RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

Site Name and Location

New Bedford Harbor/Hot Spot Area
New Bedford, Massachusetts

SDMS DocID 000218788

New Bedford
C-4
218788

Statement of Purpose

This Decision Document presents the selected remedial action for this Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), and to the extent practicable, the National Contingency Plan (NCP), 40 CFR Part 300 et seq., 50 Federal Register 47912 (November 20, 1985).

The Commonwealth of Massachusetts concurs with the selected remedy. A copy of the concurrence letter is included as Appendix C.

Statement of Basis

This decision is based on the Administrative Record which was developed in accordance with Section 113 (k) of CERCLA and which is available for public review at the information repositories located at the New Bedford Free Library, in New Bedford, Massachusetts, and at the EPA offices at 90 Canal Street in Boston, Massachusetts. Appendix B to this document identifies the items contained in the Administrative Record upon which the selection of this remedial action is based.

Assessment of the Site

Actual or threatened releases of hazardous substances from this portion of the Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare or the environment.

Description of the Selected Remedy

The selected remedial action for the New Bedford Site/Hot Spot Area is the Hot Spot Operable Unit, the first of two operable units planned for the New Bedford Harbor Superfund Site. The Hot Spot Operable Unit consists of source control measures, which will also control the continuing migration of contaminants from the Hot Spot to other portions of the Site. The major components of the Hot Spot remedial measures include:

- Dredging. Approximately 10,000 cubic yards of contaminated sediments will be removed using a cutterhead dredge. Dredging will occur in the Hot Spot Area at depths of up to four feet to remove sediments with PCB concentrations of 4,000 ppm or greater. Various control options will be used to minimize and control sediment resuspension.

- Transportation and Dewatering. The dredged sediments will be transported to the Pilot Study cove area by a floating hydraulic pipeline, where the sediments will be dewatered. Effluent produced during the dewatering process will be treated to reduce PCBs and heavy metals using best available control technology prior to discharge back into the Harbor.

- Incineration. The dewatered sediments will be incinerated in a transportable incinerator that will be sited at the Pilot Study cove area. The extremely high temperatures achieved by the incinerator will result in 99.9999% destruction of PCBs. Exhaust gases will be passed through air pollution control devices before being released into the atmosphere to ensure that appropriate health and safety and air quality requirements are met.

- Stabilization. Following incineration, the Toxicity Characteristic Leaching Procedure (TCLP), a leaching test, will be performed on the ash to determine if it exhibits the characteristic of toxicity and is, therefore, considered a hazardous waste under the Resource Conservation and Recovery Act (RCRA). If the TCLP test reveals that the ash is a RCRA hazardous waste, the ash will be solidified such that metals no longer leach from the ash at concentrations that exceed the standards set forth for determining the toxicity of a material.

During remedial activities, (solidified) ash will be temporarily stored in an area adjacent to the existing Confined Disposal Facility (CDF), a containment structure built on the New Bedford Harbor shoreline during previous Site studies. Following completion of the remedial activities, the (solidified) ash will be stored in the secondary cell of the CDF. Storage of the treated material will comply with the solid waste requirements. Ultimate disposition of this material will be addressed in the second operable unit for the Site.

Sediment removal and incineration will provide significant progress toward long-term protection of public health and the environment. Incineration is a proven technology that permanently destroys PCBs and is readily implementable for this volume of material. The selected remedy will permanently reduce the mobility, toxicity and volume of PCBs in the Hot Spot and will also reduce the amount of PCBs and heavy metals affecting the remainder of the Harbor. Short-term protection will be

achieved by engineering controls to limit the emission of contaminants during excavation and treatment.

This interim action will comply with levels or standards of control equivalent to legally applicable or relevant and appropriate standards, requirements, criteria, or limitations (ARARs) specific to this action, including but not limited to, operation of the incinerator. However, this interim action will not attain certain levels or standards of control that might be ARARs. This interim remedial action is only part of a total remedial action that will attain ARARs when completed.

Declaration

This interim action is protective of human health and the environment, complies with Federal and State applicable or relevant and appropriate requirements directly associated with this action, and is cost-effective. This action utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and this action satisfies the statutory preference for treatment as a principal element of the remedy. This action does not, however, constitute the final remedy for the entire New Bedford Harbor Site. Subsequent actions are planned to address fully the remaining threats posed by this Site.

April 6, 1990
Date

Julie Belaga
Julie Belaga
Regional Administrator
EPA Region I

RECORD OF DECISION SUMMARY

NEW BEDFORD HARBOR/
HOT SPOT OPERABLE UNIT

NEW BEDFORD, MASSACHUSETTS

APRIL 1990

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

NEW BEDFORD HARBOR/
HOT SPOT OPERABLE UNIT

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I. SITE NAME, LOCATION AND DESCRIPTION

New Bedford, Massachusetts, is a port city located at the head of Buzzards Bay, approximately 55 miles south of Boston (Figure 1). New Bedford is nationally known for its role in the development of the whaling industry in the early 1800's. Today, the harbor is home port to one of the largest commercial fishing fleets in the United States.

In the course of developing Feasibility Studies (FS) for the Site, EPA divided the Site into three geographical study areas: the Hot Spot Area, the Acushnet River Estuary, and the Lower Harbor and Upper Buzzards Bay (Figure 2). The Hot Spot is an area of approximately five acres located along the western bank of the Acushnet River Estuary, directly adjacent to an electrical capacitor manufacturing facility, the Aerovox facility. EPA has defined the Hot Spot as those areas where the sediment PCB concentration is 4,000 parts per million (ppm) or greater. PCB concentrations in this area range from 4,000 ppm to over 200,000 ppm. Contamination at levels of 4,000 ppm and greater are found at depths up to four feet, but for the most part, within the top two feet. In addition to PCBs, heavy metals (notably cadmium, chromium, copper, and lead) are found in the sediment. The remedial volume for this area is approximately 10,000 cubic yards of sediment, and it contains approximately 48 percent of the total PCB mass in sediment from the Estuary portion of the Site, and approximately 45 percent of the total PCB mass in sediment from the entire Site. Refer to Sections IV and V for further discussion of the Hot Spot, including the scope and role of the Hot Spot operable unit and site characteristics. The remainder of the Site to be addressed in a subsequent operable unit is described below.

The Acushnet River Estuary is an area of approximately 230 acres (excluding the Hot Spot), extending from the Wood Street Bridge to the north, to the Coggeshall Street Bridge to the south. Sediment PCB concentrations in this area (excluding the Hot Spot area) range from below detection to approximately 4,000 ppm. Sediment metals concentrations range from below detection to over 7,000 ppm.

The Lower Harbor area consists of approximately 750 acres, extending from the Hurricane Barrier, north to the Coggeshall Street Bridge. Sediment PCB concentrations range from below detection to over 100 ppm. Sediment metals concentrations range from below detection to approximately 3,000 ppm.

The Upper Buzzards Bay portion of the Site area extends from the Hurricane Barrier to the southern boundary of Fishing Closure Area III, and includes an area of approximately 17,000 acres. Sediment PCB concentrations here range from below detection up to 100 ppm in localized areas along the New Bedford shoreline near combined sewer and stormwater outfalls.

A more complete description of the Site can be found in Section 2 of the Feasibility Study.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. Response History

In 1976, the U.S. Environmental Protection Agency (EPA) conducted a New England-wide survey for polychlorinated biphenyls (PCBs). During this survey, high levels of PCB contamination were discovered in the marine sediment over a widespread area of New Bedford Harbor. In addition to PCBs, heavy metals (notably cadmium, chromium, copper, and lead) were found in the sediment. The survey and subsequent field studies also revealed that PCB contamination was not limited to sediment. Marine biota were also affected. Concentrations of PCBs in fish and shellfish were found to be in excess of the U.S. Food and Drug Administration (FDA) tolerance limit of 5 parts per million (ppm) for edible tissue. (FDA has subsequently reduced the PCB tolerance level to 2 ppm in 1979.) In 1977, the Massachusetts Department of Public Health (DPH) issued a public warning against consumption of shellfish or bottom fish from within the harbor and eastern sections of Buzzard's Bay to protect public health.

As a result of the widespread PCB contamination and the accumulation of PCBs in marine biota, the Massachusetts Department of Public Health established three fishing closure areas in New Bedford Harbor in September 1979 (Figure 3). These closures remain in effect. Area I is closed to all fishing, including finfish, shellfish, and lobsters. Area II is closed to the taking of lobsters and bottom-feeding finfish, such as eels, flounders, scup, and tautog. Area III is closed to lobstering only. Closure of the New Bedford Harbor and upper Buzzards Bay area to lobstering has resulted in the loss of approximately 18,000 acres of productive lobstering ground.

Two electrical capacitor manufacturing facilities, the Aerovox facility and the Cornell-Dubilier Electronics facility located on the Harbor, were major users of PCBs from the time their operations commenced in the 1940s until 1978, when EPA banned the use of PCBs. These manufacturers released PCBs onto the adjoining shoreline mudflats of the plants and into New Bedford

Harbor, through discharged wastewaters containing PCBs and through alleged intentional dumping.

The New Bedford Harbor Site was added to the EPA Superfund National Priorities List (NPL) in July 1982. Also in 1982, the Coast Guard placed warning signs along the shoreline of the Site. These signs, written in both English and Portuguese, served to notify the public of the restrictions against fishing and swimming. Additional warning signs were installed by EPA and the City of New Bedford in 1984 and 1985.

Remedial Studies

Numerous investigations have been conducted over the last decade to physically characterize the New Bedford Harbor Site, to determine the extent of PCB and metals contamination, and to assess the fate and transport of these contaminants. The major studies are summarized below. Other investigations, which were used as reference material for these studies, have been made publicly available in the Administrative Record.

Remedial Action Master Plan (1983)

The results of studies completed through early 1983 were compiled into a Remedial Action Master Plan (RAMP) for the Site in May 1983. This assessment included an area-wide air monitoring program; a sediment PCB profile for the Estuary and the Harbor; biota sampling for the Estuary, Harbor and Bay; and a study of the contamination within the New Bedford sewer system. The plan included recommendations for studies to further define the nature and extent of contamination.

Acushnet River Estuary FS (1984)

The results and recommendations of the RAMP led to a "fast-track" Feasibility Study (FS) for the 200-acre estuary area north of the Coggeshall Street Bridge. Four of the five remedial options presented in this FS involved dredging of the contaminated sediments. During the public comment period, concerns were raised surrounding the ability to dredge the contaminated sediments without causing additional impacts, both short- and long-term. As a result, the remedy selection process was extended until studies could be completed to address these concerns.

Engineering Feasibility Study (1989)

To answer questions regarding the potential impacts of dredging the contaminated sediment, the Corps of Engineers was asked to complete a dredging and disposal study. This

Engineering Feasibility Study (EFS) was conducted by the Corps' Waterways Experiment Station. The EFS consisted of bench and field scale experiments to address sediment and contaminant releases during dredging, efficacy of shoreline and aquatic disposal locations, leachate production from disposal facilities, and physical/chemical sediment profiles.

Pilot Dredging and Disposal Study (1989)

The Pilot Dredging and Disposal study, an outgrowth of the EFS, was a field test of three dredges and two disposal techniques for 9,000 cubic yards of sediment from the Estuary. The focus of this study was an attempt to verify whether the dredging and disposal techniques could be implemented without causing releases that could adversely impact public health or the environment. Additionally, the study was used to determine the optimal operating parameters for the dredging equipment and to develop monitoring programs to detect and evaluate contaminant releases.

Hot Spot Feasibility Study (1989)

The Hot Spot Feasibility Study was completed for the Hot Spot Area of the Site. The response objectives and a summary of the alternatives evaluated are provided in Sections VIII and IX of this document.

Overall Feasibility Study (ongoing)

This feasibility study was designed to combine the previous studies described above and to address the Estuary and Lower Harbor/Bay areas of the New Bedford Site. This study is scheduled to be released in June 1990.

B. Enforcement History

A number of enforcement actions have been taken related to PCB contamination of New Bedford Harbor and adjacent properties. These actions are briefly summarized below.

Cornell-Dubilier Electronics, Inc. (Cornell-Dubilier) and EPA signed a consent agreement and final order under the Toxic Substances Control Act (TSCA) in May 1982 (TSCA Docket No. 81-1001). This agreement addressed PCB handling procedures, discharges and releases to the municipal sewer system and surrounding areas, and groundwater monitoring requirements. Subsequently, EPA issued an administrative order to Cornell-Dubilier under section 106 of CERCLA in September 1983 (Docket

No. 83-1047) regarding releases of PCBs into the municipal sewer system.

Aerovox Incorporated (Aerovox) signed a consent order under section 106 of CERCLA in May 1982 (Docket No. 81-964), regarding contamination on their property adjacent to the Harbor. This order called for a cut-off wall and cap system to isolate contaminated soil, groundwater monitoring, and maintenance requirements.

EPA issued an administrative order to the City of New Bedford under section 309 of the Clean Water Act in December 1982 (Docket No. 83-06), regarding violations of the City's National Pollutant Discharge Elimination System (NPDES) permitted discharge from the municipal wastewater treatment plant (WWTP) into the Harbor. EPA issued another administrative order to the City under section 106 of CERCLA in September 1983 (Docket No. 83-1048), regarding releases of PCBs into the municipal sewer system.

On December 9, 1983, the United States filed a complaint on behalf of the National Oceanic and Atmospheric Administration (NOAA) under section 107 of CERCLA, seeking damages for injury to natural resources in New Bedford Harbor from releases of PCBs. The next day, the Commonwealth of Massachusetts filed its own section 107 action. The cases have been consolidated. On February 28, 1984, the complaint was amended to include claims on behalf of EPA for recovery of response costs incurred or to be incurred, under section 107 of CERCLA and for injunctive relief under Section 106 of CERCLA and other environmental statutes.

The United States brought the action against six companies which, at various times, owned and/or operated one of the two electrical capacitor manufacturing plants adjacent to New Bedford Harbor. The two plants are located approximately two miles apart. One of the plants, the Aerovox plant, is at the northernmost end of the inner Harbor on the Acushnet River Estuary, where the Acushnet River flows into the Harbor. The other plant, the Cornell-Dubilier plant, is a short distance south (i.e., seaward of) a hurricane barrier, which separates the inner Harbor from the outer Harbor.

Those entities which are potentially liable for the damages to the Harbor and for EPA's response costs (the PRPs) have been involved throughout the RI/FS and remedy selection process. The PRPs submitted extensive comments during the public comment period. A summary of the PRPs' comments and EPA's responses to those comments are included in the Responsiveness Summary as Appendix A to this document. All of the PRPs' comments, the summary of the comments, and EPA's responses to the comments are included in the Administrative Record.

Additionally, the EPA held an informal public hearing in New Bedford on August 22, 1989 at the specific request of AVX Corporation (AVX), one of the PRPs. In response to EPA's Proposed Plan for remediation of the Hot Spot, AVX developed its own proposal for addressing contaminated sediments in the Hot Spot and Estuary. AVX requested an opportunity to present its proposal to the EPA and the State. EPA granted AVX such an opportunity at the August 22, 1989 meeting. The transcript of this hearing is included in Attachment B to the Responsiveness Summary.

III. COMMUNITY RELATIONS

Throughout the Site's history, community concern and involvement have been and continue to be high. Consistent with its statutory obligations, EPA has kept the local community and other interested parties apprised of the Site activities through its participation at numerous meetings and its dissemination of various press releases and fact sheets. In order to better communicate with the local Portuguese community, EPA produced Portuguese translations of all public information fact sheets and provided a translator at all public hearings and meetings.

Concerns in the bordering communities initially focused on potential public health impacts as a result of living near the Harbor or eating fish caught in the Harbor, potential impacts on the local fishing industry, and potential limitations on waterfront development activities. Community concerns now also include the environmental, economic and health impacts of remedial alternatives evaluated for the Hot Spot portion of the Site, and ensuring that, following Hot Spot remediation, remaining Harbor contamination will be addressed.

EPA has presented the plans for and the subsequent results of site investigations and feasibility studies at a series of public meetings sponsored by EPA and at regular meetings of the Greater New Bedford Community Work Group (CWG). EPA also awarded a $50,000 Technical Assistance Grant in November 1988 to the CWG to hire a consultant to review the studies conducted by EPA.

In June 1989, EPA made the Administrative Record available for public review at EPA's offices in Boston and at the New Bedford Public Library. EPA published a notice and a brief analysis of the Proposed Plan in two local newspapers of general circulation, The Standard Times and The Portuguese Times, on July 27, 1989. EPA also made the Proposed Plan available to the public at the New Bedford and Fairhaven public libraries. The Administrative Record was subsequently updated on August 3, 1989 and on September 8, 1989, to include additional documents considered by the EPA for the Hot Spot Operable Unit decision.

EPA held an informational meeting on August 3, 1989 to present the results of the Hot Spot Feasibility Study, to discuss the Proposed Plan, and to answer any questions that interested persons had. This meeting also marked the beginning of the public comment period during which the public, including the PRPs, was invited to comment on the alternatives presented in the Feasibility Study, the Proposed Plan, and on any other documents previously released to the public or included in the Administrative Record.

The EPA held an informal public hearing on August 16, 1989 to accept oral comments. On the following day, August 17, 1989, EPA issued a press release announcing the extension of the public comment period from September 1, 1989 to October 2, 1989.

A second public meeting was held on August 22, 1989, to allow the PRPs an opportunity to present an alternative to EPA's Proposed Plan. Following this meeting, the public comment period was extended for a final time until October 16, 1989. The public comment period lasted a total of 74 days, considerably longer than average.

Finally, on September 25, 1989, the CWG sponsored a meeting to provide an opportunity for its members and members of the public to ask EPA representatives about EPA's Proposed Plan or AVX representatives about their proposed alternative.

A transcript of these public meetings and the comments submitted to the EPA, along with the EPA's response to these comments, are included in the Responsiveness Summary as Appendix A to this document.

A more detailed chronology of EPA's community relations activities for the Site can be found in Section II of the attached Responsiveness Summary.

IV. SCOPE AND ROLE OF OPERABLE UNIT

This Hot Spot Operable Unit is the first of two operable units planned for the New Bedford Harbor Site. Operable units are discrete actions that comprise incremental steps toward a final remedy. They may be actions that completely address a geographical portion of a site or a specific site problem. The Hot Spot Operable Unit addresses both a geographical portion of the Site and a specific Site problem.

The Hot Spot Area is an area of approximately 5 acres along the western bank of the Acushnet River Estuary adjacent to the Aerovox facility. It is noteworthy because of the extremely high levels of PCBs that have been detected in the sediment. Levels of PCBs in the Hot Spot sediments range from 4,000 ppm to over

200,000 ppm. Dermal contact and incidental ingestion of this sediment and ingestion of contaminated fish and shellfish could pose a significant risk to public health. In addition, PCB contamination threatens marine organisms. Potential routes of exposure for marine organisms include direct contact with the sediment, contact with contaminants in the water column, and ingestion of contaminated food. Finally, the Hot Spot continues to act as a source of contamination throughout the entire Site. The Hot Spot Operable Unit is designed to respond to these significant threats.

This interim action is protective of human health and the environment by providing for the removal and treatment of the highly contaminated sediments in the Hot Spot. Subsequent actions are currently being developed and evaluated to address fully the principal threats posed by the remainder of the Site. This interim action is consistent with any planned future actions because this action calls for the removal of approximately 48 percent of the total PCB mass in sediment from the estuary portion of the Site, which acts as a continuing source of contamination throughout the entire Site.

V. SUMMARY OF SITE CHARACTERISTICS

Numerous studies and reports completed for the New Bedford Harbor Superfund Site have outlined the nature and extent of contamination, the location and functional value of the wetland areas, the fate and transport of PCBs in the estuarine environment, and the risks associated with sediment contamination. These reports, which are included in the Administrative Record, highlight the relationship of the PCB contamination in the Hot Spot Area to PCB contamination in the Estuary and the Lower Harbor and Bay. Chapter 2 of the Feasibility Study contains an overview of these studies. The significant findings of the studies are summarized below.

A. Sediment

The following five sediment sampling data sets describe the nature and extent of PCB contamination in sediment in the Acushnet River Estuary, including the Hot Spot Area. These data sets were used to determine the horizontal and vertical extent of PCB contamination in the Estuary, and PCB concentration maps were prepared using these data. A summary of these data sets is presented in Appendix A of the Hot Spot Feasibility Study.

- U.S. Coast Guard Sediment Sampling Program (1982)
- U.S. Army Corps of Engineers (USACE) Field Investigation Team (FIT) Sampling Program (1986)
- Battelle Hot Spot Sediment Sampling Program (1987)

- USACE Wetlands and Benthic Sediment Sampling Program (1988)
- USACE Hot Spot Sediment Sampling Program (1988)

The above five data sets were also used for the contamination assessment and for the development of the PCB concentration maps. Other data sets included in the Administrative Record, but not specifically used in the development of the PCB concentration maps, include:

- DEQE sampling (1981)
- EPA sampling (November 1981)
- Aerovox sampling (March 1982)
- Aerovox/General Electric sampling (June 1986)
- AVX sampling (reported October 1989)

These data are consistent with the magnitude and location of PCB contamination identified in the previously mentioned data sets. These later data sets contain the highest results for any sampling taken in the Hot Spot: 190,000 ppm (EPA, 1981); 130,000 ppm (AVX, 1989); and 247,000 ppm (Aerovox, 1982). These samples were taken in the mudflats near the outfalls of the Aerovox facility.

The results of these data are described in further detail in the following subsections.

PCBs

The distribution of PCBs within the sediments of the Hot Spot Area at the depth of 0 to 12 inches is presented in Figure 4. The vertical and horizontal extent of PCB contamination in the Estuary, including the Hot Spot, is illustrated in the concentration maps prepared for the following three depths: zero to 12 inches (Figure 5), 12 to 24 inches (Figure 6), and 24 to 36 inches (Figure 7).

The sediment data also illustrate the relationship between the quantity of PCBs within the Hot Spot Area as compared to the entire Estuary (Figure 8). Approximately 48% of all the PCBs within the Estuary are located in the Hot Spot. EPA has defined the Hot Spot as those areas where the sediment PCB concentration is 4,000 ppm or greater.

Other Contaminants

In addition to PCBs, other contaminants are present throughout the New Bedford Harbor Site. These contaminants include polycyclic aromatic hydrocarbons (PAHs) and heavy metals (copper, chromium, lead, and cadmium). The extent of PAH and heavy metal contamination is presented in the Hot Spot Feasibility Study and

the Additional Contaminants of Concern Report, which are included in the Administrative Record.

Within the Estuary portion of the Site, PAH compounds were found to be co-located with PCBs. However, the range of PAH concentrations in the sediment was significantly less than the range of PCB concentrations. Total PAH sediment concentrations range from below detection limit to 930 ppm, with an average concentration of approximately 70 ppm. The highest PAH concentration of 930 ppm was detected in the Hot Spot Area. Because no discrete areas of elevated levels of PAH compounds were observed, it is probable that PAH contamination is caused by non-point sources such as urban runoff. PAH concentrations detected in the sediment are similar to PAH concentrations detected in other urban and industrialized areas. PAH compounds can be effectively treated by the technologies identified to treat PCB contamination. Thus, the selected method to treat the PCB contamination in the Harbor will effectively treat the PAH contamination.

Similar to PCB contamination, the metals concentrations are greatest in the top foot of sediment and decrease with depth. Metal concentrations have been detected in the PCB Hot Spot Area and extend throughout the 36-inch remediation depth. Many treatment technologies capable of treating the PCBs are ineffective for treating metals. For this reason, an additional treatment step may be required to treat the metals remaining in the sediment after treatment for PCBs (e.g., solidification). However, the area of highest metal contamination in the Estuary is not co-located with the PCB Hot Spot Area. The location of the high metal-contaminated sediment correlates with the location of industrial discharge and/or combined sewer overflow discharge pipes. Contamination outside of the Hot Spot Area will be addressed in the second operable unit for the Site.

Hot Spot PCB Migration

The results of several monitoring programs demonstrate that approximately 2 pounds of PCBs migrate out of the upper Estuary daily. These PCBs are ultimately transported to portions of the Lower Harbor and Buzzards Bay, where they are redeposited, volatilized into the atmosphere, or taken up into the food chain by aquatic biota. The PCBs which leave the Estuary, or the PCB flux, are composed of a dissolved (soluble) fraction and a particulate (sediment) fraction. Assessments of sediment and contaminant migration were based on field, laboratory, and model studies.

Transport of dissolved PCBs throughout the Harbor contributes to PCB migration to a greater extent than erosion and transport of sediment bed material. The following brief discussion focuses on the movement of dissolved PCBs from the bed sediment to the water

column, because studies show that the majority of the contaminated suspended solids become contaminated through contact with the water column and not from resuspension activities. A more complete discussion of Hot Spot PCB migration can be found in the following documents in the Administrative Record: Hot Spot FS (see pages 2-17 through 2-22); Corps of Engineers' Engineering Feasibility Study (see Report 2); and several reference articles (see Brown and Wagner, 1986 and Brownawell, 1986).

Within the sediment, many processes are actively moving the PCBs into the overlying water. The following mechanisms contribute to the mobilization of the PCBs:

- desorption, or release of PCBs from the bed sediment and diffusion into the overlying water;
- molecular diffusion of PCBs within the pore water of the sediment; and
- bioturbation, or mixing of the sediment by organisms.

The desorption process is influenced by the sediment organic carbon content, the specific physical and chemical properties of the PCBs, and the absorbed contaminant concentration. This desorption process is apparent by observing the extremely high water column concentrations of PCBs in the vicinity of the Hot Spot. Once into the water column, the PCBs are transported to other areas of the Site. Additionally, PCBs are volatilized into the atmosphere from the surface water and exposed mudflat areas continuously.

During the public comment period for the Hot Spot operable unit, the Potentially Responsible Parties (PRPs) submitted reports that estimate the PCB flux out of the surficial sediments within the Estuary. The results of the PRPs' studies indicate that at least 30% of the entire flux from the Estuary sediments is derived from the areas of contamination in excess of 4,000 ppm PCBs (i.e., the Hot Spot). This information supports the importance of the Hot Spot Area in the migration of PCBs within and away from the Site. Refer to the PRP document "Tidal Cycle Flux Measurement Data" and Section 4 of the Responsiveness Summary for further discussion.

Contaminant Fate in the Environment

The EPA recognizes that biotransformation of PCBs in New Bedford Harbor sediment appears to be occurring. However, studies conducted to date do not provide sufficient data for a reliable estimation of in-situ biochemical decay rates or half-lives, as well as the toxicity of the decay products. This information is crucial to evaluate the length of time that would be required for removal of PCBs from the Hot Spot sediment by natural processes. Research suggests that the half-life of anaerobic degradation of

heavily chlorinated PCBs may range from 7 to 50 years (Brown and Wagner, 1986). Based on this half-life estimate and assuming first order decay, the time required for biodegradation to reduce a sediment PCB concentration of 4,000 ppm (the lower limit of the Hot Spot) to 50 ppm would be approximately 50 to 300 years. The EPA finds this time frame for remediation unacceptable, especially when there are other remedial alternatives currently available for implementation.

Therefore, given the quantity and high level of PCB contamination in the Hot Spot sediment, the EPA believes the Hot Spot will remain a source of contamination, and that contaminants will continue to migrate to the entire Site if not addressed. Although the EPA recognizes that PCBs undergo transformation processes to varying degrees in the environment, no scientific data has been provided to the EPA to date, nor is EPA aware of any such data, which documents that the levels of contamination in the Hot Spot would be reduced to levels that the EPA believes would no longer present a risk to human health or the environment within a reasonable timeframe.

B. Surface Water

The mean PCB water column concentrations at the New Bedford Harbor Site range from approximately 3,900 parts per trillion (ppt) in the vicinity of the Hot Spot to 4 ppt in portions of Buzzards Bay. Sampling locations and corresponding mean PCB concentration values are depicted in Figure 9. These values were generated using data obtained by Battelle Ocean Sciences in 1987. In the Hot Spot Area, PCB concentrations grossly exceed the Ambient Water Quality Criteria (AWQC) for PCBs (chronic effects on aquatic life) of 30 ppt. PCB concentrations also exceed the AWQC throughout the remainder of the Estuary and the Lower Harbor.

The water column data also reflect the movement of PCBs from the sediment into the water column. The correlation between water column concentrations and the underlying sediment concentrations is as follows: the higher the sediment concentration, the higher the water column concentration. This correlation demonstrates the movement of the PCBs into the water column. The water column data, combined with EPA PCB flux measurements at the Coggeshall Street bridge, indicate that surface water from within the Estuary is transporting PCBs to other areas of the Site. The extremely high PCB concentrations, the elevated surface water concentrations, the quantity of PCBs within the area, as well as the analytical modeling conducted by the PRPs described in Section V.A above, provide evidence that the Hot Spot is a significant source to the remainder of the Site, in particular, to the Estuary portion.

C. Biota

Sampling data show that aquatic biota are contaminated with PCBs. It is also known that aquatic biota bioaccumulate and bioconcentrate PCBs. Contamination occurs when biota come into contact with contaminated sediment or surface water, or via the ingestion of contaminated organisms. Public health is threatened because contaminated biota from the Harbor may be caught and consumed.

In certain biota samples, the edible portion was found to contain levels of PCBs in excess of the 5 ppm tolerance limit established by the Food and Drug Administration (FDA). This limit was subsequently lowered to 2 ppm by the FDA in 1979.

The Massachusetts Department of Public Health (DPH) determined that under the FDA standard, the biota were "adulterated" within the meaning of state law, and responded to the public health threat by establishing Fishing Closure Areas within the Harbor and portions of Buzzards Bay.

Benthic invertebrates and fish are unable to thrive in the Hot Spot Area. However, because the Hot Spot is a significant point of origin for the migration of PCBs throughout the Harbor, biota in the rest of the Harbor are affected by Hot Spot contamination. Refer to Sections V.A, V.B, and Section 4 of the Responsiveness Summary portion of this document for discussion of the role of the Hot Spot in PCB migration.

EPA has documented fishing that occurs in the Fishing Closure Areas within Buzzards Bay (Greater New Bedford Health Effects Study, 1987). EPA believes that many of the species studied in order to assess public health risks are exposed to contaminants on a site-wide basis, since these fish may move throughout the Site. Because the Hot Spot serves as a source of contamination to the entire Site, and because certain biota may travel throughout the Site, it is necessary and appropriate to consider the levels of contamination within biota on a site-wide basis for determining public health and environmental risks posed by the Hot Spot.

Data collected by the Massachusetts Department of Marine Fisheries from Area III between 1980 and 1986, in accordance with FDA protocol, confirm that the FDA 2 ppm limit in lobsters (Figure 10) continues to be exceeded. Additional biota data, including that generated by Pruell, et al. (1988) and the Massachusetts Division of Marine Fisheries (1987), also demonstrate that the FDA tolerance level continues to be exceeded.

Data obtained in 1987 that show PCB concentrations in the edible portions of lobster, winter flounder, and clams are presented in Table 1. The biota were collected from areas that correspond to the DPH Fishing Closure Areas. The concentrations of PCBs in the lobster do not include concentrations from the tomalley, the lobster's liver, where PCBs tend to bioaccumulate. In order to be consistent with the FDA protocol requiring the tomalley be included as part of the edible portion determination in lobsters, EPA estimated the total edible tissue PCB concentration for a typical lobster from Area II. In so doing, EPA predicted a significant increase in the PCB concentration (i.e., from 0.46 ppm to 2.3 ppm). This methodology is provided on page 2-33 of the Baseline Public Health Risk Assessment.

VI. SUMMARY OF SITE RISKS

A. General Feasibility Study and Risk Assessment Information

In the feasibility study process, remedial alternatives are developed that protect human health and the environment by recycling waste or by eliminating, reducing, and/or controlling risks posed by a site through each exposure pathway. The number and type of alternatives to be analyzed shall be determined at each site, taking into account the scope, characteristics, and complexity of the site problem that is being addressed. In developing and, as appropriate, screening the alternatives, remedial action objectives are developed by specifying contaminants and media of concern, potential exposure pathways, and remediation goals. Initially, preliminary remediation goals are developed based on readily available information, such as chemical-specific ARARs or other reliable information. Preliminary remediation goals are modified, as necessary, as more information becomes available during the RI/FS. Final remediation goals are determined when the remedy is selected. Remediation goals establish acceptable exposure levels that are protective of human health and the environment and are developed by considering applicable or relevant and appropriate requirements under federal and state environmental regulations, if available, and the following factors:

1. For systemic toxicants (i.e., an agent that kills or injures animal or plant systems), acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety.

2. For known or suspected carcinogens (i.e., causes or contributes to the production of cancer), acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} (an additional 1 in 10,000 to a 1 in 1,000,000 chance of the event occurring) using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure.

3. Factors related to technical limitations such as detection/quantification limits for contaminants.

4. Factors related to uncertainty.

5. Other pertinent information.

B. Contaminants of Concern

EPA performed a Baseline Public Health Assessment to estimate the probability and magnitude of potential adverse human health effects from exposure to contaminants associated with the Site. The four contaminants of concern for the Site include PCBs and the heavy metals cadmium, copper and lead. These contaminants were selected from the contaminants present at the Site on the basis of frequency of detection, concentration and quantity of contaminant within the Site, environmental mobility, and route-specific toxicity, as specified in the Superfund Public Health Evaluation Manual. PCBs are included on EPA's list of hazardous substances under CERCLA, and PCBs are regulated under the Toxic Substances Control Act (TSCA). EPA has classified PCBs as a probable human carcinogen (B2 classification) based on the inducement of malignant liver tumors in rodents in five studies. In addition, there is suggestive evidence of excess risk of liver cancer in humans by ingestion and inhalation and/or dermal contact. Refer to Section 3 of the Responsiveness Summary for a more complete discussion of PCB toxicity.

Historically, EPA and the State focused on PCBs because of bioaccumulation in the commercial fishing grounds to levels in excess of the FDA's tolerance limit in New Bedford Harbor. The FDA tolerance limit is not solely health-based. As such, the potential risks associated with consumption of biota with PCB concentrations below the FDA limit may still present risk greater than EPA's target risk range of 10^{-4} to 10^{-6}.

C. Public Health Risks/Human Health Evaluation

EPA developed several hypothetical exposure scenarios in order to estimate quantitatively the potential human health effects associated with the contaminants of concern. The exposure scenarios reflect the characteristic uses and location of the Site. Incremental lifetime cancer risks and the potential for noncarcinogenic adverse health effects were estimated for the various exposure scenarios. Based on the results of a screening process designed to identify pathways of exposure, EPA selected direct contact and incidental ingestion of shoreline sediment and ingestion of aquatic biota as the exposure pathways of concern. Consistent with EPA guidance, the public health risk assessment assumes that institutional controls are not effective in preventing the ingestion of biota from the Harbor. For New Bedford Harbor, this assumption is substantiated by interviews conducted by the Massachusetts Department of Public Health (1987) with local residents which revealed that persons consume locally caught seafood with varying degrees of frequency.

Potential noncarcinogenic and carcinogenic risks from exposure to PCBs by direct contact and incidental ingestion of sediment from selected areas of the Estuary, including the Hot Spot Area are presented in Table 2. The corresponding area of exposure is illustrated in Figures 4 and 11. Locations within the Hot Spot Area that were evaluated in the Risk Assessment are accessible to both children and adults. For the risk calculation, EPA used a PCB concentration at a location directly on the shoreline, and assumed that a child (age 6 to 16) would be exposed. This shoreline location, identified on Figure 4, contains a PCB concentration of 9,923 ppm. Based on the direct contact hazard presented by the highly contaminated sediment in the Hot Spot Area, significant public health risks are expected under the assumed conditions of exposure.

In addition to direct contact and incidental ingestion of Hot Spot sediments, EPA examined potential risks from the ingestion of biota on a site-wide basis. These estimates were calculated on the basis of consumption of lobster, winter flounder and clams. EPA estimated risks based on consumption of one fish meal per day, per week, and per month, with a fish meal consisting of an 8-ounce portion for older children and adults and a 4-ounce portion for younger children. The potential carcinogenic risks with their corresponding exposure concentrations are presented in Table 3. Table 3 indicates that monthly consumption of biota contaminated below the FDA limit of 2 ppm results in a public health risk greater than EPA's target risk range.

The concentrations used in this evaluation are from biota caught in the Buzzards Bay portion of the Site, within Area II of the Fishing Closure Areas. The consumption of contaminated biota

presents a public health risk under the assumed conditions of exposure. The EPA believes the assumed exposure scenarios to be a reasonable estimate, since the risks were based on consumption of biota from the Bay portion of the Site, where documented fishing occurs.

A more complete discussion of Site risks can be found in the Hot Spot FS on pages 3-1 through 3-8 and in the Public Health Risk Assessment.

D. Ecological Risk

EPA is presently conducting a Baseline Environmental Risk Assessment as part of the overall Feasibility Study for the Estuary and Lower Harbor and Bay Areas. EPA is also examining sediment clean up goals for the protection of aquatic organisms as part of this study. This study is scheduled to be completed in June 1990. For the Hot Spot Operable Unit, the EPA examined potential risks to marine biota due to exposure to PCB contamination in the Hot Spot sediment and in the water column. The extremely high contaminant levels in Hot Spot surface sediment precludes benthic invertebrates and fish from thriving in this area.

Contamination of aquatic biota in New Bedford Harbor occurs through exposure to contaminated sediments and surface water, and the ingestion of contaminated food. While the PCB exposure that biota receive via direct contact with the Hot Spot sediment and the overlying water column is important, the role the Hot Spot plays in the migration and subsequent exposure on a site-wide basis is also of importance.

VII. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA adopted a Proposed Plan for remediation of the Hot Spot on August 3, 1989. The preferred alternative, specified in the Proposed Plan, included the following major provisions:

- dredging of 10,000 cubic yards of contaminated sediments;
- dewatering of the sediments in the pilot study area using the existing Confined Disposal Facility (CDF);
- treatment of the dredged sediments utilizing an on-site incinerator; and
- stabilization of the treated sediment to immobilize metals, if a leaching test indicates it is needed.

EPA will conduct pre-design studies, a normal component of most engineering design projects, to evaluate and select the unit

process equipment. These studies will focus on ensuring compliance with ARARs specific to this action identified in Section XI.B of this document.

VIII. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Prior to the passage of the Superfund Amendments and Reauthorization Act of 1986 (SARA), actions taken in response to releases of hazardous substances were conducted in accordance with CERCLA as enacted in 1980 and the revised National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, dated November 20, 1985. Until the revised NCP to reflect SARA becomes effective, the procedures and standards for responding to releases of hazardous substances, pollutants and contaminants shall be in accordance with Section 121 of CERCLA and to the maximum extent practicable, the current NCP.

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with applicable or relevant and appropriate environmental standards established under Federal and state environmental laws unless a statutory waiver is warranted; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a statutory preference for remedies that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes over remedies that do not achieve such results through treatment. Response alternatives were developed to be consistent with these Congressional mandates.

EPA analyzed a number of potential exposure pathways for risk and threats to public health and the environment in the Hot Spot Feasibility Study and in the Baseline Public Health Risk Assessment. EPA used guidelines in the Superfund Public Health Evaluation Manual regarding development of design goals and risk analyses for remedial alternatives in the development of response actions. As a result of these assessments, EPA developed remedial response objectives to mitigate existing and future threats to public health and the environment. These response objectives are:

1. Significantly reduce PCB migration from the Hot Spot area sediment, which acts as a PCB source to the water column and to the remainder of the sediments in the harbor.

2. Significantly reduce the amount of remaining PCB contamination that would need to be remediated in order to achieve overall harbor clean-up.

3. Protect public health by preventing direct contact with Hot Spot sediments.

4. Protect marine life by preventing direct contact with Hot Spot sediments.

B. Technology and Alternative Development and Screening

The term "technology" refers, in general, to a category of remedial action activity, such as, chemical treatment or capping. Early in the process of finding an appropriate remedy for a site, EPA screens or reduces the universe of potentially applicable technologies by evaluating the technologies in terms of their technical implementability. EPA then combines remaining technologies into remedial alternatives, which are developed and subsequently screened on the basis of the following three criteria.

1. Effectiveness. This criterion focuses on the degree to which an alternative reduces toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection, complies with ARARs, minimizes short-term impacts, and how quickly it achieves protection. Alternatives providing significantly less effectiveness than other, more promising alternatives may be eliminated. Alternatives that do not provide adequate protection of human health and the environment are eliminated from further consideration.

2. Implementability. This criterion focuses on the technical feasibility and availability of the technologies each alternative would employ and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration.

3. Cost. The costs of construction and any long-term costs to operate and maintain the alternatives shall be considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives may be considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and implementability similar to that of another alternatives by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated.

CERCLA, the NCP, and EPA guidance documents including, "Guidance on Feasibility Studies Under CERCLA" dated June 1985, and the "Interim Guidance on Superfund Selection of Remedy" (EPA Office of Solid Waste and Emergency Response [OSWER] Directive No. 9355.0-19) dated December 24, 1986 set forth in detail the process by which EPA evaluates and selects remedial actions. In accordance with these requirements and guidance documents, EPA developed treatment alternatives for the Site ranging from an alternative that, to the degree practicable, eliminates the need for long-term management (including monitoring) at the Site to alternatives involving treatment that reduce the mobility, toxicity, or volume of the hazardous substances as their principal element. In addition to the range of treatment alternatives, EPA developed a containment option involving little or no treatment and a no-action alternative in accordance with Section 121 of CERCLA.

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. In addition to these factors and the other statutory directives of Section 121, the evaluation and selection process was guided by the EPA documents "Additional Interim Guidance for Fiscal Year 1987 Records of Decision" dated July 24, 1987 and "Interim Final Guidance on Preparing Superfund Decision Documents" (OSWER Directive No. 9355.3-02) dated June 1989. These documents provide direction on the consideration of SARA cleanup standards and set forth nine evaluation criteria that EPA should consider in its evaluation and selection of remedial actions. The nine evaluation criteria are:

Threshold Criteria

1. Overall protection of human health and the environment.

2. Compliance with applicable or relevant and appropriate requirements (ARARs).

Balancing Criteria

3. Long-term effectiveness and permanence.

4. Reduction of toxicity, mobility or volume through treatment.

5. Short-term effectiveness.

6. Implementability.

7. Cost.

Modifying Criteria

8. State/support agency acceptance.

9. Community acceptance.

Chapter 5 of the Hot Spot Feasibility Study identified, screened and evaluated technologies based on engineering feasibility, implementability, effectiveness, and technical reliability. Chapter 6 of the Hot Spot Feasibility Study presented the remedial alternatives developed by combining the technologies identified in the previous screening process in the categories required by OSWER Directive No. 9355.0-19. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated and screened in Chapter 7 of the Feasibility Study. In summary, of the nine remedial alternatives screened in Chapter 6, four were retained for detailed analysis. Table 4 identifies the four alternatives that were retained through the screening process, as well as those that were eliminated from further consideration.

IX. DESCRIPTION/SUMMARY OF THE DETAILED ANALYSIS OF ALTERNATIVES

A brief discussion of capping as an alternative for the Hot Spot is included here to provide the reasoning why this alternative was not carried into detailed analysis for the Hot Spot. Refer to Section 7 of the Responsiveness Summary for a more complete discussion of capping for the Hot Spot.

A. Capping Alternative for the Hot Spot

The identification and initial screening of remedial technologies conducted in 1986-87 identified capping as a potentially applicable containment (or non-removal) technology in each of the Site's three geographical study areas: the Hot Spot, the Estuary, and the Lower Harbor and Bay. Two other containment technologies were also identified: impermeable synthetic membranes and

chemical sealants. As a result of the subsequent screening step, which considered effectiveness, feasibility, and implementability, EPA retained capping for further evaluation.

During 1987, EPA conducted a detailed evaluation of capping as a remedial technology. EPA evaluated capping based on three major criteria: effectiveness (including technical reliability and potential impacts to public health and the environment); implementability (including technical, institutional, and administrative feasibility of installing, monitoring and maintaining a cap); and cost. Because capping satisfied these three criteria, EPA retained capping as an applicable technology for all three geographical study areas of the Harbor.

EPA combined remedial technologies retained from the screening process into complete remedial alternatives for each of the three study areas during 1987-88. In accordance with the amendments to CERCLA which require consideration of on-site containment alternatives, EPA developed a capping alternative for the Hot Spot. This alternative consisted of installing an embankment around the Hot Spot, stabilizing the sediment, and installing a synthetic cap over the Hot Spot Area.

EPA then screened all of the remedial alternatives for the Hot Spot based on the effectiveness, implementability and cost criteria. At this step, in accordance with EPA guidance on screening of remedial alternatives, evaluation under the effectiveness criterion requires the inclusion of consideration of the alternative's ability to meet ARARs and its long-term reliability. As a result of this screening step, EPA eliminated the capping alternative because, in EPA's judgment, the long-term effectiveness of the cap for the Hot Spot sediment was uncertain. The lack of information to substantiate the appropriate thickness and effectiveness of a cap over sediment that contains extremely high levels of PCBs such as those found in the Hot Spot, contributed to the elimination of capping in the remedial alternative screening process.

EPA was concerned about the inability of the cap to provide a permanent barrier to migration of highly contaminated sediment. EPA considers breaching of the cap likely in the Hot Spot Area, since capping this area would increase accessibility by creating an upland area. In the event of failure, highly contaminated sediment that has not diminished in toxicity or volume would contaminate cap material, increasing the volume of contaminated material, and would migrate throughout the Site.

The implementation problems likely to be encountered with a capping alternative also contributed to EPA's decision to screen out capping for the Hot Spot. The difficulty in installing an embankment around the Hot Spot to allow for installation of the cap, as well as the difficulty in deploying the cap itself,

because of the poor sediment stability, indicated that capping was not an appropriate alternative for the Hot Spot.

Finally, capping the highly contaminated Hot Spot sediment is not appropriate because of the levels of contamination that would remain. EPA is currently evaluating capping as an alternative for the Estuary, excluding the Hot Spot, and has retained capping as a viable alternative for portions of the Lower Harbor and Bay.

B. Summary of the Detailed Analysis of Alternatives

This section presents a narrative summary and brief evaluation of each alternative according to the evaluation criteria described above. A detailed tabular assessment of each alternative is presented in Table 5.

The alternatives analyzed for the Hot Spot include a non-removal alternative (Hot Spot [HS]-1) and three removal alternatives (HS-2, HS-3, HS-4).

Non-Removal Alternative

Alternative Hot Spot (HS)-1: Minimal No Action

This alternative would involve no remedial action on any of the contaminated sediments in the Hot Spot. This alternative would, however, entail restricting Site access to the west, north and south by installing chain-link fences to ensure that there would be no access to the Hot Spot Area via the adjacent shoreline. Limiting access to the Hot Spot Area would limit the potential for direct contact with contaminated sediments. In addition to warning signs currently posted on the eastern and western shorelines, additional warning signs regarding swimming, fishing and shellfish harvesting restrictions would be posted along the western shoreline. Annual sediment and surface water sampling and analysis of PCB and heavy metal levels would be conducted.

Under this alternative, contaminants would continue to migrate from the Hot Spot Area to the Estuary and Lower Harbor. This alternative is readily implementable and provides short-term effectiveness in protecting public health, but would not protect the environment from risks posed by contaminated sediments. This alternative would not provide overall protection of human health and the environment and would not result in reduction in PCB levels. This alternative would not reduce the toxicity, mobility, or volume of contaminants in Hot Spot sediments. The Minimal No Action alternative would not provide a long-

term permanent remedy that would reduce the nature and magnitude of risk to public health and the environment within the New Bedford Harbor Site since the Hot Spot Area would continue to serve as a source of PCBs to the Estuary and Lower Harbor/Bay. EPA evaluated this alternative in detail in the FS to serve as a comparison to other remedial alternatives under consideration.

Estimated Time for Implementation:	less than 1 year
Estimated Direct Capital Cost:	$35,000
Estimated Indirect Capital Cost:	$13,000
Estimated Operation & Maintenance Cost:	$407,000
Estimated Time for Operation:	30 years of maintenance
Estimated Total Cost:	$455,000

Removal Alternatives

After the screening procedure, EPA retained three alternatives (HS-2, HS-3 and HS-4) that require removal of contaminated Hot Spot sediments for detailed evaluation. EPA used results of the EFS and the Pilot Study to examine the dredging, treatment, disposal and monitoring techniques proposed for each of these three alternatives. EPA determined that a substantial reduction in cleanup costs would result from use of the existing Pilot Study area to support the treatment operations being considered. All of the removal alternatives considered in the FS make use of this area (Figure 12).

All three removal alternatives contemplate excavation of approximately 10,000 cubic yards of contaminated sediments at depths up to four feet using dredging equipment, and transportation of the dredged material by a floating hydraulic pipeline (approximately 1 mile long) to the Pilot Study area. After settling, sediments would be pumped to a nearby secondary facility for dewatering using a filter-press unit. Effluent from the dewatering process would be treated to remove PCBs and heavy metals prior to discharge back into the harbor. Sediment treatment techniques differ in each alternative and are described in detail below.

Alternative HS-2: Incineration

EPA has selected this alternative to address the Hot Spot Area of the Site. It is discussed in Section X entitled "Description of Selected Remedy" on pages 26 through 32.

Alternative HS-3: Solidification/Disposal

In this alternative, contaminated sediments would be dredged and dewatered, and on-site solidification of the

dewatered sediment would be conducted to immobilize PCBs and heavy metals. The solidified material would be transported to an off-site Federally-approved landfill for disposal.

Solidification combined with disposal of sediments in a secure landfill would reduce the mobility of PCBs and metals. However, solidification would increase the volume of contaminated sediment, and its effectiveness on extremely high levels of organic contamination is uncertain. Solidification would not reduce the toxicity of contaminants in the sediments. This alternative would provide short-term effectiveness and is implementable, provided an off-site disposal facility is available. Off-site disposal of contaminated sediments in an approved landfill would provide long-term protection of human health and the environment. This alternative would provide significant progress toward overall protectiveness of public health and the environment since it would result in the removal of approximately 48 percent of the PCBs in the Estuary.

Estimated Time for Remediation:	1 year
Estimated Direct Capital Cost:	$9,738,500
Estimated Indirect Capital Cost:	$3,561,700
Estimated Total Cost:	$13,300,200

Alternative HS-4: Solvent Extraction

In this alternative, contaminated sediments would be dredged and dewatered, and solvent extraction would be used to treat the contaminated sediment. After the treatment process, tank trucks would transport the PCB-enriched solvent extract to an off-site federally-approved facility for incineration. Solidification of remaining waste material would be used to immobilize metals prior to storage in the CDF.

Solvent extraction is an innovative technology, a specific version of which was demonstrated at the Site during the Pilot Study. This technology, combined with incineration of the solvent and solidification of the treated sediment, would significantly reduce the mobility, toxicity, and volume of PCB-contaminated sediment. This alternative would provide significant progress toward overall protectiveness of public health and the environment because it would remove 96 to 99 percent of the PCBs from the Hot Spot sediments. Preliminary tests indicate some reduction in the mobility of metals. Because solvent extraction is an innovative technology, additional testing would be required to demonstrate its effectiveness on highly

contaminated sediment. Concerns remain over the reliability of this technology for the levels of contamination of the Hot Spot sediment and the higher residual concentrations that may remain after treatment (i.e., 96 to 99% reduction versus 99.9999% reduction with incineration). This alternative would provide long-term effectiveness because it would permanently treat PCB contamination, and the technology appears to reduce the mobility of heavy metals.

Estimated Time for Remediation:	1 year
Estimated Direct Capital Cost:	$7,806,350
Estimated Indirect Capital Cost:	$4,362,300
Estimated Total Cost:	$12,168,650

X. THE SELECTED REMEDY

The selected remedial action for the New Bedford Harbor Site/Hot Spot Area consists of source control measures.

A. Description of the Selected Remedy

1. Remedial Action Objectives

The selected remedy was developed to satisfy the following remedial objectives. These objectives will guide the design of the remedy, and they will be used to measure the success of the remedy.

- Significantly reduce PCB migration from the Hot Spot area sediment, which acts as a PCB source to the water column and to the remainder of the sediments in the harbor.
- Significantly reduce the amount of remaining PCB contamination that would need to be remediated in order to achieve overall harbor clean-up.
- Protect public health by preventing direct contact with Hot Spot sediments.
- Protect marine life by preventing direct contact with Hot Spot Area sediments.

2. Description of Remedial Components

The source control remedial measures include:

- Dredging. Approximately 10,000 cubic yards of contaminated sediments will be removed using a dredge. Dredging will occur in the Hot Spot Area at depths of up to four feet to remove sediments with PCB concentrations of 4,000 ppm or greater.

  Contaminated sediments will be excavated using a small cutterhead dredge. EPA recommended this type of dredge for use in the Hot Spot Area based on results of the Pilot Study conducted by the Corps of Engineers. This study demonstrated that the cutterhead dredge minimizes sediment resuspension and subsequent migration of contaminated sediments. The Corps of Engineers developed operational procedures for the dredge that will be followed to ensure dredging efficiency.

  In addition to using the controls examined in the pilot study which were effective, as an added protective measure, EPA will examine other control options during the design phase, such as physical barriers (floating booms and silt curtains) to formulate appropriate control options for the dredging process to minimize and control sediment resuspension.

- Transportation and Dewatering. The dredged sediments will be transported to the Pilot Study cove area by a floating hydraulic pipeline, where the sediments will be dewatered. Dewatering of sediments will increase the efficiency of the incinerator. Effluent resulting from the dewatering process will be treated to reduce PCBs and heavy metals using best available control technology prior to discharge back into the harbor.

  During design, EPA will determine the proper procedures necessary to ensure that use of the CDF in the dewatering process will comply with the State hazardous and solid waste requirements (e.g., permeability standards).

- Incineration. The dewatered sediments will be incinerated in a transportable incinerator that will be sited at the Pilot Study cove area. The extremely high temperatures achieved by the incinerator will result in 99.9999% destruction of PCBs. Exhaust gases will be passed through air pollution control devices before being released into the atmosphere to ensure that appropriate health and safety and air quality requirements are met.

  As a part of the design phase, incineration technologies will be carefully examined to determine the optimum equipment configuration and incinerator operating parameters for the Hot Spot sediment. This examination will include conducting a test burn on the Hot Spot

sediment, to assist in the development of plans and specifications for treating the material specific to this Site.

- Stabilization. Incineration of PCB-contaminated sediment will produce residual ash. Following incineration, the Toxicity Characteristic Leaching Procedure (TCLP) test will be performed on the ash to determine if it exhibits the characteristic toxicity and is, therefore, considered a hazardous waste under the Resource Conservation and Recovery Act (RCRA). If the TCLP test reveals that the ash is a RCRA hazardous waste, the ash will be solidified such that metals no longer leach from the ash at concentrations that exceed the standards set forth for determining the toxicity of a material.

  EPA investigated the technical feasibility of applying solidification/stabilization technology to New Bedford Harbor sediment in laboratory studies as a part of the EFS. Several processes were examined, and physical and chemical tests were conducted on the material. Additional testing will be conducted during the design process to tailor a solidification process for the treated Hot Spot sediment (ash) and to determine the material's chemical characteristics after treatment.

  During remedial activities, (solidified) ash will be temporarily stored in an area adjacent to the CDF. Following completion of these activities, the (solidified) ash will be stored in the secondary cell of the CDF and covered. Storage of the treated material will comply with the solid waste requirements. Ultimate disposition of this material will be addressed in the second operable unit for the Site.

Estimated Time for Remediation:	1 year
Estimated Direct Capital Cost:	$9,143,700
Estimated Indirect Capital Cost:	$5,235,600
Estimated Total Cost:	$14,379,300

B. Comparative Analysis and Rationale for Selection

The rationale for choosing the selected alternative is based on the assessment of the ability of the alternatives retained for detailed evaluation to satisfy each of the nine evaluation criteria mention above in Section VIII.B of this document. To reiterate, the evaluation criteria are:

1. Overall protection of human health and the environment.

2. Compliance with applicable or relevant and appropriate requirements (ARARs).

3. Long-term effectiveness and permanence.

4. Reduction of toxicity, mobility or volume through treatment.

5. Short-term effectiveness.

6. Implementability.

7. Cost.

8. State/support agency acceptance.

9. Community acceptance.

The first two criteria are threshold determinations that must be satisfied in order for an alternative to be eligible for selection. To evaluate the overall protectiveness of an alternative, EPA focuses on how the specific alternative achieves protection over time, if at all, and how site risks are reduced. To evaluate whether an alternative is able to comply with ARARs, EPA considers whether, after the remedial action specified in the alternative is implemented, applicable or relevant and appropriate requirements under federal and state environmental laws are achieved. EPA may also consider whether a waiver of any ARAR is warranted.

EPA uses the next five criteria, the balancing criteria, to weigh the major tradeoffs among alternatives. In evaluating the long-term effectiveness and permanence of an alternative, EPA considers the degree of certainty that the alternative will attain the response objectives, the magnitude of residual risk caused by untreated waste or treatment residuals remaining at the conclusion of the remedial activities, and the adequacy and reliability of controls that are necessary to manage treatment residuals and untreated waste. EPA also considers the potential impacts on human health and the environment should the remedy need replacement.

In evaluating alternatives under the reduction of toxicity, mobility, or volume of contaminants through treatment criterion, EPA considers the treatment process used and the materials treated, the amount of hazardous materials destroyed or treated, the degree of expected reductions in toxicity, mobility or volume, and the type and quantity of residuals remaining after treatment.

To determine how an alternative satisfies the short-term effectiveness criterion, EPA considers the impacts on the community and the environment during the construction and implementation phases of the remedial actions and the time required until the remedial objectives are achieved.

The ease or difficulty of implementing an alternative is assessed by considering its technical and administrative feasibility, and the availability of services and materials. Costs assessed under the cost criterion include capital costs, annual operation and maintenance costs, and present worth costs.

The final two criteria, state and community acceptance, the modifying criteria, are generally taken into account after EPA has received public comment on the RI/FS and the Proposed Plan.

Alternative HS-2 (Incineration) is protective of human health and the environment. The removal of PCBs from the Hot Spot Area and subsequent destruction by incineration will permanently reduce the mobility, toxicity, and volume of the PCBs. Public health and environmental risks directly associated with the Hot Spot will be significantly reduced. Removal of the Hot Spot will also serve to reduce PCBs affecting the remainder of the Site.

Incineration is technically feasible and has been proven to be an effective technology for the destruction of organics, including PCBs at levels similar to those in Hot Spot Area sediment. Mobile incineration units capable of treating 75 tons of sediment per day are currently available. Moreover, incineration systems are highly reliable because of the proven technology employed and the degree of monitoring and control practiced.

Table 5 presents a comparative summary of the four remedial alternatives that were carried through detailed analysis. A narrative discussion of EPA's evaluation of these alternatives under the evaluation criteria appears below.

Of the four alternatives, HS-1 (Minimal No Action), does not satisfy the threshold criterion of being protective of human health and the environment. Therefore, it cannot be selected as the remedial alternative for the Hot Spot sediments. Nevertheless, it provides a useful yardstick for comparison for the other alternatives.

Alternatives HS-2 and HS-4 (Solvent Extraction) would provide the greatest long-term effectiveness and permanence among the alternatives, because they both involve the ultimate destruction of PCBs. However, the reliability of HS-2 is higher than that of HS-4, since solvent extraction is a less certain method of treatment than is incineration for the high concentrations of PCBs found in the Hot Spot sediment. In contrast to these two alternatives, HS-3 (Solidification) would only immobilize the

PCBs, and its effectiveness on extremely high levels of organic contamination is uncertain, especially over a long period of time. Alternative HS-1 would not destroy, immobilize, or remove the PCBs. They would continue to provide a source of contamination to the rest of the harbor and continue to pose significant risk from direct contact in shoreline areas.

Alternatives HS-2 and HS-4 also would provide the greatest reduction in mobility, toxicity, and volume among the alternatives. Alternative HS-2 provides for removal of a greater percentage of all PCBs from the sediment, 99.9999%, as compared to 96 to 99% removal of the PCBs by Alternative HS-4, a significant difference at the levels of contamination found in the Hot Spot. While HS-3 would reduce the mobility of the PCBs in the Hot Spot sediment, the volume of the contaminated material would increase. Alternative HS-1 would provide no reduction in toxicity, mobility, or volume.

Alternatives HS-2, HS-3, and HS-4 are not distinguishable in terms of their short-term effectiveness, and each can be implemented in approximately one year. Each of these alternatives would employ dredge controls and air quality controls to minimize and control resuspension of sediments and releases of contaminants. However, some additional risk to workers may arise under these three removal alternatives during the treatment process since the contaminated sediments are being removed and treated. These risks may be minimized through training in the proper use and operation of safety equipment. EPA does not believe that the three alternatives would pose significant risk to the public because the contemplated control options have proven to be effective. Alternative HS-1 would have minimal short term effectiveness since minimal action would be taken.

Alternative HS-1 would be the simplest alternative to implement because it would involve minimal construction with no removal or treatment activities. Both HS-2 and HS-4 would require testing to verify treatment and to determine the need for solidification of residuals. While treatability testing in the form of a test burn would need to be conducted for HS-2, this testing would be for the purpose of determining optimum equipment configuration and operating parameters, and is not needed to determine effectiveness. Solvent extraction is an innovative technology. Thus, under HS-4, in addition to testing required to establish operating parameters, pilot studies would be required to initially determine the efficacy of the process on the highly contaminated Hot Spot sediment. Transportation of the PCB-solvent enriched extract to a federally-approved off-site incinerator is an implementation problem not found in HS-2.

Both HS-2 and HS-4 would require special equipment and operators. However, the equipment necessary for HS-4 may be more difficult

to obtain than that necessary for HS-2. Treatability testing would be required under HS-3, and questions regarding long-term stability would remain for the high levels of organic contamination. Additional implementation problems peculiar to Alternative HS-3, are the necessity of obtaining disposal permits under RCRA and TSCA and the necessity of transport of the solidified material over long distances. The nearest disposal site permitted to accept the contaminated sediment is approximately 500 miles from New Bedford, and the disposal site's capacity to accept the contaminated material is not guaranteed.

Alternative HS-1 is the least costly alternative. Alternatives HS-2, HS-3, and HS-4 have similar costs within the accuracy of cost estimates for Feasibility Studies.

The primary criteria that differentiate these alternatives are their long-term effectiveness and permanence and implementability. Alternative HS-2 satisfies all of the selection criteria. In contrast, Alternatives HS-3 and 4 fail to satisfy certain of the selection criteria, or do not satisfy the criteria with the consistency or performance level of Alternative HS-2. Since Alternative HS-2 has the highest reliability and involves relatively few implementation difficulties for the volume of material to be treated, it provides the best balance of tradeoffs among the protective alternatives.

EPA considered state and community acceptance of the selected remedy. The State has concurred in the selection of the remedy. Community concerns over the selected remedy are focused on the operation of the incinerator, the impacts of dredging, and storage of the treated material. EPA believes these concerns are addressed by specifying compliance with the RCRA and TSCA incinerator standards, as well as requiring air monitoring to ensure that all federal and state air standards are attained. Various monitoring and/or controls will be required during the dredging operation, which EPA believes will be effective in minimizing and controlling releases. Additionally, the use of the CDF and the storage of the treated material will comply with federal and state requirements. Based upon this assessment, taking into account the statutory preferences of CERCLA, EPA has selected this alternative as the remedial approach for the Site.

XI. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Hot Spot Area of New Bedford Harbor is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment for the Hot Spot Area, and is cost effective. This interim action will comply with ARARs specific to this action. However, this interim action will not attain certain levels or standards of control that might be

ARARs. This interim remedial action is only part of a total remedial action that will attain ARARs when completed. The selected remedy also satisfies the statutory preference for the use of treatment which permanently and significantly reduces the volume, toxicity, or mobility of contaminants as a principal element. Additionally, the selected remedy utilizes alternative treatment technologies to the maximum extent practicable. The Hot Spot contamination represents a principal threat at the New Bedford Harbor Site and will be treated under the selected remedy.

A. The Selected Remedy is Protective of Human Health and the Environment

The selected remedy is protective of human health and the environment for the Hot Spot Area. The remedy for the Hot Spot will permanently reduce the risks presently posed to human health and the environment in the Hot Spot area by dredging and treating the heavily contaminated sediments. Further, by removing approximately 48% of the mass of the PCBs in the Estuary, these contaminated sediments will no longer continue to migrate and contaminate other portions of the Site.

There are no short-term threats associated with the selected remedy that cannot be controlled with existing, available control technologies. Incineration is a proven technology for the destruction of PCBs, and air pollution control devices are routinely used to meet allowable levels of air emissions.

B. The Selected Remedy Attains ARARs to the Extent Required by Section 121 of CERCLA

Due to the limited scope of this interim action, standards or levels of control associated with final cleanup levels will not be achieved. This action will comply with those ARARs specific to this interim action. For example, compliance with RCRA facility and incinerator regulations will be achieved. Chemical-specific ARARs associated with final cleanup levels (e.g., Water Quality Criteria and Food and Drug Administration PCB tolerance level) are not specific to this action and are outside its scope. ARARs such as these will be addressed by subsequent actions at the New Bedford Harbor Site.

This interim action is consistent with any planned future actions because this action calls for the removal of approximately 48 percent of the total PCB mass in sediment from the estuary portion of the Site, which acts as a continuing source of contamination throughout the entire Site. EPA believes that the implementation of a permanent remedy for the Hot Spot is an

appropriate and necessary first step toward remediating the harbor overall. The Hot Spot operable unit is the first step in the remedial action for the entire Site, which when complete, will attain all ARARs.

ARARs which are specific to the selected remedial action for the Hot Spot are:

Toxic Substances Control Act (TSCA)
Resource Conservation and Recovery Act (RCRA)
Clean Air Act (CAA)
Clean Water Act (CWA)
Executive Order 11988 (Floodplain Management)
Executive Order 11990 (Protection of Wetlands)
Occupational Safety and Health Administration (OSHA)

310 CMR 30.00	Hazardous Waste Management Requirements
310 CMR 19.00	Solid Waste Management Requirements
310 CMR 6.00	Ambient Air Quality Standards
310 CMR 7.00	Air Pollution Control Regulations
310 CMR 10.00	Wetlands Protection Requirements
314 CMR 4.00	Surface Water Quality Standards
314 CMR 9.00	Certification for Dredging and Filling
314 CMR 12.00	Wastewater Treatment
301 CMR 20.00	Coastal Zone Management
310 CMR 33.00	Employee and Community Right To Know Requirements

Table 6 lists the ARARs specific to this action, a summary of the requirement, whether the requirement is applicable or relevant and appropriate, and the action necessary to attain the ARAR. A brief narrative summary of the ARARs specific to the selected remedy follows.

The Toxic Substances Control Act (TSCA), the Resource Conservation and Recovery Act (RCRA), and the State Hazardous Waste Management Regulations (310 CMR 30.00) are considered applicable to the remedial action for the Hot Spot. As such, the on-site incinerator will be required to operate in accordance with these requirements. Additionally, remedial activities may be subject to the Land Disposal Restrictions under RCRA. Following incineration, the Toxicity Characteristic Leaching Procedure (TCLP) test will be performed on the ash to determine if it exhibits the characteristic of toxicity and is, therefore, considered a hazardous waste under the Resource Conservation and Recovery Act (RCRA). If this test reveals that the ash is a RCRA hazardous waste, the ash will be solidified such that metals no longer leach from the ash at concentrations that exceed the standards set forth in the requirements, and to comply with the Land Disposal Restrictions.

The PCB disposal requirements promulgated under TSCA are considered to be relevant and appropriate for the heavily

contaminated sediments from the Hot Spot. Under TSCA, soils contaminated with PCBs at concentrations greater than 50 ppm that are disposed of after February 17, 1978 must be disposed of in accordance with 40 CFR Part 761, Subpart D. PCBs may be disposed of in an incinerator meeting the standards of 40 CFR §761.70, or in a landfill meeting the requirements of §761.75. Under the provisions of §761.71(c)(4), the EPA Regional Administrator may waive one or more of the specified landfill requirements upon finding that the requirement is not necessary to protect against an unreasonable risk of injury to health or the environment from PCBs. Such a waiver is not appropriate for the heavily contaminated (4,000 ppm and above) Hot Spot sediments being addressed by this operable unit. Since incineration is selected as the source treatment technology, treatment and disposal of the 10,000 cubic yards of PCB-contaminated sediment will be in accordance with the criteria of 40 CFR §761.70. In addition, disposal of dredged material will be in accordance with 40 CFR §761.60(a)(5).

Regarding the floodplains, the remedy will comply with Executive Order 11988 - Protection of Floodplains to the extent practicable. EPA finds that there is no practicable alternative to excavation of the contaminated sediments, some of which are located in the floodplain, since it is the sediments themselves that are contaminated from the historical disposal and discharges. Implementation of the remedy will utilize measures to minimize potential harm to the floodplain. However, excavation is a temporary disruption, and the design will examine ways to minimize this disruption.

Similarly for the wetlands, the remedy will comply with Executive Order 11990 - Protection of Wetlands, the Clean Water Act Section 404(b)(1) Guidelines, Wetland Protection Requirements (310 CMR 10.00), Certification for Dredge and Fill (314 CMR 9.00), and Coastal Zone Management (301 CMR 20.00). The Hot Spot sediments have been affected by the historical disposal and discharges and act as a continuing source of contamination to the remainder of the Harbor, and they will be affected by the remedy. These sediments will be dredged for thermal treatment. EPA finds that there is no practicable alternative to these actions since it is the sediments themselves that are contaminated. Implementation of the remedy will utilize measures to minimize potential harm to the surrounding areas. The design phase will examine physical controls, as well as monitoring of the area.

During dredging and treatment of contaminated sediments, air emissions will be monitored and all applicable or relevant and appropriate federal and state standards will be attained. Specifically, the National Ambient Air Quality Standards (NAAQS), the State Ambient Air Quality Standards (310 CMR 6.00), and the Air Pollution Control Regulations (310 CMR 7.00) will be met through specified techniques for the dredging activities, as well

as required air emission controls and monitoring for the incinerator, to ensure that health and safety and air quality requirements are met.

Dewatering of sediments will increase the efficiency of the incinerator. Effluent resulting from the dewatering process will be treated to reduce PCBs and heavy metals using best available technology prior to discharge into the Harbor (314 CMR 4.00 and 314 CMR 12.00). Use of the CDF, whether for dewatering or storage purposes, will comply with the hazardous and solid waste regulations (310 CMR 19.00).

During the dredging and treatment of contaminated sediments, Occupational Health and Safety Administration (OSHA) regulations will be followed, as well as the Employee and Community Right To Know Requirements (310 CMR 33.00). In particular, 29 CFR §1910.120 specifies standards for handling hazardous wastes and sets allowable ambient air concentrations for activities which involve release of volatile organic compounds (VOCs) in the workplace. VOCs are not expected to be a problem during dredging, since the sediments to be dredged are submerged, and will then be brought to the CDF area via pipeline for dewatering prior to incineration. However, air monitoring will be conducted to ensure that proper health and safety measures are followed.

C. The Selected Remedial Action is Cost-Effective

Once EPA has identified alternatives that are protective, EPA analyzes those alternatives to determine a cost-efficient means of achieving the cleanup. The costs of the alternatives are within the +50% to -30% accuracy required for Feasibility Study estimates.

EPA believes the selected remedy is cost-effective because the remedy provides overall effectiveness proportional to its costs. The slightly greater cost of the selected remedy is justified because the process used in the alternative is more reliable for the Hot Spot sediments than those called for in the other removal and treatment alternatives. While the other removal and treatment alternatives appear to be slightly less expensive, they do not assure destruction of the high levels of PCBs in the Hot Spot sediment to the same degree as the selected remedy. Finally, it is highly probable that additional costs may be incurred from the need for managing the treatment residuals which would be derived from the other alternatives.

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selection of treatment for the highly contaminated sediment is consistent with mandates of CERCLA that highly toxic and mobile wastes are a priority for treatment, and that treatment is often necessary to ensure the long-term effectiveness of a remedy.

Incineration, the principal remedial component of the selected remedy, is a treatment technology that will provide a permanent solution to the contaminated sediment problem in the Hot Spot Area. Dredging of the Hot Spot sediments and treatment by incineration will reduce the risks posed to public health from direct contact with contaminated sediments in this area, as well as address the environmental risks in this area.

Thus, the selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, as mandated by statute.

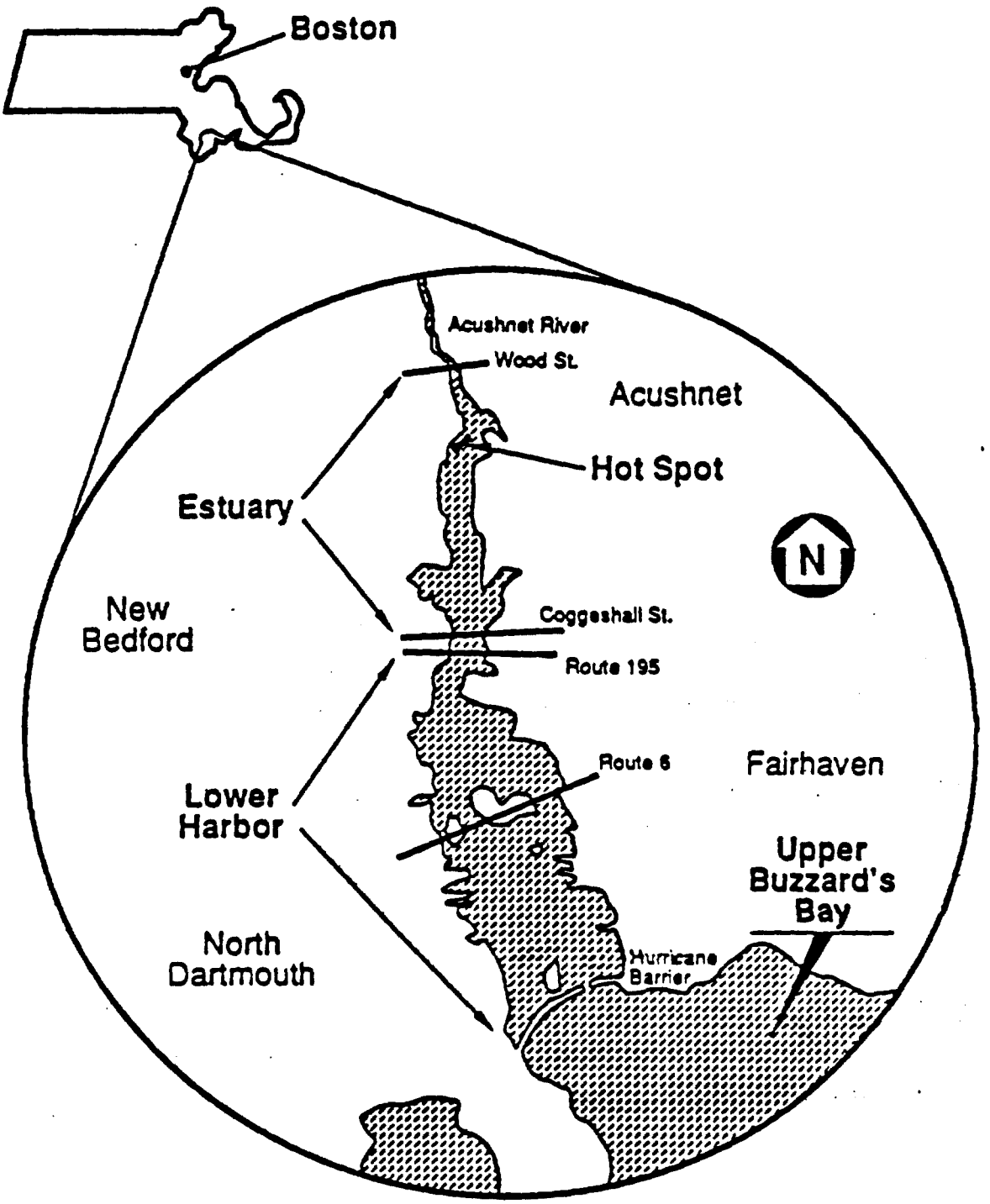
E. The Selected Remedy Satisfies the Preference for Treatment as a Principal Element

The principal element of the selected source control remedy consists of removal and on-site incineration of the contaminated Hot Spot sediments. The selected remedy thus addresses the principal threat at the Hot Spot Area through the use of a treatment technology. Therefore, the selected remedy satisfies the statutory preference for treatment as a principal element that permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances.

XII. STATE ROLE

The Massachusetts Department of Environmental Protection (DEP) has reviewed the various alternatives and fully supports the selected remedy. The Commonwealth of Massachusetts has also reviewed this Record of Decision to determine if the selected remedy will comply with State action-specific ARARs. The Commonwealth concurs with the selected remedy for the New Bedford Harbor/Hot Spot Area. A copy of the declaration of concurrence is attached as Appendix C.

FIGURE 1
SITE LOCATION MAP



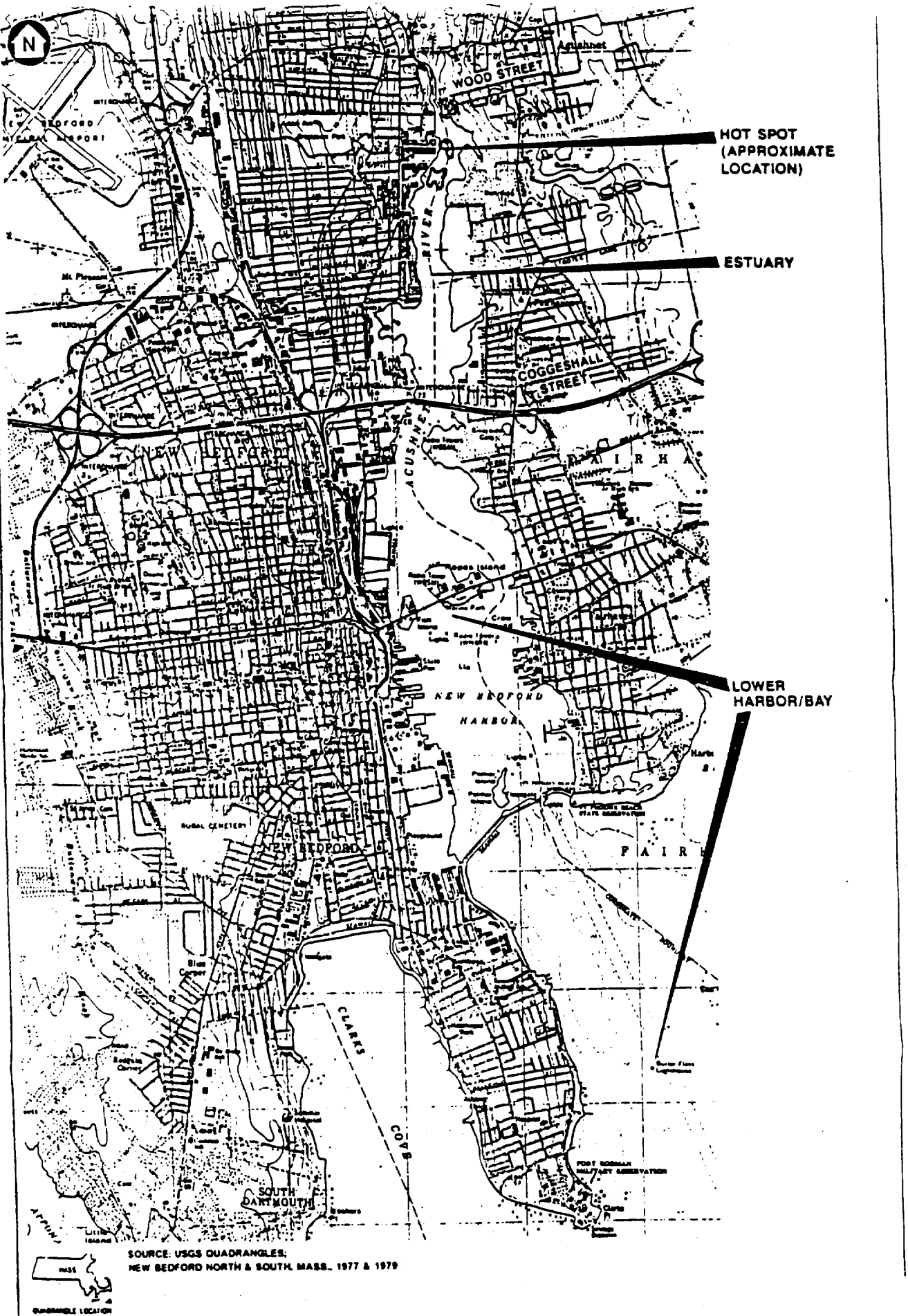


FIGURE 2
GEOGRAPHICAL STUDY AREAS

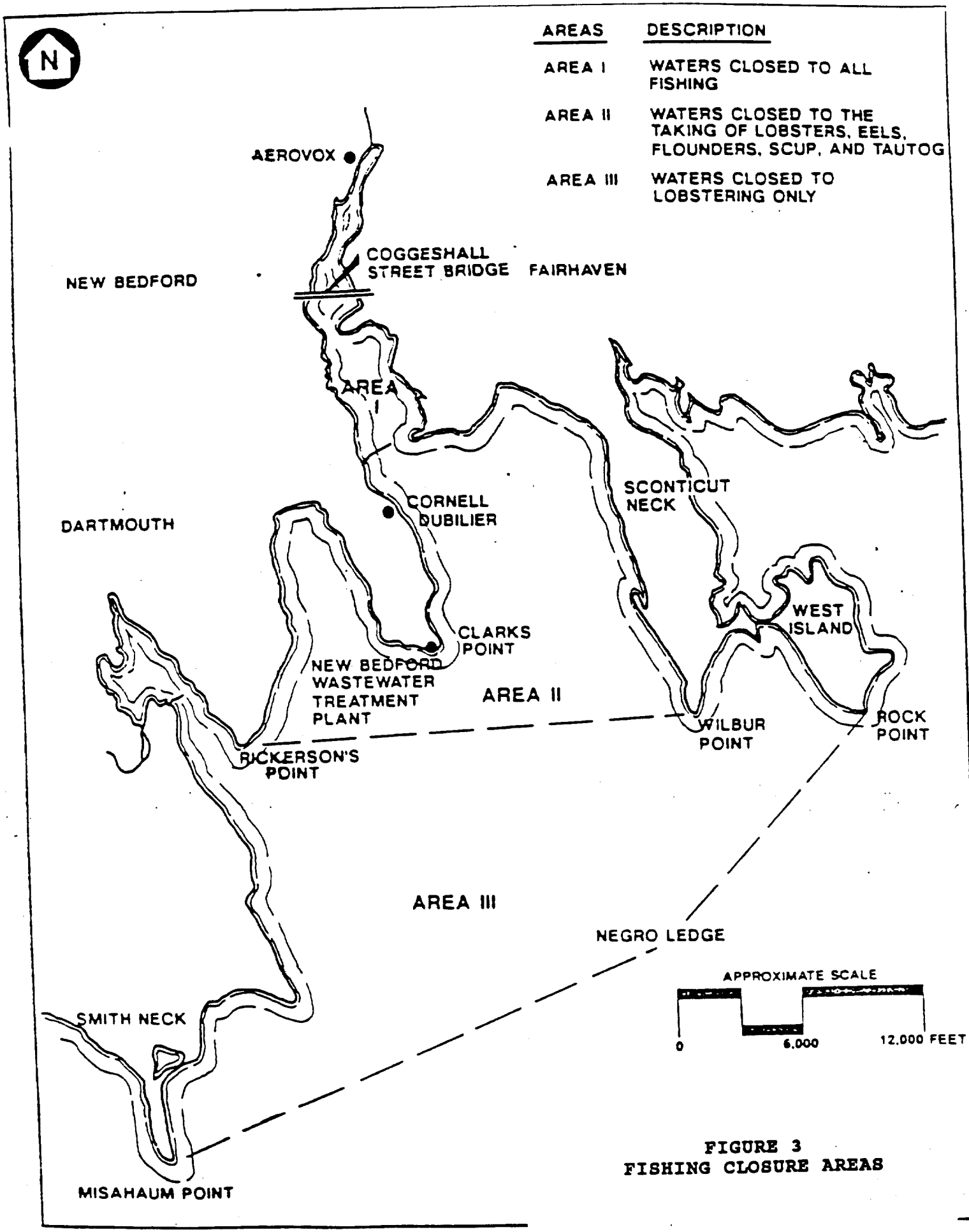


FIGURE 3
FISHING CLOSURE AREAS

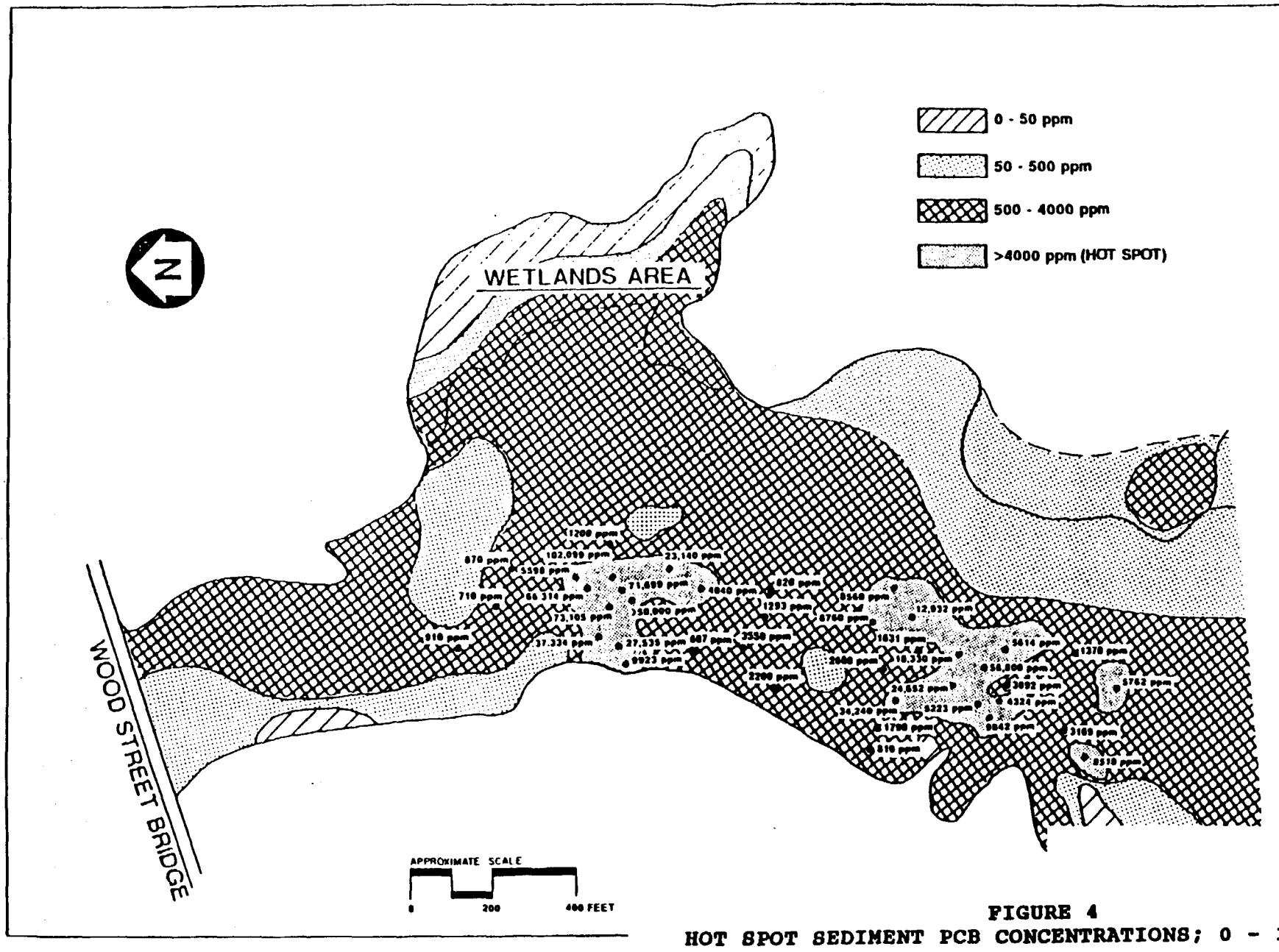


FIGURE 4
HOT SPOT SEDIMENT PCB CONCENTRATIONS; 0 - 12 INCHES

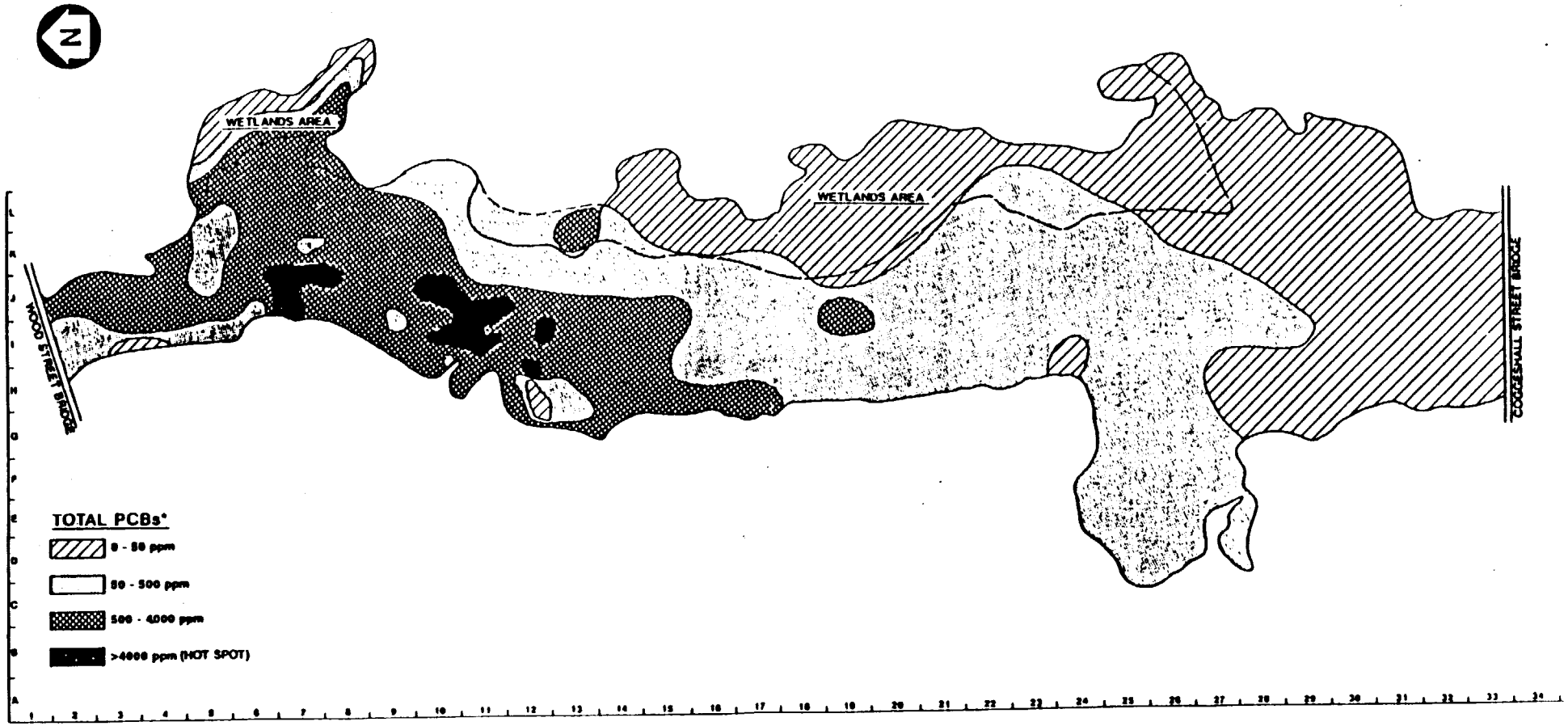


FIGURE 5

INTERPRETATION OF TOTAL PCB CONCENTRATIONS* DEPTH: ZERO TO 12 INCHES HOT SPOT FEASIBILITY STUDY NEW BEDFORD HARBOR

* SUM OF AVAILABLE AROCHLOR DATA

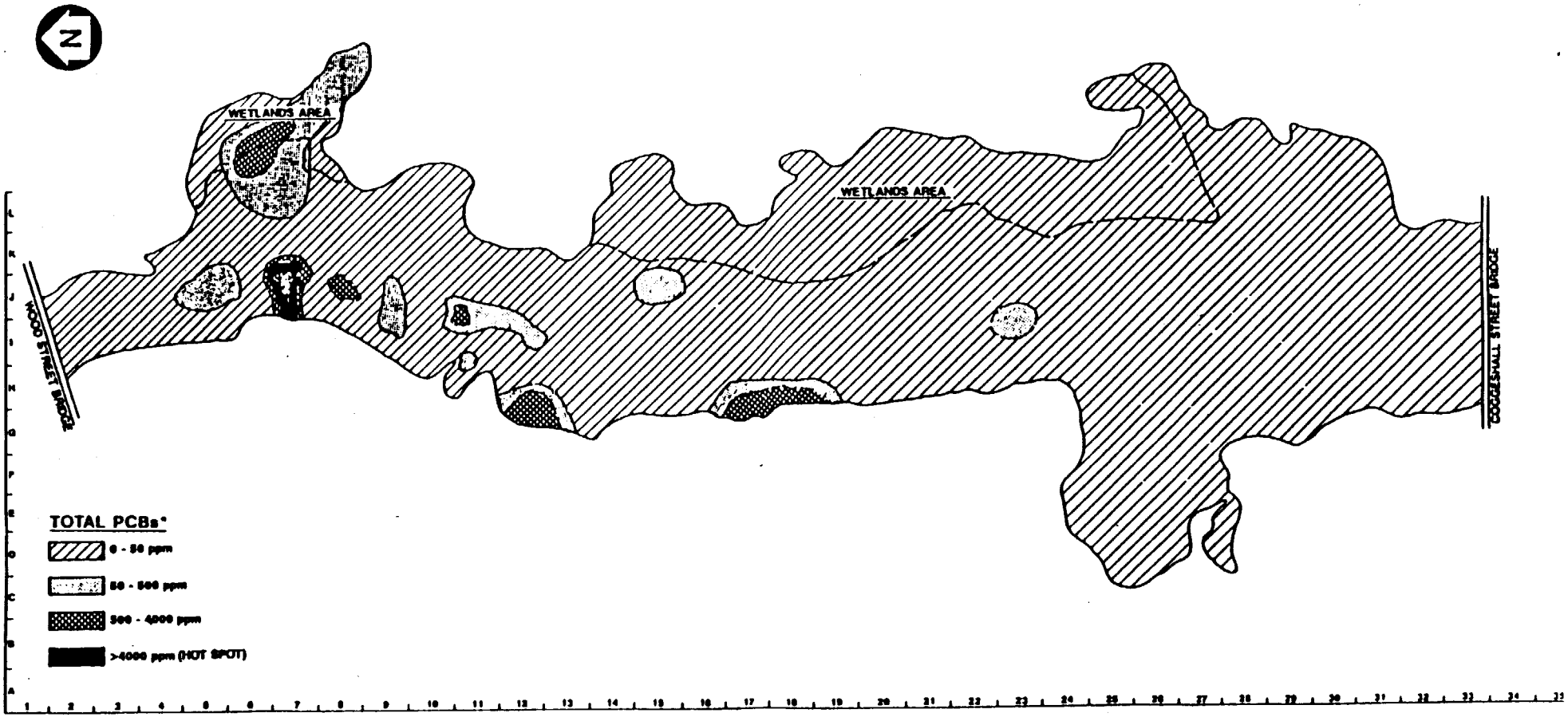


FIGURE 6

INTERPRETATION OF
TOTAL PCB CONCENTRATIONS*
DEPTH: 12 TO 24 INCHES
HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR

* SUM OF AVAILABLE AROCHLOR DATA

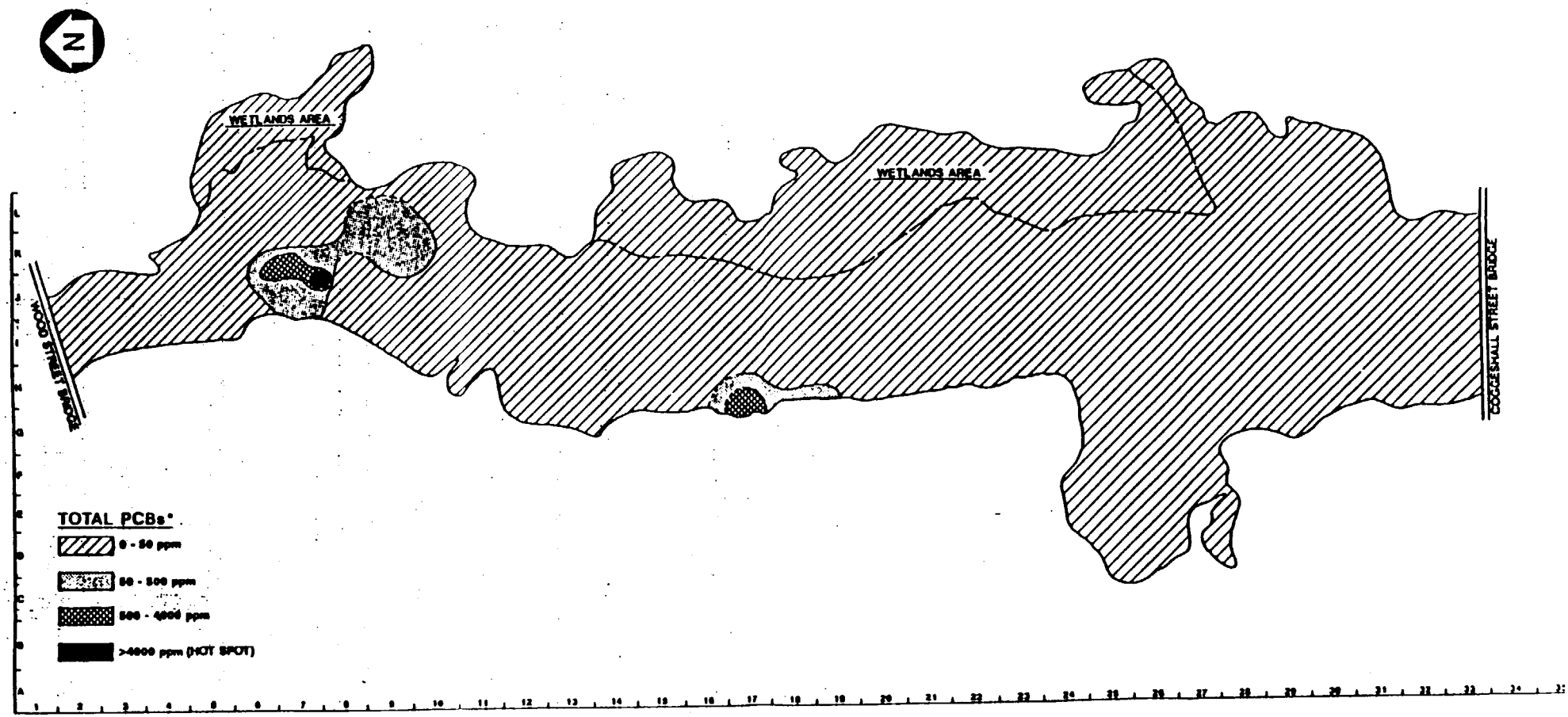


FIGURE 7

INTERPRETATION OF
TOTAL PCB CONCENTRATIONS*
DEPTH: 24 TO 36 INCHES
HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR

FIGURE 8
PCB MASS VERSUS VOLUME

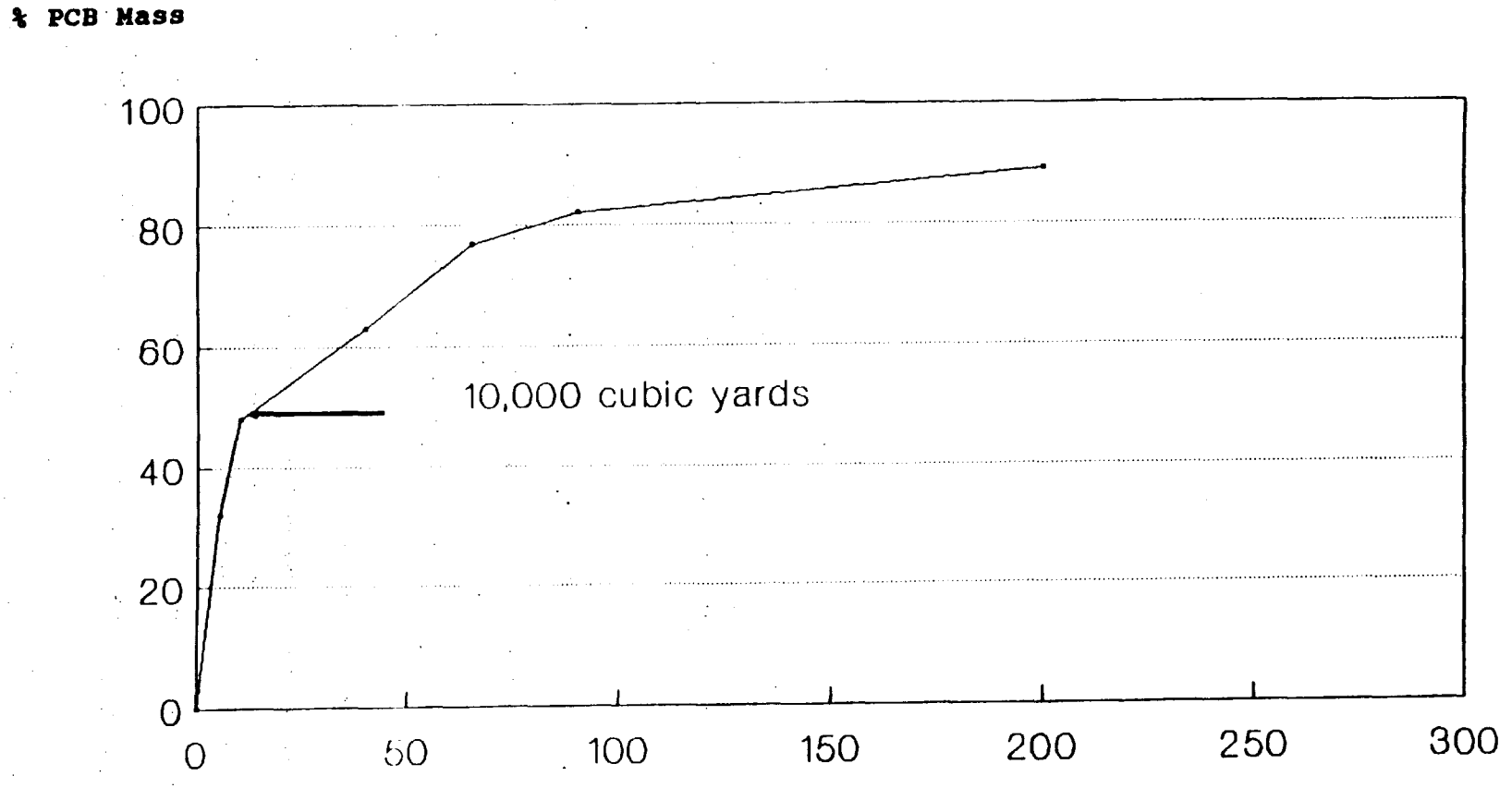
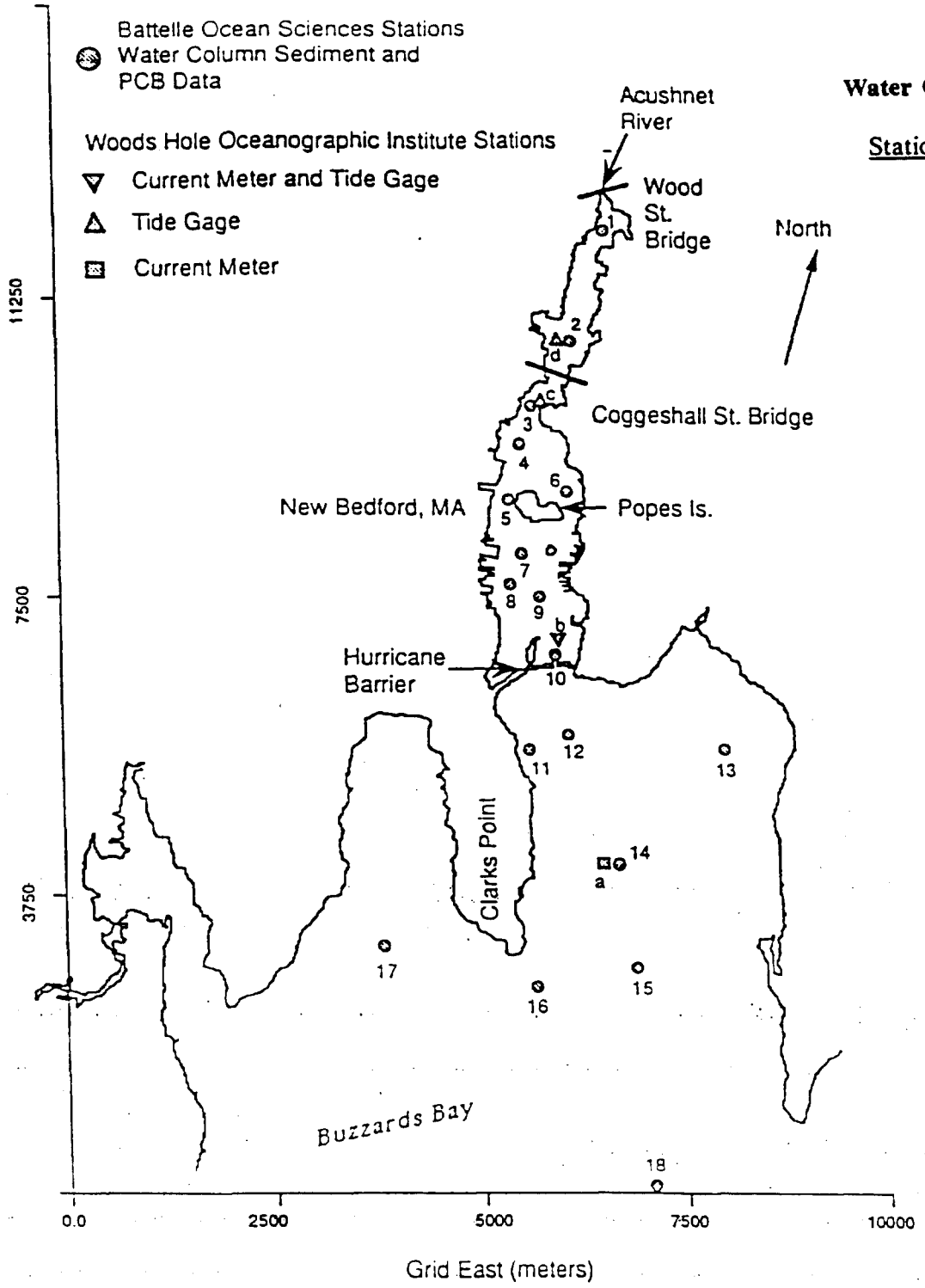


FIGURE 9
SURFACE WATER PCB CONCENTRATIONS



Water Column PCB Concentrations

Station No.	PCB Conc. (ng/ℓ)[1]
1	7635
2	1021
3	269
4	209
5	170
6	318
7	93
8	142
9	91
10	111
11	90
12	46
13	15
14	26
15	14
16	25
17	12
18	5

needs darker

Notes:

1. Water column PCB concentrations are based on the sum of geometric mean values for particulate and dissolved samples obtained from the respective sampling stations.

Reference:

"New Bedford Harbor Database," Battelle Ocean Sciences/Ebasco, 1989.

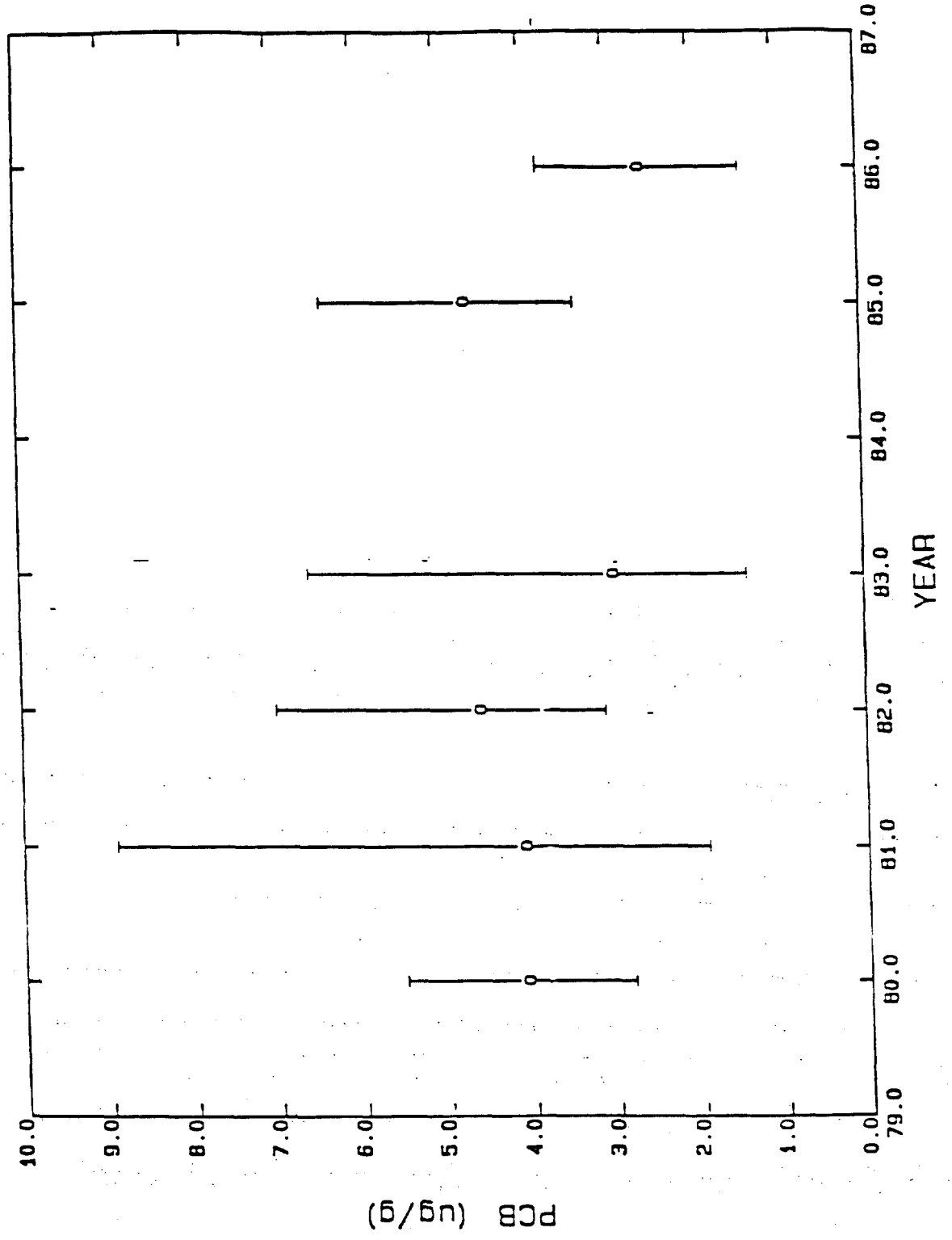


FIGURE 10

PCB CONCENTRATIONS (INCLUDING TOMALLEY) FROM LOBSTERS IN AREA 3: 1979-1987

Source: Dept. of Marine Fisheries; Spring Sampling

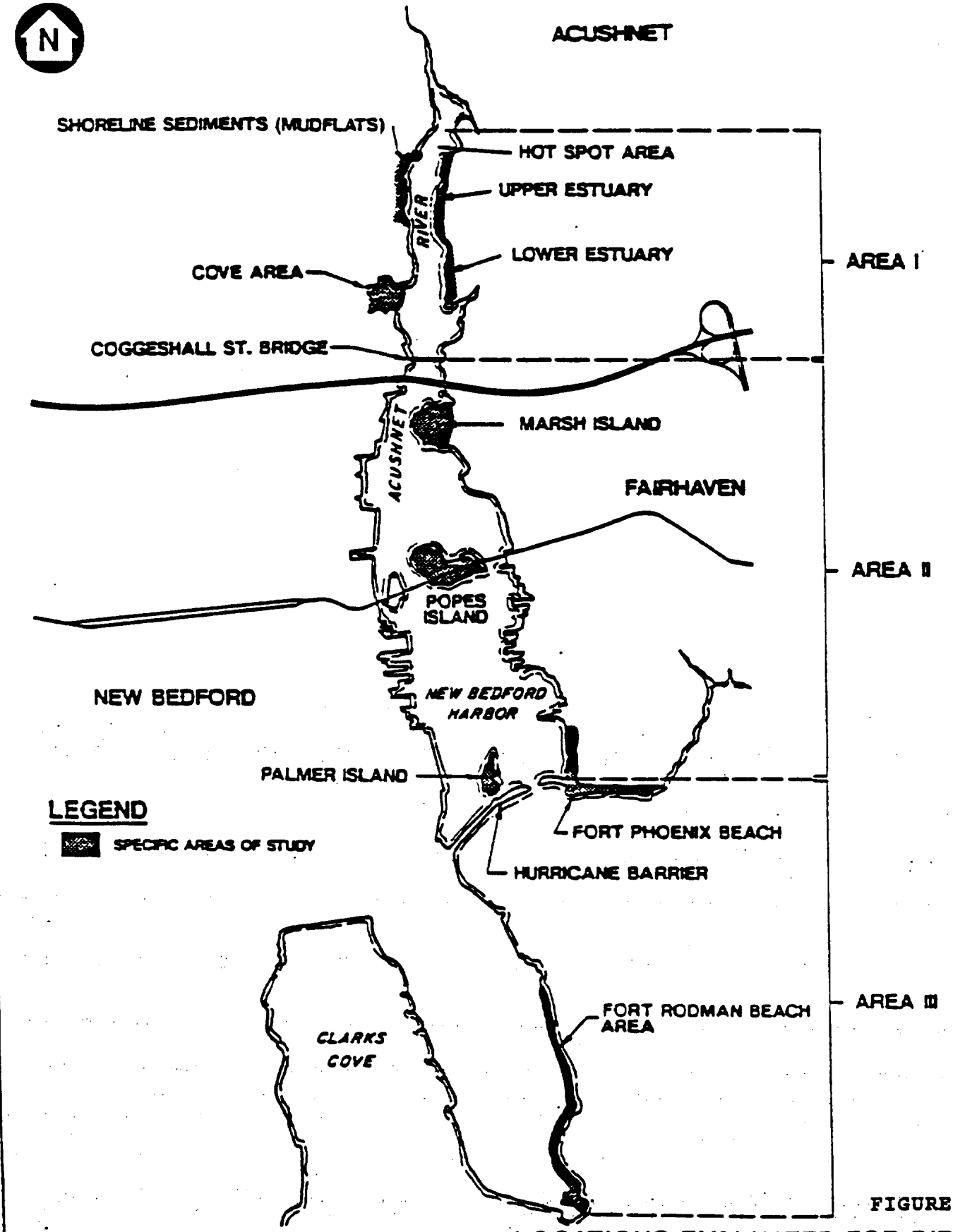


FIGURE 11

LOCATIONS EVALUATED FOR DIRECT CONTACT AND INGESTION EXPOSURE TO CONTAMINANTS IN SEDIMENTS HOT SPOT FEASIBILITY STUDY NEW BEDFORD HARBOR

4959-22

FIGURE 12

Preferred Alternative for Hot Spot Sediments

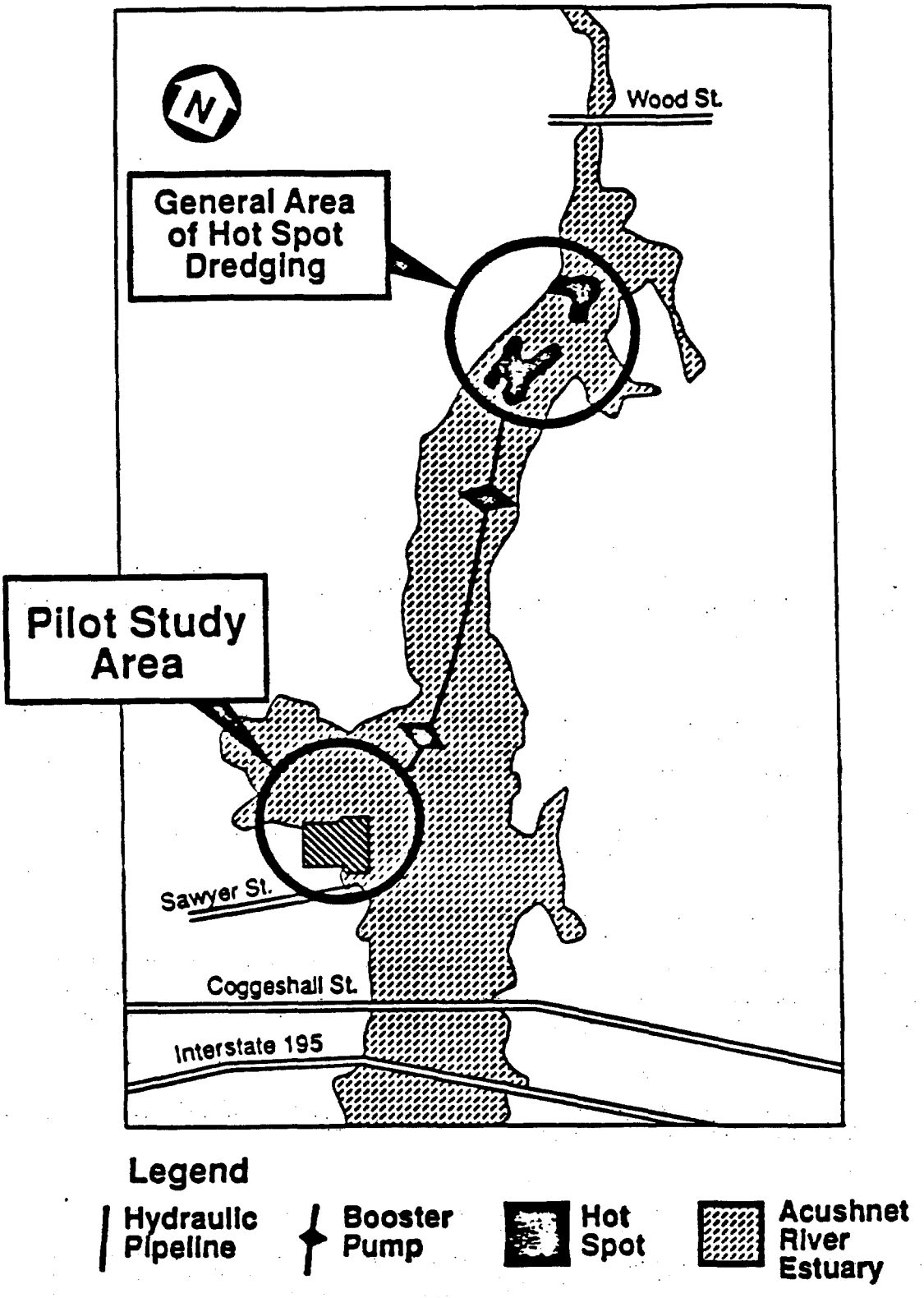


TABLE 1

CONCENTRATIONS OF TOTAL PCBs (ppm) IN EDIBLE TISSUE OF BIOTA COLLECTED FROM NEW BEDFORD HARBOR NEW BEDFORD, MASSACHUSETTS

Species	Area I [1]	Area II [1]	Area III [1]	Outside of Closure Areas [1]
American Lobster [2]				
Mean	NC	0.568	0.231	0.064
Maximum	NC	1.234	0.351	0.176
Winter Flounder [3]				
Mean	1.039	0.371	0.278	0.101
Maximum	2.629	1.048	0.825	0.340
Clam				
Mean	0.689	0.231	0.156	0.039
Maximum	2.121	1.181	0.478	0.137

Notes:

1 = Areas refer to DPH Fishing Closure Areas.
2 = Lobster concentrations do not include tomalley.
3 = The edible tissue concentration was estimated using a whole body/edible tissue ratio of 0.13 (Batelle, 1987).
NC = Not Collected; lobsters were not collected from Area I.
Mean = Arithmetic mean value of all samples collected.
Maximum = Maximum value detected in each Area.

Reference:

"Draft Final Baseline Public Health Risk Assessment," EC Jordan/Ebasco, 1989.

TABLE 2

SUMMARY OF RISK ESTIMATES FOR
PCB CONTAMINATED SEDIMENT, DIRECT CONTACT-CHRONIC EXPOSURE[1]

LOCATION	SEDIMENT PCB CONCENTRATION (ppm)		NONCARCINOGENIC RISKS		CARCINOGENIC RISKS	
	Mean Conc.	Max. Conc.	Mean Conc.	Max. Conc.	Mean Conc.	Max. Conc.
Hot Spot[2]	9923	NA	63	NA	7×10^{-3}	NA
Upper Estuary[3]	378	6393	2.4	40	3×10^{-4}	4×10^{-3}
Lower Estuary[3]	149	399	0.9	2.6	1×10^{-4}	2×10^{-4}
Cove Area[3]	286	399	1.8	2.6	2×10^{-4}	2×10^{-4}

Notes:

[1] Direct Contact exposure for direct contact only. Hypothetical exposure for an older child, age 6-16 over a 10 year period. Exposure frequency of 20 times per year.

[2] Hot Spot concentration from one sample for an area of probable exposure along western shore of the Acushnet River Estuary. (See Figure 4 for location)

[3] Exposure locations for Upper Estuary, Lower Estuary and Cove Areas are depicted on Figure 11.

NA = Not Applicable

References: "Draft Final Hot Spot Feasibility Study", EC Jordan/Ebasco 1989 and "Draft Final Baseline Public Health Risk Assessment", EC Jordan/Ebasco 1989.

TABLE 3

LIFETIME CARCINOGENIC PUBLIC HEALTH RISKS
INGESTION OF CONTAMINATED BOITA

Source	PCB Conc. (ppm^2)	Frequency of Exposure	Lifetime Risk (70 years)
Lobster[2]	2.3	Daily	7.3×10^{-2}
		Weekly	1.0×10^{-2}
		Monthly	2.5×10^{-3}
Flounder	0.371	Daily	1.2×10^{-2}
		Weekly	1.7×10^{-3}
		Monthly	3.9×10^{-4}
Clam	0.231	Daily	7.3×10^{-3}
		Weekly	1.1×10^{-3}
		Monthly	2.4×10^{-4}

Notes:

1. All biota concentrations are mean values from the DPH Fishing Closure Area II.
2. Lobster edible tissue includes the tomalley.

Reference:

"Draft Final Baseline Public Health Risk Assessment," EC Jordan/Ebasco, 1989.

TABLE 4

SUMMARY OF HOT SPOT ALTERNATIVES

HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR, MASSACHUSETTS

ALTERNATIVE DEVELOPMENT (SUBSECTION 6.1)		ALTERNATIVES ELIMINATED DURING SCREENING (SUBSECTION 6.3)	ALTERNATIVES REMAINING FOR DETAILED EVALUATION
HS-NA-1	No-action		HS-NA-1 (HS-1)
HS-CONT-1	Capping	HS-CONT-1	
HS-CONT-2	Embankment/Capping	HS-CONT-2	
HS-DISP-1	Confined Aquatic Disposal	HS-DISP-1	
HS-DISP-2	Out-of-State TSCA/RCRA Disposal	HS-DISP-2	
HS-TREAT-1	On-site Incineration		HS-TREAT-1 (HS-2)
HS-TREAT-2	Solidification		HS-TREAT-2 (HS-3)
HS-TREAT-3	Solvent Extraction		HS-TREAT-3 (HS-4)
HS-TREAT-4	Off-site Incineration	HS-TREAT-4	

TABLE 5

COMPARATIVE ANALYSIS SUMMARY TABLE

HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR, MASSACHUSETTS

ASSESSMENT FACTORS	ALTERNATIVE HS-1 NO-ACTION	ALTERNATIVE HS-2 INCINERATION	SOLIDIFICATION/DISPOSAL	SOLVENT EXTRACTION
• Reduction of Toxicity, Mobility, or Volume	No reduction in toxicity, mobility, or volume since no treatment is employed.	Reduction in toxicity and mobility of PCB-sediments. Volume also reduce unless ash is solidified to prevent metals leaching.	Reduction in mobility of the Hot Spot Sediments. No reduction in toxicity. Volume increased by solidification.	Reduction in toxicity and mobility of PCB sediments. Volume will increase if solidification is employed to prevent metal leaching.
• Short-term Effectiveness				
- Time Until Protection is Achieved	Reduction in public health risk due to direct contact could be achieved in one month. No reduction in environmental risk.	Reduction in public health and environmental risk should occur within one year after remedial action is initiated.	Same as Alternative HS-2.	Same as Alternative HS-2.
- Protection of Community During Remedial Actions	No impact to community during remedial action.	Dredge controls and air quality controls will minimize community impacts.	Same as Alternative HS-2.	Same as Alternative HS-2.
- Protection of Workers During Remedial Actions	Minimal risk to workers during fence/sign installation.	Protection required against dermal contact with dredged sediments and fugitive dust from dewatered sediments and ash.	Protection required against dermal contact with dredged sediments and fugitive dust from dewatered sediments and solidification process.	Protection required against dermal contact with dredged sediments and fugitive dust from dewatered and treated sediments.
- Environmental Impacts	No significant adverse environmental impact from fence installation.	Minimal environmental impact expected from dredging or construction.	Same as Alternative HS-2.	Same as Alternative HS-2.
• Long-term Effectiveness				
- Magnitude Of Residual Risk	Significant risks remain for public health associated with direct contact of surface soils. Environmental risks would continue unmitigated.	After sediments have been incinerated and the ash solidified (if needed). There will be minimal risk associated with the treated sediments.	After sediments have been solidified and disposed off-site, there will be minimal residual risk.	After sediments have been treated and solidified (if needed), there will be minimal residual risk.
- Adequacy of Controls	No direct engineering controls; fence subject to vandalism; annual monitoring and repair required.	Incineration is a proven technology; no long-term management of treatment residuals required.	TSCA/RCRA landfill is a proven technology; annual monitoring and maintenance is required.	Treatment by solvent extraction is expected to produce treated sediment that will not need long-term control.

(continued)
COMPARATIVE ANALYSIS SUMMARY TABLE

HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR, MASSACHUSETTS

ASSESSMENT FACTORS	ALTERNATIVE HS-1 NO-ACTION	ALTERNATIVE HS-2 INCINERATION	SOLIDIFICATION/DISPOSAL	SOLVENT EXTRACTION
- Reliability of Controls	Sole reliance on fence and institutional controls to prevent exposure; high level of residual risk.	Remedy will be highly reliable due to removal of sediment causing risk.	Likelihood of landfill failure is small as long as O&M is performed.	Same as Alternative HS-2.
• Implementation				
- Technical Feasibility	Fence/signs are easily constructed; environmental monitoring well-proven.	Incineration would require special equipment and operators; treated residuals would require testing to verify treatment effectiveness; technology has been demonstrated at other sites.	TSCA/RCRA Landfill easy to implement; dewatering and solidification of sediments proven during bench- and pilot-scale tests.	Solvent extraction would require special equipment and operators; treated residuals would require testing to verify treatment effectiveness; technology has been pilot-tested on Hot Spot sediments.
- Administrative Feasibility	No off-site construction; therefore, no permits required.	Same as Alternative HS-1.	Same as Alternative HS-1.	Same as Alternative HS-1.
- Availability of Services and Materials	Services and materials locally available.	Dredge, dewatering, and mobile incinerator equipment and operators needed; available services in eastern United States.	Dredge, dewatering, and solidification services available in eastern United States. TSCA/RCRA disposal facility not locally available.	Solvent extraction equipment available from vendors but not readily. Equipment construction or pilot-scale tests may be required.
• Cost				
- Capital Cost	$ 48,000	$14,397,300	$13,300,200	$12,168,650
- O&M Cost	407,000	--	--	--
- Present Worth Cost	455,000	14,397,300	13,300,200	12,168,650
• Compliance with ARARs/TBCs				
- Compliance with ARARs	AWQCs will not be attained.	AWQCs will not be attained. All other ARARs will be met.	Same as Alternative HS-2.	AWQCs will not be attained. Solvent extraction will need to achieve equivalent performance standards.
- Appropriateness of Waivers	Not justifiable	Justifiable based on interim remedy.	Same as Alternative HS-2.	Same as Alternative HS-2.

(continued)
COMPARATIVE ANALYSIS SUMMARY TABLE

HOT SPOT FEASIBILITY STUDY
NEW BEDFORD HARBOR, MASSACHUSETTS

ASSESSMENT FACTORS	ALTERNATIVE HS-1 NO-ACTION	ALTERNATIVE HS-2 INCINERATION	SOLIDIFICATION/DISPOSAL	SOLVENT EXTRACTION
- Compliance with Criteria, Advisories, and Guidance	Does not meet FDA level for PCBs in fish and shellfish.	Is not expected to achieve FDA level for PCBs in fish and shellfish.	Same as Alternative HS-2.	Same as Alternative HS-2.
• Overall Protection of Human Health and the Environment				
- How Risks are Reduced, Eliminated, or Controlled	Risks to public health are reduced by restricting site access; environmental risks are not mitigated.	Risks to public health and the environment are significantly reduced by the removal and treatment of the Hot Spot.	Same as Alternative HS-2.	Same as Alternative HS-2.

TABLE 6

ALTERNATIVE HS-2 ACTION-SPECIFIC ARAR EVALUATION
DREDGING AND ON-SITE INCINERATION OF HOT SPOT SEDIMENT

1. **Authority** - Federal Regulatory Requirements (FRR)

Requirement
RCRA - General Facility Standards (40 CFR 264.10 - 264.18)

Status
Relevant and Appropriate

Requirement Synopsis
General facility requirements outlining general waste analysis, security measures, inspections, training, and location standards.

Corresponding Remedial Action(s)
Facility will be constructed, fenced, and operated in accordance with this requirement. All workers will be properly trained. A written waste analysis plan must be developed and maintained on-site. Site entry must be prevented by a 24-hour surveillance system and appropriate signs posted. A written inspection program must be developed, and all personnel must complete an on-the-job training program to ensure facility compliance.

****

2. **Authority** - FRR

Requirement
RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.37)

Status
Relevant and Appropriate

Requirement Synopsis
This regulation outlines requirements for safety equipment and spill control.

Corresponding Remedial Action(s)
Safety and communication equipment will be installed on-site; local authorities will be familiarized with the site.

****

3. **Authority** - FRR

Requirement
RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)

Status
Relevant and Appropriate

Requirement Synopsis
Every hazardous waste facility must have a contingency plan that is implemented immediately upon fire, explosion, or release of harmful hazardous waste constituents.

Corresponding Remedial Action(s)
Plans will be developed during remedial design. Copies of the plans will be kept on-site and will be distributed to the appropriate persons.

****

4. **Authority** - FRR

Requirement
RCRA - Incinerators (40 CFR 264.340 - 264.599)

Status
Applicable

Requirement Synopsis
This regulation specifies the performance standards, operating requirements, monitoring, inspection, and closure guidelines of any incinerator burning hazardous waste.

Corresponding Remedial Action(s)
The transportable on-site incinerator will be operated in accordance with the applicable RCRA requirements.

****

5. **Authority** - State Regulatory Requirements (SRR)

Requirements
DEP - Hazardous Waste Regulations (310 CMR 30.00)

Status
Relevant and Appropriate

Requirement Synopsis
These regulations specify the Massachusetts requirements for hazardous waste facilities.

Corresponding Remedial Action(s)
During remedial design, these regulations will be compared to the corresponding federal RCRA regulations, and the more stringent requirements will be addressed.

6. **Authority** - SRR

Requirement
DEP - Solid Waste Management Regulations (310 CMR 19.00)

Status
Applicable

Requirement Synopsis
These regulations outline the Commonwealth of Massachusetts' procedures for regulating solid waste activities.

Corresponding Remedial Action(s)
During remedial design, the use of the CDF for storage of treated material will address these requirements.

****

7. **Authority** - FRR

Requirement
TSCA - Storage and Disposal (40 CFR 761.60 - 761.79)

Status
Applicable

Requirements
These regulations specify the disposal/destruction requirements of PCB materials in excess of 50 ppm. Dredged materials with PCB concentrations greater than 50 ppm may be disposed by alternative methods which are protective of human health and the environment, if shown that incineration or disposal in a chemical landfill is not reasonable or appropriate.

Corresponding Remedial Action(s)
The requirements of this regulation will be attained during remedial action. A test burn will be conducted to determine optimum equipment configuration and operating parameters to achieve the required PCB destruction removal efficiencies.

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8. **Authority** - FRR

Requirement
Clean Water Act (CWA) - 40 CFR, Parts 125, 230, and 307

Status
Applicable

Requirement Synopsis
These regulations specify that a best management program (BMP) be developed to minimize release of pollutants from the facility. These requirements also state that no alternative that impacts a wetland shall be allowed if there is a practicable alternative. If there is no practicable alternative, impacts must be mitigated. Effluent standards incorporated by reference are considered for target levels.

Corresponding Remedial Action(s)
A BMP will be developed and will include sedimentation control around the excavation/dredging area. Since dredging of the Hot Spot sediments is necessary since it is the sediments themselves that are contaminated, dredging will be conducted to minimize impacts to the Estuary and adjacent wetland areas. Dewatering effluent levels will utilize best available control technology to reduce contaminant levels prior to discharge.

****

9. **Authority** -Federal Criteria, Advisories, and Guidance (FCAG)

Requirement
Federal Ambient Water Quality Criteria (AWQC)

Status
Applicable

Requirement Synopsis

Federal AWQC are health-based criteria that have been developed for 95 carcinogenic and noncarcinogenic compounds.

Corresponding Remedial Action(s)
AWQC are incorporated into Massachusetts DEP surface water quality standards. Levels for effluent generated by dewatering will reflect current guidance.

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10. **Authority** - SRR

Requirement
DEP - Massachusetts Surface Water Quality Standards (310 CMR 4.00) and Wastewater Treatment (310 CMR 12.00)

Status
Applicable

Requirement Synopsis
DEP Surface Water Quality Standards incorporate the federal AWQC as standards for the state surface water.

Corresponding Remedial Action(s)
Dredging will be implemented to minimize sediment resuspension and subsequent PCB mobility. Effluent from the dewatering of the sediments will also use these standards as target levels and will utilize best available control technology.

****

11. **Authority** - FRR

Requirement
Clean Air Act (CAA) - National Ambient Air Quality Standards (NAAQS) (40 CFR Part 40)

Status
Relevant and Appropriate

Requirement Synopsis
These standards were primarily developed to regulate stationary stack and automobile emissions.

Corresponding Remedial Action(s)
Incinerator emissions will be controlled by Best Available Control Technology such that the regulations are met. In addition, fugitive dust in the work area will be controlled by water sprays or other dust suppressants, as required.

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12. **Authority** - SRR

Requirement
DEP - Air Quality and Air Pollution Control (310 CMR 6.00 - 8.00)

Status
Relevant and Appropriate

Requirement Synopsis
These standards were primarily developed to regulate stationary stack and automobile emissions.

Corresponding Remedial Action(s)
Incinerator emissions will be controlled by best available control technology so that the regulations are met. In addition, fugitive dust in the work areas will be controlled by water sprays or other dust suppressants, as required.

****

13. **Authority** - Federal Executive Order

Requirement
Wetlands Executive Order (EO 11990)

Status
Applicable

Requirement Synopsis
Under this regulation, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and beneficial values of wetlands.

Corresponding Remedial Action(s)
Dredging in the wetland is required to remove the Hot Spot contamination. However, dredging of Hot Spot sediment will attempt to minimize impacts to the extent practicable.

****

14. **Authority** - Federal Executive Orders

Requirement
Floodplains Executive Order (EO 11988)

Status
Applicable

Requirement Synopsis
Federal agencies are required to reduce the risk of flood loss, to minimize impact of floods, and to restore and preserve the natural and beneficial value of floodplains.

Corresponding Remedial Action(s)
Dredging of sediment from the Hot Spot is expected to have minimal impact on the floodplain of the Acushnet River.

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15. **Authority** - SRR

Requirement
DEP - Wetlands Protection (310 CMR 10.00) and
Certification for Dredge and Fill (314 CMR 9.00)

Status
Applicable

Requirement Synopsis
These regulations are promulgated under Wetlands Protection Laws, which regulate dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is regulated under this requirement. The requirement also defines wetlands based on vegetation type and requires that effects on wetlands be mitigated.

Corresponding Remedial Action(s)
Dredging in the wetland is required to remove the Hot Spot contamination since it is the sediments themselves that are contaminated. However, dredging of Hot Spot sediment will attempt to minimize impacts to the extent practicable.

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16. **Authority** - SRR

Requirement
Coastal Zone Management (301 CMR 20.00)

Requirement Synopsis
Under these regulations, agencies are required to minimize the destruction, loss, or degradation of wetlands, and beneficial values of wetland.

Corresponding Remedial Actions
Dredging is required to remove the Hot Spot contamination. However, dredging of Hot Spot sediments will utilize various control options and will attempt to minimize impacts to the extent practicable.

****

17. **Authority** - FRR

Requirement
OSHA - General Industry Standards (29 CFR Part 1910)

Status
Applicable

Requirement Synopsis
These regulations specify the 8-hour, time-weighted average concentrations for various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.

Corresponding Remedial Action(s)
Proper respiratory equipment will be worn, if necessary, if it is impossible to maintain the work atmosphere below the allowable concentrations. Workers performing remedial activities will be required to have completed specified training requirements. Air monitoring will be conducted during remedial activities.

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18. Authority - FRR

Requirement
OSHA - Safety and Health Standards for Federal Service Contracts (29 CFR 1926)

Status
Applicable

Requirement Synopsis
This document contains instructions concerning worker safety at RCRA or Superfund hazardous waste facilities.

Corresponding Remedial Action(s)
All appropriate safety equipment will be maintained on-site, and appropriate safety procedures will be followed during remediation.

****

19. Authority - FRR

Requirement
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)

Status
Applicable

Requirement Synopsis
This regulation outlines OSHA recordkeeping and reporting regulations for an employer.

Corresponding Remedial Action(s)
This regulation is applicable to the remedial action contractor(s) operating the facility, and compliance with this requirement will be included in the contract.

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20. **Authority** - SRR

Requirement
DEP - Hazardous Substance Right-to-Know (310 CMR 33);
DPH - Hazardous Substance Right-to Know (105 CMR 670)

Status
Applicable

Requirement Synopsis
These regulations outline the informational requirements for hazardous substances that may affect workers associated with the Department of Environmental Protection or the Department of Public Health.

Corresponding Remedial Action(s)
The requirements of these regulations will be attained during alternative implementation.

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