RETURN TO SER AR INDEX

Response to EPA Comments from USEPA Document Entitled: "NBH-South Terminal Proposal (8/25/10 Submittal)"

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September 27, 2010

SDMS DocID 509346

Response to EPA Comments from

USEPA Document Entitled: "NBH-South Terminal Proposal (8/25/10 Submittal)"

INTRODUCTION

The following information represents responses to USEPA comments that were received by the South Terminal Project team via a correspondence from USEPA entitled "NBH – South Terminal Proposal (8/25/10 Submittal)" on September 22, 2010, as well as (similar) comments that were received during an in-person briefing between members of the South Terminal Project Team and members of the USEPA review team on September 16, 2010. The responses to the USEPA comments are provided in numeric sequence, with the numbered sections matching the corresponding questions from the USEPA document entitled: "NBH – South Terminal Proposal (8/25/10 Submittal)". USEPA's document consisted of eleven (11) points; ten (10) of which are addressed within this document. The document notes that Phil Weinberg and Paul Craffey of MassDEP will respond to point number eleven (11) separately.

Response to USEPA Comment Number 1.- Linkages to SER

In an attachment to an e-mail dated September 23, 2010, USEPA requested that the nexus of the South Terminal CDF to the New Bedford Remediation be more fully detailed. (In a subsequent follow-up conversation, EPA acknowledged that the South Terminal CDF need not be linked to the dredging of the federal navigational channel in order to have a sufficient nexus). Our response is as follows:

The area in front of existing South Terminal, and the area around the Gifford Street Boat Ramp and (what is known as) the Gifford Street Mooring Area, are part of planned State Enhanced Remedy (SER) dredging (see **Appendix 1** which includes figures from the New Bedford Harbor Plan [2009] indicating the areas in need of dredging and already contemplated under the SER process). As set forth in the Record of Decision in 1998 and in the phases of navigational dredging following the decision, navigational dredging is recognized as a state enhancement to the CERCLA remediation, because this dredging removes and safely disposes of PCB's that would otherwise stay in the harbor. The dredging that will occur in this area, and the creation of the CDF, enhances the remedy in precisely the same fashion. The dredging that will be needed in order to make the South Terminal Extension serviceable wholly overlaps with the area that has already been planned to be dredged, and would be dredged with or without the South Terminal CDF, under the SER process (see Overlay Map also in **Appendix 1**). SER dredging of a part of the channel in front of existing South Terminal, as well as the Gifford Street Boat Ramp channel, was recently completed (in October of 2009) under Phase III of the SER Navigational Dredge Project in New Bedford Harbor. Additional dredging was originally scheduled (for Phase III) both for the Gifford Street Boat Ramp Channel and the Gifford Street Mooring Basin, however a

shortfall in funding for the Phase III project forced the NBHDC and the State of Massachusetts to reduce the Phase III dredge footprint in this area. It has always been the intent of the NBHDC and MADEP to finish the planned SER dredging of the Gifford Street and South Terminal areas in a future phase of SER dredging (ideally all of it in Phase IV if sufficient funding can be acquired). The footprint for the dredging that would need to be conducted to allow appropriate vessel berthing and access to the proposed South Terminal Extension overlaps with the South Terminal and Gifford Street Boat Ramp and Mooring Basin dredging that is already and otherwise contemplated for this area. Based upon this information, then, the South Terminal CDF (depending upon the final construction methodology) will be linked to the SER in the following potential ways:

- **Navigational Dredging** – Facilitation of navigational dredging, and resulting removal of contaminated sediments from the bottom of the Harbor in locations where USEPA will not be completing remediation, is the prime reason for the creation of the State Enhanced Remedy. As noted above, the dredging for the South Terminal CDF overlies navigational dredging planned by the New Bedford Harbor Development Commission. The dredge footprint for the South Terminal CDF overlies two proposed dredge areas that are included within Phase IV Navigational Dredging for the State Enhanced Remedy, and are also highlighted within the 2009 New Bedford/Fairhaven Harbor Plan:
    - **South Terminal Dredging** – The northern portion of the South Terminal CDF dredging overlies the basin for the existing South Terminal bulkhead. The South Terminal basin extends the length of the existing South Terminal bulkhead, and extends approximately 300 feet to the west of the bulkhead. Navigational dredging for the South Terminal basin is required to maintain the -20 MLLW to -

25 MLLW approved basin depth at this location. This area is scheduled to be dredged in Phase IV regardless of whether the South Terminal CDF is constructed. This area is highlighted within the New Bedford/Fairhaven Harbor Plan.

- **Gifford Street Boat Ramp and Mooring Area Dredging** – The southern portion of the South Terminal CDF dredging overlies areas that are anticipated to be dredged during Phase IV Navigational Dredging to deepen the existing Gifford Street Mooring area. This area of the harbor has accumulated sediments over time and is currently too shallow to be utilized for mooring vessels. This area is highlighted within the New Bedford/Fairhaven Harbor Plan. Therefore, part of Phase IV Navigational Dredging was to conduct maintenance dredging within the Gifford Street Mooring area.

- **Disposal of Contaminated Navigational Dredging Material Within CAD Cells** – The primary methodology for disposal of contaminated material generated during navigational dredging is disposal of that material within CAD Cells located within the Dredge Materials Management Plan-designated area north of Pope's Island within New Bedford Harbor. Disposal of contaminated navigational dredging material removed from the dredge footprint associated with the extension of South Terminal (as part of the South Terminal CDF Project) within CAD Cells is anticipated, as disposing of these materials by other means is likely to be costly and problematic from an engineering standpoint, unless the contaminated material has specific geotechnical properties that lend it to amendment and re-use within the CDF.

- **Disposal of Contaminated Navigational Dredging Material Within the South Terminal CDF** – An alternate methodology for disposal of contaminated material generated during navigational dredging is disposal of that material within the South Terminal CDF, if the contaminated material that is dredged is suitable (from a geotechnical standpoint) for amendment and re-use, and if such disposal complies with all applicable laws, including TSCA. Disposal of contaminated material in this manner within the South Terminal CDF would also facilitate the goals of the State Enhanced Remedy as it facilitates the navigational dredging in the Harbor, which removes PCB contaminated sediment and enhances the Remedy.
- **Utilization of Clean (Parent) Material From CAD Cell Construction –** Clean (parent) material is generated during CAD Cell construction. Removal of clean (parent) material is required in order to create a disposal location for navigational dredging spoils. It is likely that the quantity of contaminated material that will be generated from dredging the South Terminal CDF and/or other planned Phase IV navigational dredge activities will be greater than that which can be accommodated given the capacity of existing CAD Cells in the Harbor. As a result, a new CAD Cell will likely be needed to be created to accommodate the contaminated material. Clean material from this new CAD Cell can be incorporated into the construction of the South Terminal CDF.
- **Utilization of Clean (Parent) Material From Navigational Dredging –** Clean (parent) material will be generated during navigational dredging. This material exists, in places, below the contaminated sediments within the footprint of the navigational dredging that will be conducted as part of the Phase IV Navigational Dredge Project. This material could be placed within the South Terminal CDF, instead of separating it from placing it

into a CAD Cell (which is not necessary as the material is not contaminated and would be taking space that could otherwise be utilized to sequester other contaminated material).

Although the design process for the South Terminal CDF has not yet been completed, it is evident that both contaminated sediment and clean sediment are present within the proposed project footprint. Given this reality, there are a number of potential scenarios by which the design could be completed. Those completed designs would be linked to the State Enhanced Remedy in one or more of the above-mentioned ways. The following is a list of potential construction scenarios, and a description of the ways that that each construction scenario would be linked to the State Enhanced Remedy:

- *Use of Clean CAD Cell Material as Fill for the South Terminal CDF* - In this scenario, only clean material from the CAD Cell would be used as fill for the South Terminal CDF. This scenario likely would be linked to the State Enhanced Remedy in the following ways:
    - Navigational Dredging
    - Disposal of Contaminated Navigational Dredge Material Within CAD Cells
    - Utilization of Clean (Parent) Material From CAD Cell Construction
- *Use of Clean CAD Cell Material and Clean Material from Navigational Dredging as Fill for the South Terminal CDF* - In this scenario, clean material from navigational dredging and clean material from CAD Cell construction would be used as fill for the South Terminal CDF. This scenario likely would be linked to the State Enhanced Remedy in the following ways:
    - Navigational Dredging

- Disposal of Contaminated Navigational Dredge Material Within CAD Cells
- Utilization of Clean (Parent) Material From CAD Cell Construction
- Utilization of Clean (Parent) Material From Navigational Dredging

- *Use of Clean CAD Cell Material and Clean Material from Navigational Dredging and Contaminated Navigational Dredge Material as Fill for the South Terminal CDF* - In this scenario, clean material from navigational dredging, contaminated material from navigational dredging, and clean material from CAD Cell construction would be used as fill for the South Terminal CDF. This scenario likely would be linked to the State Enhanced Remedy in the following ways:
  - Navigational Dredging
  - Disposal of Contaminated Navigational Dredge Material Within CAD Cells
  - Disposal of Contaminated Material Within the South Terminal CDF
  - Utilization of Clean (Parent) Material From CAD Cell Construction
  - Utilization of Clean (Parent) Material From Navigational Dredging
- *Use of Clean Material from the Navigational Dredging Fill for the South Terminal CDF* - In this scenario, only clean navigational dredging would be used as fill for the South Terminal CDF. This scenario likely would be linked to the State Enhanced Remedy in the following ways:
  - Navigational Dredging
  - Disposal of Contaminated Navigational Dredge Material Within CAD Cells
  - Utilization of Clean (Parent) Material From Navigational Dredging
- *Use of Clean Material from Navigational Dredging and Contaminated Navigational Dredge Material as Fill for the South Terminal CDF* - In this scenario, clean material

from navigational dredging and contaminated navigational dredge material would be used as fill for the South Terminal CDF. This scenario likely would be linked to the State Enhanced Remedy in the following ways:

- Navigational Dredging
- Disposal of Contaminated Navigational Dredge Material Within CAD Cells
- Disposal of Contaminated Material Within the South Terminal CDF
- Utilization of Clean (Parent) Material From Navigational Dredging

Navigational dredging will be coordinated with construction of the CDF such that the time frame for both activities will align properly. We also confirm that the CDF will be constructed from clean sand from navigational dredging or CAD cell construction, and potentially contaminated sand from navigational dredging or CAD cell construction (subject to the limitations set forth in the next two paragraphs). Should a CAD Cell be constructed in association with construction of the CDF, the use of clean material from the CAD Cell in construction of the CDF will be timed to coincide with construction of the CAD Cell.

In the event that contaminated navigational dredging material is utilized within the CDF construction, the sediment will be characterized as to whether the material is solid waste, TSCA waste, or hazardous waste. Sampling and analysis protocols (as well as which analytical parameters will be utilized, RIM or 401 Water Quality Certification parameters) will be coordinated with USEPA personnel.

Should it be determined that contaminated navigational dredging material is to be placed within the South Terminal CDF, hydraulic conductivity information will be collected within the existing sediments within the proposed footprint as well as from contaminated navigational dredging material mixed with cement or other additives under consideration, that is to be placed within the South Terminal CDF and will be presented to USEPA.

Regardless of whether contaminated sand will be used, the commonwealth will supply data on hydraulic conductivity after further discussion with EPA regarding a sampling and testing protocol (see Section 2.0).

The Commonwealth submits that this project facilitates navigational dredging, which in turn enhances the CERCLA remediation in precisely the ways envisioned by the original ROD. Therefore, the EPA may properly approve this project as part of the state enhanced remedy.

Response to USEPA Comment Number 2. - Sediment Characterization

Sampling and Analytical Programs

Under the State Enhanced Remedy (SER), the project Stakeholders, including the relevant regulatory agencies, MADEP, the NBHDC, and the USEPA have been adhering to a set of Project Standards known as the *SER Performance Standards for Navigational Dredging in New Bedford/Fairhaven Harbor*. These protocols were originally developed for the "Phase I Dredging" (the State Pier berth, fairways, and channels) as part of the Navigational Dredge Program for New Bedford Harbor, and were subsequently adopted (with some minor modifications) for subsequent Phases of work (including Phase II and Phase III Navigational Dredging so far) to the later dredging Phases under the SER. The State Pier project was completed utilizing input from all of the regulatory programs that govern like projects. As such, the list of sampling and monitoring required was thought to be representative of what would otherwise required under a full permitting process for all relevant programs. As such, the Stakeholders under the SER Process felt that it represented the best model for regulatory guidance concerning future SER projects that had been developed, and the *SER Performance Standardards* have been applied to the subsequent dredging programs. At the conclusion of each

Phase of Navigational Dredging, a "Post-Dredge Report" is compiled which summarizes the work completed and the results of monitoring conducted. This document allows relevant regulatory programs to review the Navigational Dredge Program standards as the overall program unfolds, and make adjustments to the program as necessary, such as the addition of a Sediment Trap Monitoring Program at the end of the Phase II Dredge Project, that was added to the Dredge Program at the request of USEPA and MACZM, and the modification of the barge water filtering program when dredging in areas of historically high PCB concentrations (over 50 ppm total PCBs), which was added to the program for Phase III Dredging at the request of USEPA and MADEP.

The SER Performance Standards include (but are not limited to) the following types of sampling and monitoring:

- Pre-dredge sampling of contaminated sediments to document the levels of PCB's and metals in the sediments prior to dredging;
- Post-dredge sampling of contaminated sediments to document the levels of PCB's and metals in the sediments that remain on the Harbor bottom after the completion of dredging in an area;
- Water quality monitoring (meeting 401 Water Quality Program guidance) is conducted during dredging, and includes the development of background level turbidity in the Harbor and the general area of the dredging, and monitoring in and around the dredge site to determine relative impacts of the dredging on the water column. The water quality monitoring is utilized as a real-time monitoring tool to ensure that the dredging does not create an unacceptable level of turbidity (and hence entrainment of contaminated

sediment particles) in the water column. If water quality monitoring determines that levels of turbidity above the established Performance Standard criteria rare present during dredge events, then the dredge process is halted and adjustments to the methodology are made in order to bring the dredging back into compliance with the standards. If multiple exceedences occur (water quality turbidity readings are not reduced by engineering controls such as modifications to the dredge process), then sampling and analysis of the impacted water body in the area of the dredging is required by the standards.

- Pore water that results from the natural dewatering process of dredging into scows is treated through filtration systems that are identified in the Performance Standards prior to discharge. The discharge water is sampled for turbidity levels at regular intervals during the dredge process, and modifications to the dredge process (including cleaning or addition of filter systems) are implemented if exceedences are noted.
- As noted above, sediment trap monitoring of general harbor sedimentation rates (as a measure of suspended sediment that may be contaminated) is being conducted. Sediment trap data is analyzed for rate of sedimentation per time increment.
- Sampling and analytical testing of the thickness of contaminated sediments overlying "parent geological material" in the footprint of the CAD Cells is collected in order to determine the thickness of the "Top of CAD" material that must be removed during CAD Construction prior to accessing the clean parent material that is suitable for offshore disposal.

The SER Performance Standards have been incorporated in previous versions of the Alternatives Analysis for the South Terminal Project, including the latest submittal of August 25, 2010.

Additionally, the approved New Bedford/Fairhaven Harbor Plan (copy can be viewed at the New Bedford HDC website) includes a copy of the SER Performance Standards for Navigational Dredging in New Bedford/Fairhaven Harbor in an attachment entitled "Dredge Management Plan".

Additional sampling and analysis has been conducted as part of the SER regulatory program in the past to satisfy specific conditions and/or regulatory concerns. Examples of additional monitoring programs that have been undertaken include the USEPA collection of Acoustic Dopler Current Profiler (ADCP) data during the placement of sediments into the CAD Cell via dump scow, which provided regulators with information as to the settlement rate and pathway of sediments as they were disposed of in a CAD Cell in the Harbor.

Specific additional sampling and analytical parameters have been included into past navigational dredge project phases during the design process. As design specifics are determined, particularly those that have to do with construction means and methods and the potential impacts to the environment from specific construction methods, additional monitoring and sampling has been developed and approved by the SER Committee. This has been standard practice for previous Phases of SER dredging. As specific design features are developed during the design process, they are circulated to the SER Committee members for comment. If stakeholders indicate that additional sampling or monitoring of a particular aspect of the project is needed, then draft additional sampling or monitoring parameters are included in the project, and the SER Committee reviews and provides concurrence with that additional sampling and/or monitoring. In keeping with that historical context, it is the intent of the Project to likewise continue with this

approach, and review and adapt sampling and analytical testing and monitoring as necessary to satisfy the needs of the SER stakeholders.

Existing Sediment Characterization Data Relevant to South Terminal Project

USEPA has also asked for a characterization of sediments in the area. Historic sediment characterization is attached as **Appendix 2** of this document. Samples have been historically collected from within the inter-tidal area, from within sub-tidal area, both within the proposed facility footprint and within the proposed dredge footprint. The primary methodology for characterization of these sediment samples has been analysis for PCB concentrations.

In accordance with the collaborative procedures relating to existing State Enhanced Remedy protocols/procedures, the Project proposes to work directly with USEPA to develop a specific sampling and analytical program for the South Terminal Project that will both fulfill the traditional requirements of the SER Performance Standards, as well as address specific data needs that are necessary for regulatory parties that are stakeholders in the SER process. While agreeing that a sampling and analytical program that is developed at this stage in the project may need to be augmented at a later date with additional data once specific design elements are laid out in detail, the Project Team will develop a Sampling and Analysis Plan (SAP), through direct discussions with USEPA, that will be focused on quantifying and qualifying the types of materials that will be incorporated into this project. Elements that will be included in the plan include (but are not necessarily be limited to):

- Hydraulic conductivity data on organic sediments within the project footprint that may be contaminated, both prior to disturbance (i.e., un-amended) and after incorporation into the Project (i.e., amended);
- Analytical data concerning the quality of the sediments that will be disturbed as part of the project, particularly those sediments that may contain contaminants;
- Analytical data concerning the quality of sediments that may be incorporated into the CDF; and
- A sampling and analytical plan for the determination of the thickness of the contaminated sediment overlying "parent geological material" (in relevant portions of the project), and a method upon which the interface between the overlying contaminated organic sediment and the "parent material" can reasonably be determined.

As discussed in the response to Question 1, contaminated navigational dredging material will either be disposed of within the South Terminal CDF (subject to conditions described above) or will be transported to a CAD Cell for disposal.

2.1 Impacts to Aquatic Life Resulting from Re-Suspension/Bioavailability From Proposed Dredging Activity

Completion of the proposed dredging may result in some re-suspension/bioavailability of contaminated sediments. The re-suspension will be a by-product of the dredging activity that will result from either mechanical or hydraulic means of collecting sediment for sequestration and disposal. The re-suspension will be controlled utilizing a combination of Bests Management

Practices, including the use of environmental buckets, silt curtains, time of year restrictions, filtration of decant water and other methodologies.

However, the removal of the contaminated sediments within the dredge area will result in a significant reduction in bioavailability of contaminants in the long-term. The suspension of harbor sediments within the water column during dredging operations will cause a temporary increase in the bioavailability of superfund contaminants of concern. However, based on the results of previous studies (WES, 1986; Bohlen et al., 1979), re-suspended dredged material should settle rapidly (within approximately 1,500 feet) of the dredge area, and typically within hours of the cessation of dredging activities. This information is further supported by a study completed by Battelle on behalf of USEPA, dated December 15, 2009, and referenced within the Essential Fish Habitat Assessment prepared for this project which stated that the plume of suspended sediment that was generated during disposal of sediment within a CAD Cell dissipated to near-background levels within 90 minutes.

Given the commitment to using best management practices, and the documented minimal re-suspension effects of dredging, the dredging will not significantly increase the bio-availability of the contaminants and will not have a significant adverse effect on aquatic life.

Dredging will produce conditions similar to those which arise whenever rough seas or turbid conditions form within New Bedford Harbor, as the result of storm events. Observed conditions over the past nine years in New Bedford Harbor have indicated that storm events, particularly in shallow-water areas, are very likely to create sufficient turbulence due to wave action such that visibility when diving within New Bedford Harbor is virtually non-existent. The removal of the

fine-grained contaminated material reduces the amount of turbidity that such storm events will create in the future, and will further reduce the bioavailability of PCB and metals impacts within sediment that is entrained within the water column during these storm events in the vicinity of the South Terminal CDF.

It is expected that the dredging portion of the project will last for approximately one to two months and suspended sediment (absent the proposed controls) would be elevated during this time period. Although dredging will temporarily increase turbidity during the dredging activity (which will last a matter of hours before settling out from the water column), this effect will only last for the short lifespan of the dredge project. The re-suspension and increased bioavailability of sediment due to storm events in shallow waters (such as those at the South Terminal CDF) will be a continual process, repeated during each storm event, until such time as the impacted sediment is removed.

2.2 Source of PCB Contamination

USEPA stated within its letter that "sediment characterization for the subtidal and intertidal areas needs to document the assertion that the area below MHW at the South Terminal site acts as a source of PCB contamination to other parts of New Bedford Harbor." The Commonwealth has **not** stated that the areas below MHW act as a particularly noteworthy source of PCB contamination to other parts of New Bedford Harbor, but instead asserted that all contaminated areas within New Bedford Harbor act as sources of contamination to non-impacted areas outside of New Bedford Harbor. The following are quoted from the Functions and Values Assessment prepared for this site:

- *Within Sediment/Toxicant Reduction – "Fine grained material or sediment are present below the low tide line and are also interspersed within the sand-dominated coastal beach, which results in the elevated concentrations of PCBs in both locations; however, this area of New Bedford Harbor is not one typically that is responsible for sediment retention, and it definitely is not responsible for toxicant retention, and instead serves to export toxicants to un-impacted areas within Buzzard's Bay."*
- *Within Nutrient Removal/Retention/Transformation and Production Export (Nutrient) – "The flow regime, low detention time, absence of slowly draining fine-grained material or deep organic/sediment deposits limit the capabilities of the wetland areas to act as a sink for nutrients. As stated before, the sediments within the wetland areas are contaminated with PCBs. The production of food or usable products for humans or other living organisms by the wetland areas are not beneficial to humans, wildlife, fish or the environment. Therefore, the functions/values of Nutrient Removal/Retention/ Transformation and Production Export (Nutrient) are not highly functioning for the wetland areas, and those aspects that are functioning, present a significant risk to the environment."*

The results of analysis of intertidal sediments (see **Appendix 2**) has shown that concentrations of PCBs at these locations may be lower than many other locations within New Bedford Harbor; however, the concentrations are still well above the acceptable level for sediments within the Commonwealth of Massachusetts. Analysis of sediments collected within the footprint of the facility to date range from 0.07 mg/kg to 2 mg/kg in concentrations of total PCBs. Analysis of

sediments collected within the proposed dredge footprint to date range from 1 mg/kg to 16 mg/kg.

When assessing the potential for re-use of sediment within fresh water bodies in the Commonwealth of Massachusetts under the Federal 401 Water Quality Certification (which is considered a suitably analogous standard by which to evaluate ecological risk under 310 CMR 40.0000, the Massachusetts Contingency Plan for releases of PCBs), MassDEP utilizes the level of 0.0598 mg/kg. The Commonwealth of Massachusetts has set an upper limit of < 2 mg/kg for reuse of soil (or sediment) within either lined or unlined landfills. Regardless of the benchmark utilized for assessment, the sediments both within the footprint of the proposed facility, as well as within the proposed dredge footprint contain concentrations of PCBs that are higher than that of uncontaminated locations outside of New Bedford Harbor. Storm events, natural erosion, and tidal exchanges naturally transport sediment from within New Bedford Harbor to Buzzard's Bay and other surrounding areas. Therefore, these areas act as a source of contamination to uncontaminated areas outside of New Bedford Harbor.

Response to USEPA Comment Number 3. - Impacts from Pilings and Shadings

A temporary bridge is currently proposed to connect the southern portion of the South Terminal CDF to the southern ancillary properties. In order to support the bridge, up to 10 pilings (between 30-inches and 48-inches in diameter) will need to be installed beneath the bridge. The bridge would be removed at a later date, after the initial use of the facility was complete. The pilings are intended to be temporary, and would be removed from the substrate when the structure is removed. It is currently anticipated that the pilings would be installed via a barge-

mounted crane, that would drive the pilings to the appropriate depth. The pilings would be extracted in a similar fashion from a barge-mounted piece of construction equipment.

A “Bailey Bridge” is constructed from metal truss sections, and reinforced steel grid for the deck of the bridge. It is currently anticipated that the bridge would be approximately 30 to 40 feet wide, and would be approximately 300 to 400 feet long. As a result of the truss/grid type of construction, the structure is not opaque, and allows sunlight to penetrate (see **Appendix 3** for a picture of a bridge deck). Therefore, the bridge will minimize shading issues on the adjacent salt marsh. Additionally, the bridge is located adjacent to, rather than atop, the salt marsh, which will further minimize shading to the salt marsh. Once work at the facility is complete, and the bridge is removed, the pilings will be extracted.

Impacts from installation and removal of the bridge are anticipated to be minor, as the pilings for the bridge will be able to be installed from a barge-mounted crane or pile driver or similar piece of equipment or from a piece of land-based equipment, depending on the location of the pilings. Similarly, a combination of barge-mounted cranes and land-mounted cranes (or similar pieces of equipment) would be utilized to transport the bridge units into place atop the pilings. It is currently anticipated that suspended sediment generation will be minor during the installation operation; however, silt curtains will be utilized, where they can be utilized effectively to minimize ecological damage (for example, silt curtains would not be utilized in water shallower than -5 MLLW, as they would increase the suspension of sediment, rather than decreasing suspended sediment).

It is currently anticipated that the temporary bridge will be required for the first offshore renewable energy support project. It is anticipated that an easement for a land-connection to the southern parcels will be negotiated in the future to deal with subsequent offshore renewable energy support projects. Should, in the future, the bridge be needed again, a separate permitting process would be undertaken to re-install the bridge.

Response to USEPA Comment Number 4. - Boat Traffic Secondary Impacts

The analysis of boat traffic secondary impacts is broken down into two sub-sections:

1). An analysis of the increased risk due to oil spills due to operation of the new facility.
2). An analysis of the increased vessel traffic due to operation at the new facility.

Please note that both question 4.0 and question 5.0 both refer to potential prop wash and associated turbidity secondary impact issues. The response to both of these questions with regard to prop wash and turbidity temporary impacts are included within Section 5.0.

4.1 Oil Spill Analysis

The following is an analysis that was conducted in order to determine the increased risk in oil spills due to the South Terminal CDF construction. In order to conduct this analysis, existing research into the vessel traffic and the risk of associated oil spills was reviewed. The most up-to-date analysis of the risk posed to coastal communities in Massachusetts by oil spills was prepared by Nuka Research & Planning Group, LLC for the Massachusetts Department of Environmental Protection, titled "Evaluation of Marine Oil Spill Threat to Massachusetts Coastal Communities", dated December 2009 (included as **Appendix 4**).

As stipulated within this report, the main risk of spills in many harbors and ports (not to mention navigable waterways) is the possibility that a vessel will accidentally discharge petroleum through a vessel sinking, grounding, collision, fire or through accidental or illegal discharges from vessel operations, such as bilge pumping, changing engine oil, or refueling. For the purposes of this section, the assumption is made that the larger the size of the fleet of vessels servicing a harbor, the larger the threat of an oil spill from any of these possible sources. To estimate the magnitude of each oil spill threat for the purpose of comparison, a gallons of petroleum exposure measure (GPE) is calculated for each threat within each harbor in Massachusetts. For vessels permanently stationed within a harbor, the total GPE is the volume of petroleum product that could be released at any one point in time (usually the volume of the fuel tank of the vessel); for vessels in transit, the total GPE is the volume of petroleum product times the number of visits that the vessel makes to that port.

There are two categories of potential risk from vessels that are evaluated below: oil spill risk from vessels within and/or transiting to and from New Bedford Harbor, oil spill risk from increases in bulk oil storage within New Bedford Harbor, and the potential increased risk for oil spills from regional vessel transits. The following outlines the existing Oil Spill Threat in these three categories:

Existing Oil Spill Threat For New Bedford Harbor

The following is a summary of the existing oil spill threat based upon existing traffic (based upon data gathered from 2006) in Gallons of Petroleum Exposure (GPE) for the City of New Bedford, based upon the category of vessel:

- Oil Tanker or Tank Barge Activity – 43,250,000 GPE

- Large Nontank Vessels – 1,725,000,000 GPE
- Recreational and Charter Vessels – 300,000 GPE
- Commercial Fishing Vessel Fleet – 7,500,000 GPE
- Ferry Terminals – 5,500 GPE
- Other Large Vessels (Tugs, Training Vessels) – 84,000 GPE
- Vessels Associated with Shipyard Activity – 900,000 GPE

Total Existing Oil Spill Threat in GPE for Vessels, New Bedford Harbor: **1,777,039,500 GPE**

Existing Oil Spill Threat for Vessel Activity Within Shipping Lanes

The following is a summary of the existing oil spill threat for existing shipping lanes based upon existing traffic (based upon data gathered from 2006) in Gallons of Petroleum Exposure (GPE) for the following areas:

- Regional Transit Vessels (South Coastal/New Bedford) – 1,517,636,000 GPE
- Regional Transit Vessels (Dartmouth/Fairhaven/Marion/Mattapoisett/Wareham/ Westport) – 1,562,611,000 GPE
- Cape and Islands – 1,562,611,000 GPE

Increased Vessel Traffic Due to South Terminal CDF Construction and Operation

Increased traffic at the South Terminal CDF site is anticipated to include the following vessels during the first year:

- An international vessel (similar to a traditional non-tank vessel), between 140 - 150 meters (460 – 490 feet) in length. The international vessel can only carry components for 6 turbines at one time. Therefore, for constructing an offshore wind energy facility

for 130 turbines, 22 separate shipments from international vessels would need to be received at the support facility. These shipments would be anticipated to be receive within the first year of operation of the facility.

- Two installation vessels would be also required at the facility. Offshore renewable energy facility installation ships would consist of jack-up barges that would be approximately 91 meters (300 feet) in length and 30 meters (100 feet) in width. The vessels would not be powered on their own, and would require a tug to maneuver them out of dock and out to the construction site. It is currently anticipated that each barge would require one tug (each tug is estimated to be approximately 30 meters, or 100 feet in length) to maneuver the vessel out to sea; however, the facility would employ two tugs (one for each installation vessel). Each installation vessel would be capable of delivering components for installation of 2 wind turbines for each trip, resulting in a total of 65 total trips for the vessels during the first year.

In accordance with the categorization system created by Nuka Research & Planning Group, LLC within their report, the anticipated increased oil spill threat for the additional vessels is as follows:

- International Vessels: Nontank Vessels within New Bedford area anticipated to have an average fuel capacity of 75,000 gallons. 22 annual non-tank vessels X 75,000 gallons per vessel equates to 1,650,000 GPE for the international vessels.
- Installation Vessels (and tugs) Within the Port of New Bedford: For commercial tugs between 65 and 100 feet in length, the average fuel capacity is 17,500 gallons. There are anticipated to be two tugs in port at any one time in order to assist in tendering the

installation vessels in and out of port. Therefore, the increased oil spill threat due to the additional tugs is: 2 tugs X 17,500 gallons per tug, which equates to an increase of 35,000 GPE.

- Installation Vessels (and tugs) In Transit to the Construction Site: There are anticipated to be one tug that accompanies each installation vessel to the construction site. There are anticipated to be approximately 65 trips to the construction site. Therefore, the increased oil spill threat in transit to the construction site due to the installation vessels is: 65 tugs X 17,500 gallons per tug, which equates to an increase of 1,137,500 GPE.

The total increase in oil spill threat for New Bedford Harbor is: 1,650,000 GPE + 35,000 GPE = **1,685,000 GPE.** As stated earlier, the total existing oil spill risk for the Port of New Bedford is: 1,777,039,500 GPE. Therefore, the construction of the South Terminal CDF will result in a 1,685,000/1,777,039,500 = **0.095%** increase in oil spill risk for the Port of New Bedford, an extremely small increase over current existing conditions.

The total increase in oil spill threat for areas within which the international vessels and installation vessels/tugs will transit is: 1,650,000 GPE + 1,137,500 GPE = **2,787,500 GPE** over the course of a year of installation. As stated earlier, the total existing oil spill risk for areas surrounding the south coast as well as Cape Cod and the Island is:

- Regional Transit Vessels (South Coastal/New Bedford) – 1,517,636,000 GPE
- Regional Transit Vessels (Dartmouth/Fairhaven/Marion/Mattapoisett/Wareham/ Westport) – 1,562,611,000 GPE
- Cape and Islands – 1,562,611,000 GPE

Therefore, the relative increase in oil spill risk due to the addition of international vessels and the transit of installation vessels is:

- Regional Transit Vessels (South Coastal/New Bedford) – 2,787,500/1,517,636,000 = **0.18%**
- Regional Transit Vessels (Dartmouth/Fairhaven/Marion/Mattapoisett/Wareham/ Westport) – 2,787,500/1,562,611,000 = **0.18%**
- Cape and Islands – 2,787,500/1,562,611,000 = **0.18%**

All of which represent an extremely small increase in oil spill risk over current existing conditions.

Maritime Terminal Operation

After the initial use of the facility as an offshore renewable energy support facility, the facility will serve as a maritime terminal. Increased traffic at the South Terminal CDF site (subsequent to the first year) is anticipated to include the following vessels:

- An average of one cargo vessel per week is currently anticipated at the facility subsequent to the first year. This vessel would likely be similar in size to the above-mentioned international vessel (similar to a traditional non-tank vessel), between 140 - 150 meters (460 – 490 feet) in length. Alternately, several smaller, short-seas shipping barges may service the site, (transmitting a similar quantity of cargo) which could result in an average of approximately four smaller barges (similar in size to the installation vessels) per week. Therefore, the total anticipated traffic increase is an average of 3 vessels per week (approximately 156 vessels per year).

In accordance with the categorization system created by Nuka Research & Planning Group, LLC within their report, the anticipated increased oil spill threat for the additional vessels is as follows:

- Non-Tank Cargo Vessels within New Bedford area anticipated to have an average fuel capacity of 75,000 gallons. 156 annual non-tank vessels X 75,000 gallons per vessel equates to **11,700,000 GPE** for the oil spill threat (after the first year) for cargo vessels. This value would be the same for both vessels within New Bedford Harbor and Vessels in transit to the site.

The total increase in oil spill threat for New Bedford Harbor is: **11,700,000 GPE.** As stated earlier, the total existing oil spill threat for the Port of New Bedford is: 1,777,039,500 GPE. Therefore, the oil spill threat (after the first year) will result in a 11,700,000/1,777,039,500 = **0.65%** increase in oil spill threat for the Port of New Bedford, an extremely small increase over current existing conditions.

The total increase in oil spill threat for areas within which the cargo vessels will transit is: **11,700,000 GPE** over the course of a year. As stated earlier, the total existing oil spill risk for areas surrounding the south coast as well as Cape Cod and the Island is:

- Regional Transit Vessels (South Coastal/New Bedford) – 1,517,636,000 GPE
- Regional Transit Vessels (Dartmouth/Fairhaven/Marion/Mattapoisett/Wareham/ Westport) – 1,562,611,000 GPE
- Cape and Islands – 1,562,611,000 GPE

Therefore, the relative increase in oil spill threat after the first year of operation of the new terminal is:

- Regional Transit Vessels (South Coastal/New Bedford) – 11,700,000/1,517,636,000 = **0.77%**
- Regional Transit Vessels (Dartmouth/Fairhaven/Marion/Mattapoisett/Wareham/ Westport) – 11,700,000/1,562,611,000 = **0.75%**
- Cape and Islands – 11,700,000/1,562,611,000 = **0.75%**

All of which represent an extremely small increase in oil spill risk over current existing conditions.

4.2 Vessel Traffic Analysis

Another potential secondary impact is the potential for increased vessel traffic to result in resulting restrictions to the usage of the harbor (due to limited Harbor accessibility and resources) or resulting in increased ecological impacts (due to the potential for prop wash to res-suspend sediments and cause turbidity that would affect avian wildlife or essential fish within New Bedford Harbor). In order to conduct this analysis, existing research into vessel traffic was reviewed. The most up-to-date analysis of vessel traffic in coastal communities in Massachusetts was formulated in order to assess oil spill risks within a document prepared by Nuka Research & Planning Group, LLC for the Massachusetts Department of Environmental Protection, titled "Evaluation of Marine Oil Spill Threat to Massachusetts Coastal Communities", dated December 2009 (included as **Appendix 4**). To help translate some of these numbers into vessel trips (from the GPE oil risk metric utilized within the report) information on vessel types and traffic was utilized from the New Bedford/Fairhaven Harbor Plan.

For the purposes of this section, the assumption is made that the larger number of vessels transiting in and out of a port, the larger the potential impact of interference to other vessels and from prop wash or disturbance of bottom sediments. To estimate the traffic within New Bedford Harbor, vessel numbers and usage are extrapolated from a gallon of petroleum exposure measure (GPE) metric calculated within Nuka Research & Planning Group, LLC report.

There are two categories of potential risk from vessels that are evaluated below: the potential for additional vessels to restrict usage of the harbor for existing vessels (particularly restrictions at the New Bedford Hurricane Barrier), and the potential increased ecological risk posed by increased prop wash or disturbance of bottom sediments. The following outlines the existing vessel traffic impacts in these two categories:

Existing Maritime Traffic Within New Bedford Harbor

The following is a summary of the existing marine traffic (based upon data gathered from 2006) for the City of New Bedford, based upon the category of vessel:

- Oil Tanker or Tank Barge Activity – Total traffic within New Bedford Harbor is formulated at 43,250,000 GPE. Typical general purpose tankers that transport bulk fuel within New Bedford Harbor are approximately 10,000 Dead Weight Tons, which equates to an approximate average capacity of 4,375,000 gallons per tanker. Therefore the average number of trips per year for oil tankers within New Bedford Harbor is 10 trips/year for Oil Tankers or Tank Barges.

- Large Nontank Vessels – Information within the Nuka Research & Planning Group, LLC report specifically states that there are currently approximately 23 trips per year of Non-Tank Vessels.
- Recreational and Charter Vessels – Total recreational and charter vessel traffic is formulated at 300,000 GPE. Typical recreational vessels have an average capacity of approximately 200 gallons per vessel, which equates to approximately 1,500 recreational vessels. Assuming each vessel on average takes a trip once every other week between May and October of each year, there are 12 trips per year per vessel = 18,000 trips per year.
- Cruise Ships - American Cruise Lines makes weekly port calls to the New Bedford State Pier from late Spring to early Fall for a total of between 20 and 24 visits = approximately 22 trips per year.
- Vessel Maintenance and Repair - There are two major facilities in Fairhaven that service commercial and recreational vessels and there are several other smaller repair facilities scattered around the harbor. These facilities account for approximately 200 trips per year within New Bedford Harbor.
- Government vessels - A variety of government boats regularly operate in the Harbor including law enforcement boats (US Coast Guard, Mass Environmental Police, State Police Marine Unit, New Bedford Police Marine Unit, Harbormasters (New Bedford and Fairhaven)), EPA, Army Corps of Engineering, research vessels, and visiting vessels. These vessels account for approximately 1,500 trips per year.
- Harbor Work Boats - These include harbor tugs, pilot boats, commercial assist vessels (e.g. SeaTow), marina launches, or marine contractor vessels working on infrastructure

projects ranging from dredging to pier repair. These vessels account for approximately 2,000 trips per year.

- Commercial Fishing Vessel Fleet – According to the New Bedford Harbor Development Commission, the New Bedford Commercial Fishing Fleet currently is comprised of approximately 500 vessels, 120 of which are transient vessels. Due to current fishing restrictions, over the course of a year, an average fishing vessel spends 226 days in port. Every extended commercial fishing trip lasts one to two weeks. Therefore there are (on average) 15 trips per year per vessel, which is a total of 7,500 trips per year for the commercial fishing fleet.
- Ferry Terminals – There is currently one ferry terminal within New Bedford Harbor (The New Bedford-Martha's Vineyard Fast Ferry). According to the New Bedford Fast Ferry Website, the ferry makes approximately (approximately 1,300 trips per year).

Therefore, the total estimated number of trips in and out of New Bedford Harbor each year is 30,555 trips per year or approximately 84 trips per day.

According to the New Bedford Harbor Development Commission and Port Security personnel, the existing level of traffic is quite low compared to the existing capacity of traffic that the New Bedford Hurricane Barrier can accommodate; in fact, New Bedford Harbor is generally considered to be severely under-utilized. New Bedford Harbor is a relatively low-traffic harbor, and significant expansion of vessel traffic would be extremely unlikely to hinder the demands on traffic. Waits for entrance into New Bedford Harbor are currently extremely infrequent, and often there is no traffic transiting the Hurricane Barrier opening, nor are there typically lines to enter or exit the harbor. Therefore, the existing traffic numbers calculated above indicate

relatively low quantity of traffic, and relatively small increases or decreases in traffic would have a relatively small change in either the operational or environmental impact to New Bedford Harbor.

Increased Vessel Traffic Due to South Terminal CDF Construction

Increased traffic at the South Terminal CDF site is anticipated to include the following vessels during the first year:

- An international vessel (similar to a traditional non-tank vessel), between 140 - 150 meters (460 – 490 feet) in length. The international vessel can only carry components for 6 turbines at one time. Therefore, for constructing an offshore wind energy facility for 130 turbines, 22 separate shipments from international vessels would need to be received at the support facility. These shipments would be anticipated to be receive within the first year of operation of the facility.
- Two installation vessels would be also required at the facility. Offshore renewable energy facility installation ships would consist of jack-up barges that would be approximately 91 meters (300 feet) in width and 30 meters (100 feet) in width. The vessels would not be powered on their own, and would require a tug to maneuver them out of dock and out to the construction site. It is currently anticipated that each barge would require one tug (each tug is estimated to be approximately 30 meters, or 100 feet in length) to maneuver the vessel out to sea; however, the facility would employ two tugs (one for each installation vessel). Each installation vessel would be capable of delivering components for installation of 2 wind turbines for each trip, resulting in a total of 65 total trips for the vessels during the first year.

Increased traffic at the South Terminal CDF site (subsequent to the first year) is anticipated to include the following vessels:

- An average of one cargo vessel per week is currently anticipated at the facility subsequent to the first year. This vessel would likely be similar in size to the above-mentioned international vessel (similar to a traditional non-tank vessel), between 140 - 150 meters (460 – 490 feet) in length. Alternately, several smaller, short-seas shipping barges may service the site, (transmitting a similar quantity of cargo) which could result in an average of approximately four smaller barges (similar in size to the installation vessels) per week. Therefore, the total anticipated traffic increase is an average of 3 vessels per week (approximately 156 vessels per year).

Proportional Increase in Marine Traffic

- *First Year Traffic Increase:* The increase in traffic for the first year is anticipated to be (22 + 65 = 87) 87 total trips. This represents an increase of 87/30,555 = 0.28% increase in marine traffic.
- *Post-First Year Traffic Increase:* The increase in traffic for subsequent years is anticipated to be 156 total trips. This represents an increase in 156/30,555 = 0.5% increase in marine traffic.

Both of the above scenarios represent very small increases in marine traffic for the Port of New Bedford, and are extremely unlikely to cause any major disruption to marine traffic.

Potential for Traffic Interference With Commercial Fishing Industry

Conflict with commercial fishing vessels is not anticipated, particularly considering the professional skills/experience of both the fishing vessel crews and the merchant mariners operating the large freighters and tugs. This is confirmed by long (literally centuries of) experience with the operation of both merchant ships and commercial fishing vessels in the Harbor.

South Terminal itself serves as a temporary berth for commercial fishing vessels for off-loading of catches at fish processing facilities. Long-term berthing for vessels is generally not permitted. Cargo vessels transiting to the South Terminal CDF location will not disrupt operations at the fish processing facilities, as the cargo vessels will transit sufficiently far from the bulkhead to allow unloading operations at the facilities to proceed unhindered. Interference with arrivals and departures at the fish processing facilities due to the additional vessel traffic will also be relatively minor, as unloading at the facilities typically takes up to an hour or more and transiting vessels will likely only pass through the channel in front of the existing South Terminal bulkhead for 10-15 minutes or so. Once the vessels have passed the fish processing facilities, no further interference is anticipated during berthing operations of the cargo vessels.

A similar sharing of the water sheet currently exists in the area north of the Route 6 Bridge at Bridge Terminal on Fish Island and at Maritime Terminal and North Terminal. North Terminal currently harbors existing fish processing facilities, and also allows berthing of fishing vessels. Maritime Terminal and Bridge Terminal load and unload cargo vessels. The mixture of commercial fishing vessels and cargo vessels and has not proved burdensome to existing

commercial fishing traffic in this location; similarly, it is not anticipated to be burdensome at South Terminal.

Should unexpected conflicts arise regarding vessel traffic at either the Hurricane Barrier or at South Terminal, it may prove necessary to implement various traffic management practices to ensure that vessels can continue to operate safely, efficiently, and with minimal impact on the environment. Although not currently anticipated, if required, these considerations will be included in the design and in evaluation of the proposed future operation of the South Terminal CDF.

Response to USEPA Comment Number 5. - Proportional Increase in Prop Wash and Turbidity

In most areas within New Bedford Harbor, a proportional increase in prop wash (caused by a proportional increase in vessel traffic) could be linked to a representative corresponding increase in suspended sediment caused by prop wash (however, this is anticipated not to be the case at the South Terminal CDF location, see discussion below). Prop wash from marine vessels increases turbidity by mixing sediment below the prop into the water column via turbulence. The suspended sediment becomes entrained within the water column, and is subsequently more bio-available to marine life via ingestion or respiration. Bottom sediment within New Bedford Harbor is impacted with PCBs and heavy metals; therefore, entrainment of this sediment within New Bedford Harbor, while not adding to contaminants within New Bedford Harbor, re-suspends contaminants, increasing their bio-availability to marine life.

The greatest risk for increased turbidity lies at each vessel's docking location. This is because each dock location is dredged to the approximate depth that vessels berthing at that facility require. Therefore, although a vessel may draft only 6 feet, that vessel typically is moored within an area that can accommodate at most 7 to 8 feet; therefore, the vessel has the most risk of entraining sediment when it is berthing and leaving its dockage, due to the proximity of its prop to the harbor bottom (channels and fairways are typically deeper than the deepest draft vessel that will transit the Harbor, and therefore there is much less of a risk from entrained sediment within these areas).

Although there are mitigating factors that will likely result in significantly less (or perhaps no) additional turbidity to be added to New Bedford Harbor as a result of the new facility (see discussion below), the worst-case scenario is that, as stated above, turbidity would increase proportionally with harbor traffic. Existing traffic within New Bedford Harbor can be utilized as a relative measure of the existing level of turbulence caused by prop wash within New Bedford Harbor from marine operations. The relative increase in marine traffic due to the South Terminal CDF can then be compared to the existing level of marine traffic to determine the relative increase in turbidity and therefore suspended sediment and water quality impact, as follows.

- *First Year Traffic Increase:* The increase in traffic for the first year is anticipated to be (22 + 65 = 87) 87 total trips. This represents an increase of 87/30,555 = 0.28% increase in marine traffic.

- *Post-First Year Traffic Increase:* The increase in traffic for subsequent years is anticipated to be 156 total trips. This represents an increase in 156/30,555 = 0.5% increase in marine traffic.

It is assumed in this worst-case analysis, that all vessels, regardless of draft, generate increased turbidity due to prop wash: vessels with smaller draft tend to berth or moor in shallower areas and vessels with deeper drafts tend to berth in deeper areas. In both cases, the props for the vessels will be relatively close to the bottom of the harbor, and will therefore have impacts on turbidity within the Harbor. Therefore, in the worst case analysis, the relative increase in entrained sediment within New Bedford Harbor from creation of the South Terminal CDF will range from 0.28% to 0.5%, a very small increase, relative to existing conditions.

It is very likely that operations at the South Terminal CDF will result in significantly less increased suspended sediment than the worst-case scenario described above. The greatest risk of entrained sediment occurs from fine-grained organic material that accumulates at the bottom of the harbor. Specifically within New Bedford Harbor, fine-grained organic material that is impacted by metals and PCBs would generate the largest potential impact to marine organisms; however, this material will be removed from the South Terminal CDF dredge footprint prior to the start of operations at the facility. It is anticipated that, due to the dredge depth within the footprint of the proposed facility (-20 to -30 MLLW, as stated previously), that the geologic material that will be present below the props within the South Terminal CDF dredge footprint will be glacial till material. Glacial till is tightly-packed combination of sand, silt and gravel that was left after passage of the glaciers. This material will be free of anthropogenic contaminants as a result of the date of its formation (the glaciers retreated from this region 13,000 years ago).

Due to the density of this material, it is often very difficult to remove even with heavy equipment. Therefore, it is highly unlikely that prop wash could dislodge it. As a result, prop wash from the new vessels is unlikely to be a significant concern. Therefore, although the worst-case scenario indicates an increase in turbidity of 0.28% to 0.5%, the actual increase in turbidity is anticipated to be significantly less than this number.

Response to USEPA Comment Number 6. - Bilge and Ballast Water

Language included in the first submittal was intentionally conservative. Our recent follow-up contacts with shippers, Coast Guard regulators, and marine operators have allowed us to temper/refine our analysis of the challenges and potential hazards of handling expected bilge and ballast water from vessels that will be associated with offshore renewable energy support as well as vessels that are expected to utilize the South Terminal CDF after the first offshore renewable energy support project is complete.

Bilge Water

Handling bilge water is a routine task for licensed merchant ships. Section 311 of the Clean Water Act, as amended by the Oil Pollution Act of 1990 (33 U.S.C. 2701-2720), applies to ships and prohibits discharge of oil or hazardous substances in harmful quantities into or upon U.S. navigable waters, or into or upon the waters of the contiguous zone, or which may affect natural resources in the U.S. EEZ (extending 200 miles (320 km) offshore). Coast Guard regulations (33 CFR §151.10) prohibit discharge of oil within 12 miles (19 km) from shore, unless passed through a 15-ppm oil water separator, and unless the discharge does not cause a visible sheen. Beyond 12 miles (19 km), oil or oily mixtures can be discharged while a vessel is proceeding en

route and if the oil content without dilution is less than 100 ppm. Vessels are required to maintain an Oil Record Book to record disposal of oily residues and discharges overboard or disposal of bilge water.

In addition to Section 311 requirements, the Act to Prevent Pollution from Ships (APPS) implements MARPOL Annex I concerning oil pollution. APPS applies to all U.S. flagged ships anywhere in the world and to all foreign flagged vessels operating in the navigable waters of the United States, or while at a port under U.S. jurisdiction. To implement APPS, the Coast Guard has promulgated regulations prohibiting the discharge of oil or oily mixtures into the sea within 12 nautical miles (22 km) of the nearest land, except under limited conditions.

Coast Guard regulations are very specific, inspections are frequent, and federal penalties and fines for noncompliance are stiff. A No Discharge Zone has been created for Buzzards Bay which includes New Bedford Harbor. Non-compliance also can result in significant fines from State regulators. No discharge of bilge water into the harbor will be permitted from vessels while at the South Terminal CDF or while transiting through inland waters to or from New Bedford Harbor. The Coast Guard Marine Safety Detachment in New Bedford enforces compliance, boarding each large international merchant vessel prior to their entering port to ensure all their systems are functioning properly and they are fully compliant with all applicable safety, environmental and port security regulations. The Coast Guard also responds to all reports of observed discharges or oily sheens on the water (that would likely result if bilge water were improperly discharged).

Please note that large merchant ships do routinely have contaminated bilge water of varying quantities. The principle contaminant of bilge water is almost exclusively hydrocarbons or cleaning solvents from products used to clean, fuel or lubricate onboard machinery. Most, if not all, of these ships will have oil-water separators that collect the waste oil and some other contaminants in bilge water. The cleaned water is often discharged at sea. The concentrated oil waste collected from the bilges is pumped off in port for disposal at licensed facilities, usually to tanker trucks specifically designed, licensed, and exclusively used for this purpose. This waste is then taken to approved disposal sites. No bilge water will be pumped into the POTW.

In the event oily bilge water needs to be pumped and disposed of, there are many experienced commercial contractors located in Eastern Mass that provide this service (existing maritime cargo support facilities within New Bedford Harbor utilize these contractors). The contractors listed below are some that have vacuum trucks and disposal facilities available:

- Clean Harbors
- General Chemical
- Maxymilliam Technologies
- Cyn Environmental
- Moran Environmental
- Triumvirate Environmental

Ballast Water

Vessels involved in offshore wind renewable energy construction projects will most likely not have a need to carry any ballast water. The freighters carrying the renewable energy components

from international destinations will be fully laden, and thus unlikely to need ballast except possibly a small amount for vessel trim. This will also apply to international cargo vessels. Vessels transiting from over-seas are required to flush out their ballast tanks (if in use) several times enroute to minimize the risk of carrying an invasive/non-indigenous species into U.S. waters.

The jack up barges and support vessels for wind farm construction, and the smaller short-seas shipping vessels will most likely not need any ballast, both due to the construction of the vessels and the type of loading (i.e., similar to the international vessels, these vessels will be fully loaded and will likely not require ballast). No discharge of ballast water will be allowed in port or in transit while these vessels are operating in inland waters. In the unlikely event that ballast water has to be dealt with, the water will be profiled appropriately and collected and disposed of in accordance with all requisite regulations. No discharges of contaminated ballast water will be intentionally made into New Bedford Harbor or the Buzzards Bay No Discharge Zone by vessels operating out of the South Terminal CDF.

Response to USEPA Comment Number 7. Stormwater Discharges

The following abbreviated stormwater management plan has been prepared to address concerns raised by USEPA. A more formal stormwater management plan, with additional detail, will be finalized with design documents prior to construction:

SITE EVALUATION, ASSESSMENT, AND PLANNING

7.1.1 Soils, Slopes, Vegetation, and Current Drainage Patterns

Soil type(s): The two major soil types on the site are defined as (651) Udorthents smoothed and (602) Urban Land. Their approximate distribution on the site is depicted in Figure 1. These two soil types compose the landward soils with the other unit on the map (607) being salt water.

Figure 1 Approximate distribution of NRCS Mapped Soil Units at Site[1]

[1] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Udorthents smoothed (651) - These soils are described as made land over loose sandy and gravelly glaciofluvial deposits and/or firm coarse-loamy basal till derived from granite and gneiss. They have a wide range of water transmitting capability which ranges from moderately low to very high. Typical profile is 0 to 6 inches variable and 6 to 60 inches variable. The depth to the water table is typically more than 80 inches.

Urban Land (602) – These soils are filled lands composed of urban fill material which has been excavated and transported to the area. These are not naturally occurring soils.

Slopes/Drainage Patterns: The project site is located on a parcel of land approximately 7 acres abutting the New Bedford Inner Harbor New Bedford, MA. The parcel is relatively flat and gently slopes towards the harbor. The current site consists mainly of previously disturbed land which has reverted back to shrubland and small amounts of developed and paved surfaces. The site slopes generally from west to east.

Existing off-site runoff currently flows across the site via sheet flow and discharges into New Bedford Inner Harbor. Two stormwater easements are located on the northern and southern portions of the projects and contain stormwater outfalls which discharge directly into the harbor. During construction stormwater which would be traveling through the site will be temporarily re-routed around the construction area to minimize sediment in the runoff. This rerouted runoff will be controlled by BMPs utilizing diversions, check dams, and temporary sedimentation basins. The current stormwater outfalls will be extended and not impacted during construction activities. The outfalls will be extended to ensure that the water conveyed by them is not discharged into

the new bulkhead area being created as part of the project.

Vegetation: Vegetation on the site in the project area is representative of disturbed shrubland community. Native grasses and weeds are interspersed in the herbaceous layer. The site is partially located within the footprint of a former mill building which was demolished in 1939. Much of the rubble from the factory remains on-site and pioneering vegetation has taken over and stabilized the soils. The vegetation on the beach is sparse limited to some occasional beach grass. The beach is not a barrier beach and the project will not impact any existing dune areas. The entire area surrounding the project has been previously disturbed and developed.

7.1.2 Receiving Waters

Description of receiving waters: The receiving water for this project is the New Bedford Inner Harbor. The Inner Harbor abuts the site and direct discharges to the harbor will be avoided. The Inner Harbor is considered an impacted water body and has TMDL limits set for it. Through the use of properly engineered sediment and erosion controls no sediment from the project will enter into the receiving waters without prior treatment for suspended solids and other TMDL limits. The stormwater system will be designed and operated to ensure that discharges from the site do not cause or contribute to a violation of any applicable water quality standard, in accordance with federal and/or state ARARs.

Description of stormwater:

Existing stormwater patterns

Two existing piped drainage systems pass through the project in the northern portion of the property and include outfalls within the project limits. One system is near the northern limit of the project roughly extending east from Wright Street. This storm drain discharges through the existing bulkhead into New Bedford Harbor. The second piped system extends east from the cul-de-sac on Blackmer Street passing beneath the shoreline and discharges just offshore. Only limited amounts of runoff from the margins of the project area drain to these piped systems. The majority of runoff from the landward portions of the project area is generally by overland flow easterly to the harbor.

The southern portion of the project has no defined drainage system. Runoff is overland either onto abutting commercial/industrial property to the east or to existing storm drainage systems in Gifford Street to the north and Cove Street to the south. The small portion of the project areas located north of Gifford Street are drained primarily by overland flow directly or indirectly (across abutting property) to the harbor with small portions draining toward Gifford Street.

Proposed stormwater system

With respect to the existing stormwater outfalls on the northern portion of the project, it is proposed that the two pipelines will be extended through the new bulkhead as it is constructed. The existing pipelines will be modified and strengthened or replaced as necessary to accommodate anticipated loads from filling, storage, trucks and other heavy equipment including cranes.

During construction considerable effort will be taken to eliminate the potential of sediment or other pollutants reaching the harbor. As is typical of any project covering several acres and requiring the movement of large quantities of earth materials, the project must be designed to address concerns for control of erosion and sedimentation due to potentially large areas of unstabilized soil materials. As detailed below, these will be addressed by implementation of conventional stormwater controls and BMPs. The project must also address control of the runoff from dredged materials used for site fills which have the potential for pollutants including PCBs and metals. Containment of stormwater and active controls will be implemented to address this potentiality. A system including handling and dewatering basins; monitoring stormwater; active control of outlet; filtering or additional settling, as necessary; and testing and monitoring will be implemented to control runoff.

Following construction the stormwater system must accommodate the intended facility use for support of offshore wind energy. It is anticipated that small portions of the site (less than 10%) will have paved access driveways or haul routes, but the predominant surface will be crushed aggregate (stone and other clean material) for the storage of components and the operation of cranes and other heavy equipment. It is reasonable to assume that over time there will be some changes in surfaces as equipment changes occur which may require isolated hardstands or support pads. However at this time it is envisioned that crushed aggregate will remain the predominant surface material.

After the initial use of the facility for offshore renewable energy support, the facility will be

utilized for other types of maritime commerce. As previously stated, it is currently anticipated that sufficient compaction of the crushed aggregate surface will have occurred during the facility's initial use, that the crushed stone surface can be used without paving to service maritime commerce. Although it may be found to be necessary to pave the site at some future date, it is currently not anticipated that that will be necessary at this time. Therefore, it is not practical at this time to predict when this might occur or how much additional land area might be covered by additional impervious surfaces such as buildings or pavement. Should the use of the facility change in the future, any proposed changes would have to be designed to the then-applicable codes and regulations and be permitted in accordance with the applicable regulations.

Description of impaired waters or waters subject to TMDLs: New Bedford Inner Harbor which is the water body which abuts the project site is listed as a Category 5 impaired water body. A Category 5 TMDL has thresholds placed on target pollutants which have exceeded the TMDL in the past and are potentially impacting the water body. The TMDL's listed for New Bedford Inner Harbor are; priority organics, metals, nutrients, organic enrichment/low dissolved oxygen, pathogens, oil & grease, taste odor color, and objectionable deposits.

7.1.3 Potential Sources of Pollution

Potential sources of sediment to stormwater runoff:

During the site construction potential sources of sediments would include:

- Clean stockpiled dredge material for filling behind the bulkhead

- Contaminated dredge material for filling behind the bulkhead (if utilized)
- Contaminated soils currently under an asphalt engineered barrier located at the DMF properties (MassDEP information for Release Number #4-0015490 located at 16 Blackmer Street states that the primary pollutant for this site is lead, but other contaminants include PAHs, and TPH).
- Clearing, grading, excavating and un-stabilized areas
- Soil transported on the construction vehicles during transport
- Dust from construction activities
- Run-off from stock piled material

Table 7.1 Potential pollutants and sources, other than sediment, to stormwater runoff:

Stormwater Pollutants	Location
PCB's	Limited to the approximate upper two to three feet of dredged sediment
Heavy Metals	Limited to upper foot of dredged sediment and soils beneath the engineered barrier at 16 Blackmer Street.
Oil, Grease, Fuel	Construction vehicle washing area, vehicle maintenance area and vehicle storage area
Fuel	Construction vehicle re-fueling area
Paint	Structure construction area and supply storage areas
Trash & Debris	Waste storage area
Sanitary Waste	Portable bathroom facilities
Landscaping materials (fertilizers, pesticides etc.)	Supply storage area and landscape areas under construction
Building materials	Supply storage area and structure construction areas

In order to be protective of water quality in New Bedford Harbor, the above potential stormwater pollutants will be controlled through a number of measures, including use of retention and/or detention basins, installation of erosion and sedimentation controls, isolation of contaminated material both during construction and post-construction, protection of stockpiled sediment, control of sheet flow runoff at the site, maintenance (or appropriate alteration) of existing Activity and Use Limitations, treatment (as necessary) of detained stormwater prior to discharge, and use of Best Management Practices.

In order to prevent sources of sediment and pollution from discharging into the harbor, contaminated dredged sediments (if utilized) will be stock piled in protected areas to prevent contamination of clean areas. The material will be allowed to dry, and the water from the dredged material will be directed to a selected basin where additional settlement will occur. It is anticipated that the majority of water will naturally infiltrate. Since PCB's are strongly organophilic, they adhere to organic sediments or soil particles which will be filtered by the soils beneath the dredged material and will not migrate into the groundwater. The potentially contaminated material will be carefully managed to ensure that the sediment remains on-site and does not travel to clean areas. The material will be used on-site and will be buried beneath several feet of clean dredged material or crushed stone. Although there may be some impacted sediment, the majority of dredged material will be clean material and will be stockpiled separately during the handling and dewatering process.

Dewatering will be conducted in accordance with the State Enhanced Remedy Performance Standards. The erosion and sediment controls associated with dewatering will include at a minimum, earth berms, hay bale barriers and silt fencing. The material will only remain

stockpiled on-site temporarily until it can be used behind the sheet piles which will be installed. Stormwater from the handling and dewatering basins will be carefully controlled and no discharge will occur until the stormwater is monitored for turbidity.

Turbid stormwater from dredge handling and dewatering basins will be conveyed to secondary basins for additional settling. If fine-grained sediments persist in the stormwater, sand and/or geotextile filters will be employed to further reduce particulates. Stormwater on-site will either infiltrate or drain towards the sheet pile contained fill area. Any water which is not captured by temporary sediment basins or which is traveling through the site via sheet flow during stormwater events will be held behind the sheet piled area. This will allow for additional settlement of the sediments suspended in the stormwater.

Weep holes in the sheet piling (if shown to be necessary during the design process) will be sealed with a filter fabric or geotextile capable of filtering contaminated fine-grained material, while allowing inter-change of pore-space water. Water within the stormwater basins will be monitored and can be tested for turbidity and other parameters prior to being either treated and/or discharged.

Contaminated dredge material (if utilized) will be isolated from stormwater flows via several feet of clean dredge material and crushed stone. Additionally, contaminated dredge material will need to be mixed with concrete or other solidifying agent for geotechnical purposes; as a result, it is anticipated that there will be no erosion of contaminated dredge material during operation of the facility.

In order to satisfy the conditions of the existing Activity and Use Limitation in place at the property at 16 Blackmer Street, the existing asphalt barrier will either need to be maintained, a 3" concrete barrier will need to be installed, or three feet of clean material will need to be placed on top of the contaminated material. Alternately, the site can be re-opened under 310 CMR 40.0000, and an adjustment to the remedy for the facility can be assessed, in which an alternate method for handling impacted soils (consistent with 310 CMR 40.0000) is instituted. One of the above-mentioned strategies will be implemented to maintain a level of "No Significant Risk" from the impacted soils at this location.

7.2 EROSION AND SEDIMENT CONTROL BMPS

7.2.1 Minimize Disturbed Area and Protect Natural Features and Soil

1. Prior to the start of any earthwork silt fences and hay bales will be installed. Temporary detention basins for handling and dewatering dredge materials will be installed prior to dredging activities.
2. All silt fences will be inspected weekly and after every rain event that produces runoff within a 24-hour period and will be repaired or replaced as necessary. Silt fencing will be cleaned out when sediment has reached 6 inches in depth.
3. Any environmental or historic resource areas will be surveyed and flagged to define limits of work.
4. Installation of siltation booms and water quality protection measures will be installed prior to the driving of sheet piling.
5. All areas to be excavated will be laid out by a surveyor prior to excavation.

7.2.2 Phase Construction Activity

The site will be constructed in several phases. Erosion control measures will be installed incrementally with each phase. After these measures are in place the land will be cleared, stabilized, construction entrances will be constructed, and staging areas will be established. Siltation curtains and booms will be deployed prior to navigational dredging work within the water begins, as required by State Enhanced Remedy Performance Standards. The sheet piles will be placed and dredging in front of the bulk head will commence. A CAD Cell may be constructed in coordination with constructed with the facility. CAD Cell construction will likely begin prior to the start of dredging, in order to allow placement of contaminated material from the site for disposal. Material from dredging activities (either from the CAD Cell or from navigational dredging or both) will be separated and staged on-site for dewatering. Once material is sufficiently dewatered it will be utilized as fill behind the bulkhead to establish additional land area. To the extent practicable and allowed under applicable law, contaminated navigational dredge material will be buried at depth, covered by several feet of clean dredge material and filled to preclude their erosion after the construction phase is completed. The entire site will then receive final grading, installation of crushed aggregate surface. Prior to finish grading, the permanent stormwater detention basins and controls will be installed.

7.2.3 Control Stormwater Flowing onto and through the Project

Temporary re-routing of sheet flow through the area by means of diversions and swales will be employed to control stormwater run-off traveling through the site and entering the area behind the new bulkhead area. Stormwater within the project area will similarly be controlled by diversions and swales, routed to temporary detention basins which will allow for settling and

infiltration of stormwater. The area immediately behind the bulkhead will be utilized as a final storage location for stormwater. This area will not yet have weepholes installed, and therefore, detention of the stormwater behind the sheet-pile wall will allow suspended sediment to settle out prior to its percolation or discharge (if necessary). Once installed, weep holes in the sheet piling (if shown to be necessary) will be sealed with a filter fabric or geotextile capable of filtering contaminated fine-grained material, while allowing inter-change of pore-space water.

7.2.4 Stabilize Soils

TEMPORARY MEASURES

1. All soil excavated and stockpiled on site will be covered with pneumatically applied straw mulch with tackfiers or polymer emulsions to resist erosion if it is to be left in place for more than 48 hours without re-handling.
2. All dredged material will be transferred to earth enclosed basins for handling and dewatering. Surface sediments, fine-grained sediments and other dredge material which has the potential for containing pollutants will be segregated and placed in separate dewatering and handling areas. Materials of particular concern will be placed on polyethylene liner rated for the pollutant of concern and will be surrounded by hay bales and silt fencing to reduce or remove the possibility of migration of sediment through the site.
3. All stockpiles of topsoil and other earth materials will be contained at a minimum by continuous silt fence. All soil stockpiles on existing slopes in excess of 1:10 (10 percent) will be surrounded by berm and swale system to ensure erosion and sedimentation are minimized. Sediment stockpiled from dredging will initially be placed within dewatering basins constructed of earthen berms. Runoff from the dewatering basins will be monitored

and routed to temporary sediment basins. Once adequately dewatered, clean sediments will be moved to stockpiles and will have hay bales and silt fencing surrounding the piles. All runoff will be routed to temporary sediment basins.

4. During construction, those areas of exposed soil that have been graded but will not be worked for three weeks or more will be treated periodically with water containing liquid polymer emulsions as necessary or covered with pneumatically applied straw mulch.

PERMANENT MEASURES

1. As soon as weather permits after the completion of fine grading, all disturbed areas will be permanently stabilized with placement of crushed rock, mulch or grass seed. Small portions of the site will be paved for access driveways, equipment pads and hardstand areas. Landscaping will generally be limited to the site perimeter and will consist of trees and shrubs for screening and loam and grass seeding for surface stabilization.
2. All plantings shall be installed as early as possible upon completion of grading and construction and will be maintained (in the case of plantings) to ensure proper growth for a minimum of three months.

7.2.5 Protect Slopes

1. Erosion control matting will be used on any cut, fill or regraded slopes steeper than 3 horizontal to 1 vertical.

7.2.6 Protect Storm Drain Inlets

1. Outlets from basins and culverts will be protected during construction activities with crushed rock and hay bales.

2. After the construction activities are competed, paved areas are to be swept and catch basins (where applicable) are to be inspected and cleaned if necessary twice annually to prevent a build up of sediment.
3. When sediments reach a depth of 6 inches, they are to be removed from the stormwater management basin.

7.2.7 Establish Perimeter Controls and Sediment Barriers

1. Prior to the start of any earthwork silt fences and hay bales will be installed. Clearing will initially be limited to the site perimeter and other areas of silt fence installation.
2. All silt fences will be inspected weekly and after every rain event that produces runoff within a 24 hour period and repaired or replace as necessary. Silt fencing will be cleaned out when sediment has reached 6 inches in depth.
3. Siltation curtains and booms will be installed as needed during work within water in accordance with the State Enhanced Remedy Performance Standards.

7.2.8 Retain Sediment On-Site

1. Temporary sediment basins will be constructed at selected locations on the lower portions of the project area to treat runoff from the construction sites. These temporary basins will be repositioned as construction progresses. Ultimately construction runoff will be routed through completed portions of the drainage system to the detention basins.
2. Dredged material will initially be deposited within dewatering basins which will allow for infiltration of the water from the stock piled material. Stormwater from within the basins will be routed to temporary sediment basins to remove additional suspended soils and reduce sediment migration through the site.

3. Silt fence and hay bales will be installed down gradient from slopes which have the potential of sediments washing away during construction.
4. Soil will be stock piled on-site for reuse. No soils will be removed from the project area.

7.2.9 Establish Stabilized Construction Exits

1. Construction entrances will be either through the entrance off of Blackmer Street or from the entrance to the northern portion of the site on Wright Street.
2. Pavement will be swept periodically to limit the tracking of sediment off-site. At a minimum, sediments are to be swept on a weekly basis.
3. All soil or sediment tracked onto Wright Street or Blackmer Street will be removed immediately.
4. A stone stabilization pad at the site entrance will be maintained by the contractor. The maintenance will include removal and replacement, top dressing with additional stone or constructing additional length as conditions demand or as directed by the engineer.
5. The stones will be replaced whenever sediment has in-filled spaces between stones limiting the tracking pads ability to capture soil from the tires of trucks and other construction equipment.

7.3 GOOD HOUSEKEEPING BMPS

7.3.1 Material Handling and Waste Management

Solid waste disposal from the project site during construction or operation of the facility will be stored in portable dumpsters, removed by a private hauler and brought to municipal facilities.

During the construction period, portable toilets will be placed on site for the construction workers. Sanitary waste from these toilets will be disposed of by a private company.

7.3.2 Establish Proper Building Material Staging Areas

For the duration of the construction period a staging area and a supply storage/stockpile area will be designated and established. No materials are to be stored in other locations. Materials within the staging area will be covered when not in use. No cans will be left open when not in use. It can be anticipated that the following items will likely be stored within the staging area; wood, construction material, sheet piles, lubricating oil/grease, gasoline, paint and other coating materials. Additional items such as construction equipment may be stored during the site construction.

7.3.3 Designate Washout Areas

A construction washout area will be established near the construction entrance. Signs will be installed designating the washout area. A temporary polyethylene liner will be installed in the washout area. This will allow any solids suspended in the wash water sufficient time to settle out, concrete to harden and water to evaporate. The washout area shall be inspected daily for leaks and to determine when the contents need to be removed. Silt fence and hay bales will be installed immediately down gradient from the washout area to capture and detain any wash water which by-passes the area.

7.3.4 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Most standard rubber tire equipment/vehicle fueling will occur off-site. By re-fueling equipment/vehicles off-site the risk of fuel spills will be reduced. Track equipment and some

select rubber tired equipment/vehicles will be re-fueled on site. Personnel will stay with the equipment during re-fueling to prevent over-filling and/or spilling. Maintenance and refueling shall occur away from drainage paths. Equipment/vehicles will be inspected daily for leaks, damage and/or other service problems. Precautionary measures will be taken to prevent contamination of the ground water or surface runoff when maintenance is necessary. The ground surface will be protected with drip pans, drip clothes or absorbent pads. Spent fluids will be placed in appropriate receptacles and removed from site and recycled when possible.

7.3.5 Control Equipment/Vehicle Washing

Equipment/vehicles will be washed off-site whenever possible. On-site washing will be without detergent and the wash water shall be directed to a detention area to allow for settling and infiltration. An area will be designated with signs as the equipment/vehicle washing area to prevent wash water from by-passing the designated detention area.

7.3.6 Spill Prevention and Control Plan

This site does not, and is extremely unlikely to, contain above ground oil storage over 1,350 gallons nor below ground storage of greater then 42,000 gallons and therefore is not subject to a Spill Prevention Control and Countermeasures Plan (SPCC).

7.3.7 Any Additional BMPs

Permanent BMPs include the detention basins which will control flow from the site. In the process of detaining the stormwater runoff, some of the runoff will infiltrate into the ground and some will evaporate. Both inlet and outlet controls will be protected by riprap to prevent un-necessary erosion.

7.4 SELECTING POST-CONSTRUCTION BMPs

The utilization of crushed aggregate for the majority of the projects' finished surface will allow for the direct storage of three or more inches of rainfall and its subsequent infiltration. It is anticipated that runoff from the site will be limited to large rain events. The site will be graded to flow via sheetflow directly toward stormwater detention basins. Where sheetflow is not practical, swales and ditches will be utilized and in limited areas, catch basins and closed piping will be necessary. Contaminated dredge material (if utilized) will be isolated from stormwater flows via several feet of clean dredge material and crushed stone. Additionally, contaminated dredge material will need to be mixed with concrete or other solidifying agent for geotechnical purposes; as a result, it is anticipated that there will be no erosion of contaminated dredge material during operation of the facility. Filtration of weep-hole water (if necessary) will also keep impacted material from migrating offsite; therefore, it is anticipated that separate surface-level stormwater controls to deal with impacted material will be unnecessary. All of these conveyances will direct stormwater runoff to detention basins for treatment. Detention basins with outlet control structures will be constructed as part of the post-construction BMPs. The basins will allow for the settling out of sediments and the longer retention time will allow for infiltration and evaporation of the runoff water. Landscape areas will be minimal and typically limited to the site perimeter. Landscaping will consist primarily of turf and screening trees and shrubs. The landscape areas will provide additional areas for infiltration and for uptake from the trees and plantings, thereby reducing the amount of runoff reaching the detention basins. Rip rap will be provided at outlets as energy dissipating devices which will reduce the erosion potential.

7.5 FINAL STABILIZATION

Upon completion of final grading in a given area of the site, that area shall be provided with final stabilization. Final stabilization may include the installation of crushed rock, landscaping or pavement.

7.6 OVERALL SEQUENCE OF CONSTRUCTION ACTIVITY

The following is an estimate of the approximate sequence of construction for the development of the site:

- Mobilize
- Install perimeter erosion and sedimentation controls
- Install sheet pile bulkheads. Bulkheads will be terminated with a tight connection at the shoreline.
- To filter water leakage through the weep holes, non-woven geotextile will be utilized on the inside face of the sheet pile to filter water passing outward to the harbor.
- Grub and clear site vegetation
- Construct dredge material handling and dewatering areas using earth berms sized to contain all stormwater inside without any uncontrolled runoff
- Install additional sedimentation basins and traps for treatment of stormwater from dredge material handling and dewatering areas
- Install additional temporary stormwater basins for sediment control for the remainder of the project areas
- Construct CAD Cell (if necessary and transport clean material to South Terminal CDF).

- Complete navigational dredging seaward of sheet pile bulkheads. Dredging will be accomplished using water tight buckets, tight bottom barges, sediment curtains, floating booms and other BMPs, as necessary, to control introduction of turbidity into the harbor's waters
- Separate soft, organic and/or contaminated sediment from clean sediment for dewatering
- After dewatering to improve engineering properties, dredge material will be utilized for backfill behind (landward of) bulkheads to dispose of the dredged material and create usable land area
- Potentially contaminated or contaminated dredge material will be disposed of at depth so as to be protected from any long-term erosion potential and therefore not be a potential source or reintroduction of contaminants back into New Bedford Harbor
- Grade upland portion of the site to design contours and elevations
- Establish crushed aggregate surface in laydown areas
- Construct paved areas, hardstand, equipment pads and building foundations and building structures and/or renovation of existing building structures (as stated earlier, asphalt areas are projected to be very minimal).
- Install permanent soil stabilization

Response to USEPA Comment Number 8. - Truck Traffic, Noise and Air Impacts and Environmental Justice

8.1 ENVIRONMENTAL JUSTICE

U.S. Executive Order 12898 (Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations) directs federal agencies to assess proposed actions or alternatives for disproportionately high and adverse human health or environmental impacts on minority and low-income populations. Identification of health and environmental issues is accomplished through public involvement and the scoping process. Environmental justice has been an important consideration in the NEPA process since the issuance of Executive Order 12898 in 1994, which required all federal agencies, including the U.S. EPA, to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations in the United States."

To determine the potential impacts on EJ populations, the U.S. EPA provides guidelines for conducting an analysis of the area, and including the following steps:

- Encourage meaningful community representation in the permitting process through the use of effective public participation strategies and special efforts to reach out to communities of color and low income populations;
- Identify the area impacted by the proposed facility or activity and assessing whether there is the potential for a disproportionately high and adverse human health or

environmental effect on low-income or minority populations from the Proposed Action;

- If a disproportionate impact is found, considering alternatives that have a less disproportionate effect on low-income and minority populations; and
- Identifying mitigation measures that address and needs of affected low-income and minority populations.

8.1.1 Determination of the Environmental Justice Areas

STUDY AREA

The community of concern (CoC) or study area for EJ includes ten U.S. Census block groups along or adjacent to the truck route for vehicles that would service the proposed South Terminal in New Bedford (see **Appendix 5**, Block Groups along the Proposed Truck Access Route). The proposed truck access and egress route is expected to be along Route 18, which extends approximately 2.6 miles from Interstate 195 on the north side to Gifford Street on the south side. Route 18 runs approximately through the middle of these block groups. Most of the land use on the east side of the route is industrial, supporting the waterfront businesses as well as the city. Most of the land use on the west side of the route is residential with some commercial uses.

MINORITY COMMUNITY OR POPULATION

EPA's Office of Environmental Justice has defined the term "minority" to include Hispanics, Asian-Americans and Pacific Islander, African-Americans, and American Indians and Alaskan Natives. If an area is found to be at or above 50 percent minority, then it is flagged as an EJ area.

LOW INCOME COMMUNITY OR POPULATION

Although the U.S. Census Bureau does not provide a specific definition for "low income," it is used interchangeably with "poverty." The Census determines poverty by comparing the total income of each family against it corresponding threshold.

The 2000 Census data will be used to determine whether an area along the truck route meets the low-income and/or minority criteria. The U.S. Census Bureau tracts located wholly or partially within or along the truck access route (Route 18) will be analyzed.

STATISTICAL REFERENCE AREA

As part of this analysis, a statistical reference area was chosen to compare the results of the CoC area, described above. Data was derived from the U.S. Census 2000 for the New Bedford Urbanized Area, Central Place statistical area.

RESULTS AND ANALYSIS

Minority and low income data for the statistical reference area and the CoC areas are shown in Table 1. Two block groups (tract 6519 BG 2 and Tract 6526 BG 1) were determined to be EJ areas since their minority percentages were greater than 50 percent (in bold). All but one block group had low-income percentages at or above 25 percent (in bold).

Table 1. Demographics of Truck Route Access Areas

U.S. Census Location		Total Population	Minority Population	% Minority	Low-Income Population	% Low-Income
Census Tract 6511	Block Group 1	960	394	41.0	457	**48.2**
Census Tract 6512	Block Group 2	877	307	35.0	360	**41.1**
Census Tract 6513	Block Group 1	1,178	273	23.2	328	**27.8**
Census Tract 6513	Block Group 2	1,065	386	36.2	290	**27.6**
Census Tract 6518	Block Group 1	1,091	255	23.4	384	**35.6**
Census Tract 6518	Block Group 4	757	300	39.6	291	**40.3**
Census Tract 6519	Block Group 1	802	373	46.5	179	24.2
Census Tract 6519	Block Group 2	1,063	822	**77.3**	397	**37.8**
Census Tract 6526	Block Group 1	513	309	**60.2**	198	**38.6**
Census Tract 6526	Block Group 2	1,042	427	41.0	473	**45.4**
Census Tract Average		9,358	385	42.4	336	36.6
New Bedford	Urbanized Area, City (part)	93,465	19,622	21.0	18,468	20.2

Source: U.S. Census 2000, SF-3 data, Tables P7 and P87.

The average percent of minorities and low-income populations for the ten block groups are 42.4% and 36.6%, respectively. These percentages are significantly higher than those of the New Bedford Urbanized Area, Central Plan geographic area. In fact, all the census tract block groups for minority and poverty populations are significantly higher than the statistical reference area. Therefore, all of the block groups along the proposed truck access route are considered as EJ areas.

SUMMARY OF EJ CRITERIA

The EJ CoC Area contains neighborhoods with highly diverse populations in terms of minority and income characteristics.

Minority EJ populations greater than 50 percent exist in two block groups within the CoC.

Low income populations at or above 25% exist in the entire within the CoC area except for one block group.

All of the block groups have higher percentages of minority and low income populations greater than the New Bedford Urbanized Area, Central Place statistical area.

8.2 EXISTING AND PROPOSED VEHICLE TRAFFIC

The project proposes to construct the South Terminal within a Designated Port area along the New Bedford industrial waterfront (see **Appendix 5**). Vehicular access to the proposed terminal will be along Route 18. The route runs approximately 2.6 miles from I-195 on the north side to one of the main roads, Potomska Street, that lead to the terminal on the south side.

This route currently serves hundreds of businesses within the industrial port on the east side as well as hundreds of residences and some commercial operations on the west side. See **Appendix 5** for the primary land uses along this route.

EXISTING VEHICULAR TRAFFIC ALONG ROUTE 18

Available traffic data from MassDOT was collected for this route. Annual average daily traffic (AADT) ranged between 48,600 and 23,700 with the high volumes being in the north and the lowest numbers being in the south. The average of all the AADT traffic counts is 33,330.

Existing truck traffic along Route 18 has been estimated to generate approximately 1,370 trips, which represents 4.0 percent of the average AADT for the traffic route based on MassDOT data for 2007.

PROPOSED VEHICULAR TRAFFIC ALONG ROUTE 18

The proposed South Terminal project at the southern end of Route 18 will generate different amounts of traffic during the three main stages of its construction and use:

1. Construction of the South Terminal (9 months),
2. Use of the Terminal as a staging area for wind turbines (second year), and
3. Use of the Terminal for port shipping operations (third year and beyond).

Each of these uses will generate a different level of truck activity along Route 18 as shown in the following table:

Table 2. Vehicle and Truck Trips Along Route 18

	AADT(1)	Cumulative	% Increase	Trucks	Cumulative	% Increase
Existing	34,240 (2)			1,370 (3)		
Stage 1	168	34,408	0.5	168	1,538	12.3
Stage 2	0	34,240	0.0	0	1,370	0.0
Stage 3	42	34,282	0.1	42	1,412	3.1

1. AADT: Average Annual Daily Traffic
2. Source: MassDOT, Average of Route 18 AADT, 2004 – 2005.
3. Source: MassDOT, Truck Peak Hour and Average Day History, 2007.

Truck traffic will generate only a half percent increase over existing traffic and increase 12.3 percent over existing truck traffic during Stage 1, the construction of the South Terminal. When the terminal is used for wind turbine lay down area during Stage 2, there will not be any additional vehicular traffic over the current amounts. During Stage 3, there will be a 0.1 percent increase in AADT counts or 3.1 percent increase over existing truck counts.

8.3 Environmental Justice Effects

8.3.1 Direct and Indirect Effects

PROPOSED ACTION AND COMMUNITY RESPONSE

As discussed above, the CoC impact area is considered to have Environmental Justice (EJ) areas because significant portions of its population are made up of minorities and low income people.

The proposed South Terminal expansion is a compatible land use with the surrounding community and similar to existing industrial port uses that are located along New Bedford's waterfront. The South Terminal expansion has been proposed for some type of waterfront industrial use as part of the development of the New Bedford Fairhaven Municipal Harbor Plan, which was approved by the State and City in June 2010. During the review and approval process, there were a considerable number of community meetings that identified this project as well as other port development projects. Fort Point Associates, Inc (FPA) led the consultant team and was responsible for overall project planning and public participation. According to FPA, there were no concerns or objections raised about this project during the public review

process. The following is a summary of the public process associated with the preparation of the harbor plan:

The Harbor Plan Renewal Committee had thirteen (13) members - seven from New Bedford and six from Fairhaven. Six New Bedford members were named by the Mayor and the seventh by the President of the City Council. The Fairhaven Town Selectmen named the six Fairhaven members. The Committee met approximately monthly over the period of Plan development, commencing in February 2008 until August 2008 and than during review and approval of the draft plan in the spring of 2009. All Committee meetings were open to the public. The Committee reviewed the consultants' analyses and findings and provided overall policy direction and guidance in shaping the Harbor Plan.

Four public workshops and two general public meetings were held. The workshops focused on the commercial fishing industry, dredging, recreational boating, and tourism/public access/environmental issues. A general public meeting was held near the beginning of the process to inform the public about the goals and objectives of the renewal, to obtain preliminary input and an update on the planning process, and to offer an opportunity for the public to contribute to shaping overall project direction. A second public meeting was in May 2009 to review the draft plan with interested individuals and organizations. Notices were placed on the Harbor Development Commission website and in the local newspaper, emails sent out and flyers posted to advertise workshops and public meetings. Over 45 individual interviews were held with key waterfront harbor stakeholders who offered a broad range of perspectives on harbor issues and activities.

Furthermore, the project will bring in significant benefits to the surround community, including enhancing the local economy and bringing increased employment opportunities and tax revenues to the area.

As a result of the proposed South Terminal project, there will be a slight increase in truck traffic over existing traffic due to the trucking needs during its construction and operation after it is constructed.

ANALYSIS OF THE POTENTIAL FOR DISPROPORTIONATE EFFECTS

Stage 1 Construction Impacts – Traffic, Air, and Noise

During the construction (Stage 1) of the project, all the EJ communities along Route 18, which include the project site, may experience a temporary increase in traffic, air, and noise impacts from construction vehicles because of their location and proximity. The average annual daily traffic (AADT) during this nine-month construction period will increase less than one half percent over existing traffic. Noise levels, in general, do not increase proportionally with increases in traffic due to the existing noise levels and any increases are expected to be minimal. Air quality impacts are expected to be minor since the construction truck use of Route 18 will be spread over the course of the day and will not be concentrated at any one time or place. Furthermore, the Project will develop a Construction Management Plan (CMP) to minimize construction-related transportation impacts. The CMP will include measures to control time of route use, methods to control fugitive dust, wash down controls, measures to reduce potential emissions, and related best management practices to reduce traffic and construction impacts. Therefore, no disproportionately high and adverse health or environmental effects due to traffic, air, or noise impacts are expected within the EJ communities along Route 18.

Stage 2 Impacts – Traffic, Air, and Noise

During the use of the project area for wind turbine assembly, which will be approximately one year, no additional trucks are expected since the wind turbine components will be brought to and taken from the site by ocean going vessels. No traffic, air, or noise impacts are expected within the EJ communities along Route 18. Therefore, the use of the terminal during this stage does not create disproportionately high and adverse human health effects on EJ populations.

Stage 3 Impacts – Traffic, Air, and Noise

During Stage 3, the project site is expected to be used for break bulk operations and generate relatively small amount of truck traffic. Due to the relatively minor amount of traffic (approximately 0.1 percent increase) over existing traffic, traffic, air, and noise impacts are expected to be minimal. Therefore, no disproportionately high and adverse health or environmental effects due to traffic, air, or noise impacts are expected within the EJ communities along Route 18.

Cumulative Impacts – Traffic, Air, and Noise

The primary sources of air quality and noise impacts to the EJ communities to the west of Route 18 arise directly or indirectly from port activities, including vessel activities, seafood processing and cargo activities. Over the past several decades there have been significant year to year variations in the number of fishing vessels in the harbor, the pounds of seafood landed and processed and the tons of freight handled at local port facilities. These year to year variations are

part of the normal functioning of the port and relate to economic conditions and natural resource cycles.

Fishing vessels as a source of noise and air quality impacts from idling engines has diminished in recent years with increased restrictions on the number of days at sea allowed for each vessel and by retirement of older fishing vessels in the fleet. The City of New Bedford is working to provide shoreside power at City owned fishing vessel docks to further minimize the need to run engines and generators while at the dock. Further, fishing vessels are located generally 1500 feet or more from EJ communities and thus would have little to no impact.

Truck traffic volume, and related noise and air quality impacts, derives directly from the volume of products shipped in and out of the port. While these volumes vary over time, the number of trucks involved in supporting existing conditions in New Bedford Harbor is so much greater than those from the proposed project that the change in impacts would be minimal. In the context of the Route 18 reconstruction project now under design, the levels of service (LOS) along Route 18 are at or above LOS D, suggesting that air quality impacts from idling vehicles will be minimal. In fact, the project will include signal timing to improve traffic flow, while making the highway more pedestrian friendly. Cumulative impacts from noise are similarly expected to be minimal as the overall increase in traffic in the long term is expected to be a 0.1 percent increase in average daily vehicular traffic or a 3.1 percent increase over average daily truck traffic. Using the inverse square law of calculating sound levels, such a small increase in noise generation would not produce a noticeable change in overall levels of sound as measured in dBA. For example, a doubling of traffic would result in only a 3 dBA increase in noise levels.

Given that the impacts of proposed project alone are insignificant, the cumulative impacts of continued port operations and the proposed project are expected to be insignificant as well.

MITIGATION MEASURES

The proposed South Terminal project, which is still going through its approval process, will have additional public input. This input will inform the residents of the adjacent EJ communities with descriptive information on flyers and notices in the appropriate language (Portuguese, Spanish, etc.). One or more community meetings will be held in the affected neighborhoods.

During this process, traffic concerns identified by the public will be addressed. For example, the state is currently improving intersections along Route 18 near the State Pier to allow better access to the industrial waterfront. Community concerns about other intersections may improve their use and reduce impacts.

A construction management plan will be required as part of the development. As explained above, this will ensure that the measures are implemented to reduce traffic and air quality impacts as a result of the project.

Response to USEPA Comment Number 9. - Flood Plain Impacts

Construction of the South Terminal CDF will result in minor flood storage loss due to filling within the footprint of the facility. USEPA asked us to assess the impact of the loss of flood storage volume, particularly under the circumstance of a major coastal storm when the New

Bedford Hurricane Barrier would be closed and heavy rain is expected within the watershed for New Bedford Harbor. This analysis has been completed utilizing a combination of 100-year flood elevations associated with FEMA flood maps as well as an analysis of the impact of filling within New Bedford Harbor conducted by the US Army Corps of Engineers.

The US Army Corps of Engineers assessed the potential impacts that filling and diking may have upon the elevation of flood levels within New Bedford Harbor when the New Bedford Hurricane Barrier is closed and heavy rains are expected within the document entitled "Hydrology of Floods, New Bedford Harbor, Massachusetts" completed by the Hydrologic Engineering Section of the Water Control Branch, Engineering Division of the Department of the Army, Corps of Engineers, New England Division, dated September 1987. This document states that "for every 100 acres of harbor area lost above +2.0 feet NGVD, but below +6.0, either by diking or filling, there will be a resulting rise in project design flood level of about 0.2 feet." 100 acres lost between +2.0 feet and +6.0 feet (4 feet of filling over 100 acres) equates to approximately 400 acre-feet, the flood storage loss of which is estimated to result in a rise in flood level within New Bedford Harbor of 0.2 feet.

The following table outlines the volume of material that will be placed within the footprint of the facility between elevation +2.0 and elevation +6.0 NGVD as follows:

Elevation	Area Within Project Footprint (ft^2)	Average Area (ft^2)	Average Volume (yd^3)
+2.0 NGVD	255475	268235	9934.63
+3.0 NGVD	280995	290990	10777.41
+4.0 NGVD	300985	307308.5	11381.80
+5.0 NGVD	313632	324177	12006.56
+6.0 NGVD	334722	0	0
		TOTAL (yd^3):	**44100.40**

Where:

Area within Project Footprint = Area within the footprint of the facility at the noted elevation.

Average Area = Average between two successive elevations (for example, average between the area of the footprint of the facility at +2.0 NGVD and +3.0 NGVD).

Average Volume = Average Area X 1 Foot (in cubic yards).

The analysis indicates that 44,100 cubic yards of fill equates to approximately 27.33 acre feet of fill material that will be placed between elevation +2.0 and elevation +6.0 NGVD due to the South Terminal CDF project. Therefore, 27.33 acre-feet of flood storage loss equates to a rise in project design flood level of approximately **0.01367 feet**, or **0.164 inches**.

In order to illustrate the impact that a 0.164 inch change in flood elevation would have upon the City of New Bedford, a location was chosen within New Bedford upon which to assess the impact of the vertical change in flood storage elevation (a location at North Terminal along the New Bedford waterfront). A plan of the location and a cross-section of the area is attached as **Appendix 6**. The FEMA flood map shows that the 100-year flood elevation within New

Bedford Harbor is at the elevation of +5 NAVD 88. The location in question was chosen because the area is relatively flat and is near in elevation to the FEMA 100-year flood elevation (between +4 and +6 NAVD 88); therefore, a change in flood elevation is most likely to have the greatest horizontal change in flood water encroachment in this location, and other locations are likely to be impacted less than this location. As can be seen on the cross-section, a vertical change in flood elevation of +0.164 inches, results in a corresponding horizontal flood encroachment of **11.28 inches.** Please note that this represents the horizontal encroachment during a worst-case flooding event, and is analyzed at a representative worst-case location, where the flood elevation occurs within a flat area. *Other areas within New Bedford Harbor should see significantly less encroachment (if any), either because the 100 year flood elevation is below existing land elevation, or because existing land elevation is steeper than the relatively flat study location. Therefore, the anticipated rise in flood elevation due to filling due to construction of the South Terminal CDF is unlikely to have an adverse impact to the surrounding floodplain.*

Response to USEPA Comment Number 10. - Compensatory Mitigation

Within the mitigation proposal submitted thus far to USEPA, two items include proposed work within an area designated as OU-3 by the Record of Decision for the New Bedford Superfund Site:

- Planned enhancement to 16.1 acres of near-shore, shallow, subtidal areas via the sequestration of PCBs in sediment outside of the Hurricane Barrier at the OU3 New Bedford Superfund Site; and

- Historic enhancement to 18.9 acres of near-shore, shallow, subtidal areas in 2005 via the sequestration of PCBs in sediment outside of the Hurricane Barrier at the OU3 New Bedford Superfund Site.

Within the more detailed descriptions for the work associated with those two proposals, the following statements are made: "*Either remediation or capping of the OU-3 area is part of the New Bedford Superfund Record of Decision. Capping this area not only will have significant environmental benefits, but will complete a significant task associated with Superfund Cleanup, and will save significant costs and logistical difficulties for USEPA.*" **Please note that this statement was NOT made for the 11.8 acre area that was presented as a primary location for enhancement/mitigation for intertidal and shallow-water essential fish habitat and/or tern foraging grounds.** The 11.8 acre enhancement/mitigation work is entirely new work that is not required to be done, and therefore should be fully credited as mitigation. This statement is only applicable to areas within OU-3 that contain concentrations of PCBs above 50 mg/kg. The approximate area of OU-3 that was delineated as "to be capped" during the Phase II Navigational Dredge Project is approximately 35 acres in size. Only 4.8 acres of the "to be capped" area within OU-3 contains PCBs above 50 mg/kg. According to the as-built plan for the capping of OU-3 during Phase II, it appears that the entire 4.8 acre area that contained PCB concentrations above 50 mg/kg was capped in 2005 (see **Appendix 7** for a figure showing the delineation of the 50 mg/kg area within the greater OU-3 area).

As discussed with USEPA, USEPA does not grant mitigation credit for work that is required to be completed; however, in this case, USEPA was required to remediate the 4.8 acre area under the 1998 Record of Decision, and the New Bedford Harbor Development Commission capped

the area, through funding granted by the Commonwealth of Massachusetts. Additionally, capping of the material had the additional environmental benefit of not only sequestering PCB contaminated sediment, but also raising in elevation the area, such that it enhanced the habitat by making the area more suitable for Essential Fish spawning and foraging, as well as foraging by avian wildlife. Therefore, it is currently unclear exactly how much credit may be granted for this 4.8 acre area; however, the area should be broken out and considered separately. Therefore, the above-listed two mitigation proposals are broken into three proposals as outlined below:

- Planned enhancement to 16.1 acres of near-shore, shallow, subtidal areas, which contain PCB concentrations below 50 mg/kg, via the sequestration of PCBs in sediment outside of the Hurricane Barrier at the OU3 New Bedford Superfund Site; and
- Historic enhancement to 14.1 acres of near-shore, shallow, subtidal areas in 2005, which contain PCB concentrations below 50 mg/kg, via the sequestration of PCBs in sediment outside of the Hurricane Barrier at the OU3 New Bedford Superfund Site.
- Historic enhancement to 4.8 acres of near-shore, shallow, subtidal areas in 2005, which contain PCB concentrations above 50 mg/kg, via the sequestration of PCBs in sediment outside of the Hurricane Barrier at the OU3 New Bedford Superfund Site.

Please note that these three areas do not represent the full mitigation proposal, which was forwarded to USEPA in a separate document, and only represent a clarification of the two individual proposals (divided into three separate proposals herein). In addition, even if the EPA were to disregard these items entirely (which it should not do), the other mitigation proposed, which is new and is not required, is sufficient to mitigate the impacts of the project.

APPENDIX 1

ATTACHMENT A-1

Harbor Plan Sections Relating to Navigational Dredging Projects

Identification of Individual Properties

At a minimum, the project stakeholders whose mission includes Harbor maintenance, have identified the commercial properties that are in specific need of dredging and should fall under the SER process umbrella. It is anticipated that, at a minimum, all commercial properties will be conducted under the auspices of the SER Process. As part of the Harbor Master Plan update process, stakeholders and users of the Harbor were interviewed to determine infrastructure maintenance and redevelopment nees for the next 5-15 years. The list of dredge projects anticipated over that time frame was distilled by property and lot number of the watersheet adjacent user.

The projects associated with the New Bedford/Fairhaven Harbor Dredge Program are listed on **Table A-4** and the general dredge areas for the program are depicted on **Figure A-4.**

TABLE A-4: Proposed Navigational and Maintenance Dredging Projects

City/ Town	Plot/ Lot	Current Owner	Address	Description	Estimated Volume
NB	N/A	N/A	NB/Fairhaven Harbor	Channels, Turning Basins, Anchorages, Fairways	850000
	N/A	N/A	USEPA	Material From Upper Harbor	300000
NB	N/A	N/A	Harbor North of Route 6 Bridge	DMMP Area	Storage (2,000,000 yards)
NB	60-19	Mitchell Mark S "Trustee"	83 Popes Island	Whaling City Marina	15,000
NB	60-12	Popes Island Harbor Development Corp.	173 Popes Island	Niemic Marine	15000
NB	60-18	Popes Island Harbor Development Corp.	243 Popes Island	Gear Locker Marina	5000
NB	60-11	BLF Realty Trust	226 Popes Island	The Olde New Bedford Yacht Club/Captain Leroy's	3000
NB	60-2	City of New Bedford Marine Park	102 Popes Island	Pope's Island Marina	17000
NB	60-1	Maritime Terminal, Inc.	NS Fish Island	Bridge Terminal/ NORPEL	5000
NB	60-23	M A T Marine Inc.	Fish Island	Empty Lot/For Sale	3000
NB	60-4	Fish Island Nominee Trust	SS Fish Island	AGM Marine Contractors, Inc.	15000
NB	N/A	City of New Bedford	Gifford Street	Gifford Street Boat Ramp	100000
NB	31-263	Shuster, Richard A	4 Wright Street	Shuster Corporation	5000
NB	31-254	R P C Realty LLC	6 Hassey Street	Eastern Fisheries	5000
NB	31-252	Maritime Realty, Inc.	16 Hassey Street	Northern Wind, Inc.	5000
NB	31-251	Tichon Seafood Corp.	8 Hassey Street	Bergies Seafood, Inc.	2500

NB	37-304	D Fillet Inc.	38 Hassey Street	Tempest Fisheries, Inc.	2500
NB	37-329	Pier Side Realty, LLC	50 Hassey Street	Whaling City Seafood Display Auction	5000
NB	37-305	Port Side Realty, LLC	62 Hassey Street	Whaling City Seafood Display Auction	5000
NB	37-303	South Terminal Leasing	7 Conway Street	Tichon Seafood Corporation	10000
NB	42-268	Trio Algarvio, Inc.	26 Green & Wood Pier	MASC Fabricating & Welding, Inc.	7500
NB	42-260	W Trading, Inc.	25 Green & Wood Pier	MASC Fabricating & Welding, Inc.	7500
NB	42-160	Sprague Massachusetts Properties, LLC	1 Pine Street	Sprague Energy	20000
NB	42-84	Commonwealth Electric Co C/O Property Tax Department	180 Macarthur Drive	NSTAR	10000
NB	47-181	Commonwealth Electric Co C/O Property Tax Department	180 Macarthur Drive	NSTAR	10000
NB	47-212	City of New Bedford	Leonard's Wharf	Leonard's Wharf	10000
NB	47-180	City of New Bedford Harbor Development Commission	Homers Wharf	Homer's Wharf	10000
NB	47-204, 47-179, 47-225	City of New Bedford	ES Macarthur Drive	Coal Pocket Pier and Steamship Pier	18000
NB	47-203, 53-217	Commonwealth of Massachusetts State Pier	ES Macarthur Drive	State Pier	24000
NB	53-120, 53-253, 53-254	City of New Bedford	51 Macarthur Drive	Fisherman's Wharf and Tonneson Park	5000
NB	53-34	Co-Op Wharf Realty Trust	101 Co-Op Wharf	Global Fuels Marine, Inc.	5000
NB	53-116	155 Front Street Realty Corporation	248 Macarthur Drive	Crystal Ice	2500
NB	53-241	178 Front Street Corporation	252 Macarthur Drive	Crystal Ice	2500
NB	53-42, 59-173, 59-217	Maritime Terminal, Inc.	276 Macarthur Drive	Maritime Terminal, Inc.	5000

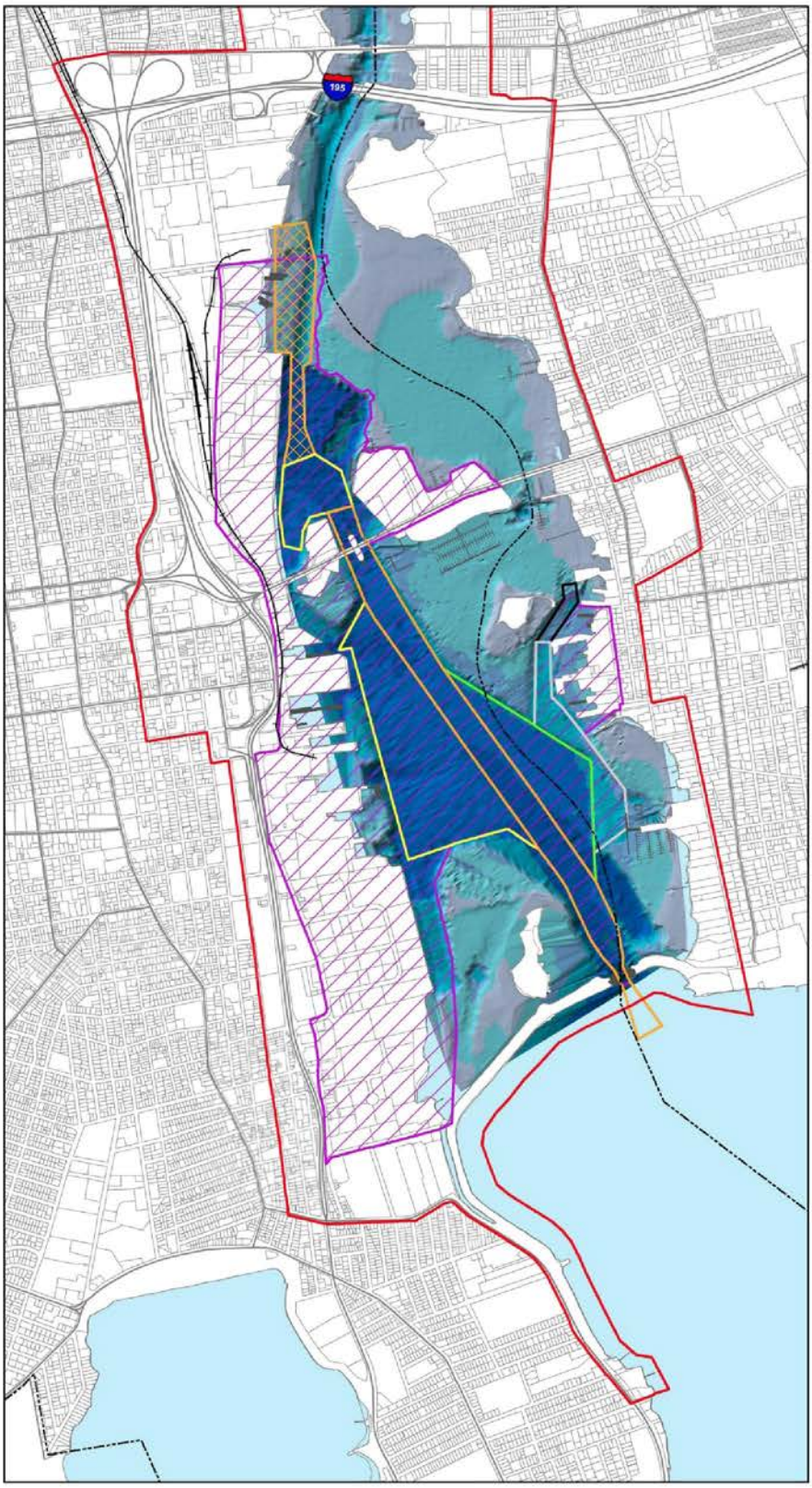
NB	59-41, 66-134	American Seafoods International, LLC	40 Herman Melville Blvd	American Pride Seafoods (American Seafoods Group, Southern Pride Catfish and Frionor)	10000
NB	66-165	New Bedford Land Company, Inc.	Herman Melville Blvd.	Mass Tow Boat	7000
NB	66-128, 66-147	M A E Realty, LLC	SS Antonio L Costa Blvd.	Eastern Fisheries	10000
NB	66-125	Sea Watch International, LTD	15 Antonio L Costa Blvd.	Sea Watch International	2000
NB	72-284	U S EPA c/o Harbor Development	NS Hervey Tichon Ave.	US EPA Dewatering Facility	5000
NB	72-248	Marine Hydraulics	256 Herman Melville Ave.	Marine Hydraulics, Inc.	7500
NB	72-292	Cook, Robert C.	286 Herman Melville Ave.	New Bedford Welding Supply	5000
NB	72-297	Dolinsky, Marvin L.	300 Herman Melville Ave.	ABCO Electric, Task International	5000
NB	72-299	Acushnet River Shipyard, Inc.	302 Herman Melville Ave.	Evergreen Sheet Metal/Acushnet River Shipyard, Inc.	7500
NB	72-293	City of New Bedford Harbor Development Commission	352 Herman Melville Ave.	Tisbury Towing/ Packer Marine	10000
NB	79-5	PAL Realty, LLC	10 N Front Street	Former MacLean's Seafood	20000
NB	79-2	Revere Copper Products	26 N Front Street	Revere Copper Products	10000
NB	79-4	Revere Copper Products	24 N Front Street	Revere Copper Products	10000
NB	79-1	B S Realty Limited Partnership	94 Kilburn Street	Old Mill Building (Various Occupants) – Boat Ramp	6000
NB	86-3	North Wharf Trust	2 Washburn Street	Kyler's Catch Seafood Market	10000
NB	86-25	City of New Bedford	ES Washburn Street	Right of Way	5000
NB	86-20	North Wharf Trust	Washburn Street	No Occupants/Old Piers	5000
NB	93-265	USA c/o Army Corps of Engineers	Sawyer Street	Vacant	5000
NB	93-263	Aprak Realty Trust	Sawyer Street	Abandoned Building/ Under Demolition	5000
NB	93-265	USA c/o Army Corps of Engineers	Sawyer Street	Vacant	5000

NB	93-120	City of New Bedford Park Dept	103 Sawyer Street	USEPA De-Sanding Facility	5000
NB	N/A	N/A	Harbor North of Coggeshall Street Bridge	Future Rowing Course	110,000
F	05-015, 05-016, 03-001, 03-001A,	Rodman Candle Works Realty, LLC	38-48 Fort Street	Fairhaven Shipyard	40000
F	07-014	Wood's Hole Martha's Vineyard Steamship Authority	2 Water Street	Steamship Authority	40000
F	07-012, 07-013	Kelley South, LLC	4 Water Street	Warren Alexander Property	2500
F	07-011	Kelley South, LLC	7 Union Wharf	DN Kelley and Son	2500
F	07-009	Town of Fairhaven	2 Union Wharf	Union Wharf	15000
F	07-001	Kelley Dock & Marine Co, Inc.	24 Water Street	D N Kelley and Son	20000
F	09-002A	E&W Properties, LLC	42 Water Street	Harbor Hydraulics + Machine	5000
F	09-002	Olde North Wharf	4 Washington Street	Olde North Wharf/ Harbor Blue Seafood	5000
F	09-001, 09-116A	L&L Realty Co., Inc.	50 Middle Street	Linberg Marine	20000
F	11-012	Town of Fairhaven	Pease Park	Pease Park Boat Ramp	10000
F	11-008, 11-009. 11-010	Acushnet River Safe Boating Club	80-82 Middle Street	Acushnet River Safe Boating Club – Coast Guard Auxiliary	20000
F	12-016A, 12-016, 12-017. 12-018. 12-019. 12-020, 12-020A, 12-020B, 12-021, 12-022, 12-023, 12-024	Sky View Lines, LLC/Town of Fairhaven	110 Middle Street	Harbor front Center (Former Holiday Inn Express and Marina)	20000
F	13-066	Jerco, LLC	2 Elm Avenue	Cozy Cove Marina	4000
F	17-016	Two River Ave, LLC	2 River Avenue	Moby Dick Marina	10000
	17-001			Residence/Business Docks	4000
				Total:	**1998000**

Figure 6.1 Harbor Bathymetry

New Bedford / Fairhaven
Harbor Plan Update 2008

Federal Channels, Achorage, Turning Basin & the DPA with Approximate Bathymetry



- 2008 Planning Area
- Federal Channel
- Anchorage
- Turning Basin
- 15ft Channel
- 10ft Channel
- Proposed North Terminal Channel
- Approximate Designated Port Area

Depth (ft)

- -5 to 0
- -10 to -5
- -15 to -10
- -20 to -15
- -25 to -20
- -30 to -25
- -35 to -30
- -40 to - 35
- -45 to -40
- -45+

N

0 500 1,000 2,000 Feet

Prepared by the
Urban Harbors Institute
of the University of Massachusetts Boston

For the
New Bedford / Fairhaven
Harbor Plan Renewal Committee

On behalf of
Fort Point Associates
Urban Harbors Institute
Apex Companies
and
FXM Associates

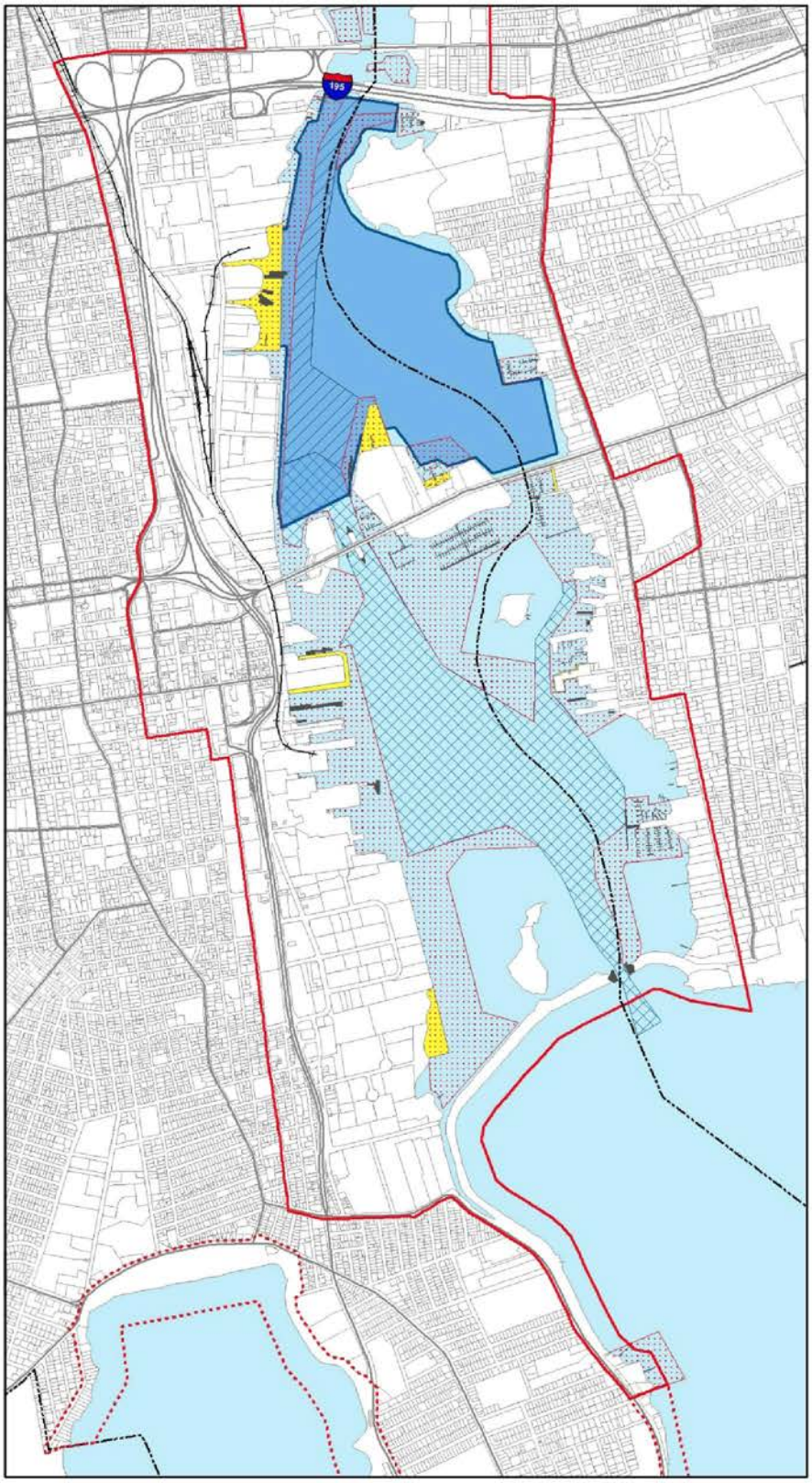
Data from
MassGIS
City of New Bedford
Town of Fairhaven
Urban Harbors Institute
Apex Companies

September 2008

Figure 6.2 Dredging Projects

New Bedford / Fairhaven Harbor Plan Update 2008

Potential Waterfront Development Shoreline Facilities (WDSFs) and Dredge Areas



Secondary Planning Area
2008 Planning Area
TOWNS_POLY
Potential Dredge Area*
State/Other Channel
Army Corps Dredge Project Areas
Potential WDSFs
Boundary for CAD Cells (2008)

* Based on individual properties scheduled for dredging

N

0 500 1,000 2,000 Feet

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Data from
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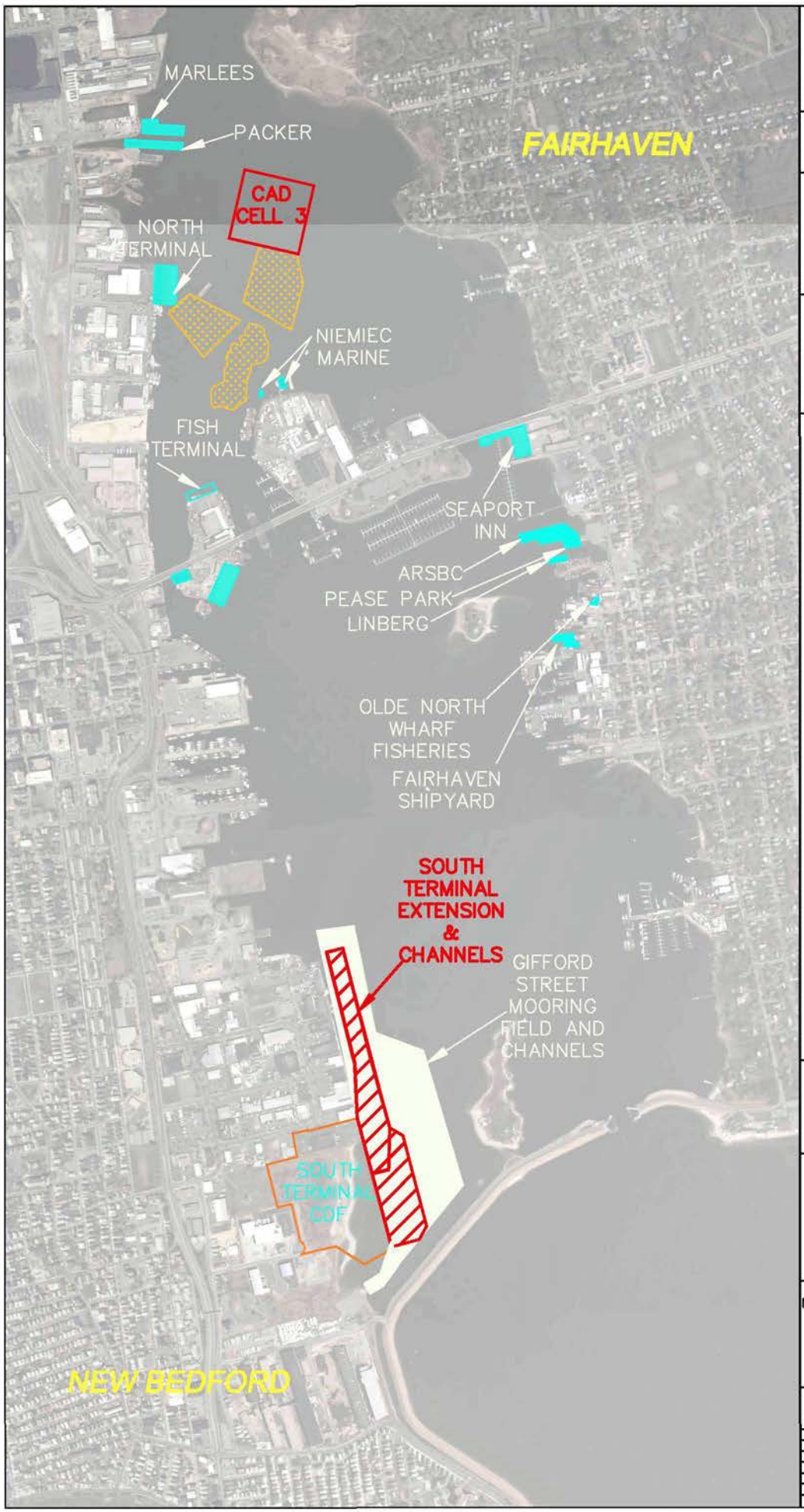
December 2009



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REVISIONS

NO.	DATE	DESCRIPTION

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KEY:

- OTHER PHASE 4 AREAS
- CAD #3 PROPOSED
- CAD CELLS EXISTING
- GIFFORD STREET AREA (PHASE 4 DREDGING)
- SOUTH TERMINAL EXTENSION DREDGE AREA

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

NEW BEDFORD/FAIRHAVEN PHASE IV DREDGE AREAS AND SOUTH TERMINAL AREAS

Scale: 1"=400'

0 200 400 800 1200

Date 9/23/10	Drawing No.
Proj. Mgr.	
Design	
Check CM	L-1
Drawn GCD	
Job. No. 6815	
Last Rev. 9/23/10	

APPENDIX 2

Table 1:
Analytical Data: Linberg Marine
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (µg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
307A 0-1	10/23/2006	300000	1300000	310000	320000	830	830	830	830	830	830	830	1000	2000	990	890	1300	830	920	1700	1700	830
308 0-1	10/23/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
307A 0-1	10/23/2006	5.9	32	4.4	260	190	1.4	1.8	0.94
308 0-1	10/23/2006	NS	NS	NS	NS	NS	NS	NS	NS

		PCB Congeners (µg/kg)																							
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209	Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
307A 0-1	10/23/2006	87	300	1500	370	570	620	740	920	270	0.31	290	760	29	130	540	460	54	100	66	9.2	19	3.8	18.0	150
308 0-1	10/23/2006	14	33	190	39	84	94	84	120	32	0.24	36	110	4.1	20	80	80	8.3	12	9.6	1.1	1.6	1.1	2.4	NS

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 2:
Analytical Data: Olde North Wharf Fisheries
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (μg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
309 0-1	10/24/2006	48000	300000	100000	110000	650	650	650	650	650	650	650	860	1800	650	650	650	650	650	1300	1300	650
310 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
311 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
309 0-1	10/24/2006	6	160	1	56	360	1	1	0
310 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS
311 0-1	10/24/2006	NS	NS	NS	NS	NS	NS	NS	NS

		PCB Congeners (μg/kg)																								
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209	Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
309 0-1	10/24/2006	26	57	330	73	160	180	140	240	61	0	65	200	7	36	150	140	15	24	16	2	3	2	4.4	190
310 0-1	10/24/2006	85	260	1100	280	420	420	460	700	220	0	210	530	19	98	420	350	42	65	46	6	5	3	13.2	NS
311 0-1	10/24/2006	29	65	390	95	170	200	190	300	78	0	81	240	9	43	180	160	20	32	21	3	3	1	5.3	NS

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 3:
Analytical Data: Union Wharf
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (μg/kg)																				
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aroma	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
321 0-1	10/25/2006	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
325 0-1	10/25/2006	880000	2200000	1000000	1100000	1000	1000	1000	1000	1000	2400	1200	8500	10000	5700	5200	5600	2400	4100	3700	3700	2800

		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
321 0-1	10/25/2006	NS	NS	NS	NS	NS	NS	NS	NS
325 0-1	10/25/2006	20	330	5.1	200	3000	3.0	1.2	7.3

		PCB Congeners (μg/kg)																							
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209	Summation of Congeners (mg/kg) [NOAA 18]	Reactive Sulfide (mg/kg)
321 0-1	10/25/2006	24	68	270	82	120	110	140	170	45	0.28	46	97	43	22	180	180	77	170	96	18	8.8	0.36	4.6	NS
325 0-1	10/25/2006	73	150	720	220	370	320	350	940	280	0.37	250	620	120	150	810	870	210	440	300	42	33	9.4	17.0	79

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 4:
Analytical Data: Steamship Authority Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program
New Bedford, Massachusetts

		PCB Congeners (µg/kg)																					
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209
329 0-1	10/23/2006	48	87	540	120	260	290	220	370	90	0.7 U	97	310	18	57	240	260	37	69	46	7.3	7.3	1.7
330 0-1	10/23/2006	140	260	1300	340	600	620	600	930	260	2.4 U	250	680	56	140	580	570	110	210	140	26.0	22.0	6.3
331 0-1	10/25/2006	2	3	14	4	8	9	6	12	2	0.33 U	3	9	2	3	8	10	2	4	3	0.33 U	0.33 U	0.33 U
332A 0-1	10/23/2006	2	3	14	4	7	8	5	11	3	0.19 U	3	8	1	2	7	8	1	3	2	0.7	0.19 U	0.3

Summation of Congeners (mg/kg) [NOAA 18]
7.2
18.0
0.234
0.210

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.

Table 5:
Additional Analytical Data: Additional Pre-Dredge Locations
Phase III Harbor Maintenance Dredge Program, USEPA Data, Intertidal Sampling Results
New Bedford, Massachusetts

		Extractable Petroleum Hydrocarbons (µg/kg)																			
Sample Name	Collection Date	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	Unadjusted C11-C22 Aromatics	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
VC-07C-08	11/17/2008	25000	213000	152000	185000	803 U	803 U	803 U	803 U	803 U	3790	803	6330	5250	2920	3180	2740	2470	2520	2040	803	1880

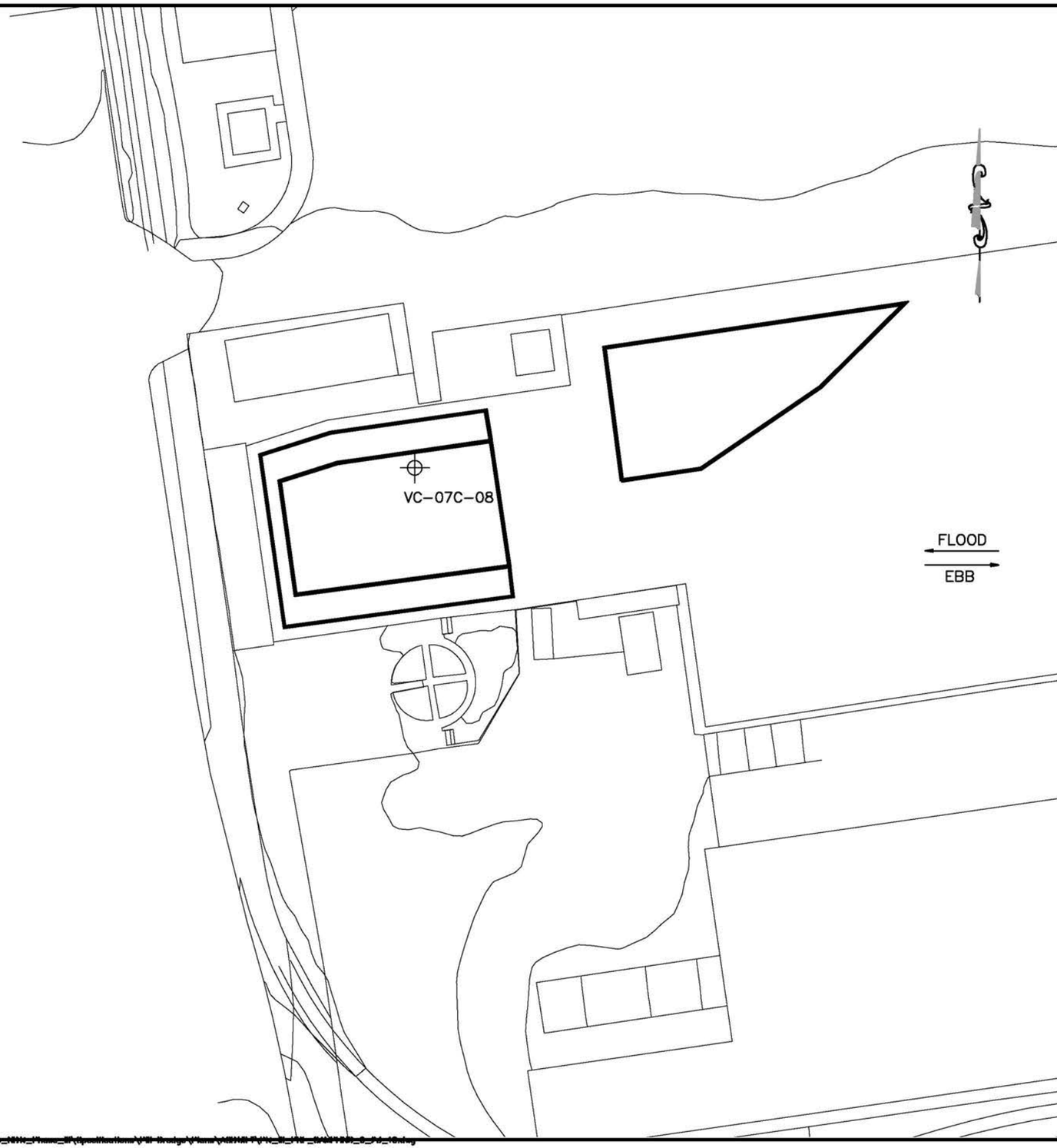
		Metals (mg/kg)							
Sample Name	Collection Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury
VC-05-08	11/13/2008	4.58	20	1.59	82.7	64.4	0.729	0.793	0.283
VC-07C-08	11/17/2008	6.6	87.2	8.01	86.5	547	0.744	11.9	0.803
VC-16-08	11/21/2008	8.22	44.4	0.948	57.7	107	1.2	0.524	0.641

		PCB Congeners (µg/kg)																					
Sample Name	Collection Date	Cl2-BZ#5/#8	Cl3-BZ#18	Cl3-BZ#28/#31	Cl4-BZ#44	Cl4-BZ#52	Cl4-BZ#43/#49	Cl4-BZ#66	Cl5-BZ#101/#84	Cl5-BZ#87	Cl7-BZ#184	Cl5-BZ#105	Cl5-BZ#118	Cl7-BZ#183	Cl6-BZ#167/#128	Cl6-BZ#138/#163	Cl6-BZ#153	Cl7-BZ#170/#190	Cl7-BZ#180	Cl7-BZ#182/#187	Cl8-BZ#195	Cl9-BZ#206	Cl10-BZ#209
VC-05-08	11/13/2008	39.7	166	529	156	296	209	184	359	127	1.13 U	127	386	10.8	72.5	320	224	29.9	38.3	23.8	2.47	3.49	1.35
VC-07C-08	11/17/2008	576	1490	2150	656	1240	620	285	504	174	1.03 U	143	390	23.2	97.3	400	309	57	90.9	66.9	9.52	16.5	2.77
VC-16-08 (0-1.5')	11/21/2008	17.2	95.9	153	145	340	132	96.9	207	207	1.22 U	163	478	13.8	108	464	300	41.8	50.1	27.2	1.22 U	6.62	3.85
H1	8/6/2010	1.80	7.41	20.4	9.54	16.6	11.4	4.13	16.1	2.08	0.958 U	4.38	13.6	0.958 U	3.14	12.2	10.4	1.19	1.16	0.958 U	0.958 U	0.958 U	0.958 U
D2	8/6/2010	0.870 U	1.09	3.01	1.45	4.10	2.73	0.870 U	3.49	0.870 U	0.870 U	0.870 U	2.83	0.870 U	0.870 U	3.20	2.57	0.870 U	0.870 U	0.870 U	0.870 U	0.870 U	0.870 U
F1	8/10/2010	0.912 U	2.38	7.14	2.89	7.57	5.12	1.40	7.25	0.912 U	0.912 U	2.00	6.59	0.912 U	1.31	5.34	4.72	1.25	0.912 U	0.912 U	0.912 U	0.912 U	0.912 U
B1	8/10/2010	0.856 U	2.64	7.63	2.44	8.52	5.5	1.87	7.77	0.856 U	0.856 U	1.8	6.7	0.856 U	1.2	6.07	6.37	0.933	0.968	0.856 U	0.856 U	0.856 U	0.856 U

Summation of Congeners (mg/kg) [NOAA 18]
7.7
22.1
7.0
0.32
0.07
0.14
0.15

Sample Name	Collection Date	Total PCBs [Method Unknown] (mg/kg)
S-203316	Pre-ROD	16
S-ae538	Pre-ROD	1
S-ae539	Pre-ROD	5
S-ae540	Pre-ROD	4
S-ae542	Pre-ROD	3
S-403	10/6/1999	2
S-405	10/6/1999	0.2
S-406	10/7/1999	9.2
S-af541	Pre-ROD	1
S-ae531	Pre-ROD	10
S-ae532	Pre-ROD	6
S-ae517	Pre-ROD	4
S-ae525	Pre-ROD	2
S-ae532	Pre-ROD	6

Notes:
U = Concentration is below the laboratory's method detection limit.
NS = Not sampled.



NOTES

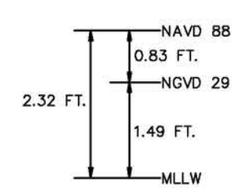
1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

3. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

VC-07-08 PRE DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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184 HIGH STREET
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(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	9/2/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

THESE DRAWINGS PREPARED BY APEX FOR THIS PROJECT ARE INSTRUMENTS OF APEX'S SERVICE FOR USE SOLELY WITH RESPECT TO THIS PROJECT, AND APEX SHALL BE DEEMED THE AUTHOR OF THE DRAWING AND SHALL RETAIN ALL COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS WITH RESPECT THERETO, INCLUDING COPYRIGHT. THE DOCUMENTS SHALL NOT BE USED ON OTHER PROJECTS, FOR ADDITIONS TO THIS PROJECT OR FOR COMPLETION OF THIS PROJECT BY OTHERS, EXCEPT BY AGREEMENT IN WRITING AND WITH APPROPRIATE COMPENSATION TO APEX.

PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

TONNESSON PARK DREDGE AREAS- PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

Scale: 0 10 20 40 50 FEET

Date 9/5/08	Drawing No.
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Design GCD	
Check CM	V-1
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	

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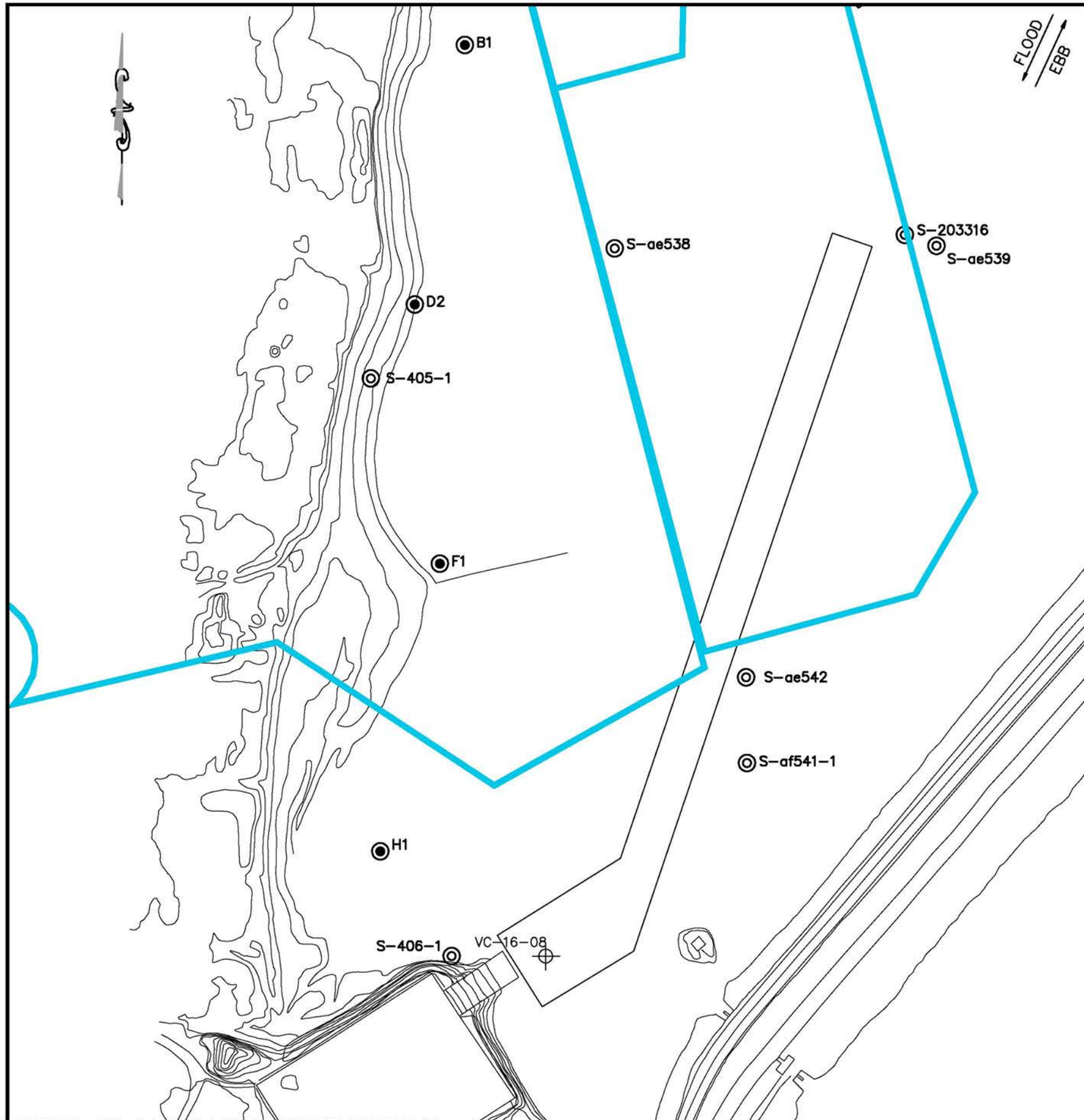

NOTES

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2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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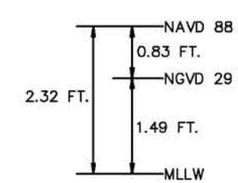
VC-07-08 — PRE DREDGE SAMPLE LOCATION

B1 — APEX SAMPLES 8-6-2010, 8-10-2010

S-ae-538 — USACE SAMPLES

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

GIFFORD STREET BOAT RAMP DREDGE AREA- PRE AND POST DREDGE SAMPLING LOCATIONS

NOT FOR CONSTRUCTION

Scale: 0 30 60 120 150 FEET

Date 9/5/08	Drawing No.
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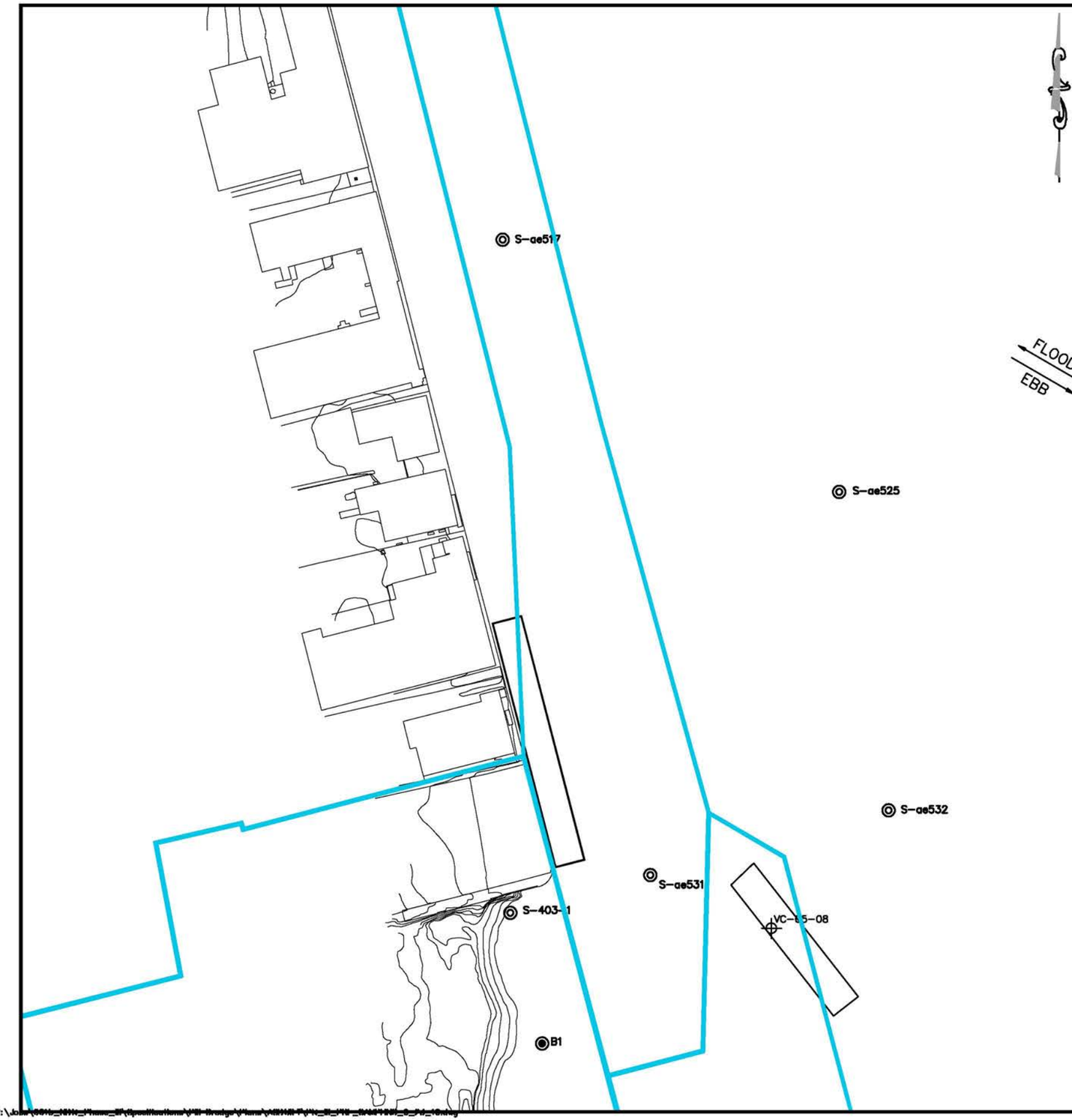
Design GCD	
Check CM	V-2
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



NOTES

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2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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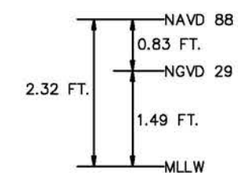
FLOOD
EBB

VC-07-08 — PRE DREDGE SAMPLE LOCATION

B1 — APEX SAMPLES 8-6-2010, 8-10-2010

S-ae-538 — USACE SAMPLES

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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REVISIONS

NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

SOUTH TERMINAL DREDGE AREAS- PRE AND POST DREDGE SAMPLING LOCATIONS

NOT FOR CONSTRUCTION

Scale: 0 40 80 160 200 FEET

Date 9/5/08	Drawing No.
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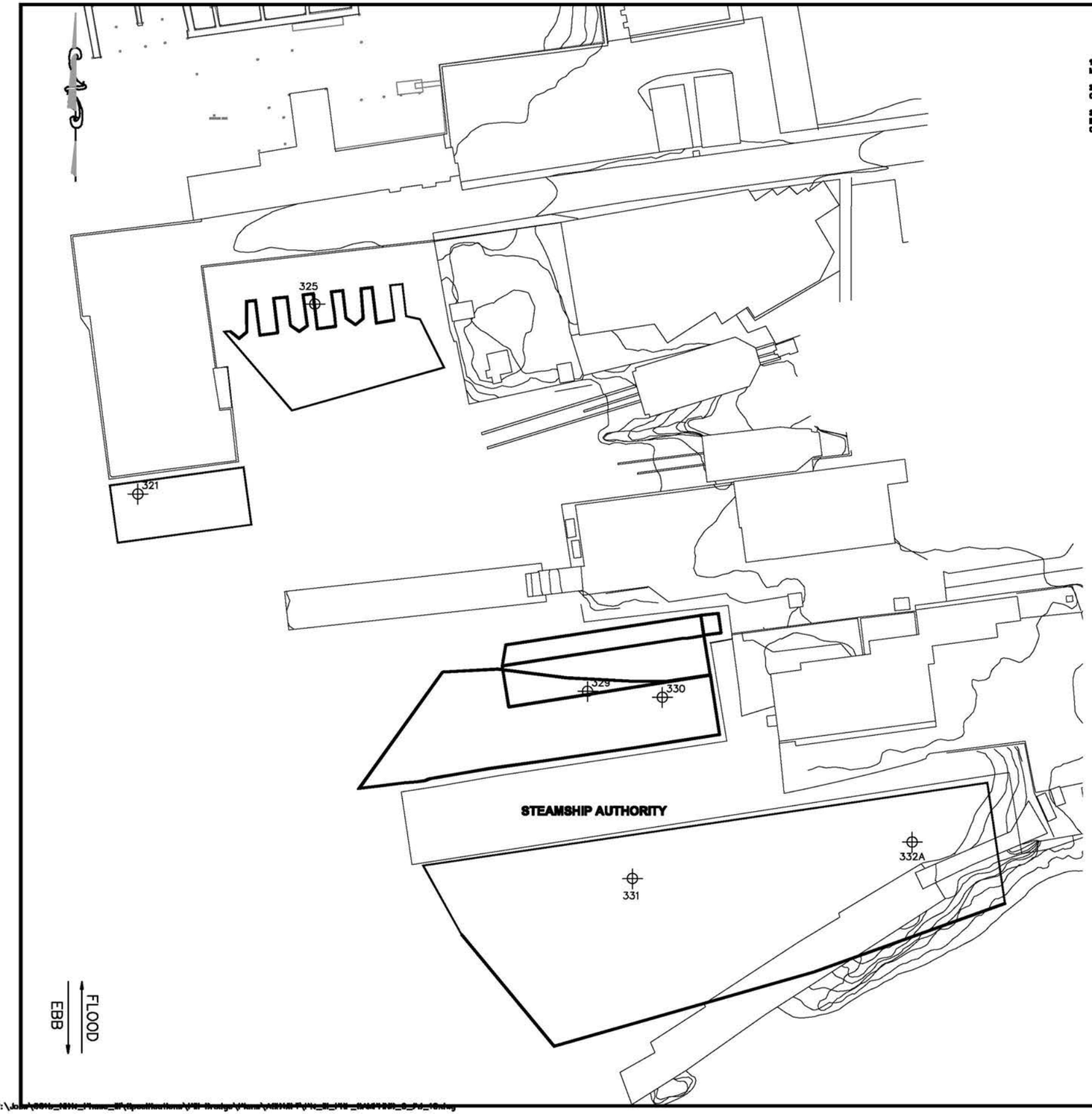
Design GCD	
Check CM	V-3
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

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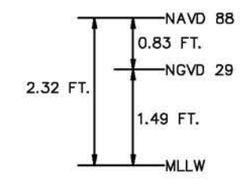
VC-07-08 PRE DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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(617) 728-0070

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NO.	DATE	DESCRIPTION
1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/09	BID SET
3.	1/18/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

WARREN ALEXANDEER SOUTH AND UNION WHARF DREDGE AREAS- VIBRACORE AND BORING LOCATION SHEET NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
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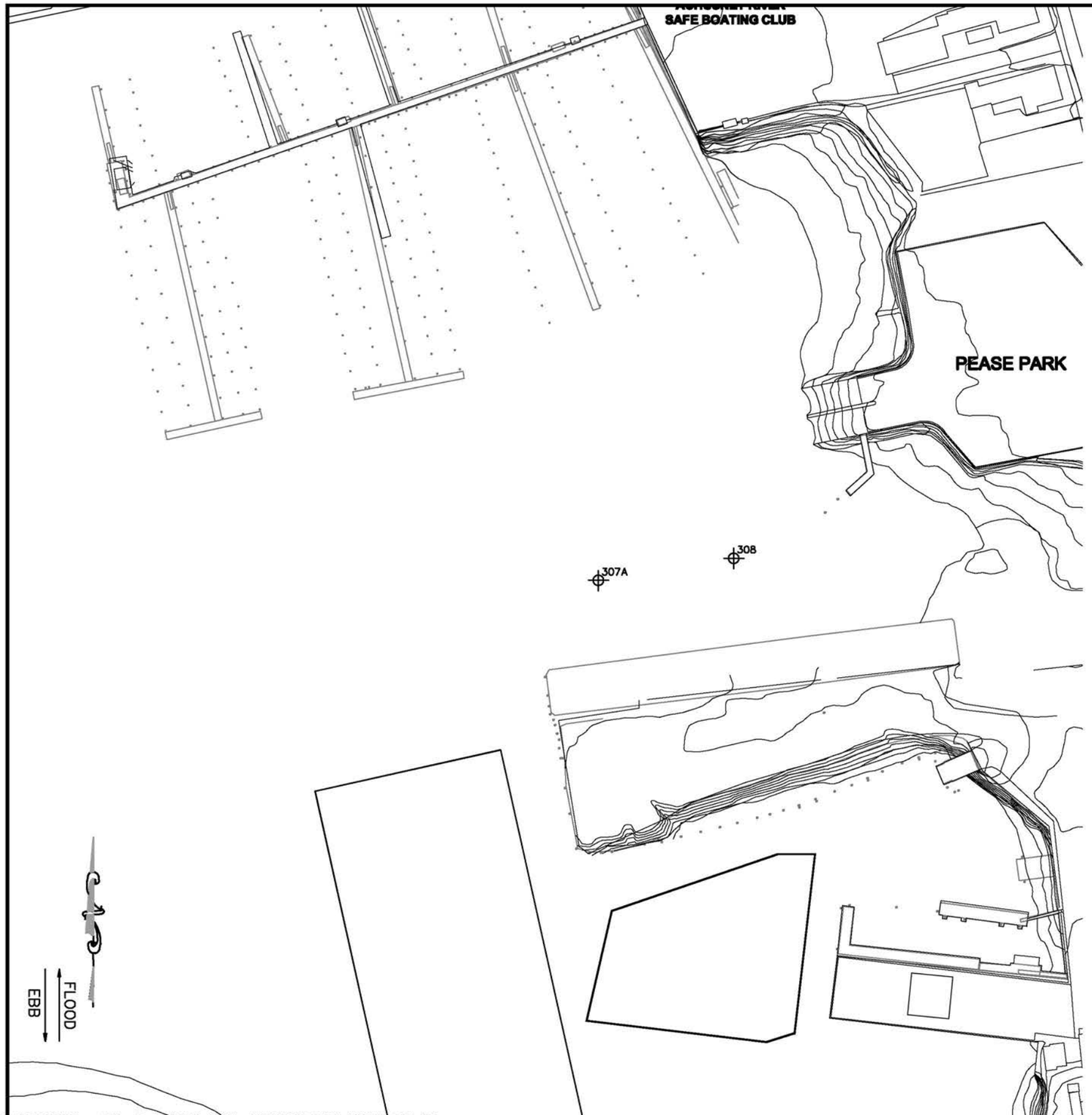
Design GCD	
Check CM	V-4
Drawn GCD	
Job. No. 6615	
Last Rev. 1/22/10	



NOTES

1. COORDINATES SHOWN ARE IN THE STATE PLANE COORDINATE SYSTEM, MASSACHUSETTS MAINLAND ZONE 2001, REFERENCED TO THE 1983 NORTH AMERICAN DATUM.

2. HYDROGRAPHIC SURVEY IS A COMPILATION OF SURVEYS PREFORMED BETWEEN 6-11-08 AND 11-6-08.

3. HYDROGRAPHIC SURVEY DATUM IS REFERENCED TO MEAN LOWER LOW WATER (MLLW) ON THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL OCEAN SERVICE TIDAL BENCHMARK BM7884 J 1977 - SURVEY DISK SET FLUSH IN THE SURFACE OF A CONCRETE SIDEWALK ON THE SOUTH SIDE OF U.S.HIGHWAY 6 ON THE NORTH SIDE OF THE MOBIL SERVICE STATION, 4 FEET (1 M) WEST OF A FIRE HYDRANT AND 1 FOOT (0.3 M) SOUTH OF U.S. HIGHWAY 6. DATUM SEPARATIONS WERE COMPUTED BY COLER AND COLANTONIO, INC. FEBRUARY 2002 AS MLLW - 1.52 FT = NGVD29 0.0 FT. TO OBTAIN VALUES IN NGVD29, SUBTRACT 1.52 FEET FROM THE INDICATED VALUE AT ANY POINT. HORIZONTAL CONTROL CAN BE OBTAINED FROM THE ENGINEER.

4. BASE PLAN FOR THIS FIGURE OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS. EXISTING CONDITIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR.

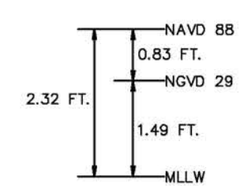
5. HORIZONTAL AND VERTICAL CONTROL HAVE BEEN PROVIDED BY THE OWNER AND HAVE NOT BEEN INDEPENDENTLY VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF CONTROL DATA.

6. THE INFORMATION DEPICTED ON THIS DRAWING REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED ABOVE AND CAN ONLY BE CONSIDERED AS INDICATING THE CONDITIONS AT THE TIME OF THE SURVEYS AND AT THE SOUNDING POINTS NOTED ON THE DRAWING.

312 VIBRACORE LOCATION

312 BORING LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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115 BROAD STREET
SUITE 200
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(617) 728-0070

REVISIONS

NO.	DATE	DESCRIPTION
1.	[illegible]	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

LINBERG DREDGE AREAS- VIBRACORE AND BORING LOCATION SHEET

NOT FOR CONSTRUCTION

Scale: 0 20 40 80 100 FEET

Date 9/5/08	Drawing No.
Proj. Mgr. JAB	
Design GCD	
Check CM	V-5
Drawn GCD	
Job. No. 6615	
Last Rev. 10/30/08	

NOTES

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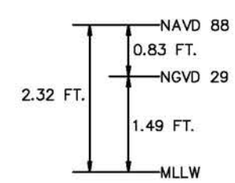
PRE DREDGE SAMPLE LOCATION

GRAPHIC DEPICTION OF DATUM SEPARATIONS FOR NEW BEDFORD HARBOR



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1.	9/05/08	PRELIM. DREDGE LAYOUT
2.	11/14/08	BID SET
3.	1/16/09	RE-BID
4.	1/22/10	POST-DREDGE SAMPLES

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PROJECT TITLE:

NEW BEDFORD HARBOR NAVIGATIONAL DREDGE - PHASE III, PART A & B

PREPARED FOR:

THE NEW BEDFORD HARBOR DEVELOPMENT COMMISSION AND THE TOWN OF FAIRHAVEN, MASSACHUSETTS

DRAWING TITLE:

OLDE NORTH WHARF FISHERIES DREDGE AREAS PRE AND POST DREDGE SAMPLING LOCATIONS NOT FOR CONSTRUCTION

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Drawn GCD	
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APPENDIX 3

APPENDIX 4

Evaluation of Marine Oil Spill Threat to Massachusetts Coastal Communities

For the COMMONWEALTH of MASSACHUSETTS

Prepared for: Massachusetts Department of Environmental Protection

December 2009

Prepared by: Nuka Research & Planning Group, LLC

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Executive Summary

This report compiles and analyzes information regarding the threat of marine oil spills to coastal communities in Massachusetts. The report was developed by Nuka Research and Planning Group, LLC under contract to the Massachusetts Department of Environmental Protection (MassDEP) under the "Project to Identify Priority Coastal Communities for Distribution of Future Oil Spill Response Equipment, Training and Geographic Response Plans for the Commonwealth of Massachusetts."[1] The content of this report may be used by MassDEP to facilitate oil spill prevention and response resource allocation decisions.

This report represents an assessment of threat levels by threat categories in the harbors, communities, and regions of coastal Massachusetts. To assess overall threat levels and to compare oil spill threats among geographic locations, a methodology was developed to estimate threat exposure at the harbor and community level to three different categories of threat and ten discrete threat factors. Three general categories were used to distinguish threat types – vessel movement, resident vessel fleets, and land-based storage. A measure of gallons of petroleum exposure (GPE) was calculated for ten different threat factors by geographic area. The methodology used to develop the assessment, a description of the data sources used, and an analysis and evaluation of the results are included in this report. This report aggregates and analyzes various measures of oil spill threat exposure, but it is not a quantitative or numeric risk assessment.

The use of GPE to estimate oil spill threat levels is based on the assumption that oil spill risks are directly related to the amount of petroleum storage, transfer, and utilization activity occurring within a designated geographic area. In most cases, the GPE at the local level can be summed to estimate regional threat levels. No effort is made to rank the various threat categories relative to each other; therefore all types of spill threats are considered to have equal priority.

This report finds that the largest oil spill threat for all factors combined occurs in the Boston Harbor Region, due mainly to the level of petroleum imports. The Cape and Islands Region has the second highest threat level largely due to the amount of vessel transits in shipping lanes near their coast. The other regions in order of decreasing threat levels are: South Coastal, North Shore and South Shore. At the harbor level, Boston Harbor, New Bedford Harbor, Sandwich Boat Basin and Great Harbor (Woods Hole) ranked among the highest in terms of total exposure to oil spill threats.

Across all harbors and regions, the oil spill threat from vessel movement was much higher in terms of gallons of petroleum exposure than any other source. This is mostly attributable to the fact that tank vessels moving through shipping channels and in and out of harbors (primarily the Port of Boston) represent the single largest exposure to oil by quantity. Land-based storage in regulated tanks is the second largest total exposure. The third largest threat factor is nontank

[1] Project #101300.

vessel activity. After nontank vessel activity, fishing fleets account for the fourth highest exposure threat. After fishing vessels, recreational and charter vessels seem to pose the fifth largest overall exposure level.

This study is presented as an initial assessment of the magnitude of the threat of an oil spill in coastal Massachusetts and a methodology for continued analysis. One of the goals of this study was to create a basic data set that could be used in future risk assessment or risk management planning. The data supporting the analysis for each threat category can be revised as additional and more detailed sources of information are identified, and additional threat categories can be analyzed and added to the model. Additional factors that may magnify or reduce spill threats could be considered as part of a more comprehensive risk assessment.

Based on the threat evaluation by harbor, region, and threat factor and the conclusions of the companion Response Equipment report, this report recommends specific measures that MassDEP may consider in developing future oil spill prevention and response planning projects, including:

- Tailor prevention activities to the highest-exposure locations and activities by continuing with targeted prevention measures such as escort tugs in high-threat areas, ensuring that GRPs are developed for high threat areas, and ensuring that sufficient equipment is available to support priority GRP deployments.
- Enhance response capacity and spill preparedness in highest-exposure harbors and regions through development of additional tactical plans, supplementing oil spill response inventories, developing harbor and regional spill response plans, and conducting scenario analyses to better assess preparedness in high threat areas.
- Diversify state-owned equipment stockpiles to enhance overall response capability.
- Identify opportunities for outreach and education to encourage awareness of oil spill threats from resident vessel fleets and other smaller magnitude threats that may have cumulative impacts.

Evaluation of Marine Oil Spill Threat to Massachusetts Coastal Communities

Report to Massachusetts Department of Environmental Protection

April 2009

1 Introduction

This report presents the analysis and recommendations developed by Nuka Research and Planning Group, LLC under contract to the Massachusetts Department of Environmental Protection (MassDEP) under the "Project to Identify Priority Coastal Communities for Distribution of Future Oil Spill Response Equipment, Training and Geographic Response Plans for the Commonwealth of Massachusetts."[2] The content of this report is intended to be used by MassDEP to facilitate oil spill prevention and response resource allocation decisions. This report presents an estimate of oil spill threat by geographic area using a measure of gallons of petroleum exposure (GPE).

This report discusses the rationale for estimating oil spill threats in order to develop comparisons of relative spill threats by geographic area. The methodology used to estimate oil spill threat exposure is presented. The report also presents a description of the data sources used, and an analysis and evaluation of the results. While this report discusses how the GPE threat estimate may be analyzed in the context of overall oil spill risk, the report does not present a quantitative or numeric risk assessment and the results, which estimate comparative oil spill threats, should not be confused with a comprehensive risk assessment.

This report is a companion report to the *Inventory and Assessment of Marine Oil Spill Response Resources in Massachusetts and New England States* report (hereafter, Equipment Report). This report discusses the major findings from the Equipment Report in the context of this analysis and makes recommendations to MassDEP regarding the current state of oil spill threats and response readiness. Both reports establish a foundation for further analysis and activity regarding oil spill prevention and response.

1.1 Background

The three-year plan for implementing the Massachusetts Oil Spill Prevention and Response Act and Amendments (June 2009) outlines oil spill prevention and response planning efforts to be led by the Massachusetts Department of Environmental Protection to implement lessons learned from the 2003 Buzzards Bay spill as reflected in the mandates of the 2004 Oil Spill Act and Amendments (2008 and 2009).[3]

[2] Project #101300.

[3] Chapter 251 of the Acts of 2004: An Act Relative to Oil Spill Prevention and Response in Buzzards Bay and Other Harbors and Bays of the Commonwealth. "The Oil Spill Act", including 2008 and 2009 amendments.

A major planning task in the implementation plan is to conduct a coastal oil spill threat evaluation that will serve as the basis for prioritizing future equipment and training deliveries and Geographic Response Plan development. This report presents recommendations regarding relative spill threats, and establishes a foundation that may be used in the future to develop a more robust risk analysis and management program.

Other programs and activities conducted to date in support of the interim plan to improve oil spill preparedness and response capabilities include:

- The delivery of oil spill response trailers to 68 coastal communities.
- The development of geographic response plans (GRP) to protect environmentally sensitive areas in Buzzards Bay, Cape Cod and the Islands, and the North Shore.
- The execution of oil spill response training field exercises to familiarize local first responders with oil spill response equipment, tactics, and GRPs.
- The compilation of an inventory of oil spill response equipment by town, city and region to compare against actual requirements and help determine procurement decisions.

Additional activities in support of the interim Plan will be developed by MassDEP through the Bureau of Waste Site Cleanup with the support of the Massachusetts Oil Spill Act Advisory Committee (OSAAC).

1.2 Purpose and Objectives

An overarching goal of the Oil Spill Act is to develop a statewide oil spill response capability. The purpose of this project was to conduct an informal evaluation of the marine oil spill threats in the Commonwealth of Massachusetts to support future expenditures from the Massachusetts Oil Spill Act Fund for oil spill response equipment trailers, geographic response plans, and other efforts.

The main objective of this report is to develop an assessment of the relative oil spill threat levels in the coastal Massachusetts region and report on the analysis in a manner that can be used in procurement and operational planning decisions.

A secondary objective of this project is to develop the methodology and analysis in such a way that it can be:

- Scaled to provide additional information for specific threat factors as part of future studies;
- Replicated to assess trends in oil spill threats by town, city, and region; and
- Utilized as a first step in a larger risk management program.

1.3 Scope of Work

The comparison of spill threats by region contained in this report may be used to develop or validate intermediate priorities for allocation of spill response planning efforts. This report also presents recommendations for additional

planning and response activities that might supplement the overall response capability within Massachusetts.

The Oil Spill Threat Analysis has been conducted to present an initial assessment of the oil spill threats by geographic location and by relative size of each threat. To complete the analysis the following major tasks were undertaken:

- Identification of those towns and cities in Massachusetts that may be considered "coastal" based on the potential threat for an oil spill from any source that would require a coastal (on-water or nearshore) oil spill response;
- Identification of harbors within each coastal town that would likely be exposed to oil spill threats, thus allowing for analysis and evaluation at the harbor level and aggregation of data to the regional level;
- Identification of the major threat factors and activities that contribute to the potential for a marine oil spill to impact a Massachusetts coastal community;
- A compilation of recent, available data regarding the presence or absence of each major threat factor and the size of the threat or activity by geographic location (harbor, town, city, or region);
- Calculation of gallons of petroleum exposure (GPE) for each threat factor at different geographic levels in order to develop a comparative analysis of the relative threats levels;
- Consideration of relative threat levels compared to oil spill response equipment stockpile levels; and
- Publication of the final analysis along with recommendation for future analysis.

1.4 Study Approach

This report identifies potential oil spill threats by geographic region as part of a larger effort to identify and mitigate the risk of an oil spill and the consequent damage the spill would cause. By focusing on the threats, the report presents information that can be used in the initial stages of a comprehensive risk management program.

Risk management can be defined as a logical and systematic method of identifying, evaluating and managing the risks associated with any activity, function or process in a way that will enable an organization to minimize losses and maximize opportunities. Risk management is an iterative process consisting of well-defined steps which, taken in sequence, support better decision-making by contributing a greater insight into risks and their impacts.

Risk assessment, which is a subset of risk management, is the process of identifying the likelihood of a particular event occurring and its potential consequences. Likelihood can be measured in quantitative terms of probability based on the historical frequency of similar events. Or it can be measured in qualitative terms, such as more and less or high and low, and based on an in depth understanding of the system or systems and the possible failure points.

The major components of a risk management program are as follows:[4]

Establish the context - Establish the strategic, organizational and risk management context in which the rest of the process will take place.

Identify risks - Identify what, why and how things can arise as the basis for further analysis.

Analyze risks - Determine the existing controls and analyze risks in terms of consequence and likelihood in the context of those controls.

Evaluate risks - Compare estimated levels of risk against the pre-established criteria.

Treat risks - Accept and monitor low-priority risks. For other risks, develop and implement a specific management plan.

Monitor and review - Monitor and review the performance of the risk management system.

Communicate and consult - Communicate and consult with internal and external stakeholders as appropriate.

This study focuses on the first two components of risk management: 1) Establish the context and 2) Identify risks. The identification of threats is an important step in the overall risk assessment process. The study identifies the types of oil spill threats that exist and compiles relative measures of threat levels by geographic location in order to estimate the comparative level of exposure an area has to the threat of an oil spill.

This study provides MassDEP with a basis from which to conduct further risk analysis and evaluation potentially leading to programs which may reduce the risk of an oil spill or prepare to mitigate the consequences.

The study was designed to include input and review from local, state and federal agencies with harbor management or oil spill oversight authority. Questionnaires and surveys have been sent to stakeholders to determine threat components and draft reports and interim data sets have been reviewed by representatives of MassDEP, the U.S. Coast Guard (USCG), and the National Oceanic and Atmospheric Administration (NOAA) Office of Restoration and Response.

The final report will be made available to OSAAC for their consideration and review.

1.5 Geographic Scope

Geographic designations are important to the final analysis and presentation of the data collected in this study since response planning efforts and projects are to be allocated by community (town or city) and region. In the interest of consistency with other statewide ocean and coastal planning and management initiatives, this study uses the same regional designations used by the Massachusetts Coastal Zone Management (CZM) program.

[4] Standards Association of Australia, *Risk Management AS/NZS 4360 1999*, 12 April 1999

1.5.1 Municipality and Region

As shown in Figure 1.1, the state is divided into five regions for the purpose of coastal oil spill response planning: North Shore, Boston Harbor, South Shore, Cape and Islands, and South Coastal. Three major criteria were applied to Massachusetts communities within the coastal regions to determine whether or not they would be included in the threat evaluation study: [5]

- Does the municipality have a boundary that reaches the marine coast? If **yes**, the community was included. If **no**, then question #2 was considered.
- Does the municipality include a tidal river, estuary, marsh or inlet that flows to marine waters without impediment? If **yes,** then the community was included. If **no**, then question #3 was considered.
- Based on best professional judgment, are there reasonable scenarios where spilled oil from a marine transportation related facility could migrate to the tidal rivers within the community? If **yes**, then the community was included. If **no,** then the community was excluded.

Based on the above criteria, 71 towns and cities were identified as being at risk of being impacted from a marine oil spill and/or being a potential source of a marine oil spill. Municipalities that are included in each region are shown on the map in Figure 1.1.

1.5.2 Harbor and Waterbody

In addition to municipality and region, two other levels of geographic information were identified to assist with the analysis. First, a list of individual harbors within each community was compiled to allow for analysis of oil spill threats by source and quantity. Second, each harbor was listed by the waterbody that it is adjacent to so that information can be aggregated by major waterbody.

A geographic location was considered a harbor if it met at least one of the following criteria:

- The location was called a harbor on the NOAA chart for the area.
- The location provides a refuge from waves and wind and has mooring or docking facilities for more than 25 – 50 vessels.
- The location has a marina or boatyard.
- The location has a significant amount of commercial maritime activity[6].

The analysis identified 95 harbors in the 71 coastal towns and cities with 14 of the 95 harbors shared by more than one municipality. Boston, Everett and Chelsea, for example, each have waterfront commerce, but they each abut Boston Harbor. Seven towns do not have a harbor - Freetown, Dighton,

[5] For a more detailed discussion of how coastal towns were identified, see the report to MassDEP entitled "Rationale for Identifying Massachusetts Communities for Inclusion in Coastal Oil Spill Threat Evaluation," June 2008. http://www.mass.gov/dep/cleanup/ctrec.pdf.

[6] For purposes of this study; A "port" is defined as a location on a waterway that has facilities for loading or unloading cargo from ships or barges.

Acushnet, Berkeley, and Peabody abut rivers above identifiable harbors, and Swampscott and West Tisbury are coastal towns that do not have an identified harbor. Falmouth has fourteen harbors and abuts two waterbodies. The remaining towns have between one and six harbors.

To assist with future analysis of oil spill threats, the waterbody that each harbor is adjacent to was added as an additional geographic identifier. Aggregation of the oil spill threat data by waterbody may be valuable in future studies to assess the effect of very large spills across regions. For example, the Cape and Islands region is adjacent to five different waterbodies (Cape Cod Bay, Atlantic Ocean, Nantucket Sound, Vineyard Sound, and Buzzards Bay) and shares two of the waterbodies with other regions. For a large spill in Cape Cod Bay, the response would likely involve resources from the Cape and Islands and the South Shore regions. For a spill in Buzzards Bay, the response will likely involve resources from the Cape and Islands and the South Coast regions.

Figures 1.2.1 through 1.2.5 contains five maps showing the harbor locations by region. The 95 harbors are numbered in the map and the accompanying index, beginning in the North Shore region and then working south through Boston Harbor and the South Shore, then clockwise around the Cape and Islands and counterclockwise around Buzzards Bay and Mount Hope Bay in the South Coastal Region. Appendix A provides the list of Massachusetts harbors by region, municipality, and waterbody.

Figure 1.1 Map of Coastal Regions and Municipalities Included in this Study

Figure 1.2.1 Harbors located in the North Shore Region

Figure 1.2.2 Harbors Located in the Boston Harbor Region

Figure 1.2.3 Harbors Located in the South Shore Region

Figure 1.2.4 Harbors Located in the Cape and Islands Region

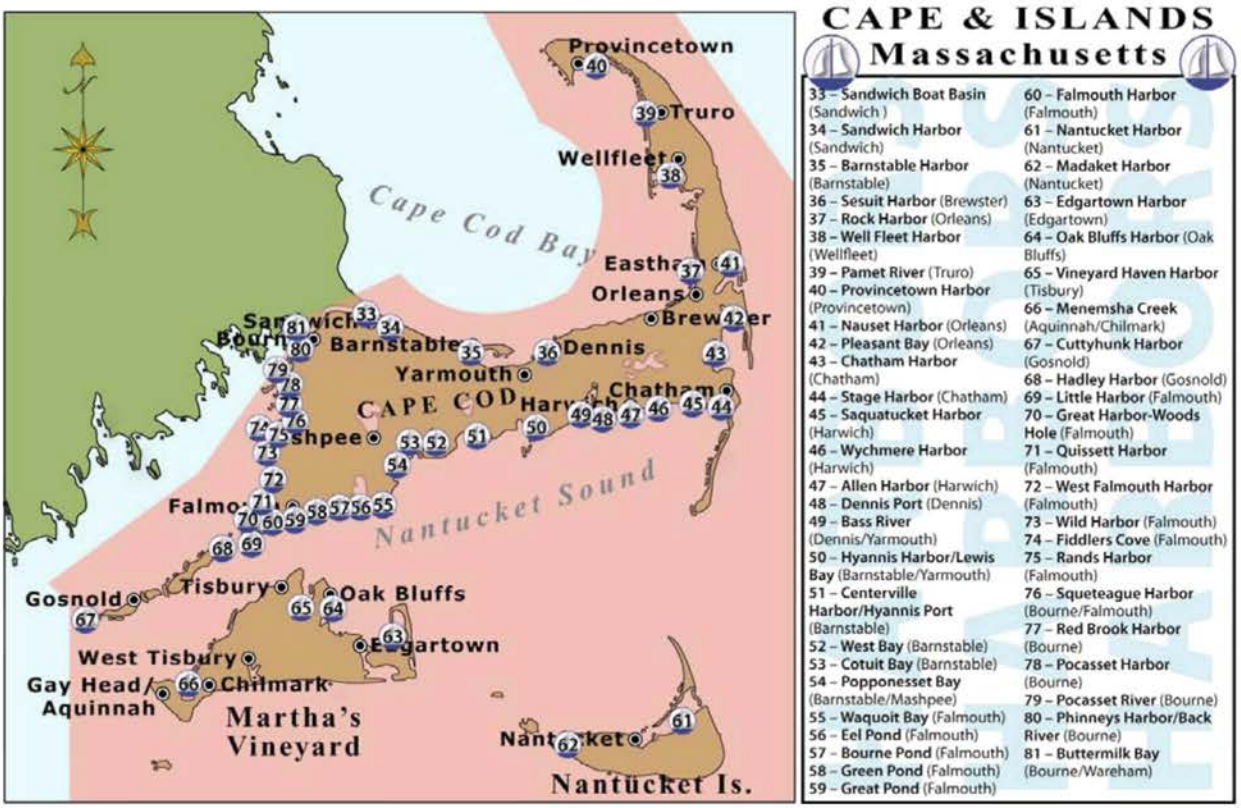
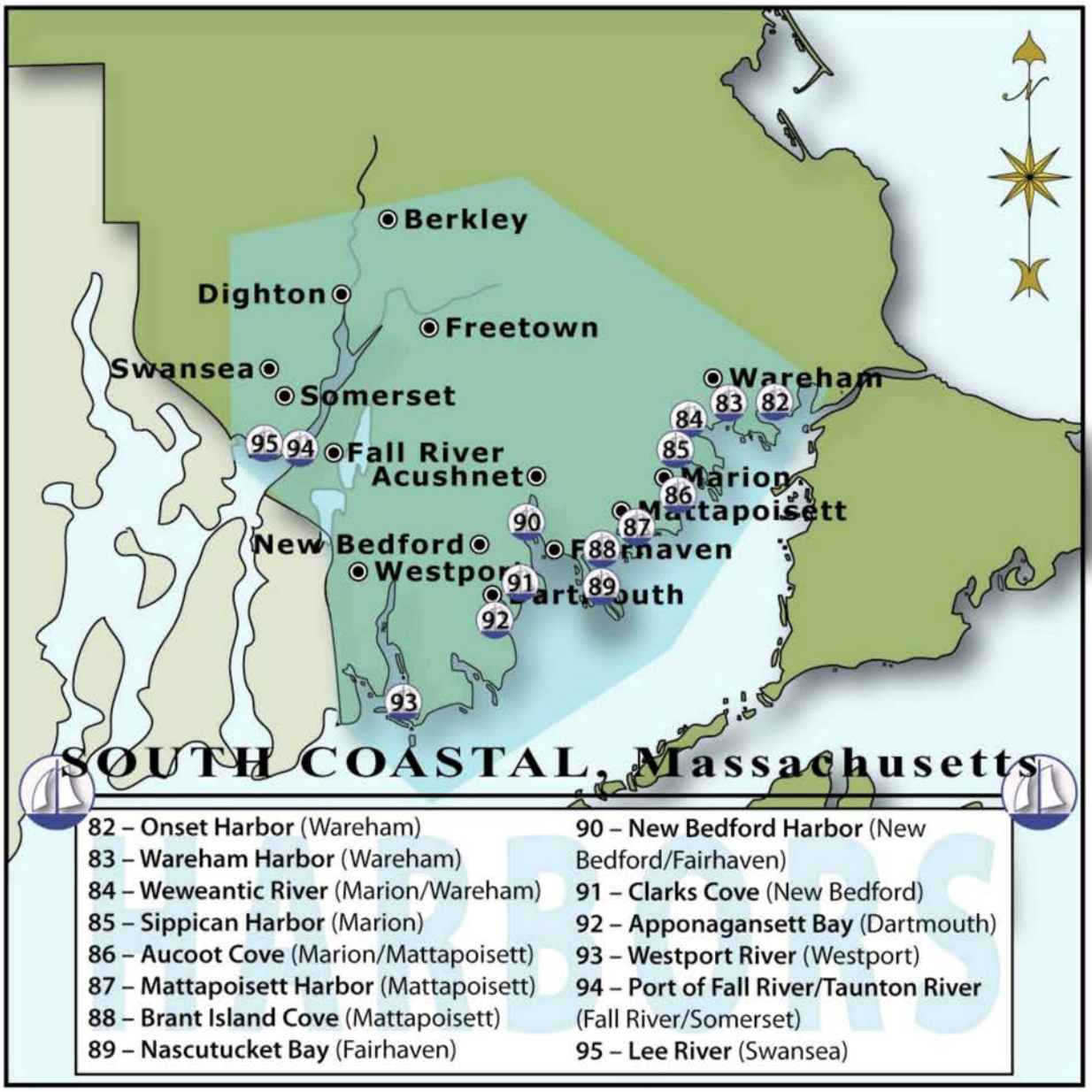


Figure 1.2.5 Harbors Located in the South Coastal Region



2 Threat Categories

This study evaluates relative oil spill threat levels using a measure of total gallons of petroleum product that a harbor, town, city or region could be exposed to on an annual basis. The resulting measurement of Gallons of Petroleum Exposure (GPE) then allows for comparative assessment of marine oil spill threats within and among Massachusetts harbors, towns, cities, and regions.

This study considers the oil spill threats to coastal communities from both marine and land-based sources. Three categories of oil spill threats were analyzed. The first category includes indicators of large vessel movements in the major ports of the state and along shipping routes. The analysis focused on petroleum deliveries in tank vessels and on the movement of large vessels that use petroleum as fuel. The second category of threat factors includes residential vessel fleets that are moored or docked in a harbor. These indicators were analyzed for their total fleet size and average vessel size to determine estimates on the total amount of fuel carried. The third category accounts for land-based bulk fuel storage and non-EPA regulated fuel tanks to provide a total number of gallons of exposure from these sources. The threat factors identified through this study are not exhaustive, but reflect those factors for which sufficient data was available to make a reasonable assessment.

One threat category not considered in this study is the history of oil spills by location. An initial review of local oil spill records indicated that the accuracy of the data was not sufficient to draw meaningful conclusions. Data sets reviewed included MassDEP records, USCG records, and a survey sent to local fire chiefs. Problems with data quality and consistency were noted both within and across databases. A more expansive review of these and possibly other data sets may be useful for future studies of probability and/or frequency of oil spills. Historical studies of oil spills by location and threat type combined with an analysis of oil spill prevention methods and an ongoing accurate tracking of oil spills could become part of a more comprehensive risk management program as discussed in Section 1.4.

Another potential area of study that is not addressed by this report is a location's vulnerability to oil impacts. The NOAA Office of Response and Restoration has classified shoreline types from least vulnerable to most vulnerable and inventoried the natural resources found along the shorelines of Massachusetts. A vulnerability analysis of the NOAA data combined with the threat analysis would provide another layer of information that could be used to better understand overall risks by community and/or region.

Mitigating measures are also not accounted for in this study. Every gallon of oil present in a location is considered to have an equivalent likelihood for being spilled. This is a somewhat artificial assumption, since there are a wide range of spill prevention and mitigation measures in place for vessels and shoreside facilities that can impact the likelihood of a spill from one source as compared to another. A broader risk management program would also factor in such preventative measures and account for the corresponding potential reduction of spill threat or magnitude.

2.1 Vessel Movements

Vessel movements into and out of major ports and along traffic routes can impact the threat of coastal oil spills in a number of ways. A port with a large number of vessel calls may have a higher relative threat of spills than a less active harbor. Vessel traffic patterns in shipping lanes or ship channels may contribute to oil spill threats due to navigational challenges, congestion areas, or other factors. The size and type of vessels that call on a port and the quantity of petroleum they carry as either cargo or fuel (bunker) may also contribute to oil spill threats. An oil spill in Alaska from the vessel *Selendang Ayu* and a spill in San Francisco Bay, CA from the vessel *Cosco Busan* are both examples of fuel oil (bunker) spills.

The individual threat factors for vessel activities that were considered in this study are:

- Oil tank vessel or tank barge activity in ports
- Large nontank vessel activity in ports (freight, passenger, or other vessels – over 300 gross tons)
- Oil tank vessel and large nontank vessel transits in major shipping lanes.

Data on vessel activity in Massachusetts harbors was gathered from several sources, including port entry data, vessel movement information, and surveys with professional mariners and harbor managers in the communities and region.

In aggregating the data from the harbor level up to the regional level, information regarding tank vessel or tank barge activity and large nontank vessel activity within each harbor has been added together to create the regional GPE measure.

However, quantities of GPE calculated as a result of vessel transits are recorded only once per vessel route and then applied without aggregation to each level of analysis. Each gallon of petroleum cargo or fuel in tanks that transits by a harbor adjacent to the vessel routes presents only a single threat of being spilled. Therefore, the same threat level is experienced whether the analysis is by harbor or by region. To aggregate these numbers from the harbor level up to the regional level would overstate the exposure.

2.2 Residential Vessel Fleets

For many harbors in Massachusetts the most likely threat of an oil spill comes from the thousands of recreational and charter vessels, fishing vessels, and commercial vessels that operate within the harbor and utilize it for moorage and dockage. These vessels typically range in size from 18 ft to 65 ft; however a few harbors have recreational and commercial vessels that exceed 100 ft in length. Oil spills from these sources occur during fuel transfer operations, bilge pumping, as a result of a collision or grounding, and as a result of accidental or illegal discharges of fuel, lube oil, or hydraulic oil.

To estimate the magnitude of the threat factors from residential vessel fleets, the following data was collected for this study:

- Recreational and charter vessel range of lengths and average size along with the total number of recreational and charter vessel moorings and slips in the harbor.
- Commercial fishing vessel range of length, average size, and type of vessel.
- Ferryboat lengths and type.
- Information on other large vessels moored and operated in the harbor (i.e. tugboats, whale watching boats, research vessels, and training ships).
- Information on shipyards within a harbor that service large vessels.

For this study, information on moorings and slips was used to estimate the size of the recreational and charter vessel fleet rather than use USCG, state or local registries of vessels. While a detailed analysis of these registries may provide an accurate assessment of the actual vessel fleet size; utilizing mooring and slip counts as an indicator of fleet size allows for an efficient method of information gathering, a high level of accuracy and a consistent measure across different harbors. The assumption made for the study is that all moorings and slips are utilized during the summer season. Thus the total size of the fleet in any given harbor will include vessels that are registered to the harbor as well as transient vessels that utilize the harbor for less than a full season. This assumption then works well for harbors such as Cuttyhunk Harbor in the town of Gosnold, where nearly all moorings are occupied during the summer months by transient vessels, yet there are very few vessels registered with Cuttyhunk as a homeport.

Data collected on these threat factors came from surveys to harbormasters, web-based research on commercial vessel activity and phone conversations with industry personnel, mariners, and harbor managers.

2.3 Land-Based Bulk Fuel Storage

Coastal communities in close proximity to land-based bulk fuel storage have an increased threat of being impacted by a spill. Bulk fuel storage facilities considered for this study include EPA regulated facilities with storage tanks over 10,000 gallons (per the Oil Pollution Act of 1990 requirements for Facility Response Plans) as well as smaller bulk fuel storage tanks at harbors and marinas (typically between1,000 gallons and 4,000 gallons).

The individual threat factors for land-based bulk fuel transportation and storage that were considered in this study are:

- EPA Regulated facility with potential to discharge to tidal waters
- Locally regulated bulk fuel storage at harbor or marina (any product)

Information about spill threats from fuel storage was compiled from several sources. The Environmental Protection Agency (EPA) provided a list of all regulated facilities in Massachusetts (those required to file Facility Response Plans with the EPA, which generally have at least 42,000 gallons of total aboveground storage).[7] Information on smaller bulk fuel storage at harbors and

[7] United States, U.S. Code of Federal Regulations, 40 CFR 112.

marinas (1,000 gallons total or more) was gathered through surveys municipal fire chiefs and harbor masters.

Spills during transfers or vessel refueling are considered the primary oil spill threat from these sources, although it is possible that oil could also be spilled through primary leaks from the tanks themselves or catastrophic tank failures. The GPE from these sources are therefore used as in indicator of the relative level of oil spill threat in any given harbor and can be aggregated together to calculate regional threat indicators.

The evaluation of fuel storage does not distinguish between the types of petroleum product stored; however, it is important to acknowledge that a gasoline spill would pose a much different response scenario than a home heating oil or marine diesel fuel spill. Therefore, as this threat factor is evaluated for the purpose of future planning decisions, it may be salient to consider the type of petroleum storage and tailor prevention and response planning strategies accordingly.

3 Data Sources, Assumptions and Methods

Section 3.1 describes data sets used to estimate the threat factors discussed in Section 2 and identifies limits and constraints encountered in their compilation. One of the objectives of the study was to conduct the analysis using readily available data sources, and the information collected does provide reasonable indications of the type, location and quantity of oil spill threats along coastal Massachusetts. However, to assist future studies, each data set description also discusses some of the constraints encountered while collecting and analyzing the information. These lessons can be applied to future efforts to compile data for analysis of trends, causes, and potential mitigation programs. Section 3.2 discusses several sets of data that were reviewed but not used in this study.

The assumptions used to guide the data collection process are presented in Section 3.3. These assumptions may or may not apply to future studies; however, a review of the criteria presented will be useful to future efforts to either replicate or expand on this study.

To assess the level of oil spill threat in the coastal areas of Massachusetts, this study converts the collected data into a measurement of gallons of petroleum exposure (GPE). The underlying assumption of the method is that the level of threat for an oil spill is directly related to the amount of petroleum in the area. In converting the data to the GPE measure and aggregating the amounts to assess municipal and regional threat levels, it is important to understand that the threat categories have different temporal scales and thus the aggregated numbers provide an indication of the threat level rather than a quantitative measurement of risk.

All GPE estimates are limited by the strength of the data that underlie their calculation, and for this reason data sources are described in this section and their strengths and limitations identified.

The Vessel Movement threat factors capture the quantity of oil that is in transit (both as cargo and as vessel fuel) through the ports and shipping lanes, and the petroleum cargo that is in transition as it is being discharged to shoreside storage tanks. Data gathered for this category are presented as annual numbers and represent the total threat factor for the area over the time span of one year.

For the other two categories, Residential Vessel Fleets and Land-based Bulk Fuel Storage, the GPE measure is a static measure of how much petroleum can be expected to be in a location on any given day based on total storage capacity. This measure then represents the potential of an oil spill based on the number of point sources in the area and the maximum quantity that each source may contain.

To assess the total threat factor to various geographic locations, this study aggregates the quantities from all three categories and presents them as an indication of oil spill threat for the municipality or region. This method allows for a valid comparison across areas and thus meets the objectives of the study. Other approaches that could be used in additional analysis could include calculating an average daily vessel activity GPE and using that as the component

of overall threat or identifying the maximum static or transit/transitional GPE and assessing threat on a worst case scenario basis.

3.1 Data Sources

Table 3.1 identifies the sources used to compile information for the study and indicates the threat factors that were associated with each data set. Some of these sources provided necessary background information and others provided specific values directly entered into the GPE calculation.

Table 3.1 Threat Factors and Data Sources

Threat Category	Threat Factor	Data Sources
Vessel Movement		
	Tank Vessel Port Visits	
		Army Corp of Engineers - Waterborne Commerce Reports
		USCG - Port of Entry Reports
	Nontank Vessel Activity	
		Army Corp of Engineers - Waterborne Commerce Reports
		USCG - Port of Entry Reports
	Tank and Nontank Vessel Transits	
		USCG - Port of Entry Reports
		Army Corp of Engineers - Cape Cod Canal traffic data
		NOAA navigational charts
Vessel Resident Fleets		
	Recreational and Charter	
		Harbormaster Surveys
		Massachusetts Harbormaster Association Web-site
		Interviews with Coastal Zone Managers
	Fishing Vessels	
		Harbormaster Surveys
	Ferryboats	
		Harbormaster Surveys
		Follow-up research on websites and with phone calls
	Other Large Vessels	
		Harbormaster Surveys
		Follow-up research on websites and with phone calls
	Shipyards	
		Harbormaster Surveys
		Follow-up research on websites and with phone calls
Land-based Storage		
	EPA Regulated Storage Tanks	
		EPA Schedule of facilities with Facility Response Plans
	Locally (Non-EPA) Regulated Storage Tanks	
		Harbormaster and Fire Chief Surveys

3.1.2 USCG Port Call Data

The USCG port call data was reviewed to identify the type, size, cargo and fuel capacity of vessels arriving at Massachusetts commercial ports. Vessels over 300 gross tons (GT) arriving at U.S. ports are required to submit an arrival notice to the U.S. Coast Guard. In Massachusetts, these arrival notices are collected and compiled by two different units – Sector Boston and Sector Southeastern New England (SENE). Sector Boston compiles port call records for Boston Harbor and the North Shore. Sector SENE compiles port call records for commercial ports in Buzzards Bay, Mt. Hope Bay and the Cape and Islands.

Sector Boston provided data on port calls for 2006 through 2008 for the Port of Boston. Sector SENE provided data on port calls for 2002, 2003, and 2006. Since data sets are for different years and each data set only shows three years worth of information, they should be considered as snapshots of "typical" vessel traffic. They were used to compile data regarding the gross size and type of cargo for vessels calling at major ports in Massachusetts.

For the GPE analysis, the vessel information from 2006 was used since this was the one year that overlapped for both data sets.

3.1.3 Army Corps of Engineers Waterborne Commerce Reports

The Army Corps of Engineers (ACOE) Waterborne Commerce Reports were reviewed to identify the type, size, cargo, and fuel capacity of vessels traveling through Massachusetts waterways monitored by the Army Corps. The ACOE Navigational Data Center publishes annual reports summarizing waterborne commerce traffic through U.S. waterways. The Atlantic Coast report includes data for the following Massachusetts harbors: Port of Boston (including Chelsea, and Everett), Fore River, New Bedford Harbor, and the Port of Fall River. The reports summarize the total short tonnage of vessels transporting various cargoes through these waterways. The reports also contain information comparing current-year data to previous years. Data reports were available from 2002, 2003, 2005, and 2006. The 2006 report was used in this analysis to identify the volume of petroleum delivered to Massachusetts ports.

The ACOE Waterborne Commerce Reports also contains information on vessel trips by draft within each reporting port. This information was found to be unusable do to the lack of detail provided. A vessel trip is recorded for each movement of a commercial vessel within a port including tank vessels, freight vessels, transfers of barges from one dock to another and all ferry transits. However, the report only provides the total number of trips by draft of vessel, not by type of vessel. In analyzing the traffic from each port, the busiest port in Massachusetts would appear to be Edgartown, MA at 143,058 vessel transits in 2006. For comparison, the port of Boston had 88,801 vessel transits. Conversations with the ACOE staff in New Orleans, LA revealed that the high number of trips was due to the Edgartown ferry operation. A follow-up call to the Edgartown Harbormaster indicated that the ferry service between Edgartown and Chappaquiddick Island runs two vessels every 6 minutes during the summer season. Two trips every six minutes for 12 hours a day for 90 days would equal 129,600 trips, or close to the recorded amount for the harbor. If this level of

detail could be supplied for all ports in Massachusetts by the ACOE, then the information would prove valuable for future risk studies. At the current level of detail however, the raw data could lead to incorrect conclusions regarding the true level of port activity.

3.1.4 Army Corps of Engineers Cape Cod Canal Transit Data

The ACOE is responsible for operating the Cape Cod Canal and maintains detailed records of all vessel transits. Data was reviewed for the calendar years 2006 and 2007. Data collected by the ACOE includes the vessel name, vessel type, vessel tonnage, date of transit, and cargo carried. This information was then analyzed to estimate the number and size of tank vessels and nontank vessels transiting the canal and Buzzards Bay. Values from the 2006 Cape Cod Canal data set were used in the GPE model for the vessel transit threat indicator.

This data proved to be the most useful for analyzing vessel activity. Detailed information at the individual recorded transit level allowed the data to be categorized to fit the needs of this study much better than the summarized data provided in the ACOE Waterborne Commerce Reports. For a risk management program, this level of detail would be preferable for all commercial traffic.

3.1.5 NOAA Navigational Charts for the Massachusetts Coastlines

NOAA navigational charts for the Massachusetts coastline, numbered 13226 through 13282, were analyzed to determine those towns and cities that were within twelve nautical miles of a major shipping channel. Four shipping channels were identified: the Mount Hope Bay Channel depicted on NOAA chart 13266, the Buzzards Bay Vessel Traffic Lane depicted on NOAA chart 13230, the Cape Cod Traffic Separation Scheme depicted on NOAA chart 13246, and the Boston Harbor Traffic Separation Scheme depicted on NOAA chart 13267. Using estimates of the volume of ship traffic through those traffic lanes and estimates of the amount of product and/or fuel carried on nontank vessels, the GPE quantity was established.

Actual vessel transit movement measurements in these lanes were not available for this study. For future studies, vessel monitoring information such as Automatic Information System (AIS) data could be compiled to get a more accurate assessment of the actual traffic in these lanes.

3.1.6 Survey of Massachusetts Harbormasters and Fire Chiefs

Information was collected through written and oral surveys of fire chiefs and harbormasters for several purposes: (1) to identify smaller, local threat factors; (2) to compile information on vessel fleet size; (3) to query local stakeholders regarding their perception of "high threat" areas and activities; and (4) as an outreach tool to inform local communities that this project was underway.

Appendix B contains a copy of the fire chief survey, which was distributed during summer 2008. The survey was sent to the fire chiefs in all 71 coastal

communities and the response rate was approximately 40%.[8] Table 3.2 summarizes the response record for the fire chief surveys.

Appendix C contains a copy of the harbormaster survey. This survey was distributed to 39 of the 71 coastal cities and towns based on an initial review of the number of threat factors that the harbor was likely exposed to. A second criterion for receiving the survey was an identifiable harbormaster to complete the survey. Follow-up phone interviews were conducted to encourage survey completion and explain the purpose of the project. The response rate for the harbormaster surveys was 29 of 39, or approximately 75%. Table 3.3 summarizes the response record for the harbormaster surveys. Additional surveys could be conducted as part of a follow-up study.

Table 3.2 Summary of Fire Chief Survey Responses

Town/ Survey Returned		Town/ Survey Returned		Town/ Survey Returned		Town/ Survey Returned	
Barnstable	Yes	Mashpee	Yes	Gloucester	No	Quincy	No
Beverly	Yes	Mattapoisett	Yes	Gosnold	No	Revere	No
Bourne	Yes	Nahant	Yes	Harwich	No	Rockport	No
Braintree	Yes	Salem	Yes	Hingham	No	Salisbury	No
Brewster	Yes	Sandwich	Yes	Hull	No	Saugus	No
Chatham	Yes	Wellfleet	Yes	Kingston	No	Scituate	No
Chelsea	Yes	Westport	Yes	Lynn	No	Somerset	No
Danvers	Yes	Yarmouth	Yes	Marblehead	No	Swampscott	No
Dartmouth	Yes	Acushnet	No	Marshfield	No	Swansea	No
Duxbury	Yes	Aquinnah	No	Nantucket	No	Tisbury	No
Eastham	Yes	Berkley	No	New Bedford	No	Truro	No
Edgartown	Yes	Boston	No	Newbury	No	Wareham	No
Essex	Yes	Chilmark	No	Newburyport	No	West Tisbury	No
Everett	Yes	Cohasset	No	Oak Bluffs	No	Weymouth	No
Fairhaven	Yes	Dennis	No	Orleans	No	Winthrop	No
Ipswich	Yes	Dighton	No	Peabody	No		
Manchester	Yes	Fall River	No	Plymouth	No		
Marion	Yes	Falmouth	No	Provincetown	No		

[8] Responses were voluntary and were beyond the scope of the fire chiefs' regular responsibilities.

Table 3.3 Summary of Harbormaster Survey Responses

Town/ Survey Returned		Town/ Survey Returned		Town/ Survey Returned		Town/ Survey Returned	
Barnstable	Yes	Gosnold	Yes	Provincetown	Yes	Hingham	No
Beverly	Yes	Hull	Yes	Rockport	Yes	Lynn	No
Boston	Yes	Marblehead	Yes	Salem	Yes	Manchester	No
Bourne	Yes	Marion	Yes	Sandwich	Yes	Nahant	No
Chilmark	Yes	Marshfield	Yes	Scituate	Yes	Newburyport	No
Dartmouth	Yes	Mattapoisett	Yes	Tisbury	Yes	Oak Bluffs	No
Edgartown	Yes	Nantucket	Yes	Wareham	Yes	Quincy	No
Fairhaven	Yes	New Bedford	Yes	Wellfleet	Yes	Weymouth	No
Falmouth	Yes	Orleans	Yes	Westport	Yes	Winthrop	No
Gloucester	Yes	Plymouth	Yes	Chatham	No		

3.1.7 Ferry Operator Websites and Route Maps

A list of ferryboat operators was compiled based on the information contained in the harbormaster surveys and follow-up investigations were conducted using the operator's websites and individual phone calls. The Massachusetts Steamship Authority provided copies of their route maps. The quantity of fuel carried by the ferry vessels was estimated based on conversations with industry professionals. These amounts were added to each home port's GPE measurements for vessel fleets.

3.1.8 Boston and Buzzards Bay PAWSA reports

Reports generated through the Ports and Waterways Safety Assessment (PAWSA) workshops were reviewed for information about specific threats associated with vessel traffic in certain high-traffic areas of the state. PAWSAs are held periodically by the U.S. Coast Guard to collect information from waterway users and other experts regarding navigational safety threats in major U.S. waterways. Within Massachusetts, PAWSA workshops have been held for two areas: Boston Harbor and Buzzards Bay. The most recent workshop reports from each PAWSA (June 2000 for Boston and September 2003 for Buzzards Bay) were reviewed for information pertaining to navigational hazards and vessel casualty threats. The results of this review were used to determine the initial assessment of exposure to oil spill threat factors by town or city.

3.1.9 Information from Massachusetts CZM Regional Coordinators

The Regional Coordinators from the Massachusetts Coastal Zone Management (CZM) Program were surveyed informally regarding the activity levels in their local harbors and their perceptions of which coastal communities were at the highest threat of an oil spill. The Regional Coordinators (North Shore, Boston Harbor, South Shore, Cape and Islands, South Coastal) manage and implement a number of local planning projects, including reviewing Harbor Management Plans, overseeing pollution prevention initiatives, and working with local harbormasters to improve harbor safety and environmental protection.

Therefore, they have an "expert" understanding of many of the factors that might contribute to the threat of a spill at each harbor within their jurisdiction.

The Regional Coordinators were asked to answer two questions: (1) identify all "active" harbors within the region (meaning harbors with some level of municipal harbor facilities and services); and (2) indicate which harbors within the region you would consider to be at highest threat for a marine oil spill, and explain as necessary.

This information was considered among other subjective input from local, state, and federal agencies and stakeholders regarding relative threats within regions and statewide and used in the initial assessment of oil spill threat factors by city or town.

3.1.10 EPA Facility Response Plan Database

The EPA Facility Response Plan (FRP) database was queried to show all facilities with FRPs on file in Massachusetts. The resulting data set was used to identify which cities and towns have one or more EPA regulated bulk fuel facilities in operation. While the presence of one of these larger storage facilities increases the threat of a major oil spill, the fact that these facilities are required to have planning and resources in place to respond to such a spill is an example of a mitigating measure that is not considered in this study.

The size of each tank farm was determine or estimated based on one of three methods: 1) information contained in the harbormaster or fire chief surveys, 2) direct communication with tank farm operator, or 3) estimate of fuel tank capacity based on analysis of aerial photos of the tank farms and an average size per tank based on the previous information. The EPA was approached to provide the actual quantities per tank farm, however, the data was not provided. Future risk management programs would benefit from a detailed report of the quantities held at each facility.

3.2 Data Reviewed but Not Included in this Analysis

Three sources of data that were reviewed and initially considered likely contributors to this threat analysis are 1) oil spill history data sets, 2) Massachusetts Department of Revenue data base for petroleum imports to the State, and 3) vessel traffic information from vessel Automatic Identification Systems (AIS). Although these data sets were not used in this study, a quick summary of the analysis that was completed may help future risk management projects.

3.2.1 Historical Oil Spill Records

Historical oil spills were reviewed from three sources: the USCG Sector Boston spills database, the MassDEP Emergency Response historical oil spills database, and as part of the surveys sent to the fire chiefs. Measurement of historical oil spills by location, size, type, cause and impact would allow future risk management and oil spill reduction programs to calculate the probability of an oil spill by threat category and allow for assigning resources by threat type and location to reduce the likelihood of future spills. Over time, trends could be analyzed to determine which programs are effective and which could be

improved. However, at present, the information reviewed in the two data sets and from the interviews was not recorded in sufficient detail to develop a reliable estimate of oil spill threat level based on historical occurrences. Future projects conducted by MassDEP could address this gap by establishing new guidelines and requirements for oil spill data compilation that provides the necessary level of information to analyze the data for location, frequency, type, cause, and other factors that could then be used to develop oil spill reduction programs. Other efforts to coordinate state and federal data bases would be useful for tracking oil spills in different jurisdictions.

3.2.2 Massachusetts Department of Revenue Petroleum Import Data

The Massachusetts Department of Revenue (MassDOR) collects a $.02 per barrel fee on all petroleum products imported into the state's ports and harbors in tank vessels. Nuka Research obtained and analyzed copies of MassDOR's 2007 monthly "Uniform Oil Response and Prevention Fee Report" which provided petroleum import information by customer, type of petroleum and quantity. However, because the information was provided by customer and not by port, and some customers have operations in more than one port, the information could not used in this analysis. Additionally, the total gallons reported by the ACOE for 2006 of petroleum commerce was approximately 4.5 billion gallons while the MassDOR quantity for imported petroleum gallons in 2007 was 3.9 billion gallons. This difference in total amounts may be due to the conversion factor used to convert the ACOE data from short tons to gallons, a difference in oil imports during 2007 versus 2006, and/or the fact that ACOE data includes transfers of product between Massachusetts terminals, while the MassDOR data includes only imports. The ACOE data also accounts for vessels that transit through the Cape Cod Canal *en route* from one out-of-state port to another.

For future risk management studies, additional information may be mined from the MassDOR data and should be considered a possible source of detailed information.

3.2.3 Vessel Traffic Monitoring Data

In estimating vessel traffic, Nuka Research relied on vessel arrival information provided by the USCG NOA data and the ACOE Waterborne Transit and Cape Cod Canal data. In total, these data sets provide an overview of vessel traffic for the region. To improve the accuracy of the information by vessel type, size, route and frequency, efforts should be made to procure Automated Information System (AIS) data for detailed analysis. This information is available through private database queries; however the fees associated with accessing the information were prohibitive for this study.

Information that has already been aggregated, such as the port of Boston arrival information, does not answer questions such as days in port by vessel, average size of vessels, seasonality trends, or accurate tracking of vessel routes. Answers to these questions and others would be valuable to any risk management program and can be developed through analysis of AIS data. The data is available through purchase from the private sector. Future MassDEP projects could be designed to include the acquisition of the data and design the tracking programs necessary to support a risk management program.

3.3 Assumptions

A number of assumptions were made during the process of gathering and compiling data for each of the threat categories. Assumptions applied to the data collection, analysis and interpretation are listed in no particular order.

- The threat categories address only those activities that increase the threat of an oil spill that may impact the Massachusetts coastline. Threat mitigation and oil spill prevention measures, as they relate to a specific threat category, are not considered. (e.g. single and double-hulled tank vessels are considered to pose equal threats, despite the fact that most studies show that double-hulled vessels have a lower probability of spilling oil than single-hulled vessels do).
- This study assumes that every gallon of oil present in any given location at any given time has an equal opportunity of being spilled.
- The data does not distinguish between type of petroleum product (gasoline, diesel, heavy fuel oils), although some of the discussion points later in the report do address this issue as it relates to spill response readiness and cleanup equipment.
- This study does not take into consideration vulnerabilities to oil spill impacts. Therefore, the potential for shoreline oiling at any given location is weighted equally, despite the fact that certain stretches of shoreline may be much more vulnerable to oil spill impacts than others.
- This study does not consider spill threats that were determined to be pervasive throughout most or all of the state. Therefore, the study does not attempt to compile the threat of spills from home heating oil tanks (regardless of size), bulk oil storage tanks that hold less than 1,000 gallons, or tank vessel trucks.
- This study does not consider the role of environmental and oceanographic conditions such as wind, tides, currents, and sea state in oil spill threats. It is assumed that all coastal communities and water bodies have an equivalent potential for adverse weather or environmental conditions that could contribute to oil spill threats.
- This study does not consider seasonal variations in threat factors.

Assumptions related to how data was compiled, weighted, and used to determine oil spill planning priorities are discussed in Sections 4, 5, and 6.

4 Oil Spill Threats at Harbor and Municipal Levels

This threat analysis was conducted in two parts. First, all Massachusetts coastal harbors were evaluated for the presence or absence of oil spill threat factors. Harbors that were identified as having two or more threat factors present underwent a second level of analysis, while harbors where less than two threat factors were present were not examined further. For the second part of this analysis, information was gathered on the "high threat" (two or more factors present) harbors to develop a relative measure of the size of each threat based on the estimated amount of petroleum in each category. This section of the report details the analysis conducted in each of these two phases. Section 5 presents regional aggregation of this data.

4.1 Initial Assessment of Threat Factors by Harbor

The initial assessment of exposure to the identified threat factors by harbor used all of the data sources identified in Table 3.1, with the exception of the harbormaster surveys. The initial assessment only assessed whether the threat was present or not, and did not consider the size or quantity of the threat.

Data analysis for the initial assessment did not include data from the harbormaster surveys because it had not been fully compiled at that point. Because of this, the locally (non-EPA) regulated oil storage tank threat factor was not included in the initial assessment. Similarly, for the initial assessment, information on vessel fleet size by harbor was estimated based on a review of the available data and using firsthand knowledge. Fleet size information was updated in the second phase of the study after receipt of the harbormaster surveys. Therefore, the threat factors used in the initial assessment for the presence of an oil spill threat factor were:

Vessel Movements

- Oil tank vessel or tank barge activity in ports
- Large nontank vessel activity in ports (freight, passenger, or other vessels – over 300GT)
- Oil tank vessel and large nontank vessel activity in major shipping lanes.

Resident Vessel Fleets

- Recreational and charter vessel fleet estimated at greater than 500 vessels
- Commercial fishing vessel fleet estimated at greater than 10 vessels
- Initial indication of ferryboat service from the harbor
- Initial indication of large vessels moored and operating in the harbor (i.e. tugboats, small fuel barges, whale watching boats, research vessels, and training ships)
- Initial indication of shipyards within a harbor that service large vessels

Land-Based Storage Facilities

- Regulated facility identified by the EPA with potential to discharge to tidal waters

Based on the initial analysis, 45 of the 71 coastal communities were determined to have harbors that are exposed to two or more threat factors. At the harbor level, of the 95 harbors identified, 60 were found to have exposure to two or more threat categories. Table 4.1 contains the entire list of harbors along with their identified threat factors. The analysis points out that some of the mid-size harbors face nearly the same number of threats as the largest harbors. The town of Tisbury on Martha's Vineyard, for example, has seven identified threat factors, a relatively high number for a small town. Figure 4.1 shows the locations of the municipalities with two or more threat factors present.

4.2 Detailed Assessment and Measurement of Oil Spill Threat Levels

The initial assessment described in Section 4.1 identified 45 municipalities that were likely exposed to two or more of the identified threat factors. To estimate the magnitude of each oil spill threat for the purpose of comparison, a gallons of petroleum exposure measure (GPE) was calculated for each threat within each harbor. Data on two of the oil spill threats, EPA regulated and locally (non-EPA) regulated tanks, was collected in units of gallons. Data on tank vessel transits provided in the ACOE Waterborne Commerce Reports is measured in short tons of cargo and has been converted to gallons using the formula:

Gallons of petroleum = (2000 lbs/ton * tons of petroleum) / (8 gallons/lb).

The other nine measures depend on an estimate of average gallons of petroleum carried on board the identified vessels. Therefore, to calculate the GPE for each vessel fleet, a table of average fuel tank size was created using information from industry representatives and vessel databases.[9] Table 4.2 presents the averages used in this study along with notes supporting the estimates.

The main threat of spills in many harbors and ports is the possibility that a vessel will accidentally discharge petroleum through a vessel sinking, collision, fire, or through accidental or illegal discharges from vessel operations such as bilge pumping, changing engine oil, or refueling. For this study, an assumption has been made that the larger the size of the resident fleets, the larger the threat of an oil spill from any of these possible scenarios. The harbormaster survey was used to estimate the actual size of the fleets in each harbor of interest. Each vessel fleet was then analyzed for their GPE. Surveys were sent to those municipalities that have a harbormaster contact listed with the Massachusetts Harbormaster Association.[10] Of the 45 municipalities of interest, 39 of them have harbormasters and received a copy of the survey.

[9] Chris Bryant, Burr Brothers Boatyard, Marion, MA, personal communications regarding recreational and charter Vessels; Ron Fortier, Fairhaven Shipyard, Fairhaven MA, personal communications regarding large private vessels and fishing vessels; Adam Doherty, Arthur Fournier, Canal Towing, Bourne, MA, personal communications regarding tugboats; Greg Gifford, MA Steamship Authority, Falmouth, MA, personal communications regarding ferry vessels; Mike McGurl, Harbor Express, Quincy, MA, personnel communications regarding ferry vessels, tank vessels, and NTVs.

[10] Mass Harbormaster Association, Website, February 2009, http://mass.harbormasters.org/members.shtml

Approximately 75% of the harbormaster surveys were returned by the harbormasters.

Additional information on the methods used to calculate the GPE for each threat factor along with an analysis of the results is presented in Sections 4.2.1 through 4.2.10.

Table 4.1 Identified Threat Factors by Municipality

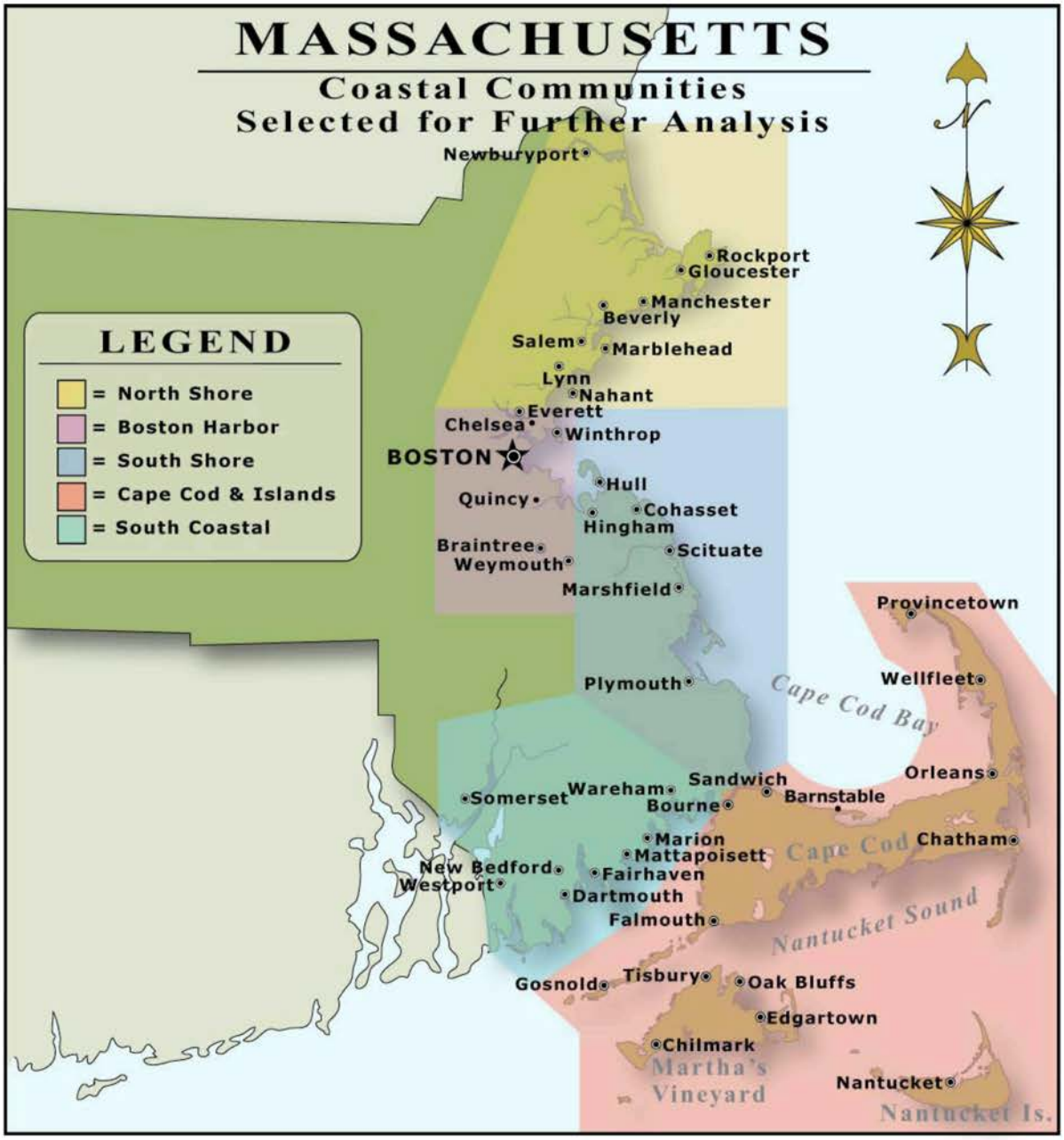
Municipality	Tank Vessel	NTV	Vessel Transit	Rec. and Charter	Fishing Vessels	Ferry	Other Large Vessel	Ship-yard	Reg. Tank
Boston/ Chelsea/ Everett	✓	✓	✓	✓	✓	✓	✓	✓	✓
New Bedford/ Fairhaven	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fall River/ Somerset	✓	✓	✓	✓	✓		✓	✓	✓
Sandwich	✓	✓	✓	✓	✓		✓		✓
Tisbury	✓	✓		✓	✓	✓	✓		✓
Gloucester	✓	✓		✓	✓		✓	✓	
Falmouth		✓	✓	✓	✓	✓	✓		
Nantucket	✓	✓		✓	✓	✓			✓
Salem	✓	✓		✓	✓	✓			
Plymouth	✓	✓		✓	✓	✓			
Barnstable		✓		✓	✓	✓			
Beverly				✓	✓				✓
Bourne			✓	✓			✓		
Braintree/ Weymouth	✓	✓	✓						
Chatham				✓	✓				
Chilmark				✓	✓				
Cohasset			✓	✓	✓				
Dartmouth			✓	✓					
Edgartown				✓	✓	✓			
Gosnold			✓			✓			
Hingham			✓	✓	✓	✓			
Hull			✓	✓					
Lynn			✓	✓					
Manchester				✓	✓				
Marblehead			✓	✓	✓				
Marion			✓	✓					
Marshfield				✓	✓				
Mattapoisett			✓	✓					
Nahant			✓	✓					

Municipality	Tank Vessel	NTV	Vessel Transit	Rec. and Charter	Fishing Vessels	Ferry	Other Large Vessel	Ship-yard	Reg. Tank
Newburyport				✓	✓				
Oak Bluffs				✓		✓			
Orleans			✓	✓	✓				
Provincetown			✓	✓	✓	✓			
Quincy	✓	✓	✓	✓		✓			
Rockport				✓	✓				
Scituate			✓	✓	✓				
Wareham			✓	✓					
Wellfleet			✓	✓	✓				
Westport			✓	✓	✓				
Winthrop			✓	✓					

Table 4.2 Estimated Average Fuel Capacity by Vessel Fleet

Fleet	Vessel Size (length in feet)	Average Fuel Capacity (gal)	Notes
Recreational	15-200 15-135 15-110 15-90 15-70 15-50 15-40 15-35	200 150 125 110 100 80 60 50	A power vessel of 30 ft has a fuel tank capacity of approximately 80 -100 gallons. A sailboat of 30 to 60 ft has a fuel tank capacity of approximately 30 - 50 gallons. Large yachts in the 65 - 100 ft range carry about 10,000 gallons of fuel. Super yachts carry up to 30,000 gallons of fuel (Bryant, C., Fortier, R)
Commercial Fishing	20- 35 25-45 25-65 25-110	300 500 5,000 15,000	Smaller inshore vessels carry between 200 and 1000 gallons. Larger offshore fishing vessels carry approximately 10,000-20,000 gallons of fuel. (Fortier, R)
Commercial Tugs	65-100 100-130	17,500 80,000	Inshore tugs carry between 15,000 and 20,000 gallons of fuel. Offshore tugs carry between 60,000 and 100,000 gallons of fuel. (Doherty, A., Fournier, A.)
Commercial Ferry Boats	Small Displacement Hi-Speed Passenger Passenger/Vehicle	750 2,000 5,000 7,500	Hi-speed ferries carry between 1,000 and 4,000 gallons of fuel. Small displacement ferries carry between 500 and 1000 gallons of fuel. Large displacement ferries carry between 5,000 and 10,000 (Gifford, G., McGurl, M)
Nontank Vessels	Boston, Fall River, Salem (150-1,000) Cape Cod Canal, New Bedford (150 -750*) Nantucket and Martha's Vineyard*	100,000 75,000 50,000	Freight vessels carry between 50,000 and 150,000 gallons of fuel (McGurl, M). * Draft restrictions prevent larger ships from entering these ports.

Figure 4.1 Massachusetts Municipalities with Two or More Threat Factors



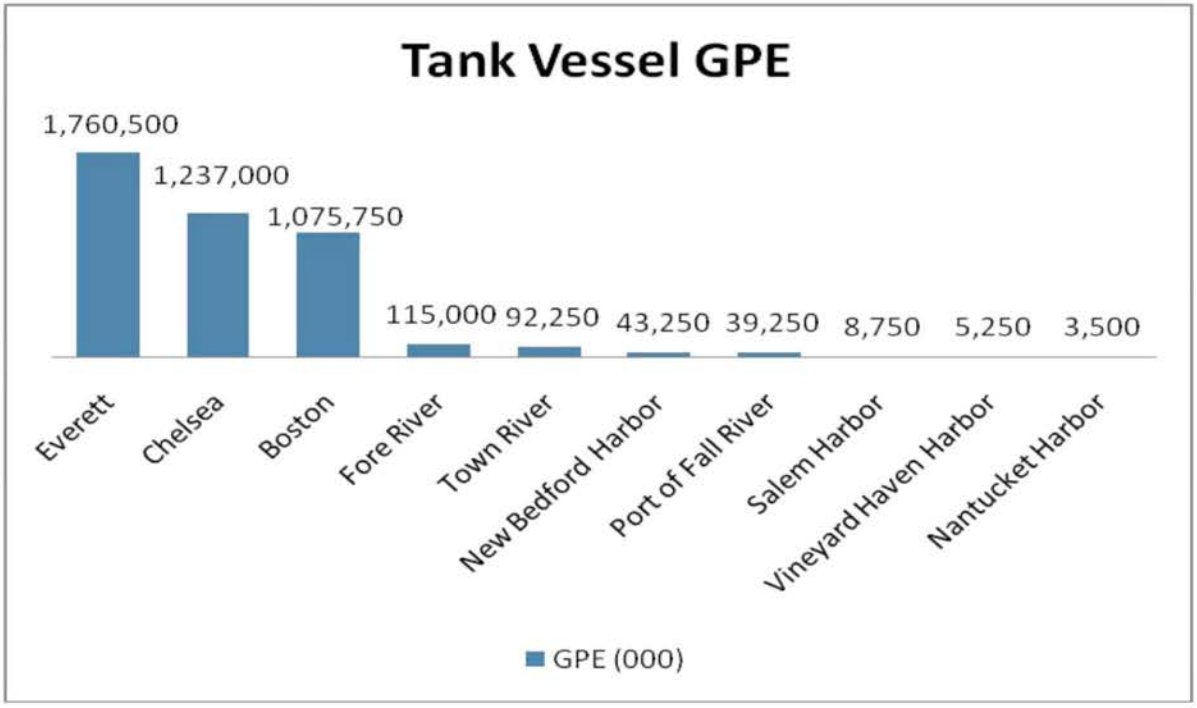
4.2.1 Oil Tanker or Tank Barge Activity in Ports and Harbors

The ports that were listed in the ACOE Waterborne Commerce Report as having received oil deliveries in 2006 along with the quantity received are listed in Table 4.3. Boston Harbor (Boston, Chelsea, and Everett combined) accounts for approximately 93% of the total volume. The ACOE data is recorded in short tons (2000 lbs) of petroleum. An average weight of 8 lbs per gallon of petroleum product was used to convert tons of petroleum into gallons of petroleum. Figure 4.2 shows a graph of the GPE from tank vessel activity for the top ten ports in Massachusetts.

Table 4.3 Tank Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[11] by Port or Harbor (based on data for 2006)

Port/Harbor (City)	GPE	Port/Harbor (City)	GPE	Port/Harbor (City)	GPE
Everett	1,760,500	Town River (Quincy)	92,250	Vineyard Haven (Tisbury)	5,250
Chelsea	1,237,000	New Bedford	43,250	Nantucket	3,500
Boston	1,075,750	Port of Fall River	39,250	Gloucester	2,250
Fore River (Braintree & Weymouth)	115,000	Salem	8,750	Plymouth	1,000

Figure 4.2 Tank Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[12] by Port or Harbor (based on data for 2006)



[11] All values in table should be multiplied by a factor of 1,000.
[12] All values in table should be multiplied by a factor of 1,000.

4.2.2 Large Nontank Vessel Activity in Ports

Information on Large nontank vessels (freight, passenger, or other vessels over 300 gross tons that carry oil as fuel rather than cargo) was determined from vessel arrival data provided by the USCG. Notice of Arrivals are required to be filled out by all foreign vessels entering the U.S. ports and by all U.S. vessels over 300 GT (not including tug/barge combinations) traveling between US Coast Guard Captain of the Port areas. Information on nontank vessel (NTV) traffic from Boston Harbor, Fore River, Town River, and Salem Harbor were received from USCG Sector Boston as one total quantity. USCG Sector Southeastern New England provided the information for the Port of Fall River, Hyannis Harbor, Nantucket Harbor, New Bedford Harbor, Sandwich, and Vineyard Haven.

Because NTV traffic for Salem was included in the USCG Sector Boston NTV report and this volume should be applied to the North Shore Region, the ACOE Waterborne Commerce Report was analyzed to estimate that 22 of the 297 NTV trips into the Sector Boston area were for the port of Salem. The main activity in Salem is the delivery of coal to the Salem power plant.

For this analysis, NTV shipments do not include tank vessel shipments as these are accounted for in the previous indicator (tank vessel activity). However, an argument could be made the fuel carried in tank vessels and tug/barge combinations adds an additional threat to the port and future studies may want to consider this added volume of petroleum.

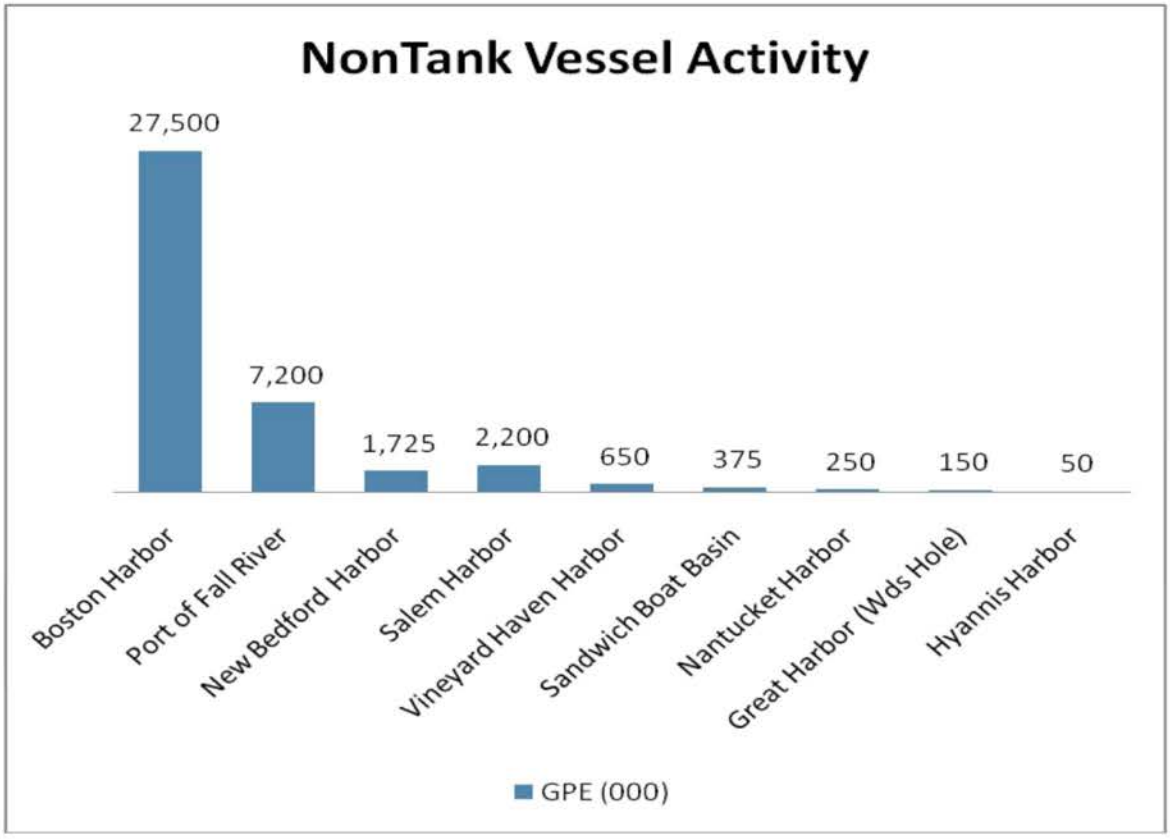
Finally, the data used in this analysis was taken from 2006 activity as presented in the ACOE and USCG reports. This one-year data set provides a snap shot of vessel activity but does not necessarily reflect trends or changes in traffic levels, which might be better captured in a multi-year data set. For example, the port of Boston realized a significant increase in NTV traffic from 297 arrivals in 2006 to 510 arrivals in 2007. The increase was largely due to an increase in container ships.

To calculate the NTV vessel traffic petroleum exposure, the number of NTV trips was multiplied by the GPE quantities presented in table 4.2. The total amount of petroleum exposure by port for 2006 is presented in Table 4.4. As indicated, Boston Harbor accounts for 69% of the NTV activity in Massachusetts ports. Figure 4.3 shows a graph of the gross petroleum exposure volumes from the nine ports reporting NTV traffic in 2006.

Table 4.4 Nontank Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[13] by Port or Harbor (based on data for 2006)

Municipalities	Harbors	Annual NTV Traffic	Average Fuel Tank Size	GPE
Boston, Braintree, Chelsea, Everett, Revere, Quincy, Weymouth	Boston Harbor, Fore River, Town River	275	100,000	27,500,000
Fall River/ Somerset	Port of Fall River	72	100,000	7,200,000
New Bedford/ Fairhaven	New Bedford Harbor	23	75,000	1,725,000
Salem	Salem Harbor	22	100,000	2,200,000
Tisbury	Vineyard Haven Harbor	13	50,000	650,000
Sandwich	Sandwich Boat Basin	5	75,000	375,000
Nantucket	Nantucket Harbor	5	50,000	250,000
Falmouth	Great Harbor (Woods Hole)	3	50,000	150,000
Barnstable	Hyannis Harbor	1	50,000	50,000

Figure 4.3 Nontank Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[14] by Port or Harbor (based on data for 2006)



[13] All values in table should be multiplied by a factor of 1,000.
[14] All values in table should be multiplied by a factor of 1,000.

4.2.3 Tank Vessel and Nontank Vessel Activity in Major Shipping Lanes

Vessel transits into and out of Massachusetts ports, through the Cape Cod Canal, and traveling near the coast of outer Cape Cod represent the largest oil spill threat for many coastal communities. The municipalities determined to be at risk were selected based on the assumption that harbors within twelve miles of a major shipping lane were most likely to be impacted from an oil spill. NOAA charts for the region were analyzed to determine the location of shipping lanes and the municipalities they abut. The shipping lanes from the NOAA charts and the towns within twelve miles of the lanes are shown in Figure 4.4.

In Table 4.5, the total threat level from vessel activity in shipping lanes is listed by region and by harbor. Although each municipality is affected by the threat, it is assumed that the threat is transient, passing by each municipality within a relatively short period of time. Thus the threat is the same at the regional level as it is at the harbor level. However, for each harbor that has identified tank vessel or NTV traffic, these quantities are removed from the vessel transit quantity so as not to double count the threat from vessels that both visit the port and transit by it.

Therefore, for the towns within the Boston Harbor region, the vessel transit threat was calculated as the net difference between the quantity of petroleum shipped into each port and the quantity that was shipped into the region, to avoid double counting the shipped quantities.

For municipalities to the north and south of Boston, and for municipalities on the outer Cape, vessel transits were estimated using 1/3 of the total vessel traffic volume in the Boston Region. Traffic into Boston converges from the north, east, and south and because specific traffic pattern information was not available, the study divides the traffic evenly by the three possible routes. This method of calculating the threat factor could be greatly enhanced by an analysis of actual AIS data. However, these estimates provide a reasonable quantity to use in this analysis with the understanding that should a study of AIS data become available; the quantities can be updated in the GPE model.

For Mount Hope Bay, the transit quantity is based on petroleum deliveries and NTV traffic into the Port of Fall River/Taunton River. Thus, the municipalities of Fall River and Somerset[15] do not experience any additional threat over the amount that was calculated in the Tank Vessel and NTV threat categories. However, the town of Swansea would be exposed to the entire vessel transit quantity.

For towns close to the Buzzards Bay traffic zone, the ACOE Cape Cod Canal traffic data was analyzed and provided an accurate assessment of vessel transits. The data set has information on each vessel transit and includes the vessel type and size. An assumption was made for the report that all vessels transiting the canal also transit the entire length of Buzzards Bay. This likely

[15] Fall River and Somerset are considered as a single port in this analysis because they are located on opposing banks of the Taunton River. The Army Corps of Engineers uses the same convention in their vessel transit data, considering Fall River and Somerset together as the Port of Fall River.

overstates the threat to some of the towns in the lower part of the Bay because some commercial traffic entering the Canal from the east discharges at the Sandwich power plant and does not transit the entire Bay. A future analysis should attempt to separate out these vessels from the impact to towns further south in the Bay.

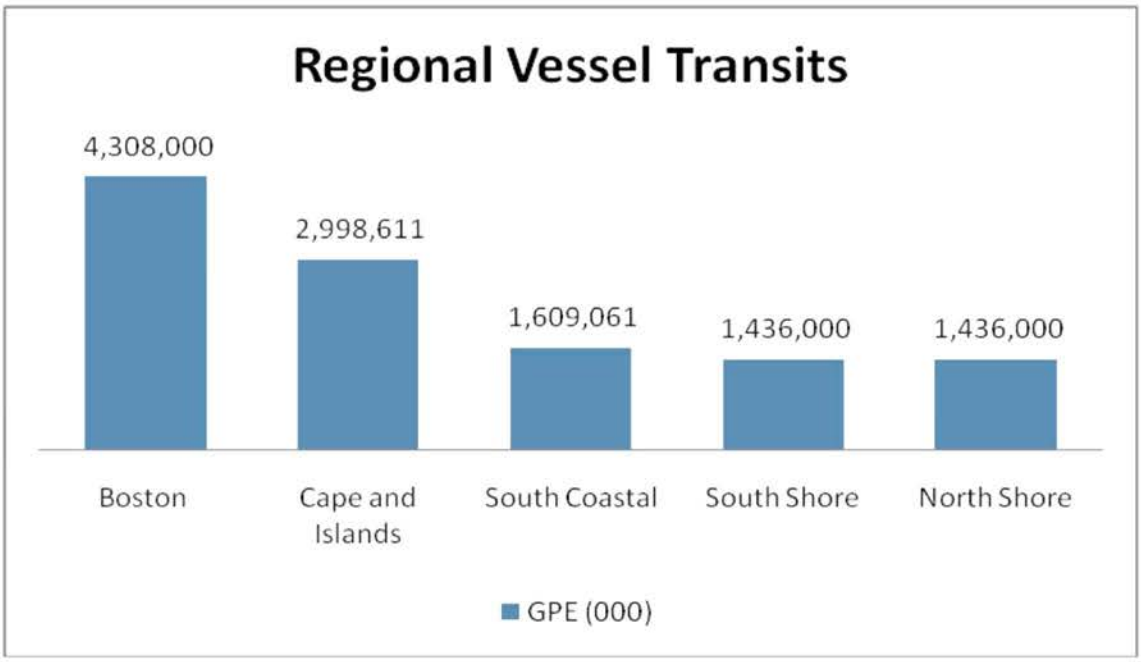
Figure 4.5 shows total estimate gallons of petroleum exposure from vessel activity in shipping lanes for each region.

Figure 4.4. Major Shipping Lanes and Proximity to Massachusetts Coastal Towns.

Table 4.5 Vessel Transit Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Municipality and Region

Region	Municipalities Affected	GPE Quantity	Method of Calculation
North Shore	Lynn	1,436,000,000	Estimated using one third of the vessel traffic into Boston Region.
	Marblehead		
	Nahant		
	Swampscott		
Boston	Winthrop	4,308,000,000	Based on Boston Region vessel traffic of 4,308,000,000 minus individual port traffic.
	Quincy	4,215,750,000	
	Braintree/ Weymouth	4,339,900,000	
	Boston	3,204,750,000	
	Chelsea	3,071,000,000	
	Everett	2,547,500,000	
South Shore	Cohasset	1,436,000,000	Estimated using one third of the vessel traffic into Boston Region.
	Hingham		
	Hull		
	Scituate		
Cape and Islands	Bourne	1,562,611,000	Based on Cape Cod Canal Data
	Gosnold		
	Falmouth		
	Sandwich		
	Eastham	1,436,000,000	Estimated using one third of the vessel traffic into Boston Region.
	Orleans		
	Provincetown		
	Truro		
	Wellfleet		
South Coastal	Dartmouth	1,562,611,000	Based on Cape Cod Canal traffic of 1,562,611,000 minus individual port traffic.
	Fairhaven		
	Marion		
	Mattapoisett		
	Wareham		
	Westport		
	New Bedford	1,517,636,000	
	Fall River/ Somerset	-	Based on Fall River/ Somerset vessel traffic minus individual port traffic.
	Swansea	46,450,000	

Figure 4.5 Vessel Transit Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[16] by Region



4.2.4 Recreational and Charter Vessels

Harbors initially identified as having a recreational and charter vessel fleet larger than 500 vessels were flagged as having a threat of oil spills in this category. As described in Section 2.2, the information collected to indicate the actual size of the recreational and charter fleet was the total number of moorings and slips in the harbor. Additional information was collected in the harbormaster survey regarding the range of vessel lengths in each harbor. Most harbors reported a fleet size ranging from 18 to 65 feet, with five harbors reporting vessel sizes in excess of 100 feet.

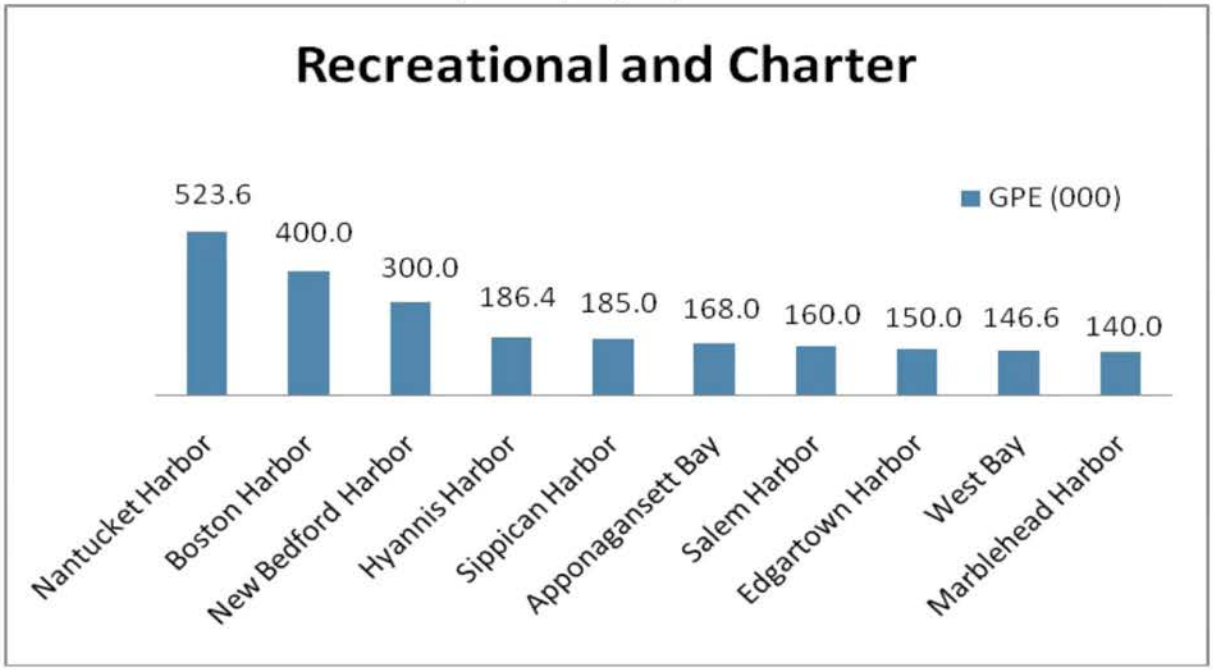
To estimate the petroleum exposure for each harbor, the average fuel capacities identified in Table 4.2 were multiplied by the number of moorings and slips. Boston, Nantucket, New Bedford and Hyannis all reported having recreational vessels up to 200 feet in length. Each also had a high number of moorings and slips. Sippican Harbor, in the town of Marion, appears fifth on this list with the third highest number of moorings and slips reported. The GPE for the recreational and charter fleets by harbor is presented in Table 4.6 and the quantities for the top ten harbors are graphed in Figure 4.6.

[16] All values in table should be multiplied by a factor of 1,000.

Table 4.6 Recreational and Charter Fleet Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	GPE	Harbor	GPE	Harbor	GPE
Nantucket Harbor	523,600	Scituate Harbor	104,000	Wellfleet Harbor	40,000
Boston Harbor	400,000	Onset Harbor	88,800	Green Harbor	38,800
New Bedford Harbor	300,000	Beverly Harbor	85,000	Great Harbor (Woods Hole)	33,800
Hyannis Harbor	186,400	Red Brook Harbor	82,160	Nauset Harbor	29,520
Sippican Harbor	185,000	Pleasant Bay	78,960	Rockport Harbor	21,600
Apponagansett Bay	168,000	Plymouth Harbor	68,000	Sandwich Boat Basin	18,000
Salem Harbor	160,000	Gloucester Harbor	64,600	Buttermilk Bay	12,100
Edgartown Harbor	150,000	Barnstable Harbor	61,000	Cuttyhunk Harbor	11,000
West Bay	146,630	Wareham Harbor	60,720	Weweantic River	8,700
Marblehead Harbor	140,000	Allerton Harbor	52,500	Buttermilk Bay	7,900
Vineyard Haven	125,000	Falmouth Harbor	50,400	Little Harbor	5,800
Westport River	122,000	Mattapoisett Harbor	42,720	Menemsha Creek	4,480

Figure 4.6 Recreational and Charter Fleet Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[17] by Harbor

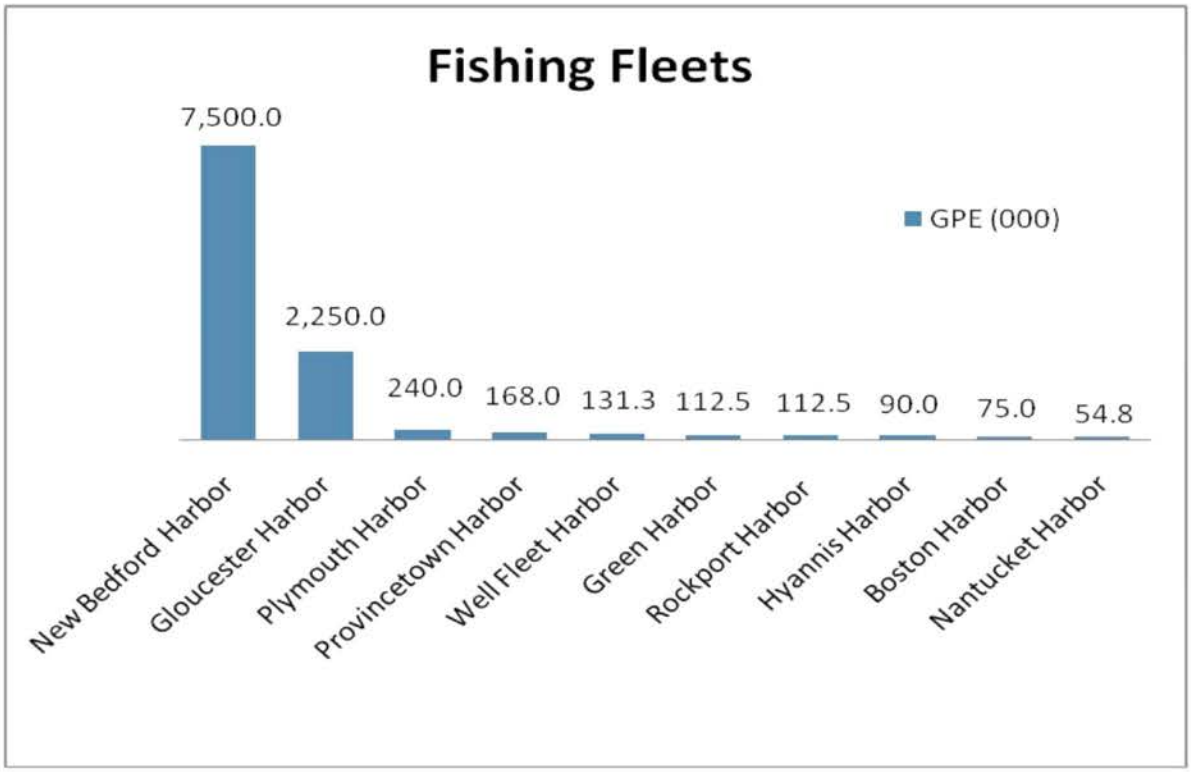


[17] All values in table should be multiplied by a factor of 1,000.

4.2.5 Commercial Fishing Vessel Fleet

Information collected in the harbormaster surveys included the number and type of fishing vessels in the harbor. Lobster and other trap vessels, tuna and shellfish vessels were assumed to be inshore vessels of under 45 feet in length. Draggers, scallopers, and trawlers were assumed to be larger offshore vessels up to 130 feet in length with fuel capacities capable of staying offshore for multiple days or weeks. New Bedford Harbor reported having fishing vessels up to 150 feet in length that are part of the herring fishing fleet. The information provided by the harbormasters along with information gained in the follow-up phone calls was used to determine the average number of vessels in each category. The GPE was then calculated by multiplying the number of vessels by the average fuel tank capacity. The results for the top ten harbors are presented in Figure 4.7 while Table 4.7 contains the GPE for all 30 harbors that reported fishing activity. New Bedford Harbor reported the highest number of vessels with a fleet size of 500, many of which are large offshore scallopers and draggers. The GPE for the New Bedford Harbor fishing fleet is estimated at 7,500,000 gallons, more than three times the next largest amount.

Figure 4.7 Fishing Fleets Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[18] by Harbor



[18] All values in table should be multiplied by a factor of 1,000.

Table 4.7 Fishing Fleets Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	GPE	Harbor	GPE	Harbor	GPE
New Bedford Harbor	7,500,000	Beverly Harbor	45,000	Vineyard Haven Harbor	7,500
Gloucester Harbor	2,250,000	Scituate Harbor	41,250	Barnstable Harbor	3,750
Plymouth Harbor	240,000	Sandwich Harbor	30,000	Allerton Harbor	1,800
Provincetown Harbor	168,000	Marblehead Harbor	24,000	Buttermilk Bay	900
Wellfleet Harbor	131,250	Westport River	22,500	Apponagansett Bay	900
Green Harbor	112,500	Edgartown Harbor	18,750	Sippican Harbor	900
Rockport Harbor	112,500	Nauset Harbor	18,750	Mattapoisett Harbor	900
Hyannis Harbor	90,000	Menemsha Creek	15,000	Pocasset River	300
Boston Harbor	75,000	Salem Harbor	9,000	Cuttyhunk Harbor	300
Nantucket Harbor	54,750	Great Harbor (Woods Hole)	7,500	Wareham Harbor	300

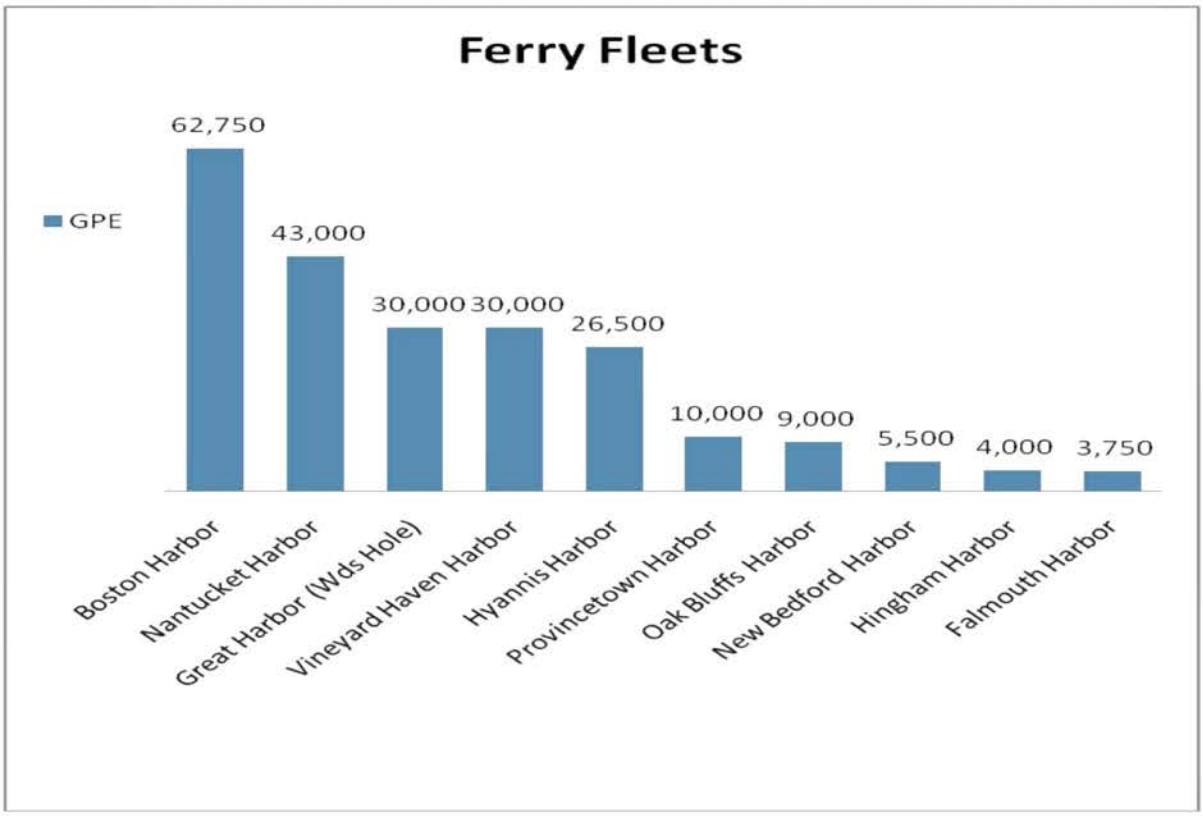
4.2.6 Ferry Terminals

Commercial ferry traffic can represent a significant portion of the daily activity within a harbor. Some ferries operate on a year round basis, while others are operated on a seasonally adjusted basis. Based on the information supplied by the harbormasters regarding which harbors had ferry service, an investigation was then conducted on each operation regarding the type, size, and vessel routes of the ferry service. Much of the information was gathered from ferry company websites while additional information was gathered from personal conversation with company managers. The petroleum exposure for the fourteen harbors that were found to have ferry service is shown in Table 4.8 and Figure 4.8.

Table 4.8 Ferry Fleet Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	GPE	Harbor	GPE	Harbor	GPE
Boston Harbor	62,750	Provincetown Harbor	10,000	Plymouth Harbor	3,000
Nantucket Harbor	43,000	Oak Bluffs Harbor	9,000	Salem Harbor	2,000
Great Harbor (Woods Hole)	30,000	New Bedford Harbor	5,500	Cuttyhunk Harbor	1,500
Vineyard Haven Harbor	30,000	Hingham Harbor	4,000	Edgartown Harbor	750
Hyannis Harbor	26,500	Falmouth Harbor	3,750		

Figure 4.8 Ferry Fleet Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor



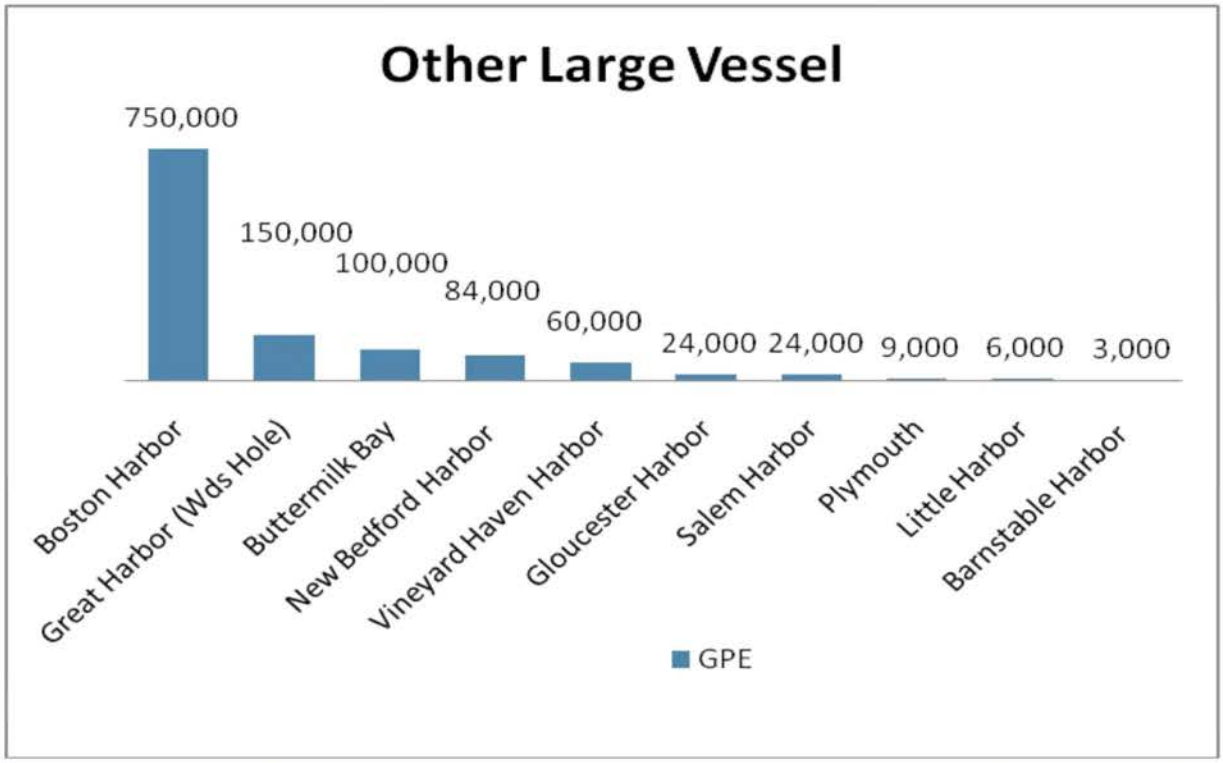
4.2.7 Other Large Vessel Activity

Many other vessels less than 300GT operating or moored within a harbor contain large amounts of fuel. Examples are harbor tugs, training ships, military vessels, and excursion vessels. The harbormaster survey was used to identify these vessels by harbor location. Estimates of fuel capacity for these vessels represent a best professional estimate of these quantities. The vessels by harbor included in the analysis are presented in Table 4.9 along with the calculated GPE estimate. Figure 4.9 presents the GPE estimates for the top ten harbors.

Table 4.9 Other Large Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	Vessels Types	Est. # of Vessels	Average Fuel Capacity	GPE
Boston Harbor	Coast Guard, Harbor Tugs, Work Boats, USS Constitution	50	15,000	750,000
Great Harbor (Woods Hole)	NOAA Vessels	3	50,000	150,000
Buttermilk Bay	TS Kennedy	1	100,000	100,000
New Bedford Harbor	Tugs, Training Vessels	7	12,000	84,000
Vineyard Haven Harbor	4 Tugs	4	15,000	60,000
Gloucester Harbor	8 Whale Watching Vessels	8	3,000	24,000
Salem Harbor	Whale Watching, Tug	4	6,000	24,000
Plymouth	Whale Watching	3	3,000	9,000
Little Harbor	Coast Guard	3	2,000	6,000
Barnstable Harbor	Whale watching vessels	1	3,000	3,000
Allerton Harbor	Research Vessel	1	600	600
Sandwich Boat Basin	Pilot Boats	3	200	600
Scituate Harbor	NOAA Vessel Auk	1	600	600
Wellfleet Harbor	1 commercial vessel	1	600	600
Westport River	1 commercial vessel	1	600	600
Sippican Harbor	Tabor Boy	1	500	500

Figure 4.9 Other Large Vessel Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor



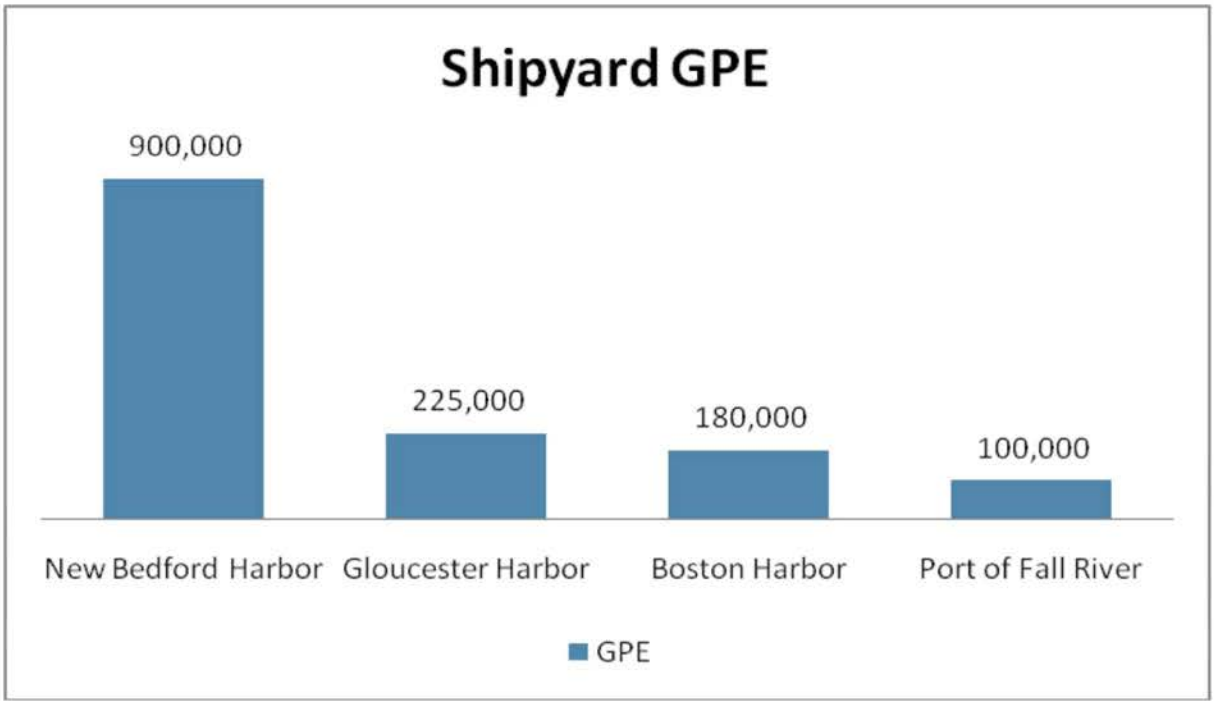
4.2.8 Shipyards

Large shipyards in harbors represent a source of increased activity for vessel movement. While Massachusetts once had a number of shipyards, only four harbors reported having operating shipyards that service vessels larger than 70 feet. These are Gloucester, Boston, New Bedford/Fairhaven, and Fall River/Somerset. The shipyards and their estimated addition to the total threat are listed in Table 4.10. A graph of the GPE quantities is presented in Figure 4.10. The GPE was calculated for these locations based on an estimate of the number of vessels that are being serviced on any given day. For Gloucester, New Bedford and Boston, the estimates were based on follow-up conversations with the harbormasters. The Fall River/Somerset shipyard activity was estimated to be in line with the other three; however this should be updated upon further investigation.

Table 4.10 Shipyard Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	Number of Shipyards	Average Size	Vessels in Repair or Construction	Average Fuel Capacity	GPE Shipyard
New Bedford/Fairhaven	2	45-110	20	45,000	900,000
Gloucester	1	45-110	5	45,000	225,000
Boston	1	45-110	4	45,000	180,000
Somerset	1	25-80	4	25,000	100,000

Figure 4.10 Shipyard Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor



4.2.9 Land-Based Bulk Oil Storage Facilities - EPA Regulated

The EPA requires that all oil storage facilities with a capacity to hold 42,000 gallons or more of petroleum products in aboveground storage tanks must file a Facility Response Plan (FRP) with the Environmental Protection Agency (EPA). The EPA provided a list of all of the FRPs on file for Massachusetts, and this information was used to identify communities with bulk fuel oil storage facilities.

The information provided did not include the total quantity of oil per facility, nor did it identify the size of individual fuel tanks. Quantity information was also not available on the EPA's website listing of facility plans by plan number, status and contact information. Fire chiefs from Braintree, Chelsea, and Sandwich provided information on storage quantities for the facilities in their towns. Additional information on the storage tank sizes for Nantucket was provided by the harbormaster and for Tisbury from the terminal operator.

To estimate the quantities in the remaining facilities, an average amount per tank was calculated based on the information received from Braintree, Chelsea, Sandwich, Tisbury, and Nantucket and the number of tanks in each facility based on a review of aerial photographs of each tank farm. For example, the two facilities in Braintree hold 58,000,000 gallons of petroleum in approximately 18 tanks. The five facilities in Chelsea hold 57,000,000 gallons in approximately 17 tanks. The average quantity for these facilities then is 3.2 million gallons per tank. The amounts for Tisbury and Nantucket were calculated at approximately 100,000 gallons per tank. The amount per tank for Sandwich was calculated at 400,000 per tank. These ranges were then applied to the visual count and approximate size of the tanks for the other municipalities to estimate the tank farm quantity in gallons. The largest concentration of facilities occurs in the Braintree, Boston, Chelsea, Everett, and Revere area with an estimated 92% of the total capacity in coastal Massachusetts.

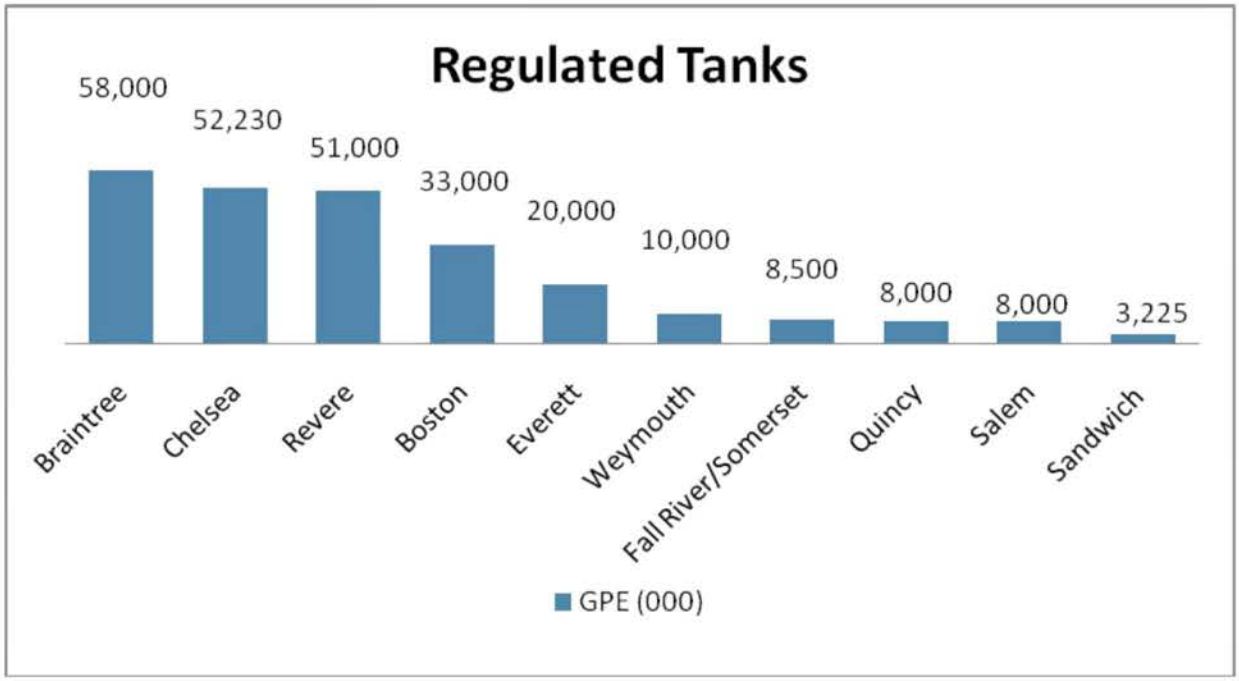
For the facilities with FRPs in Beverly, Lynn, and Peabody, it was not possible to estimate the number or size of storage tanks with available aerial photographs. Therefore, the total storage quantity for each of these three is assumed to be 42,000 gallons, which is the minimum regulated quantity. This is likely an underestimate for these three locations.

The estimated GPE values by municipality and harbor are presented in Table 4.11. Figure 4.11 presents the GPE quantities for the top ten municipalities.

Table 4.11 EPA Regulated Storage Tank Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Municipality

Municipality	Harbor	# of Tank Farms (EPA)	Approx. # Tanks	GPE	GPE Source
Braintree	Fore River	2	18	58,000,000	Fire Chief survey
Chelsea	Boston Harbor	5	17	52,230,000	Fire Chief survey
Revere	Boston Harbor	7	34	51,000,000	Estimated at 1.5 mil per Tank
Boston	Boston Harbor	9	22	33,000,000	Estimated at 1.5 mil per Tank
Everett	Boston Harbor	3	40	20,000,000	Estimated at 1.0 mil per Tank
Weymouth	Fore River	2	10	10,000,000	Estimated at 1.0 mil per Tank
Fall River/ Somerset	Port of Fall River	4	17	8,500,000	Estimated at 500,000 per tank
Quincy	Town River Bay	3	8	8,000,000	Estimated at 1.0 mil per tank
Salem	Salem Harbor	2	8	8,000,000	Estimated at 1.0 mil per tank
Sandwich	Sandwich Harbor	3	8	3,225,000	Fire Chief survey
New Bedford/ Fairhaven	New Bedford Harbor (2)	3	6	2,400,000	Estimated at 400,000 per tank
Nantucket	Nantucket Harbor	2	10	953,000	Harbormaster survey
Tisbury	Vineyard Haven	1	8	780,000	Per Direct Contact
Beverly	Beverly Harbor	1	Plant	42,000	Estimated at the minimum for FRP
Lynn	Lynn Harbor	1	Plant	42,000	Estimated at the minimum for FRP
Peabody	None	1	Plant	42,000	Estimated at the minimum for FRP

Figure 4.11 EPA Regulated Storage Tank Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[19] for Ten Municipalities with Highest Threat Levels



[19] All values in table should be multiplied by a factor of 1,000.

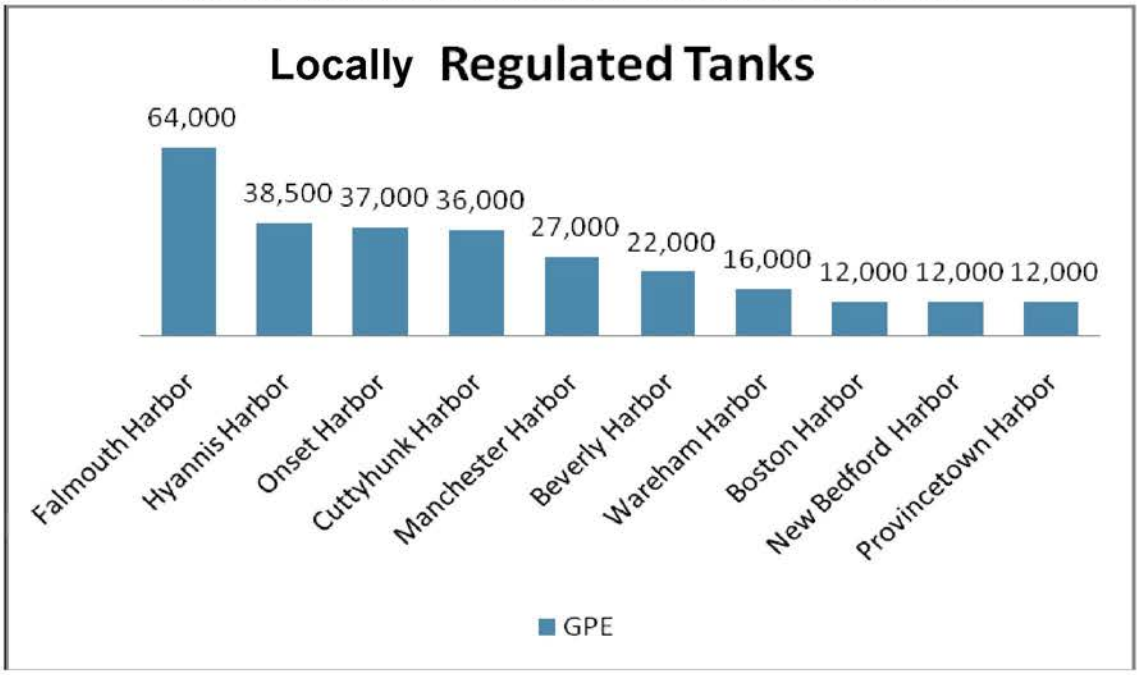
4.2.10 Locally Regulated Bulk Fuel Storage at Harbor or Marina

Information on locally regulated tanks, greater than 1,000 gallons but less than 10,000 gallons that are not regulated by the EPA, was compiled from data contained in the fire chief survey and the harbormaster survey. Additional information was gathered by telephone calls to selected sites to validate information. Most of the fuel storage tanks identified in the surveys are used for providing fuel to marine traffic and are part of marina or boatyard operation. However, at least one (in the town of Gosnold on Cuttyhunk Island) is also used to provide fuel for a small number of vehicles. Table 4.12 presents the data on non-regulated tanks and Figure 4.12 shows the quantities in a graph.

Table 4.2 Non-EPA Regulated Storage Tank Oil Spill Threat in Estimated Gallons of Petroleum Exposure by Harbor

Harbor	GPE	Harbor	GPE	Harbor	GPE
Falmouth Harbor	64,000	Gloucester Harbor	10,000	Sippican Harbor	6,000
Hyannis Harbor	38,500	Little Harbor	10,000	Pleasant Bay	6,000
Onset Harbor	37,000	Plymouth Harbor	10,000	Scituate Harbor	6,000
Cuttyhunk Harbor	36,000	Wellfleet Harbor	10,000	Vineyard Haven Harbor	6,000
Manchester Harbor	27,000	Edgartown Harbor	9,000	Westport River	5,000
Beverly Harbor	22,000	Nantucket Harbor	8,000	Apponagansett Bay	4,000
Wareham Harbor	16,000	Red Brook Harbor	7,500	Allerton Harbor	4,000
Boston Harbor	12,000	Popponesset Bay	6,500	Green Harbor	4,000
New Bedford Harbor	12,000	Barnstable Harbor (1)	6,000	Buttermilk Bay	4,000
Provincetown Harbor	12,000	West Bay	6,000	Menemsha Creek	3,000
Neponset River	12,000	Fore River	6,000	Weweantic River	2,500
Sandwich Boat Basin	12,000	Marblehead Harbor	6,000	Rockport Harbor	1,200

Figure 4.11Locally (Non-EPA) Regulated Storage Tank Oil Spill Threat in Estimated Gallons of Petroleum Exposure for Ten Harbors with Highest Threat Levels



4.3 Analysis of Combined Oil Spill Threats by Harbor

The analysis in the previous section provided estimates of GPE for each threat factor by harbor. In this section, the combined GPE for each harbor is considered.

In considering each threat factor separately, the scale of the threat among the highest-ranking harbors varied considerably. The scale of four of the threat factors – tank vessel activity, NTV activity, vessel transit activity and EPA regulated tanks – was generally in the range of hundreds of millions to billions of gallons. The other six factors – all of those in the residential vessel fleet category as well as locally regulated tanks – were on a scale of tens of thousands to millions of gallons.

Because the magnitude of threats varied so greatly in scale, the threat factors were considered in two sets– as "high magnitude" threats and "low magnitude" threats. In order to allow for a more meaningful analysis of total threat by harbor, the aggregated totals for high and low magnitude threat categories are considered separately.

4.3.1 Analysis by Harbor for High Magnitude Threat Factors

Table 4.13 presents the aggregated GPE for the harbors that registered threat estimates in this study for the four high magnitude threat factors - tank vessel activity, NTV activity, vessel transit volume, and EPA regulated land-based storage tanks. Of the 95 harbors identified in Section 1.5, 60 are represented on this list. Within those 60 harbors, 43 of the harbors are exposed to only the vessel transit threat factor while 17 are exposed to the vessel transit threat factor and at least one of the other three high magnitude threats.

The eight Boston area harbors have the largest high magnitude GPE total, ranging from 4.31 billion gallons to 4.41 billion gallons due to the amount of petroleum delivered to Boston Harbor and the large tank farms located in Boston, Chelsea and Everett. Five of the eight harbors are exposed to only the vessel transit GPE and to no other high magnitude threats.

Outside of the Boston Harbor region, New Bedford Harbor and the other harbors on Buzzards Bay have the next highest GPE. This is mainly attributable to the number of vessel transits through Buzzards Bay, generating a GPE of 1.56 billion. In addition to being exposed to the vessel transit threat, New Bedford has 44.9 million gallons in tank vessel and NTV GPE and 2.4 million gallons in land-based storage GPE. Sandwich has 3.2 million gallons in land-based storage and 500,000 in NTV GPE. The tank vessel traffic into Esco Terminal in Sandwich was not separated from the Cape Cod Canal data in the ACOE database and thus is included in the vessel transit GPE. The only other harbor on Buzzards Bay to have a threat exposure other than the vessel transit quantity is Great Harbor (Woods Hole), which recorded 150,000 GPE for NTV traffic.

Revere is listed with a GPE of 1.48 billion due to two factors: 1.44 billion in vessel transits and 51 million in land-based storage. The land-based storage tanks in Revere are located on the upper portion of the Chelsea Creek and could have been assigned to the Boston Harbor Region. However, because the

municipality of Revere is part of the North Shore Region, the tank farm quantity was assigned to the Pines River in Revere.

The next group of harbors by total GPE amount includes those of the North Shore, South Shore and Cape and Islands regions that are exposed to vessel traffic entering and leaving Boston Harbor. The vessel traffic GPE for each of these harbors is 1.44 million. The only harbor of this group with additional GPE is Lynn Harbor, which has a manufacturing site with a facility response plan with an estimated 42,000 GPE for regulated tanks.[20]

Of the Harbors not located near the Port of Boston or Buzzards Bay shipping lanes, the Port of Fall River has the next highest GPE, due to their 54.9 million gallons of tank vessel and NTV activity. Salem, Vineyard Haven, Nantucket, Gloucester, Plymouth, Hyannis, and Beverly all have exposure to tank vessel, NTV, and/or regulated tank threat factors.

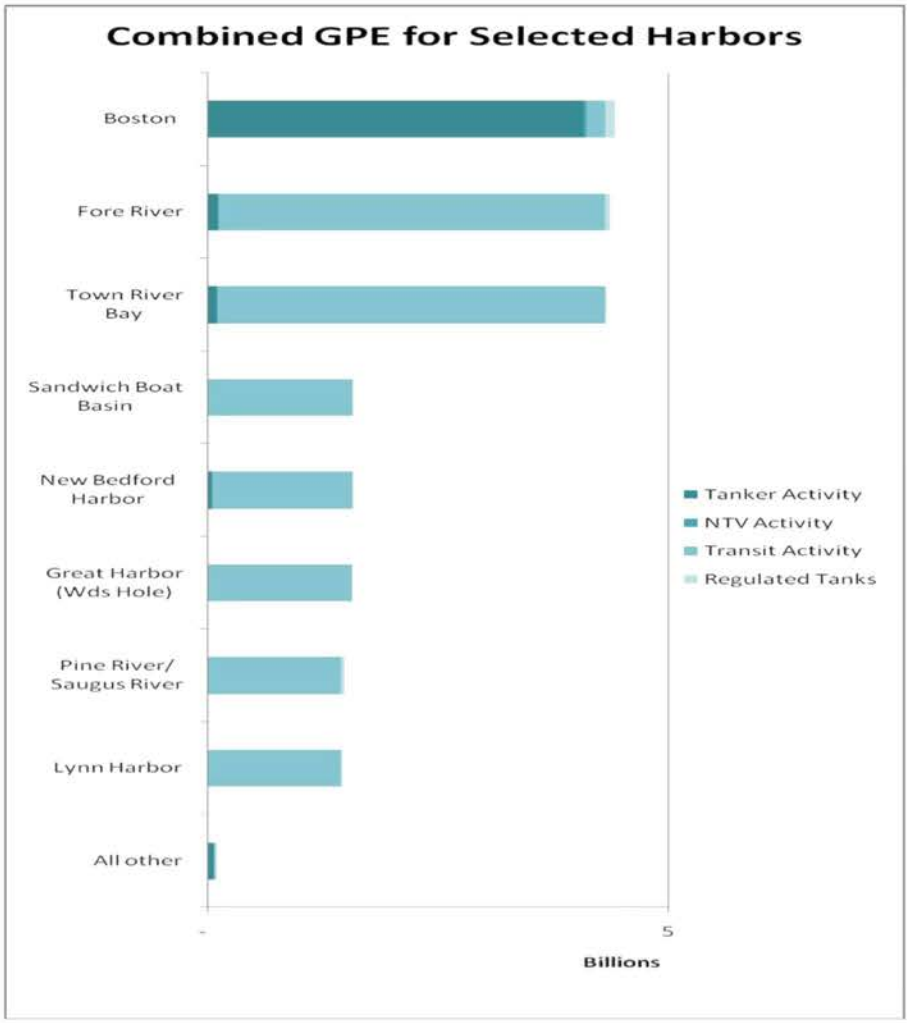
Figure 4.12 shows the GPE estimates for harbors that have exposure to "high magnitude" threat activities. The harbors with less than 100 million GPE are combined in the "all other" column.

Table 4.13 Total GPE by Harbor for Vessel Activity and EPA Regulated Tanks (000)[21]

Harbors	Total GPE	Harbors	Total GPE	Harbors	Total GPE
Boston	4,413,230	Little Harbor	1,562,611	Cohasset Harbor	1,436,000
Fore River	4,366,000	Mattapoisett	1,562,611	Hingham Harbor	1,436,000
Town River Bay	4,316,000	Nasketucket Bay	1,562,611	Marblehead	1,436,000
Back River	4,308,000	Onset Harbor	1,562,611	Nahant Harbor	1,436,000
Dorchester Bay	4,308,000	Phinneys Harbor	1,562,611	Nauset Harbor	1,436,000
Neponset River	4,308,000	Pocasset Harbor	1,562,611	Pleasant Bay	1,436,000
Quincy Bay	4,308,000	Pocasset River	1,562,611	Provincetown	1,436,000
Winthrop	4,308,000	Quissett Harbor	1,562,611	Rock Harbor	1,436,000
Sandwich Basin	1,565,836	Rands Harbor	1,562,611	Scituate Harbor	1,436,000
New Bedford	1,565,011	Red Brook	1,562,611	Weir River	1,436,000
Sandwich Harbor	1,562,611	Sippican Harbor	1,562,611	Wellfleet Harbor	1,436,000
Great Harbor	1,562,611	Squeteague	1,562,611	Port of Fall River	54,950
Apponagansett	1,562,611	Wareham Harbor	1,562,611	Lee River	46,450
Aucoot Cove	1,562,611	Weweantic	1,562,611	Salem Harbor	18,950
Brant Island	1,562,611	West Falmouth	1,562,611	Vineyard Haven	6,680
Buttermilk Bay	1,562,611	Westport River	1,562,611	Nantucket	4,703
Clarks Cove	1,562,611	Wild Harbor	1,562,611	Gloucester	2,250
Cuttyhunk	1,562,611	Pines River	1,487,000	Plymouth Harbor	1,000
Fiddlers Cove	1,562,611	Lynn Harbor	1,436,042	Hyannis	50
Hadley Harbor	1,562,611	Allerton Harbor	1,436,000	Beverly	42

[20] This is a conservative estimate and may in fact be much higher. The EPA did not provide data on total storage amounts at each regulated facility.
[21] All quantities should be multiplied by a factor of 1,000.

Figure 4.12 Total GPE for Selected Harbors (in billions of gallons) for Combination of Four "High Magnitude" Threat Factors



4.3.2 Analysis by Harbor for Low Magnitude Threat Factors

Table 4.13 presents the aggregated GPE for the harbors that registered threat estimates in this study for the six low magnitude threat factors – fishing fleets, recreational/charter vessel fleets, ferry fleets, homeport fleet, shipyards, and locally regulated storage tanks. Of the 95 harbors identified in Section 1.5, 43 are listed as having exposure to the low magnitude threat factors. Harbors that were not included in the Harbormaster survey because they did not have two or more identified threat factors or harbors for which a survey was not returned would account for the other 52 harbors.

New Bedford harbor, with a combined GPE of 8.8 million gallons, has the highest estimated GPE for the measures analyzed in this section. Their resident fishing fleet accounts for 7.5 million gallons, the two shipyards account for 900,000 gallons, and the recreational and charter fleet account for 300,000 gallons.

Gloucester's 2.57 GPE is largely due to the 2.25 million gallons in the resident fishing fleet GPE and the 225,000 gallons in the one Gloucester shipyard.

Boston Harbor has the third highest combined GPE for these low magnitude factors at 1.48 million gallons, mainly due to the 750,000 gallons in the resident homeport fleet and the 400,000 gallons in the recreational and charter fleet. Boston Harbor does not have a large fishing fleet compare to some of the other harbors, placing ninth among the harbors represented.

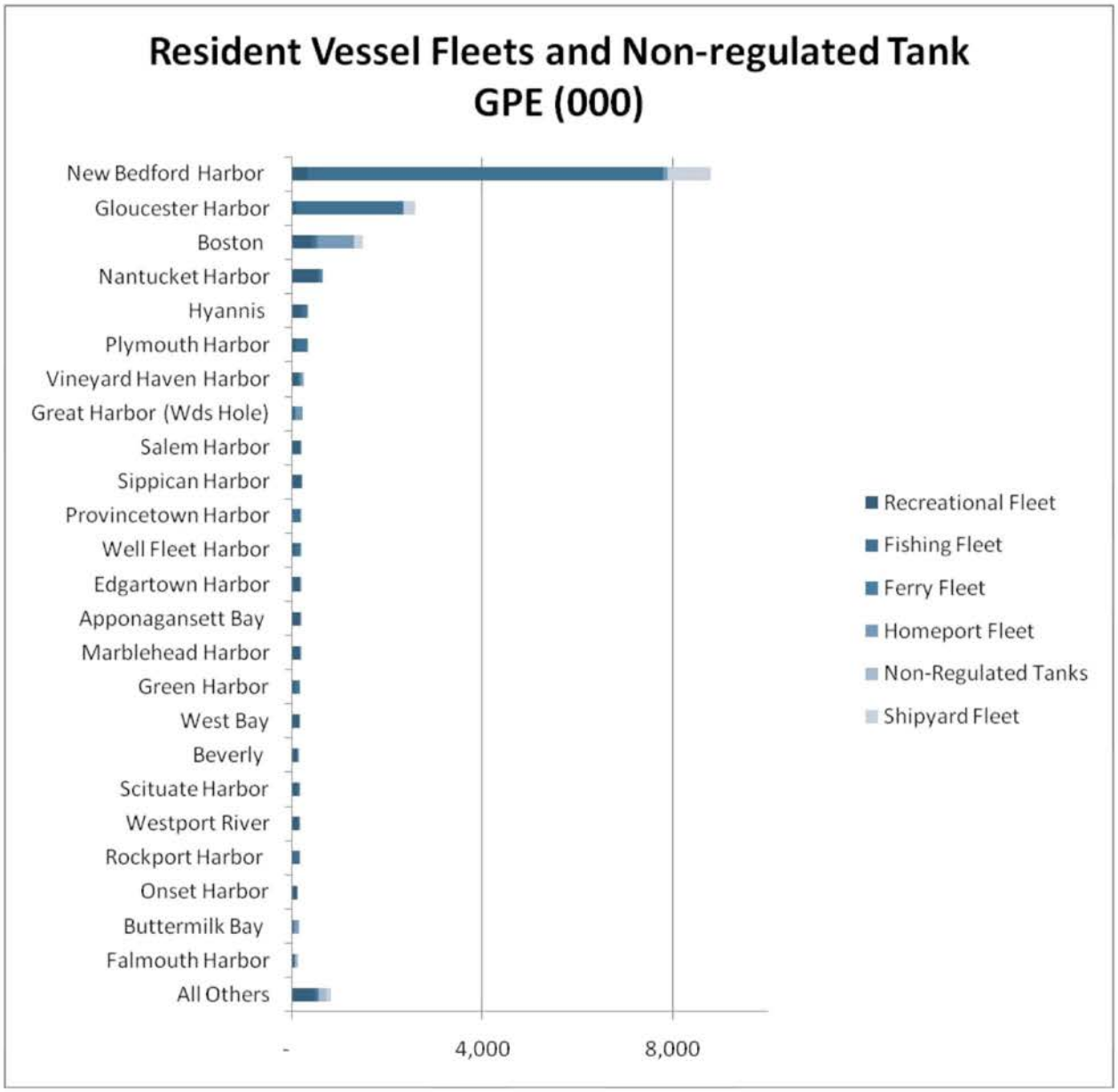
Nantucket follows in fourth place with a combined GPE of 629,350 gallons, mostly due to having the highest estimated recreational and charter fleet GPE of 523,600 gallons. Plymouth and Provincetown harbors have relatively large fishing vessel fleets at 240,000 and 168,000 gallons respectfully. Great Harbor falls in eighth place due to the homeport fleets at the Woods Hole Oceanographic Institute, while Vineyard Haven, Salem and Sippican harbors round out the top ten each with relatively large recreational and charter fleets.

Figure 4.13 shows the GPE estimates for those harbors that have recorded exposure to the resident vessel fleet and locally regulated tank threat factors. The harbors with less than 100,000 GPE are combined in the "all other" column.

Table 4.14 Combined GPE by Harbor in Order of Magnitude

Harbors	Total GPE	Harbors	Total GPE	Harbors	Total GPE
New Bedford	8,801,500	Green Harbor	155,300	Allerton Harbor	58,900
Gloucester	2,573,600	West Bay	152,630	Cuttyhunk	48,800
Boston	1,479,750	Beverly	152,000	Nauset Harbor	48,270
Nantucket	629,350	Scituate Harbor	151,850	Mattapoisett	43,620
Hyannis	341,400	Westport River	150,100	Manchester	27,000
Plymouth	330,000	Rockport Harbor	135,300	Menemsha Creek	22,480
Vineyard Haven	228,500	Onset Harbor	125,800	Little Harbor	21,800
Great Harbor	221,300	Buttermilk Bay	124,900	Neponset River	12,000
Salem Harbor	195,000	Falmouth Harbor	118,150	Weweantic	11,200
Sippican Harbor	192,400	Port of Fall River	100,000	Oak Bluffs	9,000
Provincetown	190,000	Red Brook	89,660	Popponesset Bay	6,500
Wellfleet	181,850	Pleasant Bay	84,960	Fore River	6,000
Edgartown	178,500	Wareham	77,020	Hingham Harbor	4,000
Apponagansett	172,900	Barnstable	73,750	Pocasset River	300
Marblehead	170,000	Sandwich Basin	60,600		

Figure 4.13 Total GPE for Selected Harbors (in billions of gallons) for Combination of Four "Low Magnitude" Threat Factors



4.3.3 Harbors with Highest Concentration of Threat Factors

Of the eight harbors with the highest level of exposure to high magnitude threat factors (Section 4.3.1) and the twenty-four harbors with the highest level of exposure to low magnitude threat factors, the following harbors overlap: Boston, New Bedford, and Great Harbor. The harbors which have a high level of exposure to the high magnitude threats but minimal exposure to the low magnitude threats are the Fore River and Town River in the Boston Harbor region, the Pines River and Lynn in the North Shore Region, and the Sandwich Boat Basin in the Cape and Islands Region. Figure 4.14 shows the highest-

ranking harbors for exposure to both low and high magnitude threats. Section 5 discusses regional threat factors based on aggregated data from all harbors in each region.

Figure 4.14 Map Showing Harbors with Highest Exposure to Oil Spill Threat Factors

5 Regional Assessment of Threat Factors

Previous sections of this report estimate the location, source, and relative size of oil spill threats by harbor. The information provided should be useful for local harbor planning and oil spill preparedness activities, and also to MassDEP and other state and federal agencies interested in preventing and responding to coastal oil spills. It provides a useful reference for general oil spill threats at the harbor and municipal level, which is discussed further in Section 6 of this report.

Section 5 of the report considers some of the threat factors discussed in Sections 3 and 4 aggregated to the regional level, in order to compare types and magnitude of threats across geographic region. A major objective of this report is to facilitate the decision making process used by MassDEP to allocate oil spill prevention and response resources. Programs and supplies may be allocated at the harbor or municipal level, but others are likely be allocated by region. This section discusses threat exposure by region and highlights those activities that have the highest comparative contribution to regional oil spill threats.

Like the harbor analysis, the regional assessment uses an estimate of gallons of petroleum exposure (GPE) to compare threat factors within and across regions. All of the GPE estimates are derived from the data described in Section 3, and are limited as noted in that discussion. This section compares threats both by region and by individual threat factor in order to highlight both the geographic areas where spill threats are highest as well as those activities that contribute to these higher oil spill threat levels.

For the regional analysis, the comparative level of individual and aggregated threat, as expressed by estimated gallons of petroleum exposure, is described in order to compare overall oil spill threat among regions. Within each region, the total contribution of each of the ten threat factors is described and the major threats are highlighted. This region-by-region analysis also compares the level of threat from individual factors within the three main threat categories: vessel movement, resident vessel fleet, and land-based storage.

5.1 Comparison of Regional Oil Spill Threats by Category

This study identified three broad categories of oil spill threat for the purpose of data compilation and analysis: vessel movement activity, resident vessel fleets, and land-based bulk fuel storage. Within each of these three categories, individual threat factors were identified.

Figure 5.1 shows the total threat exposure for each coastal region of Massachusetts, and also shows the proportional contribution of the three categories of threats – vessel movements, residential vessel fleets, and land-based storage – to the total threat level in each region. Figure 5.2 shows the proportionate contribution of the ten individual threat factors to total threat in all regions.

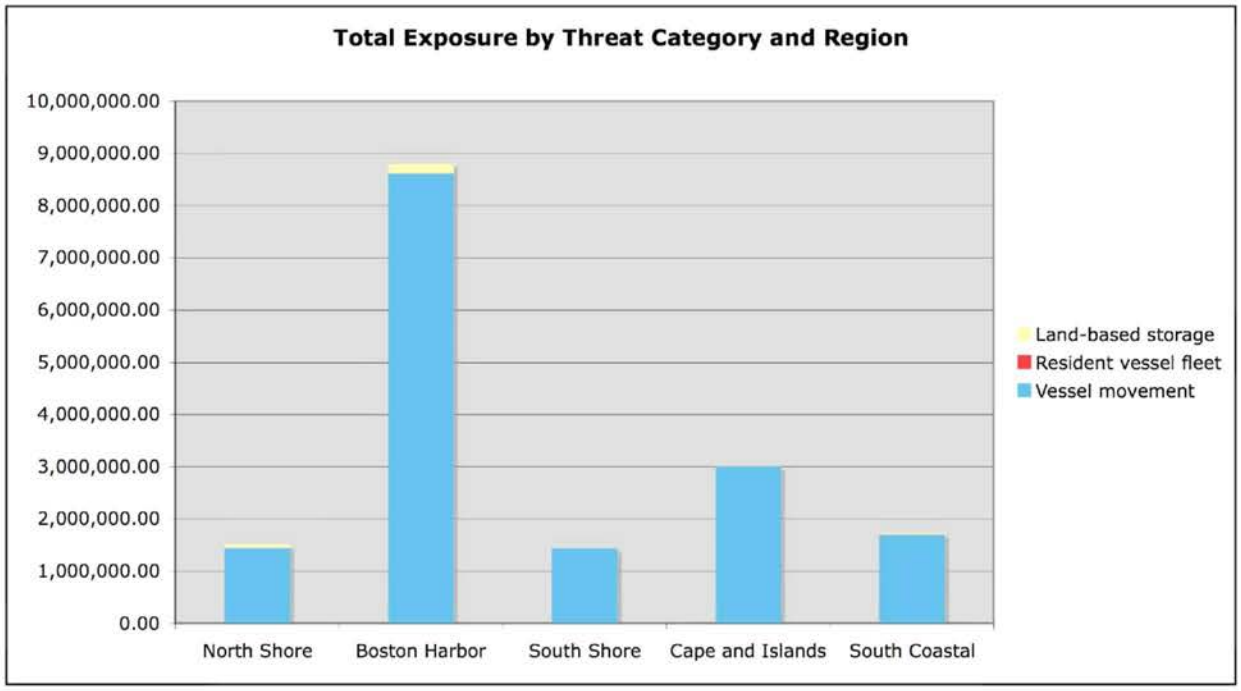
Figure 5.1 shows that vessel movement activity dominates the total threat for all five regions. Figure 5.2 shows that, within the vessel movement category, two threat factors – tank vessel activity and transit volume – account for nearly 100% of the threat exposure, with a minimal contribution from nontank vessel

activity. Transit volume is by far the largest contributor to vessel movement threat and to total threat overall. Transit volume refers to the quantity of oil carried in bulk through shipping channels and in and out of ports and harbors.

Land-based storage provides a minimal contribution to total threat level in two regions (North Shore and Boston Harbor), and accounts for approximately 1% of the total threat for all regions.

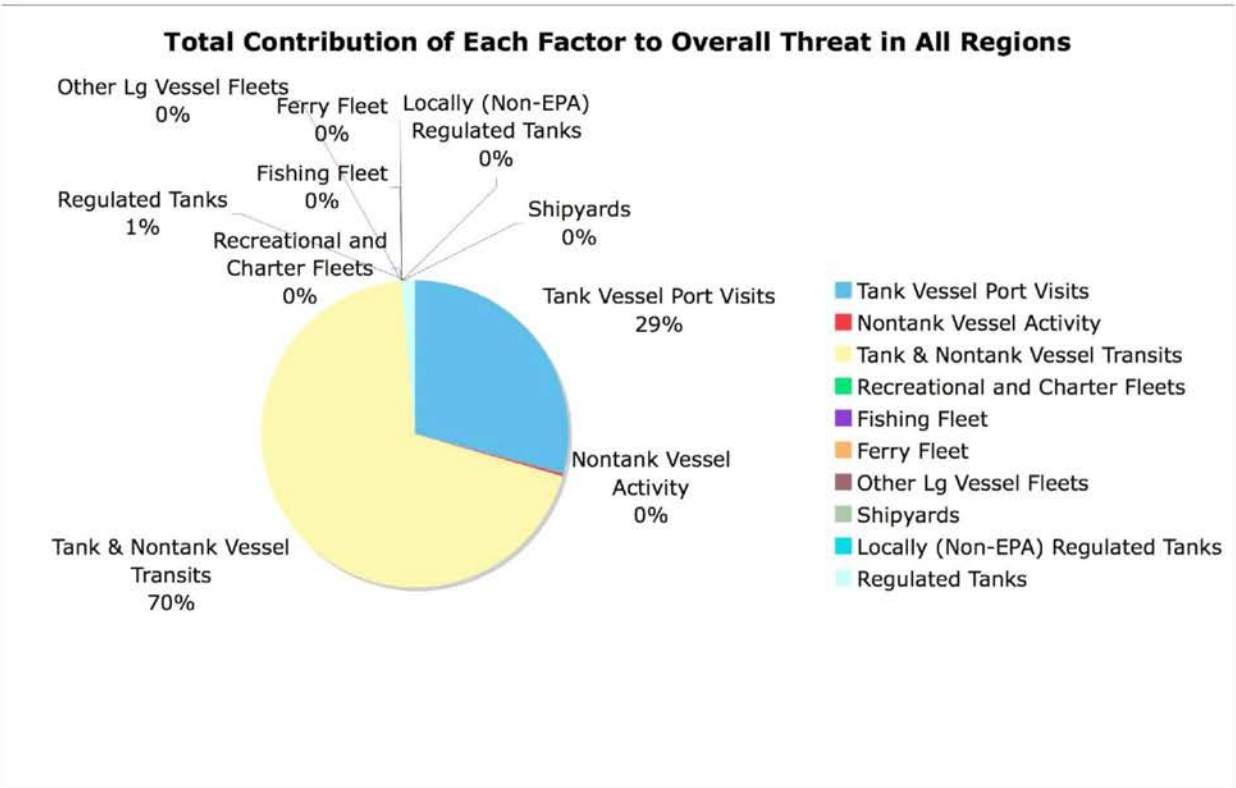
The overall threat from residential vessel fleets does not register for any of the regions, and contributes less than 1% to the total threat for all regions, because the total GPE from residential vessel fleets is an order of magnitude less than the total from vessel movement and land-based storage.

Figure 5.1 Total Threat Exposure for Each Region by Threat Category (000)[22]



[22] All values in table should be multiplied by a factor of 1,000.

Figure 5.2 Proportionate Contribution of all Threat Factors to Total Threat Level for All Regions



5.1.1 Vessel Movement Threat Exposure

Figure 5.3 shows that the total threat exposure from vessel movement activity is highest in the Boston Harbor region, followed by the Cape and Islands and South Coastal regions. The North Shore and South Shore both have similar exposure levels.

Figures 5.4 through 5.7 contain four pie charts. The first chart (Figure 5.4) shows the proportionate contribution of the three threat factors that comprise the vessel movement estimate – tank vessel activity, nontank vessel activity, and vessel transits – to the overall threat for all regions. This chart shows that 70% of the threat exposure from vessel movement is attributable to the volume of petroleum products transported as cargo through shipping channels. The other 30% of the total threat exposure is attributed to tank vessels calling on ports and harbors. Nontank vessels, which are larger vessels that carry oil as fuel rather than cargo, account for less than 1% of the total threat exposure for vessel movement.

When analyzing vessel activity at the region level, the North Shore, South Shore, and Cape and Islands regions do not have any overlap in GPE between the tank vessel and nontank vessel activity with the vessel transit activity. Some overlap does occur in the South Coastal Region where approximately 5% of the transit activity was associated with South Coastal ports. For the Boston Region there is a 100% overlap between the tank vessel and NTV activity with the vessel transit activity. When accounting for the overlaps at the harbor level in

Section 4, the GPE calculation subtracted out the overlap in the estimate of these threat factors. However, at the region level, the tank vessel, NTV, and transit threat factors are considered as independent threat indicators to highlight the magnitude of the activity within ports as well as the magnitude of the activity in the shipping lanes. Nevertheless, it is important to note that the aggregated levels of vessel movement activity is double counting the traffic in Boston Harbor and, to a lesser extent, in the South Coastal Region because the same vessels calling on those ports are also transiting offshore.

Figures 5.5 through 5.7 show the proportionate contribution from each region to the total threat exposure for the three vessel movement threat factors. The Tanker Activity chart (figure 5.5) shows that 98% of the total tank vessel threat exposure occurs in Boston Harbor, with the remaining 2% in the South Coastal region. The Nontank Vessel Activity chart (Figure 5.6) shows that the majority of the exposure to nontank vessel spill threats also occurs in Boston Harbor (69%). The second highest threat exposure to nontank vessel spills is in the South Coastal Region (22%), with the remaining exposure allocated to the North Shore (5%) and Cape and Islands (4%). The South Shore region contributes less than 1% of the total GPE from tank vessel activity.

The Transit Volume chart (Figure 5.7) shows a more even allocation of threat from vessels in transit, with all five regions contributing to the total threat. The highest level is still in Boston Harbor (37%), followed by the Cape and Islands (25%), and with similar levels attributed to the North Shore, South Shore, and South Coastal (12-14% each). Since the transit volume threat is transient, and all regions have some exposure to shipping routes, this more even distribution makes sense. It is important to note that the GPE estimates for the North Shore, South Shore and part of the Cape and Islands (those communities abutting the Atlantic Ocean) were based on an equal distribution of one-third of the volume in and out of Boston Harbor. Further analysis of vessel movement data for specific waterbodies may show that a larger proportion of vessel traffic in and out of Boston Harbor may concentrate in one region or another.

In considering the breakdown of vessel movement threat factors within each region, it becomes obvious that transit volume is the primary contributor to vessel movement threats for all regions except Boston Harbor, where the threat is allocated evenly between tank vessel activity and transit volume. Tanker activity contributes a small amount to the total threat in the South Coastal and North Shore regions.

Overall, the vessel movement activity threat exposure shows that transit volume accounts for more than two-thirds of the total exposure level (measured in gallons of petroleum) to oil spill threats from vessel movements. The Boston Harbor region has the highest threat level for oil spills from vessel movement.

Figure 5.3 Vessel Movement Activity Threat Exposure by Region (000)[23]

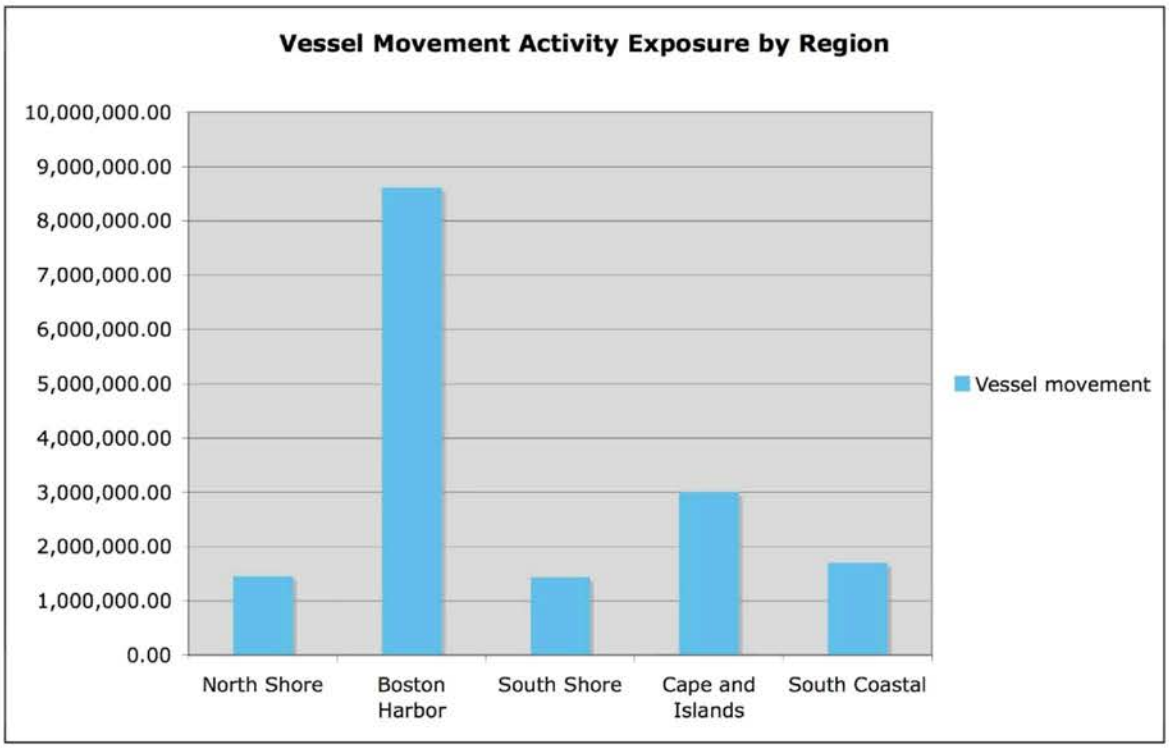
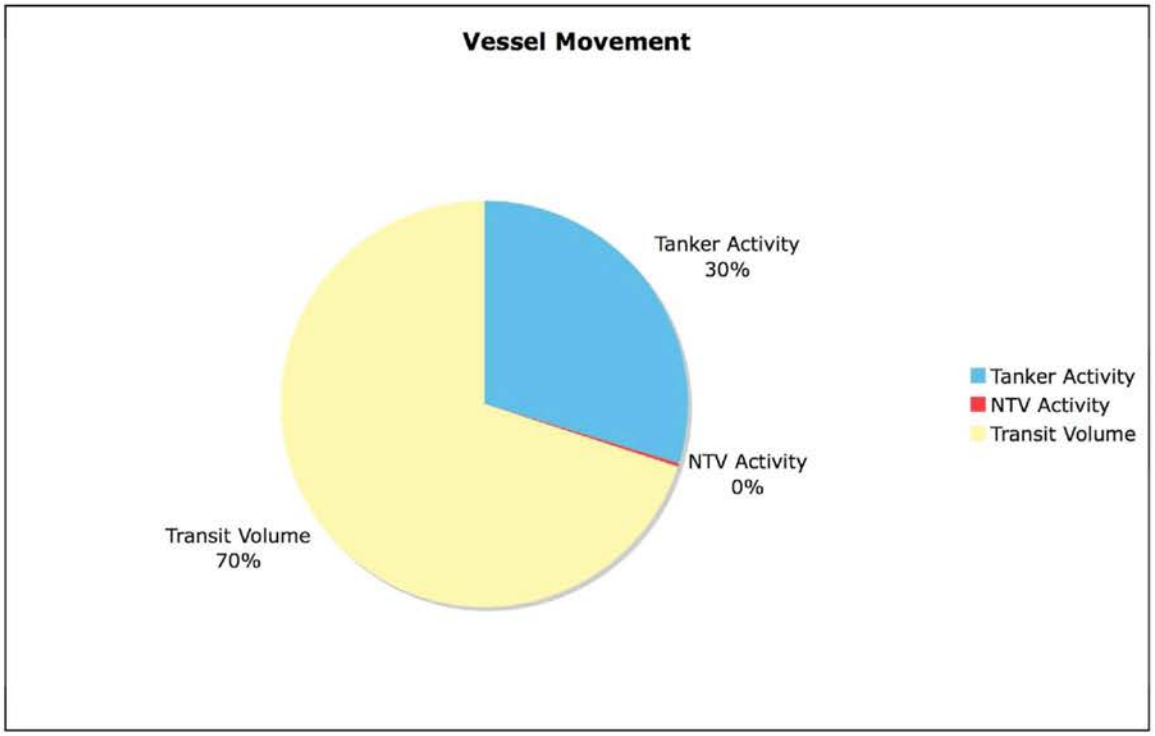


Figure 5.4 Contribution of Threat Factors to total Vessel Movement Threat and Comparison of Threat Factors by Region – Vessel Movement



[23] All values in table should be multiplied by a factor of 1,000.

Figure 5.5 Contribution of Threat Factors to total Vessel Movement Threat and Comparison of Threat Factors by Region – Tanker Activity

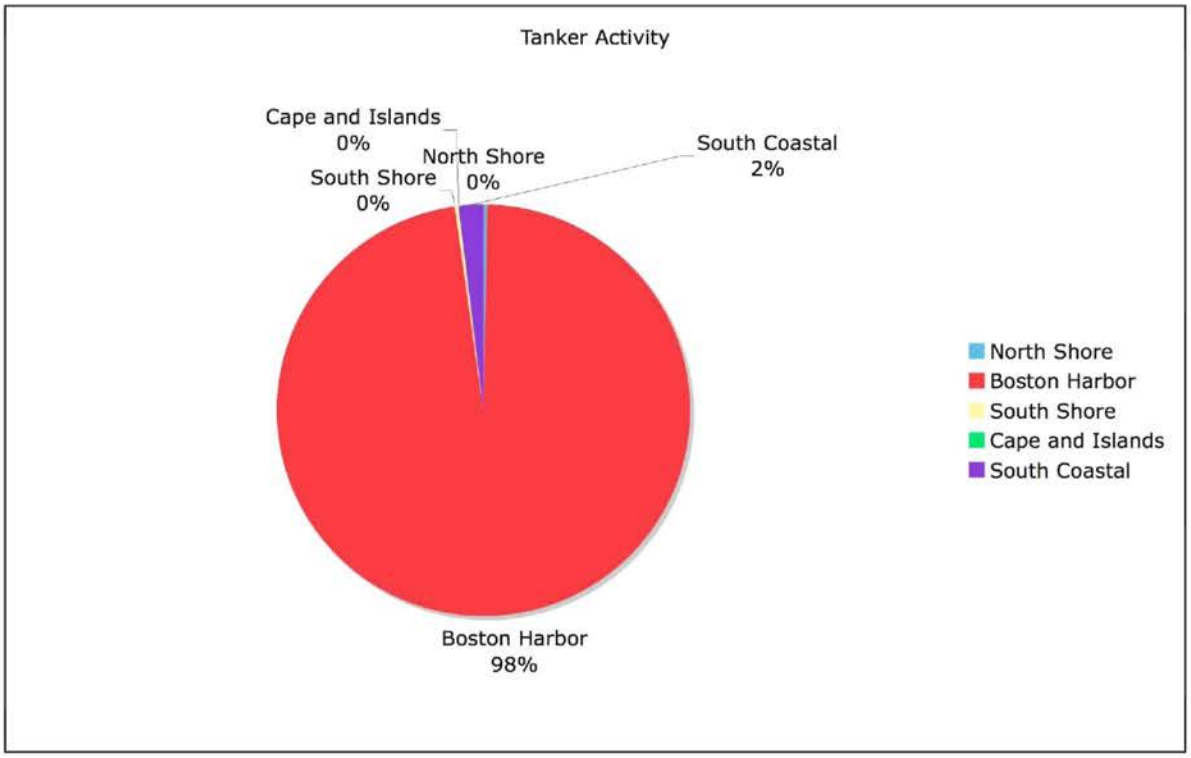


Figure 5.6 Contribution of Threat Factors to total Vessel Movement Threat and Comparison of Threat Factors by Region – Nontank Vessel Activity

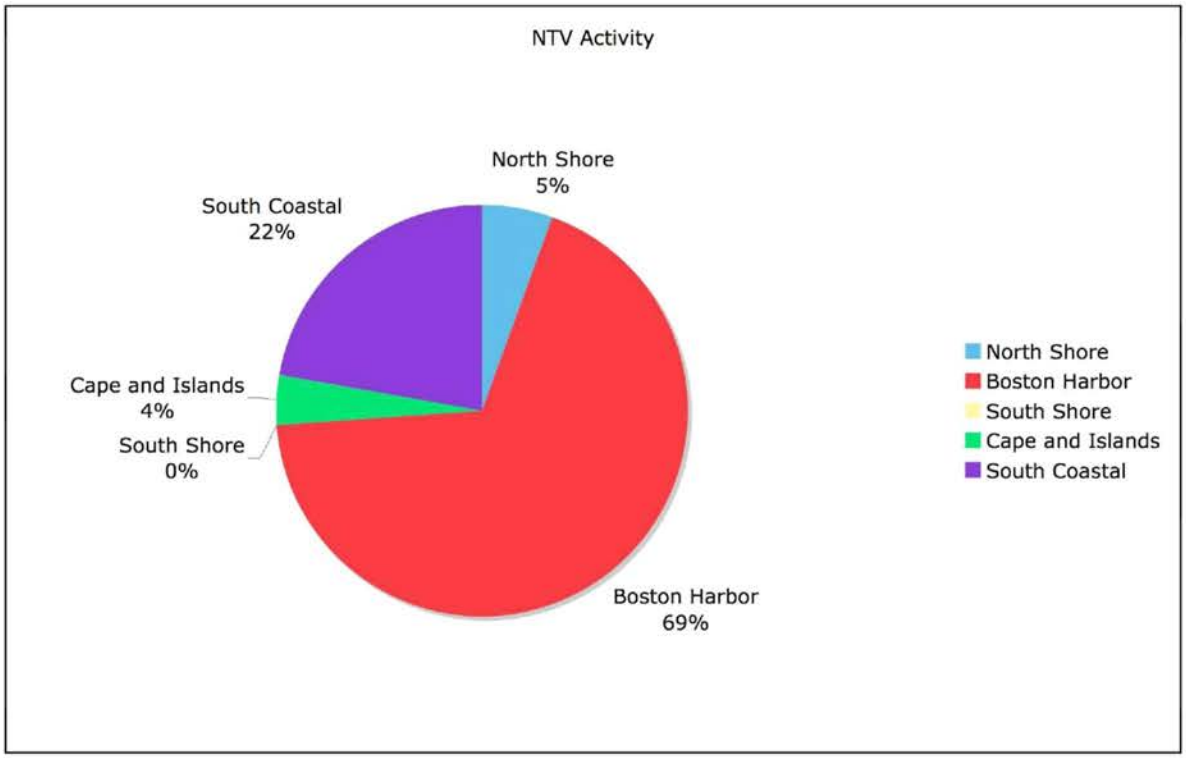
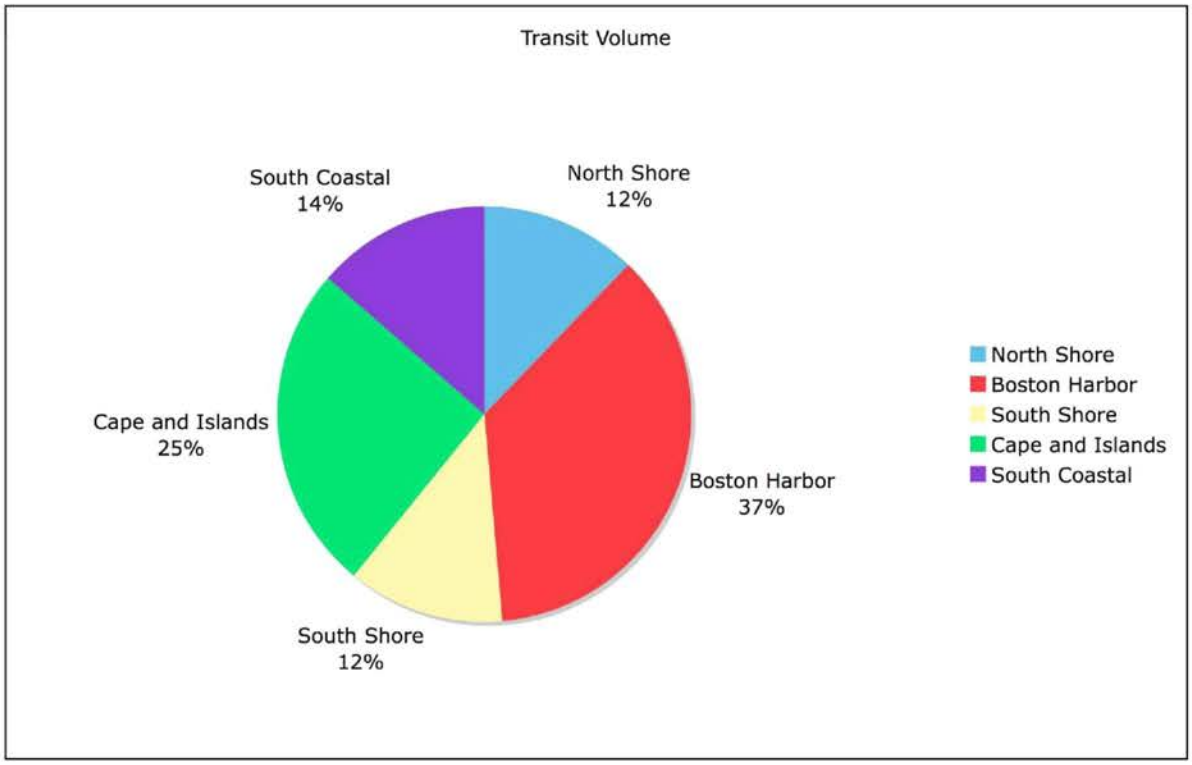


Figure 5.7 Contribution of Threat Factors to total Vessel Movement Threat and Comparison of Threat Factors by Region – Transit Volume



5.1.2 Resident Vessel Fleet Threat Exposure

Figure 5.8 shows that the total threat exposure from resident vessel fleets is highest in the South Coastal region, followed by the North Shore, Cape and Islands, Boston Harbor and the South Shore.

Figure 5.9 shows the proportionate contribution of the five threat factors that comprise the vessel movement estimate – fishing vessels, recreational and charter vessels, ferry boats, homeported vessels, and shipyards – to the overall threat for all regions. This chart shows that 59% of the threat exposure from resident vessel fleets is attributable to the volume of petroleum stored onboard fishing vessels. The next-highest contributor to total threat exposure is recreational and charter vessels. For all regions combined, shipyards and homeported vessels contribute 9% and 8% respectively to the total threat exposure. The smallest contributor to this threat factor is ferry vessels, at 2% of the total.

Figures 5.10 through 5.14 show the proportionate contribution from each region to the total threat exposure for the five resident vessel fleet threat factors. The recreational and charter fleet chart shows that 42% of the total threat exposure from residential and charter vessels occurs in the Cape and Islands, with the next highest level (27%) in the South Coastal region. The North Shore contributes slightly more (13%) to the total threat exposure than Boston Harbor

(11%). The South Shore contributes the smallest amount (7%) to the total GPE for recreational and charter vessel fleets.

The fishing fleet in the South Coastal region has 68% of the total statewide exposure to oil spill threats from fishing vessels, followed by the North Shore (22%). This makes sense, since the two largest fishing ports in Massachusetts are New Bedford (South Coastal) and Gloucester (North Shore). Figure 5.8 shows the relatively high contribution of fishing vessel fleets to total threat exposure in these two regions. The remaining three regions contribute between 1% and 5% to the total threat exposure for fishing vessel fleets.

Of the small amount of oil spill threat exposure attributable to the ferry fleet, 67% of this threat occurs in the Cape and Islands. Boston Harbor has 27% of the total exposure to the ferry fleet spill threat, and the remaining three regions contribute between 1% and 3% to the total threat exposure.

Boston Harbor has the majority (62%) of the exposure to oil spill threats from homeport vessel fleets, with the next highest exposure in the Cape and Islands (26%). The remaining three regions contribute between 1% and 7% to the total threat exposure from homeport vessels.

The threat exposure to petroleum on vessels in shipyards is highest in the South Coastal region (73%). The North Shore contributes 15% to the total threat exposure for this factor, and Boston Harbor contributes 12%. The South Shore and Cape and Islands both account for less than 1% of the total threat exposure statewide for shipyards.

Overall, the resident vessel fleet threat exposure shows that fishing vessels account for more than half of the total exposure level (measured in gallons of petroleum) to oil spill threats from resident vessels in Massachusetts ports and Harbors. The South Coastal region has the highest threat level for oil spills from vessel fleets, and most of this threat is attributable to the large commercial fishing fleet in New Bedford harbor as well as to recreational and charter fleets in several municipalities and harbors. The Cape and Islands region is most exposed to oil spill threats from recreational and charter fleets.

Figure 5.8 Residential Vessel Fleet Threat Exposure by Region (000) [24]

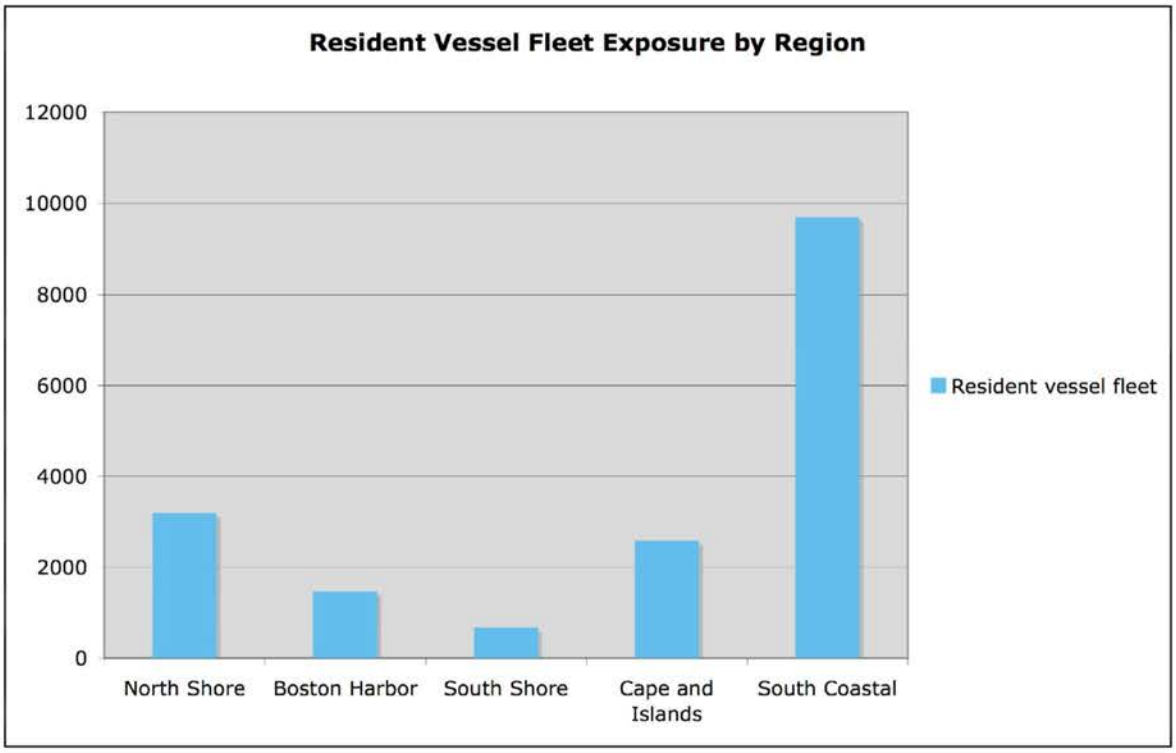
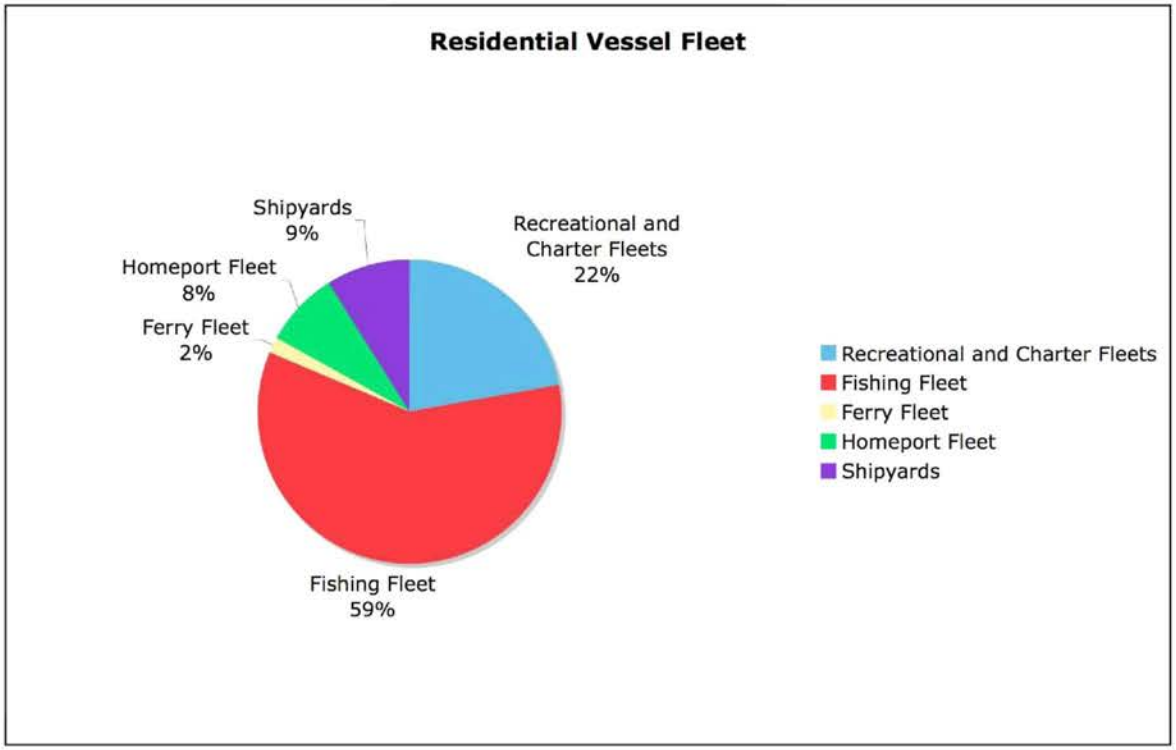


Figure 5.9 Contribution of Threat Factors to total Residential Vessel Fleet Threat



[24] All values in table should be multiplied by a factor of 1,000.

Figure 5.10 Comparison of Threat Factors by Region – Recreational and Charter Fleets

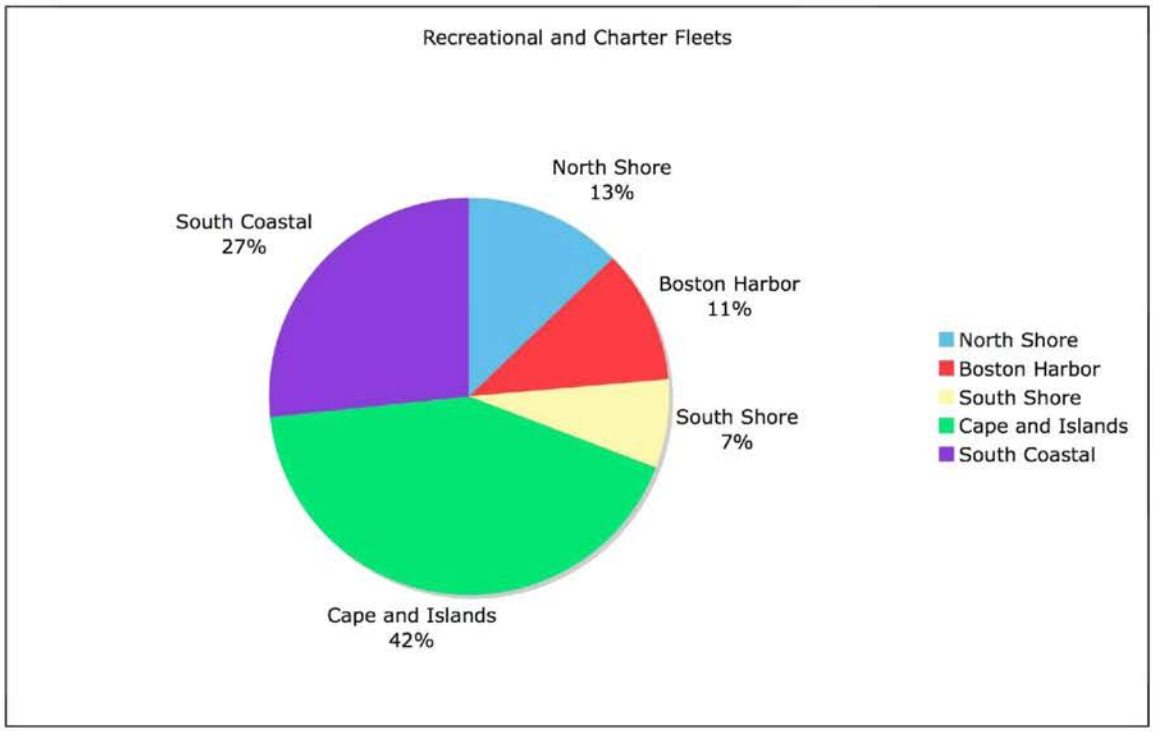


Figure 5.11 Comparison of Threat Factors by Region – Fishing Fleet

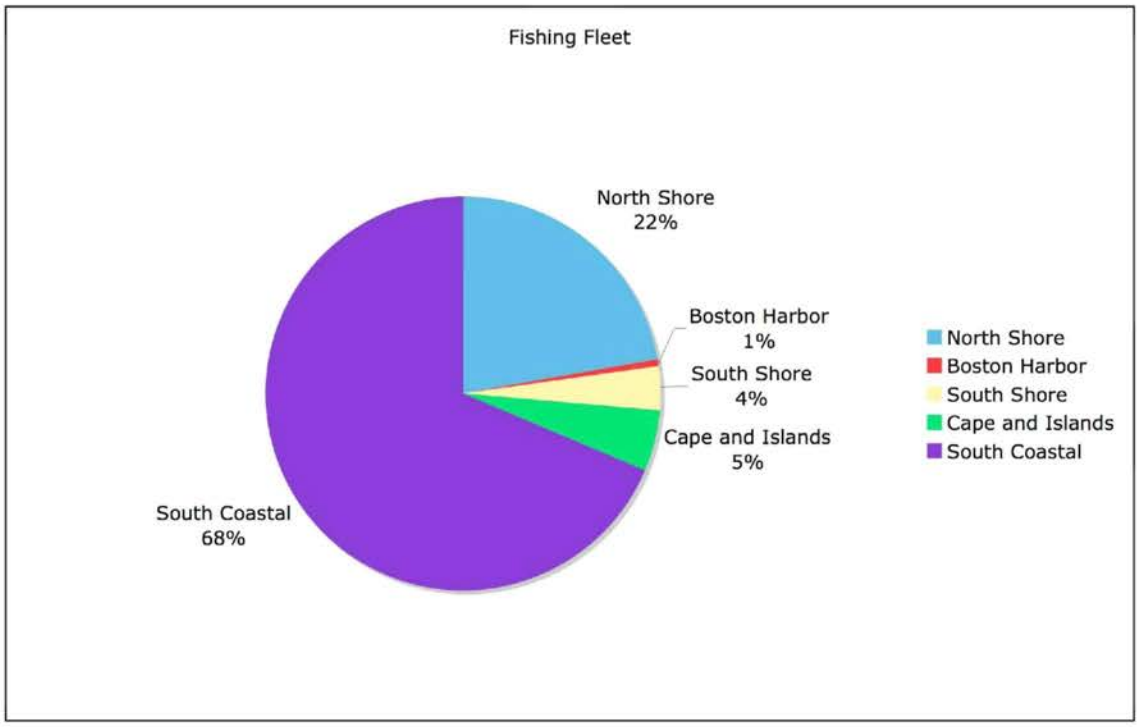


Figure 5.12 Comparison of Threat Factors by Region – Ferry Fleet

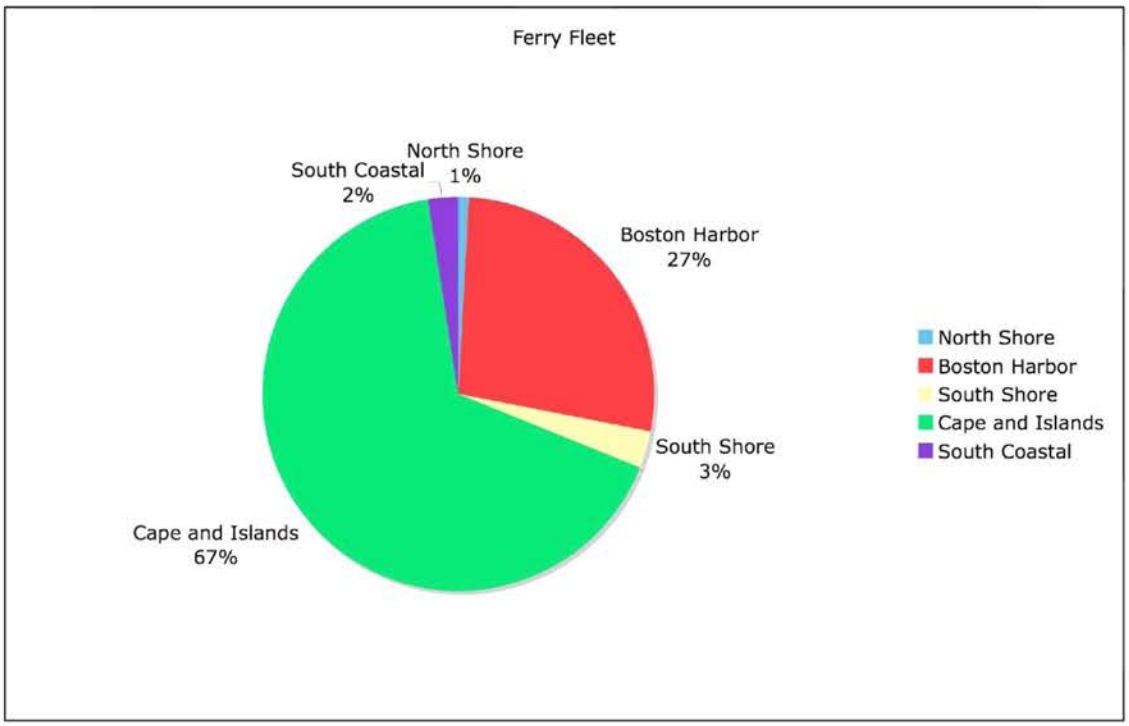


Figure 5.13 Comparison of Threat Factors by Region – Homeport Fleet

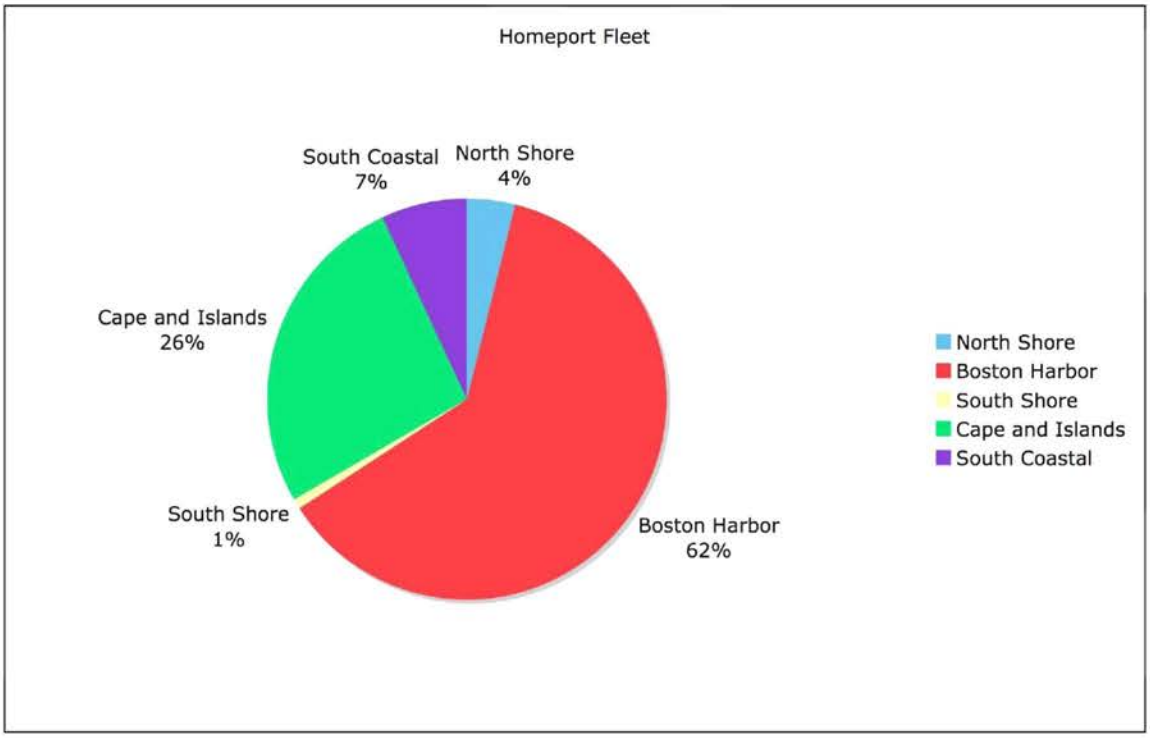
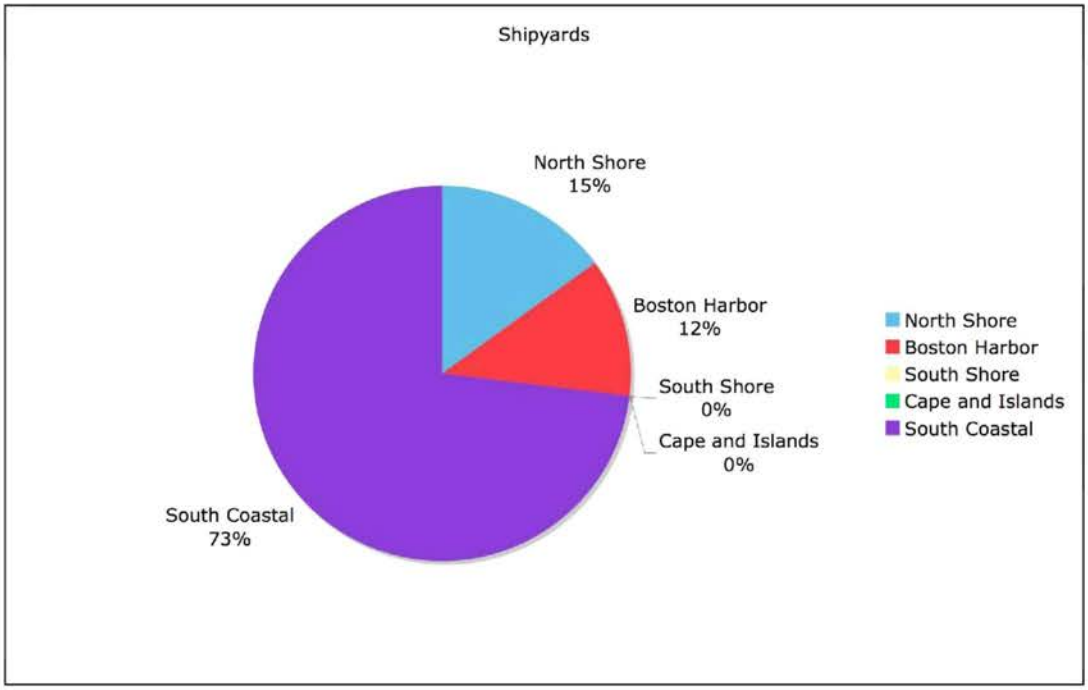


Figure 5.14 Comparison of Threat Factors by Region – Shipyards



5.1.3 Land-Based Petroleum Storage Threat Exposure

Figure 5.15 shows that the total threat exposure from land-based petroleum storage is highest in the Boston Harbor region, followed by the North Shore, South Coastal, and the Cape and Islands. The South Shore has virtually no exposure.

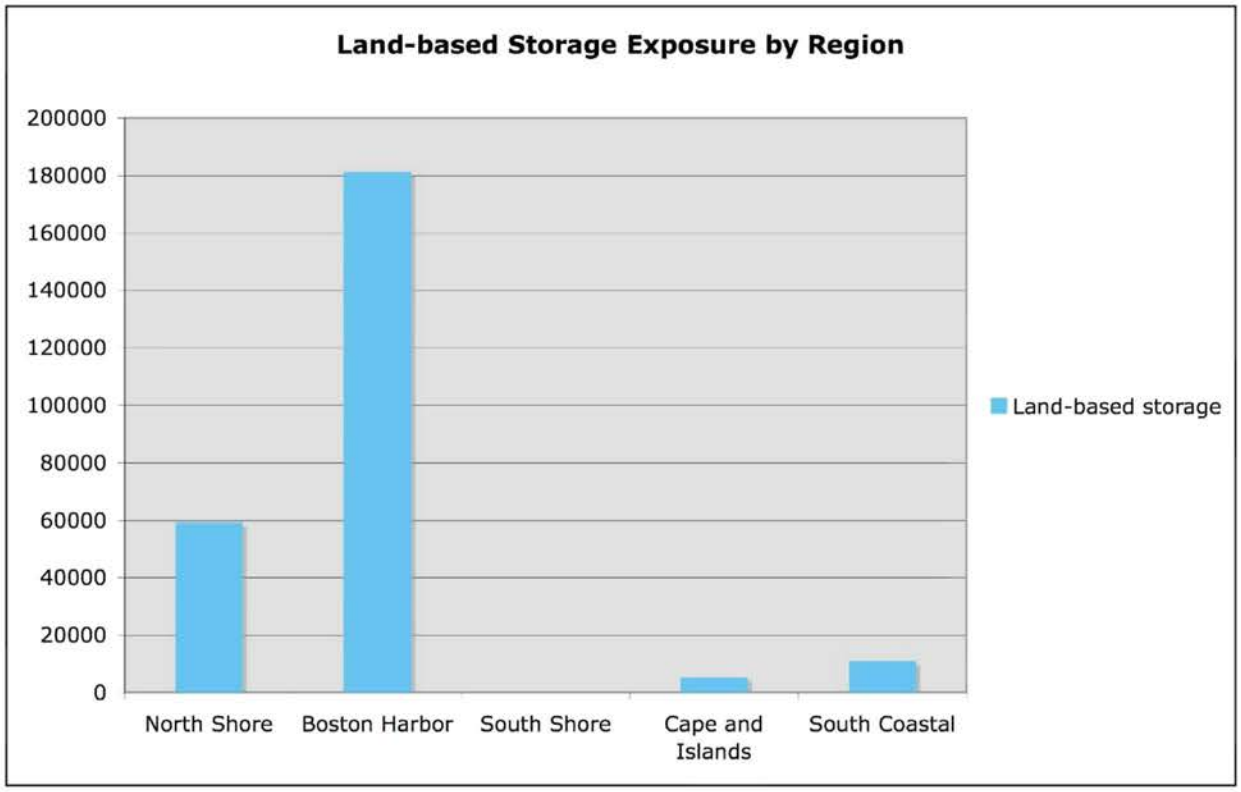
Figure 5.16 shows the proportionate contribution of the two threat factors that comprise the land-based storage estimate – EPA regulated and locally regulated tanks – to the overall threat for all regions. This chart shows that virtually all of the threat exposure from land-based storage is attributable to the volume of petroleum stored in regulated tank farms (those tank farms with over 42,000 gallons total storage capacity that are required to file oil spill response plans with the EPA). Locally (non-EPA) regulated tanks (smaller storage tanks at harbors and marinas, used primarily for vessel fueling) make up less than 1% of the total exposure. This is a reflection of the order of magnitude difference between the size and number of tanks at some of the larger tank farms and the relatively smaller size of locally regulated tanks.

Figure 5.17 and 5.18 show the proportionate contribution from each region to the total threat exposure for the two types of land-based storage threat factors. For regulated tank farms, which make up more than 99% of the total threat exposure from land-based storage, 71% of the exposure is located in Boston Harbor, with 23% in the North Shore. The South Coastal region has 4% of the total exposure to spill threats from regulated tank farms, and the Cape and Islands has 2%. The South Shore does not have any regulated tank farms and therefore contributes less than 1% to the total statewide exposure.

The allocation of threat exposure among regions for locally regulated tanks is much different than for EPA regulated tanks. More than half (54%) of the threat exposure is allocated to the Cape and Islands region. The South Coastal and North Shore regions have similar proportions of the total exposure (19% and 15% respectively). Boston Harbor is the second smallest contributor to statewide exposure from locally regulated tank vessels (7%) followed by the South Shore (5%).

The threat exposure for land-based storage varies by region. Overall, regulated tank farms account for nearly 100% of the total exposure level (measured in gallons of petroleum) to oil spill threats from oil storage tanks in Massachusetts coastal communities. This threat is concentrated in the Boston Harbor region, and to a lesser extent the North Shore. Locally regulated tanks contribute less than 1% of the total exposure from storage tanks. This much lower threat level is concentrated in the Cape and Islands region, where there are a large number of marinas.

Figure 5.15 Land-Based Storage Threat Exposure by Region (000) [25]



[25] All values in table should be multiplied by a factor of 1,000.

Figure 5.16 Contribution of Threat Factors to total Land-based Bulk Storage Threat

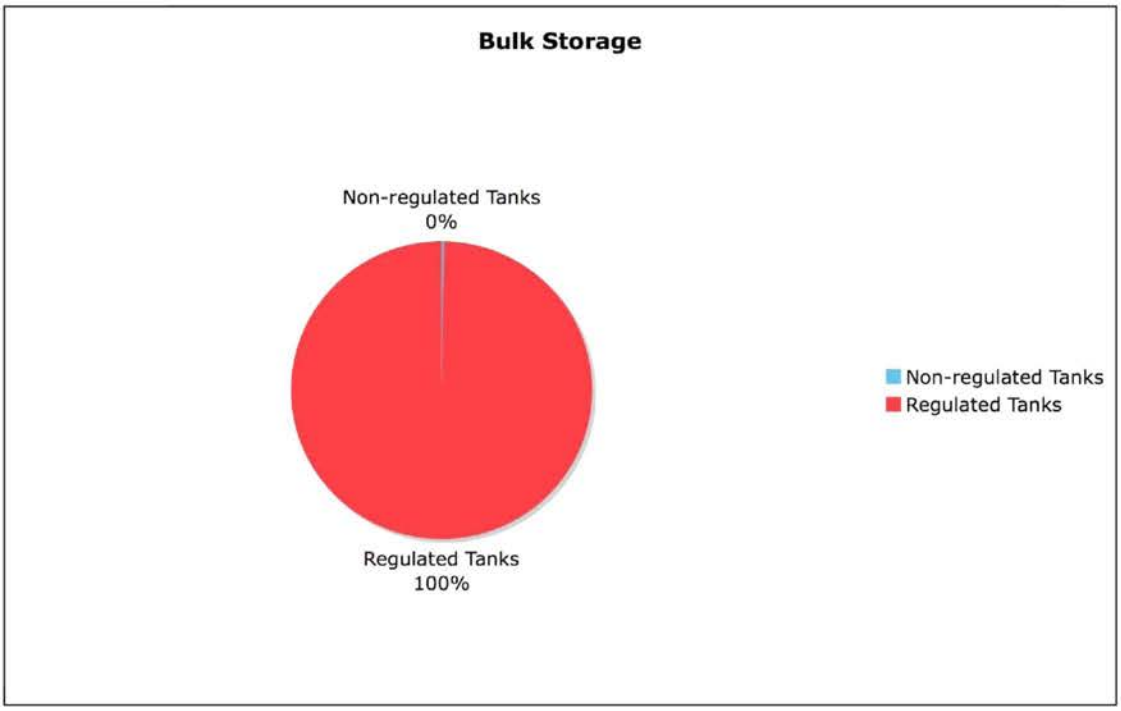


Figure 5.17 Comparison of Threat Factors by Region – Locally Regulated Tanks

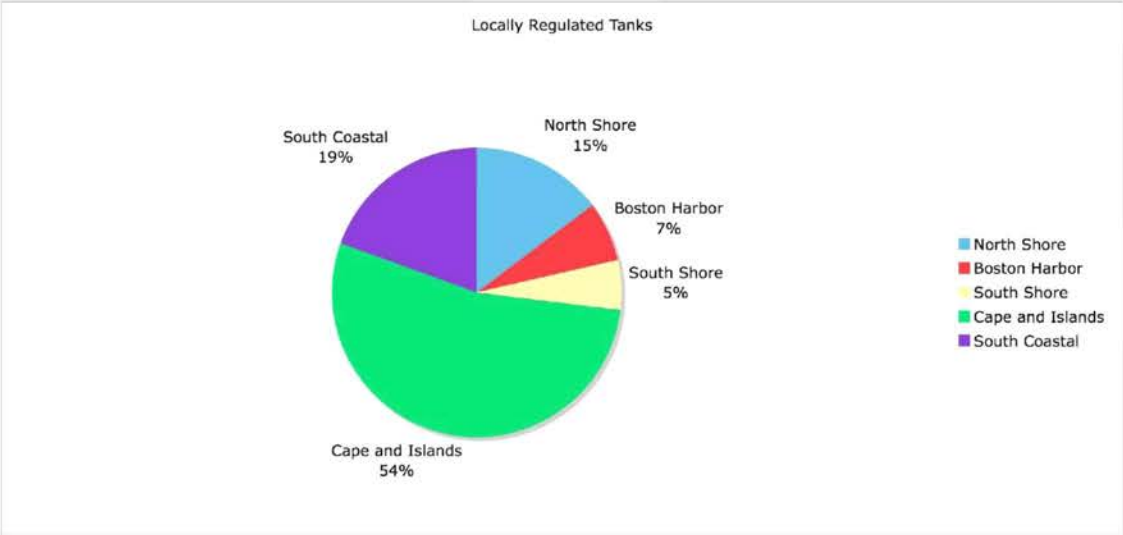
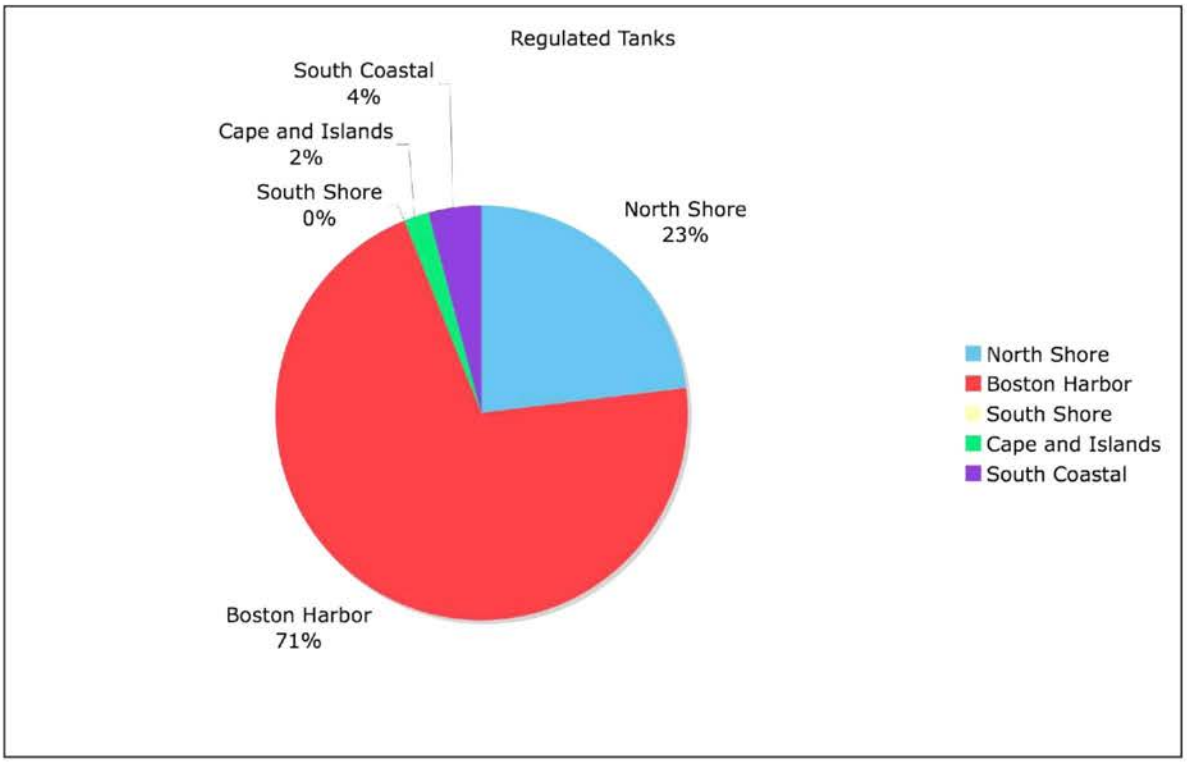


Figure 5.18 Comparison of Threat Factors by Region –EPA Regulated Tanks



5.2 Comparison of Oil Spill Threat Exposure by *Region*

Figure 5.19 shows the aggregated totals by region for estimated gallons of petroleum exposure from all threat factors. Table 5.1 summarizes the estimated gallons of petroleum exposure for of each of the ten threat factors by region. Boston Harbor has the highest threat level of any region, with an estimated 8.8 billion gallons of petroleum exposure. The next highest level is in the Cape and Islands, and just over 3 million estimated gallons of petroleum exposure – nearly one-third the level in Boston Harbor. The South Coastal, North Shore, and South Shore regions all have similar total threat levels – ranging from 1.4 to 1.7 billion gallons of estimated petroleum exposure – less than one-quarter of the level in Boston Harbor.

Figure 5.19 Regional Oil Spill Threat in Estimated Gallons of Petroleum Exposure (000)[26] for all Threat Factors Combined

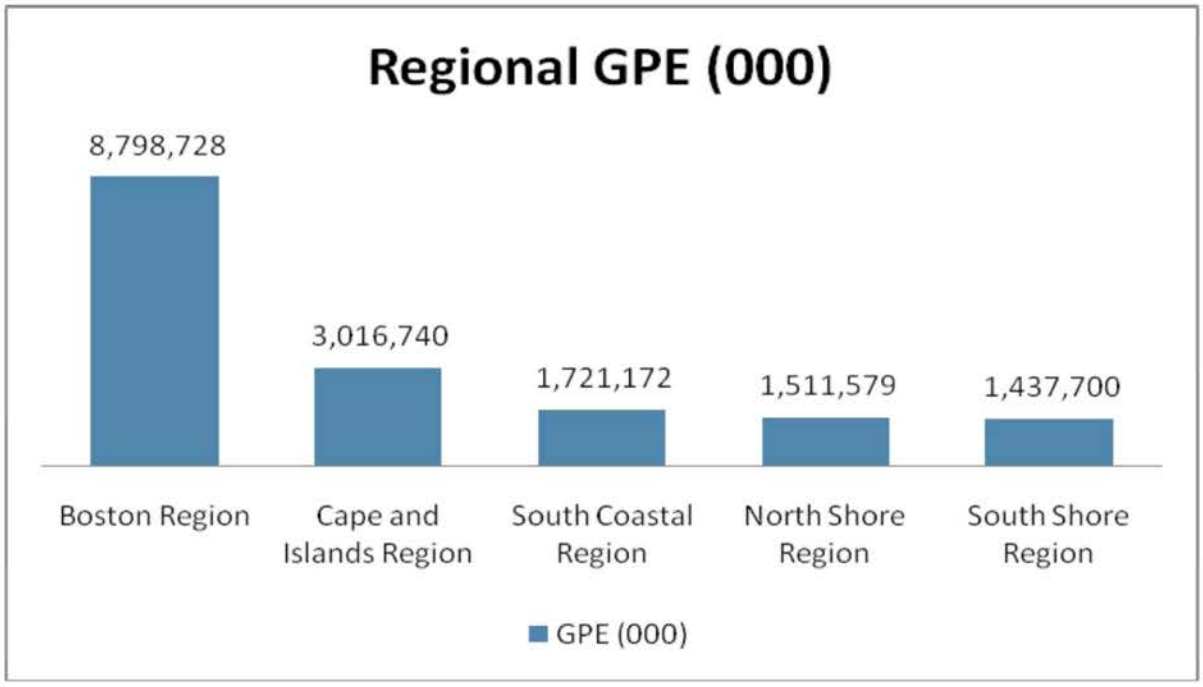


Table 5.1 Regional Summary of Oil Spill Threats in Estimated Gallons of Petroleum Exposure (000)[27]

	North Shore	Boston Harbor	South Shore	Cape and Islands	South Coastal	Total
Tanker Activity	11,000.0	4,280,500.0	1,000.0	8,750.0	82,500.0	**4,372,750.0**
NTV Activity	2,200.0	27,500.0	-	1,600.0	8,925.0	**38,025.0**
Transit Volume	1,436,000.0	4,308,000.0	1,436,000.0	2,998,611.0	1,609,061.0	**10,351,672.0**
Recreational and Charter Fleets	471.2	400.0	263.3	1,558.9	983.8	**3,206.0**
Fishing Fleet	2,440.5	75.0	395.6	546.8	7,525.5	**8,542.8**
Ferry Fleet	2.0	62.8	7.0	154.5	5.5	**229.8**
Homeport Fleet	48.0	750.0	10.2	320.2	85.1	**1,165.5**
Shipyards	225.0	180.0	-	-	1,100.0	**1,280.0**
Locally regulated Tanks	66.2	30.0	24.0	240.5	86.5	**381.0**
Regulated Tanks	59,126.0	181,230.0	-	4,958.0	10,900.0	**197,088.0**
Total by Region	**1,511,578.9**	**8,798,727.8**	**1,437,700.1**	**3,016,739.8**	**1,721,172.4**	

[26] All values in table should be multiplied by a factor of 1,000.
[27] All values in table should be multiplied by a factor of 1,000.

5.2.1 North Shore Region

The North Shore Region has an estimated threat level of approximately 1.5 billion GPE. Figure 5.20 shows the comparative threat levels for all threat factors within the North Shore region. The largest threat within the region is from vessel transit activity, which is attributed primarily to the volume of oil transiting into and out of Boston Harbor as it passes through the region.

As Figure 5.21 shows, the comparative threat from vessel transit activity accounts for 99% of the total threat from vessel movements. While tank vessel activity represents only 1% of the total vessel movement threat, it is actually the third largest threat exposure for the North Shore region.

The second highest threat level is from EPA regulated tank farms, most of which are located in Revere. Regulated tank farms make up nearly 100%[28] of the threat for spills from land-based storage in the North Shore region.

Approximately 76% of the threat exposure for the resident vessel fleet comes from fishing vessels. This is primarily attributable to the large fishing vessel fleet in Gloucester.

Within the North Shore region, Pines River and Lynn Harbor are the two harbors with the highest exposure to the high magnitude threat factors discussed in Section 4.3 (tanker activity, NTV activity, transit activity and regulated tanks). Gloucester has by far the highest level of exposure to low magnitude threats (resident vessel fleet and locally regulated tanks), and has the second highest level of exposure statewide in all regions. Other North Shore harbors with high levels of exposure to oil spill threats from resident vessels and locally (non-EPA) regulated tanks are Salem, Marblehead, Beverly, and Rockport.

Not included in these estimates are current and planned shipments of liquefied natural gas (LNG) to the two new offshore LNG terminals located 10 miles and 13 miles southeast of Gloucester. The first terminal, built and operated by Gateway/Excelerate Energy experienced its first delivery of LNG in May of 2008 and is now operating at less than full capacity.[29] The second terminal, built and operated by Neptune/Suez LNG is scheduled to come on line in September of 2009.[30] The Gateway/Excelerate Energy terminal can discharge one ship at a time while a second ship is moored in standby. The Neptune/Suez project will be able to discharge two ships at the same time. According to a Neptune/Suez project update press release, ships will discharge in four to eight days with some overlap between the two discharge ports. Given this information, an estimate of one ship arriving each 5 days would lead to 73 ships per year under full operation for Neptune/Suez and 35 – 40 ships per year for Gateway/Excelerate Energy.

[28] As Table 5.1 shows there is a small amount of GPE from non-regulated tank farms in the North Shore region, but it accounts for less than 1% of the total GPE from land-based storage.
[29] Greg Farmer, Boston Harbor Pilots, personal conversation, March 27, 2009
[30] Neptune-Suez, Project Update, March 2009, website, http://www.neptunelngconstruction.com/

The impact on the North Shore threat estimate will be an increase in the Vessel Transit estimate by 10.0 million GPE per year if both terminals operate at full capacity. A small increase to the resident fleet GPE for Boston Harbor will also occur due to the 2 – 4 support vessels that will berth in the port.

5.2.2 Boston Harbor Region

The aggregated estimates of total threat level shown in Figure 5.1 emphasizes the level of threat in Boston Harbor, which has the largest total threat amount for any regional area at approximately 8.8 billion GPE. As shown in Figure 5.22, Boston Harbor's high threat level can be attributed to the fact that the region has the highest total threat level for four factors - tank vessel activity, nontank vessel activity, vessel transits, and bulk petroleum storage.

Boston Harbor has the largest amount of tank vessel deliveries at an estimated 4.3 billion GPE within the municipalities of Boston, Chelsea, Everett, Quincy, Braintree, and Weymouth, accounting for the top six municipalities in the state. Figure 5.23 shows that tank vessel activities account for 50% of the threat from vessel movement, with the other 50% attributable to vessel transit activity. Although nontank vessel activity is the fourth largest component of overall spill threat within the Boston Harbor region and is the highest overall compared to the other four regions in the state, it accounts for less than 1% of the overall oil spill threat exposure for vessel movement activities within Boston Harbor.

As discussed in Section 5.1.1, there is a 100% overlap between the tank vessel and NTV activity and the vessel transit activity. This overlap was discounted at the harbor and municipal levels, but was not removed from the regional aggregation of data. This means that the GPE for vessel movement activity is double counting the traffic in Boston Harbor because the same vessels calling on those ports are also transiting offshore. To avoid counting the same vessels twice, the GPE estimate for vessel transit volume could be cut in half for Boston Harbor, which would reduce the total GPE to approximately 4.4 billion. This would still represent the highest overall threat for any region, due largely to tank vessel traffic.

The homeport fleet comprises just over half of the total petroleum exposure from resident vessels in Boston Harbor. Despite the fact that Boston Harbor has the highest homeport volume of any region in the state, the relative contribution of resident vessel exposure to total GPE in the Boston Harbor region is minimal.

The Boston Harbor region also has the highest amount of petroleum storage at 181 million GPE. This threat is derived from the large number and size of regulated tank farms within the region.

Within the Boston Harbor region, Boston, Fore River, and Town River Bay are the three harbors with the highest exposure to the high magnitude threat factors discussed in Section 4.3 (tanker activity, NTV activity, transit activity and regulated tanks). They also have the three highest exposure levels statewide, due to tanker activity in Boston and vessel transits in Fore and Town Rivers. All can be attributed to tanker traffic in and out of the Port of Boston. Boston also has the highest level of exposure within the region to low magnitude threats (resident vessel fleet and locally regulated tanks), and has the third highest

level of exposure statewide in all regions. No other harbors within the Boston Harbor region are exposed to high levels oil spill threats from resident vessels and locally regulated tanks. Again, this fact emphasizes the relative contribution of tanker activity and transits to overall threats in the Boston Harbor region.

5.1.3 South Shore Region

The South Shore Region has an estimated threat level of approximately 1.5 billion GPE. Figures 5.24 and 5.25 show the comparative threat levels for all threat factors within the South Shore region. The largest threat within the region is from vessel transit activity, which is attributed primarily to the volume of oil transiting into and out of Boston Harbor as it passes through the region. The threat from vessel transit activity accounts for 100% of the total threat from vessel movements.

All other threats combined make up less than 1% of the total exposure in the South Shore when compared to vessel transits. The threat factors that contribute most to this much smaller exposure are recreational and charter fleets, fishing fleets, and locally regulated tank farms.

None of the harbors in the South Shore region have a high level of exposure to the high magnitude threat factors discussed in Section 4.3 (tanker activity, NTV activity, transit activity and regulated tanks). Plymouth has the highest level of exposure to low magnitude threats (resident vessel fleet and locally regulated tanks), and has the sixth highest level of exposure statewide in all regions. Other South Shore harbors with high levels of exposure to oil spill threats from resident vessels and locally regulated tanks are Green Harbor and Scituate Harbor.

5.1.4 Cape and Islands Region

The Cape and Islands Region has the second largest total threat quantity of the five regions with a total GPE of 3.02 billion (Figure 5.26). Figures 5.26 and 5.27 show the comparative threat levels for all threat factors within the region. The largest component of the total quantity is from the transit volumes through the Cape Cod Canal and around the outside of Cape Cod at 3.00 billion gallons, presenting the threat of an oil spill to the towns of Bourne, Falmouth, Sandwich, Provincetown, Truro, Eastham, and Wellfleet. The Cape and Islands Region also has the highest recreational and charter fishing fleet largely due to the size of the Nantucket fleet.

Ferry traffic for the Cape and Islands is the highest of the five regions due to the ferry routes between Cape Cod, Martha's Vineyard, and Nantucket. Lastly, Cape Cod has the fourth highest regulated tank farm quantity due to the tank farms located in Tisbury.

Within the Cape and Islands region, Sandwich Boat Basin and Great Harbor (Woods Hole) are the two harbors with the highest exposure to the high magnitude threat factors discussed in Section 4.3 (tanker activity, NTV activity, transit activity and regulated tanks). Nantucket Harbor has the highest level of exposure to low magnitude threats (resident vessel fleet and locally regulated tanks), and has the fourth highest level of exposure statewide in all regions. Of

all regions, the Cape and Islands region by far has the largest number of harbors with high levels of exposure to oil spill threats from resident vessels and locally regulated tanks. In decreasing order of magnitude, these harbors are Hyannis, Vineyard Haven (Tisbury), Great Harbor (Woods Hole), Provincetown, Wellfleet, Edgartown, West Bay, Buttermilk Bay, and Falmouth Harbor.

5.1.5 South Coastal Region

The South Coastal Region has the third highest total threat factor at 1.7 billion GPE. Figure 5.28 shows that vessel transit volume comprises most of this threat, which can be attributed to the volume of oil transiting Buzzards Bay and the Cape Cod Canal. The South Coastal Region also has the second highest threat level of tank vessel deliveries at 82.5 million GPE due to the shipping volume into New Bedford/Fairhaven and Fall River/Somerset. As discussed in Section 4, there is approximately a 5% overlap between the tank vessel and NTV activity and the vessel transit activity in Mt. Hope Bay. This overlap was discounted at the harbor and municipal levels, but was not removed from the regional aggregation of data. This means that the GPE for vessel movement activity is double counting the traffic in Mt. Hope Bay because the same vessels calling on those ports are also transiting the region. Even if the transit volume GPE estimate were reduced to reflect this 5% overlap, transit volume would still present the largest threat factor to this region due to the Buzzards Bay/Cape Cod Canal traffic.

The South Coastal region has the highest level of resident fishing fleet threat quantities of all regions, at 7.5 million GPE. New Bedford Harbor has more than three times the number of fishing vessels as the next highest port. Many of these are large offshore trawlers and scallopers. Three of five working shipyards in Massachusetts are also located in the South Coastal Region. Despite the fact that the resident vessel fleet threat level in South Coastal is high compared to other regions, the total quantity of exposure still accounts for less than 1% of the oil spill threat in the South Coastal region, because the comparative volume of oil in tank vessel deliveries and vessel transits is so high.

Land-based storage of petroleum products in regulated tanks is the second highest overall threat in the South Coastal region, after vessel transits, at approximately 59 million GPE. This amount makes up approximately 4% of the total threat exposure in the South Coastal region (Figure 5.29).

Within the South Coastal region, New Bedford Harbor has the highest overall exposure to the high magnitude threat factors discussed in Section 4.3 (tanker activity, NTV activity, transit activity and regulated tanks). New Bedford also has by far the highest level of exposure to low magnitude threats (resident vessel fleet and locally regulated tanks) both in the South Coastal region and statewide. Other South Coastal harbors with high levels of exposure to oil spill threats from resident vessels and locally (non-EPA) regulated tanks are Sippican, Apponagansett Bay, Westport River, and Onset Harbor.

Figure 5.20 Comparative Oil Spill Threat Levels within North Shore Region in Estimated Gallons of Petroleum Exposure (000)[31]

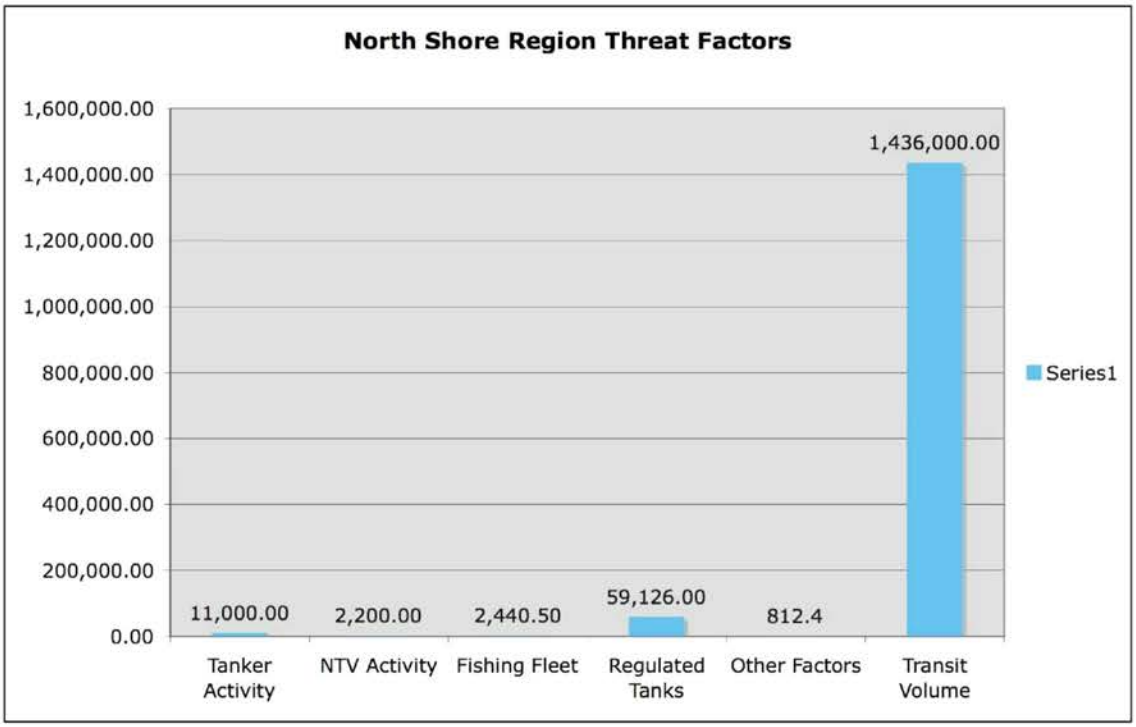
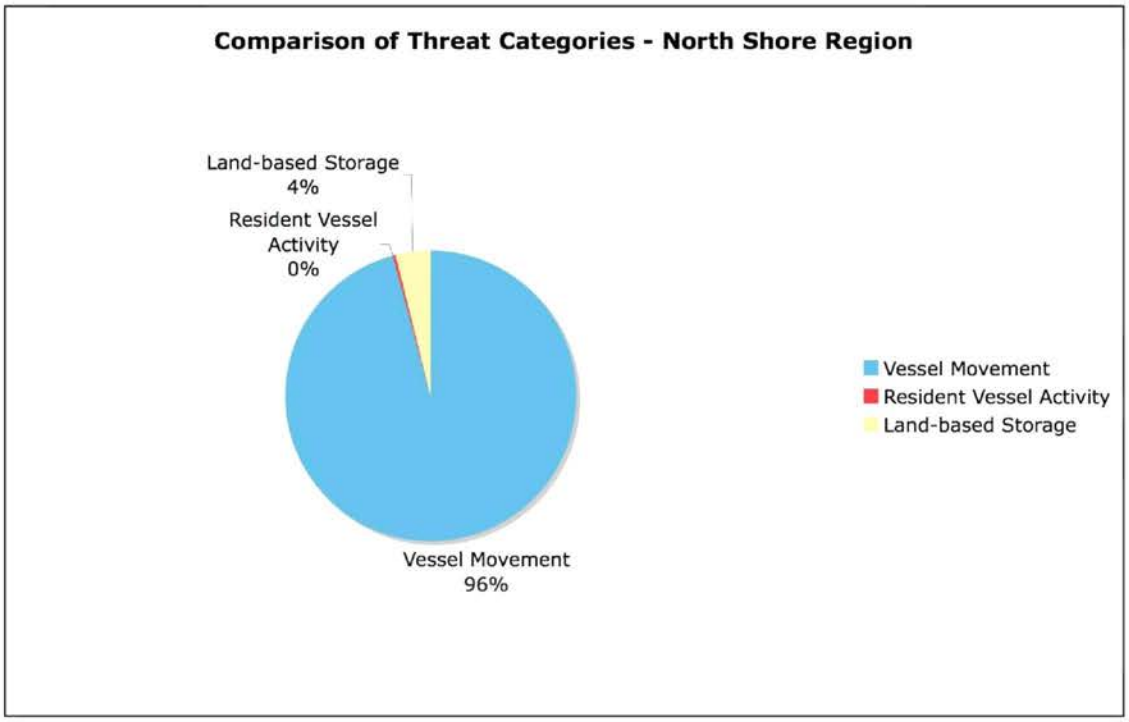


Figure 5.21 Comparative Oil Spill Threat Levels within North Shore Region by Threat Category



[31] All values in table should be multiplied by a factor of 1,000.

Figure 5.22 Comparative Oil Spill Threat Levels within Boston Harbor Region in Estimated Gallons of Petroleum Exposure (000)[32]

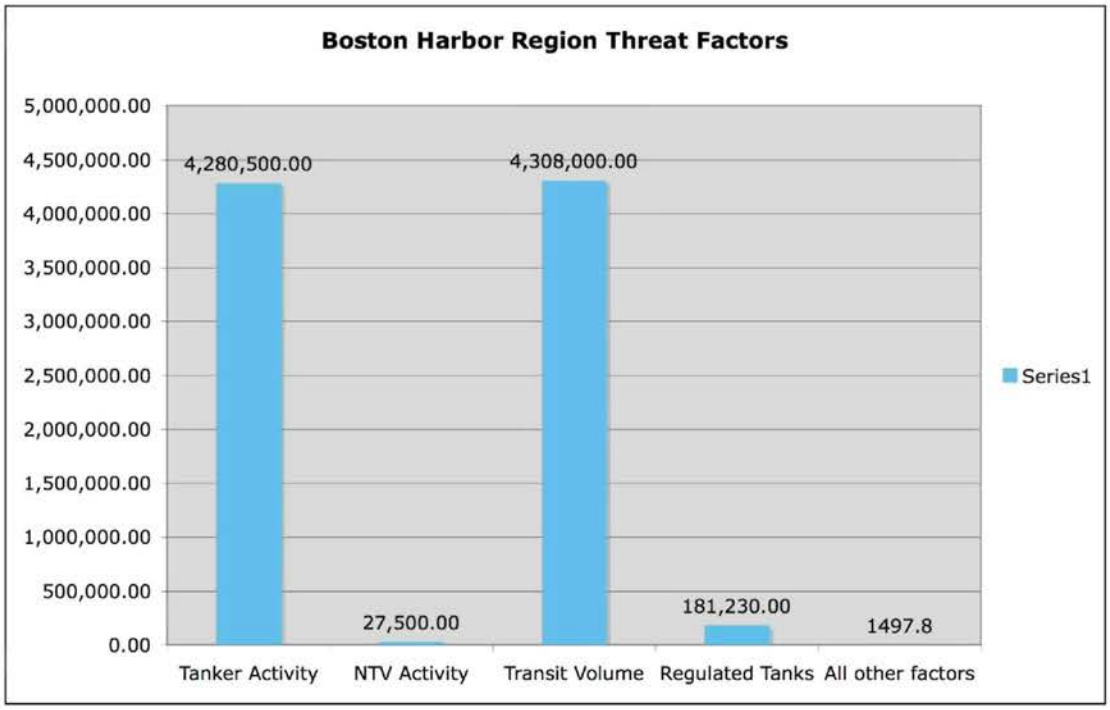
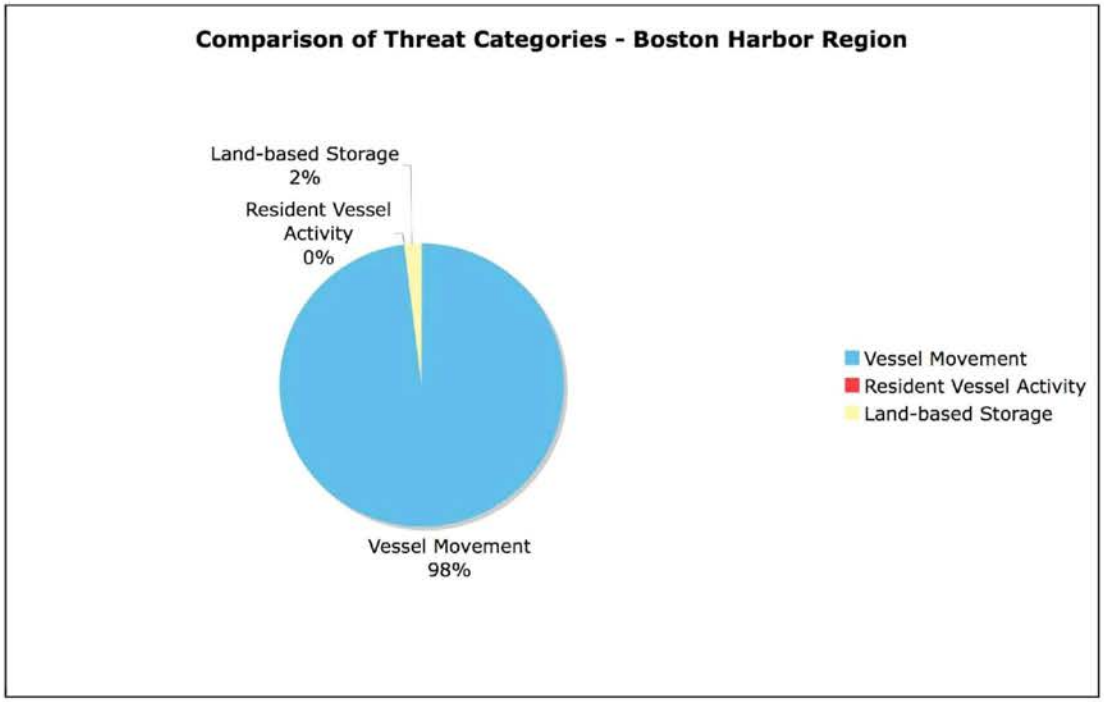


Figure 5.23 Comparative Oil Spill Threat Levels within Boston Harbor Region by Threat Category



[32] All values in table should be multiplied by a factor of 1,000.

Figure 5.24 Comparative Oil Spill Threat Levels within South Shore Region in Estimated Gallons of Petroleum Exposure (000)[33]

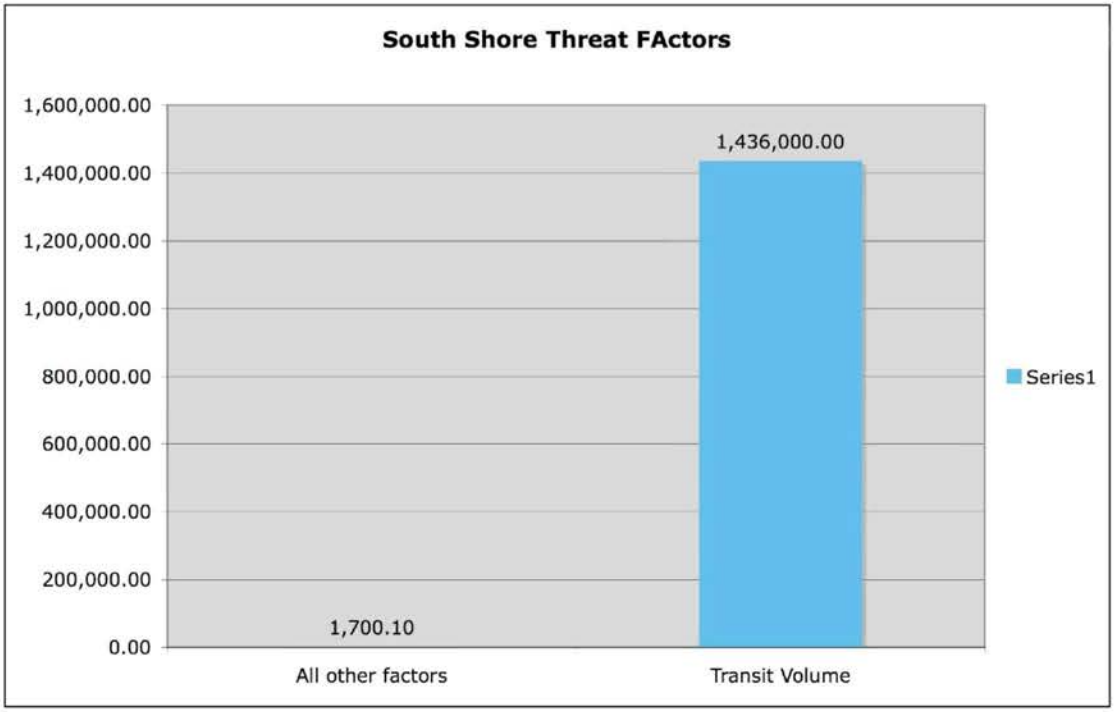
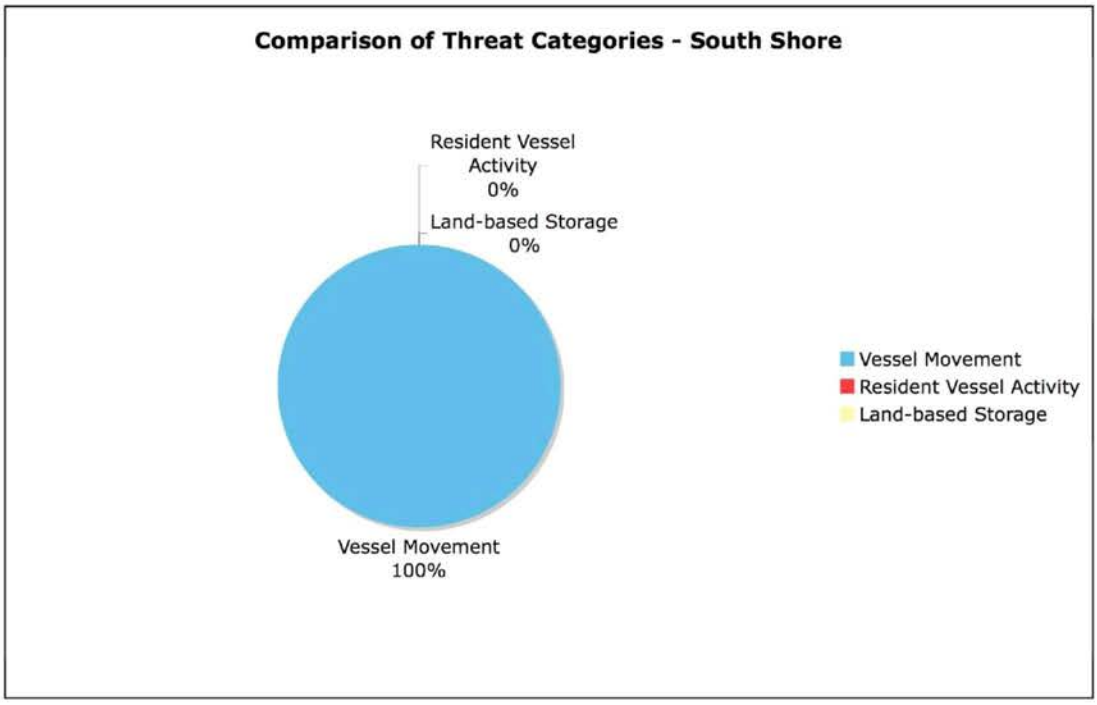


Figure 5.25 Comparative Oil Spill Threat Levels within South Shore Region by Threat Category



[33] All values in table should be multiplied by a factor of 1,000.

Figure 5.26 Comparative Oil Spill Threat Levels within Cape and Islands Region in Estimated Gallons of Petroleum Exposure (000)[34]

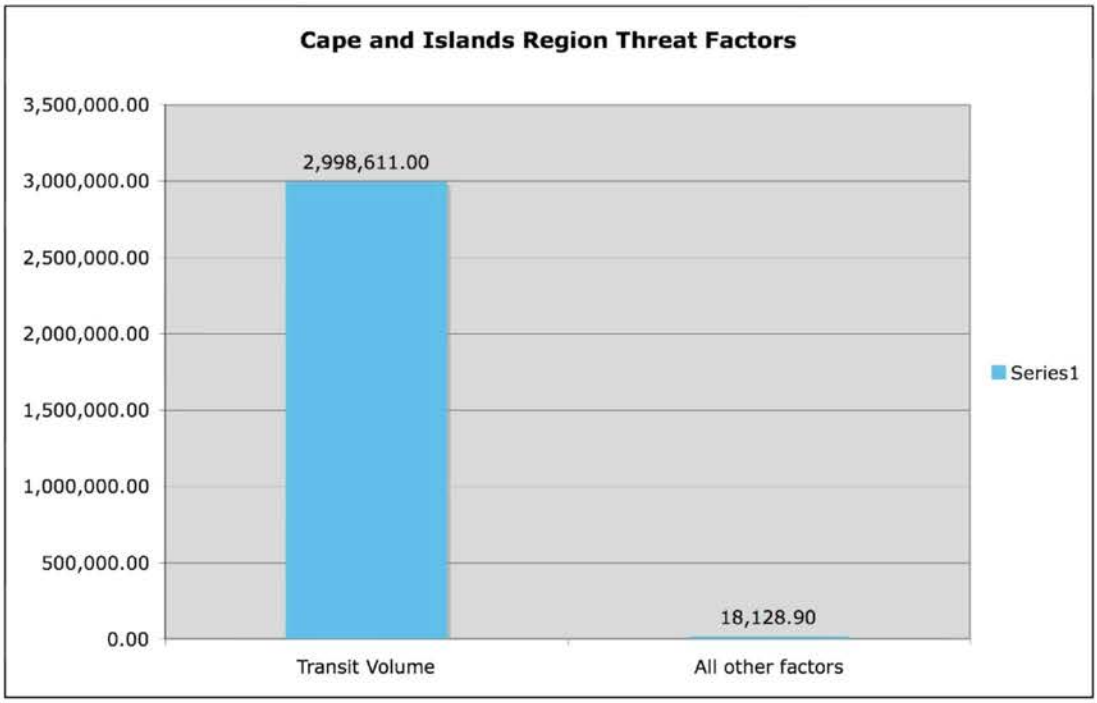
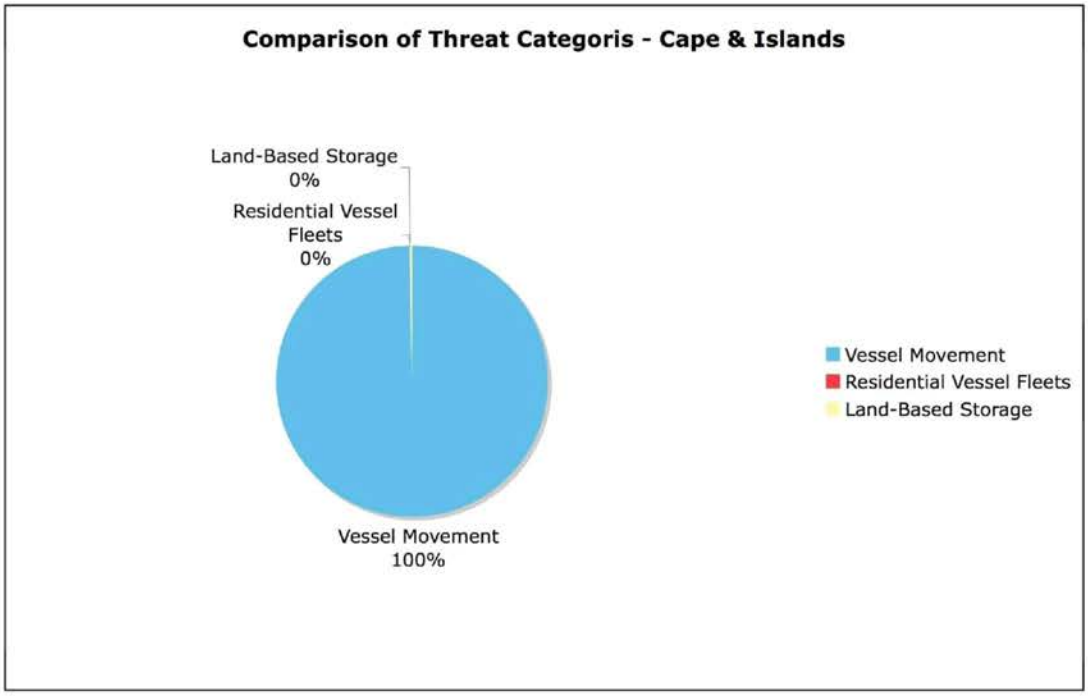


Figure 5.27 Comparative Oil Spill Threat Levels within Cape and Islands Region by Threat Category



[34] All values in table should be multiplied by a factor of 1,000.

Figure 5.28 Comparative Oil Spill Threat Levels within South Coastal Region in Estimated Gallons of Petroleum Exposure (000)[35]

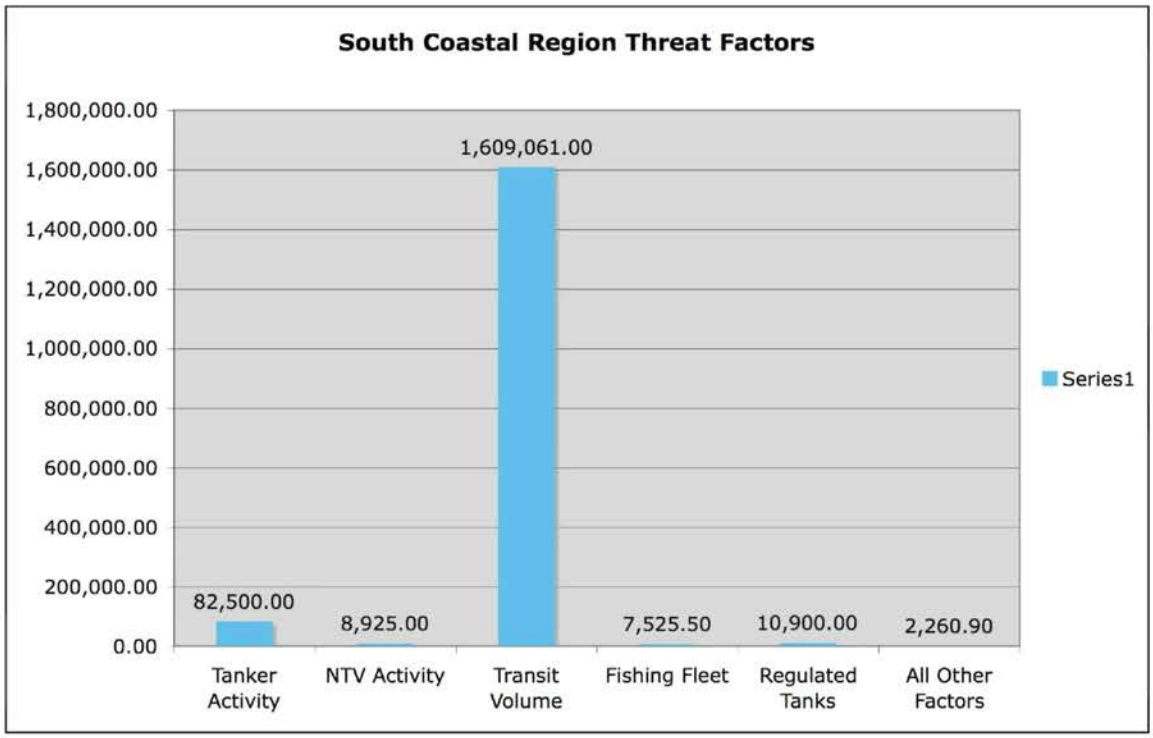
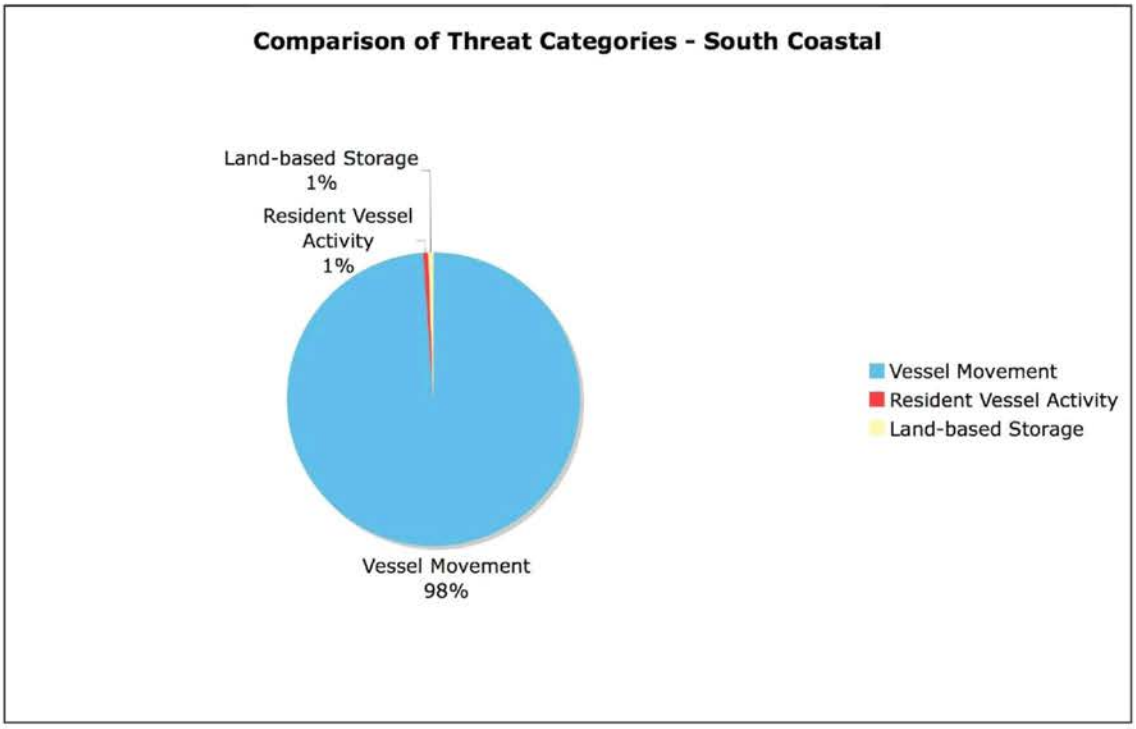


Figure 5.29 Comparative Oil Spill Threat Levels within South Coastal Region by Threat Category



[35] All values in table should be multiplied by a factor of 1,000.

5.3 Summary of Regional Oil Spill Threats by Region

The aggregated data for oil spill threat factors by region provides some insight into how oil spill threats compare across region both overall and by threat factor, and also provide some relative measure of the magnitude of various threats within each region. Figure 5.30 compares the GPE for all threat factors for all five regions. This graph shows that The Boston Harbor region has the two highest GPE levels, for tanker activity and transit volume. Because of the overlap between these two measures at the regional level, this threat can be considered as a single exposure. Still, it shows that tank vessel movements in and out of the Boston Harbor region present the single largest quantity of exposure for any activity in any region of the state. Moreover, vessel transit activity represents the single highest exposure level for the other four regions as well, with the second highest regional level in the Cape and Islands.

The total exposure to petroleum from vessel transits and tanker activity is so much higher than all other threat factors that it is difficult to see much beyond that threat in Figure 5.30. To look further, Figure 5.31 displays the same data with the exception of the tanker and vessel transit estimates. This shows clearly that regulated tanks comprise the second largest regional exposure, with the highest level in the Boston Harbor region, followed by the North Shore.

The third largest threat factor in terms of regional threat is from nontank vessels, with the highest regional exposure again in the Boston Harbor region, followed by the South Coastal, North Shore, and Cape and Islands (see Figure 5.32). After nontank vessel activity, fishing fleets account for the fourth highest exposure threat, particularly in the South Coastal Region and the North Shore (see Figure 5.33). After fishing vessels, recreational and charter vessels seem to pose the fifth largest overall exposure level, most prominently in the Cape and Islands and South Coastal Regions.

Since the Boston Harbor region accounts for the highest threat level of all regions for the four largest threat factors, Boston Harbor data is excluded from Figure 5.34, as is data for the top four threat factors. This shows the relative threat of the remaining six low magnitude threat factors for the other four regions of the state on a more meaningful scale, and shows that the South Coastal region has the highest exposure to these "lower magnitude" threats, followed by the North Shore.

Figure 5.30 Comparison of Estimated Gallons of Petroleum Exposure (000)[36] for all Threat Factors Across Regions

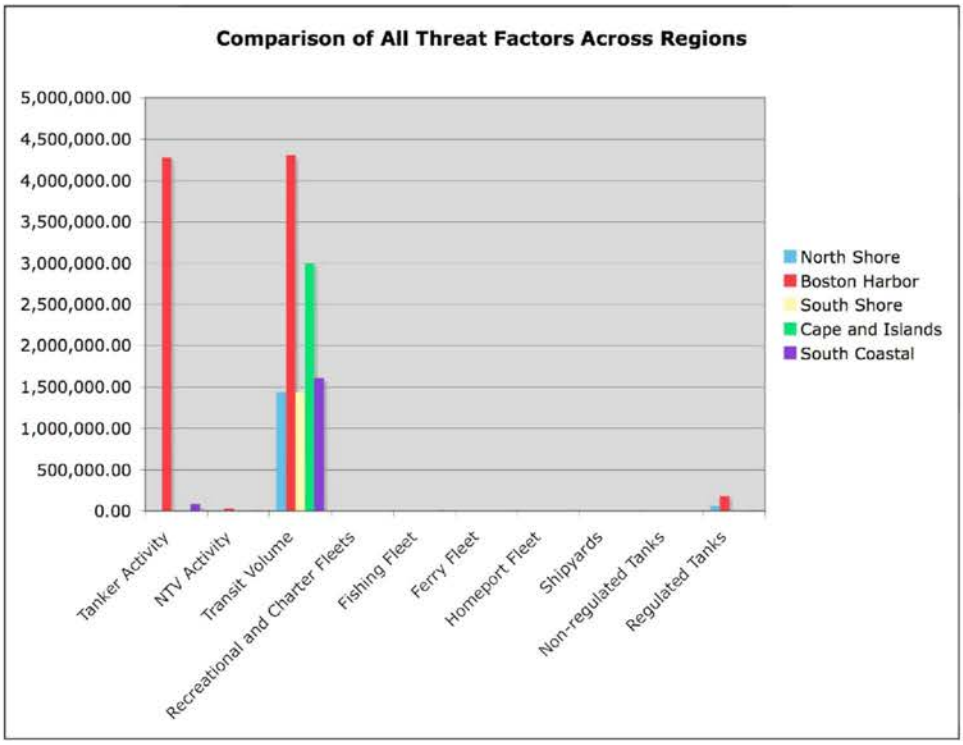
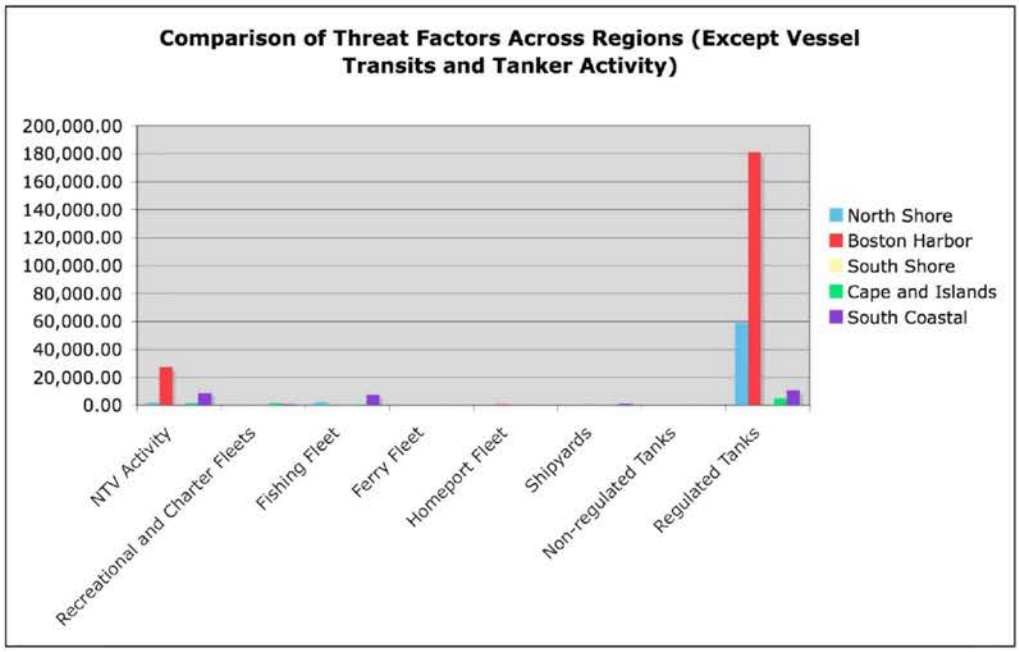


Figure 5.31 Comparison of Estimated Gallons of Petroleum Exposure (000)[37] for all Threat Factors Across Regions, Excluding Transit Volume and Tanker Activity



[36] All values in table should be multiplied by a factor of 1,000.
[37] All values in table should be multiplied by a factor of 1,000.

Figure 5.32 Comparison of Estimated Gallons of Petroleum Exposure (000)[38] for all Threat Factors Across Regions, Excluding Transit Volume, Tanker Activity, and Regulated Tanks

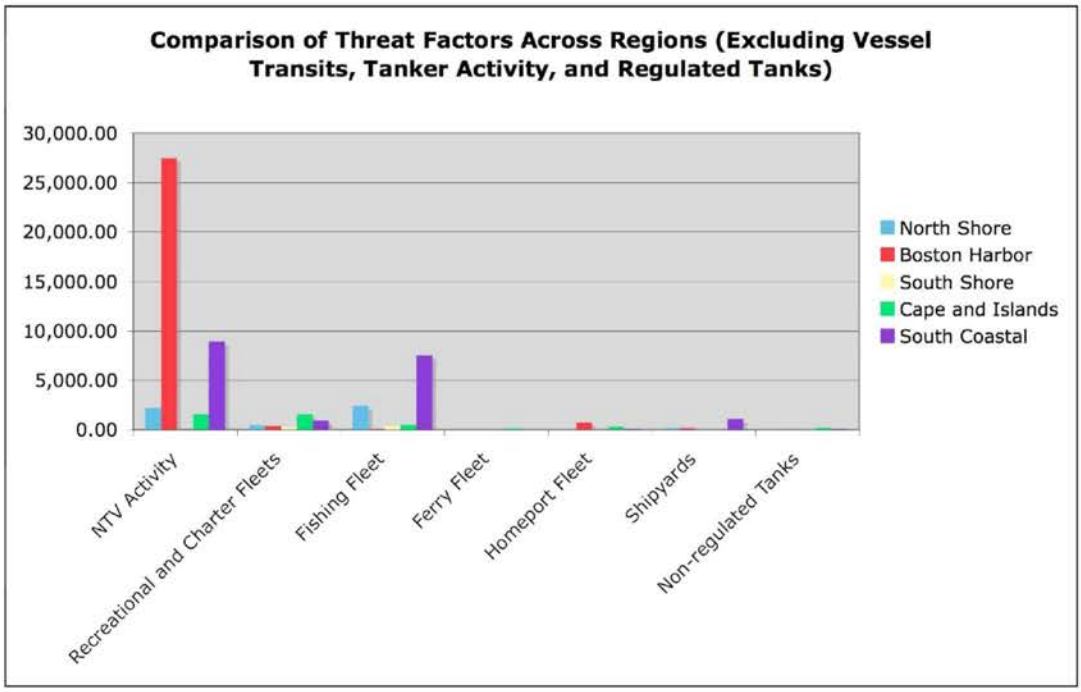
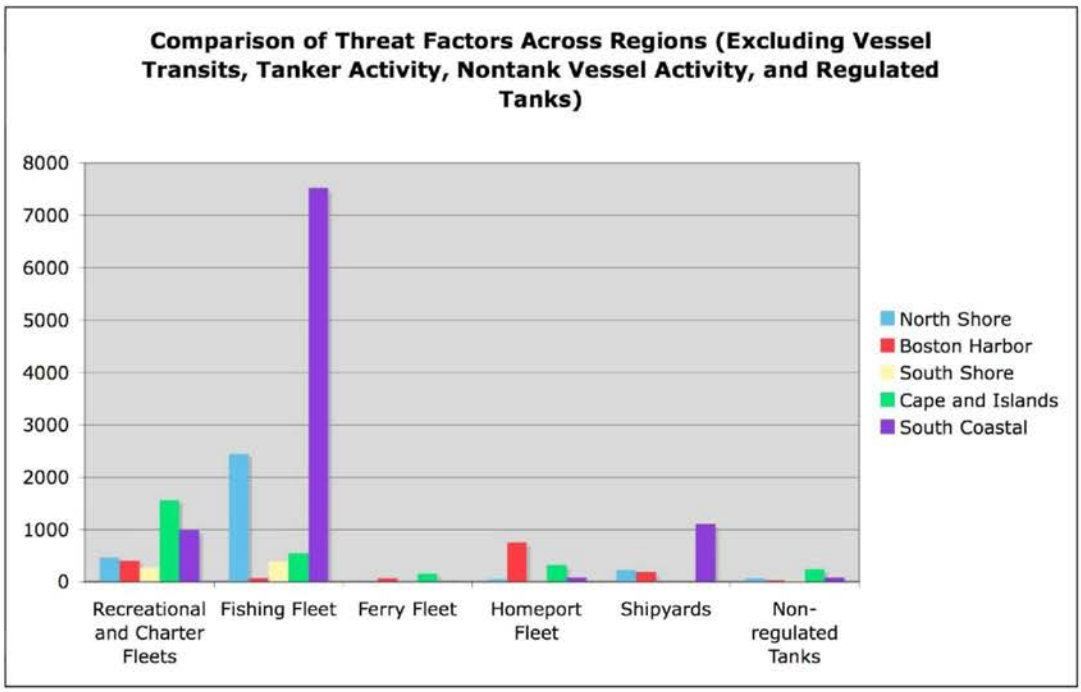
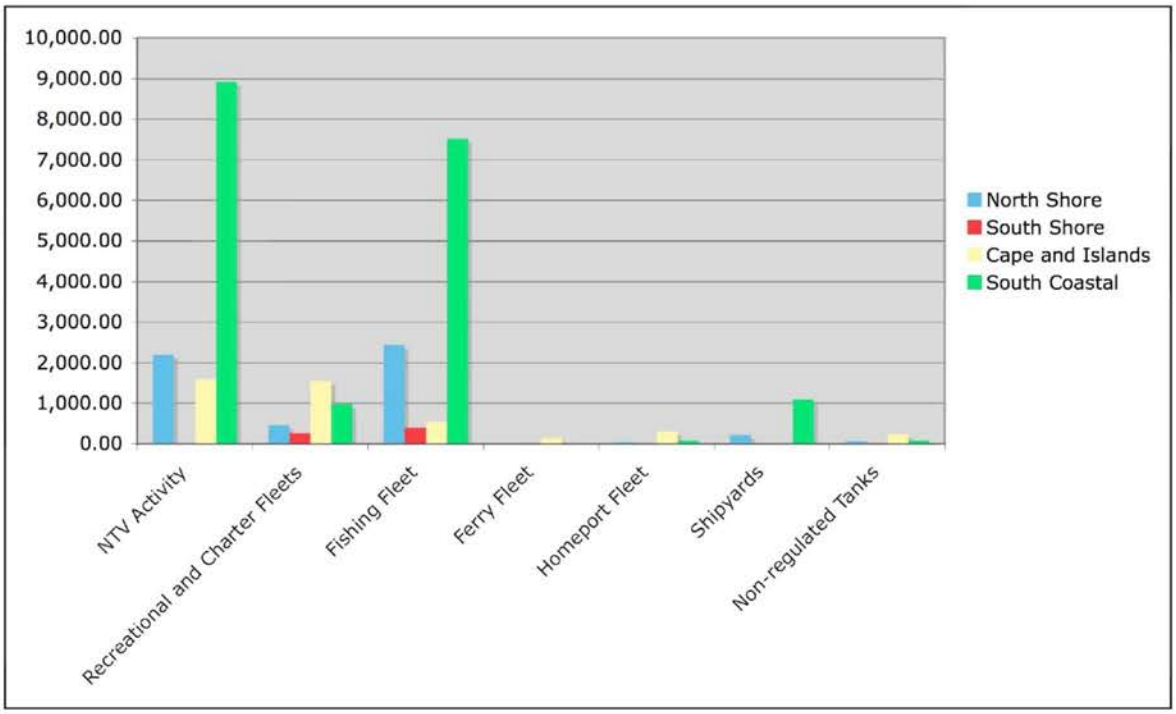


Figure 5.33 Comparison of Estimated Gallons of Petroleum Exposure (000)[39] for all Threat Factors Across Regions, Excluding Transit Volume, Tanker Activity, Nontank Vessel Activity, and Regulated Tanks



[38] All values in table should be multiplied by a factor of 1,000.
[39] All values in table should be multiplied by a factor of 1,000.

Figure 5.34 Comparison of Estimated Gallons of Petroleum Exposure (000)[40] for all Threat Factors Across Regions, Excluding All Data for Boston Harbor Region and Excluding Transit Volume, Tanker Activity, Nontank Vessel Activity, and Regulated Tank Data for Other Regions



[40] All values in table should be multiplied by a factor of 1,000.

6 Discussion

This study was conducted to identify, measure, and compare oil spill threats to coastal Massachusetts. This analysis is more informal and qualitative than a comprehensive risk assessment, and represents a "snapshot" measurement of various factors that may contribute to the overall threat of an oil spill occurring. This report provides specific details about the data sources and data sets developed, in the interest of encouraging future studies to build on this effort.

While none of the observations in this report should be interpreted as absolute measure of oil spill risk, they are still extremely useful in that they provide a methodical approach to identifying and estimating how various types of activities contribute to the overall threat of marine oil spills, and identifying differences and similarities in these threat factors across geographic areas.

Sections 2 and 3 of this report described the types of threat factors considered for this study and Sections 4 and 5 compiled and analyzed data describing each factor by harbor, municipality, and region. Three general categories were used to distinguish threat types – vessel movement, resident vessel fleets, and land-based storage. Across the board, the oil spill threat from vessel movement was much higher in terms of gallons of petroleum exposure than any other source. This is largely attributable to the fact that tank vessels moving through shipping channels and in and out of harbors (primarily the Port of Boston) represents the single largest exposure to oil by quantity. A typical tank vessel can carry millions of gallons of petroleum onboard, compared to hundreds of thousands on a large nontank vessel and thousands to tens of thousands on a large fishing or recreational vessel.

These differences in scale highlight the need to look closely at the data for each threat type, harbor, town, and region. While the total threat exposure from all other factors combined does not approach the vessel transit threat level, there are other reasons to consider these lower magnitude exposures in attempting to interpret overall spill threats and to allocate planning and resources accordingly.

6.1 High Threat Activities

The highest total exposure to oil spill threats comes from tank vessel activity and vessel transits in shipping lanes. Land-based storage in regulated tanks is the second largest regional exposure. The third largest threat factor is nontank vessel activity. After nontank vessel activity, fishing fleets account for the fourth highest exposure threat. After fishing vessels, recreational and charter vessels seem to pose the fifth largest overall exposure level.

6.2 Geographic Areas of Concern

Sections 4 and 5 of this report describe the relative threat levels for coastal oil spills at the harbor and regional levels. These analyses show that by far the highest level of exposure to oil spill threats occurs in the Boston Harbor region, due to the high level of tank vessel activity and the concentration of bulk storage facilities in the Port of Boston. After Boston Harbor, the Cape and Islands region has the second highest total exposure to oil spill threats. The

South Coastal, North Shore, and South Shore regions all have comparable levels of overall exposure, although the composition and relative contributions of threat factors varies in each region.

At the harbor level, Boston Harbor, New Bedford Harbor and Great Harbor (Woods Hole) are the only three harbors that ranked among the highest exposure to both high magnitude threats (tankers, NTV, transits and regulated storage) and low magnitude threats (resident vessel fleets and locally regulated tanks). High magnitude threats were most prevalent in Boston Harbor's harbors, followed by the Cape and Islands, North Shore, and South Coastal regions. None of the South Shore harbors had a significant concentration of high magnitude threat factors.

Ten of the twenty-four harbors with high levels of exposure to low magnitude threat factors are located in the Cape and Islands region, although the harbor with by far the highest level of exposure to lower magnitude threats is New Bedford, in the South Coastal Region. Gloucester Harbor had the second highest level of exposure to low magnitude threats. Other harbors with high levels of exposure for low magnitude threats were Boston, Nantucket, Hyannis, and Plymouth.

6.3 Considerations in Interpreting the Gallons of Petroleum Exposure Estimates

6.3.1 Temporal Considerations

As discussed earlier in this report, the GPE measurement does not account for temporal distribution of oil spill threats. In other words, although the total amount of oil transported by tank vessel is highest compared to all other threat factors, this estimate reflects and annual total and not a daily average. So there is some degree of artificiality in comparing a threat such as vessel transit volume, which can vary considerably over time and is never all present in one area at one time, with a threat such as land-based fuel storage, which is more constant (although storage volumes also fluctuate over time). Neither threat factor attempts to allocate the threat exposure by season, despite the fact that both the volume of vessel transits and the volume of oil stored in land-based tanks may be much higher in winter because of the widespread use of home heating oil in this region.

Similar seasonal variations affect other threat factors. Commercial fishing vessels, which are the single largest contributor to total threat exposure from resident vessel activity, vary their operations based on which fisheries they are targeting. Recreational and homeport vessels are typically only present during the summer boating season, and most are dry-docked through the colder months. Therefore, the total exposure to a spill from resident vessels will vary considerably over the course of a year depending on which fishing vessel are in port, and the level of recreational boating activity.

6.3.2 Oil Type Not Considered

The type of oil transported or stored is not factored into this analysis, yet the type of petroleum product is an important consideration in planning for and

responding to oil spills. The data sets for tank vessel activity and land-based storage (both regulated by EPA and locally regulated) contain some information about types of oil stored and transported, but this information was not consistent enough to allow for analysis across data sets. Types of petroleum stored and transported include gasoline, marine diesel, aviation fuel, home heating oil, and intermediate to heavy fuel oils. Future analyses could look more closely at fuel types in order to consider potential response scenarios and planning needs.

6.3.3 Exposure Does Not Equal Risk

In this study, the measurement of gallons of petroleum exposure by region and threat type presumes that every gallon of oil has the same likelihood of spilling. In the real world, this is not the case. Mitigation and prevention measures such as secondary containment at tank farms, double hulls on tank vessels, or transfer procedures at marine terminals may reduce the likelihood of a spill occurring, and/or reduce the total amount spilled in the case that a spill does occur. A quantitative risk assessment would take into considerations these types of factors; this study does not.

This study estimates total exposure by aggregating and comparing the total storage amounts across type of threat and geographic area. While this study uses gallons of petroleum exposure as a unit of measure to estimate and compare spill threats, these gallon measurements should not be confused with a worst case spill size for a single event. It is important to recognize that the aggregation of total volumes within each threat factor means that the GPE estimates far exceed a worst case discharge estimate. For example, the 8.8 billion GPE estimate for the Boston Harbor region does not mean that an 8.8 billion gallon oil spill should be expected or planned for in this region.

6.4 Assessment of Spill Threat Levels Compared to Equipment Stockpiles

A separate study done in parallel to this Threat Evaluation, the *Inventory and Assessment of Marine Oil Spill Response Resources in Massachusetts and New England States* (Equipment Inventory) considered the comparative stockpiles of oil spill response equipment by region, and found that the overwhelming majority of skimmers, skimming systems, and temporary storage capacity in Massachusetts is concentrated in the Boston Harbor region. The inland region has a small stockpile of skimming systems, but otherwise all other regions of the state have virtually no recovery or storage capacity.

The distribution of boom statewide is more even, with the highest percentage of all types of boom combined in the Boston Harbor region, followed closely by the Cape and Islands. Boston Harbor has the highest concentration of larger boom suitable for open water response. Calm water boom is more evenly distributed, with the highest concentration in the Cape and Islands region, followed by Boston Harbor, the North Shore, South Coastal, South Shore, and Inland regions.

Interestingly, the two regions of the state with the highest threat exposure also have the highest overall equipment levels. However, in looking at those specific

communities and harbors with the highest threat exposure, outside of Boston Harbor there are limited response resources with the exception of calm water (up to 18 inch) boom. In considering those harbors with the highest total exposure (combined GPE by harbor, see Figure 4.14), all have state spill response trailers within their town, containing 1,000 feet of calm water boom. Some harbors are in close proximity to several state response trailers. However, beyond the hard boom, sorbents, and associated equipment in the trailers, there are no significant stockpiles in several of the highest risk harbors, including Gloucester, Woods Hole, and New Bedford. While the oil boom is useful for initial containment or protection, skimming systems and temporary storage devices are needed to recover spilled oil. Adding such capacity to some of the highest risk harbors might improve the likelihood of successful spill response and reduce overall impacts by cutting down on the time required to transport and deploy these resources.

6.5 Use of Threat Estimates in Other Planning Activities

A common approach to oil spill contingency planning, which is based to some degree on an assessment of overall spill risks, is to consider various categories of oil spill types and to plan accordingly for each type. Two terms are commonly used to differentiate between the types of spills that may occur for a particular operation or region – worst case and average most probable. A worst case event represents the maximum possible spill size based on the total quantity of oil stored in a given location or operation. An average most probably event takes into consideration the source and severity of a spill that is considered most likely to occur, again based on the nature of the operations.

The data collected for this study could be used to estimate the potential magnitude of worst case and/or average most probable oil spills by harbor, municipality, region, and threat factor. For example, a worst case discharge for the South Coastal region from a tank vessel could be estimated as the total capacity of the largest tank vessel transiting through or calling on a local port in that region. The average most probable spill source could be estimated by looking at some of the lower magnitude threats that were most prevalent for a harbor or region. For example, the South Coastal region has the highest exposure to petroleum from the resident fishing fleet; therefore a fishing vessel spill could be used as an average most probably spill scenario in that region. The data collected and analyzed for this study could also be useful to developing scenarios for oil spill drills and exercises.

7 Recommendations

The information and analysis compiled for this study has two broad applications: 1) to facilitate decision-making regarding oil spill prevention and response planning projects in Massachusetts based on relative threat types and concentrations; and 2) provide a foundation for future data collection and analysis. The recommendations in this section address each of these two areas.

7.1 Oil Spill Prevention and Response Planning for Coastal Massachusetts

This study represents the first attempt to measure and assess the types of factors that contribute to oil spill threats for Massachusetts coastal communities and the relative magnitude of these threats statewide, by region, and by harbor. While the presence and size of these threats is only one component of the overall risk picture, it is still useful to directing future planning and prevention efforts.

This study concludes that vessel transits adjacent to coastal communities and tank vessel activity within ports are the two major contributors to the volume of oil present in the state's coastal regions and therefore at risk of spilling. This threat is most significant in the Boston Harbor region, due to the proportionately high level of activity in the Port of Boston compared to the rest of the state. Other harbors with particularly high oil spill threat exposure from all sources, outside of the Port of Boston and surrounding Harbors, are New Bedford, Gloucester, Fall River/Somerset, Sandwich Boat Basin, Great Harbor (Woods Hole), Nantucket, Hyannis, and Plymouth.

Looking beyond the threat from the four high magnitude threat factors (vessel transits, tankers, NTV, and regulated storage), the data showed that every harbor seemed to have its own unique combination of factors. Harbors with large fishing fleets, such as New Bedford and Gloucester, are exposed to relatively high oil spill threats from those resident fleets. Ferry traffic and recreational vessel fleets contribute to oil spill threats in many of the Cape and Islands harbors. This next level of granularity is important to consider because it emphasizes the fact that there is a great deal of local variation by harbor, by waterbody, and by region. Thus, it is important incorporate local considerations and expertise in the oil spill planning process and to tailor prevention programs to address localized risks.

After the Boston Harbor Region, the Cape and Islands has the next highest overall threat exposure, with the other three regions at comparable total levels. While the state has been divided into five regions for the purpose of oil spill planning projects and equipment allocation, it is important to also consider that waterbody distinctions seem to impact oil spill threat levels more so than regional designations. This is particularly evident in the Cape Cod region, where threat levels from vessel transits in particular vary significantly by waterbody.

Specific recommendations for allocation of oil spill prevention and planning projects are:

- Tailor prevention activities to the highest-exposure locations and activities.

  - Continue with efforts such as escort tugs that would provide an immediate response/mitigation asset for vessel transits.
  - Ensure that adequate equipment is available and GRPs are in place for areas adjacent to harbors with the highest exposure to oil spill threats.
  - Ensure that adequate equipment is available and GRPs are in place for areas that could be impacted by a spill from land-based EPA regulated storage facilities. Review Facility Response Plans to assess the level of planning in place.
  - Develop GRPs for Boston Harbor region.
- Enhance response capacity and spill preparedness in highest-exposure locations.
  - Consider developing additional tactical spill response plans for highest exposure harbors, to supplement GRPs.
  - Supplement oil spill response equipment in high-exposure harbor areas (i.e. additional boom, larger boom, skimming equipment).
  - Develop harbor or town-level oil spill response action plans that define responsibilities and initial response priorities. Engage harbormasters and port authorities in oil spill prevention and response planning programs. Encourage oil spill response planning within Harbor Management Plans to address the specific threats associated with each harbor.
  - Develop regional plans that consider how responders and equipment will come together for a spill that impacts multiple harbors and towns in regions with high threat exposure.
  - Develop oil spill response scenario analyses for high-exposure harbors to work through the amount of resources that might be required to respond to a worst case and average most probable discharge and estimate the timeline for mobilization and deployment of the necessary resources.
- Consider diversifying equipment stockpiles to enhance overall response capability (see discussion and conclusions in Equipment Report). Also assess adequacy of equipment stockpiles through scenario analyses.
- Identify opportunities for outreach and education to encourage awareness of oil spill threats from resident vessel fleets.

7.2 Building on this Study

The process of collecting and compiling data for this study highlighted a number of gaps in data quality or availability. Many of these issues are attributable to the fact that the organizations and agencies that compile the data needed for this study do not necessarily do so from a perspective of oil spill planning or analysis. For example, the EPA Facility Response Plan database did not identify total storage by facility, which would have made the analysis of EPA regulated tank farms much easier. Similarly, vessel transit data sets use different measurements and do not cover all waterbodies of the state. AIS data is not publicly available and must be purchased at a considerable cost.

Historical spill data was also problematic, to the degree that it was not included in this study. While information on historical spill occurrences is commonly used to assess future spill risks, this study found that data sets maintained by both the U.S. Coast Guard and MassDEP were incomplete. There were also discrepancies in how data was recorded within MassDEP in different response regions. Standardization of data fields such as spill type, source, location, size, etc. would benefit future analyses. The State of Washington has developed a model for oil spill data keeping that could be adapted in Massachusetts. Efforts are underway to improve historical spill databases at the state and federal level. If efforts to improve and standardize oil spill recordkeeping are successful, then data on historical oil spill occurrences could be factored into future analyses. Once a comprehensive set of historical spill data is established, annual reports could be generated to identify trends in oil spill occurrences and to evaluate the impact of planning and prevention measures.

In addition to the ten threat factors included in this study, several other factors that may contribute to oil spill threats were identified but were not included in this study due to limits on available data and other practical constraints. Future analyses could take into consideration additional threat factors such as vessel refueling from tanker trucks, location of bridges or roadways where tanker truck accidents could impact coastal waters, and vessel refueling from harbor barges.

The data compiled for this study was done so in a manner that would make it relatively easy to revisit and update the study periodically. Continued data compilation would allow for future analyses to look at trends and changes in threat factors, and to assess threats based on a more mature data set. It would also allow for new threats – such as changes to vessel traffic in North Shore ports with new LNG developments or addition of offshore wind farms as proposed by Cape Wind.

Finally, it is important to clarify that the threats measured in this study are only one component of the overall risk equation. Risk is broadly defined as probability times consequence. This study uses a gross measurement of whether or not oil is present in order to estimate the likelihood of a spill occurring. The threat factors identified in this study inform on both components of the risk equation, but they do not provide a definitive estimate of risk. Future studies could consider other components of the risk equation – such as probability of spills from various sources or vulnerability to oil spill impacts.

Specific recommendations for building on this study are:

- Encourage agencies and organizations that compile the data used in this study to update databases and record-keeping to standardize measurements and facilitate future analyses of oil spill threats.
- Improve data recording and management practices for historical oil spill databases by standardizing data fields within and across agencies, with the goal of developing a data set that could be analyzed for trends in oil spill occurrences.
- Continue to populate the data sets developed for this report, and periodically review and analyze.
- Acquire and analyze AIS data.

- Consider additional oil spill threat factors such as:
    - Vessel refueling from tanker trucks
    - Potential for spills from tanker trucks on roads or bridges
    - Vessel refueling from harbor barges
    - Other new or emerging threats (LNG activities, Cape Wind, etc.)
- Investigate other factors related to overall spill risks such as probabilities of spill occurrence and vulnerability to spill impacts.
- Use the information in this report as the foundation for a spill risk management program as described in Section 1.4 of this report.

Appendix A – List of Massachusetts Harbors by Region and Waterbody

Region	Waterbody	Town/City	Harbor	#
North Shore	Gulf of Maine	Newburyport/Salisbury	Newburyport/Merrimack River	1
North Shore	Gulf of Maine	Newbury	Parker River	2
North Shore	Gulf of Maine	Rowley	Rowley River	3
North Shore	Gulf of Maine	Ipswich	Ipswich River	4
North Shore	Gulf of Maine	Essex	Essex Bay	5
North Shore	Gulf of Maine	Rockport	Rockport Harbor	6
North Shore	Massachusetts Bay	Gloucester	Gloucester Harbor	7
North Shore	Massachusetts Bay	Manchester	Manchester Harbor	8
North Shore	Massachusetts Bay	Beverly/Danvers	Beverly Harbor/Danvers River	9
North Shore	Massachusetts Bay	Salem	Salem Harbor	10
North Shore	Massachusetts Bay	Lynn	Lynn Harbor	11
North Shore	Massachusetts Bay	Marblehead	Marblehead Harbor	12
North Shore	Massachusetts Bay	Nahant	Nahant Harbor	13
North Shore	Massachusetts Bay	Revere	Pines River/Saugus River	14
Boston Harbor	Massachusetts Bay	Winthrop	Winthrop Harbor	15
Boston Harbor	Massachusetts Bay	Boston/Chelsea/Everett	Boston Harbor	16
Boston Harbor	Massachusetts Bay	Boston	Dorchester Bay	17
Boston Harbor	Massachusetts Bay	Quincy	Neponset River	18
Boston Harbor	Massachusetts Bay	Quincy	Quincy Bay	19
Boston Harbor	Massachusetts Bay	Quincy	Town River Bay	20
Boston Harbor	Massachusetts Bay	Braintree/Weymouth	Fore River	21
Boston Harbor	Massachusetts Bay	Weymouth	Back River	22
South Shore	Massachusetts Bay	Hingham	Hingham Harbor	23
South Shore	Massachusetts Bay	Hingham	Weir River	24
South Shore	Massachusetts Bay	Hull	Allerton Harbor	25
South Shore	Cape Cod Bay	Cohasset	Cohasset Harbor	26
South Shore	Cape Cod Bay	Scituate	Scituate Harbor	27
South Shore	Cape Cod Bay	Scituate	North River	28
South Shore	Cape Cod Bay	Marshfield	Green Harbor	29
South Shore	Cape Cod Bay	Duxbury	Duxbury Harbor	30
South Shore	Cape Cod Bay	Kingston	Kingston Bay/Jones River	31
South Shore	Cape Cod Bay	Plymouth	Plymouth Harbor	32
Cape and Islands	Cape Cod Bay	Sandwich	Sandwich Boat Basin/Esco	33
Cape and Islands	Cape Cod Bay	Sandwich	Sandwich Harbor	34
Cape and Islands	Cape Cod Bay	Barnstable	Barnstable Harbor	35
Cape and Islands	Cape Cod Bay	Brewster	Sesuit Harbor	36
Cape and Islands	Cape Cod Bay	Orleans	Rock Harbor	37
Cape and Islands	Cape Cod Bay	Wellfleet	Wellfleet Harbor	38

Region	Waterbody	Town/City	Harbor	#
Cape and Islands	Cape Cod Bay	Truro	Pamet River	39
Cape and Islands	Cape Cod Bay	Provincetown	Provincetown Harbor	40
Cape and Islands	Atlantic	Orleans	Nauset Harbor	41
Cape and Islands	Atlantic	Orleans	Pleasant Bay	42
Cape and Islands	Atlantic	Chatham	Chatham Harbor	43
Cape and Islands	Atlantic	Chatham	Stage Harbor	44
Cape and Islands	Nantucket Sound	Harwich	Saquatucket Harbor	45
Cape and Islands	Nantucket Sound	Harwich	Wychmere Harbor	46
Cape and Islands	Nantucket Sound	Harwich	Allen Harbor	47
Cape and Islands	Nantucket Sound	Dennis	Dennis Port/Herring River	48
Cape and Islands	Nantucket Sound	Dennis/Yarmouth	Bass River	49
Cape and Islands	Nantucket Sound	Barnstable	Hyannis Harbor/Lewis Bay	50
Cape and Islands	Nantucket Sound	Barnstable	Centerville /Hyannis Port	51
Cape and Islands	Nantucket Sound	Barnstable	West Bay	52
Cape and Islands	Nantucket Sound	Barnstable	Cotuit Bay	53
Cape and Islands	Nantucket Sound	Mashpee	Popponesset Bay	54
Cape and Islands	Vineyard Sound	Falmouth	Waquoit Bay	55
Cape and Islands	Vineyard Sound	Falmouth	Eel Pond	56
Cape and Islands	Vineyard Sound	Falmouth	Bourne Pond	57
Cape and Islands	Vineyard Sound	Falmouth	Green Pond	58
Cape and Islands	Vineyard Sound	Falmouth	Great Pond	59
Cape and Islands	Vineyard Sound	Falmouth	Falmouth Harbor	60
Cape and Islands	Nantucket Sound	Nantucket	Nantucket Harbor	61
Cape and Islands	Nantucket Sound	Nantucket	Madaket Harbor	62
Cape and Islands	Vineyard Sound	Edgartown	Edgartown Harbor	63
Cape and Islands	Vineyard Sound	Oak Bluffs	Oak Bluffs Harbor	64
Cape and Islands	Vineyard Sound	Tisbury	Vineyard Haven Harbor	65
Cape and Islands	Vineyard Sound	Aquinnah/Chilmark	Menemsha Creek	66
Cape and Islands	Buzzards Bay	Gosnold	Cuttyhunk Harbor	67
Cape and Islands	Buzzards Bay	Gosnold	Hadley Harbor	68
Cape and Islands	Vineyard Sound	Falmouth	Little Harbor	69
Cape and Islands	Buzzards Bay	Falmouth	Great Harbor (Woods Hole)	70
Cape and Islands	Buzzards Bay	Falmouth	Quissett Harbor	71
Cape and Islands	Buzzards Bay	Falmouth	West Falmouth Harbor	72
Cape and Islands	Buzzards Bay	Falmouth	Wild Harbor	73
Cape and Islands	Buzzards Bay	Falmouth	Fiddlers Cove	74
Cape and Islands	Buzzards Bay	Falmouth	Rands Harbor	75
Cape and Islands	Buzzards Bay	Bourne/Falmouth	Squeteague Harbor	76
Cape and Islands	Buzzards Bay	Bourne	Red Brook Harbor	77
Cape and Islands	Buzzards Bay	Bourne	Pocasset Harbor	78

Region	Waterbody	Town/City	Harbor	#
Cape and Islands	Buzzards Bay	Bourne	Pocasset River	79
Cape and Islands	Buzzards Bay	Bourne	Phinneys Harbor/Back River	80
Cape and Islands	Buzzards Bay	Bourne/Wareham	Buttermilk Bay	81
South Coastal	Buzzards Bay	Wareham	Onset Harbor	82
South Coastal	Buzzards Bay	Wareham	Wareham Harbor	83
South Coastal	Buzzards Bay	Marion/Wareham	Weweantic River	84
South Coastal	Buzzards Bay	Marion	Sippican Harbor	85
South Coastal	Buzzards Bay	Mattapoisett/Marion	Aucoot Cove	86
South Coastal	Buzzards Bay	Mattapoisett	Mattapoisett Harbor	87
South Coastal	Buzzards Bay	Mattapoisett	Brant Island Cove	88
South Coastal	Buzzards Bay	Fairhaven	Nasketucket Bay	89
South Coastal	Buzzards Bay	New Bedford/Fairhaven	New Bedford Harbor	90
South Coastal	Buzzards Bay	New Bedford	Clarks Cove	91
South Coastal	Buzzards Bay	Dartmouth	Apponagansett Bay	92
South Coastal	Buzzards Bay	Westport	Westport River	93
South Coastal	Mount Hope Bay	Fall River/Somerset	Port of Fall River/Taunton River	94
South Coastal	Mount Hope Bay	Swansea	Lee River	95

Appendix B Fire Chief Survey

Survey of Fire Departments for Massachusetts Department of Environmental Protection Coastal Oil Spill Risk Evaluation Project

April, 2008

Please complete and return survey by April 18, 2008.
Please send the completed survey and any additional information you would like to provide to:

E-mail: sierra@nukaresearch.com
Fax: (240) 368 7467
Post: Nuka Research and Planning Group
PO Box 1672, Plymouth, MA 02362

Any questions? Please contact Sierra Fletcher
E-mail: sierra@nukaresearch.com
Phone: (207) 841 0604

The Massachusetts Department of Environmental Protection (MassDEP) has contracted Nuka Research and Planning Group, LLC. to evaluate oil spill risks in all Massachusetts coastal communities (MassDEP Project # 101300).

Project Background
The 2004 Massachusetts Oil Spill Prevention and Response Act mandated the MassDEP to implement "lessons learned" from the oil spill that took place in Buzzards Bay in 2003. In 2007, MassDEP developed an interim implementation plan. One of the major tasks of this plan is to conduct an oil spill risk evaluation that will serve as the basis for prioritizing future equipment and training deliveries and Geographic Response Plan development.

Survey of Fire Chiefs
Nuka Research is surveying fire chiefs in coastal communities to identify fuel storage locations and existing oil spill response equipment. We are also surveying harbormasters and gathering data from state and federal agencies about fuel storage, fuel transfers, and vessel traffic.

This survey has 9 questions. You will be asked for information about the petroleum storage facilities (besides gasoline) located within 150 yards of tidal waters and any oil spill response equipment the Department owns. *Please feel free to send any of this information in a separate document to the contact points above, if this is more convenient for you.*

Questions

Please write your name and the name of your town.

1. For how many years have you been in service there?

2. Does your town/city have fuel storage facilities within 150 yards of tidal waters? If the answer is "no," please skip to Question 6.

3. Please complete the following table *only for tanks within 150 yards of the coast. Do not include tanks that contain gasoline or LNG.* **If you already have this information in a separate document, please feel free to send it that way.**

You may use as many rows as necessary. See example.

Name & Location of storage site	Type of Product Stored	Total storage (tank sizes, number tanks)	Other information
Jim Bob's marina Street Address	Marine Diesel	30,000 gal (3 x 10k tanks)	Amount of fuel stored is less than half total capacity in winter
Big Guy fuel terminal Street Address	#2 Home heating oil	200,000 (2 x 100k tanks)	Fully lined secondary containment

Page 2 of 3

4. Have there been any petroleum spills (excluding gasoline) that have reached water in your town?

5. If there have been spills, when and where have they occurred?

6. Does the fire department own any oil spill response equipment (not counting state spill response trailers)?

7. In your town, **what** do you consider to pose the biggest risk for an oil spill to coastal waters? (i.e. spill from a vessel, truck rollover spilling into a stream, fuel storage facility, offshore traffic, etc.)

8. Why do you consider this to be the biggest risk? (i.e., amount of product involved, frequency or congestion of activities, past spills, etc.)

9. Is there any other information you would like to provide to help us to better understand the risk of marine oil spills and the oil spill response capabilities in your city or town? Please use the space here to add additional comments or information relevant to this study.

Appendix C – Harbormaster Survey

Massachusetts Department of Environmental Protection
Massachusetts Coastal Oil Spill Threat Analysis

Town _____

Harbor _____

Harbor Master _____

Vessels – Recreational/Charter	
How many moorings are in this harbor?	
How many boat slips are in this harbor?	
How many marinas/boatyards in this harbor?	
What is the range of vessel lengths?	

Vessels – Commercial Fishing	
How many commercial fishing vessels moor/dock in this harbor?	
What types of fishing vessels moor in this harbor?	

Vessels – Ferries	
What ferry terminals are located in this harbor?	
What are the size and type of ferry vessels?	

1 of 3

Massachusetts Department of Environmental Protection
Massachusetts Coastal Oil Spill Threat Analysis

Vessels - Other	
What large commercial, research, or training vessels moor in this harbor?	
What is their range in size?	

Non-regulated Tanks	
What are the vessel fueling stations in this harbor?	
What is the size of their storage tanks?	

Petroleum Terminals/Regulated Tank Farms	
What petroleum terminals and regulated tank farms are located in this harbor?	
What is the size of these facilities in total gallons?	

2 of 3

Massachusetts Department of Environmental Protection
Massachusetts Coastal Oil Spill Threat Analysis

Cargo Terminals	
What commercial cargo loading/discharging docks are in the harbor?	
How many vessels load/unload at the dock per year?	

Shipyards	
What large vessel shipyards are located in the harbor?	
How many vessels are serviced in these yards per year?	
What is the range in size of vessels serviced?	

APPENDIX 5

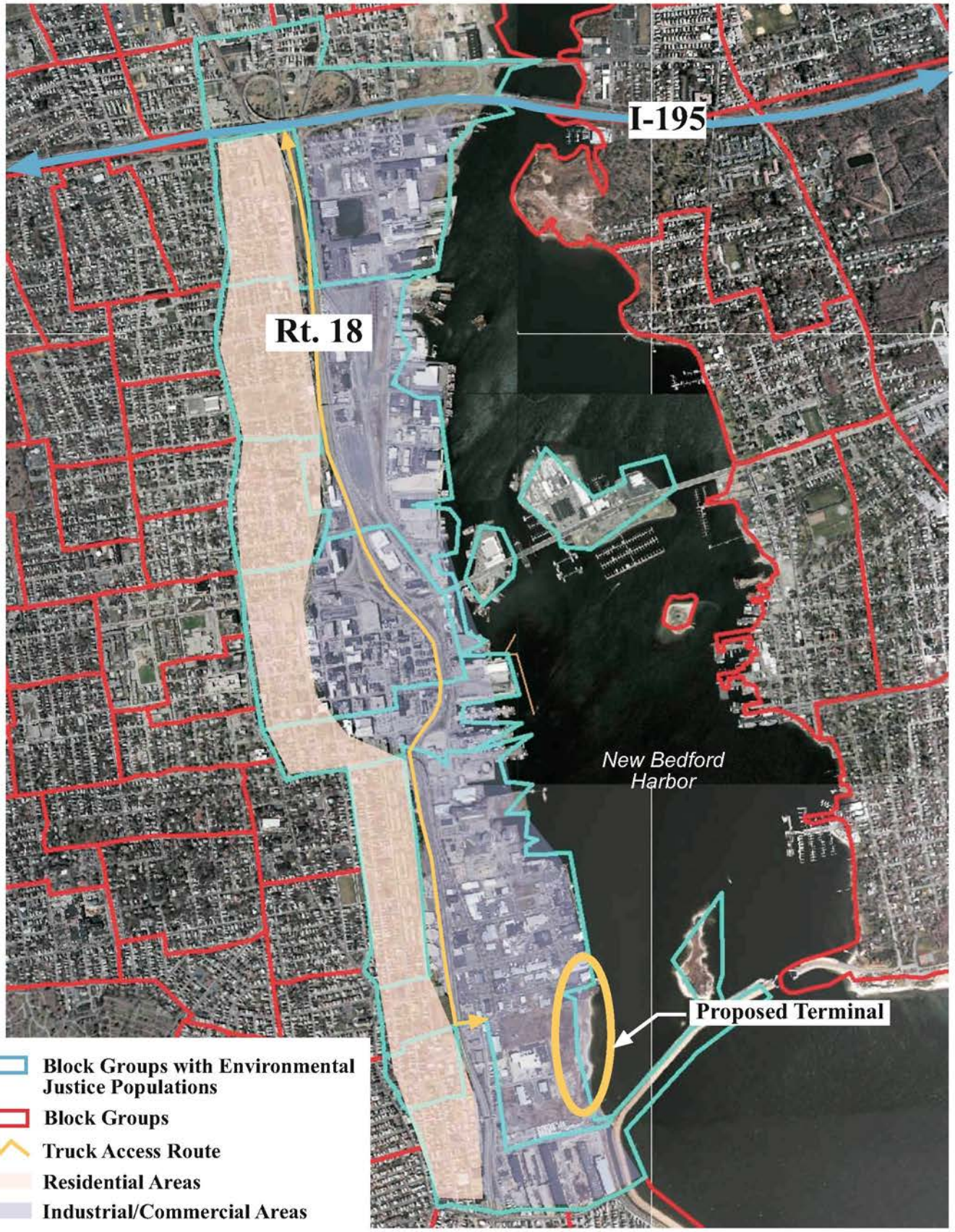
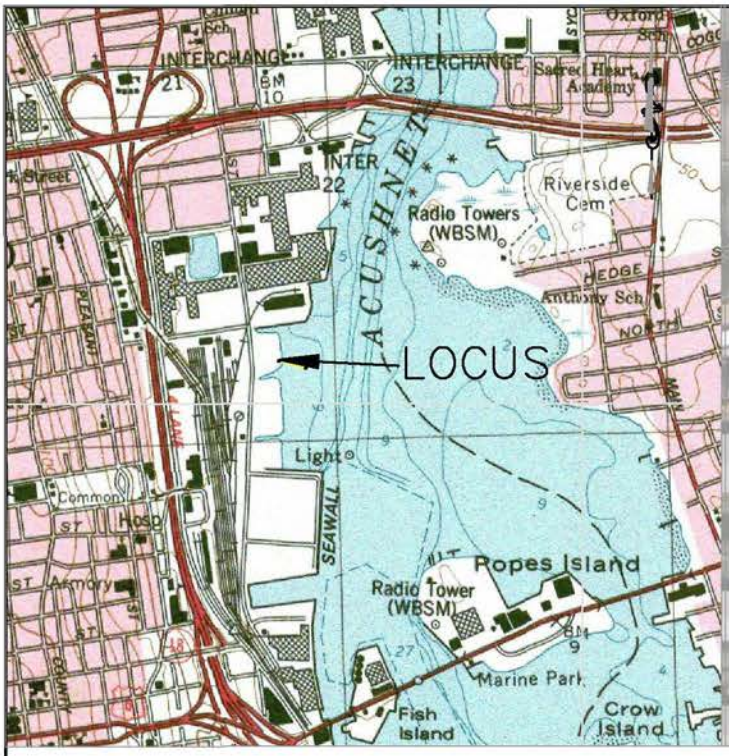


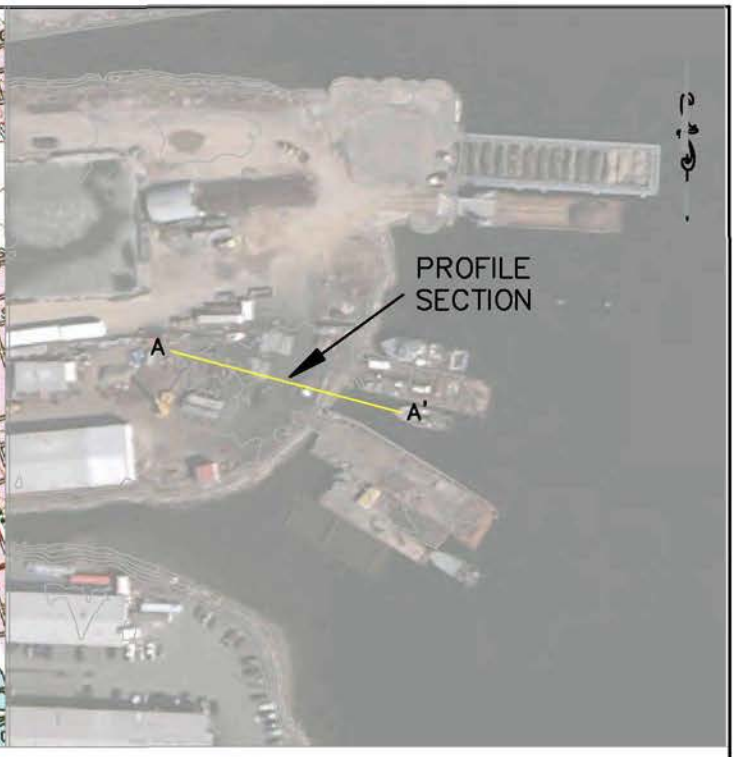
Figure 1

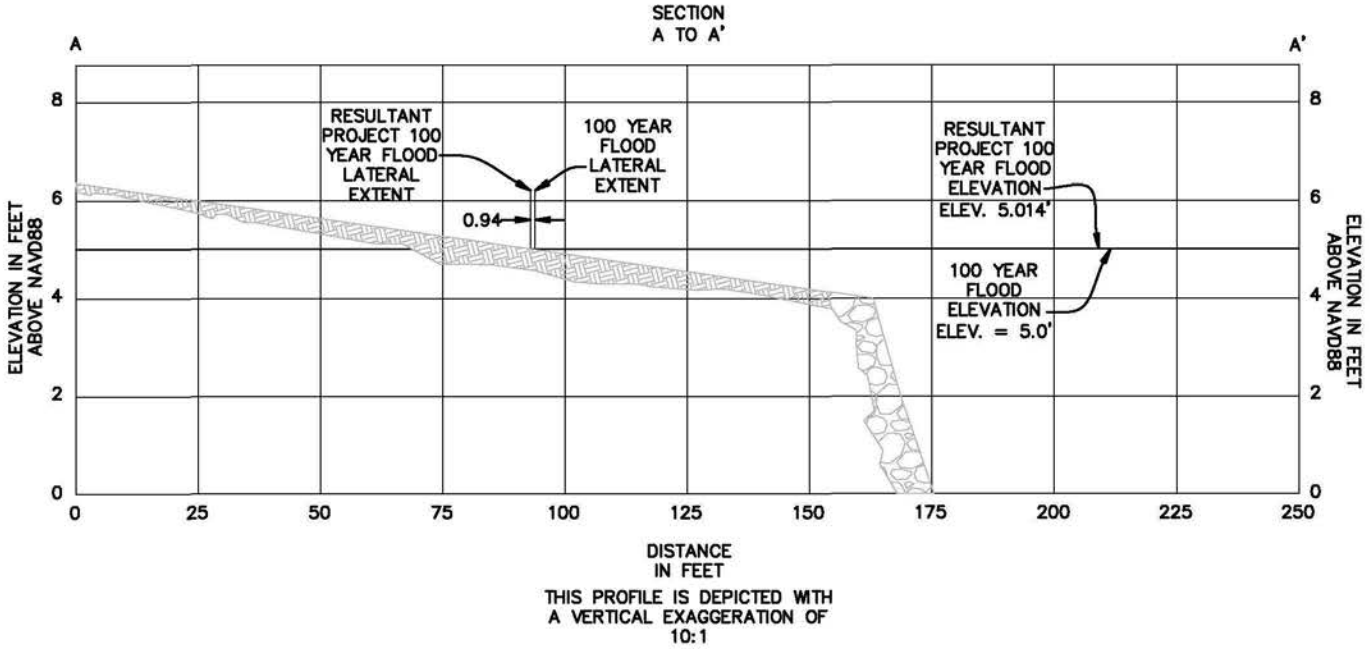
Block Groups Along the Proposed Truck Access Route

source: MassGIS, 2010; U.S. Census 2000

APPENDIX 6







THIS PROFILE IS DEPICTED WITH A VERTICAL EXAGGERATION OF 10:1

Scale: NOT TO SCALE

TYPICAL FLOOD ELEVATION IMPACT COMPARISON

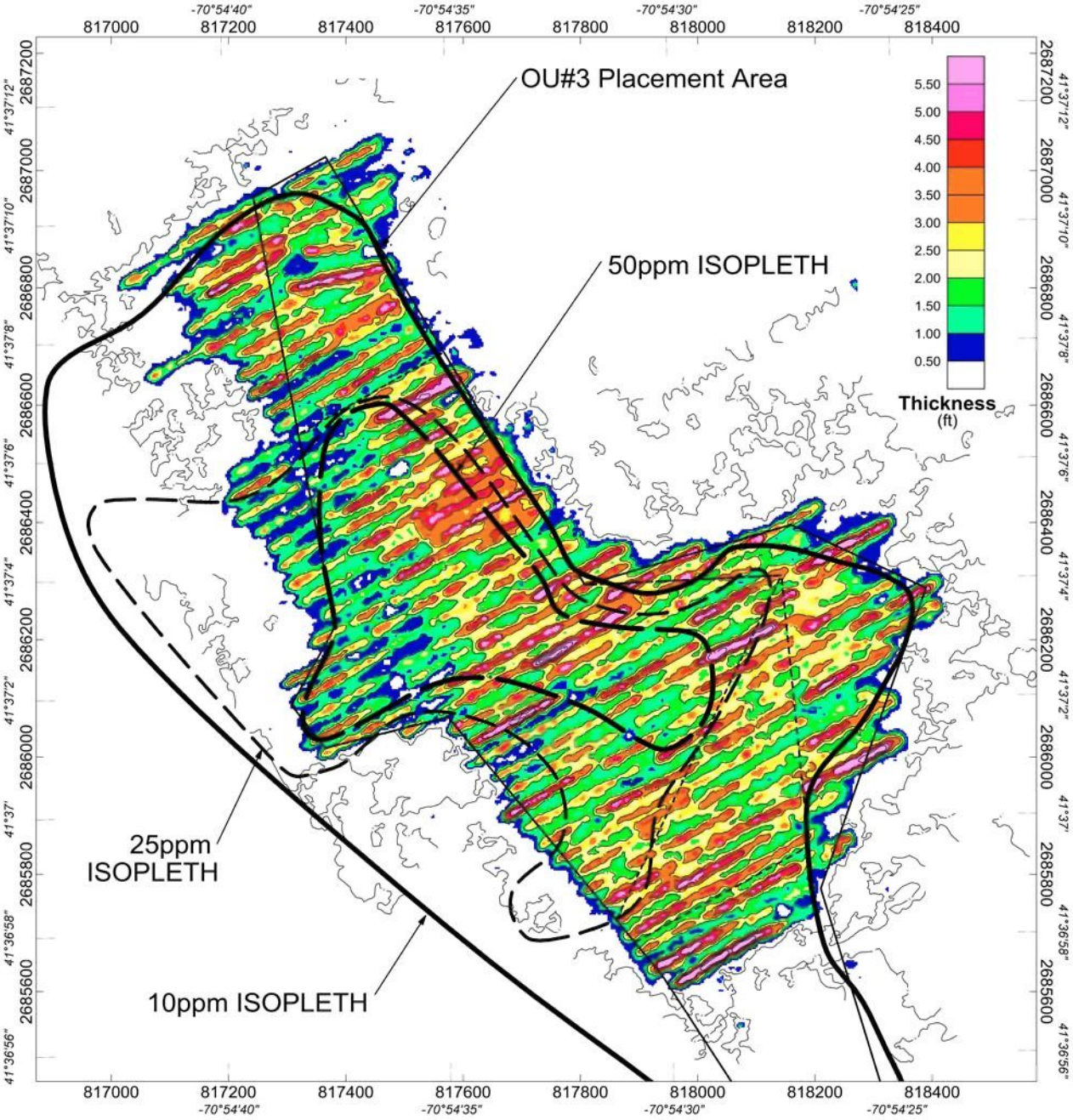
SOUTH TERMINAL CDF NEW BEDFORD, MA

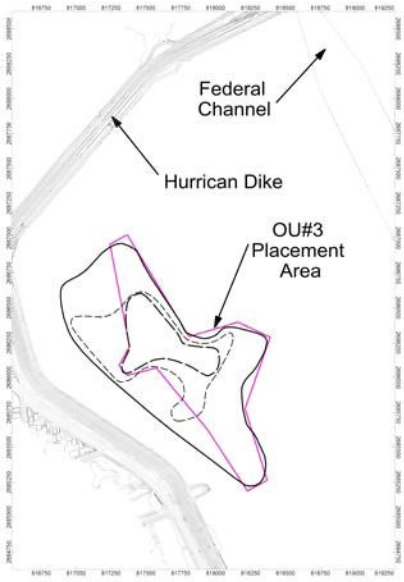
Apex Companies, LLC
1 WAMSUTTA STREET, SUITE 8
NEW BEDFORD, MA 02740
(617) 728-0070
184 HIGH STREET, SUITE 502
BOSTON MA 02110
(617) 728-0070

NEW BEDFORD HARBOR DEVELOPMENT COMMISSION
106 CO-OP WHARF
NEW BEDFORD, MASSACHUSETTS 02740
(508) 961-3000

P:\Jobs\6690 NBH_ Phase IV\PLANS\STERMINAL-AA-XS.dwg

APPENDIX 7





Scale 1:2400

100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 95%
>2-FOOT 65%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 7/26/05. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 7/26/05 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.

2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.

3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.

4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.

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Suite 610
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MA 02210

07/26/05 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Final Placement Surveys

Apex Environmental