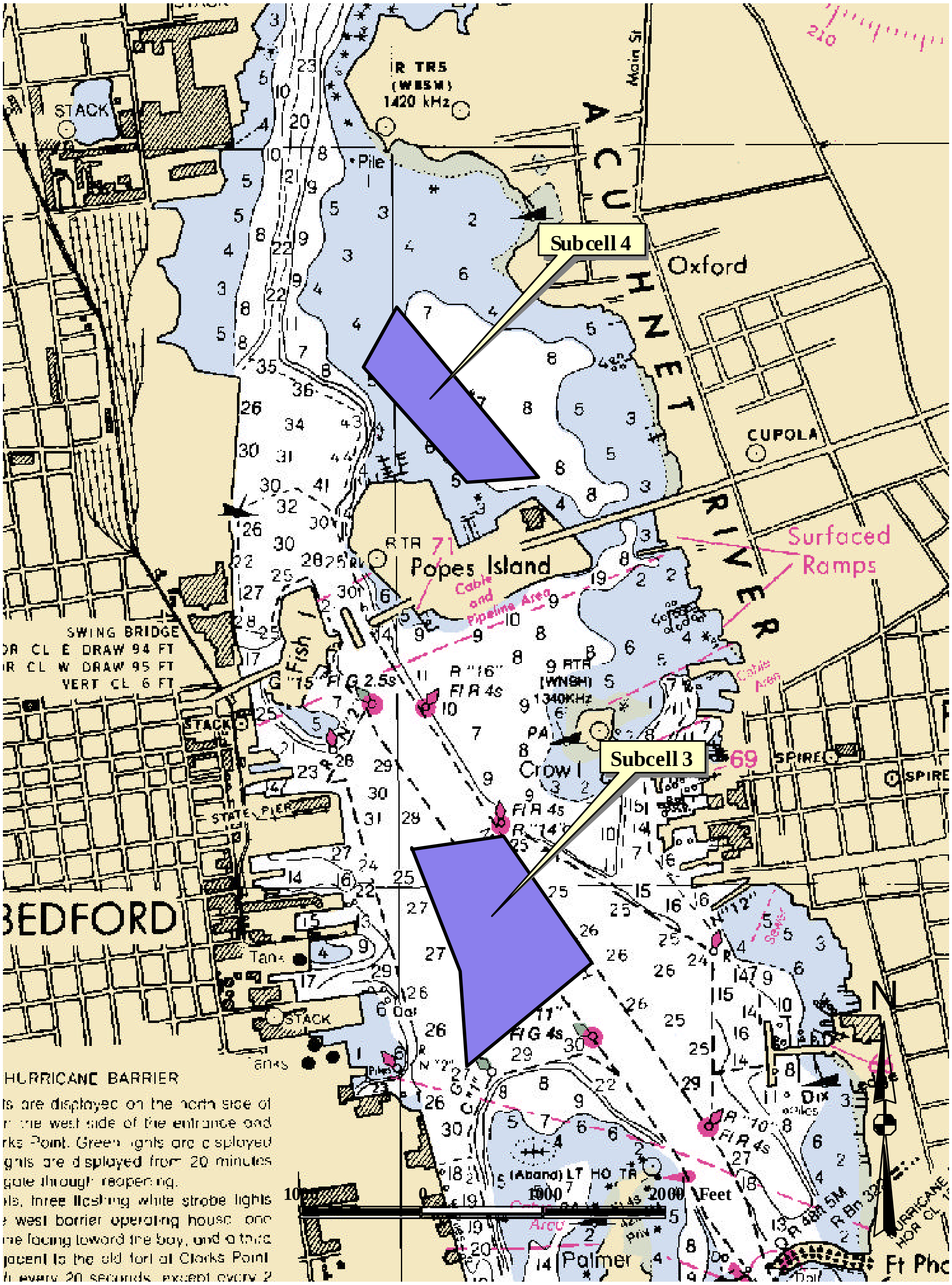


Figure 8-4: Scenario 2 Subcell Phasing

Additional scenarios involving combinations of subcells from both Channel Inner and Popes Island North sites could also be considered if operational or site-specific information dictates using multiple sites. Properties testing conducted on materials from borings taken as part of the marine seismic refraction study indicate that some portions within the cell footprints investigated may be able to support steeper slopes and provide potentially greater capacities (Appendix N). This data will be incorporated into site specific analysis and refined capacities calculated for the FEIR.

Please note that for each five year phase, the DMMP is proposing that each CAD disposal cell be open for UDM disposal for one dredging season within each five year phase. 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.

In the FEIR, detailed site specific data will be collected for the proposed disposal sites. These data will be examined and revised cell capacities will be calculated based upon site-specific data. The results of the final design of the disposal cells will be determined by coordinating with state, federal and local agencies on cell phasing preferences in developing the both the configuration of the final alternative disposal cell footprints and the phasing sequence proposed in the FEIR.

8.2 CAD Cell Construction

8.2.1 Construction Sequencing

The general construction phasing proposed in this report is divided into four major steps: cell construction, UDM disposal, cell closure, and management. Prior to the commencement of dredging projects, the construction of the CAD disposal cell needs to be completed first. Dredging of the disposal cells will be completed during an environmentally favorable window to reduce the disturbance to marine life. Cell construction involves the following actions: conducting a pre-dredge survey, project mobilization, dredging the cell footprint, dredging to create cell capacity and final cell contouring. During this step, dredged material suitable for open ocean disposal would be taken to CCDS and UDM (if footprint material determined to be UDM) would be stockpiled for disposal in the cell being constructed.

To construct each cell, dredge limits and locations will be located by Geodetic Positioning System (GPS), which is a satellite positioning system, accurate to within a foot of the intended horizontal design limits. The dredge machinery will most likely be a large barge mounted crane with a clamshell bucket. Bucket size will likely be in excess of ten cubic yards. The material will be removed to the intended depth and side slopes. The Dredging contractor will also be compensated for an allowable over-dredge limit to ensure that the intended depths are achieved. The material is removed by a bucket and deposited within a transport barge called a scow. The scow will deliver the material to the CCDS where it is positioned prior to dumping using GPS. A bottom dumping or split hull scow will most likely be used. These barges open from the bottom allowing the material to drop out through the water column to the seafloor below. This material is clean and will therefore not need to be capped.

Following the completion of the disposal cell, the dredging of UDM from the facilities in the Harbor will be completed by mechanical means, using siltation curtains to minimize turbidity impacts. After being dredged, the UDM will be placed on a dump scow and transported to the disposal cell, where the material will be deposited. If UDM from the footprint had been stockpiled, it would also be placed in the CAD disposal cell.

To close or "cap" the cell, clean material would be placed over the UDM to achieve a thickness of three (3) feet deep to sequester the UDM from the marine environment. By conducting a post capping survey, the need to perform final contouring or placement of additional cap material would be determined. The end result of the capping will be a surface that mimics the ambient seafloor elevations and pre-construction contours.

The final step in the cell construction process is management. To ensure long-term environmental protection, a CAD cell monitoring plan would be implemented. A proposed monitoring plan for consideration is described in Section 9.0. The CAD aquatic disposal cell construction management sequence is illustrated in Figure 8-5.

8.3 CAD Construction, Design and Operation Under New DEP Regulations

The DEP is developing new dredging and disposal regulations, which are expected to be finalized in 2002. Any dredging and disposal associated with CAD cells in New Bedford/Fairhaven Harbor will be done under the new regulations. The following two subsections provide specific information related to CAD cells based on the Boston Harbor project. In the absence of existing, formal regulations, the Management Plan and Model Water Quality Certificate are presented here to illustrate the approach to management and operations that will be documented in site-specific detail in the FEIR, under the new regulations. These subsections have been developed to meet the provisions of the draft regulations to the greatest extent practicable, and are not intended to supercede any regulatory provisions, draft or final. The FEIR will contain a management plan and draft Water Quality Certificate based on the final, approved regulations.

8.3.1 CAD Cell Best Management Practices

CZM 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 developed are applicable as 1) stand alone guidelines, 2) the basis for new dredged material disposal regulations, and 3) the basis for site management recommendations in the DMMP FEIR. 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.

CAD CONSTRUCTION/MANAGEMENT SEQUENCE

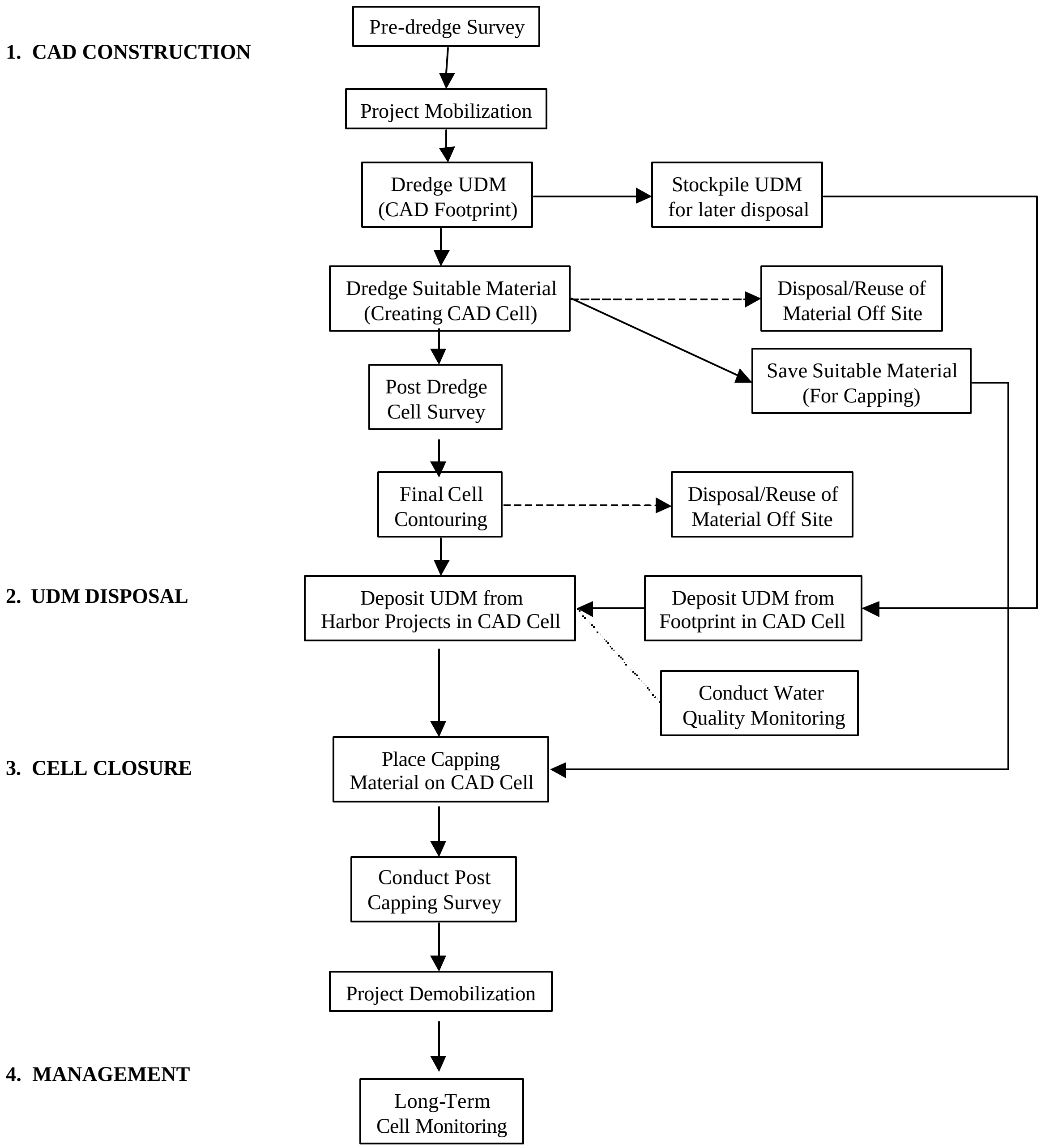


Figure 8-5: Aquatic Disposal Cell Construction Management Sequence

The proposed BMPs for confined aquatic disposal (CAD) of dredged material include a reference to the development of a Dredging Management Plan (DMP). A DMP is a detailed description of the dredging and disposal activities associated with the operation of a given project, i.e., the volume and quality of the material to be dredged, the equipment planned for use, and the overall schedule of operations.

Following the organization and content of the example will provide project proponents guidance in the development of consistent DMPs. This is important for a CAD cell that may accept dredged material from multiple smaller projects. The DMP should be included in the Environmental or Environmental Impact Statement for a given project, starting with the draft. It should be revised according to comments received during the review process. Following this approach will help assure that regulators have all the information needed to plan, approve, and manage the use of constructed CAD cell(s).

8.3.2 Sample Water Quality Certificate

CZM has also developed a model Water Quality Certificate (WQC) building upon the experiences of the BHNIP (Appendix M). This model WQC will be applicable to future CAD projects for UDM. The WQC includes provisions for baseline monitoring and monitoring both during and post construction. As with the Draft CAD BMPs, the model WQC has been developed with input and participation of applicable state and federal agencies. The model WQC provides a series of consideration points in developing projects involving dredging and the disposal of dredged material that is unsuitable for unconfined open water disposal at a CAD site. The consideration points presented in the model WQC are based on experience from the BHNIP and review of other related projects.

SECTION 9.0 - DISPOSAL SITE MANAGEMENT PLAN

9.0 DRAFT DISPOSAL SITE MANAGEMENT PLAN

The potential for negative impacts associated with the disposal of UDM requires ongoing monitoring and management to ensure the integrity of the environment in which the material is placed. This section describes monitoring and management measures to be implemented to confirm compliance with permit standards and long-term sequestering of UDM for the marine environments, to minimize any potential pollution pathways associated with the implementation of the preferred alternative disposal sites.

9.1 CAD SITE MONITORING

9.1.1 Monitoring Objectives

Evaluation of the environmental impacts of dredged material disposal in New Bedford/Fairhaven Harbor is best addressed through the use of a tiered monitoring strategy. With the exception of a few aquatic dredged material disposal monitoring programs including New England (DAMOS), Washington (PSDDA), and New York, most have suffered from a lack of clearly defined objectives, testable hypotheses, careful sampling design, statistical rigor, and conclusive results. The tiered monitoring approach is based upon addressing key questions and/or formal hypotheses at a series of predetermined levels to ensure compliance with objectives and permitting requirements. The decision criteria are used to create a framework for defensible management decisions and eliminate the tendency for a "shotgun" approach to data collection.

The tiered monitoring approach is dependent on rapid data return and analysis to identify and respond effectively to any detected changes in physical, chemical, or biological condition within the disposal site. The monitoring program will incorporate data at multiple temporal and spatial scales and of various media (e.g., video, photographs, maps); it is critical that these data be quickly integrated into digital and written products. Utilization of state-of-the-art decision-making tools such as Geographic Information Systems (GIS) will facilitate the rapid dissemination of spatially-explicit information for decision-making by resource managers.

The New Bedford/Fairhaven disposal site management/monitoring plan addresses both the engineering aspects of the disposal and capping operations and the environmental impacts of the project, through the following major objectives:

- Establish an environmental baseline prior to dredging and disposal of the dredged material,
- Establish acceptance guidelines for Water Quality Standards during dredging and disposal operations,
- Evaluate the short-term effects of disposal on benthic habitat quality and marine resources,
- Assess the engineering effectiveness and integrity of the CAD approach cap, and
- Evaluate the effectiveness of the confined disposal method and cap for preventing long-term impacts on biological resources.

Federal guidelines for laboratory testing of dredged material prior to its discharge in open water require that reference sediment be used as a basis for comparison. Reference sediment typically is collected in areas outside the influence of previous disposal operations at a dredged material disposal site, but near enough to the disposal site that the reference sediment is subjected to the same water quality and hydrodynamic influences. The laboratory test results for the proposed dredged material are compared to the reference sediment test results to evaluate the likelihood of adverse environmental impacts. Likewise, in environmental monitoring of dredged material disposal impacts in the field, results from reference areas are used in a comparative way to evaluate environmental impacts at the disposal site. Thus, use of reference sediment and/or reference areas is key to the evaluation of dredged material disposal impacts. The following information will provide the basis for the monitoring section of the management plan. These recommendations will be modified in response to the public and agency comments, and to accommodate additional site-specific data yet to be collected.

9.1.2 Baseline Studies

Although the dredged material disposal siting process in New Bedford/Fairhaven Harbor incorporated vast amounts of information about the physical and chemical properties of seawater and sediments at the proposed disposal sites, much of this information was either dated, spatially insufficient to provide site-specific details, or lacking temporal resolution. Collection of additional information prior to usage of the designated site is necessary before proceeding to dredging or disposal activities. The baseline study should include the collection of additional data to characterize existing (i.e., pre-disposal) conditions at the designated site, including current velocity, background suspended sediment concentration, and water quality. The measurement of several of the parameters will continue during dredging and disposal activities, but it is critical to characterize existing ambient conditions prior to the disturbance to provide a comparison with later measurements.

9.1.2.1 Wave, Current, and Tidal Measurement

Circulation patterns and sediment transport in New Bedford/Fairhaven Harbor have not been well characterized due to the limited number of oceanographic studies. In order to develop an understanding of the physical processes influencing the stability of sediments at disposal sites, monitoring of current flow dynamics using instrument deployments is required. The major objective of monitoring activities will be to acquire site-specific data on waves, near-bottom tidal currents, and sediment resuspension within the disposal site. In addition, vertical current profile measurements are necessary as input variables into computer models (i.e., STFATE and LTFATE) to predict the fate of dredged material during disposal operations. The collected data will be used to evaluate and predict the potential for dredged material resuspension and transport under typical conditions, as well as during storm events. Measurement of critical site-specific data may also help determine the potential for sediment resuspension as a result of propeller wash from passing vessels, surface waves, and storm events.

The suggested approach is to deploy a bottom-mounted instrument array from a surface vessel, to be left in place on the seafloor at a selected location within the disposal site. The use acoustic Doppler current profilers (ADCP) for several days during a maximum tidal phase (spring tides) will provide needed information characterizing local hydrodynamic conditions at the disposal site. It is suggested that one of the ADCPs be upward-looking to provide a profile of current speed and direction in the overlying water column. A second ADCP could be used to measure tidal current speed and direction within one meter of the bottom. The equipment can be deployed with no surface buoy and an acoustically released retrieval mechanism to reduce potential fouling with lobster trawls or anchor lines, although there is a low probability of disturbance to the instruments since fishing activity within New Bedford/Fairhaven Harbor is minimal.

Accurate measurement of tidal height is also necessary since it can be used as input to nearshore circulation and tidal current amplitude predictions. Presently all tidal measurements in New Bedford/Fairhaven Harbor are based on predicted estimates from the Woods Hole tidal gauge, the nearest permanent NOS/NOAA measurement station. More accurate tidal height measurements in New Bedford/Fairhaven Harbor are possible by deploying high resolution pressure sensors at one or more locations to provide vertical control and record tidal height measurements over a 28-day cycle. This information could then be used to predict the tidal component of currents and be correlated to long-term current data gathered from vertical profiles or bottom-mounted current measurements.

9.1.2.2 Water Quality Monitoring

To provide an accurate assessment of water quality impacts as a result of dredged material disposal, a detailed characterization of baseline conditions at the disposal site should be undertaken using a monitoring plan that conducts sampling at multiple time scales. The greatest potential change to background water column conditions is likely to occur during periods of high suspended sediment loads immediately following barge disposal. It is recommended that monitoring of water quality conditions be conducted at the time of disposal using both shipboard and stationary sampling instruments.

The data collected at the disposal site will also need to be compared with data collected at one or more nearby reference sites to determine if any detected changes are a result of localized or regional patterns. Water quality measurements should include vertical profiling of total suspended solids, dissolved oxygen, salinity, and temperature. These variables provide sufficient information to gauge the presence of low dissolved oxygen levels (hypoxia or anoxia), the development of a thermocline, and/or localized disturbances that may influence water quality.

9.1.3 Water Quality Standards

The development of water quality standards prior to dredging and disposal actives will provide target baseline conditions, which are not to be exceeded during operations. Failure to meet these standards will trigger mitigation responses to ensure that water quality conditions and marine resources within New Bedford/Fairhaven Harbor are not compromised. The following criteria are recommended:

> The boundary of the mixing zone for dredging and disposal of project sediments should be located 300 ft downcurrent from the operations. Both acute and chronic water quality criteria shall be met at the mixing zone boundary, with the acute criteria to be met at all times. Acute criteria are defined

as the one hour average concentration, which should not be exceeded more than once every three years on average. Chronic criteria are defined as the four day average concentration which should not be exceeded more than once every three years, except for the PCB chronic criterion which is a 24 hour limit of exposure.

Exceedence of the water quality criteria shall be attributed to operations when the sample concentration down current from the project operations exceeds the particular standard and the sample concentration is 30% higher than the reference sample. Real-time measurements of DO should be used to measure compliance and failure to meet the standards when there is a statistical difference at a 95% confidence interval between the mean of the reference sample and the mean of the down-current sample. If the samples exceed the water quality standard and this effect is attributed to project operations than repeat samples should be analyzed for TSS and the parameter(s) of concern within 24 hours.

If two consecutive water samples fail to meet acute water quality criteria the project operants can take the following actions to limit such exceedences: implement pre-approved contingency plan or cease all activities until a suitable alternative is provided.

If two consecutive water samples fail to meet acute water quality criteria than the following actions shall be implemented: work may continue if chronic bioassay tests are conducted within 24 hours or an approved mitigation effort is implemented.

In the event that compliance with the water quality standards is not maintained, the following bioassay and bioaccumulation tests are recommended:

Conduct bioassays to monitor disposal of dredged material. Collect water samples during first two days of monitoring, four to six hours after disposal 300 yards downcurrrent from the cell. Conduct two bioassay tests: sea urchin (*Arbacia punctulata*) fertilization and 7 day shrimp (*Mysidopsis bahia*) chronic endpoint studies to assess the biological effects of pollutants that may be present.

Conduct a bioaccumulation study to assess the long-term impacts of contaminants on blue mussels (*Mytilus edulis*). Deploy caged mussels for at least 60 days at mid water column depth 300 yards from the disposal cell. Analyze mussel tissues for the metals arsenic, cadmium, lead, mercury, and organics (PCBs and PAHs).

9.1.4 Monitoring of Short-term Water Quality Impacts

The proposed tiered approach to monitoring dredged material disposal impacts in New Bedford/Fairhaven Harbor has been summarized in a series of "decision tree" flow charts, which are presented and discussed in the following sections. Each flow chart is organized around a null hypothesis. Different "tiers" within the flow chart present a series of questions and "yes/no" decision points used to address this null hypothesis. Tier 1 generally represents the minimum or "routine" level of monitoring. If the monitoring at this level indicates an absence of adverse environmental impacts, then there typically is no need to take management action and proceed to higher levels (involving more extensive and costly monitoring). However, the decision tree is structured such that indications of adverse effects at lower levels will trigger management actions involving more thorough examination of the impacts at higher levels. The following sections refer to the decision tree flow chart shown in Figure 9-1, which is designed to test the following null hypothesis: "Dredging and disposal activities have no short-term impact on water quality."

9.1.4.1 Tier One: Acute and Chronic Water Quality Standards

Box 1.1: "Assess Water Quality in Mixing Zone"

The assessment of short-term (hours to days) water quality impacts from disposal activities will require standardized and frequent monitoring during disposal events. The Tier 1 monitoring activities shown in Figure 9-1 also are required to verify compliance to the water quality standards. There was an intensive water quality monitoring effort associated with the placement into CAD cells of material generated by the Boston Harbor dredging project. This experience showed that exceedances of water quality criteria during disposal operations were rare. The proposed plan for New Bedford/Fairhaven Harbor, therefore, incorporates the water quality monitoring deemed necessary to verify compliance while avoiding unnecessary data collection. The following standards are recommended:

- The mixing zone for disposal of project sediments should be located 300 ft downcurrent from the activity.
- To ensure that water quality standards are maintained, samples should be taken within the downcurrent turbidity maximum; use of instrumentation capable of real-time display of the plume extent is recommended. Use of a transmissometer can provide a depth profile of light transmittance or turbidity values. This instrument provides the capability to generate turbidity contour plots showing the areal extent and concentration.
- Suspended solids should not exceed 25mg/l over background levels at 25 m from the operation when ambient levels are lower than 100 mg/l.
- Turbidity should not exceed ambient levels by more than 30% at 25m from the operation.
- Plume samples should be taken at 0.5 and 1.0 hours, and four and six hours after the disposal at a location 300 feet downcurrent from the cell. Samples should be obtained from within 3 feet of the harbor bottom and from the mid-water column. These samples can either be combined or depth integrated. The first set of samples will be used to determine if acute criteria are met and the second set to determine whether chronic criteria are met.
- Acceptable locations for reference samples include a point 1000 ft upcurrent of the disposal cell, a point 300 ft downcurrent from the disposal cell prior to disposal, or some other pre-approved location.
- Water quality monitoring and analysis should be conducted during the first five days of disposal.

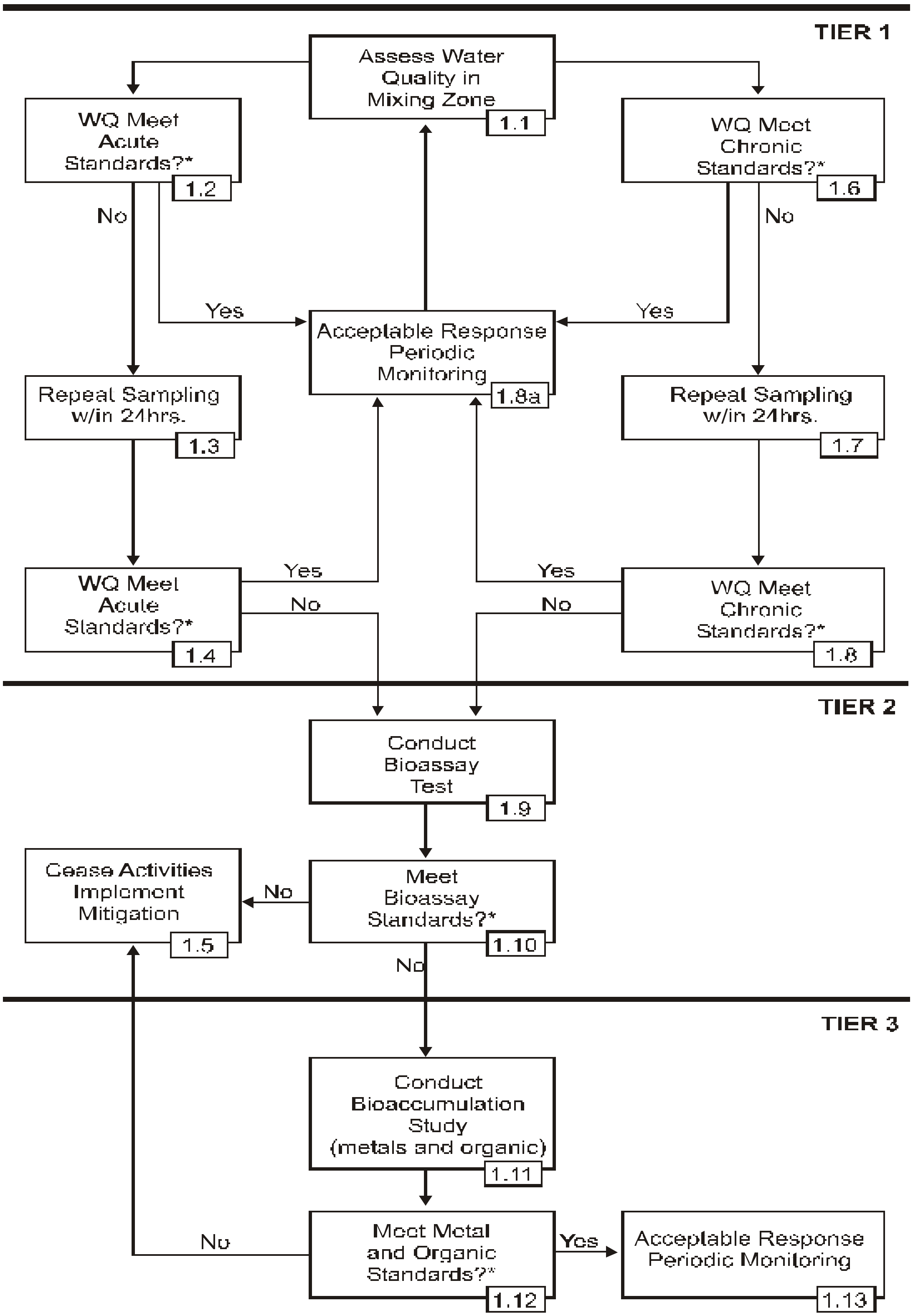


Figure 9-1: H_o1: Dredging or Disposal Activities have no Short-Term Impact on Water Quality.

Box 1.2 and Box 1.6 "Water Quality Conditions meet Acute and Chronic Standards"
Acute criteria are defined as the one hour average concentration which should not be exceeded more than once every three years on average. Acute criteria should be met within the mixing zone at all times. Chronic criteria are defined as the 4 day average concentration which should not be exceeded more than once every three years, except that the PCB chronic criterion is a 24 hr limit of exposure.

Box 1.3 and Box 1.7 "Repeat sampling within 24 hrs."
If samples fail to meet water quality standards, than repeat samples should be obtained within 24 hrs under similar conditions. The repeat samples should be analyzed for the parameter(s) of concern and TSS.

Box 1.4: "Water Quality Conditions meet Acute Standards"
If two consecutive water samples fail to meet the acute water quality criteria than either a pre-approved mitigation measure must be implemented or all disposal activities should cease within the effective area till further notice.

Box 1.8 : "Water Quality Conditions meet Chronic Standards"
If two consecutive water samples fail to meet chronic water quality criteria the following action should be implemented: work may continue if chronic biossay tests are conducted within 24 hours or mitigation controls are implemented.

9.1.4.2 Tier Two: Bioassay Testing

Box 1.9 "Conduct Bioassay Test"
Conduct sea urchin fertilization test and seven-day *Mysidopsis bathia* (shrimp) test according to EPA protocols for chronic endpoints. The results of the biological test should be considered as more significant than the water quality criteria in determining any operational mitigation measures to be required.

Box 1.10 "Meet Bioassay Standards"
Failure to meet Chronic bioassay standards will require all disposal activities to cease or implementing pre-approved mitigation controls

9.1.4.3 Tier Three: Bioaccumulation Testing

Box 1.11 "Conduct Bioaccumulation Study"
Should continued concern over water quality impacts result from the first two tiers, conduct a bioaccumulation study for the contaminants of concern by deploying caged blue mussels (*Mytilus edulis*) at mid-water column depth within approximately 1000 ft of the disposal area for at least 60 days.

Box 1.12 "Meet Metal and Organic Standards"
Failure to meet bioaccumulation standards will require all disposal activities to cease or implementing pre-approved mitigation controls.

Box 1.13 "Acceptable Response, Periodic Monitoring"
Meeting the bioaccumulation standards will be considered an acceptable response. Disposal can continue with periodic water quality monitoring during events.

9.1.5 Verify Successful Placement of Dredged Material and Cap Material

The following sections refer to the decision tree flow chart shown in Figure 9-2, which is designed to test the following null hypothesis: "Dredged material and cap material have been successfully placed according to design specifications."

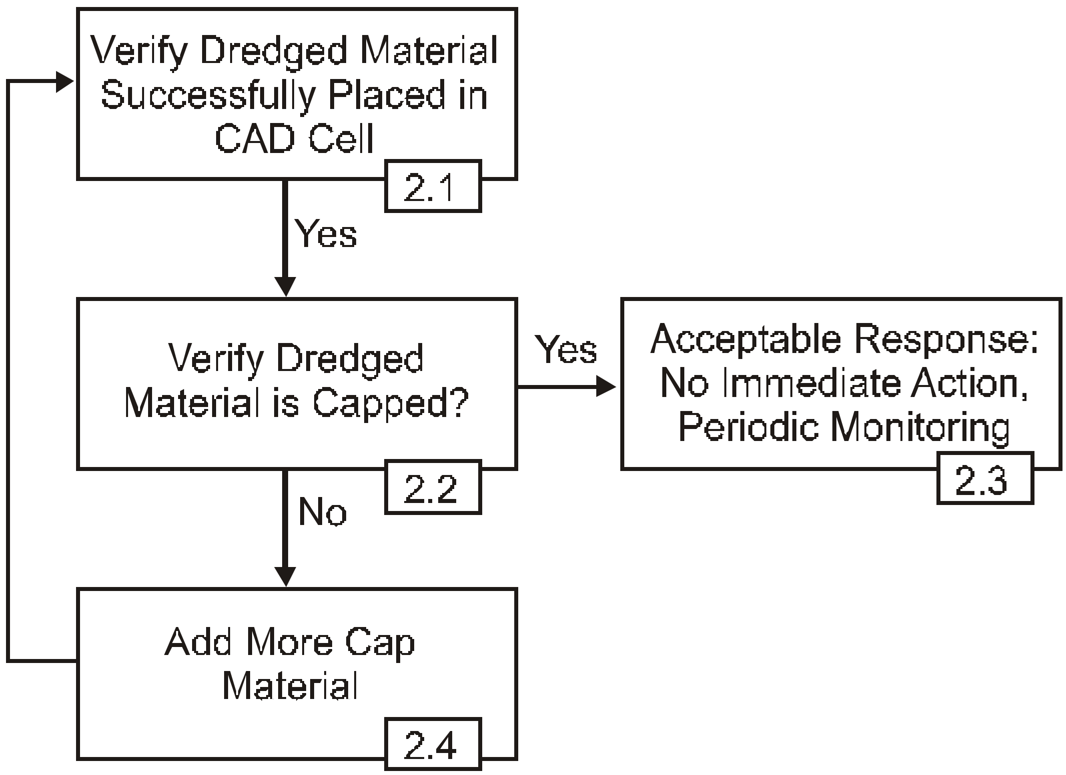


Figure 9-2: H_o2: Dredged material and cap material have been successfully placed according to design specifications.

9.1.5.1 Tier I: Operational Processes

Box 2.1 "Verify Dredged Material Successfully Placed"
Monitoring is required to verify that dredged material is placed accurately within a disposal site or CAD cell. The position of all vessels (e.g., barges, scows, dredges) used for placing material within a CAD cell must be controlled using a navigation system capable of achieving horizontal accuracy on the order of less than 10 m (e.g., differential GPS or microwave system). In addition, it is recommended that the position of all disposal vessels be recorded during loading at the dredging site, transit, and placement of the material at the disposal location using an automated "black box" surveillance system (e.g., ADISS system or equivalent). The combination of high-resolution navigation systems and automated surveillance of vessel position will help to ensure that material is placed accurately during the disposal operations.

Box 2.2 “Verify Placement of the Cap”

Similar to the dredged material placement operations, the position of all vessels (e.g., barges, scows, dredges) used for placing cap material within a CAD cell must be controlled using a navigation system capable of achieving horizontal accuracy on the order of less than 10 m (e.g., differential GPS or microwave system). Vessel position should be recorded using an automatic surveillance system. Following cap placement, physical monitoring is conducted to verify complete coverage of the dredged material. This evaluation typically involves conducting a high-resolution bathymetric survey in combination with sub-bottom profiling to verify depth of the cap material. Sediment cores might also be collected to measure cap thickness at individual points. A minimum average thickness of cap material should be specified (typically 1 meter), and the postcap monitoring should serve to verify whether or not this goal has been attained.

Box 2.4 “Add More Cap Material”

If the dredged material is insufficiently covered with capping material, further capping operations are necessary until the specified average cap thickness is achieved. Once the recapping has been completed, the disposal site should be re-surveyed to verify the cap thickness. If the cap thickness is found to be sufficient, no further operational monitoring is deemed necessary (Box 2.3).

9.1.6 Verify Isolation of Sediment Contaminants

The operational monitoring described above is used to verify successful placement of the cap according to design specifications. Additional monitoring is necessary to verify that the in-place cap is effective in isolating chemical contaminants known to occur at elevated levels in the underlying dredged material. The following sections refer to the decision tree flow chart shown in Figure 9-3, which is designed to test the following null hypothesis: "Capping has isolated sediment contaminants effectively."

9.1.6.1 Tier I: Surface Sediment Chemical Analysis

Box 3.1 “ Collect Surface Sediments for Chemical Analysis”

Sediments comprising the surface of the cap are collected using a grab sampler and analyzed for the chemical contaminants known to be present at elevated levels in the underlying dredged material. The chemical concentrations in the surface of the cap are compared to those found in nearby reference areas (Box 3.2). If the concentrations are not significantly higher than those in the reference areas, it is assumed that the cap is effectively isolating the contaminants. Chemical analysis of the surface sediments should occur at regular intervals to ensure continued effectiveness of the cap through time (Box 3.3). Significant elevations above reference values indicate possible migration of the chemicals through the cap. Such results would trigger Tier 2 monitoring involving further sampling to ascertain the source of the contamination.

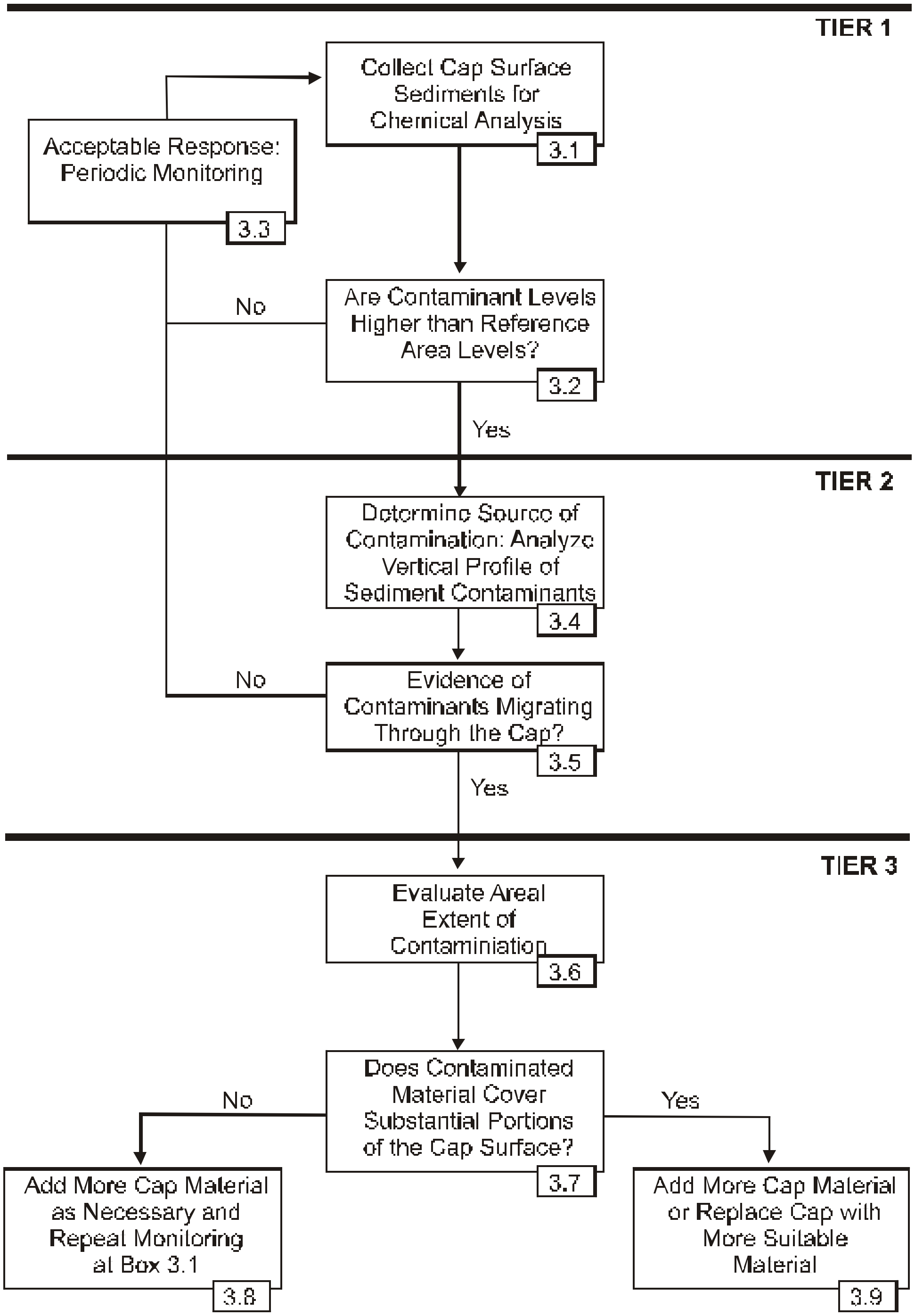


Figure 9-3: H_o3: Capping has Isolated Sediment Contaminants Effectively.

9.1.6.2 Tier II: Vertical Sediment Chemical Profiling

Box 3.4 "Determine Source of Contamination: Analyze Vertical Profile of Sediment Contaminants"
If there are contaminants present in the surface sediments of the cap at significant elevations above reference area levels, it is likely that the contaminated material has not been from sufficiently contained below the cap. Sediment core samples should be collected; these cores should be long enough to encompass both the cap material and the underlying dredged material. Chemical analysis of the sediment at discrete intervals within each core can be used to evaluate whether there are any vertical concentration gradients serving to implicate the underlying dredged material as the contaminant source.

Box 3.5 "Evidence of Contaminants Present Above the Cap?"
If the cores indicate there is contaminated material at the surface of the cell that originated from below the cap, it is possible that the cap not functioning as designed. The extent of the cap failure should be investigated further under Tier 3.

9.1.6.3 Tier III: Evaluate Extent of Cap Failure

Box 3.6: "Evaluate Areal Extent of Contamination"
Using the methods to establish cap presence (Figure 9-2) along with the coring data from above, the areal extent of the contaminated sediments should be measured to establish the areas most in need of additional cap material. Results from this study may indicate whether new material has been deposited on the site, an errant disposal event occurred, or large-scale failure of the cap occurred.

Box 3.7 "Does Contaminated Material Cover Substantial Portions of the Cap"
If the survey data collected above indicates that contaminated material has migrated through the cap in substantial portions of the disposal site, mitigation efforts are considered necessary to prevent further bioavailability of contaminants.

Boxes 3.8 and 3.9 "Add More Cap Material or Replace Cap with more Suitable Material"
The existing cap will need to be enhanced, based upon the identified origin of the cap failure. For example, the cap may need to be enhanced with sediment having a coarser grain size, which is less prone to erosion. It may also be necessary to increase the thickness of the cap material to provide a more effective barrier and greater insurance against future cap failures.

9.1.7 Long-term Impact on Biological Resources

9.1.7.1 Tier I: Benthic Recolonization of the Placed Material

The following sections refer to the decision tree flow chart shown in Figure 9-4, which is designed to test the following null hypothesis: "Dredging or disposal activities have no long-term adverse impacts on biological resources." Tier 1 of the flowchart addresses potential impacts to benthic infauna, while Tiers 2 and 3 address impacts to fisheries (Figure 9-4).

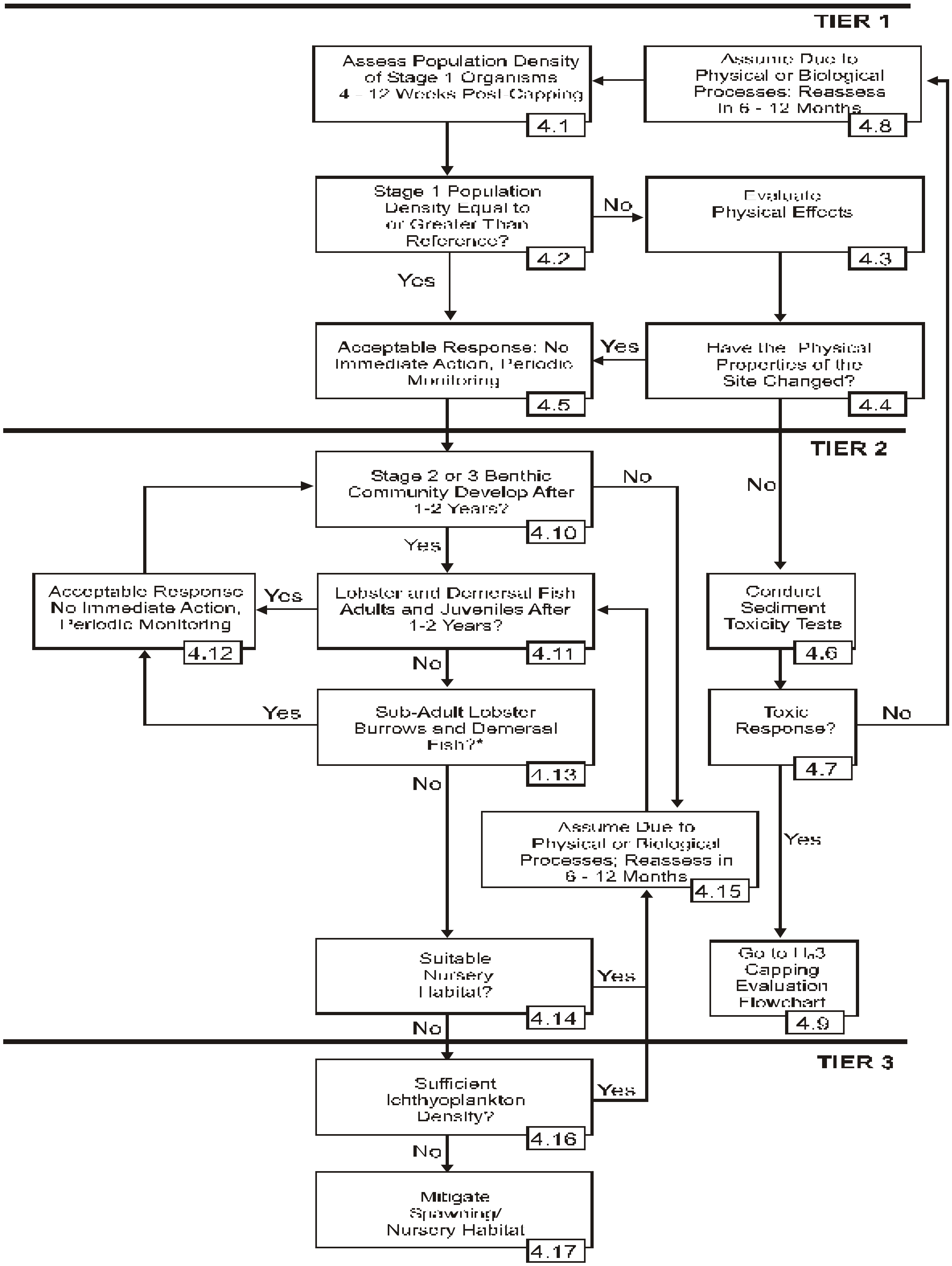


Figure 9-4: H_o4: Disposal/Capping Have No Long-Term Adverse Impacts on Biological Resources.

Box 4.1 : Assess Population Density of Stage 1 Organisms"

Uncontaminated, fine-grained sediment (e.g., dredged material or cap material) placed on the seafloor represents a clean, open substrate suitable for colonization by both adult and larval benthic organisms. Extensive past experience has demonstrated that benthic organisms colonize soft bottoms following a predictable pattern or successional sequence. Typically, the new sediment is populated first by an assemblage of pioneering or opportunistic species. This "Stage I" assemblage is usually comprised of small, tube-dwelling marine worms (polychaetes) which thrive at the sediment surface within days to weeks of material placement. With time (weeks to months), other benthic organisms which live at and a few centimeters below the surface begin to appear. This transitional, "Stage II" community may be comprised of small, shallow-dwelling bivalves and amphipods. Ultimately (months to years), the successional sequence leads to a "climax" or "equilibrium" community dominated by larger-bodied organisms which live and feed at depth within the sediment. This "Stage III" community is typically comprised of organisms which orient themselves in a head-down position and feed by ingesting the fine-grained sediment; these "deposit feeders" extract the organic matter and eject their waste (sediment and feces) at the sediment surface.

The feeding and burrowing activities of benthic infauna act to mix and thus enhance aeration of the sediment through a process called bioturbation. A mature, healthy soft-bottom benthic community typically is comprised of a diverse mixture of both surface-dwelling, Stage I and Stage II organisms and larger-bodied, deeper-dwelling Stage III organisms.

Since Stage I organisms are expected to be the initial colonizers of a newly-placed deposit of dredged material or cap material, Box 4.1 of Figure 9-4 involves assessing the population density of these organisms following the completion of capping operations. The Stage I population densities can be assessed through traditional grab sampling followed by taxonomic analysis of the benthic community, or by using a sediment-profile camera to obtain a vertical cross-section image of the sediment surface and associated organisms.

Box 4.2 "Stage 1 Population Density Equal to or Greater than Reference Area(s)"

The densities of surface-dwelling, Stage I polychaetes at the disposal site should be compared with densities at one or more reference stations located outside the designated boundaries of the disposal site. The selection of reference areas should include the following factors: similar sediment type as the disposal site cap, comparable water depths and water quality conditions, and a benthic and fisheries community structure similar to that at the disposal site prior to activities. Based on the standard benthic successional model for soft-bottom communities, it is expected that Stage 1 population densities at the disposal site will be equal to or higher than in the undisturbed reference areas within a few weeks of dredged material or cap material placement. If this condition is found, it indicates an acceptable response (Box 4.5). Monitoring at regular intervals (i.e., every 6 to 12 months) should continue to ascertain that the successional sequence proceeds to later, more advanced stages (see Tier 2).

Box 4.3 "Evaluate Physical Effects"

The detection of anomalous rates of colonization at the disposal site are typically attributed to physical or chemical properties of the dredged material or cap material.

Box 4.4 “Have the Physical Properties of the Site Changed?”
Sediment erosion and scour or differences in sediment material may cause anomalous recruitment patterns at the disposal site that may disrupt larval colonization.

Box 4.5 “Acceptable Response: No Immediate Action Necessary, Periodic Monitoring”
If the anomalous recolonization is due to a physical event, no immediate mitigation is warranted.

9.1.7.2 Tier II: Recovered Adult and Juvenile Marine Resources

Box 4.6 “Conduct Toxicity Tests”
If the anomalous recolonization pattern is not due to a physical event, testing of the sediment using the 10-day amphipod test is recommended to determine whether the anomaly is due to sediment toxicity (Box 4.7).

Box 4.8 “Assume Due to Physical or Biological Processes”
If the toxicity test shows an absence of sediment toxicity, the anomalous benthic results are most likely due to natural environmental conditions. The Stage I benthic recolonization status should be re-assessed in 6 to 12 months.

Box 4.9 “ Go to $H_0$3 Disposal Evaluation Flowchart (Figure 9-3)”
If the toxicity test shows a toxic response, there may be a problem with the containment of the contaminated dredged material. The H_o3 (Effective Sediment Isolation) Flow Chart must be re-visited.

Box 4.10 “Stage 2 or 3 Benthic Community Develops after 1 Year”
As previously indicated, experience has shown that benthic succession on newly placed dredged material or cap material will result in the establishment of a more mature (i.e., Stage 2 or 3) benthic community within 1 to 2 years. Using either traditional grab sampling and taxonomic analysis or sediment-profile imaging, the benthic community can be compared to the reference area to evaluate longer-term recovery.

Box 4.11 “Lobster and Demersal Fish Adults and Juveniles after 1 Year”
Disposal activities are usually scheduled during winter and early-spring to avoid impacts to reproduction and recruitment dynamics of marine and invertebrate species. Establishment of a healthy, mature (i.e., Stage III) benthic community traditionally has been used as an indicator of acceptable recovery following dredged material or cap placement. Direct sampling of the fisheries at the disposal site also can be used to evaluate potential long-term impact. These data need to be collected over several seasons and analyzed with caution due to the temporally and spatially variable nature of fisheries data.

Box 4.12 “Acceptable Response: No Immediate Action, Periodic Monitoring”
The presence of both an advanced benthic community (Stages 2 and/or 3), as well as benthic fisheries (demersal fish and commercially valuable crustaceans like lobster) would suggest no long-term adverse impact from the disposal or cap placement activities.

Box 4.13 "Sub-adult Lobster Burrows and Juvenile Fish"

If the lobster and demersal fisheries data show a paucity of numbers, additional information on different life stages of these species can be collected.

Box 4.14 "Suitable Nursery Habitat"

The lack of juvenile fish might indicate that the habitat at the disposal site is no longer productive as a fisheries resource. This information would trigger more evaluation in Tier 3.

Box 4.15 "Assume Due to Physical or Biological Processes"

If the juvenile fish data indicate acceptable nursery habitat, the lack of both adult and juvenile fisheries at the site may be due to natural environmental processes, and additional data should be collected within a year, potentially during a different sampling season.

9.1.7.3 Tier III: Recovered Spawning and Nursery Habitat for Marine Resources

Box 4.16 "Sufficient Icthyoplankton Density"

An icthyoplankton survey would help to evaluate the suitability of the disposal site as an acceptable spawning and nursery habitat for benthic fisheries.

Box 4.17 "Mitigate Spawning/Nursery Habitat"

If all of the data collected indicate that the disposal site, as compared to reference, has been negatively impacted by the dredging and disposal operations, a mitigation plan should be implemented. The anomolous fisheries results may be indicating that the underlying contaminated dredged material has not been isolated effectively, and the site may need to be reassessed relative to the contaminant isolation flowchart (Figure 9-3).

9.1.8 Description of Monitoring Techniques

This section provides brief descriptions of various surveying and sampling techniques commonly used to address marine environmental monitoring objectives and explains how each can be utilized to address specific questions associated with the disposal of dredged material in coastal embayments.

9.1.8.1 Disposal Tracking

Verification of the location and timing of dredged material or cap placement is a critical component of monitoring efforts. One approach involves the use of an automated vessel tracking system. Available systems provide fully automated tracking of disposal scow positions and draft level information using highly accurate differential GPS and pressure sensors during the loading, transit, and disposal phases of dredging operations. The disposal tracking equipment consists of an electronic box, battery, and antennas that can be easily installed onto one or more disposal scows. The instrumentation records the trackline of the scow navigation path, position of the released dredged material based on changes in vertical measurement of the scows position, and uplinks the data via ARGOS satellite for easy retrieval.

These data can then be automatically updated and displayed via the internet using a Geographic Information System. By recording the precise locations and timing of disposal positions when placing dredged and cap material, vessel tracking data can greatly increase the accuracy of cap material placement.

9.1.8.2 Sediment-Profile Imaging

Sediment-profile imaging is a benthic sampling technique in which a specialized camera is used to obtain vertical cross-section photographs (profiles) of the upper 15 to 20 cm of the seafloor. It is a reconnaissance survey technique used for rapid collection, interpretation and mapping of data on physical and biological seafloor characteristics; it has been employed in estuarine, coastal and deep-sea environments worldwide for almost 20 years. Measurements obtained from sediment-profile images are used to characterize sediment types, evaluate benthic habitat quality, map disturbance gradients, and follow ecosystem recovery after disturbance abatement. This technique was first introduced under the name REMOTS® (REmote Ecological Monitoring Of The Seafloor), a registered trademark of Science Applications International Corporation (SAIC). REMOTS® is a formal and standardized technique for sediment-profile imaging and analysis (Rhoads and Germano 1982; 1986). In generic terms, this sampling technique is called sediment-profile imaging (SPI) or sediment vertical profile imaging (SVPI).

The SPI hardware consists of a wedge-shaped optical prism having a camera (sensor) mounted horizontally above in a watertight housing. The prism is shaped like an inverted periscope, with a clear Plexiglas window and an internal mirror mounted at a 45° angle to reflect the image in the window up to the camera. The entire assembly is lowered to the bottom using a standard winch mounted aboard the survey vessel. Upon contact with the bottom, the prism descends slowly into the seabed, cuts a vertical cross-section profile of the upper 15 to 20 cm of the seabed, and a photo is taken. The camera normally is raised and lowered multiple times at each sampling station to obtain replicate images. Because the photographed sediment is directly in contact with the prism window and light is provided by an internal strobe, turbidity of the ambient seawater is never a limiting factor. Typically, 100 to 200 images can be obtained in a single survey day (i.e., three replicate images obtained at roughly 30 to 70 stations).

In the laboratory, a suite of physical and biological parameters are measured directly from the film negatives using a video digitizer and computer image analysis system. The measured parameters include sediment grain-size major mode and range, prism penetration depth (a relative measure of sediment shear strength), boundary roughness as measured from small-scale topographic relief (e.g., ripples, fecal mounds), depth of the apparent redox potential discontinuity (RPD), surface mud clast number and diameter, thickness of dredged material or other depositional layers, linear density of tubicolous fauna at the sediment-water interface, depth and number of subsurface feeding void structures, and designation of infaunal successional stage. Complete image analysis, interpretation, mapping and reporting can be accomplished within 1 to 4 weeks, depending on the size of the survey.

Sediment-profile imaging has proven to be an effective tool for addressing the monitoring objectives of several dredged material disposal projects (SAIC 1998). The information on physical sediment characteristics and biological activity has been useful for assessing benthic habitat quality both prior to and following disposal and capping operations. Sediment-profile imaging has also facilitated monitoring of the recolonization of capped dredged material mounds by benthic organisms following cap placement. In addition, sediment-profile imaging can be used to detect and map depositional layers of disposed project material occurring on the mound apron in layers too thin to be detected using high-resolution bathymetric techniques. For example, information on the disposal mound "footprint" was used to ensure that dioxin-contaminated dredged material was covered with clean capping material and thus isolated from the overlying water column at the New York Mud Dump Site (SAIC 1998).

9.1.8.3 Subbottom Profiling

Subbottom seismic profiling is a standard technique for determining changes in acoustic impedance below the sediment-water interface. In a seismic profiling survey, the vessel is driven over the seafloor along consecutive lanes in a manner similar to that used for bathymetric surveys. Penetration of sound in sediment is both a function of system frequency and the impedance contrast between the water column and sediment. In general, sound penetrates further into fine-grained sediment because the impedance of silt and clay with a high water content is closer to that of the water column. Sediments having different geotechnical characteristics (i.e. bulk density) will have distinct acoustic impedance, and therefore sound will reflect from the boundary between layers of sediment having different densities. The digital information collected via subbottom sampling can be used to identify depth to bedrock, and therefore potential containment capacity of a CAD cell, and for verifying the thickness and distribution of cap material in a CAD cell or on the open seafloor.

9.1.8.4 Geotechnical and Chemical Analysis of Sediment Cores

Geotechnical surveys are generally performed as part of a dredged material monitoring program to obtain sediment core samples at stations located on and around the disposal site. Vibracorer systems (which employ a motor to "vibrate" the core into the sediment) are used for sediment core analysis because they are capable of obtaining long, relatively undisturbed cores from coarser-grained sand caps, while conventional gravity corers (which rely on weight alone to push into the sediment) are incapable of penetrating to the desired depths. The cores provided a vertical section of both the sand cap and the underlying, fine-grained dredged material at a single location. Visual observations and geotechnical analyses of these vertical sections enable assessments to be made of sand cap thickness and stability through time, while chemical analyses enable a determination of cap effectiveness in isolating underlying contaminants.

9.1.8.5 Macrobenthic Analysis

Although the overall response of benthic infaunal populations to disposal activities can be assessed using sediment-profile imaging, ground-truthing of the images and more detailed information about benthic community structure including dominant species, diversity, and population density and abundance is primarily obtained through traditional benthic sampling and taxonomic identification of invertebrates. Grab samples are typically collected and analysed when assessing soft bottom infaunal communities.

Laboratory analysis consists of sample transfer to alcohol, Rose Bengal staining, and sorting to major taxonomic groups (e.g,. crustaceans, polychaetes, mollusks, nemerteans). Following initial sorting procedures, each organism is counted and identified to the lowest practical taxon (typically to the species level) by taxonomic specialists. Taxonomic data can be loaded into a database and evaluated using a variety of statistical procedures (e.g., Analysis of Variance and multivariate techniques such as principal component analysis and clustering) to quantify the relative similarity of benthic infaunal populations among the stations sampled. Summary information derived for each station from macrobenthic analyses may include estimates of: 1) mean number of individuals; 2) total number of individuals; 3) total number of taxa; 4) species diversity; 5) dominance; 6) species richness; and 7) species evenness.

9.1.8.6 Fisheries Assessment

A number of organizations have conducted assessments of seasonal fisheries distribution, abundance, and species composition in coastal Massachusetts using a variety of techniques and gear types, including boat trawls, beach seining, and diver transects. Shellfish resources have been mapped by delineating information provided by Commonwealth resource managers, digitizing data shown in the Massachusetts Monograph series, and interpreting video transect data.

Despite these efforts, continued monitoring is necessary to further define the pre-disposal (i.e., baseline) abundance of marine resources, estimate the magnitude and rate of reuse by non-benthic species, and assess the success of mitigation efforts. Effort is necessary to elucidate the relationship between physical conditions (i.e. sediment type, flow conditions, water quality) and marine resources at proposed disposal sites, to estimate the potential long-term consequences of permanent disturbance to the habitat from dredged material and cap material placement. This objective is best met by more intense but continued use of methods which have been successful to date such as diver transects and lobster early benthic phase suction sampling. Sampling techniques such as visual observations, benthic grabs, patent tonging, or raking can also be used to better estimate the presence and density of ecologically important bivalve species at disposal sites. This information should then be transcribed to cartographic products to provide a spatially-explicit record of shellfish and their abundance.

Post-capping sampling efforts are best addressed using a mixture of collection techniques for targeting demersal and pelagic species. These include use of otter trawls for capturing lobster and demersal species and experimental gill nets to sample pelagic fish species of various sizes. In waters less then 20 m, i*n situ* observation using video or 35 mm photographic images from a drop camera may also be utilized to estimate lobster size-class distributions or burrow densities. Shellfish colonization plates can be deployed at strategic positions in the water column to assess recruitment and attachment of larval forms of bivalves like blue mussels or eastern oysters. Further information about impacts (positive and negative) to commercial and recreational activities can be obtained from on-site interviews with local fishermen, bait shops, and resource managers, as well as conducting visual assessment of any commercial fishing activity and/or lobster pot distributions. Continuous contact with lobstermen and local fishing clubs or organizations can aid in identifying timeframes and locations of greatest activity, as well as provide a review of any proposed dredging "windows" (i.e. months in which dredging and disposal should be limited due to the presence of spawning or nursery activity).

9.2 AQUATIC DISPOSAL MANAGEMENT OPTIONS

As part the DMMP process, management examples within the state and throughout the country were investigated including the Cape Cod Disposal Site, NY/NJ Port Authority, and Barnstable County Dredge Program, to serve as potential models to be applied. The two most relevant approaches are discussed below.

9.2.1 State Managed Site

At the conclusion of the MEPA process and the designation of the Preferred Alternative, the state would own the site as Commonwealth Tidelands. Massachusetts Department of Environmental Management (DEM) would manage the operation of the aquatic disposal site in New Bedford/Fairhaven Harbor based upon a plan approved by MEPA and subject to recommendations of a technical advisory committee. This agency has a long history of managing state owned waterfront properties, such as state fish/cargo piers, and maintenance of waterways, including dredging state channels, harbors and berthing areas.

As the disposal site manager, DEM would officially obtain site designation by securing permits from DEP and USACE; announce the availability of the disposal site to public and private users; levy any fees for use; have legal authority to manage liability; oversee disposal activities; and monitor short and long term impacts and environmental conditions of the disposal site environs. DEM would also publish operating specifications to ensure that contractors meet disposal and capping specifications.

9.2.2 City/Town Managed Site

To establish a City managed site, an application would be filed by the City to use the disposal site designated by the MEPA process. The City managed site would be subject to a MEPA approved management plan. The City would license the facility under Chapter 91, assuming all management responsibilities. The City would be responsible for permit compliance, legal agreements with contractors using the sites, establishing disposal rates long-term monitoring and remediation if necessary.

Under this option, an agency of the City of New Bedford and/or Town of Fairhaven, or an existing or created semi-public authority would manage the disposal site. The agency would levy fees for use and manage liability much like that of a municipal landfill. The City would establish a revolving or enterprise fund to manage the long-term operation of the facility. New Bedford and/or Fairhaven would be responsible for program implementation, operation, and monitoring.

9.3 SUMMARY

CZM will develop, implement and monitor a detailed Disposal Site Management Plan for the final preferred alternative pursued in the FEIR. This plan will identify the site specific measures necessary to minimize potential negative impacts to the environment associated with implementing the final preferred alternative. The plan will include the monitoring measures discussed in this section. The plan will also establish the environmental baseline upon which performance of the site will be gauged. The Disposal Site Management Plan will also include triggers for appropriate actions to be taken if criteria are exceeded.

SECTION 10.0 - DRAFT SECTION 61 FINDINGS

10.0 PROPOSED SECTION 61 FINDINGS

This section of the DEIR presents the Proposed Section 61 Findings for the New Bedford/Fairhaven Harbor DMMP, as required under the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.12. Section 11.07 of the MEPA regulations require that the proposed Section 61 Findings be included in the DEIR for a project. As a state agency, CZM is bound by the statutory requirement under MEPA to take all feasible measures to avoid or minimize damage to the environment. This section presents draft Section 61 Findings for the preferred alternative for New Bedford/Fairhaven Harbor.

10.1 Aquatic Sites - Channel Inner and Popes Island North

Potential environmental impacts associated with selection of the preferred alternative aquatic disposal sites in New Bedford/Fairhaven Harbor (Channel Inner and Popes Island North) include those associated with sediments and water quality, benthos, finfish, wetlands, wildlife, endangered species, navigation and shipping, land use, air quality and noise, historic and archaeological resources and recreation areas.

10.1.1 Sediments and Water Quality

Construction of disposal cells and dredged material disposal activities at the preferred alternative sites will lead to temporary impacts to the existing sedimentary environment at the site, including mortality of existing benthic organisms and the alteration of existing sediment composition. Analysis of sediment profile imaging data was gathered from the vicinity of the preferred aquatic disposal sites indicates that the existing benthic habitat quality exhibits characteristics indicative of minimal to moderate impact from existing harbor conditions. Existing benthic conditions include sediment aeration depths sufficient to support epifaunal and infaunal macro benthic organisms. The depth of aeration may be from adequate, tidal flushing, bioturbation by deposit feeding (Stage III) infauna, or a combination of both factors.

Placement of a final sand cap over the disposed dredged material will allow re-colonization to occur, although at a slow rate, as the organisms present at the site prefer finer grained sediments. Changes in species composition may result in the sand cap. As finer grained harbor sediments within the water column settle on the final sand cap over time, the benthic species composition at the site is likely to approach the composition of other nearby areas of the harbor.

The location of the proposed disposal sites within the Inner Harbor, above the Hurricane Barrier, minimizes potential storm-induced wave action impacts, minimizing the impacts to water quality from the resuspension of cap sediments. Also, the depth of the disposal sites, with a final cap elevations no higher than the ambient elevation, will also minimize any sediment resuspension at the site. The placement of coarse-grained sand as a final cap will also minimize sediment resuspension at the preferred alternative sites.

10.1.2 Benthos

Benthic resources include marine epifauna and infaunal invertebrates, and submerged aquatic vegetation. As described above, the community structure of benthic organisms is typically a function of sediment characteristics and water quality (Day, et. al., 1989). Dredging and disposal of sediment may impact benthic marine organisms by altering preferred microhabitat (i.e. sediment composition) or via interference with the organism's feeding type. Therefore, impacts to benthic epifauna and infaunal sessile invertebrates such as various bivalve mollusks and echinoderms are expected. The area of the disposal sites are closed to shellfishing. Motile invertebrates such as various crustacea can avoid impact areas. However, they may have sedentary stages of their life cycle that could make them more susceptible to dredging and disposal of sediment. For instance, lobsters enter an early benthic phase of their life cycle following their planktonic larval stage. However, juvenile and adult lobsters are highly mobile, and these forms are likely able to avoid dredging and disposal impacts. The timing of disposal cell construction and dredged material disposal after maintenance dredging of the area will limit the number of juvenile or adult lobsters impacted. Additionally, there were no eelgrass beds identified in the area of the proposed disposal site. The closest eelgrass area are located outside of the Hurricane Barrier.

10.1.3 Finfish

Construction and disposal activities at the preferred alternative sites will have little impact on existing fisheries resources. Commercial fishing within the Inner Harbor is prohibited. Loss of lobstering ground would occur as the cells are excavated and filled, however lobster fishing in this area is also prohibited. Lobster recolonization via emigration from surrounding areas is expected. Most of the important recreational sport fishing species in the harbor are neritic or pelagic and are able to easily avoid dredged cell construction and dredged material disposal activities. Many sport fish species, including cod, striped bass and tautog frequent areas proximal to submerged structures such as rocky ledges and reefs in the harbor, rather than the muddy and relatively featureless conditions at the disposal sites. However, winter flounder, an important recreational species in the area that frequents neritic waters, are bottom spawners. Larvae live as pelagic forms but return to estuaries to live as demersal adults. Timing of cell construction and dredged material disposal activities to avoid the spawning and egg development cycle of demersal fish will avoid impacts to these resources.

10.1.4 Wetlands

There would be no impacts to coastal wetlands or salt marsh. The entire area of the preferred disposal sites are sub-tidal, therefore, no coastal wetlands exist there. The sites are, however, classified as Land Under the Ocean within a DPA under the Massachusetts Wetlands Regulations at 310 CMR 10.26. Under the regulations, a project impacting Land Under the Ocean in a DPA must minimize adverse impacts to water circulation and water quality, including fluctuations in dissolved oxygen, temperature or turbidity, or the addition of pollutants. As discussed in the preceding section on water quality impacts, no adverse long term impacts to water quality are expected from construction and dredged material disposal activities at the sites. Likewise, the impacts to water circulation are described in the preceding section. No adverse impacts are expected.

10.1.5 Wildlife

Wildlife impacts assessed included those to avifauna, marine mammals, and marine reptiles. No shorebird breeding or foraging habitat is located within the confines of the disposal site, since these areas are generally intertidal or supratidal areas. Shorebird habitat in New Bedford/Fairhaven harbor lies outside of the UDM disposal zone of influence. The nature of the disturbance (sub-tidal) dictates that impacts to nesting habitat would not occur. Since finfish will leave the area to avoid dredging and disposal impacts, piscivorous waterfowl will also avoid the impact areas as they follow departing finfish concentrations. Molluscivorous waterfowl tend to congregate in areas with high mollusk density such as the vicinity of shellfish beds and reefs. Since shellfish beds lie within the vicinity of the disposal areas or within the zones of UDM disposal influence, minimal, temporary impacts to molluscivorous waterfowl is expected.

The various species of whales and other cetaceans found in the region, occur far offshore of New Bedford/Fairhaven, rarely, if ever, entering harbor waters. Therefore, the only marine mammal species commonly found in New Bedford/Fairhaven Harbor is the harbor seal, which frequent shorefront areas, not the deep water and muddy bottom conditions of the disposal site. The harbor seal is also highly mobile, and quite able to avoid cell construction and dredged material disposal events. Therefore, no impacts to marine mammals are expected.

Marine reptiles in the region are represented by sea turtles. Two species of marine turtles that occur in the North Atlantic are not commonly found in New Bedford/Fairhaven Harbor. They occur in the much deeper open ocean waters off New Bedford/Fairhaven and the north Atlantic Ocean and rarely, if ever, enter New Bedford/Fairhaven Harbor. The distance from the disposal site to the sea turtle habitat will preclude any impact to these species or their habitat from either cell construction or dredged material disposal activities.

10.1.6 Endangered Species

Although five whale and two sea turtle species listed by the USFWS occur in the ocean waters off of New Bedford/Fairhaven, there is no indication that these species occur at the disposal sites within the harbor. Therefore, no impacts to endangered species habitat from construction and dredged material disposal activities will occur.

10.1.7 Navigation and Shipping

New Bedford/Fairhaven Harbor has developed into the one of the regions leading fishing ports. The harvesting, processing and supporting industry to the fishing industry in New Bedford/Fairhaven is directly linked to the ability of vessels to navigate within the Harbor in a safe fashion. Continued access to shore-side locations is an integral component of the Harbor Plan's vision of maintaining and expanding existing maritime, industrial and visitor harbor uses, to continue the Harbor as a working, productive port and economic asset for the City, Town and Commonwealth. Disposal cell construction and dredged material disposal activities will be scheduled to avoid vessel movements, avoiding temporary impacts to existing navigation and shipping. The depth of the final cap elevation at the disposal sites with portions within the channel, will be below the existing authorized depth, and the portion of the cells outside of the navigation channel will be restored to ambient depths. Therefore, there will be no permanent impacts to existing navigation and shipping in New Bedford/Fairhaven Harbor.

10.1.8 Land Use

The proposed CAD disposal sites are entirely within subtidal waters, therefore there would be no direct impacts to existing shore front land use patterns surrounding New Bedford/Fairhaven Harbor. Being located entirely under water, the CAD disposal sites are not visible from land. Positive indirect impacts will result from the construction and use of the CAD disposal site. The presence of the disposal sites will allow for the environmentally sound, cost effective disposal of UDM from New Bedford/Fairhaven Harbor dredging projects, maintaining the economic viability of existing marine facilities and existing land use patterns along the New Bedford/Fairhaven Harbor shoreline.

Construction and use of all the proposed aquatic disposal sites are consistent with the stated goals of the New Bedford/Fairhaven Harbor Plan. As noted on the preceding paragraph, the presence of the disposal sites will encourage the completion of the anticipated public and private dredging projects in New Bedford/Fairhaven Harbor and provide a local disposal option for the UDM from those dredging projects. The New Bedford/Fairhaven Harbor Plan also encourages the coordination with the DMMP to develop a suitable alternative for disposal of UDM.

10.1.9 Air Quality and Noise

Air quality and noise impacts from construction and use of the disposal site in New Bedford/Fairhaven Harbor are expected to be temporary and minor in nature. Impacts will result from the heavy construction equipment used to construct the disposal site and to conduct dredged material disposal activities.

Air quality impacts will be minimized through the use of equipment that complies with emission standards applicable to equipment, use of proper emission controls, and the temporary nature of the activity. Temporary stockpiling on or near land of dredged material may result in minor air quality and odor impacts to adjacent properties due to anaerobic decomposition of organic materials in the dredged sediment. These odors will be minimized with the use of lime as necessary. Volatilization of organic compounds in the stockpiled dredged material is not expected to occur because the short duration of stockpiling activities will not allow for complete drying of the dredged material.

Unavoidable noise impacts are also expected to be temporary, localized and minor. Also minimizing adverse noise impacts will be the use of properly mufflered construction and dredging equipment, the temporary duration of the noise-producing activities and limiting activity to daylight hours.

10.1.10 Historic and Archaeological Resources

The location of the proposed disposal site within the subtidal area of New Bedford/Fairhaven Harbor avoids direct and indirect impacts to nearby land-based local-, state- and federal-listed historic sites and districts.

New Bedford/Fairhaven Harbor has a long and rich maritime history and is an area of archaeological sensitivity. However, the portions of the proposed disposal sites located within the confines of the existing federal navigation channel, have been previously disturbed by past dredging activities that deepened the area. This deepening of the area has likely destroyed any underwater archaeological resources at the site. Therefore, no impacts to underwater archaeological resources are expected in these areas.

Portions of the preferred disposal sites are within the federal channel and in areas that have not been previously dredged. These areas have the potential to contain underwater shipwrecks, although no known shipwrecks occur in this area. Nevertheless, detailed underwater archeological surveys will be conducted for all areas of the preferred alternative explored in the FEIR.

10.1.11 Recreation Areas

The CAD sites will not pose direct impacts to existing recreation areas from the construction or use of the proposed disposal sites. The Inner Harbor is closed to fishing an swimming, minimizing the potential for recreational conflict associated with Channel Inner and Popes Island North sites. Popes Island North construction could impact movement of small draft recreational boats that may use this area currently. Potential recreational boating conflicts associated with the construction of the CAD disposal sites will be mitigated by clearly delineating the work area and issuing boating advisories. This temporary impact is minimized by the presence of other recreational boating opportunities areas in the Outer Harbor area and beyond.

10.2 Implementation of Mitigation Measures and Proposed Mitigation Implementation Schedule

Prior to the commencement of dredging projects, the construction of the CAD disposal cells need to be completed. Dredging of the disposal cells will be completed during an environmentally favorable window to reduce the disturbance to marine life. Dredge limits and locations will be located by GPS Geodetic Positioning System, which is a satellite positioning system, accurate to within a foot of the intended horizontal design limits. The dredge machinery will most likely be a large barge mounted crane with a clamshell bucket. Bucket size will likely be in excess of ten cubic yards. The material will be removed to the intended depth and side slopes. The Dredging contractor will also be compensated for an allowable over-dredge limit to ensure that the intended depths are achieved. The material is removed by a bucket and deposited within a transport barge called a scow. The scow will deliver the material to CCDS or MBDS where it is positioned prior to dumping using GPS. A bottom dumping or split hull scow will most likely be used. These barges open from the bottom allowing the material to drop out through the water column to the sea floor below. This material is clean and will therefore not need to be capped.

Following the completion of each disposal cell, the dredging of UDM from the harbor will completed by mechanical means, using siltation curtains to minimize turbidity impacts. After being dredged, the UDM will be placed on a dump scow and transported to the disposal cell, where the material will be deposited. After the completion of all UDM disposal the CAD cell would be capped, for long-term water quality protection and benthic recolonization would occur.

Potential mitigation for direct impacts will be determined during the permitting process through consultation with the appropriate agencies. The party responsible for the implementation of the required mitigation measures has not been identified to date. Potential entities include the Massachusetts Department of Environmental Management, the US Army Corps of Engineers, or the City of New Bedford/Fairhaven operating through an existing or created public authority.

10.3 Draft Section 61 Finding

With the selection of the two preferred alternatives for UDM disposal from New Bedford/Fairhaven Harbor, CZM finds that, with implementation of the mitigation measures listed above, all feasible means have been taken to avoid or minimize damage to the environment.

SECTION 11.0 - RESPONSE TO COMMENTS

11.0 RESPONSE TO COMMENTS

This section of the DEIR provides individual responses to the public and agency comments received on the Environmental Notification Form (ENF) for the New Bedford/Fairhaven Harbor DMMP. In this section, each comment letter is addressed in a specific subsection, with individual comments listed, followed by a response to the comment. Letters are addressed in the order in which they are listed in the MEPA ENF Certificate of June 30, 1998.

Comments are presented in italicized text for ease in distinguishing between comments and responses. Where appropriate, the response may direct the commentator to the specific sections of the DEIR where the comments are answered. The Certificate of the Secretary of Environmental Affairs is included in the front matter of this report, copies of the original comment letters are included in Appendix A.

11.1 Certificate of the Secretary of Environmental Affairs on the Environmental Notification Form

Comment: *Project Description, Purpose and Need*

The EIR should contain a full description of the project that includes a description of the purpose and need for the DMMP in New Bedford/Fairhaven Harbor.

Response: A full description of the New Bedford/Fairhaven Harbor DMMP is included in Section 1.0, Executive Summary. Purpose and Need for the project is described in Section 3.0.

Comment: *Sediment Quality and Quantity - The EIR should contain an analysis of the quality and quantity of dredged material for DMMP dredging projects in New Bedford/Fairhaven Harbor. It should summarize dredge sampling and testing programs and discuss conformance with DEP and Army Corps/EPA requirements, including physical, bulk chemistry and any required biological testing. The EIR should also identify low, medium and high volume dredge volume estimates in consultation with New Bedford Working Group and Harbor Plan Committee. For overdredge and adjacent to channel aquatic disposal alternatives, it should provide a summary of results of subsurface investigations.*

Response: Section 3.3 includes a complete discussion of the quality and quantity of the dredged material for the New Bedford/Fairhaven DMMP. Please note that the DEIR analysis assumes conservative UDM volume estimates, roughly corresponding to the "high volume" dredging estimates included in the ENF. This approach has been taken to ensure that disposal site planning considers the maximum volume of UDM that may need to be disposed. Future chemical and biological, if required, analyses of individual dredging projects will pinpoint the capacity required for the final disposal sites or alternative treatment technology.

Comment: *Identification of Disposal Alternatives - The EIR should identify the full range of practicable disposal alternatives considered under all DMMP Phases, including:*

a. Alternative Technologies and Methodologies
Identify potential alternative technologies, and discuss operational requirements, regulatory feasibility, and characteristics of output and sidestream flows and associated environmental impacts. Based on these factors, identify potentially practicable technologies.

b. Upland Reuse/Disposal
Identify potential upland alternatives within the municipal boundaries of New Bedford, consistent with existing DEP regulations and policy. Also consider the use of brownfield sites consistent with DEP policy and the Massachusetts Contingency Plan.

c. Aquatic Disposal
Identify all potential aquatic disposal alternatives as defined under DMMP Phase I within the New Bedford Zone of Siting Feasibility, consistent with Army Corps operational policies and Clean Water Act, Section 404 provisions.

Response:

a. Alternative Technologies and Methodologies: Section 4.5 summarizes the alternative treatment technologies and methodologies analyzed for practicability in the DMMP.

b. Upland Reuse/Disposal: Section 4.7 summarizes the Upland Reuse and Disposal Alternatives analyzed for the New Bedford/Fairhaven DMMP.

c. Aquatic Disposal: Section 4.8 summarizes the Aquatic Disposal Alternatives analyzed for the New Bedford/Fairhaven DMMP.

Comment: *Screening of Disposal Alternatives - Perform a first order screen of disposal alternatives for impacts to natural resources, permitting feasibility, engineering characteristics, capacity, cost, logistics, and users conflicts, based on existing information. Screening criteria used in the analysis should be developed in consultation with local interests and state and federal resource agencies. Identify potentially practicable alternatives resulting from the screening.*

Response: Sections 2.0 and 4.4 of the DEIR describe the coordinated development of the DMMP screening criteria with local interests, state and federal regulatory agencies and the specifics of the DMMP screening process. Sections 4.5, 4.6, 4.7 and 4.8 of the DEIR provide a summary of the first order screen for each type of disposal alternative considered, including the identification of potentially practicable alternatives resulting from the screening.

Comment: *Fisheries Investigation and Monitoring - The proposed fisheries studies are intended to fill information voids relative to the present status of marine resources in specific areas so that the potential impacts from dredging and in-water disposal can be determined. These studies will complement other resource investigations either currently underway or recently completed..*

The important marine fisheries resources in New Bedford/Fairhaven Harbor are shellfish, lobster, and finfish. The Division of Marine Fisheries (DMF) will provide direction for the required studies on these resources. Juvenile lobster and shellfish surveys shall be site specific and shall be conducted at the areas identified within each study site, subject to final direction from DMF and MCZM.

Response: Section 4.8 of the DEIR provides a detailed screening of aquatic disposal alternatives which include an assessment of benthic impacts in Section 4.8.3 and finfish impacts in Section 4.8.4. Section 6.1.3 provides a detailed assessment of impacts to benthic species, while Section 6.1.4 provides a detailed assessment of impacts to finfish for aquatic disposal alternatives. Additionally, the DMMP final report of the *Fisheries Resources Survey* for New Bedford is included in Appendix G.

Comment: *Analyze the effects of disposal activities on shore birds and the impacts of these activities on shore bird habitat. Additionally, provide the results of a cultural and historical/archaeological investigation to identify any resources that might be affected by disposal options. I suggest consultation with the Board of Underwater Archaeology and the Massachusetts Historical Commission in preparing this information.*

Response: The effects of disposal activities on shorebirds and associated habitat is described in Sections 5.3.5.1 and 6.5.1. The results of the cultural and historical/archaeological investigation are described in Section 5.3.6 and Section 6.6. Additionally, Appendix I includes the report *Possible Shipwreck and Aboriginal Sites on Submerged Land - New Bedford, Massachusetts.* On-going coordination with BUAR and MHC is described in Section 2.5.3 and correspondence is included in Appendix A.

Comment: *Characterize identified potentially practicable sites in terms of: engineering, physical, chemical, and meteorological characteristics; quantify natural resource impacts; identify permitting requirements; cost; capacity; and operational requirements, based on site specific conditions.*

Response: Sections 5.0 and 6.0 of this DEIR provides engineering, physical, chemical, and meteorological characteristics and quantification of natural resource impacts for potentially practicable site and the preferred alternative sites. Appendix F contains the Habitat Characterization study that served as the baseline for the analysis of the above sections.

Comment: *Identify, in consultation with New Bedford officials and other interested organizations and individuals, a preferred alternative(s)and/or methodology(s). Identify mitigation requirements and identify the parties responsible for implementation of mitigation measures.*

Response: The disposal site screening process has been closely coordinated with City of New Bedford, Town of Fairhaven and other key harbor stakeholders, as described in Section 2.0 of this DEIR. The Draft Section 61 Findings, Sections 8.0 and 10.0, identify mitigation requirements specific to the aquatic preferred alternative sites.

***Comment**: Disposal Site Management Plan - The EIR should contain a draft disposal site management plan detailing measures to be taken to ensure protection of the public health and welfare and to properly manage the construction and operation of the preferred disposal alternative. It should also identify parties responsible for implementation of the plan.*

Response: The Disposal Site Management Plan, detailing measures to be taken to ensure protection of the public health and welfare and to properly manage the construction and operation of the preferred disposal alternative sites, is included as Section 9.0 of this DEIR. This section also identifies potential parties responsible for implementation of the DMMP in New Bedford/Fairhaven Harbor.

***Comment**: Draft Section 61 Findings - The EIR should contain a draft Section 61 Finding for the preferred alternative. This finding should set out what mitigation is available to minimize or eliminate environmental impacts.*

Response: Section 10.0 of this DEIR includes the Draft Section 61 Findings outlining mitigation available to minimize or eliminate environmental impacts in New Bedford/Fairhaven Harbor associated with UDM disposal.

***Comment**: Federal permitting requirements - The EIR should contain, as appropriate, the draft federal Endangered Species Act Section 7 consultation and draft Clean Water Act Section 404(b)(1) analysis.*

Response: Section 7.2.1 includes a draft Clean Water Act Section 404(b)(1) analysis for the preferred aquatic disposal sites in Salem Harbor. As the preferred aquatic disposal sites are located outside of any federally-listed Endangered Species habitat areas, a draft ESA Section 7 consultation is not included in this DEIR. Consultation and coordination with the NMFS and the USFWS is continuing to determine the need for a formal Section 7 consultation process. Correspondence with NMFS and USFWS are included in Appendix B.

11.2 Department of Environmental Protection

***Comment:** DEP experiences with CA/T materials (both excavate and dredged sediments) have demonstrated that even though there initially appeared to be a fairly large demand for these materials at public (or private) landfills, the reality was that very few landfills actually decided to use the materials. In addition, by 1999 most unlined landfills in Massachusetts will be capped, the exception being a category of historic landfill disposal sites, most of which have been unused for over 30 years, and the potential for placement of significant volumes of dredged sediments at any of these sites is questionable and severely limited at best. Nevertheless, the DMMP should fully assess any and all historic landfills and DEP will work with the consultant in this activity.*

The New Bedford ENF specifically refers to an existing 12-acre municipal solid waste landfill in New Bedford (Shawmut Ave.) As the ENF correctly states, the facility is partially closed and capped. On July 22, 1997, the City of New Bedford and DEP entered into a Consent Order for final assessment and capping/closure of the Shawmut Ave Landfill. The Consent Order includes the following provisions:

- *By December 31, 1998, the Municipality shall cease accepting solid waste at the Landfill.*
- *By June 1, 1999, the Municipality shall award a contract for final capping of the Landfill.*
- *By November 1, 1999, the Municipality shall complete capping of the Landfill. The municipality shall submit a Landfill closure certification report within 60 days of the completion of the construction of the final cover.*

Based on the above, this facility will <u>*not*</u> *be available for receipt of any contaminated or non-contaminated sediments from the DMMP and therefore should be removed from consideration for sediment reuse/disposal.*

Response: CZM has worked in consultation with DEP on the inclusion and assessment of historic landfills within 50 miles of New Bedford/Fairhaven Harbor in screening of upland disposal sites. This analysis is described in detail in Section 4.8. The screening of the universes of potential upland disposal sites, of over 1,000 sites, failed to identify a practicable upland option, including the Shawmut Avenue Landfill.

Comment: *The DMMP estimates a total volume of up to 400,000 and 2,000,000 cubic yards of dredged material unsuitable for unconfined ocean disposal for the ports of Fall River and New Bedford, respectively. This estimate includes all anticipated dredging projects; private, federal, state and municipal, consistent with the anticipated future port and land use. DEP fully supports the conclusion in the Phase I DMMP that this large volume and physical/chemical quality of dredged material drives an informed alternatives analysis; one that must carefully review all possible mechanisms for both in-water and upland disposal/reuse.*

Response: This comment is acknowledged. The DMMP disposal site screening analysis involved a comprehensive analysis of all practicable alternative treatment technologies, upland and aquatic disposal options, including a detailed review of potential dewatering sites, a key mechanism to implementing upland and alternative treatment technology disposal options. Section 4.4 provides a detailed description of the alternatives analysis process conducted for the New Bedford/Fairhaven DMMP.

Comment: <u>*Upland Disposal/Reuse at Locations Subject to Jurisdiction of M.G.L. c, 21E and the Massachusetts Contingency Plan, 310 CMR 40.0000 et. seq.*</u>

Section III. E. 3. of the ENF at page 7 states that, if upland disposal is selected, ... the use of already despoiled areas, such as "brownfield" sites would be preferable. Potentially contaminated areas of an otherwise suitable brownfield site will be identified via the Environmental Site Assessment Process under M.G.L. c. 21E and the Massachusetts Contingency Plan (310 CMR 40.0000).

Response: Since the preferred disposal alternatives proposed in the DEIR for New Bedford/Fairhaven

Harbor are in the marine environment, the proposed sites are not subject to provisions Chapter 21E and the MCP.

Comment: *The ENF description is problematic in its use of language; specifically the terms "despoiled areas" and "brownfields" and in the assumptions made about the substantive authority and jurisdiction of c. 21E and the MCP.*

In Massachusetts, "brownfields" are not automatically synonymous with "despoiled areas". Neither M.G.L. c. 21E nor the MCP defines "brownfields". While "despoiled areas" have been identified in several state statutes, excluding c. 21E, these descriptions have been provided to define locations in need of social, economic and infrastructure redevelopment, not to identify, as a primary focus, locations that may have been subject to contamination by oil or hazardous material.

DEP agrees that if upland disposal, outside of the locations that have undergone the site assignment process required for the management of solid/hazardous waste, is necessary, it is preferable to select locations that have already been subject to contamination over "pristine" locations. However as described in this section of the ENF, that would not be the automatic result.

Assuming that non-pristine locations were identified, and proved to be suitable for redevelopment, which is what the common understanding of a "brownfield" is , such areas would not easily lend themselves to disposal of dredged sediments.

Chapter 21E and the MCP have jurisdiction over releases and threats of release of oil or hazardous materials where such releases have come to be located. This does not necessarily encompass all locations that have been subject to prior contamination, but only those subject to notification under c. 21E § 7as the result of a release in the concentration or quantity prescribed by the MCP. The reference in the ENF to the "Environmental Site Assessment Process" appears to envision (1) a much broader knowledge of locations that may be subject to contamination and (2) broader scope of jurisdiction than what is prescribed by the statute .

DEP wishes to again emphasize that the process for assessment, containment and removal of oil or hazardous material at locations where release(s) have come to be located; that is 21E sites; is complex, may require years of careful oversight, and is not necessarily applicable to the use and management of dredged sediments, particularly the volumes described by the ENF.

Finally, DEP feels it imperative to point out that the cleanup of 21E sites is managed and achieved through a privatized program. The vast majority of 21E cleanups are performed by Licensed Site Professionals employed by the persons undertaking site remediation. Except for a relatively small category of sites, DEP's involvement in remediation decisions about the management, treatment alternatives, cleanup levels and future site activities and uses is limited.

Response: The above comments are acknowledged and has been incorporated into the analysis for sites that could impact the upland environment including alternative treatment technologies, dewatering sites and upland disposal and reuse.

Comment: *Project Permitting - The ENF correctly indicates the various potential major DEP Permits that might be necessary to implement the construction and operation of dredged sediment reuse/disposal facilities. Depending on the alternative(s) finally chosen additional DEP permits (or technical reviews) may be required under the jurisdiction of c.111 s.150A and 310 CMR 16.000 and 19.000 (Solid Waste Review); c.21E/MCP at 310 CMR 40.000; 310 CMR 7.00 (Air Plans Review); and c.131, s.40 (Wetlands Protection Act) if a Superseding order or Variance is deemed to be necessary.*

As MEPA is aware, the Commonwealth and EPA are currently in the final stages of revising a Record of Decision (ROD) for disposal of PCB contaminated sediments from the New Bedford Harbor Superfund Project under CERCLA, 42 U.S.C. § 9601 Et seq. and the National Contingency Plan, 40 CFR Part 300. Prior to and during the Phase I DPA/DMMP, staff from DEP and other relevant federal state and local agencies assessed and considered the option of formally performing the New Bedford ROD, which provides for an enhanced remedy and the DPA/DMMP Project, as a single consolidated site cleanup and navigation improvement action. Such a process could provide significant procedural and technical advantages, including reducing the procedural requirements to the requirements prescribed for the issuance of an concurrence with a ROD, while maintaining the substantive requirements, and coordinating the sequencing of the dredging work. This coordination will, in particular, be a critical component to successful and protective hot spot collection/containment.

Response: CZM acknowledges the above comments and recognizes the benefits of coordinating with ROD efforts where practicable.

Comment: *Procedurally, if the DMMP moves forward as an independent project, the management and disposal requirements prescribed by the federal Toxic Substances Control Act (TSCA), 15 U.S.C. § 2605 et. seq. and the implementing regulations promulgated thereunder at 40 CFR Parts 750 and 761, will apply, in that much of the dredged material will be found to be contaminated with PCBs > 50 mg/Kg. These requirements will be incorporated through any §404 permit and, even in light of the effort to streamline the management and disposal of TSCA remediation waste, which includes dredged sediments, are onerous; very time consuming, very costly, and procedurally difficult, adding potentially 1 to 2 years to the overall time line. Inclusion of the DMMP in the Final ROD, with which as of now, the state plans to concur, would eliminate the substantive and procedural requirements of TSCA would otherwise impose upon the project. Therefore the option of implementing through the ROD should be very carefully considered.*

Response: CZM has participated in "linkage" meetings with federal, state and local entities to investigate ways to integrate the implementation of the DMMP with the ROD, and will continue to participate in pursuance of "linkage" opportunities as practicable. Ongoing coordination with federal, state and local agencies is described in Section 2.0 of this DEIR.

Comment: *Waterways Permitting - The project will require a Chapter 91 dredge permit. If the Confined Disposal Facility (CDF)or the Tidal Habitat Creation option is chosen, a Chapter 91 license will be necessary. Chapter 91 licenses require the payment of Commonwealth tidelands occupation fees at $30/sq.yd. and tidewater displacement fees at $2.00/cu.yd. These costs may* *become quite prohibitive for large amounts of fill. Public agencies however are exempt from these licensing fees. So if one of these options is chosen, a public agency should be the permittee. A further requirement of the Waterways regulations at 310 CMR 9.32 (1)(b), is that within DPAs, a project shall be eligible for a license only if it is restricted to fill or structures for water-dependent-industrial use, provided that, in the case of proposed fill, neither pile-supported nor floating structures are a reasonable alternative. The EIR should address how this requirement will be met.*

The Ten Mile River and Islands and Buzzards Bay Watershed Basin Teams indicate that both the Confined Disposal Facilities and Confined Aquatic Disposal can be authorized by the Chapter 91 program , with the following restrictions:

- *In general, Confined Disposal Facilities (CDF) within the DPA, pursuant to 9.36 (5) shall not include fill or structures for non-water dependant projects or water dependant non-industrial uses which preempt water dependant industrial use within the DPA. Shore protection structures (i.e bulkheading) should protect, construct or expand water-dependant industrial uses*

- *All future uses of any of the CDFs within the DPA require Chapter 91 review and approval.*

- *Once Confined Aquatic Disposal Facilities (CADs) are capped, the depth shall not impede safe navigation and measures shall be taken to indicate their location on navigation charts.*

The Environmental Impact Report(EIR) should indicate dredged depths and profiles of the areas to be dredged and all areas to be used as CDF and CAD sites should be designated, prioritized by site use and volume.

Response: Section 7.1.3 of the New Bedford/Fairhaven DMMP describes how the requirements of Chapter 91 for the preferred CDF disposal option identified will be met. Section 8.0 provides the conceptual engineering specifications for the CAD and CDF preferred alternatives. For the purposes of the DMMP, the assumed end use for the Popes Island North CDF is marine industrial, as proposed in the New Bedford/Fairhaven Harbor Plan. The design of CAD cells in the DMMP maintain ambient elevations to avoid long-term navigational impacts.

Comment: Wetlands Permitting *- There is not yet enough information on the Wetland Resource Areas likely to be impacted by these projects to determine what the requirements under the Wetlands regulations will be. For each of the alternatives under consideration, the EIR should address the following: which Wetlands Resource Areas will be impacted, the square footage of impact, whether the impact is temporary or permanent, whether the project will require a variance, or whether it can be considered a Limited Project under the Wetlands Regulations.*

Response: Sections 5.3.4 and 6.1.5 quantify the amount and type of wetland resource areas, and the duration of the impact, for all wetland resources which are potentially impacted.

Comment: *Solid Waste Permitting*

Reuse and disposal of dredged sediments at solid waste facilities are regulated under Solid Waste Management regulations 310 CMR 19.000. Refer to #COMM-94-007 Interim Policy of Sampling, Analysis, Handling , and Tracking Requirements for Dredged Sediments Reused or Disposed at Massachusetts Permitted Landfills

Dredged sediments may be disposed or reused at permitted landfills according to the above policy. The policy also provides guidance for sampling, handling, and tracking of dredged materials, as well as landfill operational controls.

Sediments intended to be reused at lined landfills and which have no contaminants exceeding the limits indicated in Table 1 of the policy will not require individual approval from the Department.

Sediments will require approval from Solid Waste management if:

- *they exceed table 1 contamination limits*
- *they are intended to de disposal sat lined or unlined landfills; or*
- *they are intended to be reused at an unlined landfill*

Most unlined landfills in Massachusetts will be capped and closed by December 1999. Thus the reduced number of active landfills in the region will limit land fill disposal options for the dredged sediments. Lined landfills in the region that will remain open beyond the December 1999, deadline are Taunton, Fall River and Bourne which may accept dredged sediments at the discretion of the operator.

Sediments shall not be disposed of at landfills if a feasible alternative exists that involves the reuse, recycling, destruction, and/or detoxification of such sediments in accordance with the solid waste management hierarchy established in the Solid Waste Master Plan. The applicant must fully assess the feasibility of alternatives to sediment disposal at a landfill.

In certain cases a Beneficial Use Determination permit may be appropriate if it can be demonstrated that the dredged material can be beneficially reused in an environmentally safe manner.

Response: The comprehensive alternatives analysis conducted for the New Bedford/Fairhaven DMMP did not identify an upland disposal option as practicable alternative. The details of the upland site screening process are highlighted in Section 4.7.

Chapter 21E Sites

Based on the location of information provided in the ENF, the Bureau of Waste Site Cleanup (BWSC) has searched its database for disposal sites and release notifications has found that there are numerous known sites or disposal sites or reportable release located within the New Bedford Harbor Area. Additionally, the Commonwealth Gas Company (Release Tracking Number 4-12592) has a disposal site located at 180 MacArthur Drive in the exact vicinity of the proposed project.

This site has released gas wastes subject to the jurisdiction of c.21E and the MCP into the sediments and to the full extent of the contamination is not known. The Project Proponent is advised that, if additional oil and/or hazardous material is identified during the implementation of this project , the BWSC must be notified pursuant to 310 CMR 40.0300, a Licensed Site Professional must be retained pursuant to 310 CMR 40.0000, and risk reduction measures may have to be undertaken pursuant to 310 CMR 40.0400, as appropriate. In addition, the BWSC may be contacted for guidance if questions arise.

Response: The proposed CDF disposal site in the vicinity of 180 MacArthur Street, State Pier CDF, was not elevated to a preferred alternative during the aquatic site screening process. The description of the aquatic site screening process is described in Section 4.8, including the rationale for State Pier CDF's status a reserve site.

11.3 Letter of the City of New Bedford and Town of Fairhaven

Comment: *It is our opinion, however, that some proposed disposal locations should be immediately be removed from any further consideration. These locations, as listed on Attachment 1-E of the ENF, are:*

> *North 195: This site was put forward as an option for disposal of Superfund material and was met with great opposition form area residents. Therefore EPA decided not to site a disposal facility at this location.*
>
> *State Pier: The City of New Bedford and the Department of Environmental Management are working on major capital improvements plans for piers and wharves in this area. Furthermore this area provides docking space for 80% of the City's fishing fleet.*
>
> *Seawall West: The City of New Bedford City Council has voted to oppose the disposal of contaminated sediments in the area of the Standard Times Field. There is a possibility that a modified disposal site that may be desired would allow for expanded use of Palmer's Island.*
>
> *Fairhaven South and Fairhaven North: Siting of a disposal facility in either of these locations would displace businesses and severely reduce the property values of existing homes abutting Fort Street and the existing nature of these areas. There are also numerous existing and potential boat docking facilities and moorings in these locations.*
>
> *Popes Island South: Disposal of contaminated materials at this site would completely eliminate a 198-slip recreational boating marina that was constructed there by the Commonwealth of Massachusetts in 1993.*

For the above stated reasons, each of these sites, as proposed, would be unacceptable for dredged material disposal, and we strongly urge that they be eliminated from further consideration.

Response: All of the sites mentioned above, North 195, State Pier, Seawall West, Fairhaven South, Fairhaven North and Popes Island South have not been proposed as preferred disposal alternatives in the New Bedford/Fairhaven Harbor DMMP. The screening process for the aquatic disposal alternatives is described in detail in Section 4.8.

Comment: *Furthermore, there is another location within the Zone of Siting Feasibility for this project which we feel should be considered as a potential disposal site (either CAD or CDF). This area is located immediately south of the hurricane barrier, on the western side of the harbor, and is marked on the ZSF map attached to this letter.*

Response: A CDF site, Seawall Southwest, was added to the universe of aquatic sites investigated in the alternatives analysis. This site did not pass the aquatic disposal site screening to become a preferred alternative. The details of the aquatic site screening process are described in Section 4.8.

Comment: *We would also like to go on record in opposition to the no action alternative, which would result in no maintenance or navigational dredging of the New Bedford/Fairhaven Harbor. The economic revitalization of this area relies heavily on the ability of shipping vessels to utilize this Harbor, and lack of dredging over the past few decades has resulted in very adverse impacts on this region.*

Response: The New Bedford/Fairhaven DMMP puts forward two preferred aquatic disposal alternatives, none of which is the No Action Alternative. In fact the No Action alternative helps justify the need for implementing the preferred alternatives.

Comment: *Finally, we have appointed a Dredged material Management Committee (DMMC), which will be responsible for reviewing all project related materials, holding public informational sessions, and communicating with the DMMP consultant team and the Harbor Master Planning Committee...*

Response: Development of the New Bedford/Fairhaven DMMP has been coordinated with the DMMC at key milestones, Section 2.0 describes the DMMC's involvement in the planning process.

11.4 Board of Underwater Archaeological Resources

Comment: *The BUAR conducted a very preliminary review of its files and secondary literature sources to identify known and potential submerged cultural resources. Research strongly suggests there exists the possibility for both prehistoric and historic cultural resources, now submerged, to be located within the vicinity of New Bedford Inner and Outer Harbor areas, and the upper Buzzards Bay between Dartmouth and Fairhaven. This preliminary review revealed potential submerged cultural resource (e.g., shipwrecks) in the vicinity of the New Bedford Harbor area.*

Given the geomorphological evolution of the northern shore of Buzzards Bay and New Bedford Harbor as a possible inundation feature (limited seaward exposure reducing erosional effects), there exists the strong possibility for the preservation of now submerged prehistoric cultural resources. A regional model for the southern Gulf of Maine suggests the expected site frequency for the study *area would be low for all site types dating prior to 6000 BP, but would increase from low (habitation) to high (shell middens) for the period 6000 to 3000 BP. In the period from 3000 BP to Present, the expected site frequency increases to high for habitation, camp, and shell midden sites. During both periods, the size of these sites would be small. While this model does not provide sufficient resolution to specifically identify potential site locations at the scale of the study area, it points to the need to consider the occurrence of prehistoric sites.*

A preliminary review of historic literature strongly suggests there exists some reasonable concern for possible historical site occurrence within the New Bedford Harbor areas. In general, we must recognize New Bedford was a major early colonial port in the region and maintained commercial and fishing importance throughout the historic period, and thus maintained a high volume of vessel traffic along the Bay. Additionally, the numerous coves along the shore provided small safe harbors and quays to support both fisheries and manufacturing activities. At the same time, we must recognize that the northern shore of Buzzards Bay, like Cape Cod, was a major natural landscape feature that contained numerous hazards to navigation, and thus became the site of shipwrecks. A variety of maritime related cultural resources, such as wharves/piers/quays, anchorages, careening sites, derelict and shipwreck vessels, might be anticipated to be located in the project area, either submerged or along the shore.

While the vast majority of known shipwrecks are described as occurring in Buzzards Bay, a number of shipwrecks are known to have occurred in the immediate vicinity of New Bedford Harbor; many dating into the nineteenth century. Further, secondary sources indicate that as many as sixty shipwrecks might be located in the vicinity of Buzzards Bay. The loss of earlier and smaller coastal vessels and the purposeful abandonment of derelict vessels are generally not found in the documentary record. The level and diversity of maritime commercial, fishing, and recreational activities throughout the Buzzards Bay region may have resulted in the creation of a number of undocumented and anonymous underwater archaeological sites such as small craft, derelict vessels, or dump sites. An excellent example of this type of activity/historic site is the abandoned fishing trawler EVELINA M. GOULARD removed from the Fairhaven waterfront in 1990. The GOULARD is now on display as an historic vessel at the Essex Shipbuilding Museum. These possible site types represent classes of vessels where our knowledge is severely limited and, thus, are potentially historically and archaeologically important.

Therefore, the BUAR takes this opportunity to express its concern that heretofore unknown cultural resources might be encountered during the course of work and hopes the project's sponsor will take steps to limit adverse affects and notify the BUAR, as well as other appropriate agencies, if historical or archaeological resources are encountered.

Response: This DEIR presents the results of an initial (Phase I) underwater archaeological investigation for New Bedford/Fairhaven Harbor. We concur the waters of New Bedford/Fairhaven Harbor, near the locations of the preferred aquatic disposal alternative sites, are likely to contain several potentially significant archaeological sites. As noted above, CZM will coordinate with both the BUAR and MHC to define the appropriate further investigations and identification of mitigation and avoidance measures as the DMMP site selection and disposal site design process proceeds.

11.5 Letter of Massachusetts Historical Commission

Comment: *The City of New Bedford and the Town of Fairhaven contain known archaeological sites which are recorded in MHC's Inventory of Historic and Archaeological Resources of the Commonwealth. The majority of land in these communities as well as the bottom of the harbor has never been systematically surveyed for archaeological resources. Additional as yet unidentified sites may also be present both on land and underwater in the Harbor area.*

Response: We concur the waters of New Bedford/Fairhaven Harbor, near the locations of the preferred aquatic disposal alternative sites, are likely to contain several potentially significant archaeological sites. As noted above, CZM will coordinate with both the BUAR and MHC to define the appropriate further investigations and identification of mitigation and avoidance measures as the DMMP site selection and disposal site design process proceeds.

Comment: *Given the archaeological sensitivity of the New Bedford/Fairhaven Harbor area and the proposed project impacts, MHC requests that a reconnaissance archaeological survey (950 CMR 70) be conducted for the candidate aquatic disposal locations identified in the ENF (Attachment 1-E). The goal of the reconnaissance survey and recommends that the scope be developed in consultation with the Massachusetts Board of Underwater Archaeological Resources.*

Response: This DEIR presents the results of an initial (Phase I) underwater archaeological investigation, developed in consultation with MBUAR, for New Bedford/Fairhaven Harbor DMMP in Sections 5.3.6 and 6.6. Appendix I contains the report *Possible Shipwreck and Aboriginal Sites on Submerged Land - New Bedford, Massachusetts.*

REFERENCES

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Aller, R.C. and J. Y. Yingst. 1978. Biogeochemistry of tube dwellings, a study of Amphitrite ornata (Leidy), a sedentary polychaete. *Journal of Marine Research* 36: 201-245.

Bannister, R.C.A., D. Harding, and S.J. Lockwood. 1974. Larval Mortality and Subsequent Year-Class Strength in the Plaice (*Pleuronectes platessa L.*), pp. 21-37. In: The Early Life History of Fish, J.H.S. Blaxter, ed., Springer-Verlag, New York. 765 pp.

Battelle Memorial Institute. 1990. Modeling of the Transport, Distribution and Fate of PCBs and Heavy Metals in the Acushnet River/New Bedford Harbor/Buzzard's bay System. Volume I. Final Report Contract No. 4236-MOD-0019 to EBASCO Services, Inc.

Bellmer, R.J. 1988. The Infaunal Community of a Polychlorinated Biphenyls Polluted Harbor, New Bedford, Massachusetts. New England Division, U.S. Army Corps of Engineers.

Berrill, M. and R. Stewart, 1973. Tunnel-digging in mud by newly-settled American lobsters, *Homarus americanus*. J. Fish. Res. Board Canada. 30:285-287s

Berrill, M., 1974. The burrowing behavior of newly-settled lobsters, *Homarus vulgaris* (Crustacea-Decapoda). J. Mar. Biol. Assoc. UK. 54:797-801.

Bigelow, H.B., and W.C. Schroeder. 1953. *Fishes of the Gulf of Maine*. Fishery Bulletin 74, Fishery Bulletin of the Fish and Wildlife Service, v. 53.

Black, D.E., D.K. Phelps, and R. L. Lapan. 1988. The Effect of Inherited Contamination on Egg and Larval Winter Flounder, *Psuedopleuronectes americanus*. Mar. Env. Res. 25:45-62.

Blaxter, J.H.S. 1969. Development: Eggs and Larvae. In: W.S. Hoar and D.J. Randall (eds.) Fish Physiology. Academic Press. New York, NY.

Blaxter, J.H.S. 1974. The Early Life History of Fish: the Proceedings of an International Symposium Held at the Dunstaffnage Marine Research Lab of Scottish Marine Biological Association at Oban, Scotland, 17-23 May, 1973. Springer-Verlag, New York. 765 pp.

Botero, L. And J. Atema, 1982. Behavior and substrate selection during larval settling in the lobster *Homarus americanus*. J. Curst. Biol. 2:59-69.

Brady, 2000. “Strong river herring runs reported for Spring 1000". In *DMF News*, Commonwealth of Massachusetts, Division of Marine Fisheries Service. Volume 20, Second Quarter April-June 2000.

Brown, B. and J. Neff. 1993. Bioavailability of sediment-bound contaminants to marine organisms. Report to NOAA, National Pollution Program Office, Rockville, MD.

Butman, C.A. 1987. Larval settlement of soft-sediment invertebrates. Oceanography and Marine Biology Annual Review. 25: 113-165.

Camp, Dresser & McKee (CDM). 1989. Draft Phase II Facilities Plan. Volume IV. Effluent Outfall. City of New Bedford, Massachusetts.

Cancer Incidence in Massachusetts 1994-1998: City and Town Supplement. Massachusetts Department of Public Health: www.state.ma.us/dph/bhsrc/mcr/98/mcr98.pdf.

Carey, D.A., R.M. Valente, and B.D. Andrews. 1999. Draft Disposal Options for Materials Dredged from Narragansett Bay. In: Quonset/Davisville Port Alternatives Report Baseline Economic and Environmental Data. Report prepared for Quonset/Davisville Port and Commerce Park Stakeholders Committee, January 15, 1999.

Chambers, R.C., W.C. Leggett, and J.A. Brown. 1988. Variation in and Among Early Life History Traits of Laboratory-reared Winter Founder, *Pseudopleuronectes americanus*. Mar. Ecol. Prog. Ser. 47: 1-15.

Chittenden, M.E. 1972. Salinity tolerance of young blueback herring, *Alosa aestivalis*. Transactions of the American Fisheries Society 101:123-125.

Clayton, G., C. Cole, S. Murawski, and J. Parrish. 1978. Common marine fishes of coastal Massachusetts. Institute for Man and Environmental Publication R-76-16. University of Massachusetts, Amherst. 231 pp.

Coats, D. A. 1995. 1994 Annual soft-bottom benthic monitoring Massachusetts bay outfall studies. Massachusetts Water Resources Authority. Environmental Quality Department Technical Report Series 95-20. MWRA, Boston MA

Collins, W.S., C.Cooper-Sheehan, S.C.Hughes, and J.L.Buckley. 1981. The Effects of Power Generation on Some Living Marine Resources of the Cape Cod Canal and Approaches. Massachusetts Department of Fisheries, Wildlife and Recreational Vehicles. Division of Marine Fisheries. 212 pp.

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (42 U.S.C. §9601 et. seq.)

Cooper, R.A. 1961. Early life history and spawning migration of the alewife, *Alosa aestivalis*. M.S. thesis, University of Rhode Island, Kingston. 58 pp.

Costello, C. 1997. Personal communication. Mass. Dept. Environmental Protection

Cross, Jeffrey N., Christine A. Zetlin, Peter L. Berrien, Donna Johnson, and Cathy McBride. 1999. Essential Fish Habitat Source Document: Butterfish, *Peprilus triacanthus*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-145. U.S. Department of Commerce 42 pp.

DAMOS. 1994. Sediment Capping of Subaqueous Dredged Material Disposal Mounds: An Overview of the New England Experience 1979 - 1993. Disposal Area Monitoring System (DAMOS) Contribution No. 95. New England District, U.S. Army Corps of Engineers, Concord, MA.

DAMOS. 1999. Monitoring Results from the First Boston Harbor Navigation Improvement Project Confined Aquatic Disposal Cell. Disposal Area Monitoring System (DAMOS) Contribution No. 124. New England District, U.S. Army Corps of Engineers, Concord, MA.

Day, John W.; Charles A.S. Hall; W. Michael Kemp; Alejandro Yañez-Arancibia. 1989. Estuarine Ecology. John Wiley & Sons. New York. 558 pp.

Department of Defense, Environmental Technology Transfer Committee. 1994. *Remediation Technologies Screening Matrix and Guide, Second Edition*, NTIS PB95-104782.

Ebasco Services Inc. (EBASCO). 1989. Draft Final Baseline Public Health Risk Assessment: New Bedford Harbor Feasibility Study. August 1989.

Ebasco Services Inc. (EBASCO). 1990. Draft Final Baseline Ecological Risk Assessment: New Bedford Harbor Feasibility Study. April 1990.

Ebasco Services Inc. (EBASCO). Feasibility Study of Remedial Alternatives for the Estuary and Lower Harbor/Bay. New Bedford Harbor, Massachusetts. Volume I, August 1990. EPA Work Assignment No. 04-1L43.

ENSR 1997. Summary report of independent observations, Phase 1 - Boston Harbor Navigation Improvement Project. ENSR Doc. No. 4479-001-150. Prepared for Massachusetts Coastal Zone Management Agency, Boston, MA.

ENSR. 2001. June 2000 Benthic Survey of Boston Harbor Navigational Improvement. Project Confined Aquatic Disposal (CAD) Cells. Prepared for Massachusetts Coastal Zone Management by ENSR Marine and Coastal Center Woods Hole Massachusetts, September 2001.

Environment Canada. 1996. *SEDTEC - A Directory of Contaminated Sediment Removal and Treatment Technologies*, Computer Database.

Estrella, B.T. and D.J. McKiernan, 1988. Massachusetts Coastal Commercial Lobster Trap Sampling Program, May-November 1987. Division of Marine Fisheries, Commonwealth of Massachusetts, Boston. 32 pp.

Estrella, B.T. and D.J. McKiernan, 1989. Catch per unit effort and biological paramters from the Massachusetts coastal lobster (*Homarus americanus*) resource: description and trends. National Oceanographic and Atmospheric Administration Technical Report, National Marine Fisheries Service No. 81. 67 pp.

Estrella, B.T., and R.P. Glenn. 1998. *Massachusetts Coastal Commercial Lobster Trap Sampling Program, May - November, 1997*. Mass. Div. Marine Fisheries.

Estrella, B.T. and R.P. Glenn. 2000. "Massachusetts Coastal Commercial Lobster Trap Sampling Program". May-November, 1999. Commonwealth of Massachusetts Department of Fisheries, Wildlife and Environmental law Enforcement, Executive Office of Environmental Affairs. August 28, 2000.

Etter, R. J. and J.F. Grassle. 1992. Patterns of species diversity in the deep sea as a function of sediment particle size diversity. *Nature* 360: 576-578.

Fahay, Michael P., Peter L. Berrien, Donna L. Johnson, and Wallace W. Morse. 1999. Essential Fish Habitat Source Document: Bluefish, *Pomatomus saltatrix*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-144. U.S. Department of Commerce 68.

Forster, Richard A. 1994. "Bar Graph Species Accounts" *In*: A Birder's Guide to Eastern Massachusetts. Bird Observer. 1994. American Birding Association, Inc.

Gallagher, E.D., P.A. Jumars, and D.D. Trueblood. 1983. Facilitation of soft-bottom benthic succession by tube-builders. *Ecology* 64:1200-1216.

Gallagher, Eugene D. and Kenneth E. Keay. 1998. "Organism-sediment-contaminant interactions in Boston Harbor". pp. 89-132 In: K.D. Stolzenbach and E.E. Adams, eds. Contaminated sediments in Boston Harbor. MIT Sea Grant Press. 170 pp.

Giovani, J.J. 1973. The distribution of some marine fish eggs and larvae in the Acushnet and Westport River estuarine systems, Massachusetts. Southeastern Massachusetts University Report.

Gosner, K.L., 1971. *Guide to Identification of Marine and Estuarine Invertebrates, Cape Hatteras to the Bay of Fundy*. John Wiley & Sons. 693 pp.

Gosner, Kenneth L. 1978. A Field Guide to the Atlantic Seashore. Invertebrates and Seaweeds of the Atlantic Coast from the Bay of Fundy to Cape Hatteras. 1978. Houghton Mifflin Company. Boston. 329 pp.

Grassle, J.F., and J.P. Grassle. 1974. Opportunistic Life Histories and Genetic Systems in Marine Benthic Polychaetes. J. Mar. Res. 32: 253-284

Hiscock, K. 1986. "Aspects of the Ecology of Rocky Sublittoral Areas." *In*: The Ecology of Rocky Coasts. P.G. Moore and R. Seed, eds. Columbia University Press. New York. p. 323.

Hoff, D. J. et al. 1973. A biological assessment of the Acushnet River Estuary. Unpublished paper. North Dartmouth, MA: Southeastern Massachusetts University.

Howes, Goehringer., 1996. Ecology of Buzzards Bay: An Estuarine Profile. Woods Hole Oceanographic Institution, MA Dept. Of Biology. September, 1996.

Howes, B. L., Williams T. and Rasmussen M.. 1999. Baywatchers II. Nutrient related water quality of Buzzards Bay embayments: a synthesis of Baywatchers monitoring 1992-1998. Produced by The Coalition for Buzzards Bay. 150pp.

Hudon, C., 1987. Ecology and growth of post-larval and juvenile lobster, *Homarus americanus,* off Isle de la Madeleine (Quebec). Can. J. Fish. Aquat. Sci. 44:1855-1869.

Johnson, B.H. 1990. User's guide for models of dredged material disposal in open water. Technical Report D-90-5. Waterways Experiment Station, Corps of Engineers, Vicksburg, MS. February 1990.

Johnson, L.L., E. Casillas, T.K. Collier, J.E. Stein and U. Varanasi. 1992. Contaminant Effects on Reproductive Success in Selected Benthic Fish Species. Marine Environmental Research. 35:165-170.

Jones, A.R. 1986. The Effects of Dredging and Spoil Disposal on Macrobenthos, Hawkesbury Estuary, N.S.W. Mar. Pollut. Bull. 17: 17-20.

Kaplan, E.H., J.R. Welker, M.G. Kraus and S. McCourt. 1975. Some Factors Affecting the Colonization of a Dredged Channel. Mar. Biol. 32: 193-204.

Karr, James R. 1991. Biological integrity: A long-neglected aspect of water resource management. *Ecological Applications*, 1(1):66-84.

Klemens, Michael W. 1993. Amphibians and Reptiles of Connecticut and Adjacent Regions. State Geological and Natural History Survey of Connecticut. Bulletin No. 112. Connecticut Department of Environmental Protection. 318 pp.

Knebel, H. J, R.R. Rendigs, J.H. List, and R.P. Signell. 1996. Seafloor environments in Cape Cod, a large coastal embayment. Marine Geology. 133:11-33.

Knebel, H.J. and R.C. Circé. 1995. Seafloor environments within the Boston Harbor- Massachusetts Bay sedimentary system: a regional synthesis. Journal of Coastal Research. 11:230-251.

Kolek, A. and R. Ceurvels. 1981. Polychlorinated biphenyl (PCB) analyses of marine organisms in the New Bedford area: 1976-1980. Boston: Commonwealth of Massachusetts, Division of Marine Fisheries, Pub. #12265-36-100-1-81-CR.

Landahl, J.T., B.B. McCain, M.S. Myers, L.D. Rhodes and D.W. Brown. 1990. Consistent associations between hepatic lesions (including neoplasms) in English Sole (*Paraphrys vetulus*) and polycyclic aromatic hydrocarbons in bottom sediment. *Environ. Health Perspect*. 89:195-203.

Leahy, Christopher W. 1994. "Cape Ann" *In*: A Birder's Guide ot Eastern Massachusetts. Bird Observer. 1994. American Birding Association, Inc.

Lee, G.F. et al., 1977. Aquatic Disposal Field Investigations, Galveston, Texas, Offshore Disposal Sites: Appendix B: Investigation of Water Quality Parameters and Physicochemical Parameters. Center for Environmental Studies, Richardson, Texas. Technical Report D-77-20, p. 435.

Lee, H., B.L. Boese, J. Pelletier, M. Winsor, D.S. Specht, and R.C. Randall. 1989. Guidance manual: Bedded sediment bioaccumulation tests. US.EPA, Pacific Ecosystems Branch, Newport, OR. 163 p.

Lee, H. 1996. Methods for assessing sediment bioaccumulation in marine/estuarine benthic organisms. In: Proceedings of the National Sediment Bioaccumulation Conference, September 11-13, 1996. Bethesda, MD. pp. 1:11-23.

Levinton, Jeffrey S. 1982. Marine Ecology. Prentice Hall, Inc. Englewood Cliffs, New Jersey. 526 pp.

MADEM. 1992. Cape Cod Disposal Site (Generic EIR).

MADMF (Massachusetts Division of Marine Fisheries). 1999. Massachusetts Designated Shellfish Growing Areas. Produced February 10, 1999.

Maguire Group Inc., 1997a. Dredged Material Management Plan Phase 1, Volume I, Gloucester, Salem, New Bedford and Fall River. Prepared for Massachusetts Coastal Zone Management, Boston, MA. September 30, 1997.

Maguire Group Inc., 1997b. Dredged Material Management Plan Phase 1, Volume II, Gloucester, Salem, New Bedford and Fall River. Prepared for Massachusetts Coastal Zone Management, Boston, MA. September 30, 1997.

Maguire Group, Inc. 1995. FEIS for Seawolf Class Submarine Homeporting on East Coast of the United States.

Maguire Group. 1999. Capacity Analysis of CAD Sites within Salem, Gloucester, and New Bedford Harbors. Submitted to Massachusetts Coastal Zone Management, Boston, MA. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. 467.

Maguire Group. 1999. Habitat Characterization of the DMMP Candidate Aquatic Disposal Sites. Submitted to Massachusetts Coastal Zone Management, Boston, MA. Prepared by Science Applications International Corporation, Newport, RI. SAIC Report No. SAIC-99/463.

Malkoski, V.J., 1999a. Massachusetts Division of Marine Fisheries. Personal communication.

Malkoski, V.J., February 2002. Massachusetts Division of Marine Fisheries. Personal communication.

Malkoski, V.J., 1999b. Dredged material Management Plan Soft-Bottom Suction Sampling Pilot Program. Massachusetts Department of Marine Fisheries, Boston MA.

Manahan, Stanley E. 1991. Environmental Chemistry. 5th Edition. Lewis Publishers, Inc. Chelsea Michigan. 583 pp.

Massachusetts Births 1999: Massachusetts Department of Public Health: http://www.state.ma.us/dph/bhsre/BIRTH/99/birth99d.pdf

Massachusetts Department of Public Works. 1990. Final Environmental Impact Report, Supplement: Central Artery/Tunnel Project, Part II: Project Changes and Refinements Since 1985 FEIS/R.

Matthews, W.J., 1998. Pattern in Freshwater Fish Ecology. International Thomson Publishing, New York, New York.

Maurer, D., R.T. Keck, J.C. Tinsman, and W.A. Leathem, 1982a. Vertical Migration and Mortality of Benthos in Dredged Material: Part III - Polychaeta. *Marine Environ. Res*. 0141-1136/82/0006-0049. Applied Science Publishers Ltd., England 1982.

Maurer, D., R.T. Keck, J.C. Tinsman, and W.A. Leathem, 1982b. Vertical Migration and Mortality of Benthos in Dredged Material: Part II - Crustacea. *Marine Environ. Res*. 0141-1136/81/0005-0301. Applied Science Publishers Ltd., England 1982.

McCall, P.L. 1977. Community Patterns and Adaptive Strategies of the Infaunal Benthos of Long Island Sound. J. Mar. Res. 35: 221-266.

McCall, P.L. and M.J.S. Tevesz, 1983. Animal-Sediment Relations. Plenum Press, NY.

McGurk, M.D. 1986. Natural Mortality of Marine Pelagic Fish Eggs and Larvae: Role of Spatial Patchiness. Mar. Ecol. Prog. Ser. 34: 227-242.

McMullin, T.A. 1976. Industrialization and Social change in a Nineteenth-Century Port City: New Bedford, MA, 1865-1900. PhD Dissertation, University of Wisconsin - Madison.

Murray, P., D. Carey, and T.J. Fredette. 1994. Chemical flux of pore water through sediment caps. In: Proceedings of the Second International Conference on Dredging and Dredged Material Placement. November 13-16, 1994. Lake Buena Vista, FL. pp. 1008-1016.

National Marine Fisheries (NMFS). 1999. Northeast Preliminary Fisheries Statistics. Multispecies (May-December 1999) & Scallop (March-December 1999). Fisheries Statistics Office. Northeast Regional Office, Gloucester, MA 01930.

National Marine Fisheries (NMFS/NERO). 2002. Habitat Conservation Division. www.nero.nmfs.gov/ro/doc/efhtables.pdf.

National Oceanic and Atmospheric Administration (NOAA), 1975. Environmental Survey of Effects of Dredging and Spoil Disposal, New London, CT. Various quarterly reports.

National Oceanic and Atmospheric Administration (NOAA). 1993. *Stellwagen Bank National Marine Sanctuary Final Environmental Impact Statement/Management Plan*, Vol. 1. U.S. Dept. Commerce, National Oceanic and Atmospheric Administration, Sanctuaries and Reserves Division, 149 pp.

National Oceanic and Atmospheric Administration (NOAA). 1997. NOAA's Estuarine Eutrophication Survey. Volume 3: North Atlantic Region. Silver Spring, MD: Office of Ocean Resources Conservation and Assessment. 45 pp.

National Oceanic and Atmospheric Administration (NOAA). 1998. NOAA's National Weather Service Climatology (Historical Data) for the New England area.http://tgsv5.nws.noaa.gov/er/box/.

National Oceanic and Atmospheric Administration/Massachusetts Coastal Zone Management (NOAA/MACZM). 1998. Massachusetts Environmental Sensitivity Review Maps (Draft), Map Nos. 38(New Bedford North) and 43(New Bedford South).

Nemerow, N.L. 1978. Industrial Water Pollution. Origins, Characteristics and Treatment. Addision-Wesley Publishing Company: Reading, MA.

New Bedford Harbor Trustee Council (NBHTC, 1996). New Bedford Harbor Historic Overview Natural Resources Uses Status Report. Prepared for New Bedford Harbor Trustee Council. Prepared by Vanasse Hangen Brustlin, Inc. July 1996.

Newcombe, C. P. and J. O. T. Jensen. 1996. “Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact”. *North American Journal of Fisheries Management*. Vol 16, No. 4 pp 693-727.

Nichols, J.A., G.T. Rowe, C.H. Clifford and R.A. Young, 1978. *In Situ* Experiments on the Burial of Marine Invertebrate. Journal of Sedimentary Petrology, Vol. 48, No. 2, pp. 419-425.

Normandeau Associates, Inc. (NAI), 1999. Dredged Material Management Plan. Fisheries Resources Survey for New Bedford. Final Report. Prepared for Massachusetts Office of Coastal Zone Management

Normandeau Associates Inc. (NAI). 1999. “Dredge Material management Plan Quahog Resources Survey for New Bedford and Fall River”. Prepared for Massachusetts Office of Coastal Zone Management. February, 1999.

Officer, C.B., T.J. Smayda, and R. Mann. 1982. Benthic filter feeding: A natural eutrophication control, Marine Ecology Progress Series. 9:203-210.

Palma, A.T., R.A. Wahle, and R.S. Steneck. 1998. "Different early post-settlement strategies between American lobsters *Homarus americanus* and the rock crab *Cancer irroratus* in the Gulf of Maine". *Marine Ecology Progress Series* 162:215-225.

Parsons, T.R. 1992. Biological Coastal Communities: Productivity and Impacts. In: *Coastal Systems Studies and Sustainable Development. Proceedings of the COMAR Interregional Scientific Conference, UNESCO, Paris, 21-25 May 1991.* UNESCO Technical Papers in Marine Science, No. 64: 27-37.

Payne, P.M. 1991. *A Distributional Assessment of Endangered and Threatened Marine Mammals and Turtles in the Massachusetts Bay-Cape Cod Areas with Special Emphasis on the Massachusetts Bay Disposal Site.* Mass. Dept. Public Works, Central Artery (I-93)/Tunnel (I-90) Project, Technical Appendix 3 for Biological Assessment. 57 pp.

Pawlik, J. R. 1992. Chemical Ecology of the settlement of benthic marine invertebrates. Oceanography Marine Biology Annual Review 30: 273-335.

Pearson, T.H., and R. Rosenberg. 1978. "Macrobenthic succession in relation to organic enrichment and pollution of the marine environment". *Oceanography and Marine Biology Annual Review* 16:229-331.

Pereira, Jose J., Ronald Goldberg, John Ziskowski, Peter L. Berrien, Wallace W. Morse, Donna L. Johnson, 1999. Essential Fish Habitat Source Document: Winter Flounder, *Pseudopleuronectes americanus*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-138.

Pierce, David E. 2000. "DMF Survey Identifies Juvenile Cod Habitat" In: *DMF News.* Second Quarter April - June 2000. Massachusetts Division of Marine Fisheries Publication

Rees, S.I. and P. Wilbur. 1994. Effects from thin-layer disposal of dredged material on water quality in Mississippi Sound. In: Proceedings of the Second International Conference on Dredging and Dredged Material Placement. November 13-16, 1994. Lake Buena Vista, FL. pp. 1481-1489.

Reinert, Steven E. and Mark J. Mello. 1995. Avian Community Structure and Habitat Use in a Southern New England Estuary. *Wetlands* Vol. 15, No. 1, pp. 9-19.

Rhoads, D.C. 1974. Organism-sediment relations on the muddy sea floor. Oceanography and Marine Biology Annual Review 12: 263-300.

Rhoads, D.C., R.C. Aller, and M.B. Goldhaber. 1977. The influence of colonizing benthos on physical properties and chemical diagenesis of the estuarine seafloor. In: Ecology of the marine benthos. (ed., B.C. Coull). University of South Carolina Press. pp. 113-138.

Rhoads, D.C., P.L. McCall, and J.Y. Yingst. 1978. Disturbance and production on the estuarine seafloor. American Scientist, 66:577-586.

Rhoads, D.C., and J.D. Germano. 1982. “Characterization of benthic processes using sediment profile imaging: an efficient method of remote ecological monitoring of the seafloor (REMOTS System)”. *Marine Ecology Progress Series* 8:115-128.

Rhoads, D.C. and J.D. Germano. 1986. Interpreting long-term changes in benthic community structure: a new protocol. *Hydrobiologia* 142: 291-308.

Rhoads, D.C., R.C. Aller, and M.B. Goldhaber, undated. Recruitment and Competition: The Influence of Colonizing Benthos on Physical Properties and Chemical Diagenesis of the Estuarine Seafloor.

Riley, G.A. 1967. The plankton of estuaries. In: Estuaries. G.H. Lauff (ed.). AAAS. Washington, D.C. pp. 316-326.

Rines, Marjorie W. and Robert H. Stymeist, 1994. “Boston Harbor North.” *In*: A Birder’s Guide of Eastern Massachusetts. Bird Observer. 1994. American Birding Association, Inc.

Robbins, Sarah Fraser, and Clarice Yentsch. 1973. The Sea is All About Us. A Guidebook to the Marine Environments of Cape Ann and Other Northern New England Waters. Peabody Museum of Salem. Salem, MA.162 pp.

Rogers, B.A. 1969. The tolerance of fishes to suspended solids. M.S. Thesis, University of Rhode Island.

Saila, S.B. 1961. The contribution of estuaries to offshore winter flounder fishery in Rhode Island. Proceedings of the Gulf and Carribean Fisheries Institute 14:95-109.

Santos, S.L. and J.L. Simon, 1980. Marine Soft-Bottom Community Establishment Following Annual Defaunation: Larval or Adult Recruitment? Mar. Ecol. Prog. Ser., Vol 2: 235-241, 1980.

Science Applications International Corporation (SAIC). 1988. Long-term sand cap stability: New York Dredged Material Disposal Site. Submitted to New York District U.S. Army Corps of Engineers, New York, NY. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. 374.

Science Applications International Corporation (SAIC). 1994. Analysis of the Contribution of Dredged Material to Sediment and Contaminant Fluxes in Long Island Sound. Submitted to U.S. Army Corps of Engineers, Waltham, MA. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. SAIC-89/7571&C82.

Science Applications International Corporation (SAIC) 1997. Capping dredged materials in the New York Bight: Evaluation of the effects of bioturbation. Submitted to New York District U.S. Army Corps of Engineers, New York, NY. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report CERC-88-2. 85 p.

Science Applications International Corporation (SAIC). 1998. Synthesis of Monitoring Results for the 1993 Dioxin Capping Project at the New York Mud Dump Site. Submitted to New York District U.S. Army Corps of Engineers, New York, NY. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. 430.

Science Applications International Corporation (SAIC). 1999a. Habitat Characterization of the DMMP Candidate Aquatic Disposal Sites. Submitted to Massachusetts Coastal Zone Management, Boston, MA. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. SAIC-99/463.

Science Applications International Corporation (SAIC). 1999b. Observations of Physical Oceanographic Conditions at the New London Disposal Site, 1997-1998. Submitted to U.S. Army Corps of Engineers, Concord, MA. Submitted by Science Applications International Corporation, Newport, RI. SAIC Report No. SAIC-453.

Seaport Advisory Council. 2000. *Port Profile - New Bedford, MA*

Shull, D.H. 1992. Mechanisms of Polychaete Dispersal and Recolonization in an Intertidal Sandflat. M.S. Thesis, University of Connecticut.

Sinderman, C. J. 1979. Pollution associated diseases and abnormalities of fish and shellfish: a review. Fishery Bulletin 76: 1-36.

Snelgrove, P.V.R. and C.A. Butman. 1994. Animal-sediment relationships revisited: cause versus effect. Oceanography and Marine Biology Annual Review 32: 111-177.

Sittig, M. 1975. Pollution Control in the Plastics and Rubber Industry. Pollution Technology Review No. 18. Noyes Data Corporation, Park Ridge, NJ.

Steimle, Frank W., Christine A Zetlin, Peter L. Berrien, Donna L. Johnson, and Sukwoo Chang. 1999a. Essential Fish Habitat Source Document: Scup, *Stenotomus chrysops*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-149

Steimle, Frank W., Christine A Zetlin, Peter L. Berrien, and Sukwoo Chang. 1999b. Essential Fish Habitat Source Document: Black Sea Bass, *Centropristis striata*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-143

Stern, E.M. and W.B. Stickle. 1978. Effects of turbidity and suspended material in aquatic environments. USEPA Dredged Material Research Program, Final report 1978. Vicksburg, MS. pp. 1-116.

Stern, E.A., K. Donato, K.W. Jones, and N.L. Clesceri. 1996. *Processing Contaminated Dredged Material from the Port of New York/New Jersey*, Presented at Estuarine Research Federation 96 Symposium, Middleburg, The Netherlands.

Stokman, G.N.M. and W.A. Bruggeman. 1995. “Cleaning of Polluted Sediment,” *European Water Pollution Control*, 5, 5, 25-30.

Stone, S.L., T.A. Lowery, J.D. Field, C.D. Williams, D.M. Neson, S.H. Jury, M.E. Monaco, and L. Andreasen. 1994. Distribution and Abundance of Fishes and Macroinvertebrates in Mid-Atlantic Estuaries. ELMR Rept. No. 12. NOA/NOS Strategic Environmental Assessments Division, Silver Spring, MD.

Summerhayes, C.P. et al. 1977. Fine-grained sediment and industrial waste distribution and dispersal in New Bedford Harbor and western Buzzards Bay, Massachusetts. Woods Hole, Mass: Woods Hole Oceanographic Institution, Technical Report WHOI-76-115.

Summerhayes, C.P., J.P. Ellis and P. Stoffers. 1985. “Estuaries as Sinks for Sediment and Industrial Waste - a Case History from the Massachusetts Coast”. In: Contributions to Sedimentology. H. Fuchbauer, A.P. Lisitzayn, J.D. Milliman, E. Seibold, eds. E. Scheweizerbart’sche Verlagsbuchhandlung (Nagele u. Obermiller), Stuttgart, Germany.

Teal, J. and M. Teal. 1969. Life and Death of the Salt Marsh. Ballantine Brooks. New York, NY.

Thibodeaux, L.J., K.T. Valsaraj, and D.D. Reible. 1994. Capping contaminated sediments - The theoretical basis and laboratory experimental evidence for chemical containment. In: Proceedings of the Second International Conference on Dredging and Dredged Material Placement. November 13-16, 1994. Lake Buena Vista, FL. pp. 1001-1007.

Truitt, C.L. 1986. Fate of Dredged material during open-water disposal. Environmental Effects of Dredging, Technical Notes, EEDP-01-2. US Waterways Experiment Station, Vicksburg, MS. 12 p.

United States Army Corps of Engineers. 1983. Dredging and Dredged Material Disposal. Prepared by the US Army Corps of Engineers, Washington, DC. Engineer Manual 1110-2-5025

United States Army Corps of Engineers. 1986. The Duwamish Waterway Capping Demonstration Project: Engineering analysis and results of physical monitoring. Prepared by the US Army Engineers Waterways Experiment Station, Vicksburg, MS. Technical Report D-86-2. 54 p.

United States Army Corps of Engineers and United States Environmental Protection Agency. 1991. Evaluation of dredged material proposed for ocean disposal (testing manual). EPA-503/8-91/001. USEPA Office of Marine and Estuarine Protection, Washington, DC.

United States Army Corps of Engineers, New England Division and Massport (Massachusetts Port Authority). 1995. "Boston Harbor, Massachusetts Navigation Improvement Project and Berth Dredging Project." Final Environmental Impact Report and Final Environmental Impact Statement.

Massachusetts Executive Office of Environmental Affairs, File Number 8695.

United States Army Corps of Engineers. 1996. Inventory of Dredging Needs in the Designated Port Areas of Massachusetts: 1996-2016. Conducted by the U.S. Army Corps of Engineers, New England Division for the Massachusetts Executive Office of Environmental Affairs, Office of Coastal Zone Management. December, 1996.

United States Army Corps of Engineers and United States Environmental Protection Agency. December 1997. *Dredged Material Management Plan for the Port of New York and New Jersey: Progress Report*.

United States Army Corps of Engineers, New England District. 1996. An Investigation of the Dispersion of Sediments Resuspended by Dredging Operations in New Haven Harbor. DAMOS Contribution 112. November 1996. USACE New England Division, Concord MA.

United States Army Corps of Engineers, New England District. 1998. *Waterborne Commerce of the United States*. Navigation Data Center, New Orleans, LA.

United States Army Corps of Engineers, New England District. 1998. Providence River and Harbor Maintenance Dredging Project Draft Environmental Impact Statement. U.S. Army Corps of Engineers New England District, Concord, MA.

United States Environmental Protection Agency (USEPA). 1998. Record of Decision for the Upper and Lower Harbor Operable Unit - New Bedford Superfund Site, New Bedford, Massachusetts. Region I - New England. September 1998.

United States Army Corps of Engineers, New England District.1999. Monitoring Results from the First Boston Harbor Navigation Improvement Project Confined Aquatic Disposal Cell. DAMOS Contribution 124, January 1999. U.S. Army Corps of Engineers New England District, Concord MA.

United States Army Corps of Engineers (USACE). 2001. Implementation of Dredging Risk Assessment Modeling Applications for Evaluation of the No-Action Scenario and Dredging Impacts. Dredging Operations and Environmental Research Program. ERDC TN-DOER-R2. December 2001.

United States Army Corps of Engineers (USACE). 2001. Providence River and Harbor Maintenance Dredging Project. Final Environmental Impact Statement. August 2001.

United States Census Bureau. 1990. *Selected US Census Data, New Bedford and Fairhaven MA.* Washington DC. http://factfinder.census.gov/servele

United States Census Bureau. 1990. *Selected US Census Data, New Bedford MA.* Washington DC.

United States Census Bureau. 1997. *County Business Patterns – County Profile – Bristol, MA.* Washington DC.

United States Census Bureau. 2000. *Selected US Census Data, New Bedford and Fairhaven MA.* Washington DC. http://factfinder.census.gov/bf

U.S. Environmental Protection Agency. 1993. *Selecting Remediation Techniques for Contaminated Sediment*, EPA-823-B93-001, Office of Water.

U.S. Environmental Protection Agency. 1994. *ARCS Remediation Guidance Document*, EPA 905-B94-003, Great Lakes National Program Office, Chicago, Illinois.

U.S. Environmental Protection Agency. 1996. *Vendor Information System for Innovative Treatment Technologies, Version 5*, Computer Database, Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency. 1996. New Bedford Harbor Long Term Monitoring Assessment Report: Baseline Sampling. Research Report no. 600/R-96/097 October 1996.

U.S. Environmental Protection Agency. 1998. *EPA's Contaminated Sediment Management Strategy*, EPA-823-R-98-001, Office of Water.

U.S. Environmental Protection Agency (USEPA). 1998. Record of Decision for the Upper and Lower Harbor Operable Unit - New Bedford Superfund Site, New Bedford, Massachusetts. Region I - New England. September 1998.

U.S. Environmental Protection Agency Region 2. February 22, 1999. *(Press Release) New Sediment Decontamination Technology Shows Promise*.

United States Maritime Administration. 1999. *Imports by Customs District and Port*. Washington, DC.

United States Maritime Administration. 1999. *Exports by Customs District and Port*. Washington, DC.

U. S. National Marine Fisheries Service (NMFS). 1999. *Northeast Preliminary Fisheries Statistics - Multispecies, May-December 1999.* Fishery Statistics Office, Northeast Regional Office, Gloucester MA.

U.S. Navy, 1979. Draft Environmental Impact Statement, Trident Dredging, Thames River Channel, Groton and New London, CT.

U.S. Navy, 1995. Final Environmental Impact Statement: Seawolf Class Submarine Homeporting on the East Coast of the United States. U.S. Atlantic Fleet, Norfolk, VA.

Valente, R.V., M.C. Swanson, and C.L. Seidel, 1999. Habitat Characterization of the DMMP Candidate Aquatic Disposal Sites. Prepared for Massachusetts Coastal Zone Management. SAIC Report No. 463. March, 1999.

Vanasse Hangen Brustlin, Inc. (VHB), 1996. New Bedford Harbor Historical Overview, Natural Resources Uses Status Report. Prepared for New Bedford Harbor Trustee Council, Gloucester MA.

Vanasse Hangen Brustlin, Inc. (VHB), 2000. New Bedford/Fairhaven Harbor Plan. Prepared for the City of New Bedford and Town of Fairhaven, Harbor Master Plan Committee.

Wahle, R.A. and R.S. Steneck, 1991. Recruitment habitats and nursery grounds of American lobster (*Homarus americanus* Milne Edwards): a demographic bottleneck? Mar. Ecol. Prog. Ser. 69:231-243.

Wieser, Wolfgang. 1960. Benthic studies in Buzzard's Bay II. The meiofauna. *Limnology and Oceanography*. V.5 2:121-137.

Weiss, Howard M. 1995. Marine Animals of Southern New England and New York. Identification Keys to Common Nearshore and Shallow Water Macrofauna. State Geological and Natural History Survey of Connecticut Department of Environmental Protection. Bulletin 115.

Whittaker, D.K., 1999. Quahog Standing Crop Survey. New Bedford/Fairhaven Inner and Outer Harbors. Commonwealth of Massachusetts Division of Marine Fisheries.

Wilbur, T., 1999. CZM. Personal communication.

Wilbur, Anthony. 2000. "Fish Habitat Characterization and Assessment: Approach to Integrate Seafloor Features and Juvenile Organisms Data". Massachusetts Office of Coastal Zone Management. OCEANS 2000MTS/IEEE Conference, 11-14 September 2000.

Wilk, Stuart J., R.A. Pikanowski, A.L. Pacheco, D.G.McMillan, and L.L.Stehlik. 1995. "Response of Fish and Megainvertebrates of the New York Bight Apex to the Abatement of Sewage Sludge Dumping - An Overview". In: Effects of the Cessation of Sewage Sludge Dumping at the 12-mile Site. NOAA Technical Report NMFS 124. U.S. Department of Commerce Seattle, Washington.Wolfe, S., 2000. ENSR. Personal communication.

Wilson, James G. 1988. The Biology of Estuarine Management. Croom Helm, New York. 204 pp.

Zajac, R.N. and R.B. Whitlatch. 1982a. Responses of Estuarine Infauna to Disturbance. I. Spatial and Temporal Variation of Succession. Mar. Ecol. Prog. Ser. 14, 15-2.

Zajac, R.N. and R.B. Whitlatch. 1989. Natural and Disturbance Induced Demographic Variation in an Infaunal Polychaete, *Nephtys incisa*. Mar. Ecol. - Prog. Ser. 57: 89-102.

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