New Bedford
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ARCS I PROGRAM

Remedial Planning Activities at Selected Uncontrolled Hazardous Substance Disposal Sites Within EPA Region I
(ME, VT, NH, MA, CT, RI)

EPA Contract 68-W9-0034

EBASCO SERVICES INCORPORATED

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ARCS I WORK ASSIGNMENT NUMBER 012-1L43
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EBASCO SERVICES INCORPORATED

DRAFT FINAL
SUPPLEMENTAL FEASIBILITY STUDY EVALUATION FOR UPPER BUZZARDS BAY
NEW BEDFORD HARBOR RI/FS
NEW BEDFORD, MASSACHUSETTS

MAY, 1992

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DRAFT FINAL SUPPLEMENTAL FEASIBILITY STUDY EVALUATION FOR UPPER BUZZARDS BAY NEW BEDFORD HARBOR RI/FS NEW BEDFORD, MASSACHUSETTS

MAY, 1992

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EXECUTIVE SUMMARY

A series of five remedial action alternatives have been developed to address potential threats to human health and the environment due to polychlorinated biphenyl (PCB) contaminated sediments present in the Upper Buzzards Bay portion of the New Bedford Harbor Superfund Site.

New Bedford, Massachusetts, home port of a major commercial fishing fleet, is located approximately 55 miles south of Boston on Buzzards Bay. In 1979, New Bedford Harbor and Upper Buzzards Bay were closed to fishing due to PCB contamination and PCB accumulation in marine biota. The New Bedford Harbor site was added to the U.S. Environmental Protection Agency (EPA) Superfund National Priorities List in 1982.

PCB contamination was introduced into New Bedford Harbor primarily as a result of the discharge of process wastewaters from electronics component manufacturing companies in New Bedford. The most heavily contaminated sediments are located in surficial sediments of the Estuary and Lower Harbor. In the Upper Buzzards Bay portion of the site, contamination is widely distributed but in lower concentrations than found in the estuary or lower harbor and ranges from non-detect to approximately 50 - 100 ppm in a few localized hot spots. Field studies and numerical transport modeling results suggest that some but potentially not all of the sediment PCB contamination in Upper Buzzards Bay can be attributed to transport and deposition from the more highly contaminated sediments of the Estuary and Lower Harbor.

Following identification of PCBs in New Bedford Harbor, numerous field sampling programs were conducted and the resulting data compiled by EPA. Under contract to EPA, a Feasibility Study (FS) was conducted by NUS Corporation (NUS) in 1984 to address contamination in the Estuary. In response to comments and concerns raised as a result of the FS, EPA conducted further studies to better characterize the site. These studies included an engineering feasibility study of dredging and dredged material disposal alternatives and a pilot study of dredging and disposal by the U.S. Army Corps of Engineers; wetland assessments by Sandford Ecological Services, Inc., and IEP, Inc.; and a sediment transport and food chain model by Battelle Pacific Northwest Laboratories and HydroQual, Inc., respectively. In 1986, Ebasco Services, Inc., was contracted to prepare an FS under the EPA REM III Program that would incorporate the additional studies with the work conducted by NUS and provide EPA with a range of alternatives to remediate PCB and metals contamination in New Bedford Harbor.

In 1989, a 5-acre area, known as the Hot Spot and containing 45 percent of the total PCB mass in New Bedford Harbor, was designated as a separate operable unit by EPA Region I. An FS of remedial alternatives for the Hot Spot was completed in July 1989, and a Record of Decision for the operable unit was signed in April 1990.

Subsequently, an FS of remedial alternatives for the Estuary, Lower Harbor and Bay portions of the New Bedford Harbor site was completed in August, 1990.

In January 1992, EPA issued a Proposed Plan for remediation of the Estuary, Lower Harbor and Bay. Also, in response to continuing concerns regarding Upper Buzzards Bay as expressed by the Federal and State Natural Resource Trustees (Trustees), EPA contracted Ebasco Services, Inc. to prepare a Supplemental Feasibility Study evaluation of remedial alternatives designed to achieve a sediment PCB action level of 10 ppm in the Upper Bay.

This document presents a range of remedial actions to address potential threats to human health and the environment caused by PCB contamination in the sediments of the Upper Bay. These actions were developed in response to the remedial response objectives, which consider the contaminants and media of interest, exposure pathways, and preliminary remediation goals.

An action level of 10 ppm PCB in sediment was adopted as the remedial action objective for the Upper Bay. This residual PCB concentration provides a level of protection to human health against direct contact exposure and incidental ingestion of sediment contaminated with PCBs. In addition, the 10 ppm action level will result in a reduction of PCB in biota. Some residual risk to marine biota may remain. However, achievement of a sufficiently low sediment action level for PCBs which is likely to ensure the protection of marine biota throughout the Upper Bay region is considered technically and/or economically impractical.

The five remedial alternatives which have been evaluated for the Upper Bay are consistent with the remedial strategy and approach adopted for the Estuary and Lower Harbor areas. The remedial response objectives considered for the Upper Bay are also consistent with those developed for the Estuary and Lower Harbor areas.

The five remedial alternatives which have been evaluated for the Upper Bay include the following:

ALTERNATIVE NUMBER	ALTERNATIVE DESCRIPTION
BAY-1	Minimal No-Action
BAY-2	Dredging and Shoreline Disposal
BAY-3	Capping
BAY-4	Capping with Dredging and Shoreline Disposal
BAY-5	Dredging, Treatment and Shoreline Disposal

These alternatives were evaluated in greater detail according to the following seven NCP evaluation criteria:

- short-term effectiveness
- long-term effectiveness
- reduction in mobility, toxicity, or volume
- implementability
- cost
- compliance with ARARs
- overall protection of public health and the environment

These seven criteria were also used to evaluate the alternatives relative to one another in the comparative analysis of alternatives. Two additional NCP criteria (state and community acceptance) will also be considered by EPA in its evaluation of the alternatives.

Overall, all of the five remedial alternatives will be protective of human health from risks posed by direct contact with PCB contaminated sediments and ingestion of biota assuming the use of institutional controls. The four alternatives (Bay 2 to Bay 5) involving active remediation in the Upper Bay are expected to be more protective of marine biota than the Minimal No-Action Alternative. However, the magnitude of the benefits to marine biota are somewhat uncertain.

The costs for the five alternatives range from an estimated cost of approximately 0.4 million for Alternative BAY-1 (minimal no-action) to an estimated cost of approximately $79.6 million for Alternative BAY-5 (dredging with treatment).

1.0 INTRODUCTION

This report presents the results of a Supplemental Feasibility Study (SFS) evaluation for the Upper Buzzards Bay portion of the New Bedford Harbor Superfund site located in New Bedford, Massachusetts. This report was prepared by Ebasco Services Incorporated (Ebasco) for the U.S. Environmental Protection Agency (EPA) as Work Assignment No. 012-1L43, under Contract No. 68-W9-0034. The report is a supplement to the Estuary and Lower Harbor/Bay Feasibility Study completed by Ebasco in 1990. The results of the current study will be used by EPA in conjunction with documents contained in the New Bedford Harbor Administrative Record to evaluate the potential remediation of contaminated sediment areas of Buzzards Bay not currently addressed by EPA's Proposed Plan.

The remedy proposed by EPA in the January 1992 Proposed Plan (EPA, 1992) for the Estuary, Lower Harbor and Bay involves remediation of sediments contaminated with more than 50 parts per million (ppm) of polychlorinated biphenyls (PCBs). The proposed cleanup actions presented in the Proposed Plan consist of removing the contaminated sediment with a hydraulic dredge and placing the material in sediment containment facilities constructed along the shoreline of the Estuary portion of the site.

This supplemental evaluation examines remedial alternatives for the Upper Buzzards Bay (Upper Bay) portion of the site. The evaluation is being conducted by EPA, in part, in response to concerns expressed to EPA by the Federal and State Natural Resource Trustees (Trustees) during development of the January 1992 Proposed Plan. Based on the results of the supplemental evaluation, EPA will present an Addendum to the January 1992 Proposed Plan which will specifically address contamination in Upper Buzzards Bay. Following the close of the public comment period for the combined proposal, EPA will evaluate the comments received, and issue a single Record of Decision for the Estuary, Lower Harbor and Upper Buzzards Bay areas of the New Bedford Harbor Superfund site.

This section of the report contains information on site location and history, a summary of the major studies conducted at the site and an overview of the contents of this report.

1.1 SITE LOCATION AND HISTORY

The New Bedford Harbor Superfund site is located approximately 55 miles south of Boston along the northwestern shore of Buzzard's Bay. The site consists of approximately 18,000 acres of estuary, harbor and bay areas contaminated with PCBs and heavy metals (Figure 1-1). Studies conducted by EPA during the late 1970s discovered PCB contamination in sediments over a widespread area

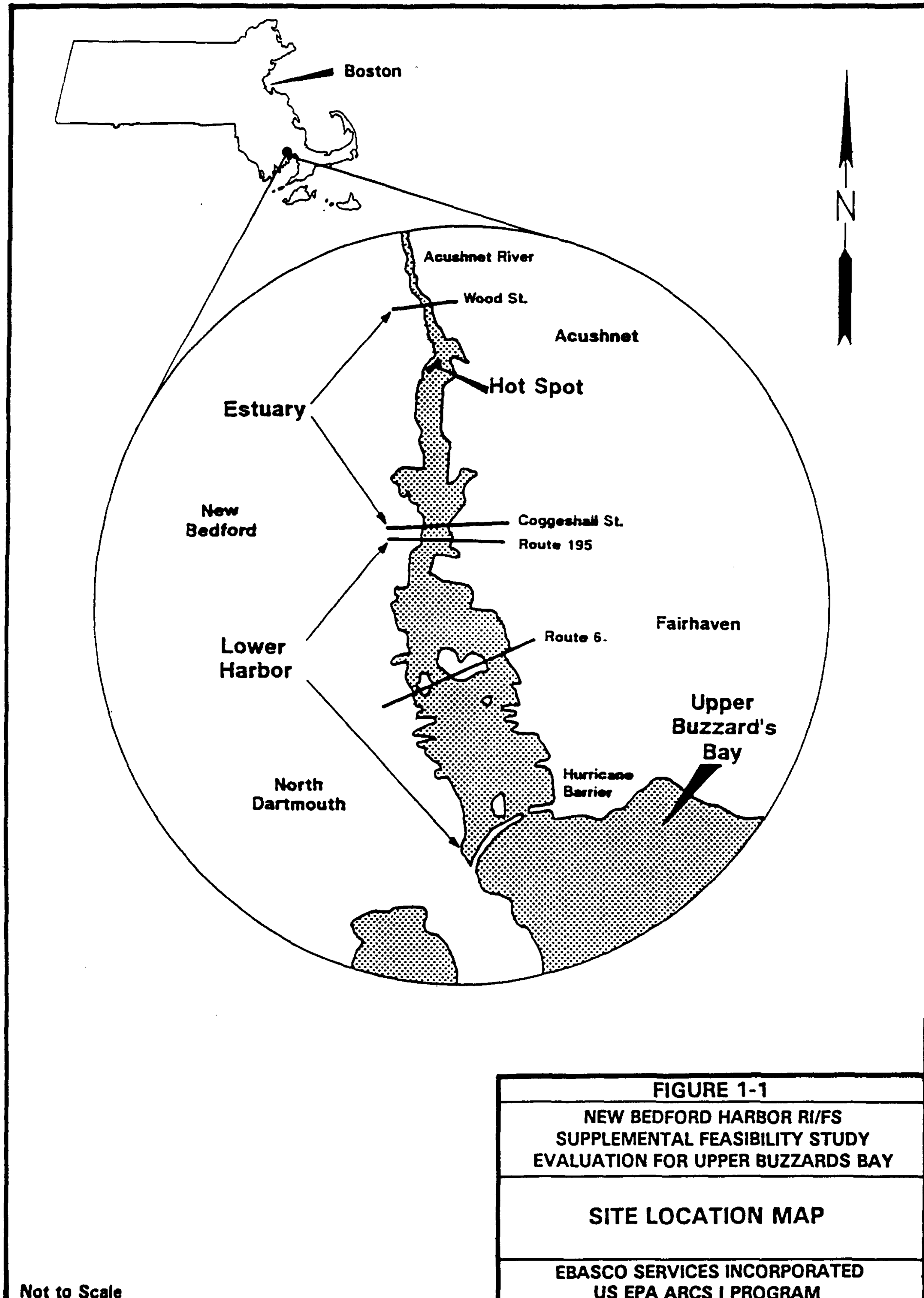

FIGURE 1-1

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

SITE LOCATION MAP

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and in several species of marine biota. The biota concentrations were in excess of the U.S. Food and Drug Administration (FDA) edible tissue tolerance limit of 2 ppm. In addition to PCBs, other contaminants including lead, cadmium, chromium, copper, and polycyclic aromatic hydrocarbons (PAHs) have also been found in the sediments.

As a result of the widespread PCB contamination and the accumulation of PCBs in marine biota, the Massachusetts Department of Public Health (DPH) established three fishing closure areas in New Bedford Harbor in September 1979 (Figure 1-2). These closures are still 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, flounder, scup, and tautog. Area III is closed to lobstering only. Closure of the New Bedford Harbor and Upper Buzzards Bay areas to lobstering has resulted in the loss of approximately 18,000 acres of productive lobstering ground.

In July 1982, the site was added to the EPA Superfund National Priorities List (NPL) making it eligible for federal funds to further investigate the nature and extent of contamination and to evaluate potential clean-up alternatives for the site.

For the purpose of conducting site studies, the New Bedford Harbor site was divided into three geographical areas: the Hot Spot area, the Acushnet River Estuary and the Lower Harbor/Upper Buzzards Bay (Figure 1-3). The Hot Spot is an approximate 5-acre area located along the western bank of the Acushnet River Estuary. PCB concentrations in the Hot Spot Area range from 4,000 ppm to over 200,000 ppm. In 1989, the Hot Spot was designated by EPA as a separate operable unit for remediation. A Record of Decision (ROD) was signed on April 6, 1990 by the EPA Region I Regional Administrator documenting the rationale and selection of the preferred remedial measures for the Hot Spot area. The remedial measures included the dredging and treatment of approximately 10,000 cubic yards of PCB contaminated sediment from this 5-acre area. The design for this operable unit was completed in 1991 and the initial stages of site-work are now underway. The current construction schedule projects the remediation of the Hot Spot area to be completed by late 1993.

The remainder of the site, the Estuary and Lower Harbor/Bay areas, are being addressed by EPA as a second operable unit. The ROD for the Estuary and Lower Harbor/Bay areas is currently scheduled for the fall of 1992. The Acushnet River Estuary is an area of approximately 230 acres (excluding the Hot Spot area), 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

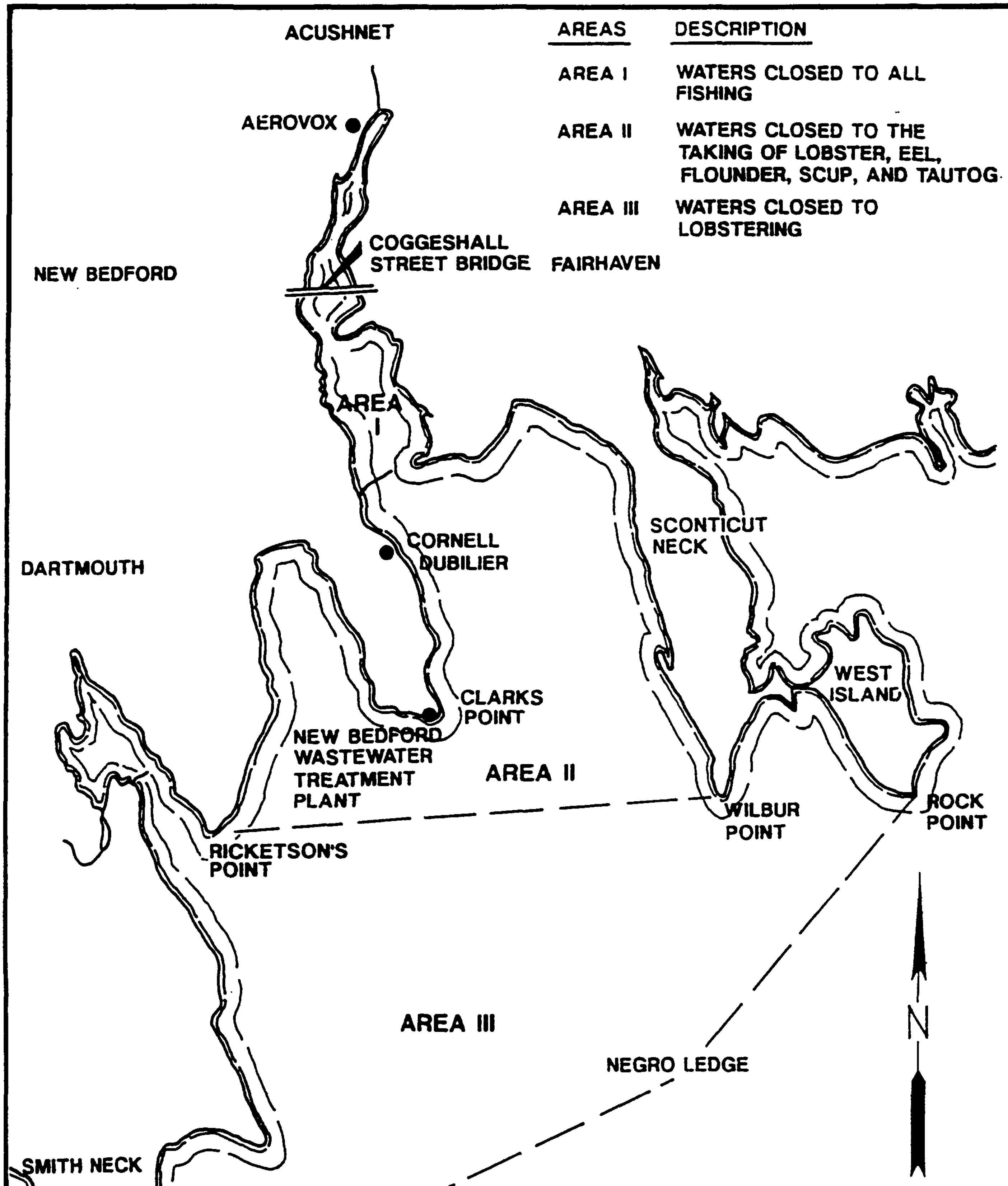

FIGURE 1-2

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

FISHING CLOSURE AREAS

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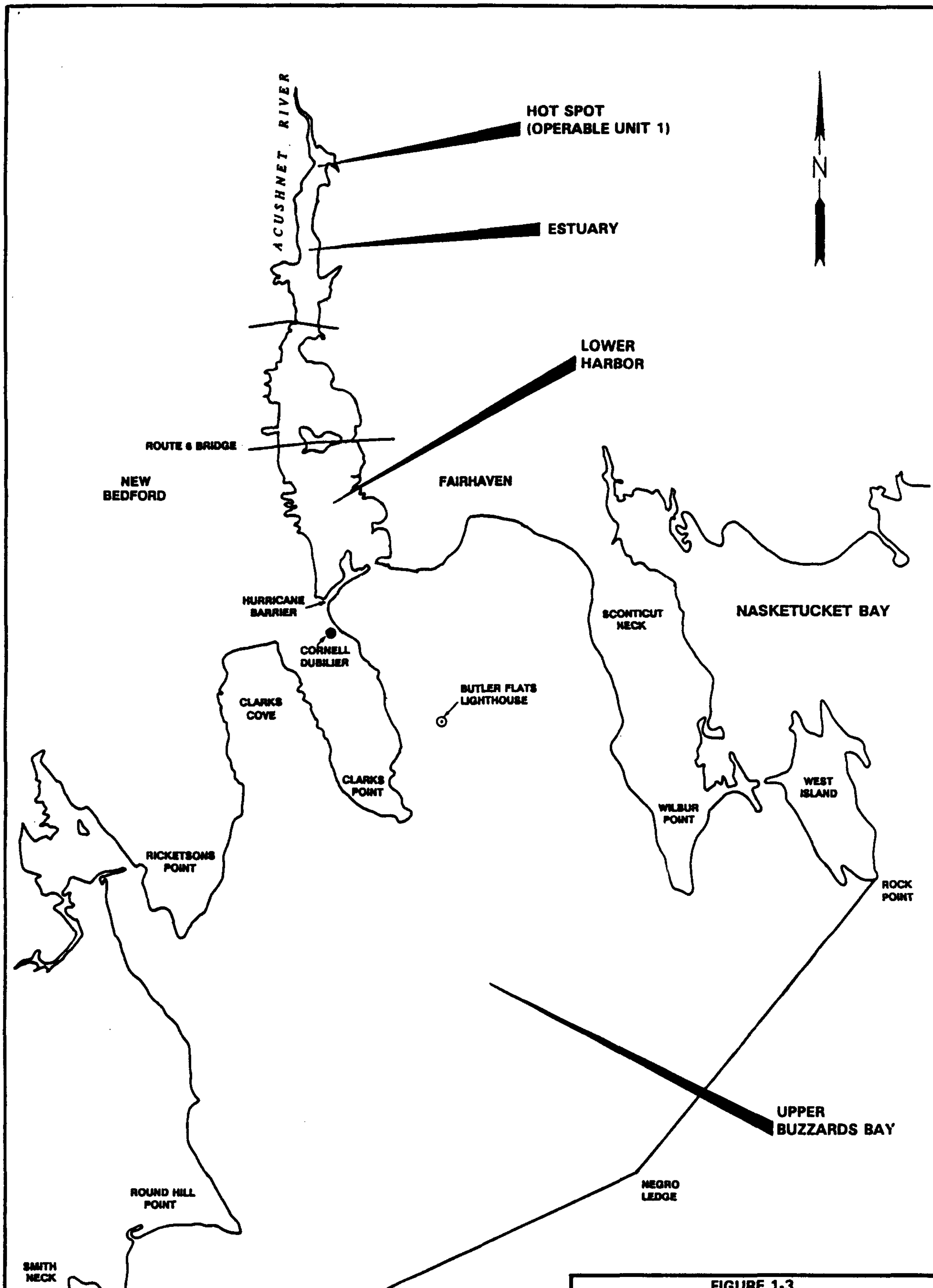

FIGURE 1-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

NEW BEDFORD HARBOR
STUDY AREAS

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approximately 4,000 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.

The Upper Buzzards Bay portion of the site area which is the focus of this study extends from the Hurricane Barrier to the southern boundary of Fishing Closure Area III, an area of approximately 17,000 acres. Sediment PCB concentrations in this area range from below detection up to over 100 ppm in certain localized areas.

Additional information on site history can be found in the Estuary and Lower Harbor/Bay Feasibility Study (Ebasco, 1990c).

1.2 SITE INVESTIGATIONS

This section briefly describes some of the major studies that have been conducted for the New Bedford Harbor site. A more comprehensive list is presented in the EPA site Administration Record.

Following the NPL listing, EPA initiated a comprehensive assessment of the PCB problem in the New Bedford area in August 1982. This assessment included environmental sampling at the New Bedford and Sullivan's Ledge landfills; an area-wide ambient air monitoring program; development of a sediment PCB profile for the Acushnet River and the harbor; biota sampling in the Estuary, Lower Harbor, and Bay; and a study of sewer system contamination. The results of this overall assessment were presented in a Remedial Action Master Plan (RAMP) for the site in May 1983 (Roy F. Weston, Inc., 1983). The RAMP included recommendations for studies to further delineate the contamination problems.

Concurrent with the assessments leading to the RAMP, EPA compiled a data base of sampling and analytical results from previous studies in the New Bedford Harbor and Buzzards Bay area. The final report on this data collection effort was issued by EPA in August 1983 (Metcalf & Eddy, 1983).

In 1984, a Feasibility Study (FS) was conducted for EPA by the NUS Corporation (NUS). This FS presented five remedial clean-up alternatives for the Estuary portion of the site, four of which involved dredging activities to remove or isolate the contaminated sediments. During the public comment period, comments from the general public, the Potentially Responsible Parties (PRPs) and other governmental agencies raised concerns regarding the adequacy of available dredging techniques. These concerns included sediment/contaminant migration and the potential release of leachate from unlined shoreline disposal facilities. In addressing these questions, EPA obtained assistance from the Corps of

Engineers. This assistance included performing a number of predesign studies to address specific concerns and to develop a conceptual dredging and disposal alternative for the Estuary portion of the site. The predesign studies which were performed included a detailed characterization of the sediment, an evaluation of leachate and surface runoff from sediment disposal facilities, a determination of the required cap thickness to isolate the contaminated sediment, bench scale testing of solidification technologies and bench scale testing and computer modeling to evaluate contaminant migration during dredging and sediment disposal activities. The results and conclusions of these predesign studies are presented in an 11 volume Engineering Feasibility Study (EFS) report series (Francingues and Averett, 1988).

In 1986, EPA initiated work on an overall Feasibility Study to address the Hot Spot, the Estuary and the Lower Harbor/Bay areas of the site. The overall study was designed to evaluate remedial measures for these portions of the New Bedford Harbor site and to integrate the work of the Corps of Engineers into the process of developing specific remedial alternatives for the three areas. Remedial alternatives for the Hot Spot area were presented in a Feasibility Study completed in 1989 (Ebasco, 1989); remedial alternatives for the Estuary and Lower Harbor/Bay areas were presented in a study completed in 1990 (Ebasco, 1990c). Several additional remedial alternatives for the Upper Bay portion of the site are considered in the current study.

The EFS was later expanded to include a pilot-scale demonstration of dredging and dredged material disposal. The pilot study evaluated the performance of three hydraulic dredges and two sediment disposal techniques under actual operating conditions. The study was conducted in a cove along the New Bedford shoreline and included an evaluation of mudcat, matchbox and cutterhead dredges to remove a total over 10,000 yd^3 of sediment, of which, approximately 3,000 yd^3 was contaminated with PCBs ranging from 150 ppm to 585 ppm. The two sediment disposal techniques tested include a shoreline Confined Disposal Facility (CDF) and a method of subaqueous capping termed Contained Aquatic Disposal (CAD). The results of the study indicated that the cutterhead was the most effective dredge with respect to minimizing sediment resuspension and contaminant migration. In addition, study results indicated that the CAD technique was not completely successful in isolating the contaminated material. The results and conclusions of the study were presented in a report prepared by the Corps of Engineers (Otis et al., 1990).

1.3 REPORT ORGANIZATION

This Supplemental Feasibility Study report is comprised of five sections in addition to this introductory section. Section 2.0 provides information on the nature and extent of contamination in Upper Buzzards Bay including PCBs in the sediment, water and biota. A summary of the baseline public health and ecological risk assessments performed for the site is presented in Section 3.0. Section 4.0 presents regulations that would be applicable or relevant to the site as well as target clean-up levels (TCLs) and remedial action objectives for the site. Section 5.0 describes the cleanup technologies considered for the remedial alternatives. The detailed analysis of the individual remedial alternatives and the comparative analysis of all the alternatives are presented in Section 6.0.

2.0 SITE CHARACTERIZATION

This section of the report provides a description of Upper Buzzards Bay including the physical setting, pollutant loading, and the nature and extent of contamination. The description is summary level in nature with a focus on the PCB contamination, and not a comprehensive synthesis of the many studies conducted for Buzzards Bay by various governmental agencies and academic/research institutions over the past 30 years. However, additional information on the various topics discussed herein, are presented in the referenced documents which are contained in the Administrative Record (EPA, 1992b).

The contamination assessment presented in this section evaluates the distribution of PCBs in the sediment, water and biota of the Upper Buzzards Bay region. Information on the distribution of several heavy metals (i.e., cadmium, copper and lead) is also included for the sediment and surface water (the water column overlying sediments) along with the distribution of total organic carbon (TOC) in the Bay's sediment.

2.1 SITE DESCRIPTION

2.1.1 Physical Setting

Buzzards Bay is a coastal embayment between the southeastern shoreline of Massachusetts, Cape Cod and the Elizabethan Islands. The Bay is made up of a series of drowned river valleys that formed as the result of retreating glaciers. In the New Bedford area of the Bay, the valleys run in a NNW to SSE direction with steep sides and relatively flat troughs. The trough of the Acushnet River forms New Bedford Harbor. For the most part, this river valley has been filled with sediment, producing a relatively uniform water depth across the region. The sediments in the Bay include gravel, sand, silt and clay deposited through glacial and runoff processes. Silts and clays are predominantly found in the deeper parts of the Bay including the central area of the Bay and the flat troughs of the drowned river valleys. However, fine sediments are also associated with some shallower areas that are well protected from the prevailing winds. This is consistent with the hypothesis of Buzzards Bay as an area of net sediment deposition. Summerhayes estimated overall sedimentation rates for the Bay to be on the order of 2 to 3 mm per year, with about five times the sedimentation in the deeper areas, as in the shallower zones (Summerhayes, et al., 1977). This difference is likely due to the fact that lower energy regimes exist in the deeper water areas and facilitate more extensive settling of fine grained sediment.

Tidal currents and wind are the predominant factors influencing circulation throughout Buzzards Bay (Battelle, 1990). However, density driven flows may occur as the result of fresh water inputs and/or warmer surface waters during the spring and summer. The effect of storms on the Bay can be substantial, as evidenced by damage caused by several hurricanes over the last century. Increased currents due to wind and wave action may resuspend sediments in the Bay during these times. This sediment will eventually settle out as the velocities return to background conditions. However, the relocation of sediments may serve to redistribute contamination associated with areas of the Upper Bay, out to the deeper areas in the central portion of the Bay that serve as a sink for the silts and clays.

Additional information on the geology, climatology, physical oceanography and their effects on the Bay are presented in Summerhayes, et al., 1977; Battelle, 1990; and Farrington and Capuzzo, 1991. Further details can be found in the many references used by these authors.

2.1.2 Pollutant Loadings

Overview of Pollutant Sources

Buzzards Bay has many uses including commercial fishing, home port to the New Bedford Harbor fishing fleet, a transit route for ships passing through the Cape Cod Canal and recreational activities including fishing, boating and bathing. The shoreline of the Bay is home to over a dozen communities, the largest of which is the City of New Bedford, also the fourth largest city in the Commonwealth of Massachusetts. These communities host many industries including fish processing, metals finishing and electrical component manufacturing.

The combination of shoreline and marine activities over the past 150 years or so has caused the release of many pollutants from both point and non-point sources to the Bay. As a result, contaminated sediment, water and biota, potentially threaten the marine environment and public health. Through their studies of the Bay, EPA and the state of Massachusetts have identified three concerns for the Bay. These concerns were presented in a study conducted for EPA (SAIC, 1991) and include:

- Closure of shellfish beds due to pathogen contamination;
- Eutrophication due to nutrient enrichment; and,
- Toxic contamination of fish, lobster and shellfish and the effects of this contamination on humans.

This report focuses on the PCB contamination aspects of these concerns for that portion of the Bay, termed Upper Buzzards Bay. This terminology is used to distinguish between the Bay as a whole, and the portion of the Bay considered to be part of the Superfund site. As such, Upper Buzzards Bay is defined as the 17,000 acre area south of the Hurricane Barrier extending to the southern border of the Massachusetts Department of Public Health (DPH) Fishing Closure Area III. The region includes Massachusetts DPH Fishing Closure Areas II and III (Figure 1-3).

Wastewater Discharges to the Upper Buzzards Bay

Upper Buzzards Bay has been subjected to discharges from point and non-point sources for many decades. Potential contamination sources include the sixteen combined sewer overflow (CSO) pipes that border the Bay along the New Bedford shoreline and which have channeled both point and non-point sources into the Bay (Figure 2-1). The CSOs currently do not always operate as designed, as evidenced by significant flow during periods of dry weather. In addition to the CSOs, there are storm drains that channel surface runoff into the Bay along the New Bedford and Dartmouth shorelines. The most significant point sources to the Bay are the four outfall pipes from local sewage treatment plants that discharge to, or near the Upper Bay region. Of these four, two are located within Upper Buzzards Bay and both are associated with the City of New Bedford's Treatment Plant located at Fort Rodman. The Treatment Plant currently consists of primary treatment (gravity settling of solids) as its principal component. The Treatment Plant maintains two outfall pipes including a 60 inch pipe that carries flow from the plant under normal operating conditions and a second 72 inch auxiliary outfall that operates only during periods of high flow (Figure 2-1). The 60 inch outfall is located approximately 3,300 feet from the Fort Rodman shoreline in a southeasterly direction. The 72 inch outfall pipe runs parallel to the 60 inch pipe and terminates approximately 1,000 feet from the shore. The average daily flow from the New Bedford Plant is 30 million gallons. Included with the effluent are a variety of pollutants including PCBs, trace metals and fossil fuel hydrocarbons.

Under a Consent Decree with EPA and the state, the City of New Bedford is currently in the early design stages for a new treatment plant which will utilize both primary and secondary treatment. The new facility will utilize the 60 inch outfall for the discharge location. However, after the plant becomes operational, a diffuser will be designed and installed at the outfall. The City, EPA and the state are still working to establish a time table to modify the CSO system, so that flow to the Bay through the CSOs will only occur during certain storm conditions.

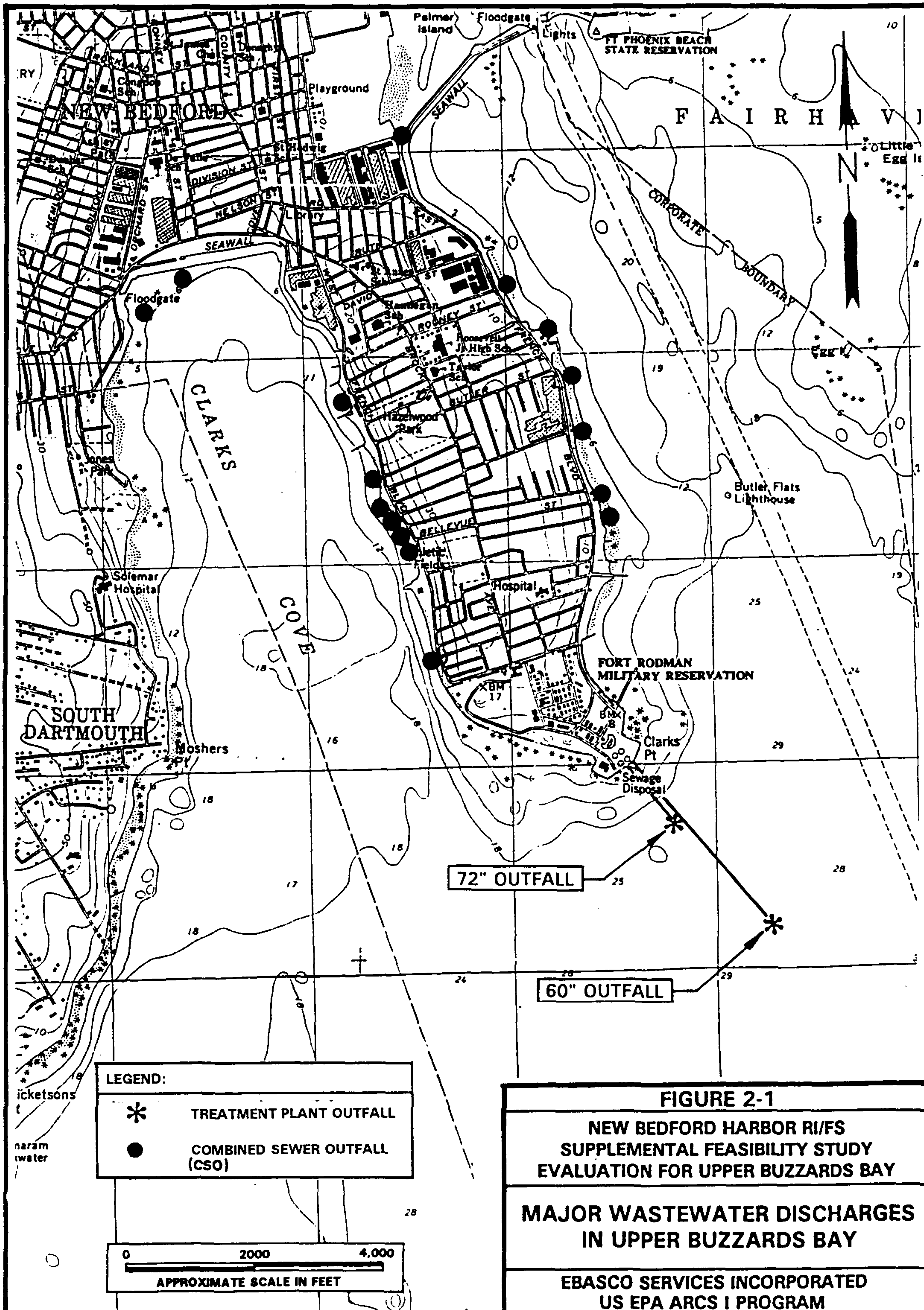

FIGURE 2-1

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

MAJOR WASTEWATER DISCHARGES
IN UPPER BUZZARDS BAY

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2.2 NATURE AND EXTENT OF PCB CONTAMINATION IN THE UPPER BAY

This section presents an overview of the data used to assess the PCB contamination in Upper Buzzards Bay and the methods used to interpret the data. PCB distributions are presented for the sediment, the surface water and for biota of the region. In addition, sediment and surface water data for cadmium, copper and lead are presented along with the sediment distributions for TOC.

2.2.1 Sediment Contamination

The sediment distribution of PCB, TOC and several heavy metals is presented in this section. Sediment contamination in Upper Buzzards Bay is important as it potentially represents a continuing source of contamination to the remainder of the Bay. Under storm conditions, sediment bound contaminants in the Upper Bay can be resuspended and eventually settle out elsewhere in the Bay.

2.2.1.1 Sediment Sampling Programs

The following data sets have been used in the current study to determine the nature and extent of PCB contamination in Upper Buzzards Bay.

- The Battelle Sampling Program (1984-1985)
- The NUS/GZA Grid Sampling Program (1986-1987)

These two data sets have been used for the Upper Buzzards Bay contamination assessment because they represent the most recent sampling events that utilized similar sampling and analytical procedures.

The Battelle Sampling Program consisted of approximately nine sampling stations with multiple samples collected at certain locations. Sampling locations were, in general, equally spaced throughout the Upper Bay. The purpose of this program was to atempt to establish regional average sediment PCB concentrations. The GZA program consisted of approximately 38 sampling locations which were primarily clustered south of the Hurricane Barrier along the New Bedford Harbor shoreline. The purpose of this program was, in part to better define sediment PCB distributions south of the Hurricane Barrier in the vicinity of the Cornell-Dubilier facility nearby CSOs.

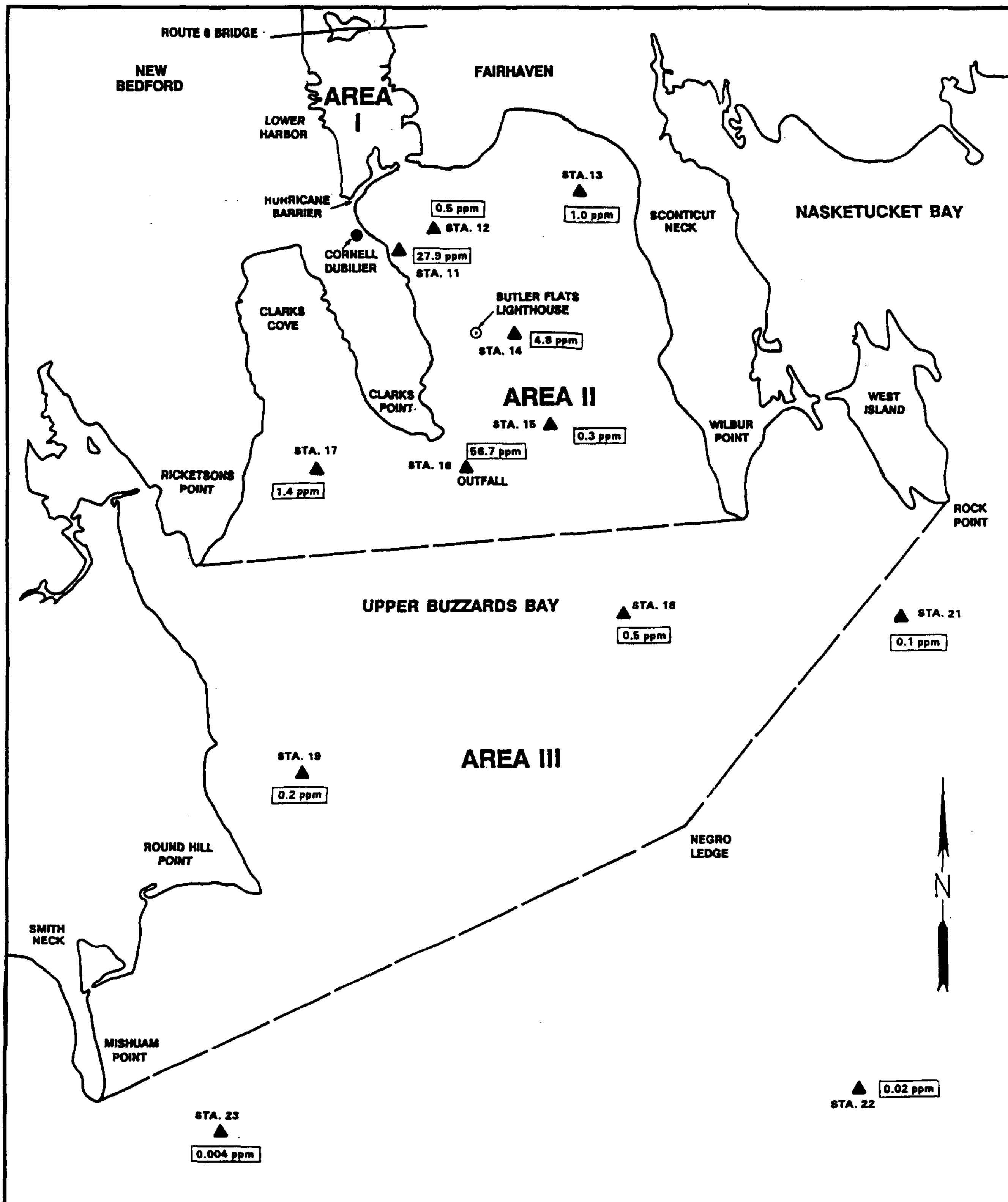
While there are additional sediment PCB data available for Upper Buzzards Bay, the samples were gathered by a variety of organizations over a period spanning 15 years. Since the sampling was completed over such an extended time frame, specific details of the programs such as sampling procedures, analytical chemistry methods, detection limits and Quality Assurance/Quality Control (QA/QC) documentation were generally not available. As a result, these data were not explicitly used in considering the scope of potential remediation, but rather, were used in considering the scope of a conceptual pre-design program. Additional information on the pre-design program is provided in Section 5.1.

2.2.1.2 Sediment PCB Distributions

The PCB concentrations in Upper Buzzards Bay are in general, markedly lower than the areas north of the Hurricane Barrier (i.e., the Estuary and Lower Harbor). The patterns of sediment contamination are generally consistent with the results of the water column and biota sampling in that PCB concentrations tend to decrease in a southerly direction through the Upper Bay. While this is the overall regional pattern, there are some individual areas of concern within the Upper Bay that are specifically highlighted below.

Based on the Battelle and GZA sampling results, sediment PCB concentrations in Upper Buzzards Bay generally range from 0.2 to 5 ppm (Figure 2-2). However, there are three locations within the Upper Bay with relatively high PCB concentrations. These three locations include the two areas adjacent to the CSO by the Cornell Dubilier plant, and an area surrounding the City of New Bedford's 60 inch outfall. The three locations roughly correspond to Battelle's Sampling Stations 11 and 16. The sampling locations and associated PCB concentrations for the three areas are presented in Figure 2-3.

Figure 2-3 demonstrates that PCB concentrations along the New Bedford shoreline south of the Hurricane Barrier generally range from 1 to 10 ppm for a mile or so. However, within this reach, the data support two discrete off-shore zones with PCB concentrations exceeding 10 ppm. It should be noted that the inner core areas for each have been proposed for remediation at a cleanup level of 50 ppm in EPA's January 1992 Proposed Plan. Moving to the south and east of this 1 mile reach, PCB concentrations appear to decline to a regional background level. This holds true with the exception of the areas surrounding the City of New Bedford's 60 inch Outfall. The limited available data from three sampling locations for this area suggest an average PCB concentration adjacent to the Outfall on the order of 50 ppm. The estimated size and shape of the area in excess of 10 ppm at the Outfall presented in Figure 2-3 was developed based on visual observation of the area, impacts based on Outfall loadings and the estimated shape of the mixing zone presented in the City's Facility Plan (CDM, 1990).



NOTES:

1. Total sediment PCB values displayed throughout Upper Buzzards Bay are arithmetic averages of surficial samples (i.e., 0-5cm) from the Battelle sampling program.
   ▲ = Battelle sampling station

2. Fishing Closure Areas:
   AREA I – Waters closed to all fishing.
   AREA II – Waters closed to the taking of lobsters, eels, flounder, scup and tautog.
   AREA III – Waters closed to lobstering only.

0 1 2
APPROXIMATE SCALE IN MILES

FIGURE 2-2

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

DISTRIBUTION OF TOTAL PCB (mg/kg) IN THE SURFICIAL SEDIMENT OF UPPER BUZZARDS BAY

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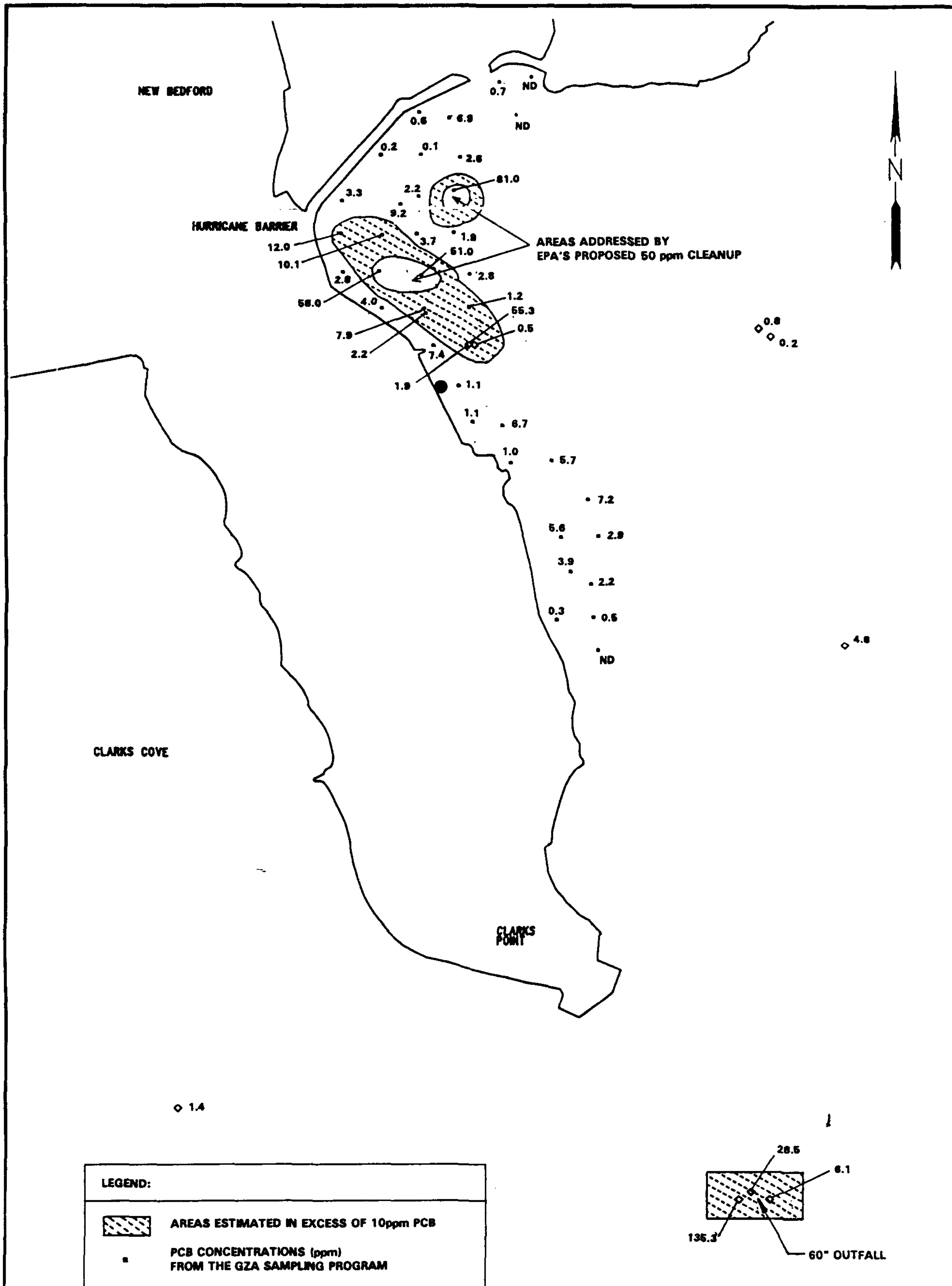

LEGEND:

(hatched)	AREAS ESTIMATED IN EXCESS OF 10ppm PCB
▪	PCB CONCENTRATIONS (ppm) FROM THE GZA SAMPLING PROGRAM
◇	PCB CONCENTRATIONS (ppm) FROM THE BATTELLE SAMPLING PROGRAM
●	CSO ADJACENT TO CORNELL DUBILIER
ND	NON-DETECT

1000 0 1000 2000
APPROXIMATE SCALE IN FEET

FIGURE 2-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

SEDIMENT PCB CONCENTRATIONS (mg/kg)
ADJACENT TO THE CORNELL DUBILIER CSO
AND THE TREATMENT PLANT OUTFALL

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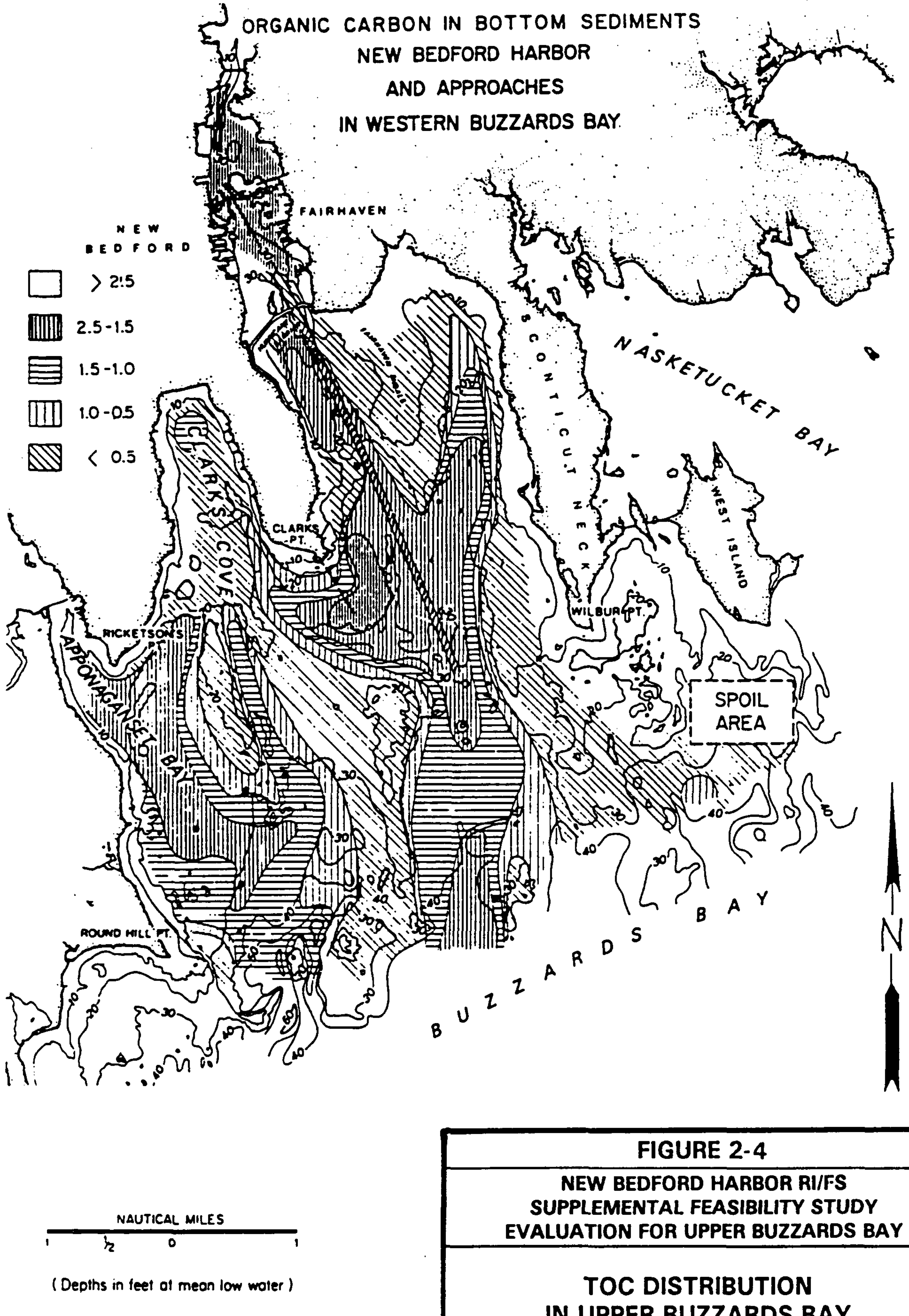
It is important to note that efforts to accurately evaluate the extent of PCB contamination in the Upper Bay are constrained by limitations in the spatial extent of the underlying sampling programs and associated data sets. While the results from the GZA Sampling Program reasonably define the New Bedford shoreline area just south of the Hurricane Barrier, there are other areas of the Upper Bay such as Clarks Cove that remain largely undefined. These areas are potentially important because some of the earlier analytical data that was not explicitly considered in this assessment indicated that certain portions of these areas contained PCB concentrations in excess of 10 ppm. Away from the shoreline areas, the results of the Battelle Sampling Program appear to provide a reasonable sense of the nature and extent of PCB contamination, with the exception of the 60 inch Outfall area. Here again, earlier data has indicated the spatial extent of the Outfall area sediments exceeding 10 ppm PCBs to be more expansive than presented in Figure 2-3.

Additional sediment PCB distribution information including sampling locations and PCB concentrations for the remainder of Upper Buzzards Bay and several locations farther out in the Bay are presented in the Appendices section of this report. The information is also available in a tabular format in Appendix A and graphically in Appendix B.

2.2.1.3 Sediment TOC Distribution

As researchers have demonstrated, the distribution of TOC in the sediment is important in that the bioavailability of organic contaminants such as PCB are likely a function of the TOC normalized sediment concentration, and not the total sediment concentration (Lake et al., 1990). This relationship is important to the study of the Upper Bay as many of the areas with the highest PCB concentrations also exhibit regionally high TOC values. The importance of the relationship is heightened in cases where the differences in sediment PCB concentrations between geographic regions are small.

The distributions of TOC in the sediments of the Upper Bay were investigated extensively in a study prepared for National Ocean and Atmospheric Administration (NOAA) during the late 1970s (Summerhayes et al., 1977). The results of this study indicate that for the area south of the Hurricane Barrier, TOC levels were the highest in the western portion of the Upper Bay, adjacent to the City of New Bedford's Treatment Plant Outfall and in the navigational channel (Figure 2-4). These areas roughly coincide with the location of the fine grain sediment of the Bay described by Summerhayes. The TOC levels in these areas were generally above 1.5 percent, but less than 5 percent. The high levels of TOC at the Treatment Plant Outfall are likely the result of sewage and



Adapted from Summerhayes, et al., 1977

FIGURE 2-4

NEW BEDFORD HARBOR RI/FS SUPPLEMENTAL FEASIBILITY STUDY EVALUATION FOR UPPER BUZZARDS BAY

TOC DISTRIBUTION IN UPPER BUZZARDS BAY

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industrial waste. Throughout the remainder of the Upper Bay, the TOC levels range between 0.5 and 1.5 percent.

The TOC data from the Battelle Sampling Program indicated that the highest sediment TOC concentration in the Bay was detected at the Outfall (4.5% at Station 16). The average values for the Battelle Stations from the Upper Bay area are presented in Figure 2-5. The TOC data for each Battelle sampling station is provided along with the corresponding percentage of sand, silt and clay in Appendix C.

It is difficult to draw conclusions on the relative bioavailability of the sediment bound PCB in the Bay based on the current PCB and TOC data sets alone. This is because of the spatial limitations of the PCB data set, and the lack of TOC measurements that directly correspond with the PCB measurements.

2.2.1.4 Other Contaminants

Upper Buzzards Bay receives pollutant inputs from a large number of point and non-point sources, the nature of contamination includes a wide variety of pollutants in addition to PCBs. These include trace metals, polycyclic aromatic hydrocarbons (PAHs) and sewage wastes. This section provides a brief summary of the PAH and trace metal contamination in the Upper Bay region.

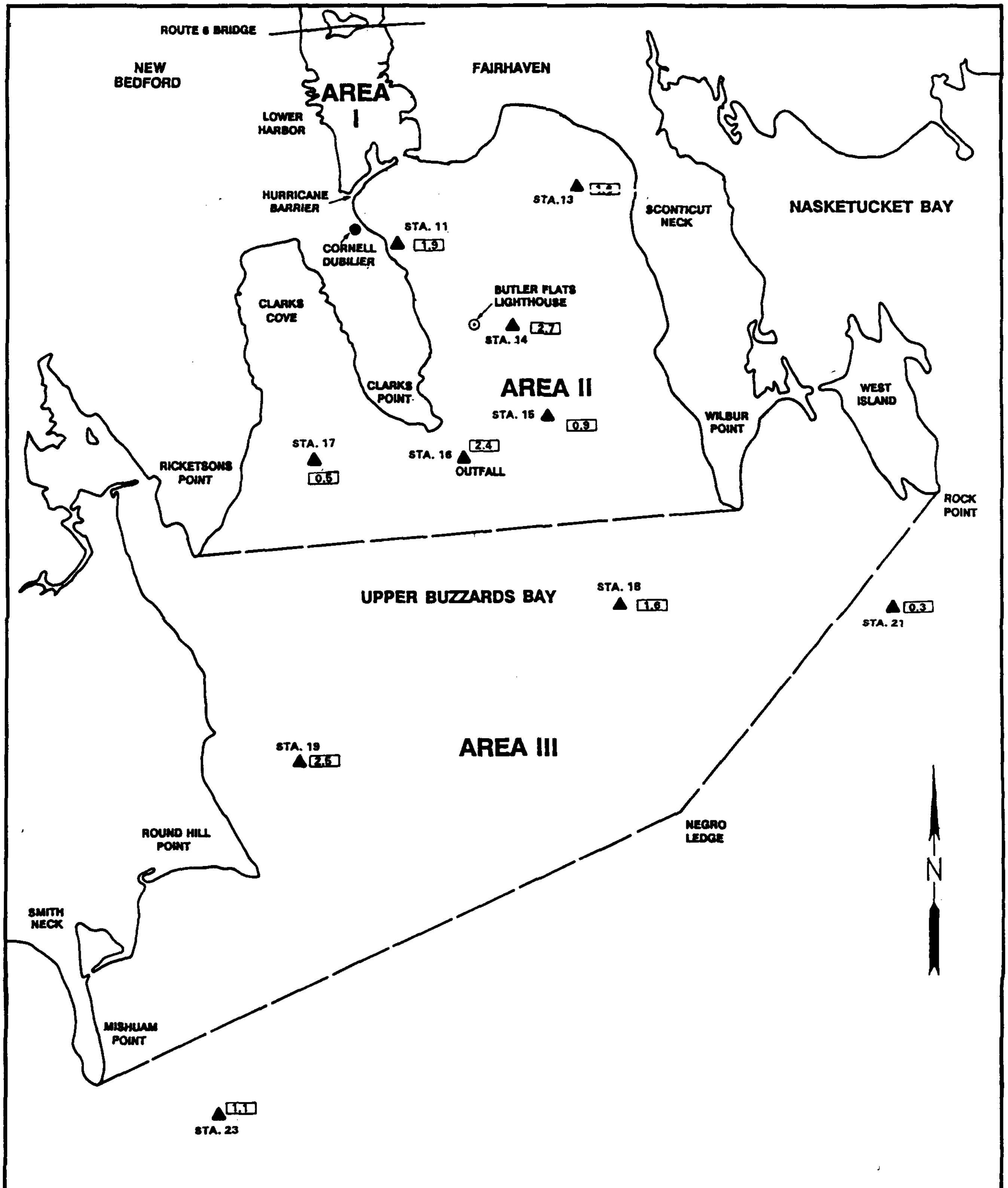
<u>Sediment Distribution of Metals</u>

Many trace metals including silver, cadmium, chromium, copper, lead and zinc have been detected in the sediment of Buzzards Bay. The presence of the metals are from a combination of natural and man-made inputs to the Bay. Available information (Summerhayes, et al 1977) suggests that given the levels of metals which have been detected and their regional distribution, man-made sources are likely a dominant factor.

Using the data from the Battelle Sampling Program (CDM, 1990), the sediment distribution of cadmium, copper and lead in Upper Buzzards Bay is presented in Figure 2-6. The average concentration for these constituents at the Treatment Plant Outfall are approximately an order of magnitude above the other sampling stations. This supports the hypothesis of the Outfall as a significant source of trace metals to the Upper Bay.

<u>Sediment Distribution of PAH Compounds</u>

The PAH compounds in Buzzards Bay are primarily attributable to combustion related sources including the incomplete combustion of fossil fuel products and the results of forest and grass fires. It has been reported that the PAH compounds associated with sediments deposited following the period of 1850 to 1900, are associated with



NOTES:

1. *Average TOC Concentrations (%) from the Battelle sampling program.*
   ▲ = Battelle sampling program.

2. *Fishing Closure Areas:*
   - AREA I – Waters closed to all fishing.
   - AREA II – Waters closed to the taking of lobsters, eels, flounder, scup and tautog.
   - AREA III – Waters closed to lobstering only.

FIGURE 2-5

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

TOC CONCENTRATIONS (%)
AT THE BATTELLE SAMPLING STATIONS
IN UPPER BUZZARDS BAY

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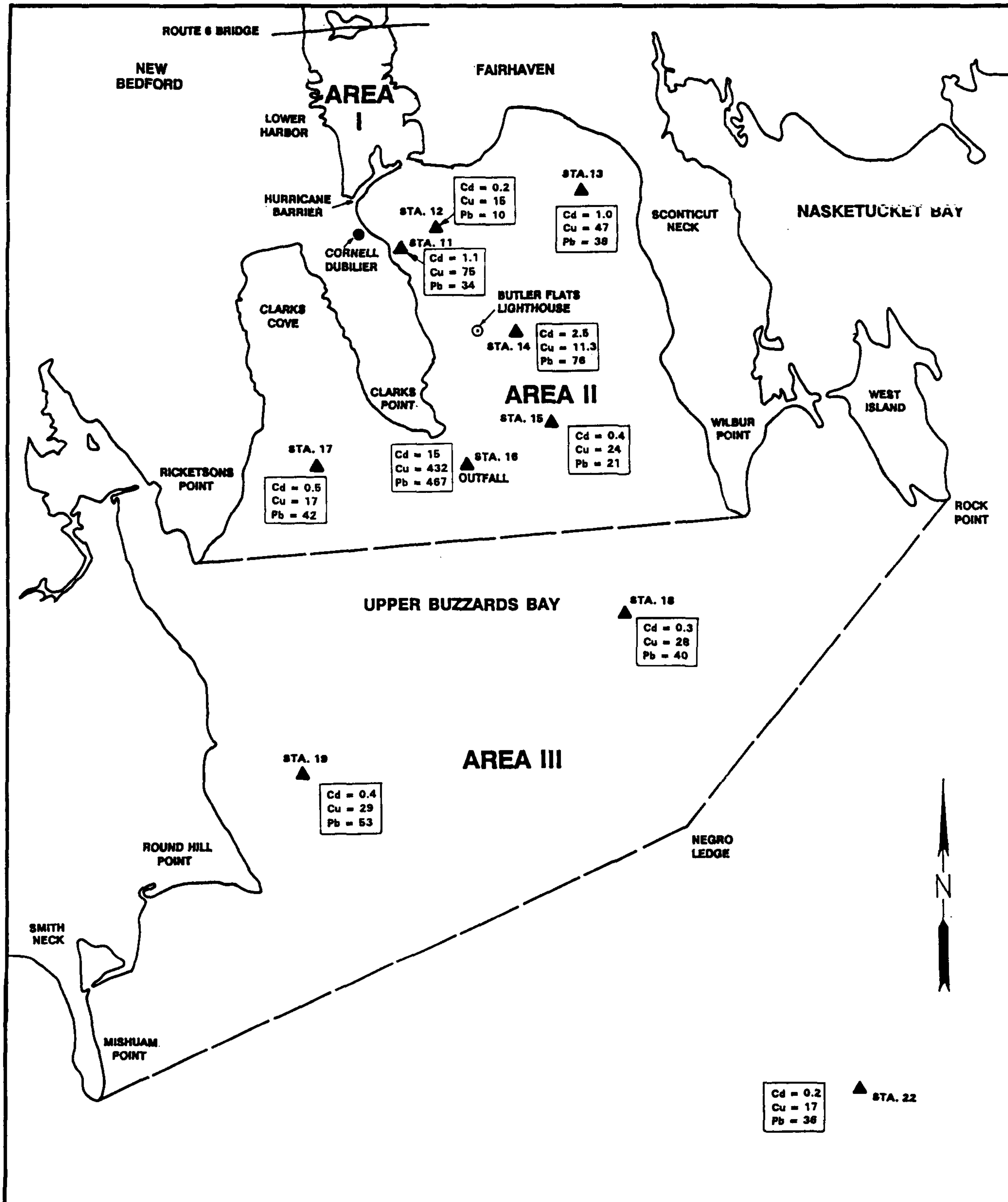

NOTES:

1. Cadmium (Cd), Copper (Cu) and Lead (Pb) concentrations are average values at selected Battelle sampling stations in Upper Buzzards Bay as reported in the City of New Bedford's Phase II Facility Plan (CDM, 1990).
   ▲ = Battelle sampling station

2. Fishing Closure Areas:
   AREA I – Waters closed to all fishing.
   AREA II – Waters closed to the taking of lobsters, eels, flounder, scup and tautog.
   AREA III – Waters closed to lobstering only.

0 1 2
APPROXIMATE SCALE IN MILES

FIGURE 2-6

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

DISTRIBUTION OF Cd, Cu AND Pb (mg/kg) IN THE SEDIMENT OF UPPER BUZZARDS BAY

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the incomplete combustion of fossil fuel products such as coal, oil and gas. Prior to this period, the PAH compounds are associated with forest and grass fires (Farrington and Capuzzo, 1991). The sediment concentrations for 18 aromatic compounds measured as a part of NOAA's National Status and Trend Program ranked Buzzards Bay ninth, out of approximately 150 marine sampling stations across the country (NOAA, 1988).

PAH compounds associated with unburned petroleum products such as fuel and laboratory oils, are also present in Upper Buzzards Bay. For the most part, the presence of these compounds in high concentrations is likely limited to the location of storm drains, CSOs, the Sewage Treatment Plant outfall, and the main navigational channel that extends southward from the Hurricane Barrier. In the central region of the Bay, petrogenic PAH concentrations are likely lower and mostly due to commercial marine traffic including spills and accidents.

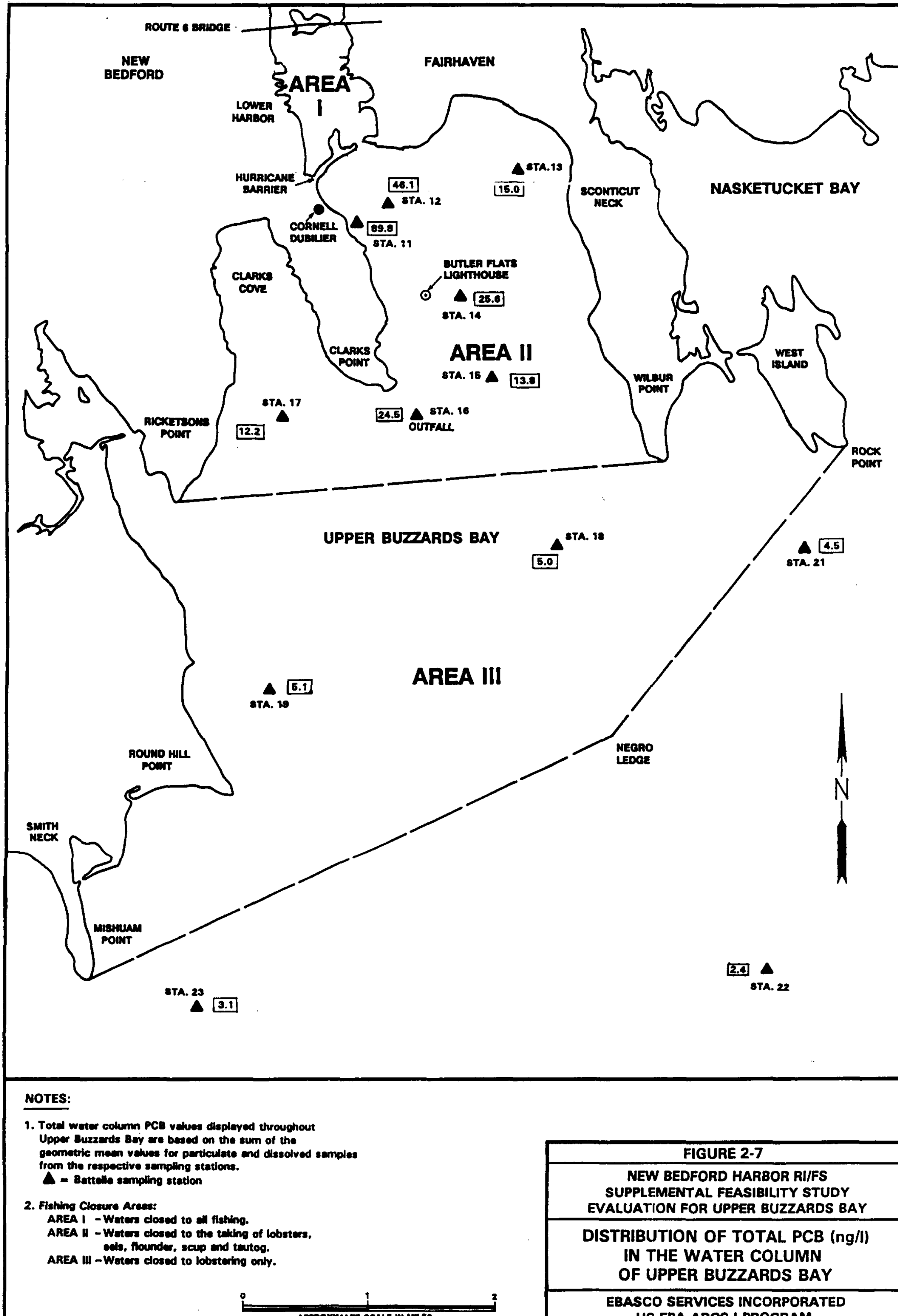
2.2.2 Surface Water Contamination

This section of the report presents the surface water (water column) distributions of PCBs and three trace metals (i.e., cadmium, copper and lead) in Upper Buzzards Bay. The assessment is based on the results of Battelle's Sampling Program (Ebasco, 1990a) and the City of New Bedford's Facility Plan (CDM, 1990). The PCB concentrations are presented as total PCBs, and are based on the sum of the geometric mean concentrations for the dissolved and particulate fractions. The average metals concentrations are total water concentrations based on dissolved plus particulate fractions.

2.2.2.1 Surface Water PCB Concentrations

Based on the surface water PCB results, the sediment areas of concern discussed in Section 2.2.1 appear to be impacting near-field water quality. At Battelle stations 11 and 12, the surface water PCB concentrations are 89.8 and 46.1 parts per trillion, respectively (Figure 2-7). Station 11 is a factor of three above the Ambient Water Quality Criteria (AWQC) for chronic exposure (i.e., 30 parts per trillion). The remainder of the stations are below the AWQC.

The concentration gradients demonstrated by the surface water PCB data also suggest that areas north of the Hurricane Barrier contribute to the surface water contamination in the Upper Bay. This hypothesis is supported by estimates of net seaward transport of PCB through the Hurricane Barrier into the Upper Bay. An EPA estimate based on PCB measurements taken at the Hurricane Barrier estimated 64 kg of PCB are transported into the Bay each year. Results from the Battelle Hydrodynamic Model which was developed to evaluate PCB fate and transport at the site were on the order of 80



NOTES:

1. Total water column PCB values displayed throughout Upper Buzzards Bay are based on the sum of the geometric mean values for particulate and dissolved samples from the respective sampling stations.
   ▲ = Battelle sampling station

2. *Fishing Closure Areas:*
   AREA I – Waters closed to all fishing.
   AREA II – Waters closed to the taking of lobsters, eels, flounder, scup and tautog.
   AREA III – Waters closed to lobstering only.

FIGURE 2-7

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

DISTRIBUTION OF TOTAL PCB (ng/l) IN THE WATER COLUMN OF UPPER BUZZARDS BAY

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kg to 100 kg per year. It should, however, be noted that on a mass basis the amount of PCBs being transported through the Hurricane Barrier (yearly) is relatively small compared to the mass of PCBs already present in the sediments and surface waters of the Upper Bay.

2.2.2.2 Surface Water Metals Concentrations

This section presents surface water data for three of the more prevalent trace metals in Upper Buzzards Bay; cadmium, copper and lead. The data appears to indicate the surface water concentrations for each of the three metals are relatively similar throughout most of Fishing Closure Zones II and III (Figure 2-8). The only exception is a station near the entrance of the Hurricane Barrier which would suggest upstream sources. This hypothesis is plausible given the higher sediment metals concentrations and the industrial discharge locations north of the Hurricane Barrier.

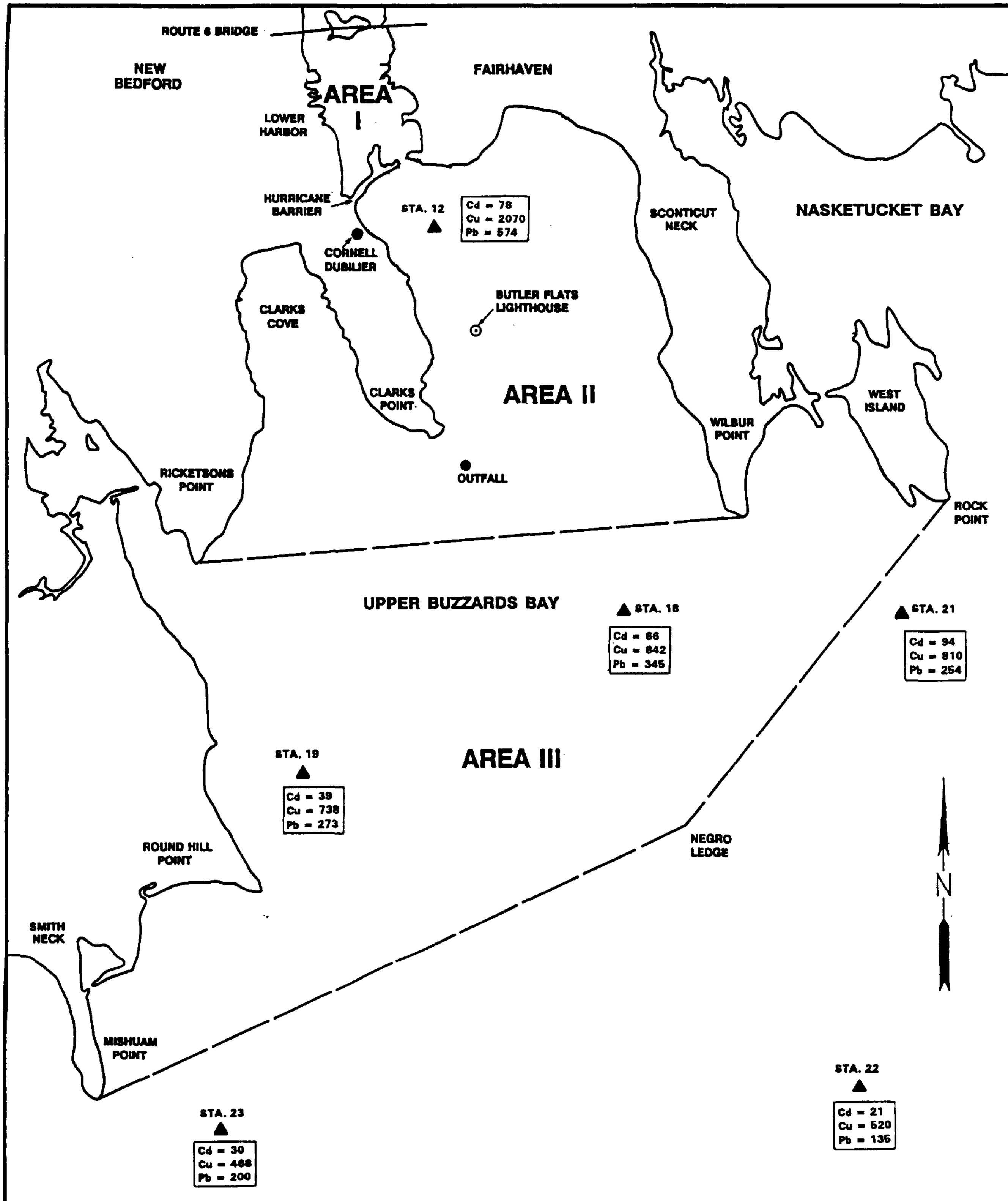
Seaward of the Upper Bay region, the metals concentrations appear to be lower, but not markedly, suggesting that perhaps surface water metals contamination extends further into the central regions of the Bay. Unfortunately, no surface water data was presented in the City of New Bedford's Facility Plan for the Outfall area. Based on the sediment data, it is reasonable to assume that metals may be higher than some of the other surrounding stations.

The chronic AWQC values for cadmium, copper and lead are 9.9 ppb, 2.9 ppb and 5.6 ppb, respectively. Based on a review of the available data presented in Figure 2-8, none of the criteria are exceeded. However, the chronic criterion for copper is close to being exceeded at the entrance to the Hurricane Barrier.

2.2.3 <u>Distribution of PCB in Biota</u>

Both lobster and flounder are important commercial and recreational resources to the Upper Bay. However, exceedances of the FDA tolerance level of 5 ppm prompted the Massachusetts DPH to establish fishing closure areas in the New Bedford Harbor and Upper Buzzards Bay in 1979. This was due to the potential health risks associated with the consumption of the PCB contaminated fish and shellfish. This closure has meant the loss of over 17,000 acres of Buzzards Bay for lobstering. Of this area, approximately 5,000 acres are also closed to fishing for bottom feeding fish including flounder.

This section presents PCB data for two representative species of the Upper Bay; lobster, <u>Homarus americanus</u>, and winter flounder, <u>Pseudopleuronectes americanus</u>. The data for this assessment are from the Battelle Sampling Program (Hillman et al., 1987), studies conducted by the Massachusetts Division of Marine Fisheries (DMF)



NOTES:

1. Cadmium (Cd), Copper (Cu) and Lead (Pb) concentrations are average values at selected Battelle sampling stations in Upper Buzzards Bay as reported in the City of New Bedford's Phase II Facility Plan (CDM, 1990).
   ▲ = Battelle sampling station

2. Fishing Closure Areas:
   AREA I – Waters closed to all fishing.
   AREA II – Waters closed to the taking of lobsters, eels, flounder, scup and tautog.
   AREA III – Waters closed to lobstering only.

0 1 2
APPROXIMATE SCALE IN MILES

FIGURE 2-8

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

DISTRIBUTION OF Cd, Cu AND Pb (ng/l)
IN THE WATER COLUMN
OF UPPER BUZZARDS BAY

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for EPA's Buzzard Bay Program (Schwartz, 1988) and unpublished data from the state (Schwartz, 1992).

2.2.3.1 Distribution of PCB in Lobster

Although the major PCB inputs to the Lower Harbor and Upper Bay have been eliminated (local use was discontinued in 1978), there has not been a dramatic drop in the body burdens for biota. This is demonstrated by the lack of a definitive trend in edible tissue PCB concentrations for lobster from Fishing Closure Area III (Figure 2-9). Although the average concentration of 4.1 ppm for the years 1980 through 1985 has dropped to 2.9 ppm for the years 1986 through 1990, this change is insignificant relative to the spatial and temporal variabilities exhibited by the data. For example, data collected by Massachusetts Department of Environmental Protection (MADEP) during the spring of 1989 for two stations in Area III include an average edible tissue PCB concentration of 2.01 ppm at one location and a concentration of 4.19 ppm from another. Data from the same two stations six months later were 2.13 ppm and 1.74 ppm respectively. Lobster data from the Battelle Program for Fishing Closure Areas II and III are 2.3 ppm and 1.4 ppm, respectively. These values were calculated using the average edible tissue PCB concentration for the edible muscle tissue and hepatopancreas (tomalley), and the mean weight for each, as presented in Pruell et al, 1988.

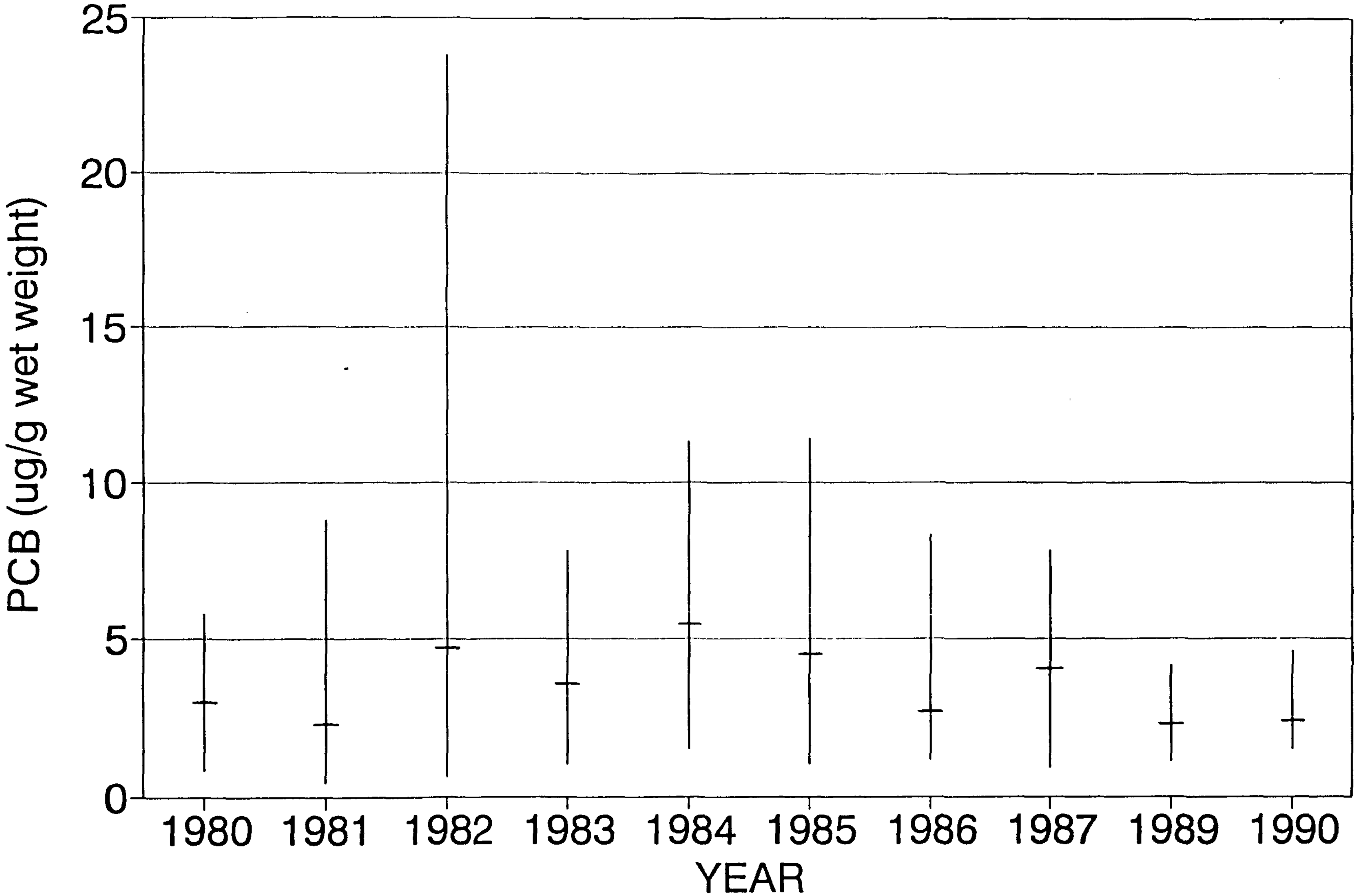
In his study of lobsters from Area III, Pruell reported the mean weights of the edible muscle and tomalley as 156 g and 14.4 g, respectively. This calculation was done to provide (1) an estimate of the risk assuming an individual would eat both the muscle tissue and the tomalley and (2) to facilitate a comparison to other data for lobster PCB concentrations analyzed using the FDA sample preparation procedures which combine the tomalley with the muscle tissue. Although the Battelle results would suggest the average edible tissue (i.e., muscle plus tomalley) concentrations in Closure Area III are below 2 ppm, the variability demonstrated by the state's data indicates that this may or may not be the case, and in fact, the state's data does demonstrate exceedances in this Area.

The variability associated with the lobster data is probably indicative of the lobsters lifecycle and seasonal habits. Larval lobsters settling out in Buzzards Bay tend to stay within close proximity of the place of settlement for the first three years. Between the fourth and sixth years, these lobsters will tend to remain in the general vicinity of settlement, but they begin to move about in order to forage. Typically by the sixth year lobsters reach sexual maturity and for the first time as seasonal waters warm, they will migrate into deeper cooler waters of Buzzards Bay, or beyond. In these offshore locations, the New

FIGURE 2-9

LOBSTER PCB CONCENTRATIONS FROM FISHING CLOSURE AREA III: 1980-1990

RANGE AND AVERAGE CONCENTRATIONS (ppm)



Source: Schwartz, 1992

Bedford Harbor area lobsters mix with lobsters originating from other shallow water areas of Buzzards Bay, as well as with lobsters from populations of deeper offshore waters (NOAA, 1992).

2.2.3.2 PCB Distribution in Flounder

PCB concentrations in flounder from the Upper Bay have on the average, been below the FDA limit of 2 ppm. Average PCB concentrations from the edible portion of the flounder from the Battelle Program were 1.22 ppm and 0.42 ppm for Closure Areas II and III respectively. The flounder data also demonstrate the high degree of variability exhibited by the lobster data. In fact, the highest individual edible tissue PCB concentration of 4.8 ppm for flounder reported by Hillman et al., (1987) was not from the Upper Bay region, or north of the Hurricane Barrier, but from outside of the Fishing Closure Areas. This variability is likely attributable to the migration of the biota in and out of different regions of the Bay as a function of the seasons and their life cycle stage as described below.

The flounder spawn in the shallows of the site and the young generally remain in these inshore nursery areas for a period of up to six years. After reaching sexual maturity, the adult flounder migrate offshore to the deeper cooler waters during the summer and inshore to the spawning areas during the late fall. Although the average flounder PCB concentration is below 2 ppm in Closure Area III where fishing for flounder is permitted, there are likely flounder within this region with PCB concentrations exceeding the FDA limit.

It is also important to note that given these migratory habits, flounder and lobster within a given Fishing Closure Area may spend a portion of their life in the areas north of the Hurricane Barrier. This area, termed, the Estuary and Lower Harbor may also contribute to the biota PCB concentration.

3.0 SUMMARY OF HUMAN HEALTH AND ECOLOGICAL RISKS

This section summarizes the human health and ecological risks associated with PCB contamination in the Upper Buzzards Bay portion of the New Bedford Harbor site. This summary is based upon the results of the Draft Final Human Health Risk Assessment (Ebasco, 1989b) and the Baseline Ecological Risk Assessment (Ebasco, 1990b) prepared for the New Bedford Harbor site. This discussion focuses on risk assessment conclusions applicable to the Upper Buzzards Bay (Upper Bay) portion of the site.

3.1 HUMAN HEALTH RISKS

As part of the overall Human Health Risk Assessment prepared for the New Bedford Harbor site (Ebasco, 1989b) risks associated with exposure to PCBs and metals in Upper Buzzards Bay were evaluated (Figure 3-1). This risk assessment included identification of environmental media and exposure pathways of potential concern and calculation of quantitative risk estimates.

3.1.1 Exposure Media

The risk assessment approach initially involved identification of contaminated environmental media of potential concern with respect to human exposure. The environmental media which were considered included surface waters, bay sediments, marine biota and site area air (Table 3-1).

Based on results of a screening process designed to identify pathways of exposure at the New Bedford Harbor site, direct contact with and incidental ingestion of shoreline sediment and ingestion of marine biota were identified as the human health exposure pathways of primary concern. Screening results performed for the Upper Buzzards Bay area (and also the Estuary and Lower Harbor) showed that under conservative exposure conditions, exposure to PCBs in the surface waters did not represent a significant contaminant exposure pathway; therefore, this pathway was not evaluated further.

3.1.2 Quantitative Risk Estimates

This section summarizes the results of quantitative carcinogenic and non-carcinogenic risk estimates for PCB contamination in the Upper Buzzards Bay presented in the Human Health Risk Assessment (Ebasco, 1989b) and includes potential exposure to sediment, biota and air.

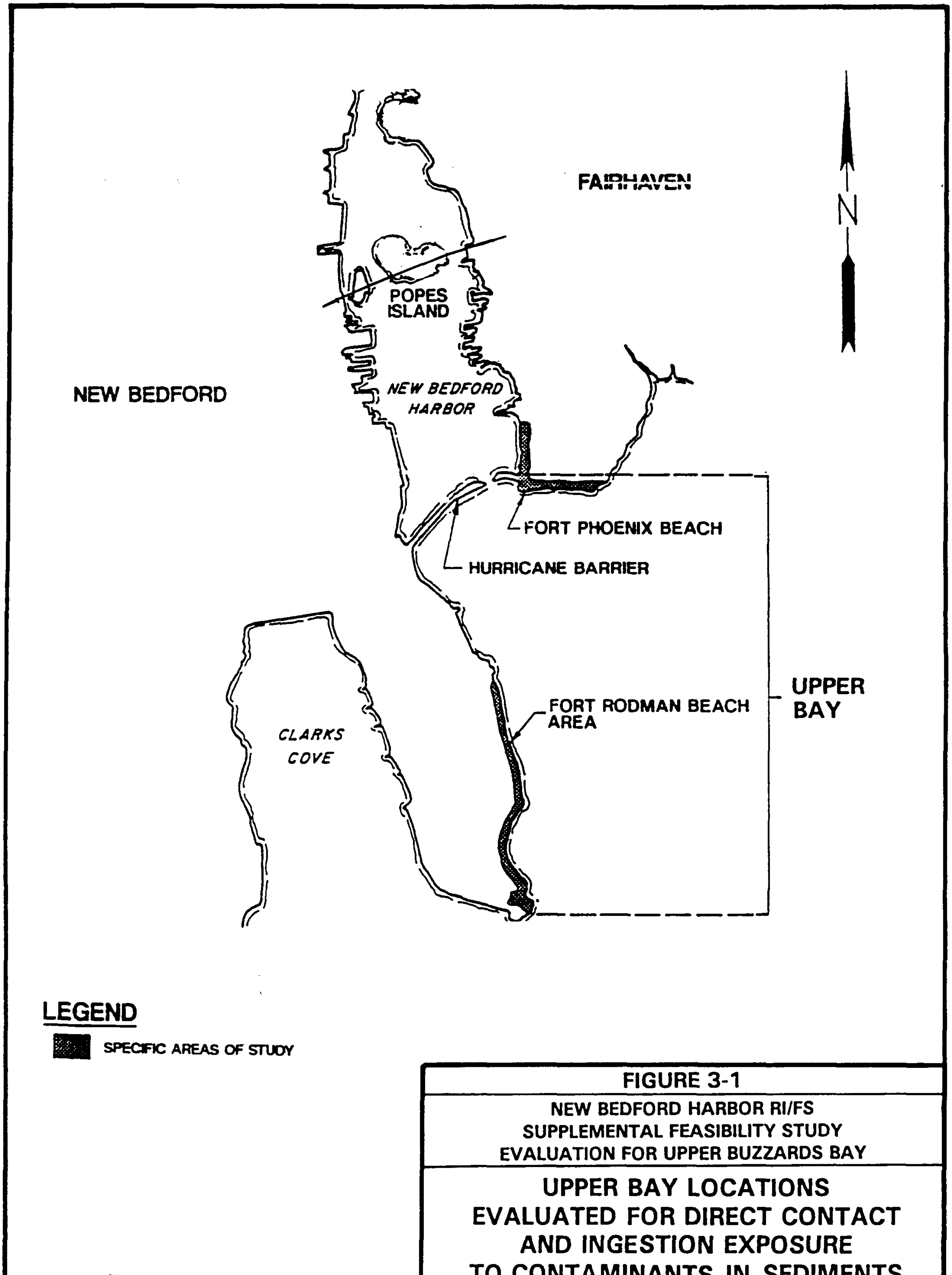


FIGURE 3-1

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

UPPER BAY LOCATIONS EVALUATED FOR DIRECT CONTACT AND INGESTION EXPOSURE TO CONTAMINANTS IN SEDIMENTS

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(Adapted from Ebasco, 1990)

In addition to the joint probability analysis, the results of certain other evaluation approaches were considered including:

- Comparisons to Ambient Water Quality Criteria (AWQC),
- Comparisons to Interim Sediment Quality Criteria (SQC), and
- Site Specific Toxicity Test Results.

Overall the cumulative results of the risk assessment evaluations indicated that aquatic organisms (particularly marine fish) may be at risk due to exposure to waterborne PCBs in portions of Upper Buzzards Bay.

Metals

As part of the overall Ecological Risk Assessment, risks from the exposure of biota to metals; specifically cadmium, copper and lead were evaluated (Ebasco, 1990b). Potential chronic effects were considered with respect to both sediment metals concentrations (based on pore water concentrations) and also water column metals concentrations for the four taxonomic groups (alga, crustaceans, mollusks, and marine fish). Results indicate that biota in Upper Buzzards Bay (represented by Zone 5) appear to be at relatively low risk due to water column metal (cadmium, copper and lead) concentrations. Even for mollusks and crustaceans, the taxonomic groups considered potentially most sensitive to aqueous metals concentrations, effects were expected to be minimal in the Upper Bay.

The results indicate that overall in the Upper Bay, metals concentrations in sediments as reflected by sediment pore water concentrations are also predicted to have minimal adverse impacts on the taxonomic groups under consideration.

TABLE 3-1

ENVIRONMENTAL MEDIA AND EXPOSURE PATHWAYS

HUMAN HEALTH RISK ASSESSMENT

ENVIRONMENTAL MEDIA	EXPOSURE PATHWAY CONSIDERED
Surface Water	Direct Contact Ingestion
Sediment	Direct Contact Ingestion
Marine Biota	Ingestion
Air	Inhalation

ECOLOGICAL RISK ASSESSMENT

ENVIRONMENTAL MEDIA	EXPOSURE PATHWAY CONSIDERED
Surface Water	Uptake by Biota
Sediment and Associated Pore Waters	Uptake by Biota
Marine Biota	Bioaccumulation

3.1.2.1 PCB Carcinogenic Risk Estimates

Sediments

Possible human health risks related to PCB contaminated sediments were evaluated for both direct contact and incidental ingestion exposure pathways. Risks were evaluated at specific locations where activities likely to result in exposure could occur (e.g., swimming, wading, and fishing).

Within Upper Buzzards Bay (see Figure 3-1), incremental cancer risks were evaluated for direct contact with and ingestion of PCB contaminated sediments at both the Fort Rodman and Fort Phoenix beach areas. For the Fort Rodman beach area, the assumed mean and maximum exposure point sediment PCB concentrations were 2 ppm and 7 ppm, respectively. For the Fort Phoenix beach area the assumed mean and maximum exposure point sediment PCB concentrations were 0.6 ppm and 0.8 ppm, respectively (Ebasco, 1989b).

For direct contact exposure to PCB contaminated sediments incremental risks for all age classes were estimated to range from $1x10^{-8}$ to $2x10^{-6}$ for the most probable exposure conditions (see Table 3-2). Considered in conjunction with the generally low concentrations of PCBs detected in the shoreline sediment samples, these risk estimates were considered to indicate a minimal risk to public health and were below to marginally within the EPA target risk range of 10^{-6} to 10^{-4} (Ebasco, 1989b).

For incidental ingestion of PCB contaminated sediments at the Fort Phoenix and Fort Rodman beach areas, incremental risks under the most probable exposure conditions were estimated to range from $2x10^{-7}$ to $3x10^{-6}$ (Ebasco, 1989b). Based upon these results, incremental risks from incidental ingestion of PCB contaminated sediments are below to marginally within the EPA target risk range of 10^{-6} to 10^{-4}.

Combined carcinogenic risks from direct contact and ingestion exposure to PCB contaminated sediment using most probable exposure assumptions for the Upper Bay beach areas ranged from approximately $2x10^{-7}$ to $5x10^{-6}$ (Ebasco, 1989b) and fell within the 10^{-6} to 10^{-4} EPA target risk range.

Biota

Possible health risks from exposure to PCBs through ingestion of biota were assessed based on concentrations detected in lobster, winter flounder, and clams (Ebasco, 1989b). These species were considered representative of biota commonly consumed in the New Bedford Harbor area. Edible-tissue PCB concentrations were used when available. The range of edible tissue PCB concentrations

TABLE 3-2

SUMMARY OF HUMAN HEALTH
RISK ESTIMATES FOR UPPER BUZZARDS BAY

CARCINOGENIC RISKS	RISK ESTIMATE[2]
Sediment[1]	
Direct Contact	$1x10^{-8}$ - $2x10^{-6}$
Ingestion	$2x10^{-7}$ - $3x10^{-6}$
Biota	
Ingestion (Fishing Area II)	$4x10^{-6}$ - $1x10^{-2}$
Air	$8x10^{-6}$

NON-CARCINOGENIC RISKS	HAZARD INDEX (HI)	
	PCBs	Metals[3]
Sediment[1]		
Direct Contact	<1	<1
Ingestion	<1	<1
Biota		
Ingestion (Fishing Area II)	>1	>1

(1) Sediment direct contact and ingestion risk are for the Fort Rodman and Fort Phoenix beach areas

(2) Risk estimate ranges reflect most probable exposure assumptions

(3) Metals - cadmium, copper, lead

evaluated in the Human Health Risk Assessment for lobster, winter flounder and clams was approximately 0.04 to 2.7 ppm. Exposure frequencies of one fish meal per day, per week, and per month were assumed; with varying fish intake amounts assumed for children (115 grams) and adults (227 grams).

Carcinogenic risks from ingestion of PCB contaminated biota were estimated to fall within or exceed EPA's target range throughout the New Bedford Harbor site. Exposure risks were considered to be greatest for children. For the exposure areas identified in Figure 3-2, the carcinogenic risk estimates for chronic exposure by adults and/or children to PCBs through ingestion ranged from approximately $4x10^{-6}$ to $1x10^{-2}$ for biota collected in Area II and $6x10^{-6}$ to $9x10^{-3}$ for biota collected in Area III. Somewhat lower values were calculated for biota collected in Area IV. Ingestion of lobster including tomalley was calculated to present the greatest potential risk (Ebasco, 1989b).

Air Exposure

As part of the overall human health risk assessment, the potential for residential exposure to PCBs in air was considered. Overall, dilution with clean air and dispersion across the entire site area (Estuary, Lower Harbor and Bay) were considered to limit possible contributions to downrange concentrations of PCBs in residential areas. A background residential PCB concentration of 10 ng/m^3 was estimated based on air monitoring conducted by NUS (NUS, 1986). Baseline risks were estimated based on an assumed "background" concentration of 10 ng/m^3 PCB (Ebasco, 1989b). The carcinogenic risk level associated with 70-year exposure to this concentration was calculated to be $8x10^{-6}$. This level is within the EPA target risk range of 10^{-6} to 10^{-4}. In addition, it is likely that volatilization of PCBs from surface waters in the Upper Bay alone would contribute only a small fraction to the existing background residential atmospheric PCB concentration.

3.1.2.2 Non-Carcinogenic Risks

Quantitative estimates were also developed for non-carcinogenic risks associated with direct contact with and ingestion of sediments and ingestion of biota (see also Table 3-2). Individual and multitoxic hazard index (HI) values were generated for acute and chronic exposure to PCBs and three metals cadmium, copper, and lead (Ebasco, 1989b). Hazard index ratios of 1 or less are generally not anticipated by EPA to pose lifetime risk to human health (EPA, 1986).

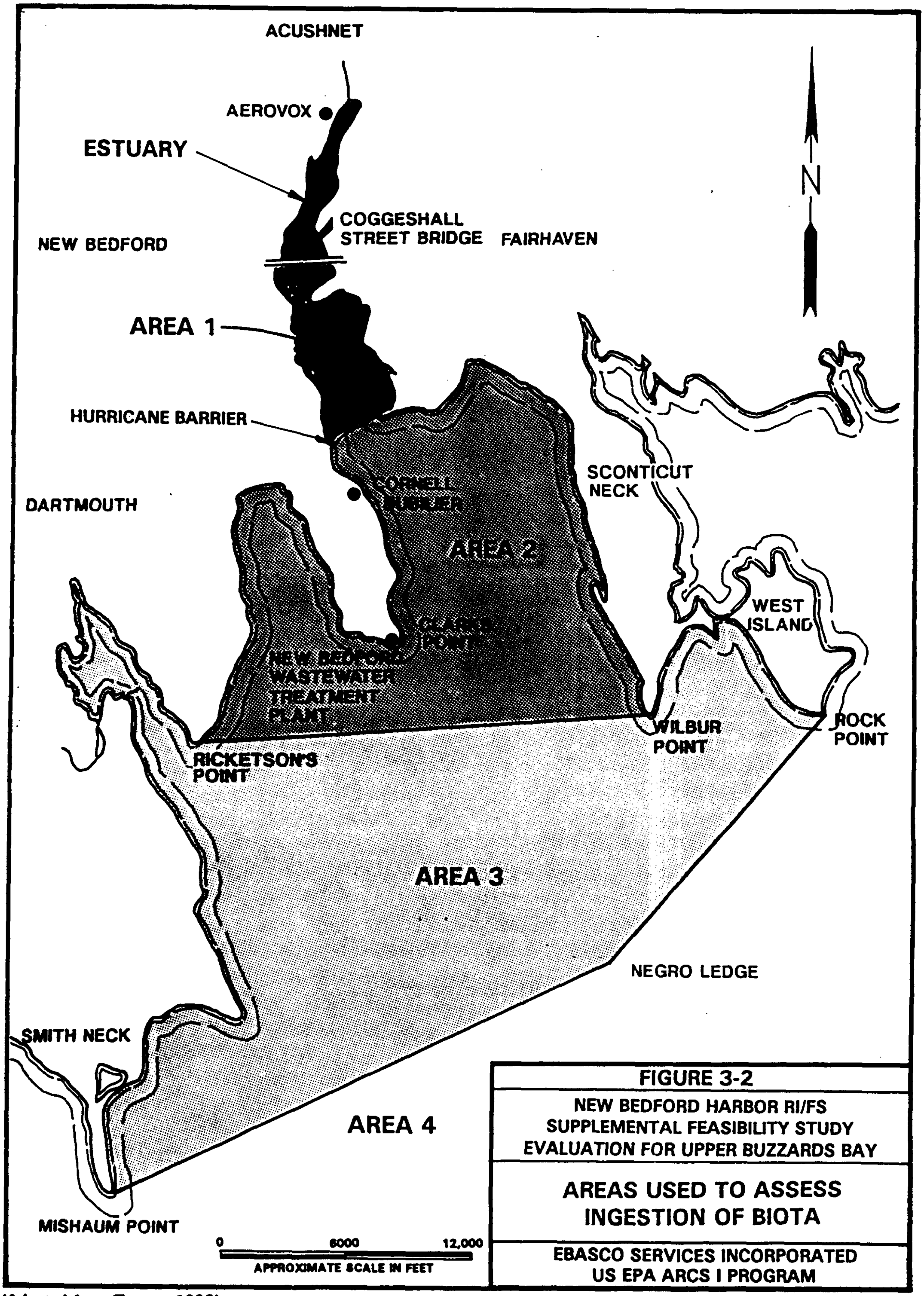

FIGURE 3-2

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

AREAS USED TO ASSESS
INGESTION OF BIOTA

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(Adapted from Ebasco, 1990)

Sediment

For PCBs, direct contact HIs based on chronic exposure to shoreline sediments at the Fort Rodman and Fort Phoenix beaches were calculated to be less than 1. Overall, direct contact exposure to PCBs from Upper Buzzards Bay shoreline sediments was not considered to present a significant non-carcinogenic public health risk (Ebasco, 1989b).

The HIs based on chronic exposure from ingestion of PCB contaminated sediment under most probable exposure conditions were less than 1.0 for the Fort Rodman and Fort Phoenix beach areas. These results indicate minimal non-carcinogenic health risks from ingestion of PCBs from shoreline sediments in the Upper Bay.

For direct contact with sediments, HIs for chronic exposure to the metals cadmium, copper, and lead were also below 1 for the Fort Rodman and Fort Phoenix beach areas for all exposure conditions. Due to the low HIs, (less than 1) these metals were not considered to present a non-carcinogenic human health risk from direct contact exposure. The multitoxic HI ratios for exposure to PCBs and the three metals, were also less than 1 for most probable exposure scenarios for the Fort Rodman and Fort Phoenix locations.

Of the three metals, it was determined that on a site wide basis (Estuary, Lower Harbor and Bay) lead posed the greatest concern with respect to ingestion of shoreline sediment. However, for the Fort Rodman and Fort Phoenix locations in the Upper Bay, lead was not detected in the beach sediments. In these two locations, non-carcinogenic health risks from cadmium, copper and lead through chronic exposure from ingestion of sediment were considered to be minimal.

Biota

For the non-carcinogenic HIs based on ingestion of PCB contaminated biota from Upper Buzzards Bay, the results exceeded 1 under both conservative and most probable exposure conditions (Ebasco, 1989b). For some exposure scenarios the HIs exceeded the 1.0 guideline by one to two orders of magnitude under conservative exposure assumptions. Therefore, chronic exposure from ingestion of PCB contaminated biota was considered to represent a potential health risk.

Quantitative risk estimates based on exposure to metals through ingestion of biota exceeded an HI of 1.0. The frequency and magnitude with which ratios exceeded 1 for the various exposure scenarios and species of concern (lobster, clams, flounder) even in the Upper Bay indicate a potential risk to public health.

3.2 ECOLOGICAL RISKS

This section summarizes the results of the Ecological Risk Assessment (Ebasco, 1990b) for the New Bedford Harbor site. This discussion focuses on the results of the risk assessment as they relate to the Upper Buzzards Bay portion of the site.

3.2.1 Overall Ecological Risks

The overall Ecological Risk Assessment (Ebasco, 1990b) evaluated risks to marine biota in the Estuary, the Lower Harbor and in Upper Buzzards Bay. The principal exposure pathways which were considered are presented in Table 3-1.

As part of the ecological risk assessment for the New Bedford Harbor site, a joint probability analysis was used to develop probabilistic risk estimates for the effects of PCBs and heavy metal (i.e., copper, cadmium, and lead) contamination on marine organisms. Probabilistic estimates included the use of maximum acceptable toxicant concentration (MATC) calculations. Probability analysis calculations were performed on four taxonomic groups (alga, crustaceans, mollusks and marine fish). The expected distribution of a taxonomic group response to a contaminant was estimated by extrapolating the responses observed in individual organisms to the larger groups.

The results of probability analysis calculations indicate that although the likelihood for adverse effects to members of the taxonomic groups which were investigated were greatest in the Estuary and Lower Harbor areas of the site, some adverse effects to marine biota may occur in Upper Buzzards Bay. Results further suggested that in the Upper Buzzards Bay area (represented by Zone 5 in Figure 3-3), marine fish (due to their sensitivity to dissolved PCBs) were more likely to sustain adverse effects from chronic exposure to water column PCB concentrations than mollusks or crustaceans.

Probability analysis calculations were also performed to evaluate potential adverse effects on marine organisms due to exposure to PCB contaminated sediments and associated pore water. Results indicate that risk probabilities for all groups from pore water PCB concentrations in Upper Buzzards Bay (as reflected by Zone 5) are lower than those for the Estuary and Lower Harbor. However, results indicated that marine fish may still be substantially impacted in Zone 5. Based on the probability analysis results, it was concluded that adverse ecological effects due to PCB contamination in Upper Buzzards Bay were likely to be less severe than in the Estuary and Lower Harbor although still potentially significant.

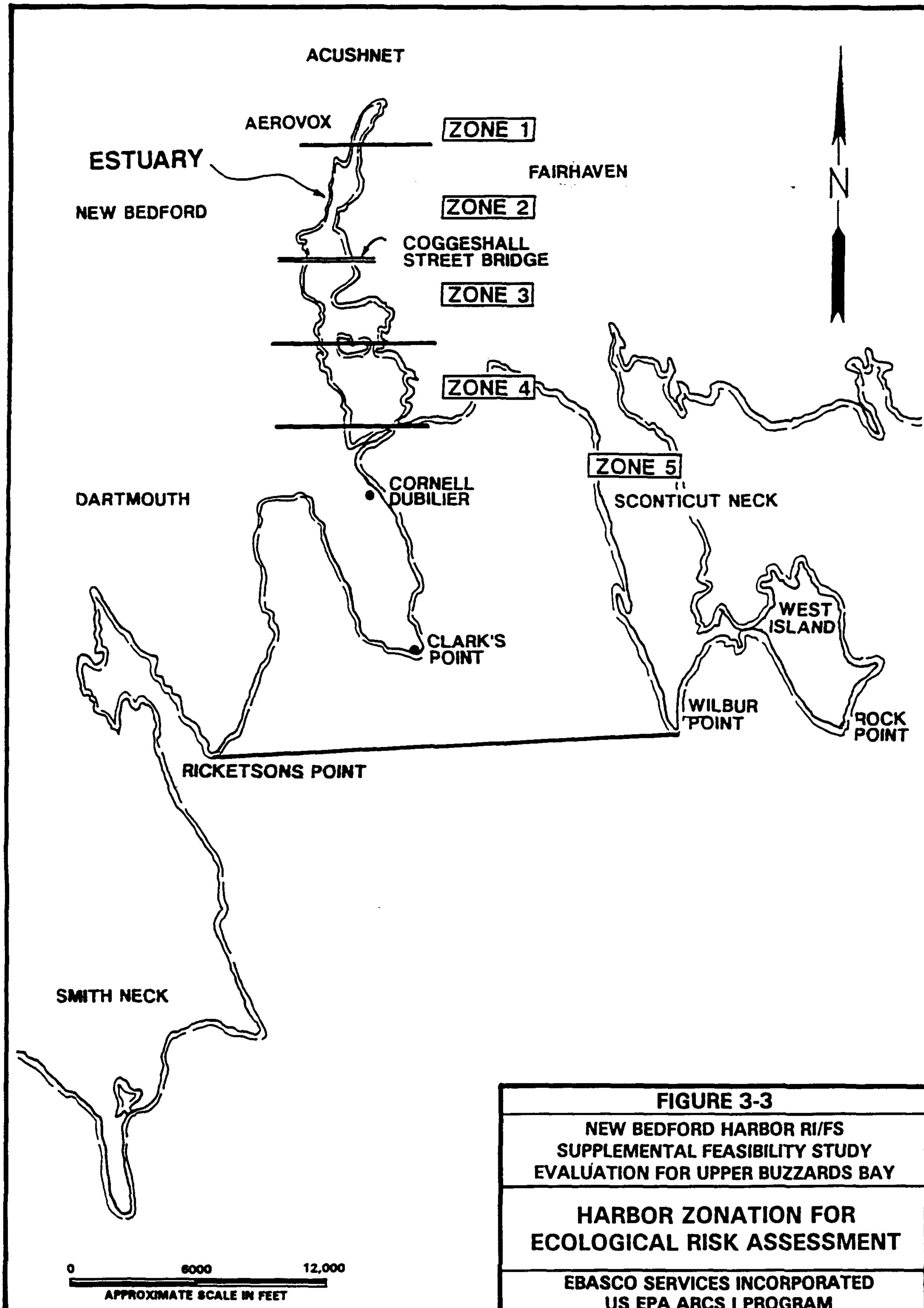

FIGURE 3-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

HARBOR ZONATION FOR ECOLOGICAL RISK ASSESSMENT

EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

(Adapted from Ebasco, 1990)

4.0 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, TARGET CLEANUP LEVELS AND REMEDIAL RESPONSE OBJECTIVES

This section presents a summary of the regulations, laws and other requirements which govern the development and evaluation of remedial alternatives for Upper Buzzards Bay. Those laws and regulations are set forth in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendment and Reauthorization Act (SARA) of 1986; the National Contingency Plan (NCP), 40 CFR Part 300, in particular, Section 300.430. Further guidance on the process of identifying and evaluating remedial action alternatives is set forth in the EPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA, 1988).

The section also identifies the applicable or relevant and appropriate requirements (ARARs) that may apply to the remedial alternatives are presented in Section 4.2. The development of the PCB Target Cleanup Levels (TCLs) and the remedial action objectives are presented in Sections 4.3 and 4.4 respectively.

4.1 ENVIRONMENTAL LAWS GOVERNING RESPONSE

Remedial actions, as defined by 300.5 of the NCP, are actions consistent with a permanent remedy, taken instead of or in addition to removal actions to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare, or the environment.

Section 121 of CERCLA establishes a statutory preference for remedies that employ treatment which permanently and significantly reduce the toxicity, mobility or volume of hazardous substances over remedies that do not use such treatment. Section 121 also requires EPA to select a remedy that is protective of human health and the environment, is cost-effective, and utilizes permanent solutions and alternative treatment technologies, to the maximum extent practicable. Furthermore, Section 121 requires that, upon completion, remedies attain Federal and state ARARs unless specified waivers are granted.

Section 300.430 of the NCP, in conjunction with the RI/FS Guidance, sets forth the remedial alternative development and remedy selection process. This process consists of the following steps:

(1) Identification of the nature and extent of contamination and threat presented by the release (300.430(d)(2)).

(2) Identification of general response objectives for site remediation (300.430(e)(2)(i)).

(3) Identification and screening of remedial technologies potentially applicable to waste and site conditions (300.430(e)(2)(ii)).

(4) Development of a range of alternatives to achieve the site-specific response objectives (300.430(e)(3)).

(5) Initial screening of alternatives (300.430(e)(7)).

(6) Detailed analysis of alternatives (300.430(e)(9)).

(7) Selection of remedy (300.430(f)).

4.2 SITE-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA as amended by SARA and Section 300.430(f) of the NCP require that remedial actions under CERCLA comply with all Federal and state ARARs. ARARs are used to determine the appropriate extent of site cleanup, to scope and formulate remedial action alternatives, and to govern the implementation and operation of the selected action. According to CERCLA Section 121(d)(4), ARARs may be waived by EPA under six specific conditions, provided that protection of human health and the environment is still assured. These conditions include the following:

- The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed;

- Compliance with such requirement at that facility will result in greater risk to human health and the environment than alternative options;

- Compliance with such requirement is technically impracticable from an engineering perspective;

- The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criterion, or limitation, through use of another method or approach;

- With respect to a state standard, requirement, criterion, or limitation, the state has not consistently applied (or demonstrated the intention to apply consistently) the standard, requirement, criterion, or limitation in similar circumstances at other remedial actions within the state; or,

- In the case of a remedial action to be undertaken solely under Section 104 using the Fund, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration, and the availability of amounts from the Fund to respond to other Sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats.

In the following subsection, ARARs are defined and the approach to identifying ARARs is discussed. Potential chemical-, action-, and location-specific ARARs are identified.

4.2.1 Definition of ARARs

A requirement under CERCLA may be either "applicable" or "relevant and appropriate" to a site-specific remedial action.

Applicable Requirements: "Applicable requirements" refer to those cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. An example of an applicable requirement would be Maximum Contaminant Levels (MCLs) for a site that causes contamination of a public water supply system which provides water service to 15 or more service entrances or 25 or more people. Only those state standards that are identified by a state in a timely manner and are more stringent than Federal requirements may be applicable.

Relevant and Appropriate Requirements: "Relevant and appropriate requirements" are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or state environmental siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. For example, while Resource Conservation and Recovery Act (RCRA) regulations may not be applicable to closing undisturbed hazardous waste in place, the RCRA regulation for closure by capping may be deemed relevant and appropriate. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate. During the FS process, relevant and appropriate requirements are intended to have the same weight and consideration as applicable requirements.

Other Requirements to be Considered: Non-promulgated advisories or guidance issued by the Federal or state government that are not legally binding do not have the status of potential ARARs. Where no specific ARARs exist for a chemical or situation, or where such ARARs are not sufficient to be protective, guidance documents or advisories may be considered in determining the necessary level of cleanup for protection of human health or the environment.

4.2.2 Development of ARARs

Under the description of ARARs set forth in the NCP and SARA, many Federal and state environmental requirements must be considered. These requirements include ARARs that are:

- chemical-specific (i.e., govern the extent of site cleanup)
- location-specific (i.e., pertain to existing site features)
- action-specific (i.e., pertain to proposed site remedies and govern implementation of the selected site remedy) A separate document, entitled "Regulation Assessment for New Bedford Harbor," was published for the New Bedford Harbor site that has identified the potential chemical-, location-, and action-specific ARARs (Ebasco, 1990a). This document identifies both Federal and state ARARs and summarizes the procedural and technical requirements of these regulations. ARARs pertinent to the Estuary and Lower Harbor and Bay areas are summarized in the following subsection.

4.2.2.1 Chemical-specific ARARs

Chemical-specific ARARs govern the extent of site cleanup and provide either actual clean-up levels or a basis for calculating such levels. For instance, surface water criteria and standards, as well as air standards, provide guidelines for clean-up goals for the Supplemental Feasibility Study.

Chemical-specific ARARs are also used to indicate acceptable levels of discharge to determine treatment and disposal requirements, and to assess the effectiveness of remedial alternatives. Table 4-1 lists and summarizes potential chemical-specific ARARs. Chemical-specific ARARs are site-specific and apply to every alternative. Descriptions of chemical-specific ARARs by surface water and air follow.

TABLE 4-1
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

MEDIUM/AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE RI/FS
<u>Surface Water</u>				
Federal Regulatory Requirements	Federal Food, Drug and Cosmetic Act	Applicable	This act sets forth the FDA limit of 2 ppm for PCB concentrations in commercial fish and shellfish.	This level will be considered as a clean-up level.
State Regulatory Requirements	MADEP - Massachusetts Surface Water Quality Standards (310 CMR 4.00)	Applicable	MADEP surface water quality standards incorporate the federal AWQC as standards for surface waters of the state.	AWQC applicable to the Upper Buzzards Bay are as follows: PCBs - 10 ppb (acute effects on aquatic life) - 0.03 ppb (chronic effects on aquatic life) Cadmium - 43 ppb (acute effects) 9.9 ppb (chronic effects) Copper - 2.9 ppb (acute effects) 2.9 ppb (chronic effects) Lead - 140 ppb (acute effects) - 5.6 ppb (chronic effects)
Federal Criteria, Advisories, and Guidance	Federal Ambient Water Quality Criteria (AWQC)	Applicable	Federal AWQC are health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds.	AWQC are incorporated into MADEP standards as discussed above.
<u>Air</u>				
Federal Regulatory Requirements	CAA - National Ambient Air Quality Standards (NAASQ) - 40 CFR 40.	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions.	Standards for particulate matter will be used when assessing excavation and emission controls for sediment treatments.
State Regulatory Requirements	MADEP - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions.	Alternatives involving excavation, air, and emission controls for sediment treatment will be compared against these standards.
Federal Criteria, Advisories, and Guidance	Threshold Limit Value (TLV)	To Be Considered	These standards were issued as consensus standards for controlling air quality in workplace environments.	TLVs could be used for assessing site inhalation risks for soil removal operations.

Surface Water - Surface water in the Bay is governed generally by the federal Clean Water Act (CWA) and specifically by the Massachusetts Surface Water Quality Standards (310 CMR 4.00). The federal statute has a general mandate to preserve water quality. The state develops general criteria for surface water quality and determining standards. The federal AWQC are applicable to the site because they are incorporated as Massachusetts surface water quality standards. Under these rules, the concentration of contaminants in sediments will need to be at levels that assure that water in the Bay meets regulatory criteria.

Remedial alternatives that propose technologies that generate process water, leachate, or supernatant to be returned to the harbor will be subject to the CWA and Massachusetts Surface Water Quality Standards. Discharge waters will have to meet the standards promulgated by the state.

The Federal Food, Drug, and Cosmetic Act (FFDCA) sets a limit of 2 ppm of PCBs in commercial fish and shellfish and is applicable.

Air - Federal and state air regulations that establish concentration limits for particulate matter are considered chemical-specific ARARs where excavation activities, for example, may generate dust and debris. Massachusetts has set an Allowable Ambient Level (AAL) of 0.0005 micrograms per cubic meter for PCBs; however, in certain areas of the Estuary and Lower Harbor and Bay, the existing background air quality currently exceeds this AAL.

4.2.2.2 Location-specific ARARs

Location-specific ARARs govern natural site features such as wetlands and floodplains, as well as manmade features including existing landfills, disposal areas, and local historic buildings. Location-specific ARARs are generally restrictions on the concentration of hazardous substances or the conduct of activities solely because of the site's particular characteristics or location. These ARARs provide a basis for assessing existing site conditions and subsequently aid in assessing potential remedial alternatives. Table 4-2 lists and summarizes potential location-specific ARARs. For Upper Buzzards Bay applicable location-specific ARARs will be requirements that protect wetland and floodplain areas. Some location-specific ARARs may be interpreted as action-specific ARARs, such as those requiring permits or licenses for work performed in a waterway, floodplain, or wetland. However, they are described herein to provide continuity for discussions of regulations affecting proposed remedial alternatives of the Estuary and Lower Harbor and Bay sediments. According to CERCLA, remedial actions undertaken

TABLE 4-2
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

MEDIUM/AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE RI/FS
Wetlands/Floodplains				
Federal Regulatory Requirements	Clean Water Act (CWA) 40 CFR Part 404 River and Harbors Act of 1899 (40 CFR Part 230 and 33 CFR Part 320-329)	Applicable	Under this requirement, no activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available. If there is no other practical alternative, impacts must be mitigated. A permit is required for construction of any structure in a navigable water. Section 307, effluent standards of 1-ppb concentrations of PCB, is incorporated into this section by reference. The 1-ppb effluent discharge standard is to be considered for guidance levels.	During the identification, screening, and evaluation of alternatives, the effects on wetlands are evaluated. Effluent levels will be used as guidance levels to which alternatives will be evaluated.
	RCRA Location Standards (40 CFR 264.18)	Relevant and Appropriate	This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain.	A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be removed safely before floodwater can reach the facility or no adverse effects on public health and the environment would result if a washout occurred.
	National Environmental Policy Act (42 U.S.C. 4321; 40 CFR Part 6)	Applicable	Set forth EPA policy for carrying out the provisions of the Wetlands Executive Order (EO 11990) and Floodplain Executive Order (EO 11988).	This requirement will be considered during the development of alternatives.
State Regulatory Requirements	MADEP - Wetlands Protection (310 CMR 10.00)	Applicable	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. This requirement also defines wetlands based on vegetation type and requires that effects on wetlands be mitigated.	Remedial alternatives must comply with the substantive requirements.

TABLE 4-2
(continued)
POTENTIAL LOCATION-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

MEDIUM/AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE RI/FS
Federal Nonregulatory Requirements to be Considered	Wetland Executive Order (EO 11990)	To Be Considered	Under this regulation, federal agencies are required to minimize the destruction loss or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands.	Remedial alternatives that involve construction must include all practicable means of minimizing harm to wetlands. Wetland protection considerations must be incorporated into the planning and decision-making about remedial alternatives.
	Wetland Executive Order (EO 11988)	To Be Considered	Federal agencies are required to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains.	The potential effects of any action must be evaluated to ensure that the planning and decision-making reflect consideration of flood hazards and floodplain management, including restoration and preservation of natural undeveloped floodplains.

entirely on-site need to comply only with substantive aspects of ARARs and not with corresponding administrative requirements (i.e., permits).

Wetlands, Waterways, and Floodplains - For actions involving construction of facilities in wetlands or alterations of wetland property, National Environmental Protection Act (NEPA) regulations (40 CFR Part 6) are applicable. NEPA requires that federal agencies include in decision-making processes appropriate and careful consideration of all environmental effects of the proposed actions, and restore and enhance environmental quality as much as possible. In general, compliance with SARA and the NCP assures compliance with NEPA.

Appendix A of 40 CFR Part 6 specifically sets forth policy and guidance for carrying out provisions of the Wetlands Executive Order (EO 11990) and the Floodplain Executive Order (EO 11988). An alternative located in a wetland or floodplain may not be selected unless a determination is made that no practicable alternative exists outside the wetland. If no practicable alternative exists outside the resource area, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values.

Section 404 of the CWA regulates the discharge of dredged and fill materials to waters of the U.S. Filling wetlands would be considered a discharge of fill material to waters of the U.S. Procedures for complying with permit conditions are contained in 33 CFR Part 323. Guidelines for Specification of Disposal Sites for Dredged or Fill Material in 40 CFR Part 230, promulgated under CWA Section 404(b)(1), maintain that no discharge of dredge or fill material will be permitted if there is a practicable alternative that would have less adverse impact on the aquatic system. Because the Bay sediments are contaminated, no practicable alternative is believed to exist that would remediate the sediment without disturbing the aquatic system. Therefore, there is no alternative remedial action which would have less adverse impacts. In addition, Section 10 of the River and Harbor Act of 1899 requires authorization from the Secretary of the Army, acting through U.S. Army Corps of Engineers (USACE), for the construction of any structure in or over any "navigable water of the U.S.," the excavation from or deposition of material in such waters, or any obstruction or alternation in such waters.

At the state level, wetlands and land subject to flooding are protected under the Massachusetts Wetlands Protection Act and Wetlands Regulations in 310 CMR 10.00.

EPA must insure that any alternative complies with the substantive requirements of 310 CMR 10.0 and the Massachusetts Waterways Act

(Massachusetts General Law [MGL], Chapter 91) and regulations at 310 CMR 9.00.

Two of these regulations, entitled "Certification for Dredging," and "Dredged Materials Disposal and Filling in Waters," encompass dredging projects in waters or wetland areas of the State that are also subject to the jurisdiction of either a federal agency under CWA (Section 401) or the Massachusetts Wetlands Act or Waterways Act. The regulations specify sampling methods and a classification system for dredge or fill material. Any alternative must attain or maintain Massachusetts Water Quality Standards and minimize adverse impact to the environment.

The Environmental Affairs Coastal Zone Management (CZM) Program (301 CMR 20.00-22.00) established the Massachusetts CZM program under the federal Coastal Zone Management Act (15 CFR 930). These regulations are promulgated to establish CZM policies and to ensure that they are administered in a coordinated and consistent manner.

The federal CZM act requires that any federal agency proposing to do work in a state's coastal zone must submit a plan outlining how all work to be performed is consistent with the state program. The Massachusetts CZM program policies are implemented with other state agencies (e.g., MADEP) through the standards and criteria of these agencies' regulations. Compliance with the Massachusetts CZM program will be met through attainment of MADEP location- and action-specific ARARs.

4.2.2.3 Action-specific ARARs

Action-specific ARARs are usually technology- or activity-based limitations that control actions at CERCLA sites. After remedial alternatives are developed, action-specific ARARs pertaining to proposed site remedies provide a basis for assessing the feasibility and effectiveness of the remedies. For example, these action-specific ARARs may include hazardous waste transportation and handling requirements, air and water emissions standards, and the Toxic Substance Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA) landfilling and treatment requirements. Potential action-specific ARARs, listed and summarized in Table 4-3, are discussed in the detailed evaluation of alternatives (see Section 6.0).

4.3 REMEDIAL RESPONSE OBJECTIVES

4.3.1 <u>Introduction</u>

This section presents the results of the evaluation of potential remedial response objectives for the Upper Buzzards Bay portion of the New Bedford Harbor site. This development of remedial response

TABLE 4-3
POTENTIAL ACTION-SPECIFIC ARARS

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

ARARS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
RCRA - General Facility Standards (40 CFR 264.10 - 264.18)	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Any facilities constructed will be fenced, posted, and operated in accordance with this requirement. All workers will be properly trained. Process wastes will be evaluated for the characteristics of hazardous wastes to assess further landfilling requirements.
RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.31)	This regulation outlines requirements for safety equipment and spill control	Safety and communication equipment will be installed at the site; local authorities will be familiarized with site operations.
RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during site work including installation of monitoring wells, and implementation of site remedies. Copies of the plans will be kept on-site.
RCRA - Release from Solid Waste Management Units (40 CFR 264.90 - 264.109)	This regulation details requirement a groundwater monitoring program to be installed at the site.	A groundwater monitoring program is a component of all alternatives. RCRA regulations will be utilized as guidance during development of this program.
RCRA - Closure and Post-closure (40 CFR 264.110 - 264.120)	This regulation details specific requirements for closure and post-closure of hazardous waste facilities.	Those parts of the regulation concerned with long-term monitoring and maintenance of the site will be incorporated into the design.
RCRA - Surface Impoundments Items (40 CFR 264.220 - 264.249)	This regulation details the design, construction, operation, monitoring, inspection, and contingency plans for a RCRA surface impoundment. Also provides three closure options for CERCLA sites; clean closure, containment closure, and alternate closure.	To comply with clean closure, owner must remove or decontaminate all waste. To comply with containment closure, the owner must eliminate free liquid, stabilize remaining waste, and cover impoundment with a cover that complies with the regulation. Integrity of cover must be maintained, groundwater system monitored, and runoff controlled. To comply with alternate closure, all pathways of exposure to contaminants must be eliminated and long-term monitoring provided.
RCRA - Waste Piles (40 CFR 264.250 - 264.269)	Details procedures, operating requirements, and closure and post closure options for waste piles. If removal or decontamination of all contaminated subsoils is not possible, closure and post-closure requirements for landfills must be attained.	According to RCRA, waste piles used for treatment or storage of non-containerized accumulation of solid, non-flowing hazardous waste may comply with either the waste pile or landfill requirements. The temporary storage of solid waste on-site, therefore, must comply with one or the other subpart.

TABLE 4-3
(continued)
POTENTIAL ACTION-SPECIFIC ARARS

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

ARARS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
RCRA - Landfills (40 CFR 264.300 - 264.339)	This regulation details the design, operation, monitoring, inspection, recordkeeping, closure, and permit requirements for a RCRA landfill.	Disposal of contaminated materials from the harbor would be to a RCRA-permitted facility that complies with the RCRA landfill regulations, including closure and post-closure. On-site disposal would include a RCRA-designed cap.
RCRA - Incinerators (40 CFR 264.340 - 264.599)	This regulation specifies the performance standards, operating requirements, monitoring, inspection, and closure guidelines of any incinerator burning hazardous waste.	On-site thermal treatment must comply with the appropriate requirements specified in this subpart of RCRA.
RCRA - Miscellaneous Units (40 CFR 264.600 - 264.999)	These standards are applicable to miscellaneous units not previously defined under existing RCRA regulations for treatment, storage, and disposal units.	Units not previously defined under RCRA must comply with these requirements.
TSCA Disposal Requirements (40 CFR part 761.60)	PCBs at concentrations greater than 50 ppm, but less than 500 ppm, must be disposed of either in an incinerator, or in a chemical waste landfill, or by another technology capable of providing equal treatment. PCBs at concentrations greater than 500 ppm must be disposed of in an incinerator or treated by an alternate technology capable of equal treatment or disposed of in a chemical waste landfill. Dredged materials with PCB concentrations greater than 50 ppm may be disposed of by alternative methods which are protective of public health and the environment, if shown that incineration or disposal in a chemical waste landfill is not reasonable or appropriate.	PCB treatment must comply with these regulations during remedial action.

TABLE 4-3
(continued)
POTENTIAL ACTION-SPECIFIC ARARS

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

ARARS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
CWA-40 CFR Part 403	This regulation specifies pretreatment standards for discharges to a publicly owned treatment works (POTW).	If a leachate collection system is installed and the discharge is sent to a POTW, the POTW must have an approved pretreatment program. The collected leachate runoff must be in compliance with the approved program. Prior to discharging, a report must be submitted containing identifying information, list of approved permits, description of operations, flow measurements, measurement of pollutants, certification by a qualified professional, and a compliance schedule.
Regulations on Disposal Site Determination Under the Water Act (40 CFR 231)	This regulations apply to all existing, proposed, or potential disposal sites for discharges of dredged or fill material into U.S. waters, which include wetlands.	The dredged or fill material should not be discharged unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact on the wetlands.
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-171.5)	This regulation provides a comprehensive program for the handling, storage, and recordkeeping at hazardous waste facilities. They supplement RCRA regulations.	Because these requirements supplement RCRA hazardous waste regulations, they must also be considered at New Bedford Harbor.
MADEP - Hazardous Waste Regulations, Phases I and II. (310 CMR 30.000, MGL Ch. ZIC)	These regulations provide the framework for the Commonwealth of Massachusetts to regulate hazardous waste activities in the state.	During remedial design, these regulations will be compared to the corresponding federal regulations, and the more stringent requirements will be applied if appropriate.
MADEP - Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers (314 CMR 12.00)	This regulation outlines the operation and maintenance requirements applicable to operators of wastewater treatment facilities. These rules require treatment to meet standards set forth in 314 CMR 3.00 and 5.00.	Operation of any treatment facilities on-site will be in accordance with the procedures and rules in this regulation.
MADEP - Massachusetts Surface Water Discharge Permit Program (314 CMR 1.00 - 7.00)	This section outlines the requirements for obtaining a National Pollutant Discharge Elimination System (NPDES) permit in Massachusetts.	Pollutant discharges to surface water must comply with NPDES requirements. Conditions and standards for different classes of water are specified.

TABLE 4-3
(continued)
POTENTIAL ACTION-SPECIFIC ARARS

ESTUARY AND LOWER HARBOR/BAY SUPPLEMENTAL FEASIBILITY STUDY
FOR UPPER BUZZARDS BAY
NEW BEDFORD, MASSACHUSETTS

ARARS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
MADEP - Supplemental Requirements for Hazardous Waste Management Facilities (314 CMR 8.00)	This regulation outlines the additional requirements that must be satisfied in order for a RCRA facility to comply with the NPDES regulation. These regulations are applicable to a water treatment unit; a surface impoundment that treats influent wastewater; and a POTW that generates, accumulates, and treats hazardous waste.	All owners and operators of RCRA facilities shall comply with the management standards of 310 CMR 30.500, the technical standards of 310 CMR 30.600, the location standards of 310 CMR 30.700, the financial responsibility of 310 CMR 30.900, and in the case of POTWs, the standards for generators in 310 CMR 30.300.
Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00)	This regulation is promulgated to establish procedures, criteria, and standards for the water quality certification of dredging and dredged material disposal.	Three categories have been established for dredge or fill material based on the chemical constituents. Approved methods for dredging, handling, and disposal options for the three categories must be met.
MADEP - Administration of Waterway License (310 CMR 9.00)	The rules were promulgated to establish procedures and criteria to protect public rights of fishing, fowling, and navigation in the marine and tidelands of the Commonwealth.	Design of capping and cover systems must be approved prior to construction. Dredging of sediment, and remedial activities conducted in tidal and saltwater areas need to comply with standards set forth in these rules.
EOEA - Coastal Zone Management (CZM) Program (301 CMR 20.00 - 22.00)	These regulations are promulgated to establish regulatory and non-regulatory CZM policies that include: #1 - protection of ecologically significant resource areas #3 - attainment of national water quality goals #5 - promote minimizing adverse effects from dredging and disposal of dredged material #10 - development in coastal zone areas complies with state and federal air and water pollution, and inland wetlands regulations.	These requirements will be attained through compliance with MADEP requirements: 310 CMR 6.00 Ambient Air Quality Standards 310 CMR 7.00 Air Pollution Control 310 CMR 9.00 Waterway Licenses 310 CMR 10.00 Wetlands Protection 310 CMR 19.00 Solid Waste Disposal 310 CMR 30.00 Hazardous Waste 314 CMR 9.00 Dredging
MADEP - Disposal of Solid Waste by Sanitary Landfill (310 CMR 19.00)	This regulation establishes rules and requirements for solid waste facilities.	Landfilling of screened, non-hazardous material will comply with this regulation.

objectives reflects the findings of the human health and ecological risk assessments presented in Section 3.0.

4.3.2 General Response Objectives

4.3.2.1 Human Health Based Response Objectives

The results of the Human Health Risk Assessment (Ebasco, 1989b) indicate that ingestion of PCB contaminated biota from Upper Buzzards Bay poses significant risks to public health under certain assumed exposure conditions. Risk estimates (Section 3.0) indicate that ingestion of PCB contaminated biota may result in risks in excess of the EPA's target risk range of 10^{-6} to 10^{-4}. Therefore, EPA considered protection of human health from ingestion of PCB contaminated biota an appropriate response objective for the Upper Bay.

Risk estimates (Section 3.0) indicate that direct contact with and ingestion of PCB contaminated sediments do not represent a significant human health risk for the Upper Bay area. Based on current shoreline sediment PCB concentration data, calculated carcinogenic risks are within EPA's target risk range of 10^{-6} to 10^{-4}. Therefore, EPA did not consider protection of human health from direct contact with and ingestion of PCB contaminated sediment an appropriate response objective for the Upper Bay.

Hazard index (HI) calculations (Section 3.0) indicate that direct contact with or ingestion of metals in shoreline sediments was not considered to represent a significant non-carcinogenic human health risk for the Upper Bay area. Therefore, EPA did not consider protection of human health from exposure to metals via direct contact with or ingestion of shoreline sediments an appropriate response objective for the Upper Bay.

4.3.2.2 Environmentally Based Remedial Response Objectives

The results of the Ecological Risk Assessment (Ebasco, 1990a) summarized in Section 3.0 indicate that uptake of PCBs from contaminated sediments, associated pore waters and overlying waters, poses potential risks to certain marine biota in the Upper Bay. Therefore, EPA considered protection of marine biota from PCB contaminated sediments and associated waters an appropriate response objective for the Upper Bay.

4.3.3 Specific Remedial Response Objectives

The specific remedial response objectives for the Upper Bay portion of the New Bedford Harbor site presented herein focus on the PCB-contaminated sediment remaining after removal of those contaminated sediment areas of the Upper Bay containing greater than 50 ppm PCBs as included in EPA's January 1992 Proposed Plan. The response objectives for the Upper Bay are consistent with those previously identified in the FS for the Estuary, Lower Harbor and Bay (Ebasco, 1990c).

Three response objectives have been developed to serve as guidelines in choosing a remedial alternative that will reduce the public health and environmental threat posed by PCB contaminated sediment in the Upper Bay. The response objectives are as follows:

- Provide protection from human ingestion of PCB contaminated biota;
- Provide protection to the environmental receptors in direct contact with Upper Bay sediment by reducing exposure to PCB-contaminated sediments;
- Provide protectiveness from PCB migration from Upper Bay sediment that acts as a PCB source to the water column and remainder of the Upper Bay environment.

4.4 TARGET CLEAN-UP LEVELS

Based upon the results of the Human Health (Ebasco, 1989b), and the Ecological Risk Assessments (Ebasco, 1990c) summarized in Section 3.0, target cleanup levels (TCLs) were developed for the Feasibility Study for the Estuary, Lower Harbor, and Bay (Ebasco, 1990c). This section summarizes these human health and ecologically based TCLs.

4.4.1 Human Health Based TCLs

TCLs for the Estuary, Lower Harbor and Bay (Table 4-4) were previously developed to be protective against concurrent oral (incidental ingestion) and dermal (direct contact) exposures to sediment contaminants (Ebasco, 1990c).

As indicated in Table 4-4, a carcinogenic risk level of 10^{-5} (one excess cancer event per 100,000 exposures) was initially selected to develop chemical-specific target levels for the environmental media of concern in the Estuary, Lower Harbor and Bay. A risk level of 10^{-5} represents the mid-point of the EPA's target risk range of 10^{-6} to 10^{-4} found in the NCP. As is indicated in Table 4-4, a sediment PCB TCL of 10 mg/kg (ppm) was determined to be required to achieve an incremental cancer risk of $1x10^{-5}$ (Ebasco, 1990c).

For shoreline sediments throughout the New Bedford Harbor site, it was subsequently determined (Ebasco, 1990c) that a PCB target clean-up level of 50 ppm would achieve a $5x10^{-5}$ incremental risk

6.0 DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

The objective of the detailed analysis of remedial action alternatives is to provide a comparative evaluation to assist in the selection of an appropriate plan to meet the remedial objectives. Section 6.1 presents a description of the evaluation process required by CERCLA, and further detailed in the NCP. In Section 6.2, the five remedial alternatives developed in Section 5 are described and evaluated individually with respect to seven evaluation criteria described in Section 6.1. The comparative analysis of remedial alternatives is summarized in Section 6.3. In the comparative analysis, each of the remedial alternatives is assessed against the others with respect to the criteria set forth in the NCP, as described below.

6.1 EVALUATION PROCESS

During the Detailed Analysis, each remedial alternative is assessed with respect to the evaluation criteria mandated by CERCLA. These criteria, as set forth in the NCP, 40 CFR Sec. 300.430 (e)(9), and described more fully in the RI/FS Guidance (EPA, 1988), are:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs
3. Long Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility and Volume
5. Short Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

Table 6-1 presents specific factors that are considered for these criteria.

Overall protection of human health and the environment and compliance with ARARs are considered threshold criteria, in that each remedial alternative must meet them. State and community acceptance will be considered by the EPA in the ROD and are not included in the following detailed analysis.

6.2 DETAILED ANALYSIS

This section presents a detailed description of the five alternatives developed in Section 5 and evaluates each against the seven criteria identified in Section 6.1. The remedial alternatives range from minimal no-action to a cleanup alternative including removal and treatment of sediment in the Upper Bay to a PCB cleanup level of 10 ppm. Within this framework, three alternatives are presented that remediate the PCB contaminated

TABLE 6-1

FACTORS FOR DETAILED ANALYSIS OF ALTERNATIVES
NEW BEDFORD HARBOR SUPPLEMENTAL FEASIBILITY STUDY
NEW BEDFORD, MASSACHUSETTS

CRITERIA	CONSIDERATIONS
1. Overall Protection of Human Health and the Environment	• How an alternative, as a whole, achieves and maintains protection of human health and the environment.
2. Compliance with ARARs	• Compliance with chemical-specific ARARs. • Compliance with location-specific ARARs. • Compliance with action-specific ARARs. • Compliance with other criteria, advisories, and guidance.
3. Long-Term Effectiveness and Permanence	• Magnitude of residual risks remaining from untreated waste or treatment residuals at the conclusion of remedial activity. • Adequacy and reliability of controls used to manage treated residuals or untreated wastes at the site.
4. Reduction of Toxicity, Mobility, or Volume through Treatment	• Amount of hazardous materials destroyed or treated. • Degree of expected reductions in toxicity, mobility, and volume.

TABLE 6-1 (cont'd)

FACTORS FOR DETAILED ANALYSIS OF ALTERNATIVES
NEW BEDFORD HARBOR SUPPLEMENTAL FEASIBILITY STUDY
NEW BEDFORD, MASSACHUSETTS

CRITERIA	CONSIDERATIONS
	• Degree to which treatment is irreversible. • Type and quantities of residual remaining after treatment. • Treatment process used and materials treated. • Whether the alternative would satisfy the statutory preference for treatment as a principle element.
5. Short-Term Effectiveness	• Time until remedial action objectives are achieved. • Protection of community during remedial action. • Protection of workers during remedial actions. • Adverse environmental impacts that may result from the implementation and construction of an alternative.
6. Implementability	• Technical feasibility of operating and constructing the technology. • Ease of undertaking additional remedial action if necessary.

TABLE 6-1 (cont'd)

FACTORS FOR DETAILED ANALYSIS OF ALTERNATIVES
NEW BEDFORD HARBOR SUPPLEMENTAL FEASIBILITY STUDY
NEW BEDFORD, MASSACHUSETTS

CRITERIA	CONSIDERATIONS
	• Ability to monitor effectiveness of remedy. • Coordination with other agencies. • Availability of off-site treatment, storage, and disposal services and capacity. • Availability of necessary equipment and specialists. • Availability of services and materials. • Reliability of technology.
7. Cost	• Capital cost. • Costs of operation and maintenance. • Present-worth cost.
8. State Acceptance*	• Features of the alternative the state supports. • Features of the alternative the state has reservations about. • Features of the alternative the state strongly opposes.

TABLE 6-1 (cont'd)

FACTORS FOR DETAILED ANALYSIS OF ALTERNATIVES
NEW BEDFORD HARBOR SUPPLEMENTAL FEASIBILITY STUDY
NEW BEDFORD, MASSACHUSETTS

CRITERIA	CONSIDERATIONS
9. Community Acceptance*	• Features of the alternative the community supports. • Features of the alternative the community has reservations about. • Features of the alternative the community strongly opposes.

* To be assessed in the ROD

sediment through removal, non-removal (i.e. capping) and a combination of these techniques.

The remedial alternatives presented herein assume the Minimal No-Action Alternative (i.e., site-wide 50 ppm PCB cleanup) will be implemented. As such, the detailed analysis of minimal no-action is consistent with the evaluation presented in the Proposed Plan (EPA, 1992a) and is the baseline for comparison.

Each of the four active remedial alternatives discussed herein has a predesign component to further define the nature and extent of sediment PCB contamination in the Upper Bay for design purposes. The Minimal No-Action Alternative has a confirmational sediment sampling program as a component to verify the current nature and extent of contamination presented in Section 2.2. The major components of the five alternatives are presented in Table 6-2.

6.2.1 ALTERNATIVE BAY-1: MINIMAL NO-ACTION

6.2.1.1 General Description

The development and evaluation of a "no-action" alternative is required under the NCP. The no-action case serves as the baseline alternative, which assesses the potential risk to human health and the environment if no measures are taken to prevent exposure. A true no-action alternative typically does not include actions taken to reduce exposure (e.g., fencing and fishing bans). This approach to "true" no-action has not been applied to this Supplemental Feasibility Study Evaluation. It has been assumed EPA's proposed cleanup measures for the Upper Bay portion of the site presented in the January 1992 Proposed Plan (EPA, 1992) will be implemented. Therefore, a "minimal no-action" remedial alternative has been developed that incorporates the remedial measures and institutional controls presented in EPA's 1992 Proposed Plan applicable to the Upper Bay and adds a confirmational sampling program designed to validate the assumed PCB distributions in Upper Buzzards Bay. The 1992 Proposed Plan includes cleanup of sediment areas exceeding 50 ppm PCBs in the Estuary, Lower Harbor and Bay. For the Upper Bay, this includes dredging of approximately 10 acres of contaminated sediment from two areas just south of the Hurricane Barrier (Figure 6-1). The sediment is then transported by barge to a Confined Disposal Facility (CDF) in the Estuary portion of the site for disposal. The proposed 50 ppm PCB cleanup does not include treatment of the sediment prior to disposal. In the event that EPA issues a Record of Decision which does not implement the measures set forth in the January 1992 Proposed Plan, the analysis herein will be redone to be consistent with the remedy set forth in the Record of Decision.

TABLE 6-2

REMEDIAL ALTERNATIVES FOR
UPPER BUZZARDS BAY

Alternative	Description
BAY-1	Minimal no-action consisting of a site-wide cleanup to 50 ppm PCBs in the sediment of the Estuary, Lower Harbor and Upper Bay. The alternative includes dredging in all areas and shoreline disposal in CDFs 1, 1a, and 3 located in the Estuary. The alternative also includes institutional controls and a sediment PCB confirmational sampling program.
BAY-2	Dredging and shoreline disposal of 120,300 yd^3 of sediment in Upper Buzzards Bay estimated to exceed 10 ppm PCBs. The sediment would be disposed in a shoreline CDF in the Lower Harbor (CDF 7). The alternative also contains a predesign sediment sampling component.
BAY-3	Capping for the 59 acres in the Upper Buzzards Bay estimated to exceed 10 ppm PCBs. The alternative also contains a predesign sediment sampling component.
BAY-4	A combination of capping and dredging with shoreline disposal for the areas in Upper Buzzards Bay estimated to exceed 10 ppm PCBs. This would include capping for the 17 acres at the Treatment Plant Outfall, and dredging and shoreline disposal for the 67,000 yd^3 adjacent to the Cornell Dubilier CSO and the Hurricane Barrier. The sediment would be disposed in a shoreline CDF within the Estuary constructed as part of a 50 ppm sediment cleanup. The alternative also contains a predesign sediment sampling component.
BAY-5	Dredging, treatment and shoreline disposal of the 120,300 yd^3 of sediment in Upper Buzzards Bay estimated to exceed 10 ppm PCBs. Treatment and disposal of the treated sediment would occur along the industrial area of New Bedford shoreline in the Lower Harbor. The alternative would also contains a predesign sediment sampling component.

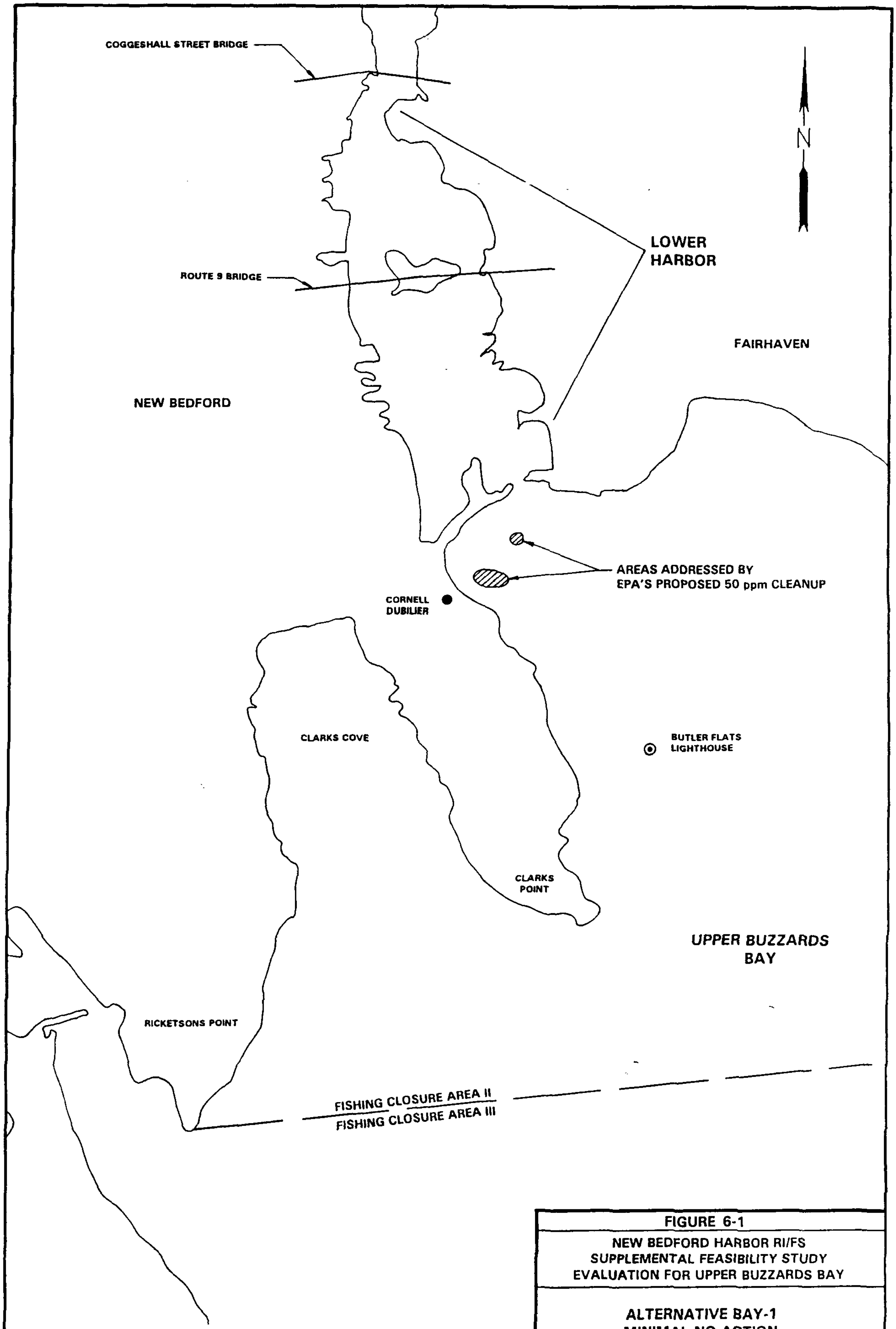

FIGURE 6-1

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

ALTERNATIVE BAY-1
MINIMAL NO-ACTION

EBASCO SERVICES INCORPORFATED
US EPA ARCS I PROGRAM

The institutional controls presented in EPA's January 1992 Proposed Plan for the 50 ppm PCB cleanup are also assumed to be present in the Minimal No-Action Alternative. These institutional controls include:

- long term monitoring of the sediment, surface water, and biota;
- continued enforcement of the Fishing Closure Areas;
- continued public awareness programs; and,
- site review once every five years.

The institutional controls associated with the Minimal No-Action Alternative would include continuation of the current ban on consumption of shellfish and finfish from the Estuary, Lower Harbor and Bay. This ban would remain in effect until the hazards associated with ingestion of contaminated seafood have been reduced to a satisfactory level. Environmental monitoring would be conducted on a periodic basis until this level have been met.

Public awareness programs would be implemented to educate the public on the potential health hazards associated with the Upper Bay. The programs would include periodic meetings and presentations in local neighborhoods, and bilingual pamphlets.

A quarterly monitoring program would be implemented to assess long-term trends in sediment and water column PCB concentrations and associated responses in aquatic biota. This program would entail collecting sediment, water, and biota samples from the Upper Bay four times per year and analyzing these samples for PCBs and metals. Similar monitoring would also be conducted for the areas north of the Hurricane Barrier. (This monitoring program would be implemented in addition to the confirmational sampling program discussed below.) For remedial actions which leave contaminated sediments on site, CERCLA legislation requires that the site be reviewed every five years. Data collected as part of the environmental monitoring program would be evaluated during the five year reviews. Recommendations for potential remedial actions would be formulated, as needed, based on the review.

In addition to the institutional controls, the Minimal No-Action Alternative for the Upper Buzzards Bay would include a confirmational sediment sampling program designed to validate the nature and extent of sediment PCB contamination presented in Section 2.2 and used as the basis for the remedial alternatives. The confirmational program would address the nine areas potentially exceeding 10 ppm identified in Section 5.1. However, the program would be less rigorous in nature than a predesign sampling program.

Details of the confirmational sampling program are provided in Appendix D.

6.2.1.2 Overall Protection of Human Health and the Environment

Cleanup of the Upper Bay through dredging and shoreline disposal of sediments contaminated in excess of the 50 ppm PCB TCL would protect public health from direct contact with the sediment. However, lobster from Upper Buzzards Bay are expected to remain contaminated with PCBs at levels above the FDA limit of 2 ppm requiring the continuance of the fishing ban.

The sediment PCB concentrations are expected to drop over the long term (Battelle, 1990). However the decline is not expected to result in residual sediment concentrations below the 1 ppm PCB sediment TCL recommended for the protection of aquatic biota (see Section 4.4) for the Upper Bay as a whole. On an overall basis, average sediment PCB concentrations in the Upper Bay range from 1 to 2 ppm. While this may appear close to the TCL of 1 ppm, it does not take into account potential exposure to the localized areas that may have PCB concentrations of up to 50 ppm that may remain in Upper Buzzards Bay.

The surface water PCB concentrations are estimated to decline following the site-wide 50 ppm sediment cleanup. While the majority of surface waters of the Upper Bay are currently below the AWQC of 30 parts per trillion, it is estimated that surface water concentrations will decline by at least a factor of two following remediation (Battelle, 1990). However, this decline is similar to the trend for the Upper Bay estimated by Battelle in the absence of any remediation (i.e. no action for the Estuary, Lower Harbor and Bay).

Some ecological impacts are expected as a result of this alternative. Benthic organisms from the sediment to be dredged would be destroyed during this process. The time to fully recolonize these areas is not known. (Ebasco, 1990b).

6.2.1.3 Compliance with ARARs

The ARARs for the Minimal No-Action Alternative (BAY-1) cover the dredging and sediment disposal activities and the institutional controls. The compliance with the chemical-specific, location-specific and action-specific ARARs is presented below. Additional details relating to the ARARs are presented in Section 4.2.

Chemical-specific. For the Upper Bay, it is anticipated that after remediation, the AWQC for PCBs would likely be met for the entire region including the one area just south of the Hurricane Barrier where the 30 parts per trillion AWQC level is currently exceeded.

Other chemical-specific ARARs for this alternative include the FDA limit of 2 ppm PCB in the edible tissue of biota. Estimates from the Battelle Model indicate the levels may drop below 2 ppm for certain species in certain areas of the site (Battelle, 1990). However, the results for lobster from Fishing Closure Area II indicate the lobster edible tissue (muscle plus tomalley) PCB concentration will not have dropped significantly below the 2 ppm limit (approximately 1.9 ppm).

Chemical-specific ARARs that apply to the discharge of water generated during the sediment dewatering process include the Massachusetts Surface Water Quality Standards (310 CMR 4.00). This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the Commonwealth.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative to ensure that remedial action does not cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging and disposal of the sediments (exceeding the 50 ppm sediment TCL) cause volatilization of any contaminants. Any impacts detected would be prevented or minimized by best available engineering controls during dredging and disposal activities.

Location-specific. Dredging sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. Substantive requirements of Section 404 of the CWA and USACE regulations presented in 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

If a functioning wetland with environmental value is negatively affected from a remedial action, mitigation techniques such as wetland restoration, enhancement, or creation may be appropriate. Executive Orders 11988 and 11990, which are implemented through NEPA (40 CFR Part 6, Appendix A), are ARARs that may also require wetlands and floodplain mitigation. If excavation of the wetlands is required, then restoration of wetlands would occur as part of the construction of this alternative. Replacement of wetland areas lost to construction may also be required as part of mitigation.

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetland protection regulations apply. Compliance with substantive requirements would be met.

Action-specific. The action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administrator of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot scale test results from the Pilot Study indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards (Otis et al., 1990). Construction and operation procedures and standards would be attained through inclusion in the design, and implementation of the alternative.

TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. This material must be disposed of in an incinerator that meets the performance requirements of 40 CFR 761.70, placed in a chemical waste landfill in compliance with the technical requirements of 40 CFR 761.75, or disposed of using a method approved by EPA's Regional Administrator if technical, environmental, and economic considerations indicate disposal in a federally permitted incinerator or chemical waste landfill is not reasonable or appropriate. Alternative disposal methods must provide adequate protection to human health and the environment.

Treatment of the sediment in order to comply with the land disposal restrictions in the Resource Conservation and Recovery Act (RCRA) is not necessary. EPA conducted TCLP testing of New Bedford Harbor sediment for several heavy metals as a part of the design process for the Hot Spot remedy. Three of the four metals tested were below their respective regulatory criteria (i.e., chromium, cadmium, lead). Since there is currently no criterion for copper, it was not directly evaluated. Further, the contemplated action does not constitute "placement in" within the meaning of RCRA.

Sediment disposal will be in accordance with the Massachusetts hazardous waste regulations at 310 CMR 30.501(3)(a). This section waives certain Massachusetts requirements for the treatment, storage, and disposal of hazardous wastes containing greater than 50 ppm PCBs if the requirements of 40 CFR Part 761 are complied with. In this case, the preferred alternative will comply with the TSCA requirements found at 761.60(a)(5)(iii) governing the disposal of dredged materials. EPA believes that at this site, disposal in a chemical waste landfill is not reasonable and appropriate and that disposal in CDFs will provide adequate protection of human health and the environment. Because the requirements of TSCA will be met at this site, the Massachusetts requirements at 30 CMR 501(3)(a) will also be attained.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the Federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is not required for all on-site activities. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements in 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

All site activities, including the monitoring activities, would be carried out pursuant to OSHA standards (i.e., 29 CFR 1904, 1910, and 1926) and Massachusetts Right-to-Know regulations (310 CMR 33.00).

6.2.1.4 Long Term Effectiveness and Permanence

The cleanup would be effective at reducing the potential public health risks associated with direct contact. However in the absence of institutional controls, the Minimal No-Action Alternative would not provide an effective or permanent long-term remedy for the Upper Bay from the potential ingestion of biota. While the results of Battelle's modeling studies indicate the 50 ppm site-wide cleanup would reduce PCB inputs to the Upper Bay from areas north of the Hurricane Barrier, the cleanup is not expected to significantly reduce PCB levels in lobster and flounder in the Upper Bay (Battelle, 1990). As a result, significant risks to public health will remain that must be controlled through the use of institutional controls. In addition, under the Minimal No-Action Alternative, some environmental risks to the biota in the Upper Bay may remain.

The results from the Battelle Modeling Program indicate the impacts of the 50 ppm cleanup alternative are likely to be localized to the general areas of sediment cleanup (Battelle, 1990). This may result in relatively little change to the existing level of PCB contamination in the biota of Upper Buzzards Bay. The estimated PCB concentrations for lobster and flounder, 10 years following completion of the 50 ppm cleanup alternative (i.e., minimal no-action for this Supplemental Feasibility Study) significantly exceed the human health based Target Cleanup Level (TCL) for biota. The biota TCL of 0.02 ppm was developed on the basis of achieving a 1×10^{-5} incremental cancer risk (see Section 4.4) for the ingestion of biota. For flounder from Fishing Closure Area II, the biota TCL was estimated to be exceeded by roughly a factor of 10. For lobster from the same area, the TCL was estimated to be exceeded by nearly 100 fold.

The magnitude of residual environmental risk as a result of minimal no-action is somewhat uncertain. While the average sediment PCB concentration for the Upper Bay as a whole (i.e., 1 to 2 ppm) may suggest substantive attainment of the 1 ppm PCB sediment TCL for protection of aquatic species (Section 4.4), the potential negative impacts associated with the localized areas of PCB contamination along the shoreline of the Bay and at the Treatment Plant Outfall are uncertain.

6.2.1.5 Reduction in Mobility, Toxicity and Volume

Since this alternative does not include sediment treatment, no reduction in mobility, toxicity or volume of the PCBs would be achieved through treatment. However, disposal of the small volume of contaminated sediment from the two areas just south of the Hurricane Barrier in a CDF is expected to reduce the PCB migration potential for this material.

6.2.1.6 Short Term Effectiveness

Under the Minimal No-Action Alternative, it is uncertain how much time would be required to achieve the remedial response objectives for Upper Buzzards Bay. Therefore, the Minimal No-Action

Alternative includes institutional controls, regular environmental monitoring and five year reviews.

Protection of the community and the workers conducting the remediation are considered under the criterion. The primary remedial components of the Minimal No-Action Alternative are dredging and sediment disposal. Dredging in the Upper Bay is not expected to generate substantial levels of airborne or volatilized contaminants to which workers in adjacent areas would be exposed (Ebasco, 1990c). Control measures would be used to reduce PCB emissions to protect worker safety and public health, if required.

Workers onsite during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations.

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed along with the sediment and destroyed during the dredging operation. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program. Results of the USACE pilot dredging study indicate that resuspension of contaminated sediment would be minimal when proper dredge operating conditions are used. Average resuspension rates for the cutterhead dredge were 12 g/sec at the dredgehead with suspended solids levels in the water column returning to background within 400 feet of the operating dredge (Otis et al., 1990).

The only institutional control that requires work at the site is environmental monitoring including the collection of water, sediment and biota samples. These activities would pose no risk to the community or the environment. However, the workers conducting the sampling would require protective equipment. The requirements for which would be specified in a site-specific Health and Safety Plan (HASP).

6.2.1.7 Implementability

The implementability of the Minimal No-Action Alternative includes the technical and administrative feasibility and the availability of the services and materials. The implementability of the dredging and shoreline disposal of the Minimal No-Action Alternative has been addressed in detail in Estuary, Lower Harbor and Bay Feasibility Study (Ebasco, 1990b). In summary, dredging and shoreline disposal have been demonstrated feasible and reliable technologies on a site specific basis during the Pilot Study. The

Pilot Study also demonstrated the availability of goods and services and the ability to monitor the effectiveness of dredging and sediment disposal activities. The coordination with other agencies would include meetings to discuss the substantive requirements of the action-specific ARARs. In addition, close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the Lower Harbor and Upper Bay. Tugs, tow vessels, and trucks would be required to move the cutterhead dredge to designated areas. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels.

Site preparation and land acquisition would be the most significant support requirements for the development of shoreline disposal sites. Access to the facilities would also need to be secured. Additional details of the implementability discussion for the dredging and shoreline disposal component of minimal no-action is presented in the Feasibility Study (Ebasco, 1990c).

Implementability concerns for the institutional controls and confirmational sampling aspects of the Minimal No-Action Alternative are relatively few. The personnel and equipment to perform the services are readily available. The coordination tasks include interfacing with local and state officials prior to conducting the public awareness programs and environmental monitoring or sampling programs. However, one implementability concern is the ability to enforce the Fishing Closure Ban given the large geographical size of the areas.

6.2.1.8 Cost

The costs associated with the Minimal No-Action Alternative include the capital costs associated with dredging and sediment disposal activities, Operation and Maintenance (O&M) costs for the sediment disposal facility for a 30 year period, costs to conduct the regular environmental monitoring and the costs to complete the sediment PCB confirmational sampling program for Upper Buzzards Bay. The only cost presented herein, is the $373,500 for confirmational sediment sampling program (Table 6-3). The other costs associated with this alternative are detailed in the 1990 Feasibility Study (Ebasco, 1990b) and are currently part of EPA's January 1992 Proposed Cleanup Plan (EPA, 1990).

6.2.2 ALTERNATIVE BAY-2: DREDGING AND ON-SITE DISPOSAL

6.2.2.1 General Description

This remedial alternative involves dredging approximately 120,300 yd^3 of PCB contaminated sediment from 59 acres in Upper Buzzards Bay. This sediment is dredged from the three areas highlighted in

TABLE 6-3

COST ESTIMATE: BAY-1
MINIMAL NO-ACTION
NEW BEDFORD HARBOR SUPPLEMENTAL FS
UPPER BUZZARDS BAY

ACTIVITY	COST
I. DIRECT COSTS	
A. Confirmational Sediment Sampling Program	$213,500
DIRECT COST	$213,500
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection	$11,000
B. Legal & Administration (@ 6%)	$13,000
C. Engineering (@ 10%)	$21,000
D. Services During Construction (@ 10%)	$21,000
E. Turnkey Contractor Fee (@ 15%)	$32,000
INDIRECT COST	$98,000
SUBTOTAL COST	$311,500
CONTINGENCY (@ 20%)	$62,000
TOTAL CAPITAL COST	$373,500
TOTAL COST - ALTERNATIVE BAY-1	$373,500

Figure 6-2. Following dredging, the sediment will be transported into the Lower Harbor for disposal in a combined disposal facility (CDF 7) to be constructed near the north terminal area (see Figure 6-2). The alternative also includes long term monitoring of CDF 7 and a predesign sediment sampling program to refine the nature and extent of contamination for predesign purposes.

Dredging adjacent to the Cornell Dubilier CSO and the Hurricane Barrier involves two separate areas totalling 42 acres (Figure 6-2). Based on the removal of 1 foot of sediment, the total dredging volume for these two areas is approximately 67,000 yd^3. Although the available PCB data indicates PCB concentrations drop off dramatically below a depth of 6 inches, a minimum removal depth of one foot is required due to the operational constraints of the dredging equipment. Sediment from these two areas will be dredged with a hydraulic cutterhead dredge similar to the one used by EPA and the Corps of Engineers during the Pilot Dredging and Disposal Study. The cutterhead was found to be both effective in removing the contaminated sediment and minimizing sediment resuspension (Otis et al., 1990). As a result of minimizing sediment resuspension, contaminant migration from the dredging area is also minimized, and thus, the potential for adverse impacts on less contaminated areas is decreased.

Based on an 8-hour day the dredge would remove approximately 500 yd^3 per day. Following dredging, the sediment slurry would be pumped to scow for transport to the CDF. The sediment slurry would contain approximately 20% solids. The scows would be operated in a no-overflow condition, so all of the dredge material slurry will be placed in CDF 7. Once in the CDF, the sediment fraction of dredge material slurry will settle out through gravity and the supernatant will be treated and then discharged into the Lower Harbor. In addition to gravity settling, the effluent would be chemically treated to promote coagulation, flocculation and precipitation followed by either carbon adsorption or UV/oxidation. Additional details of these water treatment technologies are presented in Section 5 of the 1990 Feasibility Study (Ebasco, 1990c).

Removal of the contaminated sediment surrounding the Treatment Plant Outfall will also be accomplished through dredging. However, because of the water depths and wave heights, a mechanical dredge will be used to remove approximately 53,300 yd^3 of sediment. This volume is based on removing a minimum layer of two feet. This depth is based on equipment and operational constraints, and not the depth of PCB contamination. Dredging in this area will be conducted with a 15 yd^3 clamshell dredge operating 24 hours per day with an effective production rate of 3,000 yd^3 per day. Similar to the hydraulic dredging operations described above, the sediment would be transported to CDF 7 via scow for disposal. The remainder

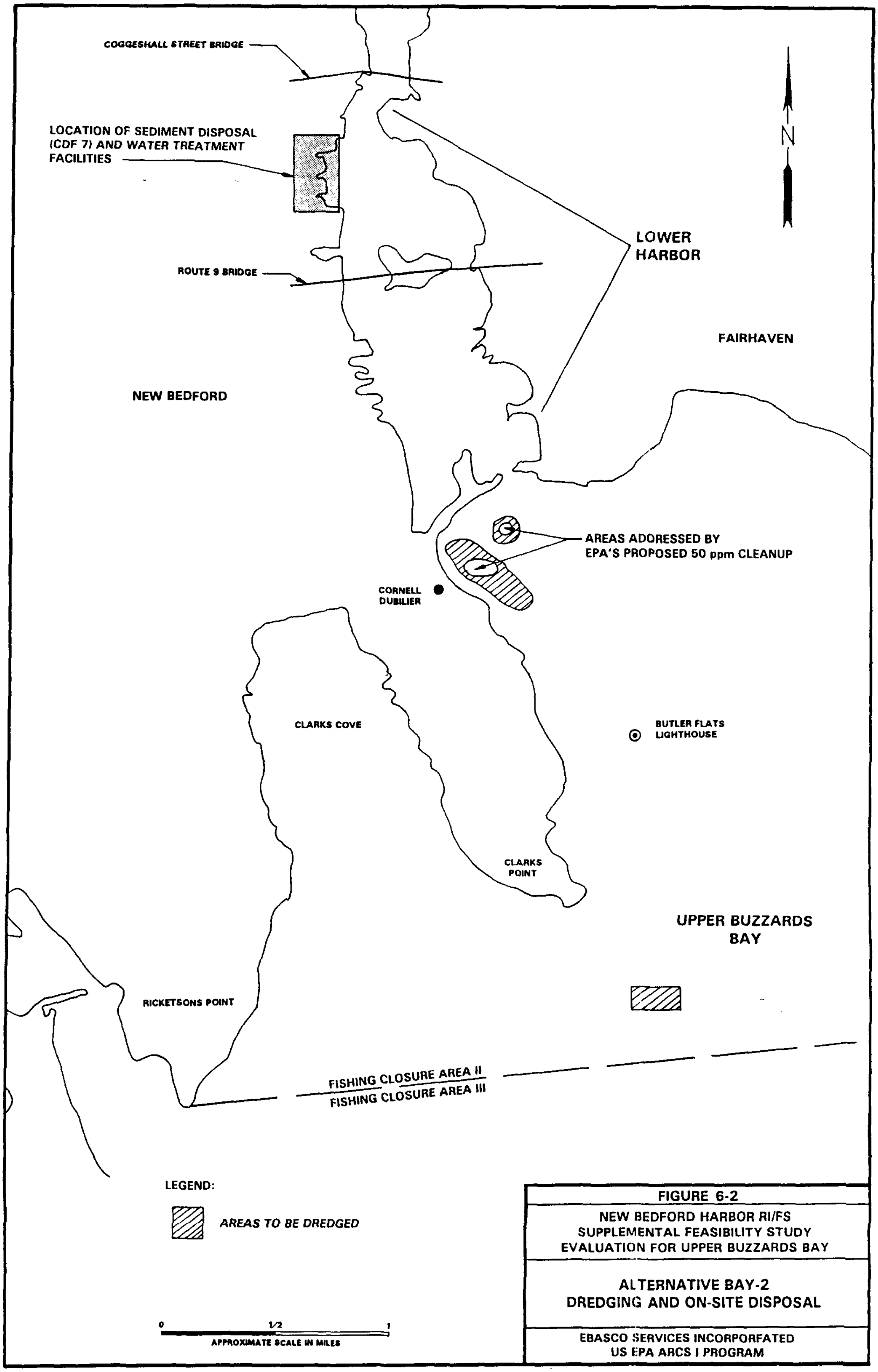

FIGURE 6-2

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

ALTERNATIVE BAY-2
DREDGING AND ON-SITE DISPOSAL

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of the dewatering and water treatment steps for this part of the BAY-2 Alternative are similar to the operations associated with the hydraulically dredged sediment. While the clamshell dredge may cause more sediment resuspension than the cutterhead dredge, the length of time it will take to dredge the Outfall area is less than one month, thereby minimizing the potential environmental impacts. The total estimated time to complete both operations is on the order of 6 to 8 months.

6.2.2.2 Overall Protection of Human Health and the Environment

Cleanup of sediment contaminated with from 10 to 50 ppm in the Upper Bay through dredging and shoreline disposal is protective of public health from direct contact with the sediment. However, based on the effectiveness evaluation prepared by the Trustees (NOAA, 1992) lobster and flounder of Upper Buzzards Bay are likely to remain contaminated with PCBs at levels near or above the FDA limit of 2 ppm. Exceedance of this ARAR and the potential public health risks associated with eating the PCB contaminated biota will require the continuance of the fishing ban. The surface water PCB concentrations in the Upper Bay which result following the 10 ppm sediment PCB cleanup are anticipated to meet the AWQC (Battelle, 1990).

Following implementation of BAY-2, sediment PCB concentrations in the remediated portions of the Upper Bay will be less than 10 ppm and may approach the recommended 1 ppm PCB sediment TCL for protection of aquatic species. The degree to which the alternative will provide environmental protectiveness is uncertain. This is because the average sediment PCB concentrations for the Upper Bay as a whole will likely remain on the order of 1 to 2 ppm, still above the recommended 1 ppm sediment TCL.

6.2.2.3 Compliance with ARARs

The ARARs for BAY-2 include the chemical-specific, location-specific and action-specific ARARs presented below. Additional details of the ARARs are presented in Section 4.2.

Chemical-specific. The AWQC for PCBs should be attained in all areas of the Upper Bay (Ebasco, 1990c). Other chemical-specific ARARs for this alternative include the FDA limit of 2 ppm PCB in the edible tissue of biota. Based on comparisons of estimates from the Battelle Model with the results of the Trustees evaluation (NOAA, 1992), it appears that PCB levels in lobsters from Fishing Closure Area II will probably not drop significantly below the 2 ppm FDA limit.

Chemical-specific ARARs that apply to the discharge of water generated during the sediment dewatering process include the Massachusetts Surface Water Quality Standards (310 CMR 4.00). This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the Commonwealth.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative to ensure that remedial action does not cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging and disposal of the sediments cause volatilization of any contaminants. Any impacts detected would be prevented or minimized by best available engineering controls during dredging and disposal activities.

Location-specific. Dredging sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. Substantive requirements of Section 404 of the CWA and USACE regulations presented in 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

If a functioning wetland with environmental value is negatively affected from a remedial action, mitigation techniques such as wetland restoration, enhancement, or creation may be appropriate. Executive Orders 11988 and 11990, which are implemented through NEPA (40 CFR Part 6, Appendix A), are ARARs that may also require wetlands and floodplain mitigation. If excavation of the wetlands is required, then restoration of wetlands would occur as part of the construction of this alternative. Replacement of wetland areas lost to construction may also be required as part of mitigation.

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetland protection regulations apply. Compliance with substantive requirements would be met.

Action-specific. The action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administration of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M of wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot scale test results from the Pilot Study indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards (Otis et al., 1990). Construction and operation procedures and standards would be attained through inclusion in the design, and implementation of the alternative.

TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. Since the PCB concentrations in the sediments to be dredged will be below 50 ppm, TSCA will not be a requirement for Alternative BAY-2. In the event, Alternative BAY-2 is conducted in conjunction with EPA's proposed 50 ppm PCB site-wide cleanup, the applicability of TSCA would have to be reevaluated.

Treatment of the sediment in order to comply with the land disposal restrictions in the Resource Conservation and Recovery Act (RCRA) is not necessary. EPA conducted TCLP testing of New Bedford Harbor sediment for several heavy metals as a part of the design process for the Hot Spot remedy. Three of the four metals tested were below their respective regulatory criteria (i.e., chromium, cadmium, lead). Since there is currently no criterion for copper, it was not directly evaluated. Further the contemplated action does not constitute "placement in" within the meaning of RCRA.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the

100-foot buffer zone. Similar to the Federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is not required for all on-site activities. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements at 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

6.2.2.4 Long Term Effectiveness

Cleanup of sediment contaminated with 10 to 50 ppm PCBs would be effective in minimizing potential public health risks associated with direct contact with sediment. Results from Battelle's modeling studies indicate a site-wide 50 ppm cleanup would reduce PCB inputs to the Upper Bay from areas north of the Hurricane Barrier. However, the site-wide 50 ppm cleanup is not expected to significantly reduce PCB levels in lobster and flounder in the Upper Bay (Battelle, 1990). Similarly, the Trustees effectiveness evaluation further suggests that additional cleanup of the localized areas of sediment PCB contamination to 10 ppm may not significantly reduce PCB concentrations in biota (NOAA, 1992). As a result, significant risks to public health will remain and will require the continued use of institutional controls.

The magnitude of residual environmental risk remaining after the implementation of Alternative BAY-2 is somewhat uncertain. While the average sediment PCB concentration for the Upper Bay as a whole (i.e., 1 to 2 ppm) may be close to the recommended 1 ppm sediment TCL for protection of aquatic species, the potential impact of lowering the localized areas of sediment contamination from 50 ppm to 10 ppm is difficult to quantify. For example, the extent to which biota spend a disproportionate amount of their time near the localized areas of contamination in the Upper Bay is unknown. However, there are studies that have documented the increased presence of some species in the vicinity of outfall areas (NOAA, 1992).

Intuitively, reducing PCB concentrations to 10 ppm in the localized areas of contamination should have positive effects on marine biota. This conclusion is further supported by the Battelle Modeling results which indicate that the effects of remediation are largely near-field. Unfortunately, the degree of improvement that will result in cleaning up the 60 acres to 10 ppm, may not be readily visible because biota move throughout the entire 17,000 acres of the Upper Bay and the PCB contamination exists at some level in all areas.

Overall, Alternative BAY-2 may result in some continued environmental risks to the marine biota in the Upper Bay.

6.2.2.5 Reduction in Mobility, Toxicity and Volume

Since this alternative does not include sediment treatment, no reduction in mobility, toxicity or volume of the PCBs would be achieved through treatment. However, disposal of the PCB contaminated sediment in a CDF is expected to reduce the PCB migration potential for this material.

6.2.2.6 Short Term Effectiveness

Under Alternative BAY-2, it is uncertain how much time would be required to completely achieve the remedial response objectives for Upper Buzzards Bay. Therefore, institutional controls, regular environmental monitoring and five year reviews would be required. These components have not been included herein as they are part of each of the remedial alternatives presented in EPA's January 1992 Proposed Plan.

Protection of the community and the workers conducting the remediation are also considered under this criterion. The primary remedial components of Alternative BAY-2 are dredging and sediment disposal. Dredging is not expected to generate substantial levels of airborne or volatilized contaminants to which workers in adjacent areas would be exposed (Ebasco, 1990c). Control measures would be used to reduce PCB emissions to protect worker safety and public health, if required.

Workers onsite during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations.

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed along with the sediment and destroyed during the dredging operation. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program. Results of the USACE pilot dredging study indicate that resuspension of contaminated sediment would be minimal when proper dredge operating conditions are used. Average resuspension rates for the cutterhead dredge during the pilot study were 12 g/sec at the dredgehead with suspended solids levels in the water column returning to background within 400 feet of the operating dredge (Otis et al., 1990). While the clamshell dredge may cause more sediment resuspension than the cutterhead dredge, the length of time to complete dredging the Outfall area with the clamshell is less than one month, thereby minimizing the potential for environmental impacts.

In addition to dredging and disposal activities, workers conducting the predesign sampling would require protective equipment. The requirements for which would be specified in a site-specific Health and Safety Plan (HASP). These sampling activities would pose no risk to the community or the environment.

6.2.2.7 Implementability

The implementability of the BAY-2 Alternative includes the technical and administrative feasibility of the alternative and the availability of the services and materials. The implementability of dredging and shoreline disposal has been addressed in detail in Estuary, Lower Harbor and Bay Feasibility Study (Ebasco, 1990b). In summary, dredging and shoreline disposal have been demonstrated feasible and reliable technologies on a site specific basis during the Pilot Study. The Pilot Study also demonstrated the availability of goods and services and the ability to monitor the effectiveness of dredging and sediment disposal activities. The coordination with other agencies would include meetings to discuss the substantive requirements of the action-specific ARARs. In addition, close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the Lower Harbor and Upper Bay. Tugs, tow vessels, and trucks would be required to move the dredges to designated areas. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels.

Site preparation and land acquisition would be the most significant support requirements for the development of shoreline disposal sites. Access to the facilities would also need to be secured. Additional details of the implementability discussion for the dredging and shoreline disposal is presented in Section 7.4 of the 1990 Feasibility Study (Ebasco, 1990c).

Implementability concerns for the predesign sampling components of Alternative BAY-2 are relatively few. The personnel and equipment to perform the services are readily available. The coordination tasks include interfacing with local and state officials prior to conducting the sampling programs.

6.2.2.8 Cost

The costs for Alternative BAY-2 include the capital costs to construct CDF 7; to dredge, transport and unload the sediment into the CDF, and to treat the water generated during the sediment dewatering process. The cost of land for CDF 7 has not been included in the direct costs as no current information on the market value of the required land was available.

The cost estimate may not fall within the level of accuracy typically developed during a Feasibility Study (+50%, -30%). This is because of the uncertainty associated with the nature and extent of PCB contamination. A sensitivity analysis was not conducted because these analyses are generally appropriate when small changes in quantities will have a large impact on costs. In this case, small changes in remedial volume would not dramatically impact the costs. However, the potential changes in remedial volume that could result from the predesign program may be on the order of a factor of four. This estimate was based on the acreage of the potential areas exceeding 10 ppm PCB discussed in Section 5.1. To assist in resolving the uncertainty, the direct costs also include a comprehensive predesign PCB sediment sampling program to establish the basis of design for sediment removal.

The total alternative cost of approximately $13 million includes the direct costs described above and indirect costs to cover nonconstruction related items such as engineering, health and safety, and legal and administrative (Table 6-4). A contingency factor has also been included to cover items not anticipated at this time. The Operation and Maintenance (O&M) costs to monitor and maintain CDF 7 are also included as net present worth (NPW) costs for a period 30 years following construction.

6.2.3 ALTERNATIVE BAY-3: CAPPING

6.2.3.1 General Description

The capping alternative for the Upper Bay includes the three areas estimated to exceed 10 ppm PCB in Upper Buzzards Bay (Figure 6-3). The total area to be capped is nearly 60 acres. A predesign sediment sampling program to refine the nature and extent of PCB contamination for design purposes is included in the alternative. A long term monitoring program for the capped areas is also included.

All three areas would be capped with material from an upland source. The material would be delivered to the site where it would be transferred to a split hull scow and towed to the area to be capped. To cap the site, the hull would be partially opened (6 to 8 degrees), and the scow slowly pushed over the target areas by two tugboats. The operation would place approximately 1,500 yd^3 of cap material per day. Given the sandy nature of the sediment in the Bay, a geotextile is not anticipated prior to placing the cap. This assumption may have to be validated during the design process for the area immediately surrounding the Treatment Plant Outfall.

For the two areas adjacent to Cornell Dubilier and the Hurricane Barrier, approximately seven months would be required to place the 268,100 yd^3 of capping material. The sediment volume required for

TABLE 6-4

COST ESTIMATE: BAY-2
DREDGE WITH SHORELINE DISPOSAL
NEW BEDFORD HARBOR SUPPLEMENTAL FS
UPPER BUZZARDS BAY

ACTIVITY	COST
I. DIRECT COSTS	
A. Dredging	$1,693,000
B. CDF Construction	$5,587,600
C. Water Treatment	$379,500
D. Predesign Program	$349,600
DIRECT COST	$8,009,700
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection	$400,000
B. Legal & Administration (@ 6%)	$481,000
C. Engineering (@ 10%)	$801,000
D. Services During Construction (@ 10%)	$801,000
E. Turnkey Contractor Fee (@ 15%)	$1,201,000
INDIRECT COST	$3,684,000
SUBTOTAL COST	$11,693,700
CONTINGENCY (@ 20%)	$2,339,000
TOTAL CAPITAL COST	$14,032,700
PRESENT WORTH COST (@ 5% for 3 years)	$12,737,950
O&M COST (CDFs) (present worth @ 5% for 30 years upon completion)	$408,600
TOTAL COST - ALTERNATIVE BAY-2	$13,146,550

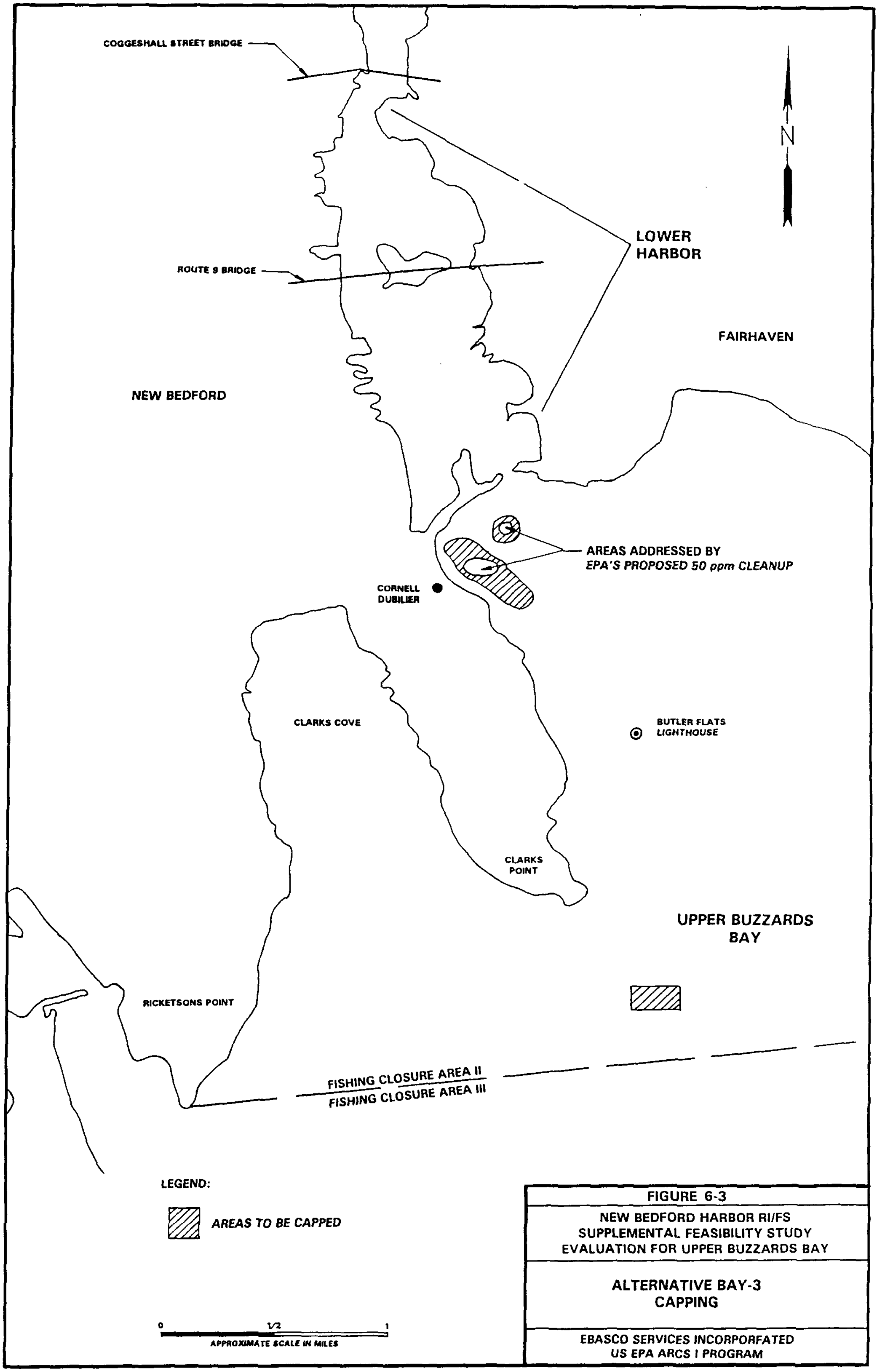

FIGURE 6-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

ALTERNATIVE BAY-3
CAPPING

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TABLE 6-5

COST ESTIMATE: BAY-3
CAPPING
NEW BEDFORD HARBOR SUPPLEMENTAL FS
UPPER BUZZARDS BAY

ACTIVITY	COST
I. DIRECT COSTS	
A. Capping	$7,661,200
B. Predesign Program	$349,600
DIRECT COST	$8,010,800
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection	$401,000
B. Legal & Administration (@6%)	$481,000
C. Engineering (@ 10%)	$801,000
D. Services During Construction (@ 10%)	$801,000
E. Turnkey Contractor Fee (@ 15%)	$1,202,000
INDIRECT COST	$3,686,000
SUBTOTAL COST	$11,696,800
CONTINGENCY (@ 20%)	$2,339,000
TOTAL CAPITAL COST	$14,035,800
O&M COST (Aquatic Cap) (present worth @ 5% for 30 years upon completion)	$2,900,400
TOTAL COST - ALTERNATIVE BAY-3	$16,936,200

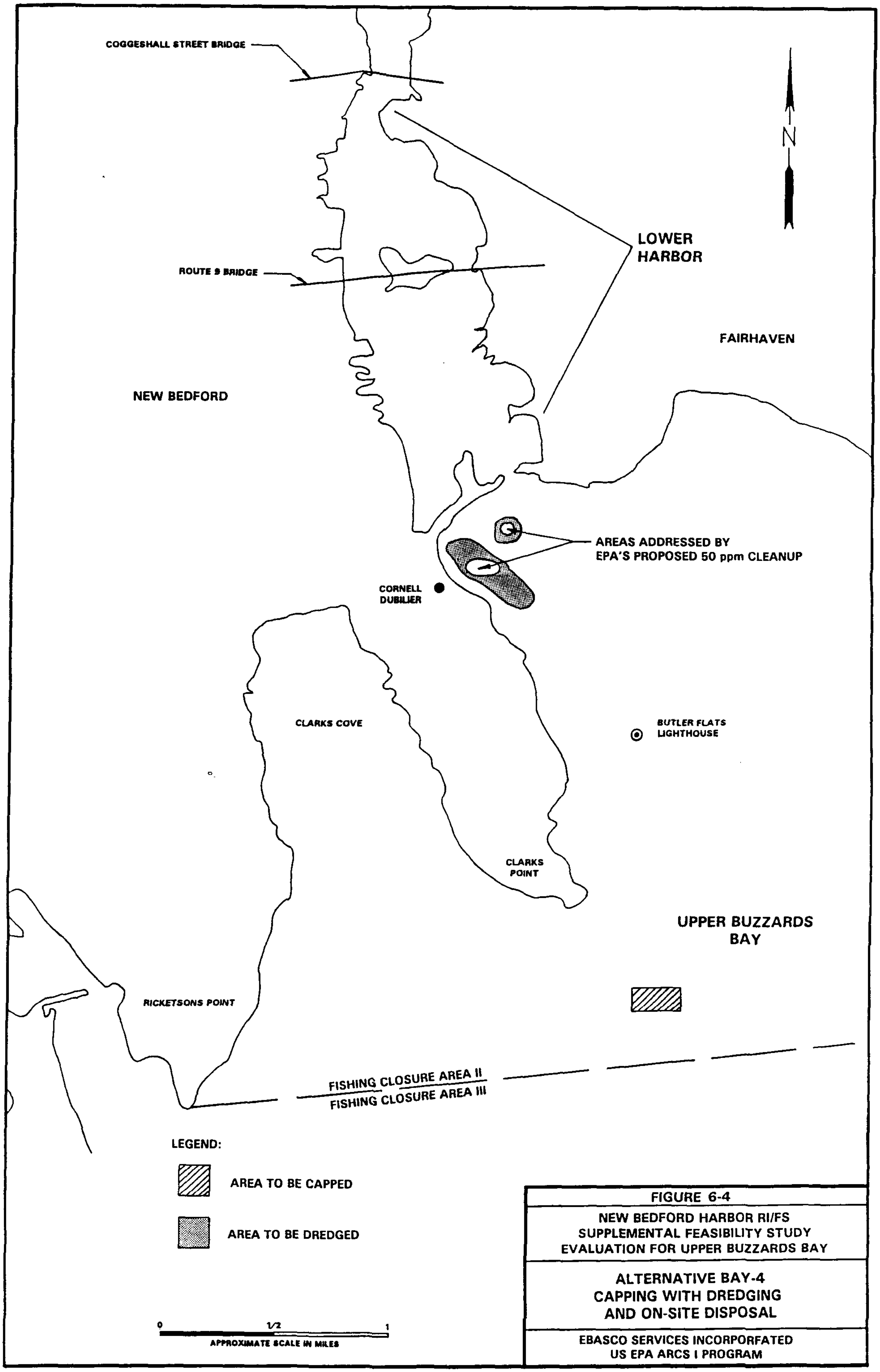

FIGURE 6-4

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

ALTERNATIVE BAY-4
CAPPING WITH DREDGING
AND ON-SITE DISPOSAL

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capping was calculated on a basis of an equivalent cap thickness of four feet. This quantity of material is what is required to achieve a cap thickness of greater than two feet in all areas given the 10 to 14 foot water depth. The two foot thickness is based on the minimum 55 cm cap thickness estimated by the Corps of Engineers to provide an effective chemical and biological barrier (Francinques et al., 1988). At the Outfall, the water depths are on the order of 30 feet. The equivalent cap thickness at this locale is six feet to attain two feet of cap throughout the entire 17 acre area. This operation would take approximately four months to place the 160,000 yd^3 of capping material. The difference in equivalent cap thicknesses between the near-shore and the off-shore locations is due to the increased water depth and susceptibility to wind driven waves. These two factors reduce the degree of precision in placing the cap and therefore additional sediment is required to attain the desired thickness throughout the area.

Special considerations during the design process will be required to evaluate how close to the existing Outfall capping can be conducted without interfering with its operation. A small amount of dredging may be required immediately adjacent to the Outfall if the cap can not completely surround the discharge pipe. Other considerations to be addressed during the predesign process include the ability to integrate a diffuser to the Outfall discharge at a later date and the degree to which the capped areas would need to be armoured to prevent erosion.

6.2.3.2 Overall Protection of Human Health and the Environment

Cleanup of sediment contaminated with from 10 to 50 ppm in the Upper Bay through capping would be protective of public health from direct contact with the sediment. However, based on the effectiveness evaluation prepared by the Trustees (NOAA, 1992), lobster and flounder of Upper Buzzards Bay are likely to remain contaminated with PCBs at levels near or above the FDA limit of 2 ppm. Exceedance of this ARAR and the potential public health risks associated with eating the PCB contaminated biota will require the continuance of the fishing ban. The surface water PCB concentrations in the Upper Bay which result following the 10 ppm sediment PCB cleanup (isolation) are anticipated to meet the AWQC (Battelle, 1990).

Following implementation of BAY-3, surficial sediment PCB concentrations in the remediated portions of the Upper Bay will be less than 10 ppm and may approach the recommended 1 ppm PCB sediment TCL for protection of aquatic species. The degree to which the alternative will be protective of the environment is somewhat uncertain as the sediment PCB concentration for the Upper Bay as a whole will be above the 1 ppm sediment TCL (i.e., on the order of 1 to 2 ppm).

6.2.3.3 Compliance with ARARs

The ARARs for BAY-3 include the chemical-specific, location-specific and action-specific ARARs presented below. Additional details of the ARARs are presented in Section 4.2.

Chemical-specific. The AWQC for PCBs should be attained in all areas of the Upper Bay (Ebasco, 1990c). Other chemical-specific ARARs for this alternative include the FDA limit of 2 ppm PCB in the edible tissue of biota. Based on comparisons of estimates from the Battelle Model with the results of the Trustees evaluation (NOAA, 1992), it appears that PCB levels in lobsters from Fishing Closure Area II will probably not drop significantly below the 2 ppm FDA limit.

Location-specific. Capping sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. Substantive requirements of Section 404 of the CWA and USACE regulations presented in 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetland protection regulations apply. Compliance with substantive requirements would be met.

Action-specific. The action-specific ARARs that would go into effect under this alternative include the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00). Actions such as capping in wetland areas should be conducted in a manner to minimize adverse impacts to the ecosystem (40 CFR 230.1(d)). The Administration of Waterways Licenses (310 CMR 9.00) sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These

6.2.3.7 Implementability

The implementability of the BAY-3 Alternative includes the technical and administrative feasibility of the alternative and the availability of the services and materials. Capping has been demonstrated as feasible, reliable and effective at many deep water locations similar to the Upper Bay. However, the current and future operational activities at the CSO locations and the 60 inch Outfall will need to be considered during design and implementation of this alternative. Coordination with other agencies would be required including meetings to discuss the substantive requirements of the action-specific ARARs. In addition, close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the Lower Harbor and Upper Bay. Tugs, scows, and trucks would be required to complete the construction operations.

The capping process would require a shoreline staging area for the loading and capping of material on the scows. Therefore, an area of shoreline access to this loading area would also need to be secured.

Additional remedial actions that may be required include placing additional cap material or removal of the contaminated sediment from beneath the cap. The latter remedial action represents a significant construction operation because of the volumes of materials involved.

Monitoring considerations for Alternative BAY-3 include hydrographic monitoring during and after construction to ensure the minimum cap thickness has been attained in all areas.

Implementability concerns for the predesign sampling components of Alternative BAY-3 are relatively few. The personnel and equipment to perform the services are readily available. The coordination tasks include interfacing with local and state officials prior to conducting the sampling programs.

6.2.3.8 Cost

The costs for Alternative BAY-3 include the capital costs to construct the cap over the three areas exceeding 10 ppm in Upper Buzzards Bay. The capping costs include material from an upland source and the construction operations to place the cap material.

The cost estimate may not fall within the level of accuracy typically developed during a Feasibility Study (+50%, -30%). This is because of the uncertainty associated with the nature and extent of PCB contamination. A sensitivity analysis was not conducted for this alternative because these analyses are generally appropriate when small changes in quantities will have a large impact on costs. In this case, small changes in remedial area would not dramatically impact the costs. However, the potential changes in remedial area that could result from the predesign program may be on the order of a factor of four. This estimate was based on the acreage of the potential areas exceeding 10 ppm PCB discussed in Section 5.1. To assist in resolving the uncertainty, the direct costs also include a comprehensive PCB sediment sampling program to establish the basis of design for sediment removal.

The total alternative cost of approximately $17 million includes the direct costs mentioned above and indirect costs to cover nonconstruction related items such as engineering, health and safety and legal and permitting (Table 6-5). A contingency factor has also been included to cover items not anticipated at this time. The Operation and Maintenance (O&M) costs to monitor and maintain the capped areas are also included as net present worth (NPW) costs for a period 30 years following construction.

Alternative Sediment Sources

The potential impact of using sediment mined with a hopper dredge from clean areas of Buzzards Bay was evaluated as a part of this analyses. The total alternative cost utilizing this assumption is lowered to approximately $9 million to $10 million. This cost does not include the effort to complete an Environmental Impact Report (EIR) that may be required prior to the mining of sediment from the Bay. Since it is not clear if the regulatory agencies would permit this activity, the capping alternative is, therefore, presented using an upland source of capping material.

6.2.4 ALTERNATIVE BAY-4: CAPPING WITH DREDGING AND ON-SITE DISPOSAL

6.2.4.1 General Description

Remedial alternative BAY-4 entails a combination of capping and dredging with sediment disposal in a shoreline CDF. The area to be capped is the 17 acres surrounding the 60 inch Outfall from the City of New Bedford's Sewage Treatment Plant (Figure 6-4). The dredging would be conducted to address the two areas adjacent to the Cornell Dubilier CSO and the Hurricane Barrier. A CDF would not be constructed as part of this alternative. Instead, sediment would be disposed in CDF 1 constructed as part of the Minimal No-Action Alternative (BAY-1). As in the other alternatives, a predesign sediment sampling program and long term O&M are included.

Capping for the Outfall area would be accomplished through the placement of approximately 160,000 yd^3 of sediment from an upland source. The material would be placed over the 17 acre area through requirements can be met through engineered controls implemented during construction.

In addition to the USACE administration of Section 404 of the CWA, the substantive requirements of the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the Federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is waived for all on-site activities.

6.2.3.4 Long Term Effectiveness

Capping of sediment contaminated with 10 to 50 ppm PCBs would be effective in minimizing potential public health risks associated with direct contact with sediment. Results from Battelle's modeling studies indicate a site-wide 50 ppm cleanup would reduce PCB inputs to the Upper Bay from areas north of the Hurricane Barrier. However, the site-wide 50 ppm cleanup is not expected to significantly reduce PCB levels in lobster and flounder in the Upper Bay (Battelle, 1990). Similarly, the quantitative model used by the Trustees in their effectiveness evaluation further suggests that additional cleanup of the localized areas of sediment PCB contamination to 10 ppm may not significantly reduce PCB concentrations in biota (NOAA, 1992). As a result, significant risks to public health through the ingestion of contaminated biota will remain and thus require the continued use of institutional controls.

The magnitude of residual environmental risk remaining after the implementation of Alternative BAY-3 is somewhat uncertain. While the average sediment PCB concentration for the Upper Bay as a whole (i.e., 1 to 2 ppm) may be close to the recommended 1 ppm sediment TCL for protection of aquatic species, the potential impact of capping of the localized areas of sediment contamination to cleanup level of 10 ppm is difficult to quantify. For example, the extent to which biota spend a disproportionate amount of their time near the localized areas of contamination in the Upper Bay is unknown. However, there are studies that have documented the increased presence of some species in the vicinity of outfall areas (NOAA, 1992).

Intuitively, reducing surficial PCB concentrations to below 10 ppm in the localized areas of contamination through capping should have positive effects on marine biota. This conclusion is further supported by the Battelle Modeling results which indicate that the effects of remediation are largely near-field. Unfortunately, the degree of improvement that will result in cleaning up the 60 acres to 10 ppm, may not be readily visible because biota move throughout the entire 17,000 acres of the Upper Bay and the PCB contamination exists at some level in all areas.

Overall, Alternative BAY-3 may result in some continued environmental risks to the marine biota in the Upper Bay.

6.2.3.5 Reduction in Mobility, Toxicity and Volume

Since this alternative does not include sediment treatment, no reduction in mobility, toxicity or volume of the PCBs would be achieved through treatment. However, capping of the PCB contaminated sediment is expected to reduce the PCB migration potential.

6.2.3.6 *Short Term Effectiveness*

Under Alternative BAY-3, it is uncertain how much time would be required to achieve the remedial response objectives for Upper Buzzards Bay. Therefore, institutional controls, regular environmental monitoring and five year reviews would be required. These components have not been included herein as they are part of each of the remedial alternatives presented in EPA's January 1992 Proposed Plan.

Protection of the community and the workers conducting the remediation are also considered under this criterion. The primary remedial component of Alternative BAY-3 is subaqueous capping. During this operation, the workers are not anticipated to contact the contaminated sediment. As a result the workers and the community are not expected to be at risk. However, as a precaution workers onsite during remedial activities may use some personal protection equipment in some instances (i.e. overalls and gloves) as needed to minimize or prevent exposure to contaminated sediment.

Capping is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be covered with a minimum of two feet of sediment and may be destroyed as a result of this operation. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program.

Workers conducting the predesign sampling would also require protective equipment. The requirements would be specified in a site-specific Health and Safety Plan (HASP). These sampling activities would pose no risk to the community or the environment.

bottom-dumping with a split hull scow as described in remedial alternative BAY-3 (Section 6.2.3.1).

The dredging component of the alternative entails the removal of approximately 67,000 yd^3 with a hydraulic dredge from the northern portion of the Upper Bay adjacent to the New Bedford shoreline. The sediment would be dredged to a depth of one foot and pumped to a scow for transport to the northern end of the Lower Harbor. From there, sediment would be pumped out of the scow through a pipeline running north to CDF 1 for disposal. To accommodate the additional sediment volume in CDF 1 dike wall elevation will have to be raised by approximately two feet. Similar to the CDF operation described in Alternative BAY-2, the sediment will settle through gravity and the water will be treated before release to the Estuary.

6.2.4.2 Overall Protection of Human Health and the Environment

Cleanup of sediment contaminated with from 10 to 50 ppm in the Upper Bay through capping and dredging with shoreline disposal is protective of public health from direct contact with the sediment. However, based on the effectiveness evaluation prepared by the Trustees (NOAA, 1992) lobster and flounder of Upper Buzzards Bay are likely to remain contaminated with PCBs at levels near or above the FDA limit of 2 ppm. Exceedance of this ARAR and the potential public health risks associated with eating the PCB contaminated biota will require the continuance of the fishing ban. The surface water PCB concentrations in the Upper Bay which result following the 10 ppm sediment PCB cleanup are anticipated to meet the AWQC (Battelle, 1990).

Following implementation of BAY-4, sediment PCB concentrations in the remediated portions of the Upper Bay will be less than 10 ppm and may approach the recommended 1 ppm PCB sediment TCL for protection of aquatic species. The degree to which the alternative will provide environmental protectiveness is uncertain. This is because the average sediment PCB concentrations for the Upper Bay as a whole will likely remain on the order of 1 to 2 ppm, still above the recommended 1 ppm sediment TCL.

6.2.4.3 Compliance with ARARs

The ARARs for BAY-4 include the chemical-specific, location-specific and action-specific ARARs presented below. Additional details of the ARARs are presented in Section 4.2.

Chemical-specific. The AWQC for PCBs should be attained in all areas of the Upper Bay (Ebasco, 1990c). Other chemical-specific ARARs for this alternative include the FDA limit of 2 ppm PCB in the edible tissue of biota. Based on comparisons of estimates from the Battelle Model with the results of the Trustees evaluation

(NOAA, 1992), it appears that PCB levels in lobsters from Fishing Closure Area II will probably not drop significantly below the 2 ppm FDA limit.

Chemical-specific ARARs that apply to the discharge of water generated during the sediment dewatering process include the Massachusetts Surface Water Quality Standards (310 CMR 4.00). This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the Commonwealth.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative to ensure that remedial action does not cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging and disposal of the sediments cause volatilization of any contaminants. Any impacts detected would be prevented or minimized by best available engineering controls during dredging and disposal activities.

Location-specific. Capping and dredging the contaminated sediment areas would trigger federal and state location-specific ARARs for wetlands and floodplains. Substantive requirements of Section 404 of the CWA and USACE regulations presented in 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetland protection regulations apply. Compliance with substantive requirements would be met.

Action-specific. The action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administration of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the Federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is not required for all on-site activities. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements at 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M of wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot scale test results from the Pilot Study indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards (Otis et al., 1990). Construction and operation procedures and standards would be attained through inclusion in the design, and implementation of the alternative.

TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. Since the PCB concentrations in the sediments to be dredged will be below 50 ppm, TSCA will not be a requirement for Alternative BAY-4. In the event Alternative BAY-4 is conducted in conjunction with EPA's proposed 50 ppm PCB site-wide cleanup, the applicability of TSCA would have to be reevaluated.

Treatment of the sediment in order to comply with the land disposal restrictions in the Resource Conservation and Recovery Act (RCRA) is not necessary. EPA conducted TCLP testing of New Bedford Harbor sediment for several heavy metals as a part of the design process for the Hot Spot remedy. Three of the four metals tested were below their respective regulatory criteria (i.e., chromium, cadmium, lead). Since there is currently no criterion for copper, it was not directly evaluated. Further, the contemplated action does not constitute "placement in" within the meaning of RCRA.

6.2.4.4 Long Term Effectiveness

Cleanup of sediment contaminated with 10 to 50 ppm PCBs would be effective in minimizing potential public health risks associated with direct contact with sediment. Results from Battelle's modeling studies indicate a site-wide 50 ppm cleanup would reduce PCB inputs to the Upper Bay from areas north of the Hurricane Barrier. However, the site-wide 50 ppm cleanup is not expected to significantly reduce PCB levels in lobster and flounder in the Upper Bay (Battelle, 1990). Similarly, the quantitative model used by the Trustees in their effectiveness evaluation further suggests that additional cleanup of the localized areas of sediment PCB contamination to 10 ppm may not significantly reduce PCB concentrations in biota (NOAA, 1992). As a result, significant risks to public health will remain and will require the continued use of institutional controls.

The magnitude of residual environmental risk remaining after the implementation of Alternative BAY-4 is somewhat uncertain. While the average sediment PCB concentration for the Upper Bay as a whole (i.e., 1 to 2 ppm) may be close to the recommended 1 ppm sediment TCL for protection of aquatic species, the potential impact of lowering the localized areas of sediment contamination from 50 ppm to 10 ppm is difficult to quantify. For example, the extent to which biota spend a disproportionate amount of their time near the localized areas of contamination in the Upper Bay is unknown. However, there are studies that have documented the increased presence of some species in the vicinity of outfall areas (NOAA, 1992).

Intuitively, reducing PCB concentrations to 10 ppm in the localized areas of contamination should have positive effects on marine biota. This conclusion is further supported by the Battelle Modeling results which indicate that the effects of remediation are largely near-field. Unfortunately, the degree of improvement that will result in cleaning up the 60 acres to 10 ppm, may not be readily visible because biota move throughout the entire 17,000 acres of the Upper Bay and the PCB contamination exists at some level in all areas.

Overall, Alternative BAY-4 may result in some continued environmental risks to the marine biota in the Upper Bay.

6.2.4.5 Reduction in Mobility, Toxicity and Volume

Since this alternative does not include sediment treatment, no reduction in mobility, toxicity or volume of the PCBs would be achieved through treatment. However, disposal of the PCB contaminated sediment in a CDF and isolation under a cap is expected to reduce the PCB migration potential.

6.2.4.6 Short Term Effectiveness

Under Alternative BAY-4, it is uncertain how much time would be required to completely achieve the remedial response objectives for Upper Buzzards Bay. Therefore, institutional controls, regular environmental monitoring and five year reviews would be required. These components have not been included herein as they are part of each of the remedial alternatives presented in EPA's January 1992 Proposed Plan.

Protection of the community and the workers conducting the remediation are also considered under this criterion. The primary remedial components of Alternative BAY-4 are capping and dredging with sediment disposal. Dredging is not expected to generate substantial levels of airborne or volatilized contaminants to which workers in adjacent areas would be exposed (Ebasco, 1990c). Control measures would be used to reduce PCB emissions to protect worker safety and public health, if required.

The capping operations are not anticipated to include direct contact with the sediment as the clean sediment cap will be placed from the water's surface, 30 feet above the contaminated sediment. In addition, the capping will be conducted off-shore, more than one half a mile from any residences. As a result, the workers and the community are not expected to be at risk from the capping operation.

Workers onsite during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations.

Dredging and capping are expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed or covered during the construction operations. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program.

Results of the USACE pilot dredging study indicate that resuspension of contaminated sediment during the dredging operation would be minimal when proper dredge operating conditions are used. Average resuspension rates for the cutterhead dredge during the pilot study were 12 g/sec at the dredgehead with suspended solids levels in the water column returning to background within 400 feet of the operating dredge (Otis et al., 1990). While the clamshell dredge may cause more sediment resuspension than the cutterhead dredge, the length of time to complete dredging the Outfall area with the clamshell is less than one month, thereby minimizing the potential for environmental impacts.

Workers conducting the predesign sampling would require protective equipment. The requirements would be specified in a site-specific Health and Safety Plan (HASP). These sampling activities would pose no risk to the community or the environment.

6.2.4.7 Implementability

The implementability of Alternative BAY-4 includes the technical and administrative feasibility of the alternative and the availability of the services and materials. The implementability of dredging and shoreline disposal has been addressed in detail in Estuary, Lower Harbor and Bay Feasibility Study (Ebasco, 1990b). In summary, dredging and shoreline disposal have been demonstrated feasible and reliable technologies on a site specific basis during the Pilot Study.

The Pilot Study also demonstrated the availability of goods and services and the ability to monitor the effectiveness of dredging and sediment disposal activities.

Capping has been demonstrated as a feasible, reliable and effective at many deep water sites similar to the Upper Bay. However, the current and future operational activities of the 60 inch Outfall will have to be considered during the design and implementation of this alternative. Monitoring considerations for implementing the cap include before and after hydrographic surveys to ensure the minimum cap thickness of 2 feet has been attained in all areas.

Additional remedial actions that may be required include placing additional cap material or removal of the contaminated sediment from beneath the cap. The latter remedial action represents a significant construction operation because of the volumes of material involved.

Coordination with other agencies would be required including meetings to discuss the substantive requirements of the action-specific ARARs. In addition, close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the Lower Harbor and Upper Bay. Tugs, scows, tow vessels, and trucks would be required to complete the construction operations. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels. Access to shoreline staging areas to support capping operations would also need to be secured.

Implementability concerns for the predesign sampling components of Alternative BAY-4 are relatively few. The personnel and equipment to perform the services are readily available. The coordination tasks include interfacing with local and state officials prior to conducting the sampling programs.

6.2.4.8 Cost

The costs for Alternative BAY-4 include the capital costs to dredge, transport and unload the sediment into CDF 1, and to treat the water generated during the sediment dewatering process. A cost to raise the height of CDF 1 by two feet has also been included. The capital costs for capping the 60 inch Outfall include an upland source of material and construction costs to place the material.

The cost estimate for Alternative BAY-4 may not fall within the level of accuracy typically developed during a Feasibility Study (+50%, -30%). This is because of the uncertainty associated with the nature and extent of PCB contamination. A sensitivity analysis was not conducted because these analyses are generally appropriate when small changes in quantities will have a large impact on costs. In this case, small changes in remedial areas and volumes would not dramatically impact the costs. However, the potential changes in remedial areas and volumes that could result from the predesign program may be on the order of a factor of four. This estimate was based on the acreage of the potential areas exceeding 10 ppm PCB discussed in Section 5.1. To assist in resolving the uncertainty, the direct costs also include a comprehensive PCB sediment sampling program to establish the basis of design for sediment removal.

The total alternative cost of approximately $10 million includes the direct costs described above and indirect costs to cover nonconstruction related items such as engineering, health and safety and legal and administrative (Table 6-6). A contingency factor has also been included to cover items not anticipated at this time. The Operation and Maintenance (O&M) costs to monitor and maintain the incremental component of CDF 1 are not included as they are insignificant.

Similar to Alternative BAY-3, the cost impact of using a marine source for the capping material was evaluated. For Alternative BAY-4, the total cost would be lowered to approximately $6.8 million. Again, it is unclear if this alternative approach is

TABLE 6-6

COST ESTIMATE: BAY-4
CAPPING WITH DREDGING AND ON-SITE DISPOSAL
NEW BEDFORD HARBOR SUPPLEMENTAL FS
FOR UPPER BUZZARDS BAY

ACTIVITY	COST
I. DIRECT COSTS	
A. Dredging Areas A&B	$1,204,200
B. CDF No. 1 Dike Mods.	$241,350
C. Water Treatment	$335,300
D. Capping of Area C	$2,752,000
E. Predesign Program	$349,600
DIRECT COST	$4,882,450
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection	$244,000
B. Legal & Administration (@6%)	$293,000
C. Engineering (@ 10%)	$488,000
D. Services During Construction (@ 10%)	$488,000
E. Turnkey Contractor Fee (@ 15%)	$732,000
INDIRECT COST	$2,245,000
SUBTOTAL COST	$7,127,450
CONTINGENCY (@ 20%)	$1,425,000
TOTAL CAPITAL COST	$8,552,450
O&M COST (Aquatic Cap Area C) (present worth @ 5% for 30 years upon completion)	$1,099,500
TOTAL COST - ALTERNATIVE BAY-4	$9,651,950

administratively feasible and whether an EIR would be required. Given this uncertainty, the alternative is presented using an upland source of capping material.

6.2.5 ALTERNATIVE BAY-5: DREDGING, SOLVENT EXTRACTION AND ON-SITE DISPOSAL

6.2.5.1 General Description

Alternative BAY-5 removes and treats the contaminated sediment with solvent extraction prior to shoreline disposal in a CDF. With the exception of the mechanical dewatering and sediment treatment steps, the alternative is identical to BAY-2 (section 6.2.2.1).

The dredging component of alternative BAY-5 includes hydraulic dredging of the two areas adjacent to the Cornell Dubilier CSO and the Hurricane Barrier and mechanical dredging with a 15 yd^3 clamshell dredge at the Treatment Plant Outfall (Figure 6-5). The hydraulic dredging would be completed to a depth of one foot over the 59 acre area generating approximately 67,000 yd^3 of sediment. A two-foot dredging depth for the 17 acres that are surrounding the Outfall will generate approximately 53,300 yd^3 of sediment.

The material from both dredging operations will be transported to the shoreline for dewatering. The dewatering process will involve two steps including gravity settling followed by mechanical dewatering. The gravity settling may be conducted in a separate portion of CDF 7 created with a sheet pile or diked wall. Following gravity settling, the sediment would be placed in a plate and frame filter press to further reduce the water content of the sediment. The water produced during these dewatering activities would be treated through the addition of coagulants and flocculants to facilitate precipitation; a second sedimentation or filtration step, and finally, carbon adsorption or UV/oxidation for final polishing.

The dewatered sediment would be treated using solvent extraction. Solvent extraction is a process in which a soluble substance is leached from a solid matrix with an appropriate solvent. Although PCBs characteristically have relatively low solubilities in water, they are readily soluble in certain organic solvents under appropriate conditions of temperature and/or pressure. The overall removal efficiency of solvent extraction depends on the number of extraction steps. The amount of PCBs that can be removed from the sediment during any one extraction step is limited by the following (Ebasco, 1987):

- the contaminant's solubility in the solvent
- the solvent and sediment mixing efficiency

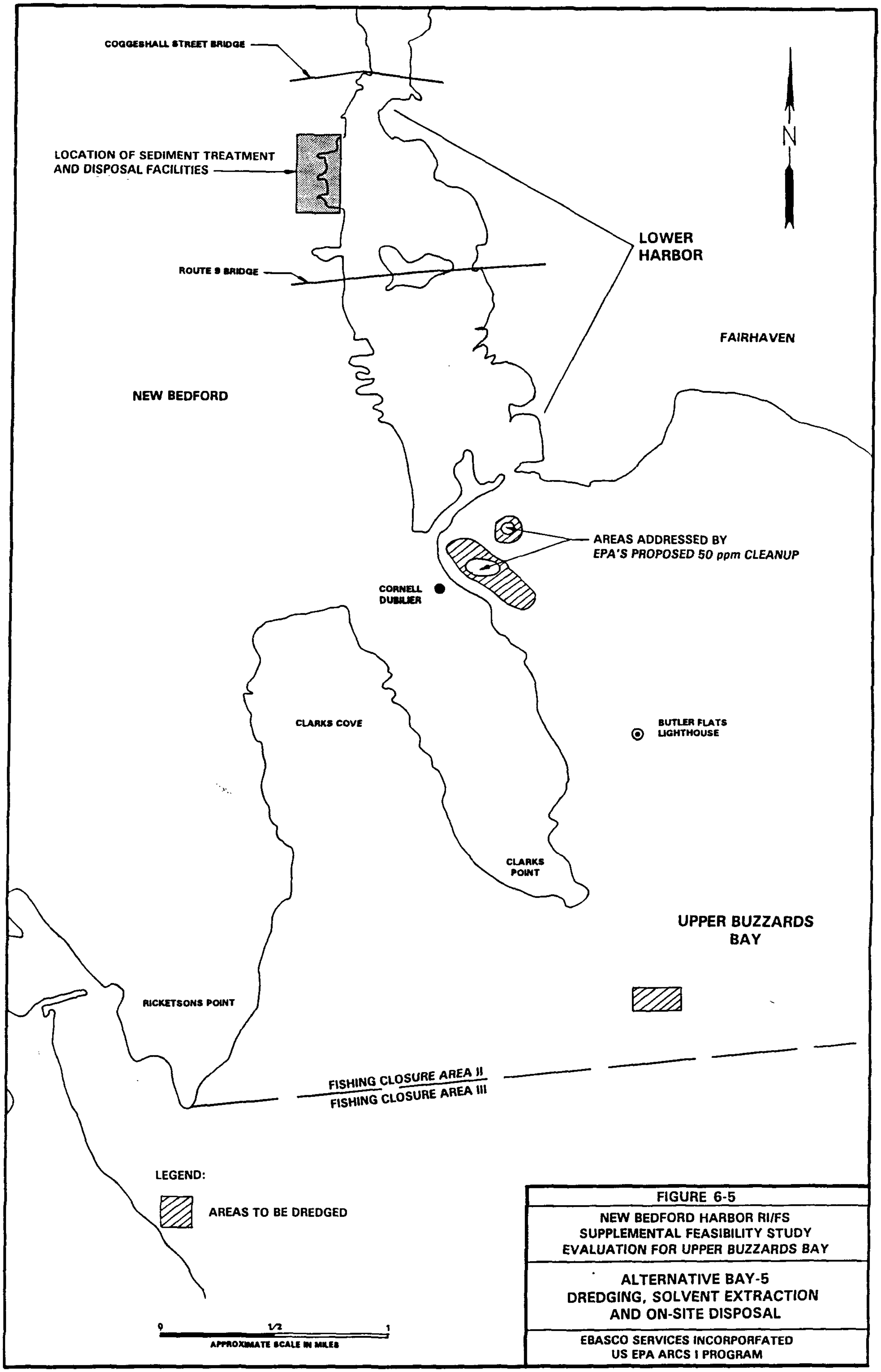


FIGURE 6-5

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

ALTERNATIVE BAY-5
DREDGING, SOLVENT EXTRACTION
AND ON-SITE DISPOSAL

EBASCO SERVICES INCORPORFATED
US EPA ARCS I PROGRAM

- mass transfer coefficients governing the rate at which the contaminant dissolves
- the time the solvent and sediment are in contact
- the ability to separate solvent from the sediment
- the presence of interfering substances in the sediment

Treatment tests were conducted on New Bedford Harbor sediment using two solvent-extraction technologies: the triethylamine (TEA)-based BEST process developed by RCC; and the liquified (gas) propane process developed by CF Systems. Treatment tests using the RCC process were conducted on a bench-scale, while the CF Systems process was tested on a pilot-scale as part of the EPA SITE program. Descriptions of these technologies and a brief summary of the test results are presented in Section 5 of the 1990 Feasibility Study (Ebasco, 1990c). Since the above tests were completed, there have been some developments with the solvent extraction technology. One such development is the emergence of the TKC process. This process has been used for several small scale PCB cleanups and the vendor is currently building a new unit to treat approximately 2,000 yds of PCB contaminated soil as part of a Superfund Cleanup. However, the technology has not been demonstrated for marine sediment. Since the BEST process was demonstrated to be effective at the bench-scale level for New Bedford Harbor sediment, it is presented here as an example technology. Since the development of innovative technologies such as solvent extraction is somewhat of a moving target, the selection of the appropriate technology would be conducted as a part of the design effort. This effort may include on-site pilot scale performance tests.

Sediment treatment by solvent extraction of PCBs (and the associated oil fraction) from the sediment would begin by batch mixing the dewatered sediment with the appropriate solvent; in this case, TEA. After mixing, the solvent containing PCBs and the sediment containing little or no residual PCBs would be separated by centrifugation and/or gravity settling. The PCB/oil fraction is then separated from the solvent, either by changing the temperature and/or pressure of the solvent which changes the solubility of the PCBs, or by distillation methods. The solvent is subsequently recycled and the PCB/oil fraction destroyed via incineration.

The solvent extraction process shown in Figure 6-6 is a simplified representation of the BEST process. The sediment processing hardware consists of Littleford rotary washer-dryer units. These units are readily available and are used extensively in the chemical-processing industry.

Following treatment, the dewatered sediment would be separated into three distinct effluent streams: sediment solids, water, and an extract containing PCBs and oil. The dry sediment solids may contain residual metals. Leaching tests would be used to determine

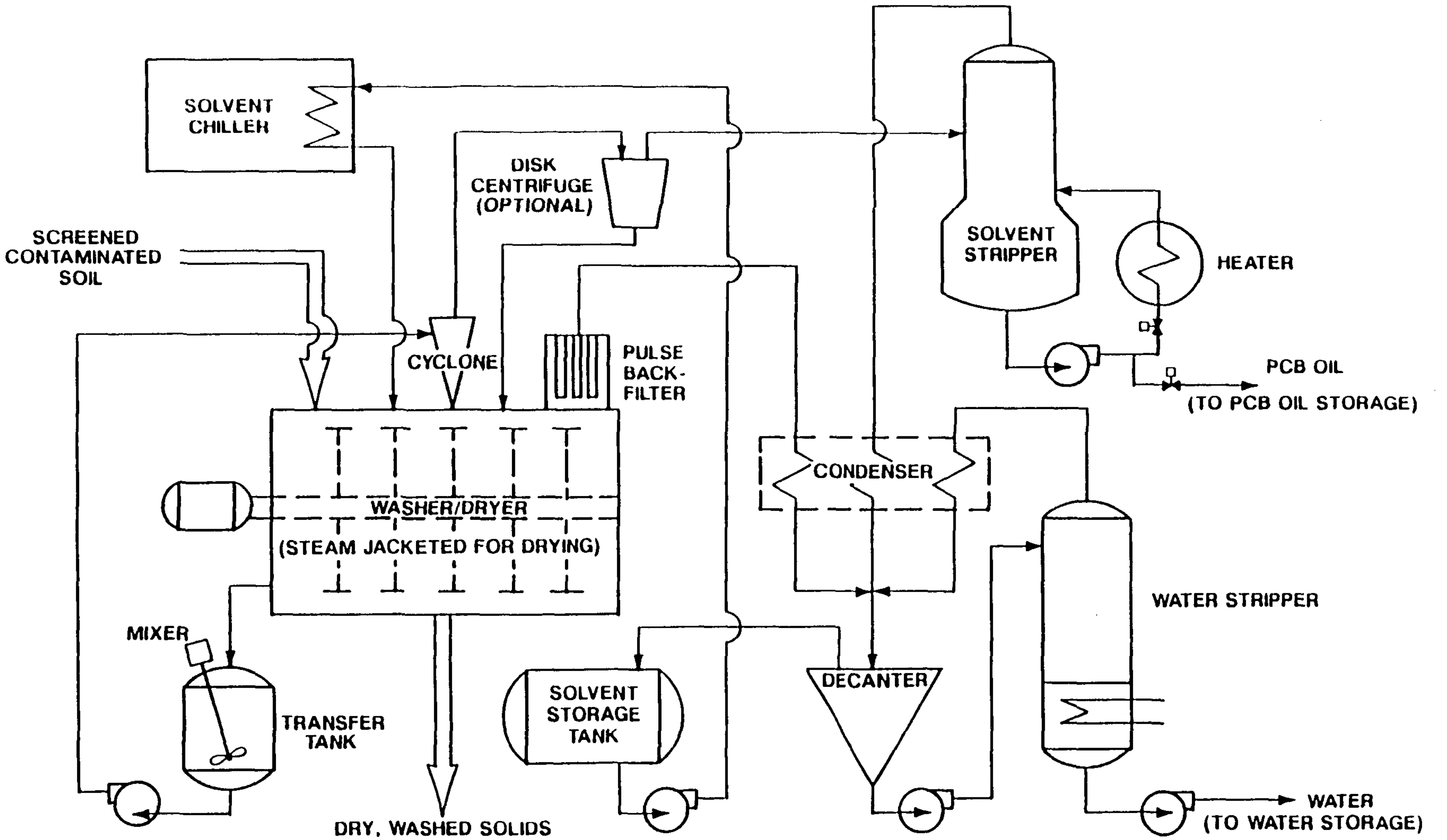


FIGURE 6-6

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

B.E.S.T.™ SOIL UNIT CLEAN-UP SCHEMATIC

EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

From Ebasco, 1990 C

the need for secondary treatment, such as solidification to immobilize the metals, prior to ultimate disposal. The water removed from the sediment would be treated by the water treatment facility prior to release to the Lower Harbor.

The PCB/oil extract generated during this process will be incinerated off-site to permanently destroy the PCBs. The treated sediment would be placed in CDF 7. A geomembrane and granular cap would be placed over the CDF as an infiltration barrier, or cap. This cap would then be graded and seeded to prevent erosion.

6.2.5.2 Overall Protection of Human Health and the Environment

Cleanup of sediment contaminated with from 10 to 50 ppm in the Upper Bay through dredging and shoreline disposal would be protective of public health from direct contact with the sediment. However, based on the effectiveness evaluation prepared by the Trustees (NOAA, 1992) lobster and flounder of Upper Buzzards Bay are likely to remain contaminated with PCBs at levels near or above the FDA limit of 2 ppm. Exceedance of this ARAR and the potential public health risks associated with eating the PCB contaminated biota will require the continuance of the fishing ban. The surface water PCB concentrations in the Upper Bay which result following the 10 ppm sediment PCB cleanup are anticipated to meet the AWQC (Battelle, 1990).

Following implementation of BAY-5, sediment PCB concentrations in the remediated portions of the Upper Bay will be less than 10 ppm and may approach the recommended 1 ppm PCB sediment TCL for protection of aquatic species. The degree to which the alternative will provide environmental protectiveness is uncertain. This is because the average sediment PCB concentrations for the Upper Bay as a whole will likely remain on the order of 1 to 2 ppm, still above the recommended 1 ppm sediment TCL.

6.2.5.3 Compliance with ARARs

The ARARs for BAY-5 include the chemical-specific, location-specific and action-specific ARARs presented below. Additional details of the ARARs are presented in Section 4.2.

Chemical-specific. The AWQC for PCBs should be attained in all areas of the Upper Bay (Ebasco, 1990c). Other chemical-specific ARARs for this alternative include the FDA limit of 2 ppm PCB in the edible tissue of biota. Based on comparisons of estimates from the Battelle Model with the results of the Trustees evaluation (NOAA, 1992), it appears that PCB levels in lobsters from Fishing Closure Area II will probably not drop significantly below the 2 ppm FDA limit.

Chemical-specific ARARs that apply to the discharge of water generated during the two sediment dewatering processes include the Massachusetts Surface Water Quality Standards (310 CMR 4.00). This regulation sets standards for maximum levels of contaminants that can be discharged to the surface waters of the Commonwealth.

National Air Quality Standards (40 CFR 40) and Massachusetts Air Pollution and Air Quality Regulations (310 CMR 6.00-8.00) would apply to this alternative to ensure that remedial action does not cause a negative impact on existing air quality. Monitoring systems can be engineered into the implementation of this alternative to gauge whether dredging, disposal or treatment of the sediments will produce emissions. Any impacts detected would be prevented or minimized by best available engineering controls during the construction activities.

Location-specific. Dredging sediment would trigger federal and state location-specific ARARs for wetlands and floodplains. Substantive requirements of Section 404 of the CWA and USACE regulations presented in 40 CFR 230 must be followed. Pursuant to Section 404 (b)(1) of the CWA guidelines (promulgated as regulations in 40 CFR 230.10), degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section 404 (b)(1) of the CWA, no discharge of dredged or fill material will be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem, providing the alternative does not have other significant adverse environmental consequences. If there is no practicable alternative, adverse impacts to the aquatic ecosystem/wetland should be minimized according to 40 CFR 230.10(d).

If a functioning wetland with environmental value is negatively affected from a remedial action, mitigation techniques such as wetland restoration, enhancement, or creation may be appropriate. Executive Orders 11988 and 11990, which are implemented through NEPA (40 CFR Part 6, Appendix A), are ARARs that may also require wetlands and floodplain mitigation. If excavation of the wetlands is required, then restoration of wetlands would occur as part of the construction of this alternative. Replacement of wetland areas lost to construction may also be required as part of mitigation.

Coordination with the U.S. Fish and Wildlife Service would occur during remedial alternative development, evaluation, and selection phases to ensure compliance with substantive requirements of the U.S. Fish and Wildlife Coordination Act.

On the state level, water quality certification, waterway procedures, and the wetland protection regulations apply. Compliance with substantive requirements would be met.

Action-specific. The action-specific ARARs would go into effect during various phases of implementation of this alternative. Under the CWA (40 CFR 231) and Massachusetts Certification for Dredged Material Disposal and Filling in Waters (310 CMR 9.00), dredging and transport of contaminated sediments to shore-based facilities would have to meet technology requirements set forth in these regulations. Dredging techniques are determined by the characteristics of sediments and material to be dredged. This material would be transported to shore using best engineering practices. The Administration of Waterways Licenses sets requirements to prevent interference with commercial and recreational navigation, and the protection of special or sensitive marine and coastal areas. These requirements can be met through engineered controls implemented during construction. Dredging activities would be timed and coordinated to minimize interference with shipping and boating traffic, and a monitoring program would be implemented during dredging to detect and minimize the spread of contaminated sediments.

ARARs that pertain to the water treatment component of this alternative relate to either the O&M of wastewater treatment facilities (314 CMR 12.00) or treatment standards for process waters. Pilot scale test results from the Pilot Study indicate that treatment of the supernatant water generated during dewatering would meet promulgated treatment standards (Otis et al., 1990). Construction and operation procedures and standards would be attained through inclusion in the design, and implementation of the alternative.

ARARs for the solvent extraction activities include Best Available Control Treatment (BACT) for any emissions from the unit under Federal and state air pollution control and air quality regulations. TSCA regulations (40 CFR 761) regulate the disposal of dredged materials contaminated with PCBs in concentrations of 50 ppm or more. Since the PCB concentrations in the sediments to be dredged will be below 50 ppm, TSCA will not be a requirement for the majority of activities associated with Alternative BAY-5. However, treatment of the PCB/oil extract with incineration will likely be subject to the disposal requirement of TSCA set forth in 40 CFR 761.60. In the event, Alternative BAY-5 is conducted in conjunction with EPA's proposed 50 ppm PCB site-wide cleanup, the applicability of TSCA would have to be reevaluated.

EPA conducted TCLP testing of New Bedford Harbor sediment for several heavy metals as a part of the design process for the Hot Spot remedy. Three of the four metals tested were below their respective regulatory criteria (i.e., chromium, cadmium, lead). Since there is currently no criterion for copper, it was not directly evaluated. However, these tests were conducted on bulk sediment and may not be applicable to the residual matrix following solvent extraction. As such, the residue may be a characteristic waste and subject to the substantive requirement of RCRA. This could be confirmed during the course of predesign studies.

In addition to the USACE administration of Section 404 of the CWA, the Massachusetts Wetlands Protection Act and regulations under 310 CMR 10.00 apply to all activities occurring in wetlands or in the 100-foot buffer zone. Similar to the Federal 404 permit, filing a Notice of Intent (NOI) with the local conservation commission is not required for all on-site activities. Compliance with all substantive requirements of 310 CMR 10.00 and with the Massachusetts Water Quality Certification requirements at 314 CMR 9.00 is also required for activities involving dredging in wetlands or waterways.

6.2.5.4 Long Term Effectiveness

Cleanup of sediment contaminated with 10 to 50 ppm PCBs would be effective in minimizing potential public health risks associated with direct contact with sediment. Results from Battelle's modeling studies indicate a site-wide 50 ppm cleanup would reduce PCB inputs to the Upper Bay from areas north of the Hurricane Barrier. However, the site-wide 50 ppm cleanup is not expected to significantly reduce PCB levels in lobster and flounder in the Upper Bay (Battelle, 1990). Similarly, the Trustees effectiveness evaluation further suggests that additional cleanup of the localized areas of sediment PCB contamination to 10 ppm may not significantly reduce PCB concentrations in biota (NOAA, 1992). As a result, significant risks to public health will remain and will require the continued use of institutional controls.

The magnitude of residual environmental risk remaining after the implementation of Alternative BAY-5 is somewhat uncertain. While the average sediment PCB concentration for the Upper Bay as a whole (i.e., 1 to 2 ppm) may be close to the recommended 1 ppm sediment TCL for protection of aquatic species, the potential impact of lowering the localized areas of sediment contamination from 50 ppm to 10 ppm is difficult to quantify. For example, the extent to which biota spend a disproportionate amount of their time near the localized areas of contamination in the Upper Bay is unknown. However, there are studies that have documented the increased presence of some species in the vicinity of outfall areas (NOAA, 1992).

Intuitively, reducing PCB concentrations to 10 ppm in the localized areas of contamination should have positive effects on marine biota. This conclusion is further supported by the Battelle Modeling results which indicate that the effects of remediation are largely near-field. Unfortunately, the degree of improvement that will result in cleaning up the 60 acres to 10 ppm, may not be readily visible because biota move throughout the entire 17,000 acres of the Upper Bay and the PCB contamination exists at some level in all areas.

Overall, Alternative BAY-5 may result in some continued environmental risks to the marine biota in the Upper Bay.

6.2.5.5 Reduction in Mobility, Toxicity and Volume

This alternative includes treatment that would reduce the mobility and volume of the PCBs by physically removing them from the sediment. A subsequent reduction in mobility, toxicity and volume would be achieved through the off-site incineration of the PCB/oil extract. The solidification step, if required would reduce the mobility of the metals and remaining PCBs associated with the sediment residual from the solvent extraction process. The solidification process would, however, increase the volume of the solids by approximately 30%.

6.2.5.6 Short Term Effectiveness

Under Alternative BAY-5, it is uncertain how much time would be required to completely achieve the remedial response objectives for Upper Buzzards Bay. Therefore, institutional controls, regular environmental monitoring and five year reviews would be required. These components have not been included herein as they are part of each of the remedial alternatives presented in EPA's January 1992 Proposed Plan.

Protection of the community and the workers conducting the remediation are also considered under this criterion. The primary remedial components of Alternative BAY-5 are dredging with sediment treatment and disposal. Dredging is not expected to generate substantial levels of airborne or volatilized contaminants to which workers in adjacent areas would be exposed (Ebasco, 1990c). Control measures would be used to reduce PCB emissions to protect worker safety and public health, if required.

Workers onsite during remedial activities would use personal protection equipment (i.e. respirators, overalls, and gloves) as needed to minimize or prevent exposure to contaminants through dermal contact and the inhalation of airborne particulates or volatilized contaminants as a result of dredging and disposal operations.

Risk to the workers is also expected to be minimal for the soil treatment activities. All of the solvent extraction treatment units are closed systems during their operation and therefore are unlikely to cause air emissions. However, air monitoring in the immediate vicinity of the treatment unit would be conducted to protect workers' safety and the surrounding community.

Dredging is expected to cause some impacts to the environment. Flora and fauna currently residing within the contaminated sediment would be removed along with the sediment and destroyed during the dredging operation. Although it is expected that this area would re-establish itself, this process could be enhanced through a recolonization program. Results of the USACE pilot dredging study indicate that resuspension of contaminated sediment would be minimal when proper dredge operating conditions are used. Average resuspension rates for the cutterhead dredge during the pilot study were 12 g/sec at the dredgehead with suspended solids levels in the water column returning to background within 400 feet of the operating dredge (Otis et al., 1990). While the clamshell dredge may cause more sediment resuspension than the cutterhead dredge, the length of time to complete dredging the Outfall area with the clamshell is less than one month, thereby minimizing the potential for environmental impacts.

Workers conducting the predesign sediment sampling would also require protective equipment. The requirements would be specified in a site-specific Health and Safety Plan (HASP). These sampling activities would pose no risk to the community or the environment.

6.2.5.7 Implementability

The implementability of the BAY-5 Alternative includes the technical and administrative feasibility of the alternative and the availability of the services and materials. The implementability of dredging and shoreline disposal has been addressed in detail in Estuary, Lower Harbor and Bay Feasibility Study (Ebasco, 1990b). In summary, dredging and shoreline disposal have been demonstrated feasible and reliable technologies on a site specific basis during the Pilot Study. The Pilot Study also demonstrated the availability of goods and services and the ability to monitor the effectiveness of dredging and sediment disposal activities.

Solvent extraction has been demonstrated to be technically feasible for treating PCB contaminated sediment from the Upper Bay. However, limited full scale data is available for any process unit capable of treating the large volume of sediment (i.e. 120,3000 yd^3). Pilot scale tests of this technology are therefore warranted during the design process. Incineration is a feasible and reliable technology for treating the PCB/oil extract. The same holds true for the water treatment technologies.

During dredging, the potential exists for unacceptable resuspension of sediment which could mobilize the sediment bound PCBs. Strict controls on operating, and controls on the dredging contractor should prevent this. However, a monitoring program will be in place during the dredging as an added control. Monitoring of all the process residuals including water and treated sediment would be analyzed to demonstrate achievement of performance standards.

Coordination with other agencies would include meetings to discuss the substantive requirements of the action-specific ARARs. In addition, close coordination with the Harbor Master would be required to minimize the impacts of these remedial actions on commercial shipping and fishing activities in the Lower Harbor and Upper Bay. Tugs, scows, tow vessels, and trucks would be required to move the dredges and sediment to various areas. Construction of the hydraulic pipelines would require floating pipes and support crews and vessels.

Site preparation and land acquisition would be the most significant support requirements for the development of shoreline disposal sites. Access to the facilities would also need to be secured.

Implementability concerns for the predesign sampling components of Alternative BAY-5 are relatively few. The personnel and equipment to perform the services are readily available. The coordination tasks include interfacing with local and state officials prior to conducting the sampling programs.

6.2.5.8 Cost

The costs for Alternative BAY-5 include the capital costs to construct CDF 7; to dredge, transport and unload the sediment into the CDF, and to treat the sediment and water generated during remedial activities. The cost of land for CDF 7 has not been included in the direct costs as no current information on the market value of this land was available.

The cost estimate for Alternative BAY-5 may not fall within the level of accuracy typically developed during a Feasibility Study (+50%, -30%). This is because of the uncertainty associated with the nature and extent of PCB contamination. A sensitivity analysis was not conducted because these analyses are generally appropriate when small changes in quantities will have a large impact on costs. In this case, small changes in remedial volume would not dramatically impact the costs. However, the potential changes in remedial volume that could result from the predesign program may be on the order of a factor of four. This estimate was based on the acreage of the potential areas exceeding 10 ppm PCB discussed in Section 5.1. To assist in resolving the uncertainty, the direct costs also include a comprehensive PCB sediment sampling program to establish the basis of design for sediment removal.

The total alternative cost of approximately $80 million includes the direct costs described above and indirect costs to cover nonconstruction related items such as engineering, health and safety and legal and permitting (Table 6-7). A contingency factor has also been included to cover items not anticipated at this time. The Operation and Maintenance (O&M) costs to monitor and maintain CDF 7 are also included as net present worth (NPW) costs for a period 30 years following construction.

6.3 COMPARISON OF REMEDIAL ALTERNATIVES

In this section, the five remedial alternatives are presented in Section 6.2 are compared to each other. Comparisons are presented in a qualitative manner and attempt to identify substantive differences between the alternatives. As in the detailed evaluation, the following criteria form the basis for the comparative analysis:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Short Term Effectiveness
- Long Term Effectiveness
- Reduction of Toxicity, Mobility and Volume
- Implementability
- Cost

State and community acceptance will be addressed at the completion of the RI/FS and the development of the ROD.

6.3.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion that must be met by any remedial alternative in order for it to be eligible for selection as a remedy for the Upper Bay. All of the alternatives discussed in this SFS, including the Minimal No-Action Alternative (BAY-1), would provide some additional level of protection to human health and the environment over baseline conditions.

The five remedial alternatives evaluated for the Upper Bay represent a range of alternatives including minimal no-action, non-removal (capping), removal and removal with treatment actions. Alternative BAY-5 includes removal and permanent destruction of the PCB-contaminated sediment. As such, this alternative would result in a permanent reduction in baseline risks and thus is the most protective of all of the alternatives. Other alternatives BAY-2 to BAY-4 include removal and/or non-removal without any treatment

TABLE 6-7

COST ESTIMATE: BAY-5
DREDGING TREATMENT AND SHORELINE DISPOSAL
NEW BEDFORD HARBOR SUPPLEMENTAL FS
FOR UPPER BUZZARDS BAY

ACTIVITY	COST
I. DIRECT COSTS	
A. Dredging	$1,693,000
B. CDF Construction	$5,587,600
C. Water Treatment	$6,253,400
D. Sediment Treatment	$37,453,300
E. Predesign Program	$349,600
DIRECT COST	$51,336,900
II. INDIRECT COSTS	
A. Health & Safety (@ 5%) Level D Protection	$313,000
B. Legal & Administration (@6%)	$3,080,000
C. Engineering (@ 10%)	$5,134,000
D. Services During Construction (@ 10%)	$5,134,000
E. Turnkey Contractor Fee (@ 15%)	$7,701,000
INDIRECT COST	$21,362,000
SUBTOTAL COST	$72,698,900
CONTINGENCY (@ 20%)	$14,540,000
TOTAL CAPITAL COST	$87,238,900
PRESENT WORTH COST (@ 5% for 3 years)	$79,189,657
O&M COST (CDFs) (present worth @ 5% for 30 years upon completion)	$408,600
TOTAL COST - ALTERNATIVE BAY-5	$79,598,257

options. While these alternatives provide an adequate level of protection to human health and the environment by limiting contaminant exposure, they would not provide for permanent destruction of PCBs. BAY-2 may be somewhat more protective than BAY-4 because CDFs are somewhat more reliable than subaqueous caps, and similarly, BAY-4 would be somewhat more protective than BAY-3, because in BAY-3 all remediated areas will be capped.

All five remedial alternatives are protective of human health from direct contact with PCB contaminated sediments. All five alternatives are also protective of human health risks due to the ingestion of contaminated biota through the implementation of institutional controls. Alternatives BAY-2 through BAY-5 are anticipated to provide some additional protection to marine biota from PCB contaminated sediment over that offered by the BAY-1 Minimal No-Action Alternative. The magnitude of additional protection to biota offered by these alternatives is, however, uncertain.

6.3.2 Compliance with ARARs

Chemical-Specific. Under this criterion, EPA evaluates the alternatives on the basis of how they will comply with ARARs. Based on the results of the Battelle Model (Battelle, 1990), the AWQC will be met throughout the entire Upper Bay under all five remedial alternatives, including the Minimal No-Action Alternative. Across much of the Upper Bay, the estimated water column PCB concentrations may be a factor of 3 below the 30 part per trillion criterion. Under minimal no-action, the FDA action limit of 2 ppm is not anticipated to be attained in the Upper Bay for all of the biota, including lobster. Based on the quantitative effectiveness evaluation conducted by the Trustees (NOAA, 1992), cleanup of the three areas of localized PCB contamination may not significantly lower the PCB concentration in the biota beyond minimal no-action.

For all of the alternatives except BAY-3, the requirements of Federal and state regulations governing air releases would have to be met.

The wastewater from a water treatment facility would have to comply with the pertinent Federal and state requirements. This includes the alternatives that involve dredging (BAY-1, BAY-2, BAY-4 and BAY-5). These include the requirements set forth by the state 314 CMR 1.00-7.00.

Location-Specific. Alternatives BAY-1 through BAY-5 would have to comply with the substantive requirements of the pertinent Federal and state wetlands regulations. The Federal regulations set forth in 40 CFR 230.10 specify that degradation or destruction of aquatic sites should be avoided to the extent possible. Under Section

404(b)(1) of the CWA, no discharge of dredge or fill material will be permitted if there is a practicable alternative that exists. Wetlands mitigation to support the requirements of the Wetlands and Floodplains Executive Orders may also be required for each of these alternatives. The state wetlands protection regulation (310 CMR 10.00) include requirements for dredging and filling activities in wetland areas. The requirements for a certification for dredge material disposal and filling will have to be met pursuant to 310 CMR 9.00. This act will also attain the requirements of CZM (301 CMR 20.00-22.00).

Action-Specific. The action-specific ARARs for Alternative BAY-1 include TSCA because the dredge sediment is by definition, 50 ppm PCB or greater. The remainder of the alternatives address PCB contamination at 10 ppm to 50 ppm and thus, TSCA does not apply. If any one of the BAY alternatives (BAY-2 to BAY-5) was implemented in conjunction with the proposed 50 ppm site-wide PCB cleanup, the applicability of TSCA would have to be reevaluated.

The only alternative that RCRA may apply to, would be Alternative BAY-5. This is the only alternative wherein the sediment is treated and which could result in the increased mobility of the metals. For remedial alternatives that do not treat the sediment (i.e., BAY-1, and BAY-2 through BAY-4) EPA has determined that the sediments are not RCRA characteristic and therefore, the requirements of RCRA do not apply.

6.3.3 Long Term Effectiveness

The long-term effectiveness and permanence criterion addresses the remaining risks after the site has been remediated. Alternative BAY-5 will provide the greatest reduction in risk. The effectiveness of alternatives BAY-2 through BAY-4 will be similar. The Minimal No-Action Alternative would provide the least reduction in risk of the five alternatives. However, all five alternatives would be protective of public health from risks due to potential exposure to PCB contaminated sediment through direct contact or incidental ingestion.

In all cases, there would be significant health risks associated with consuming PCB contaminated biota in the absence of institutional controls. Therefore, institutional controls are a component of each alternative.

Alternatives BAY-2 through BAY-5 should provide a reduction in ecological risks through the cleanup of localized areas of sediment PCB contamination to 10 ppm. However, it is unclear whether Alternatives BAY-2 through BAY-5 will be completely protective of all aquatic biota as the overall average PCB concentration in the

Upper Bay will likely still be on the order of 1 to 2 ppm, slightly higher than the recommended sediment TCL of 1 ppm.

6.3.4 Reduction in Mobility, Toxicity and Volume

This criterion evaluates the ability of the alternative to permanently and significantly reduce the mobility, toxicity, or volume of the PCB contaminant mass through treatment. Alternatives BAY-1 through BAY-4 would not address this criteria because they do not involve treatment. Alternative BAY-5 is the only alternative that involves treatment that would reduce the mobility and volume of the PCBs through solvent extraction, and ultimately reduce the mobility, toxicity, and volume of the PCB/oil extract through off-site incineration.

The volume of contaminated sediment may increase under Alternatives BAY-3 and BAY-4 if the PCBs migrate into the cap material.

6.3.5 Short Term Effectiveness

The short-term effectiveness refers to the effect of the alternative on human health and the environment during implementation. In addition, this criterion considers the time until protectiveness is achieved.

Based on the results of the Battelle model (Battelle, 1990), protection to public health from the potential ingestion of PCB contaminated biota may not be achieved for some time. As such, institutional controls are a component of all five alternatives.

Based on the air and water monitoring conducted during the pilot study, there is not expected to be a risk to the community. However, monitoring programs would be conducted to ensure protection of the community. Although the risks to site workers are expected to be minimal, protective equipment and monitoring and would be conducted during remediation. The degree to which protective equipment and monitoring equipment would be required is a function of sediment PCB concentrations and the degree to which individuals may be exposed. BAY-1 would have the least adverse short-term effect.

BAY-3 would provide the least risk to site workers, followed by BAY-4 and BAY-2. This is due to the material handling aspects associated with dredging. BAY-5 poses the greatest short-term risk due to the dredging and sediment treatment activities.

All of the alternatives would cause some degree of environmental damage, either through capping, dredging, or construction of a CDF. Alternatives BAY-1, BAY-3 and BAY-4 are potentially the least disruptive of the five alternatives because they involve less dredging. However, the areas disrupted during dredging and capping operations are likely to recolonize. This recolonization process can also be assisted through wetland mitigation techniques.

6.3.6 Implementability

The implementability of an alternative includes the technical and administration feasibility of implementing the alternative, as well as the availability of the technology. Of the alternatives developed for the Upper Bay, minimal no-action (BAY-1) would be the easiest to implement. This is based on the assumption that Alternatives BAY-2 through BAY-5 also include the proposed site-wide 50 ppm PCB cleanup alternative as a base case. The only activity beyond the 50 ppm cleanup activities required in BAY-1, is the confirmational sediment sampling program.

Alternative BAY-3 is considered the next easiest alternative to implement because it does not require construction of a CDF or employ dredging and water treatment. The dredging associated with BAY-4 would make it slightly more difficult to implement than BAY-3. Alternatives BAY-2 and BAY-5 both employ CDF 7 which may be difficult to locate along the New Bedford waterfront due to competing industrial needs.

The solvent extraction component of Alternative BAY-5 is the only technology that may not be readily available and has not been demonstrated at the scale that would be required for this alternative. The technology has however, been proven effective on a site-specific bench scale basis.

6.3.7 Cost

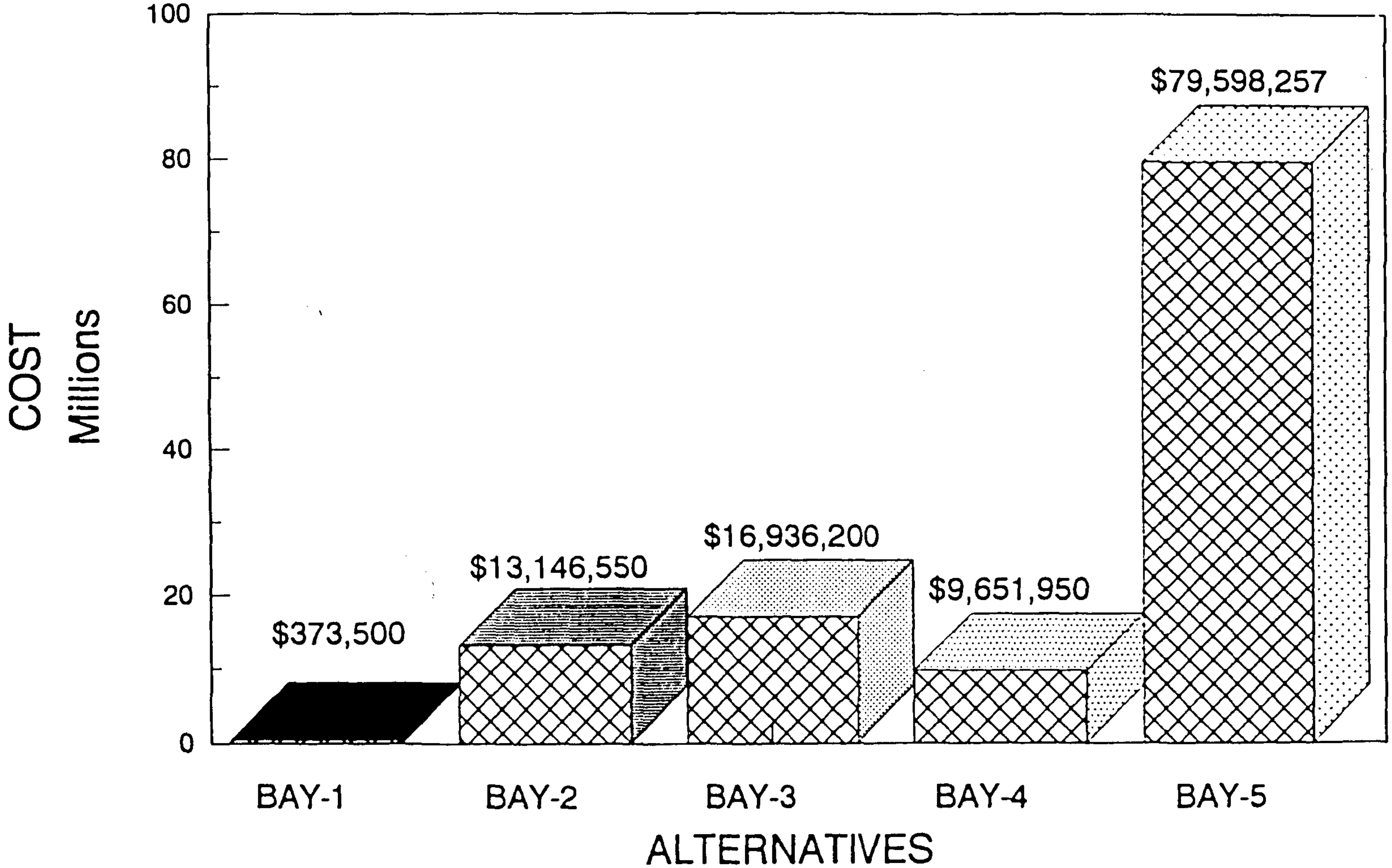
Cost estimates for each of the five alternatives were develop on the basis of capital, or direct costs, and indirect costs. The cost components for dredging and capping were developed in conjunctions with the U.S. Army Corps of Engineers (Otis, 1992). The remaining costs elements were developed in a manner consistent with the approach and unit costs presented in the 1990 Feasibility Study (Ebasco, 1990c). The costs for the five alternatives are graphically presented in Figure 6-7.

Alternative BAY-1 is the least costly (i.e., $373,500) as it only includes costs for the confirmational sediment sampling program. Of the remediation alternatives that do not employ treatment, Alternative BAY-4 is the least costly. This is because the alternative does not require the construction of a CDF and the costs associated with materials required for capping are minimized by dredging the 42 acres by the Hurricane Barrier. If the capping material required for this alternative could be mined from Upper

FIGURE 6-7

UPPER BUZZARDS BAY SUPPLEMENTAL FEASIBILTY STUDY

COMPARATIVE COST ANALYSIS



Buzzards Bay, the $9.6 million estimated cost could be reduced by several million dollars. The costs for BAY-3 are higher than BAY-2 by several million dollars because of the cost for capping material ($16.9 million vs. $13.1 million). The costs for BAY-5 are almost an order of magnitude higher than the other alternatives due to the sediment treatment costs (i.e., $79.6 million).

As indicated in the detailed analysis sections, a sensitivity analysis to evaluate the potential effect of the uncertainties associated with the remedial sediment volumes on remediation costs was not completed. This is due to the potential magnitude of these sediment uncertainties (a possible upper bound uncertainty in sediment volume of a factor of 4). In such a case, the sediment volume could undermine the cost assumptions requiring a complete reevaluation of the alternatives. For example, there may not be sufficient CDF capacity in the Lower Harbor area if the dredging volumes increased by a factor of four.

To assist in resolving some of the uncertainty, each remediation alternative includes a predesign sediment sampling program to refine the nature and extent of PCB contamination. The Minimal No-Action Alternative does not have a predesign component, but has a somewhat less rigorous sediment sampling program to assist in validating the current understanding of the nature and extent of PCB contamination.

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APPENDIX A

SEDIMENT PCB DATA FROM THE BATTELLE AND GZA SAMPLING PROGRAMS

SEDIMENT PCB DATA FROM THE BATTELLE AND GZA SAMPLING PROGRAMS

Sampling Program	Sample No.	Location x (ft)	Location y (ft)	PCB Conc. (ppm)	Fishing Closure Area	Target Remedial Area
GZA-86	6240	761,948.7	227,515.0	6.9	II	BACKGROUND
GZA-86	6243	760,614.4	225,499.5	2.8	II	BACKGROUND
GZA-86	6246	761,616.4	225,019.7	7.9	II	AREA B
GZA-86	6259	760,608.3	226,426.9	3.3	II	BACKGROUND
GZA-86	6264	762,001.6	226,562.7	81.0	II	N/A
GZA-86	6267	761,062.9	225,509.8	58.0	II	N/A
GZA-86	6268	761,587.4	225,461.4	61.0	II	N/A
GZA-86	6269	761,099.7	225,033.5	4.0	II	BACKGROUND
GZA-86	6277	762,155.3	224,561.5	1.9	II	AREA B
GZA-86	6286	762,582.8	227,977.2	0.7	II	BACKGROUND
GZA-86	6299	761,567.9	227,577.2	0.6	II	BACKGROUND
GZA-86	6300	761,097.4	227,020.0	0.2	II	BACKGROUND
GZA-86	6301	761,594.3	227,032.9	0.1	II	BACKGROUND
GZA-86	6302	760,596.6	225,998.0	12.0	II	AREA B
GZA-86	6303	761,536.6	225,993.5	3.7	II	BACKGROUND
GZA-86	6304	761,999.7	226,013.8	1.9	II	BACKGROUND
GZA-86	6305	762,190.7	225,479.7	2.8	II	BACKGROUND
GZA-86	6306	762,190.9	225,046.9	1.2	II	AREA B
GZA-86	6307	761,734.8	224,561.2	7.4	II	BACKGROUND
GZA-86	6308	762,053.6	224,040.7	1.1	II	BACKGROUND
GZA-86	6309	762,226.5	223,586.9	1.1	II	BACKGROUND
GZA-86	6310	762,603.5	223,541.4	6.7	II	BACKGROUND
GZA-86	6311	762,717.5	223,062.2	1.0	II	BACKGROUND
GZA-86	6312	763,231.0	223,096.0	5.7	II	BACKGROUND
GZA-86	6314	763,683.3	222,602.7	7.2	II	BACKGROUND
GZA-86	6315	763,346.9	222,130.8	5.6	II	BACKGROUND
GZA-86	6316	763,816.4	222,142.5	2.9	II	BACKGROUND
GZA-86	6317	763,463.6	221,696.0	3.9	II	BACKGROUND
GZA-86	6318	763,299.7	221,088.3	0.3	II	BACKGROUND
GZA-86	6319	763,761.3	221,118.8	0.5	II	BACKGROUND
GZA-86	AF274	762,085.8	226,994.8	2.6	II	BACKGROUND
GZA-86	AF212	761,557.6	226,485.1	2.2	II	BACKGROUND
GZA-86	AF213	761,330.4	226,382.3	9.2	II	BACKGROUND
GZA-86	AF214	761,105.4	225,975.8	10.1	II	AREA B
GZA-86	AF279	763,719.1	221,540.3	2.2	II	BACKGROUND
GZA-86	AF275	761,664.1	224,967.3	2.2	II	AREA B
GZA-86	AE537	763,006.1	228,013.9	ND	II	BACKGROUND
GZA-86	AE541	762,841.1	227,607.4	ND	II	BACKGROUND
GZA-86	AE225	763,873.2	221,237.7	ND	II	BACKGROUND
DUXBURY	11	762,178.6	224,566.0	55.3	II	AREA B
DUXBURY	12	769,681.0	227,048.7	1.0	II	BACKGROUND

SEDIMENT PCB DATA FROM THE BATTELLE AND GZA SAMPLING PROGRAMS
(cont'd)

Sampling Program	Sample No.	Location x (ft)	Location y (ft)	PCB Conc. (ppm)	Fishing Closure Area	Target Remedial Area
DUXBURY	14	766,915.7	220,753.0	4.8	II	BACKGROUND
DUXBURY	15	768,846.5	216,414.3	0.3	II	BACKGROUND
DUXBURY	16	765,749.7	213,760.3	28.5	II	AREA C
DUXBURY	17	758,598.6	214,824.1	1.4	II	BACKGROUND
DUXBURY	18	771,794.4	208,236.9	0.2	II	BACKGROUND
DUXBURY	19	758,002.3	201,863.7	0.2	III	BACKGROUND
DUXBURY	21	783,270.1	208,627.8	0.0	III	N/A
DUXBURY	22	781,526.3	188,470.9	0.0	N/A	N/A
DUXBURY	23	754,681.3	186,658.2	0.0	N/A	N/A
DUXBURY	24	764,554.5	178,425.5	0.0	N/A	N/A
DUXBURY	25	770,709.9	169,359.6	0.0	N/A	N/A
DUXBURY	12	765,975.9	224,693.9	0.2	II	BACKGROUND
DUXBURY	*16*	*765,598.5*	*213,658.0*	*135.3*	II	AREA C
DUXBURY	18	771,717.6	208,337.5	0.6	III	BACKGROUND
DUXBURY	21	783,345.3	208,729.6	0.0	N/A	N/A
DUXBURY	24	768,062.9	177,438.2	0.1	N/A	N/A
DUXBURY	11	762,254.6	224,566.5	0.5	II	AREA B
DUXBURY	18	771,718.4	208,236.3	0.6	III	BACKGROUND
DUXBURY	21	783,347.7	208,426.0	0.0	N/A	N/A
DUXBURY	24	765,177.0	176,506.6	0.0	N/A	N/A
DUXBURY	12	765,823.3	224,794.0	0.8	II	BACKGROUND
DUXBURY	16	765,978.4	213,660.7	6.1	II	AREA C
DUXBURY	18	772,100.7	207,935.4	0.5	III	BACKGROUND
DUXBURY	21	783,802.9	208,530.8	0.4	N/A	N/A
DUXBURY	24	767,683.1	177,334.3	0.0	N/A	N/A

APPENDIX B

SEDIMENT PCB DISTRIBUTIONS IN UPPER BUZZARDS BAY

TABLE 4-4

HUMAN HEALTH TARGET CLEAN-UP LEVELS FOR SEDIMENT
FOR THE ESTUARY, LOWER HARBOR AND BAY
(Direct Contact and Incidental Ingestion)

	NON-CARCINOGENIC HAZARD INDEX	NON-CARCINOGENIC HAZARD INDEX	INCREMENTAL CANCER RISK
	0.2[a]	1[b]	10^{-5}[c]
PCBs	--	--	10 mg/kg
Cadmium	60 mg/kg	300 mg/kg	--
Copper	4,400 mg/kg	22,000 mg/kg	--
Lead	15 mg/kg	80 mg/kg	--

a) Massachusetts Department of Environmental Protection (MADEP) criteria for total site noncarcinogenic risk. The longer-term Health Advisory for PCBs of 0.0001 (mg/kg-day) was used to estimate noncarcinogenic risk.

b) EPA criteria for noncarcinogenic risk.

c) MADEP criteria for total site carcinogenic risk; midpoint of EPA target risk range (10^{-6} to 10^{-4}). The cancer potency factor for PCBs of 7.7 $(mg/kg\text{-}day)^{-1}$ was used to estimate carcinogenic risk.

Adapted from Ebasco (1990c)

level from direct contact and incidental ingestion exposure to PCB-contaminated sediments. This result was within the EPA target risk range of 10^{-6} to 10^{-4}.

TCLs were also established for the metals cadmium, copper and lead for protection against non-carcinogenic health hazards (Ebasco, 1990c). It should be noted that including the oral route of exposure (ingestion) in the development of TCLs has a significant effect on the target concentration because the contaminant exposure dose incurred through ingestion of sediment is generally considered greater than the contaminant dose incurred through dermal contact with sediments. It should also be noted that the TCLs for the protection of human health were developed for shoreline sediments since exposure to mid-channel sediments was not considered likely. TCLs were generally based upon "most probable" exposure scenarios.

As indicated, Table 4-4 also presents TCLs which were developed (Ebasco, 1990c) to conform with the guidelines of the Massachusetts Contingency Plan (MCP). As indicated in the MCP, the total site cancer risk should be compared to an incremental cancer risk limit of 1 in 100,000 ($1x10^{-5}$). The total site noncarcinogenic risk should be compared to a risk limit represented by an hazard index (HI) equal to 0.2. It should be noted that the MCP guidelines differ somewhat from those established in the National Contingency Plan (40 CFR Part 300). NCP guidelines indicate that site risks should be compared to incremental cancer risk range limits of $1x10^{-6}$ (1 in 1,000,000) to $1x10^{-4}$ (1 in 10,000). For noncarcinogenic risks, NCP guidelines indicate that site risks should be compared to a risk limit represented by a hazard index (HI) equal to 1.0.

Target clean-up levels for human health for the ingestion of biota are presented in Table 4-5. The edible tissue TCL for biota required to achieve a $1x10^{-5}$ incremental risk level due to the ingestion of PCB contaminated biota is 0.02 mg/kg (ppm). Similarly, an incremental risk of $1x10^{-4}$ corresponds to an edible fish tissue PCB concentration of 0.2 mg/kg (ppm) for specific chronic (70 year) exposure assumptions. It should be noted that the TCLs derived for lead are based on a water column MCL for lead (Ebasco, 1990c).

It should be recognized that the TCL for PCBs in biota (Table 4-5) differs from the current FDA tolerance level of 2 ppm for residues of PCBs in fish and shellfish. These differences stem, in part, from the fact that the FDA levels are intended as national standards which assume that not all of an exposed person's diet is from the contaminated food source and not all of the contaminated food source contains PCB concentrations at the tolerance level.

TABLE 4-5

EDIBLE TISSUE LEVELS IN BIOTA
FOR PROTECTION OF HUMAN HEALTH
FOR THE ESTUARY, LOWER HARBOR AND BAY

	NON-CARCINOGENIC HAZARD INDEX	NON-CARCINOGENIC HAZARD INDEX	INCREMENTAL CANCER RISK
	0.2[a]	1[b]	10^{-5}[c]
PCBs	0.2 mg/kg	1 mg/kg	0.02 mg/kg
Lead	0.26[d] mg/kg	1.3[d] mg/kg	--

a) Massachusetts Department of Environmental Protection (MADEP) criteria for total site noncarcinogenic risk. The longer-term Health Advisory for PCBs of 0.0001 (mg/kg-day) was used to estimate noncarcinogenic risk.

b) EPA criteria for noncarcinogenic risk.

c) MADEP criteria for total site carcinogenic risk; midpoint of EPA target risk range (10^{-6} to 10^{-4}). The cancer potency factor for PCBs of 7.7 $(mg/kg\text{-}day)^{-1}$ was used to estimate carcinogenic risk.

d) The proposed MCL for lead (0.005 mg/L) was converted to units of (mg/kg-day) and used to established TCLs.

Adapted from Ebasco (1990c)

4.4.2 Ecologically Based Target Clean-Up Levels

Ecologically based TCLs for PCBs in water and sediment were developed for the Estuary, Lower Harbor and Bay portions of the New Bedford Harbor site (Ebasco, 1990c) and were based on achieving acceptable residual contaminant concentrations in view of the risks summarized in Section 3.0 and the Ecological Risk Assessment (Ebasco, 1990b). These ecologically based TCLs are discussed in the following subsections.

4.4.2.1 Water Column TCLs

For surface waters at the New Bedford Harbor site, ecologically based target clean-up levels were based upon the chronic AWQC (Ebasco, 1990c). These criteria were established by EPA and are set at levels considered protective of aquatic receptors and/or their uses. For the contaminants of concern at New Bedford Harbor site, the surface water TCLs are as follows:

Contaminant	Chronic AWQC
PCBs	0.03 ug/L
Cadmium	9.3 ug/L
Copper	2.9 ug/L
Lead	5.6 ug/L

PCB concentrations in surface water in the Estuary and Lower Harbor have been frequently detected in excess of these criteria. It should be noted (see Section 2.0) that available information indicates that water column PCB concentrations at certain locations in the Upper Buzzards Bay portion of the site also fall above the AWQC level for PCBs.

Mean water column concentrations for the metals (cadmium, copper, and lead) generally meet the respective chronic AWQC values indicated above throughout the New Bedford Harbor site. Some slight exceedances of the AWQC for copper (2.9 ug/l) have been noted for certain portions of the site. For Upper Buzzards Bay, available information indicates that water column concentrations are within the chronic AWQC levels for the metals.

4.4.2.2 Sediment TCLs

The development of TCLs for the protection of aquatic biota from contaminated sediment is somewhat more difficult than for surface water. No final Sediment Quality Criteria (SQC) values have been established by EPA, and as discussed in Section 3.0, numerous approaches and methodologies have been developed in recent years. As part of the overall Ecological Risk Assessment (Ebasco, 1990b) summarized in Section 3.0, several different methods of evaluating sediment quality were examined as to their implications for contamination levels in New Bedford Harbor. In addition to the joint probability analysis (Section 3.0), other approaches included the following:

Sediment Quality Criteria (SQC) - SQC values are sediment contaminant threshold values derived from AWQC values by back calculating potentially acceptable sediment concentrations using a partitioning coefficient (K_{oc}) normalized for site specific organic carbon content. As indicated in Table 4-6 an interim SQC value has been developed for PCBs.

NOAA Sediment Target Levels - NOAA has developed sediment target levels for PCBs. The NOAA target levels were based, in part, on observed relationships between sediment and biota PCB concentrations considered in conjunction with toxicological effects data. As indicated in Table 4-6, the NOAA sediment PCB target levels have been expressed as a range of 0.1 - 1.0 mg/kg.

The development of ecologically based sediment PCB TCLs for the Estuary, Lower Harbor and Bay (Ebasco, 1990c) was based in part, upon the results of the Ecological Risk Assessment (Ebasco, 1990b) considered in conjunction with the results of certain additional methods of evaluating sediment quality. Additional sediment evaluation approaches which were considered included; Apparent Effects Thresholds (AET), and Screening Level Concentrations (SLC) and Sediment Quality Triad (SQT).

These multiple evaluation methods were used to estimate sediment PCB concentrations which would be potentially protective of biota in New Bedford Harbor. Depending upon the particular methodology and the site specific assumptions (particularly sediment total organic carbon contents) which are utilized, a range of slightly different PCB-TCL values may be calculated for the New Bedford Harbor site. Overall, the results of the various methodologies which were examined (Ebasco, 1990c) suggested a potentially protective range of sediment PCB-TCL levels of generally less than 10 ppm with the results of most evaluation methods suggesting TCL values around or significantly below 1.0 ppm PCBs. From the multiple sediment evaluation approaches used, it was concluded that sediment PCB concentrations which were likely to be protective of aquatic resources at the New Bedford Harbor site were in the general range of 0.01 - 1.0 ppm PCB (Ebasco, 1990c).

A sediment PCB target clean-up level for the protection of aquatic biota of 0.1 to 1.0 ppm was subsequently recommended for the New Bedford Harbor site (Ebasco, 1990c). Establishment of a sediment target clean-up level within this range was considered to be protective of most marine organisms within the site area.

TABLE 4-6

SELECTED ECOLOGICAL EFFECTS GUIDELINES

MEDIA	GUIDELINE	LEVEL	REPRESENTATIVE UPPER BAY CONCENTRATION
WATER	Ambient Water Quality Criteria (AWQC)	Chronic PCB AWQC = 0.03 ug/l	• Zone 4 Water Column = 2.1 ug/l • Zone 5 Water Column = 0.7 ug/l
SEDIMENT	Interim Sediment Quality Criteria (SQC)	Carbon Normalized(1) = 0.42 ug/g (ppm) 95% Confidence Interval(1) = 0.083 ug/g (ppm)	• Contaminated Sediments > 10 mg/kg • Background (Approximate) 1-2 mg/kg Fishing Closure Area II <1 mg/kg Fishing Closure Area III
SEDIMENT	NOAA - Sediment Target Level	0.1 - 1.0 mg/kg (ppm) PCB	• Contaminated Sediments > 10 mg/kg • Background (Approximate) 1-2 mg/kg Fishing Closure Area II <1 mg/kg Fishing Closure Area III

Notes

(1) Based on assumed 1% Total Organic Carbon for Outer Harbor sediments

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4.5 REMEDIAL ACTION LEVELS

Based upon a consideration of the target cleanup levels and remedial response objectives developed for the Estuary and Lower Harbor/Bay (Ebasco, 1990c), EPA has proposed a 50 ppm PCB remedial action level (action level) for the New Bedford site as presented in its January 1992 Proposed Plan (EPA, 1992). In addition, to evaluate the potential effects of reducing the role of the localized areas of PCB contaminated sediment on biota in Upper Buzzards Bay, EPA has requested examination of clean-up measures beyond the 50 ppm sediment remedial action level presented in the January 1992 Proposed Plan (EPA, 1992). Specifically, EPA has requested evaluation of a 10 ppm remedial action level for PCBs in the Upper Bay. In this section, the implications of a 10 ppm remedial action level for PCBs in the Upper Bay are examined with respect to the Human Health and Ecological Risk Assessment results (Ebasco, 1989b and 1990b) and the target cleanup levels summarized in Section 4.3.

4.5.1 Human Health and a 10 ppm Remedial Action Level for the Upper Bay

Remediation of contaminated sediment areas of the Upper Bay portion of the New Bedford Harbor site to a sediment PCB remedial action level of 10 ppm would help to ensure that an incremental cancer risks for direct contact with or incidental ingestion of PCB contaminated shoreline sediment would remain lower than the $5x10^{-5}$ level associated with the 50 ppm remedial action level proposed for the Estuary and Lower Harbor (EPA, 1992). It should, however, be noted that the contaminated sediment areas currently identified for possible remediation to 10 ppm in the Upper Bay are offshore and, therefore, are not realistically accessible for human exposure from direct contact.

It is anticipated that even in the absence of remediation of Upper Bay contaminated sediments to a PCB action level of 10 ppm, estimated incremental cancer risk levels due to direct contact with or ingestion of shoreline sediments would remain within the EPA target risk range of 10^{-6} to 10^{-4}. This conclusion assumes that future Upper Bay shoreline sediment PCB concentrations do not significantly increase from the levels (less than 10 ppm) utilized in the Human Health Risk Assessment (Ebasco, 1989b).

<u>Biota</u>

Remediation of Upper Bay sediments to a 10 ppm action level for PCBs may reduce PCB concentrations in biota in this region (see Area II in Figure 3-2) and result in a reduction in the estimated carcinogenic risks for chronic exposure as summarized in Section 3.1.2. However, due to the complexity of PCB contaminated sediment-biota interactions, considerable uncertainty exists concerning the magnitude of possible PCB reductions in biota of concern (lobster, winter flounder, clams, etc.). Available information, including the effectiveness calculations summarized in Section 4.5.2.2, suggest that even following remediation of Upper Bay sediments to a 10 ppm action level, the EPA target risk range of 10^{-6} to 10^{-4} will probably not be achieved for ingestion of all of the principal biota of concern.

In the absence of remediation of sediments to a 10 ppm action level, estimates from the Battelle Model indicate that PCB levels in certain biota in the Upper Bay may gradually drop below the 2 ppm PCB limit established by FDA. It is, however, uncertain as to whether remediation of Upper Bay sediments to a 10 ppm action level would significantly hasten this process.

4.5.2 Ecological Risks and the 10 ppm Remedial Action Level

The 10 ppm PCB remedial action level under evaluation for the Upper Bay exceeds the 0.1 - 1.0 ppm target cleanup level (TCL) recommended for the protection of aquatic biota in the 1990 FS (Ebasco 1990c) by at least an order of magnitude. The 10 ppm action level would, however, represent a factor of five reduction in the maximum sediment PCB concentration which biota in the Upper Bay might theoretically be exposed to as compared to the site-wide 50 ppm PCB action level presented in EPA's proposed plan (EPA, 1992). It should also be noted that implementation of a 10 ppm action level in the Upper Bay is likely to leave residual sediment PCB levels of significantly less than 10 ppm. A 10 ppm action level may therefore, result in greater protection for aquatic biota in the Upper Bay.

4.5.2.1 Consideration of a 1 ppm Remedial Action Level for Upper Buzzards Bay

Available information on sediment PCB concentrations (Section 2.0) indicates that "background" PCB levels in the Upper Bay portions of the New Bedford Harbor site (Figure 3-2) may approach the upper (1.0 ppm) limit of the 0.1 - 1.0 ppm sediment PCB target clean-up range considered potentially protective from an environmental perspective and are therefore already below the 10 ppm action level under evaluation. At locations in Buzzards Bay further removed from New Bedford Harbor itself (Area 3 and beyond in Figure 3-2), "background" sediment PCB concentrations tend to decrease below 1.0 ppm.

As indicated in Section 2.0, maximum sediment PCB concentrations in the more contaminated areas of the Upper Bay may exceed 10 ppm. In addition, sediment PCB concentrations in certain portions of these areas exceed 50 ppm. For these areas, sediment PCB concentrations exceed the recommended ecologically based TCL levels by at least an order of magnitude.

Based upon the sediment PCB data presented in Section 2.0, achieving a sediment PCB action level of 1 ppm may be infeasible for the Upper Bay given the potentially widespread low level distribution of PCBs in this area. As indicated, sediment PCB concentrations throughout many areas in the Upper Bay appear likely to equal or exceed 1.0 ppm PCBs.

Achieving a 1-ppm action level in the Upper Bay through removal actions would require additional dredging and produce sediment volumes far in excess of the amounts of contaminated material that would be generated for remediation of more highly contaminated areas such as those associated with a 10 ppm sediment PCB action level. Preliminary estimates suggest that within Fishing Closure Area II of the Upper Bay, contaminated surficial sediment areas (>1 ppm) requiring remediation may exceed 1,000 acres.

4.5.2.2 Trustees Evaluation of the Environmental Effectiveness of Bay Remediation to a 10 ppm Sediment PCB Remedial Action Level

The results of the hydrodynamic/sediment transport model developed for the New Bedford Harbor Buzzards Bay system (Battelle, 1990) indicate that remediation of the Estuary and Lower Harbor portions of the New Bedford Harbor site should significantly reduce the PCB flux through the Hurricane Barrier. This reduction is, however, not predicted to necessarily have a major impact on the existing PCB levels in biota in Upper Buzzards Bay. Modeling results suggest that PCB cycling in the Upper Bay is more likely to be dominated by localized sediment/water/biota interactions within the Upper Bay region rather than the flux of PCBs through the Hurricane Barrier.

The Trustees have performed a quantitative evaluation of the potential benefits resulting from remediation of sediments in the Upper Buzzards Bay to a 10 ppm sediment PCB remedial action level (NOAA, 1992). In developing this quantitative modeling approach, NOAA assumed that PCB levels in biota from Upper Buzzards Bay were directly related to the sediment PCB levels and that Upper Bay sediments were the predominant source of PCBs for biota in this region. Quantitative estimates of the magnitude of potential changes in relative PCB exposures to organisms residing in contaminated areas were developed using area weighted average PCB concentrations in sediment. The same sediment PCB concentration data set presented for Upper Buzzards Bay in Section 2.0 was used in this analysis. Surficial sediment concentrations within PCB contaminated subareas and "background" areas were individually averaged to determine changes in average concentrations across the entire study area before and after sediment remediation.

The results of the Trustees modeling effort suggests that remediation of the Upper Bay areas (Area II and Areas II and III combined) to a 10 ppm action level may have somewhat limited impacts on PCB levels in biota in the overall Upper Bay region. Results of exposure model calculations suggest that 18% and 13% reductions in relative exposures (based on arithmetic mean values) might be expected in Area II and Areas II and III combined following remediation of the three sediment areas identified in Section 2.0 to a 10 ppm PCB action level.

Due to the sensitivity of the Trustees model calculations to certain input assumptions, some uncertainty should be considered inherent in the model's quantitative predictions. Among the factors which may ultimately influence model predictions and their applicability to biological uptake of PCBs in the Upper Bay are the following:

- The frequency and extent of actual biological exposure to individual areas proposed for remediation.
- The mechanisms responsible for introducing PCBs into biota from sediments.
- Uncertainties relating to the actual extent of sediment areas containing greater than 10 ppm PCBs and assumptions and statistical methods used for calculation of background sediment PCB concentrations based on the current limited data set.

The limited magnitude of the predicted reduction in relative exposure levels is considered to reflect, in part, the relatively limited PCB fluxes anticipated from the small total surface area of the locations proposed for remediation as compared to PCB fluxes from much larger total area of the Upper Bay.

In this regard, it should be noted that uncertainties in the estimated total acreage of Upper Bay sediments exceeding 10 ppm PCBs combined with uncertainties in the actual PCB concentrations within these areas could significantly affect model results. Should the actual area of Upper Bay sediments exceeding 10 ppm PCBs significantly exceed current estimates, then the predicted ecological effectiveness of remediation efforts would increase.

5.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section presents the development of the target remedial areas and contaminated sediment volumes in the Upper Bay considered for potential cleanup. This section also identifies the remedial technologies used to assemble the removal and nonremoval remedial alternatives evaluated in Section 6.0. This Supplemental Feasibility Study does not specifically identify and evaluate remedial technologies, but rather uses the technologies from the 1990 Feasibility (Ebasco, 1990a) where appropriate to assemble a range of remedial alternatives.

5.1 DEVELOPMENT OF REMEDIAL AREAS AND VOLUMES

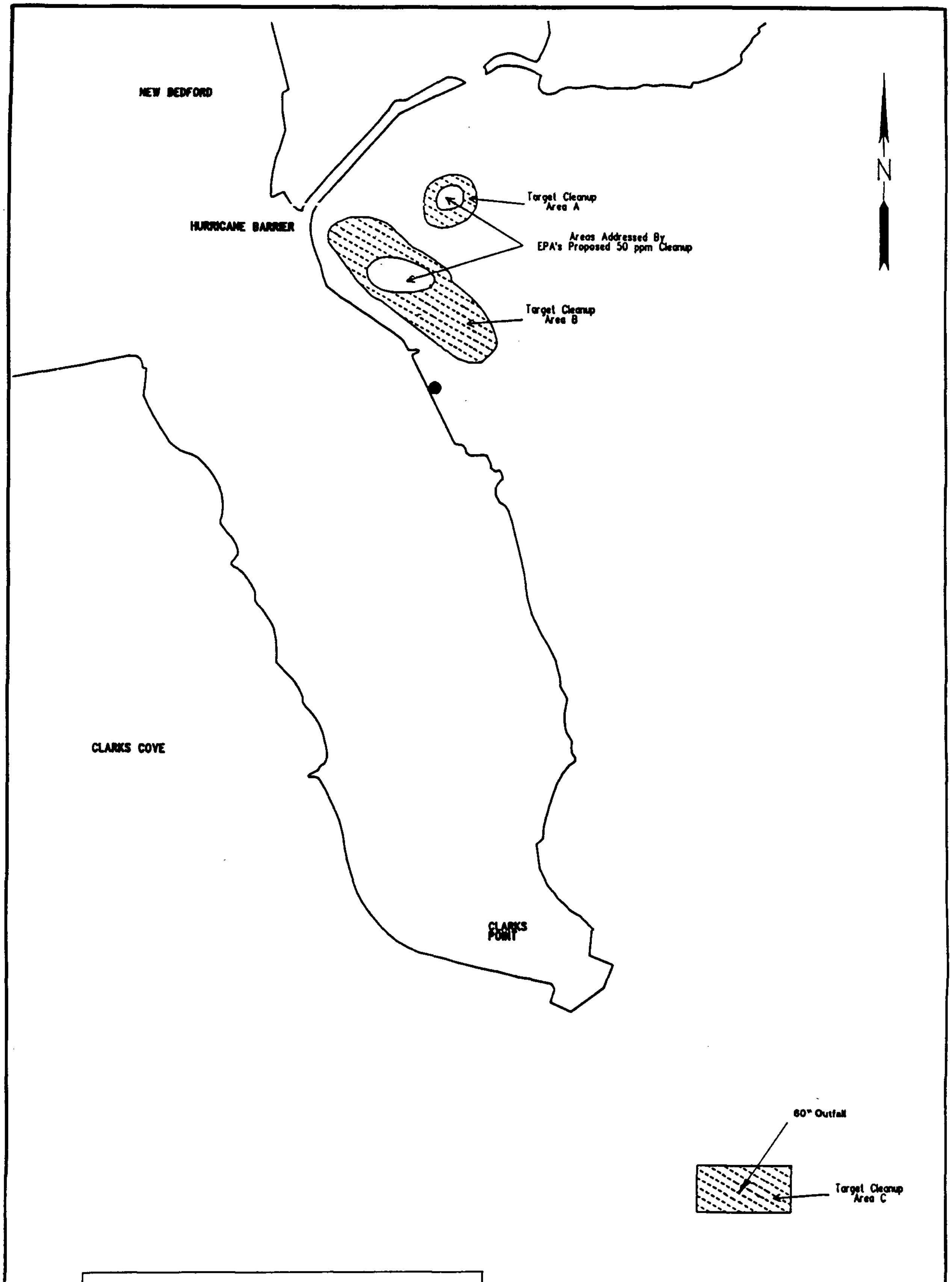
5.1.1 Remedial Volumes and Areas

The sediment PCB data from the GZA and Battelle data sets were used to define the target remedial areas in Upper Buzzards Bay. These areas in turn were used to develop remedial sediment volumes for removal purposes and delineate areas for capping. Figure 5-1 presents the Target Clean-up areas based on these two data sets. The individual and combined acreage of the three areas are presented in Table 5-1.

The contaminated sediment removal depths indicated in Table 5-1 were based on both the PCB distribution and the type of equipment that could be used to remove the sediment while minimizing sediment resuspension and contaminant migration at each location. Although the sediment PCB contamination in each of the target areas is generally confined to the top 12 inches, engineering considerations based on the types of dredges anticipated for use governed the removal depths. Additional information on the dredging (removal) equipment and selected depth for each location is presented in Section 6.2.2.

5.1.2 Scoping of the Predesign Sediment Sampling Program

The sum total of sediment PCB distribution data available for Upper Buzzards Bay includes more than the Battelle and GZA data sets. However, this larger data set is comprised of a compilation with data of unknown quality that was collected by a number of organizations over the last 15 years or so. Therefore, it was not explicitly used in establishing the nature and extent of contamination in Section 2.2. It was however, used to scope a conceptual predesign sediment PCB sampling program. The historical data was evaluated in a qualitative manner to develop an estimate of acres potentially exceeding 10 ppm in Upper Buzzards Bay (Figure 5-2). The total acreage of the nine areas in Figure 5-2 exceeds



LEGEND:

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APPROXIMATE SCALE IN FEET

FIGURE 5-1

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

TARGET CLEANUP AREAS
AT 10 ppm PCB
IN UPPER BUZZARDS BAY

EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

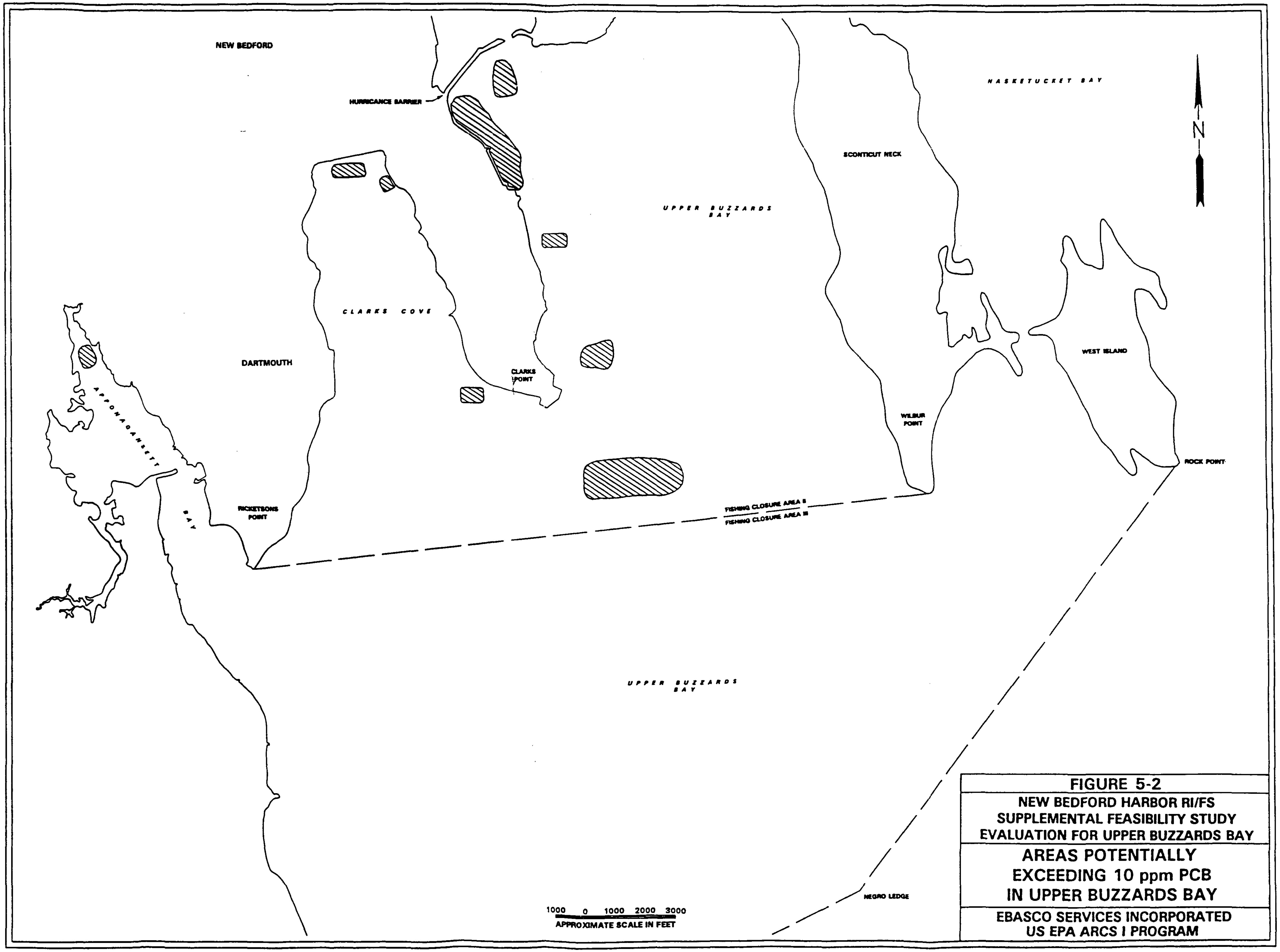

FIGURE 5-2
NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

AREAS POTENTIALLY EXCEEDING 10 ppm PCB IN UPPER BUZZARDS BAY

EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

TABLE 5-1

UPPER BUZZARDS BAY
SUPPLEMENTAL FEASIBILITY STUDY EVALUATION
REMEDIAL AREAS AND VOLUMES FOR A 10 ppm PCB CLEANUP

Target Remedial Area (From Figure 5-1)	Size (Acres)	Removal Depth (ft)	Removal Volume (yd^3)
A	7	1	10,700
B	35	1	56,300
C	17	2	53,300
TOTALS	59	NA*	120,300

* Not Applicable

250 acres. A large scale copy of this map is provided in Appendix E. Based on these areas, a conceptual PCB sediment predesign sampling program was developed for use with the remedial alternatives.

The conceptual PCB sampling program includes PCB and TOC measurements at approximately 350 sampling stations throughout the Upper Bay with approximately 300 of these in the areas of potential concern. The samples would be collected to evaluate the PCB and TOC distributions in the top six inches of all locations and a second sample at depth from select locations. A smaller number of samples would also be evaluated for grain size distribution to assist in any subsequent engineering evaluations.

A less rigorous version of this program was developed to support the Minimal No-Action Alternative. Details of this confirmational sampling program and the predesign program are provided in Appendix D.

5.2 REMEDIAL ALTERNATIVES

The remedial alternatives evaluated in Section 6.0 were generally assembled with the technologies originally retained for detailed analysis in the 1990 Feasibility Study. The only exceptions were the elimination of Contained Aquatic Disposal (CAD), the selection of a representative sediment treatment process and the addition of a clamshell dredge (Figure 5-3). The CAD technique is similar to subaqueous capping, but involves an additional step of handling the contaminated sediment. While both techniques would be effective in isolating the PCB contaminated sediment in the Upper Bay, the implementability issues associated with additional sediment handling during CAD operations, eliminated the technique from further consideration. For sediment treatment, an innovative technology was selected based on the results of site specific bench scale studies. These studies indicated the process would be effective for treating sediment contaminated with PCBs at concentrations found in the Upper Bay. This process would also reduce the mobility and volume of the PCBs.

The dredging technology which has been added to the list of technologies was a mechanical clamshell. This dredge would be used to remove sediment in the vicinity of the 60 inch Outfall. A small hydraulic cutterhead dredge would not be effective in contaminant removal in the 30 plus feet of water at this location.

The technologies were assembled to form a range of remedial alternatives. This range included a variety of response actions such as; removal, nonremoval, and combinations thereof. In addition, the range includes a removal alternative with treatment,

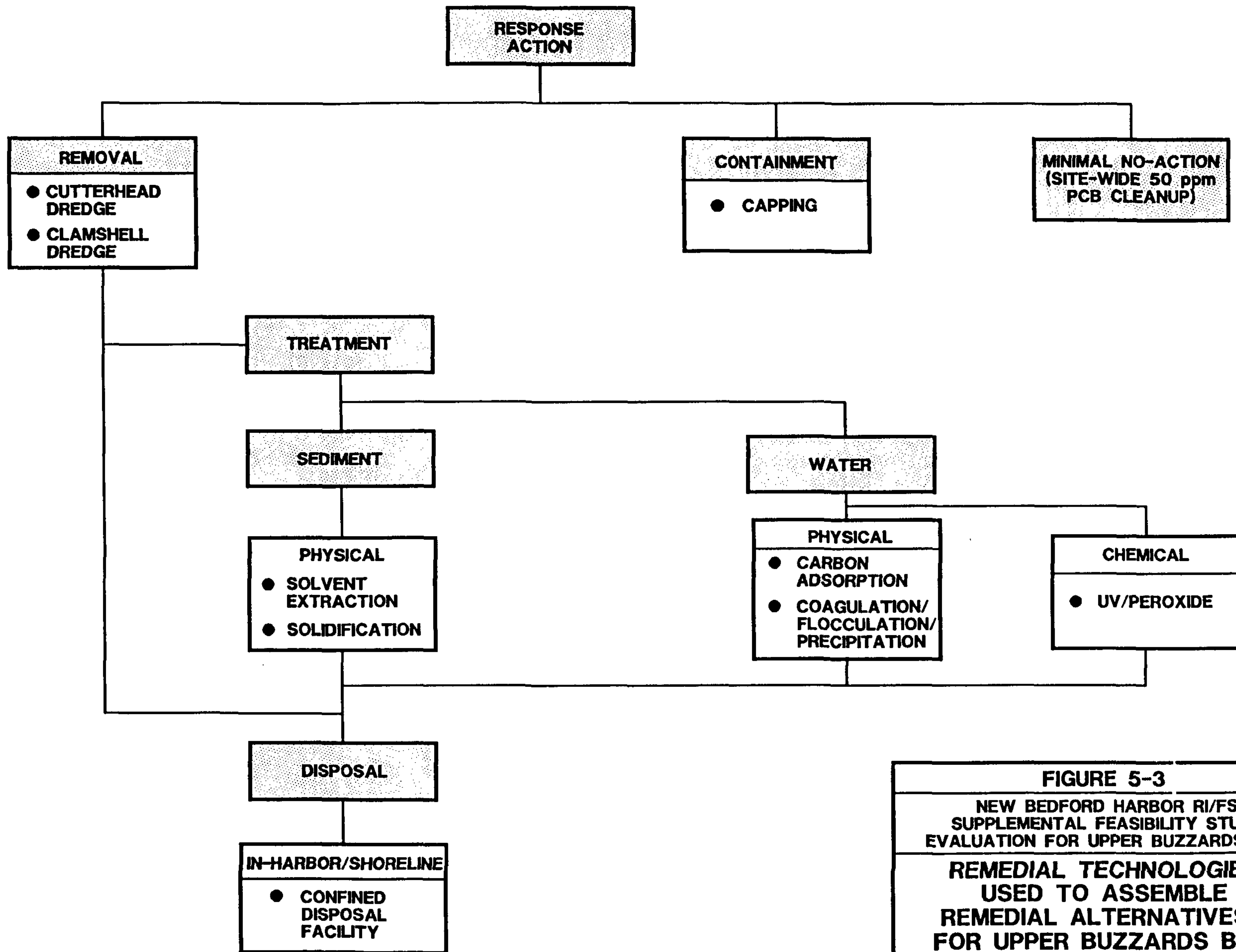

FIGURE 5-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

REMEDIAL TECHNOLOGIES
USED TO ASSEMBLE
REMEDIAL ALTERNATIVES
FOR UPPER BUZZARDS BAY

EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

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and a no-action alternative. The no-action alternative for this evaluation is a Minimal No-Action Alternative that consists of EPA's proposed 50 ppm PCB site-wide cleanup. The resulting five remedial alternatives are presented in Table 5-2.

TABLE 5-2

GENERAL DESCRIPTION OF REMEDIAL ALTERNATIVES FOR UPPER BUZZARDS BAY

ALTERNATIVE	GENERAL DESCRIPTION
BAY-1	Minimal No-Action - EPA's Proposed Site-Wide 50 ppm PCB cleanup
BAY-2	Dredging with Shoreline Disposal in a CDF
BAY-3	Capping
BAY-4	Capping and Dredging with Shoreline Disposal
BAY-5	Dredging and Treatment with Shoreline Disposal

TABLE 5-1

UPPER BUZZARDS BAY
SUPPLEMENTAL FEASIBILITY STUDY EVALUATION
REMEDIAL AREAS AND VOLUMES FOR A 10 ppm PCB CLEANUP

Target Remedial Area (From Figure 5-1)	Size (Acres)	Removal Depth (ft)	Removal Volume (yd^3)
A	7	1	10,700
B	35	1	56,300
C	17	2	53,300
TOTALS	59	NA*	120,300

* Not Applicable

250 acres. A large scale copy of this map is provided in Appendix E. Based on these areas, a conceptual PCB sediment predesign sampling program was developed for use with the remedial alternatives.

The conceptual PCB sampling program includes PCB and TOC measurements at approximately 350 sampling stations throughout the Upper Bay with approximately 300 of these in the areas of potential concern. The samples would be collected to evaluate the PCB and TOC distributions in the top six inches of all locations and a second sample at depth from select locations. A smaller number of samples would also be evaluated for grain size distribution to assist in any subsequent engineering evaluations.

A less rigorous version of this program was developed to support the Minimal No-Action Alternative. Details of this confirmational sampling program and the predesign program are provided in Appendix D.

5.2 REMEDIAL ALTERNATIVES

The remedial alternatives evaluated in Section 6.0 were generally assembled with the technologies originally retained for detailed analysis in the 1990 Feasibility Study. The only exceptions were the elimination of Contained Aquatic Disposal (CAD), the selection of a representative sediment treatment process and the addition of a clamshell dredge (Figure 5-3). The CAD technique is similar to subaqueous capping, but involves an additional step of handling the contaminated sediment. While both techniques would be effective in isolating the PCB contaminated sediment in the Upper Bay, the implementability issues associated with additional sediment handling during CAD operations, eliminated the technique from further consideration. For sediment treatment, an innovative technology was selected based on the results of site specific bench scale studies. These studies indicated the process would be effective for treating sediment contaminated with PCBs at concentrations found in the Upper Bay. This process would also reduce the mobility and volume of the PCBs.

The dredging technology which has been added to the list of technologies was a mechanical clamshell. This dredge would be used to remove sediment in the vicinity of the 60 inch Outfall. A small hydraulic cutterhead dredge would not be effective in contaminant removal in the 30 plus feet of water at this location.

The technologies were assembled to form a range of remedial alternatives. This range included a variety of response actions such as; removal, nonremoval, and combinations thereof. In addition, the range includes a removal alternative with treatment,

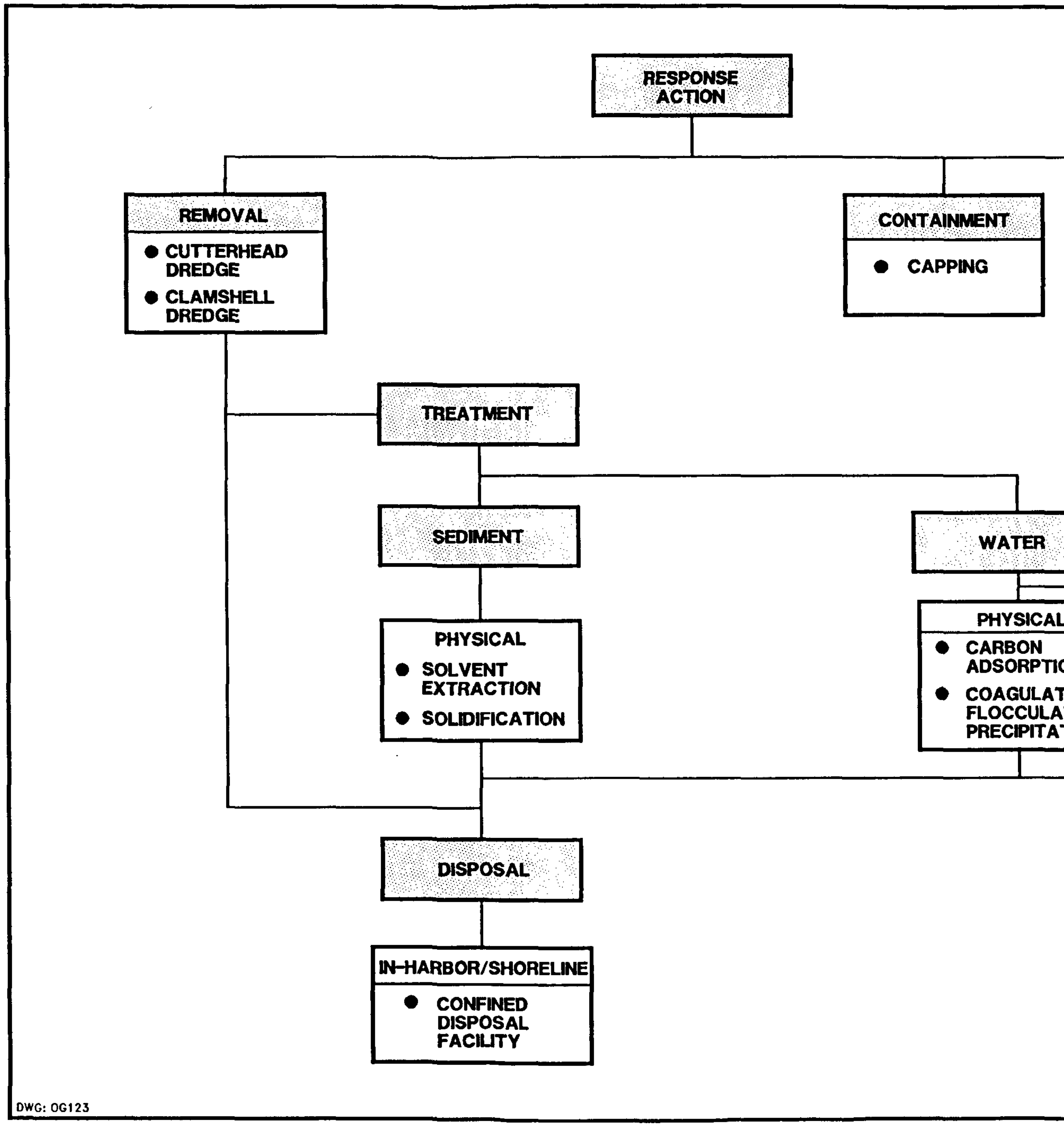


FIGURE 5-3

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

REMEDIAL TECHNOLOGIES USED TO ASSEMBLE REMEDIAL ALTERNATIVES FOR UPPER BUZZARDS BAY

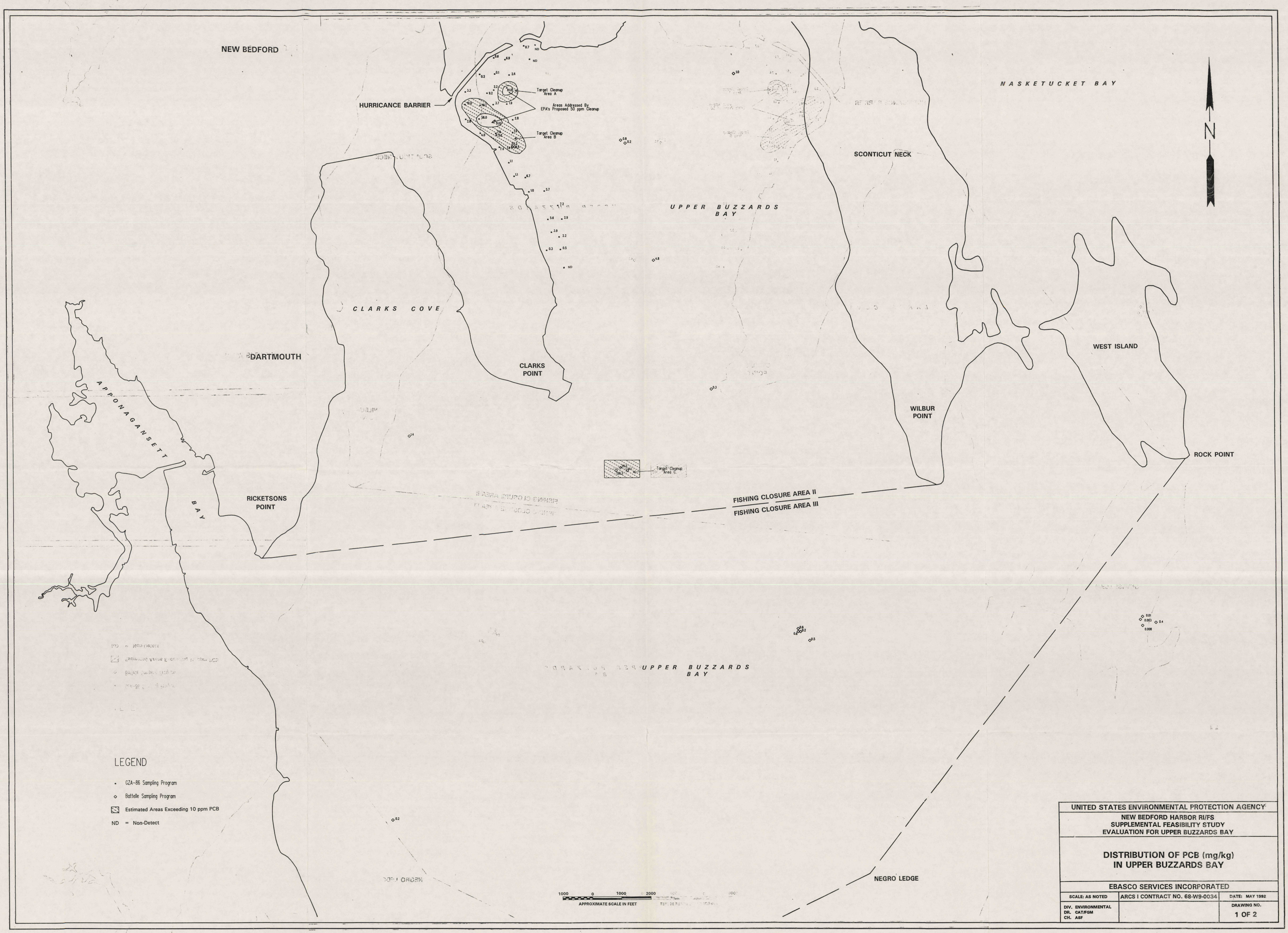
EBASCO SERVICES INCORPORATED
US EPA ARCS I PROGRAM

and a no-action alternative. The no-action alternative for this evaluation is a Minimal No-Action Alternative that consists of EPA's proposed 50 ppm PCB site-wide cleanup. The resulting five remedial alternatives are presented in Table 5-2.

TABLE 5-2

GENERAL DESCRIPTION OF REMEDIAL ALTERNATIVES
FOR UPPER BUZZARDS BAY

ALTERNATIVE	GENERAL DESCRIPTION
BAY-1	Minimal No-Action - EPA's Proposed Site-Wide 50 ppm PCB cleanup
BAY-2	Dredging with Shoreline Disposal in a CDF
BAY-3	Capping
BAY-4	Capping and Dredging with Shoreline Disposal
BAY-5	Dredging and Treatment with Shoreline Disposal



NEW BEDFORD
HURRICANE BARRIER
Target Cleanup Area A
Areas Addressed By EPA's Proposed 50 ppm Cleanup
Target Cleanup Area B
NASKETUCKET BAY
N
SCONTICUT NECK
UPPER BUZZARDS BAY
CLARKS COVE
DARTMOUTH
APPONAGANSETT BAY
CLARKS POINT
WEST ISLAND
WILBUR POINT
ROCK POINT
Target Cleanup Area C
RICKETSONS POINT
FISHING CLOSURE AREA II
FISHING CLOSURE AREA III
UPPER BUZZARDS BAY
LEGEND
GZA-86 Sampling Program
Battelle Sampling Program
Estimated Areas Exceeding 10 ppm PCB
ND = Non-Detect
NEGRO LEDGE
1000 0 1000 2000
APPROXIMATE SCALE IN FEET
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY
DISTRIBUTION OF PCB (mg/kg)
IN UPPER BUZZARDS BAY
EBASCO SERVICES INCORPORATED
SCALE: AS NOTED
ARCS I CONTRACT NO. 68-W9-0034
DATE: MAY 1992
DIV. ENVIRONMENTAL
DR. CAT/FGM
CH. ASF
DRAWING NO.
1 OF 2

CALCOMP - BOND
CALCOMP - BOND
CALCOMP - BOND

APPENDIX C

SEDIMENT TOC AND GRAIN SIZE DATA FROM THE BATTELLE SAMPLING PROGRAM FOR UPPER BUZZARDS BAY

SEDIMENT TOC AND GRAIN SIZE DATA FROM THE BATTELLE SAMPLING PROGRAM FOR UPPER BUZZARDS BAY

New Bedford Harbor Database Sediment Total Organic Carbon and Grain Sizes

North of Hurricane Barrier

Cru	Sta	Med	Dep	TOC (mg/g)	% SAND		% SILT		% CLAY	
1	01	B	01	59.1000	28.56		5.61		65.83	
1	01	B	01	74.6000	23.81		3.32		72.88	
1	02	B	01	70.9000	14.43		38.25		47.32	
1	02	B	01	89.3000	37.23		47.81		14.96	
1	03	B	01	12.5000	76.32		2.58	J	21.10	
1	03	B	01	26.5000	82.80		1.40	J	15.80	
1	04	B	01	65.5000	8.17		6.38		85.10	
1	04	B	01	77.8000	3.55		18.68		75.42	
1	05	B	01	2.2000	83.96		2.21	J	15.02	
1	05	B	01	7.6000	95.75		5.78		5.20	
1	06	B	01	76.1000	21.56		4.02	J	79.31	
1	06	B	01	69.0850	18.68		64.66		16.65	
1	07	B	01	54.3000	17.49		42.22		40.29	
1	07	B	01	163.1000	14.88		19.53		61.20	
1	08	B	01	73.5000	7.95		31.48		60.48	
1	08	B	01	60.2000	12.06		12.08		75.86	
1	09	B	01	14.8000	68.29		1.89		29.82	
1	09	B	01	19.9000	69.76		15.38		14.55	
1	10	B	01	1.4700	97.76		0.08	J	2.16	

South of Hurricane Barrier

Cru	Sta	Med	Dep	TOC (mg/g)	% SAND		% SILT		% CLAY	
1	11	B	01	19.0000	70.65		0.56	J	28.80	
1	11	B	01	19.0000	30.51		60.92	J	3.71	J
1	13	B	01	3.5000	90.79		0.67	J	8.54	
1	13	B	01	29.3000	73.24		3.71		23.05	
1	14	B	01	28.0000	17.68		3.96		78.37	
1	14	B	01	25.9000	44.02		9.03		46.96	
1	15	B	01	10.7400	82.16		9.82		8.02	
1	15	B	01	6.6000	86.68		3.79		9.58	
1	16	B	01	44.6000	78.63		1.31	J	20.06	
1	16	B	01	3.2000	43.76		8.92	J	47.32	
1	17	B	01	5.7000	67.58		0.08		32.36	
1	17	B	01	4.4000	68.35		13.40		18.23	
1	18	B	01	16.6000	43.58		18.79		35.55	
1	18	B	01	16.0000	37.63		1.52		60.85	
1	19	B	01	24.6000	15.16		5.68	J	79.15	
1	19	B	01	25.5000	17.85		5.03	J	77.17	
1	20	B	01	23.5000	44.09		7.79	J	48.12	
1	21	B	01	3.5100	84.12		1.84		14.01	
1	21	B	01	2.8000	67.80		17.12		15.08	
1	23	B	01	11.4100	47.21		5.80	J	46.98	
1	24	B	01	20.0000	16.09		49.18	J	34.73	
1	24	B	01	18.6600	18.96		78.69	J	1.71	

KEY

Estuary = Stations 01 and 02

Lower Harbor = Stations 03 through 10

Upper Buzzards Bay = Stations 11 through 18; Stations 19 through 24 are in Buzzards Bay, but are not part of the NBH Superfund site

J = Estimated Value

APPENDIX D

PRE-DESIGN AND CONFIRMATIONAL SEDIMENT PCB SAMPLING PROGRAMS FOR UPPER BUZZARDS BAY

PRE-DESIGN AND CONFIRMATIONAL SEDIMENT PCB SAMPLING PROGRAMS

1.0 INTRODUCTION

This section presents the preliminary design of the PCB sediment sampling program which has been developed for implementation as part of remedial design (RD) programs to be undertaken in conjunction with remediation of contaminated sediments in Upper Buzzards Bay to a 10 ppm TCL. Also included is a preliminary description of a confirmational PCB sediment sampling program recommended for implementation should a Minimal No-Action Alternative be adopted by EPA for the Upper Bay.

2.0 PRE-DESIGN SAMPLING PROGRAM BASIS

The spatial coverages of the GZA and Battelle sediment PCB sampling programs, upon which extent of PCB contamination assessment and subsequent PCB contaminant sediment remedial volume calculations presented in the Supplemental Feasibility Study (SFS) are based; were relatively limited. Neither the GZA nor the Battelle sampling programs were designed to provide sediment PCB concentration data at the level of detail required to accurately assess all of the areas of the Upper Bay potentially containing greater than 10 ppm sediment PCB concentrations. In addition, in those areas where the results of the GZA and Battelle sampling programs indicated sediment PCB concentrations to be above 10 ppm, sampling frequencies were inadequate to accurately assess the spatial and vertical extent of contamination from a remedial design perspective.

2.1 SAMPLING LOCATIONS

The areas of the Upper Bay recommended for inclusion in the pre-design sediment sampling program discussed herein are presented in the attached Figure. As indicated, a total of nine areas are recommended for detailed sediment PCB sampling and analysis. Only three of the nine areas indicated in the attached Figure, have been included within the technical and engineering cost evaluations of the SFS; two areas off-shore of the Cornell-Dubilier facility and an area surrounding the City of New Bedford combined sewer outfall. Inclusion of each of these three areas in the SFS evaluation was based on results from either the GZA and/or Battelle sampling programs which indicated that sediment PCB concentrations in excess of 10 ppm were detected in one or more samples collected within these areas. The remaining six areas included for detailed sampling, have been selected based upon unvalidated results from one or more previous Upper Bay PCB sediment sampling programs indicating sediment PCB levels of 10 ppm or greater.

All of the nine areas recommended for additional sediment sampling lie within Fishing Closure Area II. Five of the nine locations (including the three locations included in the SFS) lie generally south of the Hurricane Barrier and to the east and south of Clark's Point. Three of the areas recommended for sampling lie within Clark's Cove with two of the areas located near the head of the Cove. The last of the nine areas recommended for sampling lies near the head of Apponagansett Bay.

It should be noted that several of the included sampling locations (for example in Clark's Cove) are in general proximity to possible shoreline sewer or drainage outfalls. Therefore the unvalidated data indicating elevated sediment PCB concentrations are considered plausible.

2.1.1 Background Samples

In addition, to the samples recommended for collection as part of the sampling grids in the areas of suspected PCB contamination, a limited number (approximately 45) samples are included for collection in "background" Upper Bay areas. The purpose of these samples would be to more accurately assess regional background levels of sediment PCB contamination. It is proposed that approximately 30 surficial sediment samples be collected within Upper Bay areas within Fishing Closure Area II and an additional 15 samples be collected within Fishing Closure Area III.

2.2 SAMPLING APPROACH

The sediment sampling grids depicted on the attached Figure for the Upper Bay areas of suspected contamination are based upon the collection of individual sediment samples at locations approximately 250 feet on center. This spacing is generally consistent with grid spacings generally utilized by the U.S. Army Corps of Engineers in the assessment of sediment dredging requirements. Based upon the sampling grids depicted in the attached Figure, approximately 275 surficial sediment samples should be collected for PCB analyses.

2.3.1 Sampling Depths

At each sampling location, surficial sediment samples should be collected using a sediment coring device capable of the collection of 2-ft cores. Samples from the 0-6" surface sediment fraction of each core and should be submitted for PCB analyses. In addition, samples from the 12"-18" depth fractions of each core should be archived for possible PCB analysis following evaluation of the results of the 0-6" fractions. Approximately 10 percent of all 12"-18" cores from samples collected at each of the nine areas are recommended for analysis. Preference would be given to the analysis of 12"-18" samples from cores where the 0-6" sample showed elevated PCB concentrations.

2.3.2 Sampling Methodology

As indicated in Section 3.2, sediment samples should be collected as 2-foot cores. Coring devices that are potentially appropriate for sample collection would include vibrating corers and/or hydraulically-damped gravity corers. A relatively shallow draft marine vessel with a 2-3 person sampling team is anticipated for the collection of most sediment cores.

2.3.3 Sediment Sample Analyses

Each sediment sample discussed in Section 3.0, should be analyzed for PCBs using Target Compound List (TCL) methods (Statement of Work 3/90) for PCBs or an analytical equivalent.

Each sediment sample which is analyzed for PCBs should also be analyzed for total organic carbon (TOC) using EPA Method 9060 or equivalent. The analysis of TOC is considered an important element in the overall evaluation of the bioavailability of sediment PCBs.

Finally, subsamples of approximately 10% of the sediment samples slated for PCB analysis and should be submitted separately for grain size analysis (including both sieve and hydrometer testing as appropriate). Grain size data is of importance as part of the geotechnical evaluations required to support remedial design efforts.

2.3.4 QA/QC Samples

As part of the sediment sampling program, appropriate QA/QC samples should be collected. *These should include field duplicates and* rinsate blanks as required.

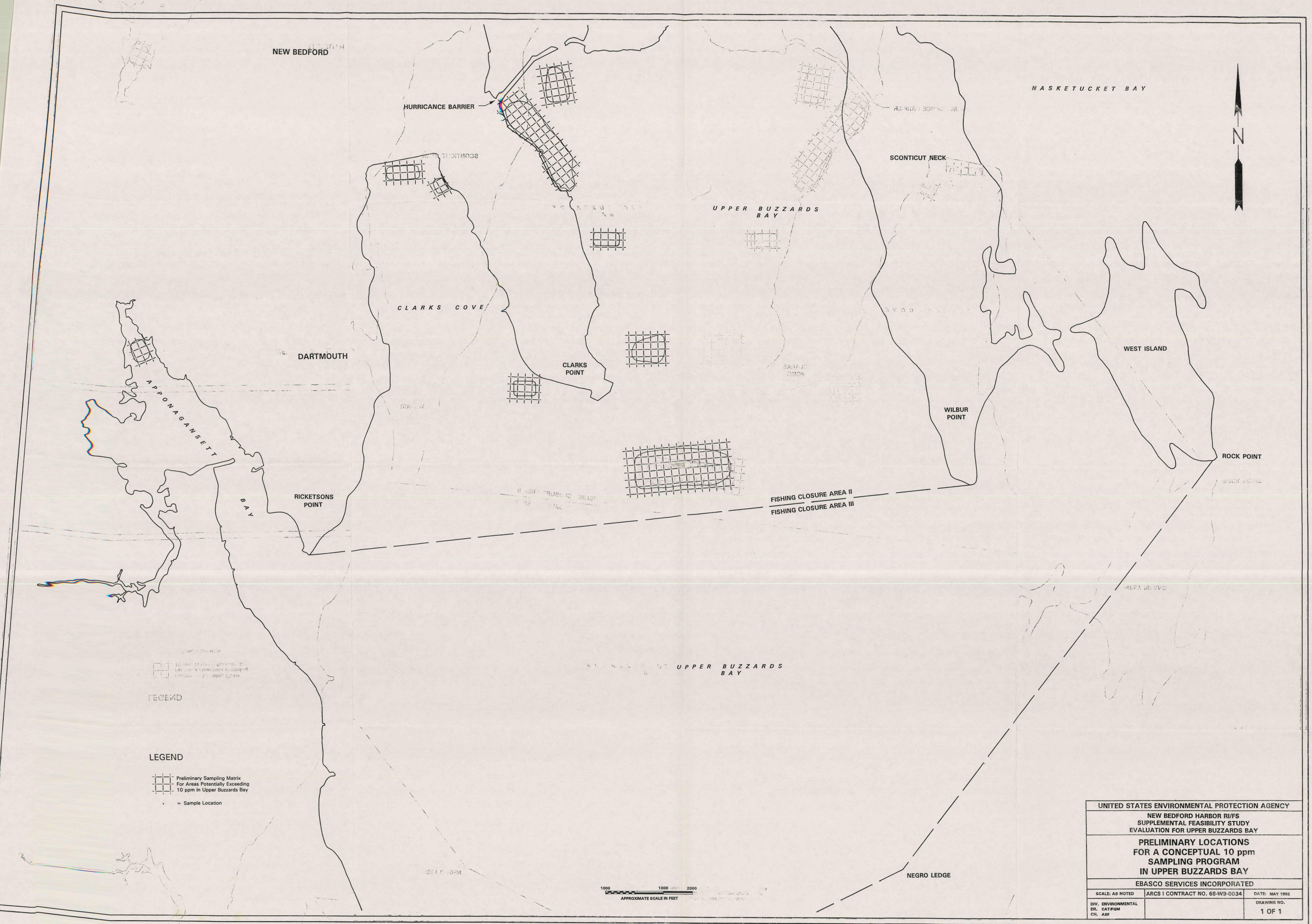
3.0 CONFIRMATIONAL SAMPLING PROGRAM

In the event that a Minimal No-Action Alternative is adopted for Upper Buzzards Bay, a confirmational sediment PCB sampling program should be implemented. The purpose of this program is to verify that the assumptions of the SFS and Feasibility Study for the Lower Harbor Estuary and Bay (Ebasco, 1990c) regarding the extent of PCB sediment contamination and associated impacts in Upper Buzzards Bay are accurate.

3.1 PROGRAM SCOPE

This confirmational sediment PCB sampling program is not intended to be as rigorous as the sampling program required to support remedial design efforts. For confirmational sampling, the collection of samples from locations approximately 500 ft on center is potentially adequate for the nine areas suspected of sediment PCB contamination. Overall, the confirmational sediment sampling program would involve the collection of approximately 138 surficial sediment samples for PCB analyses. A limited number of subsurface sediment samples (12" to 18") should be collected (approximately 10% of the surficial sediment samples). In addition, a total of approximately 25 "background" sediment samples should also be collected from Fishing Closure Areas II and III.

The methods of sample collection and analyses used in the confirmational program should be similar to those for the pre-design programs.



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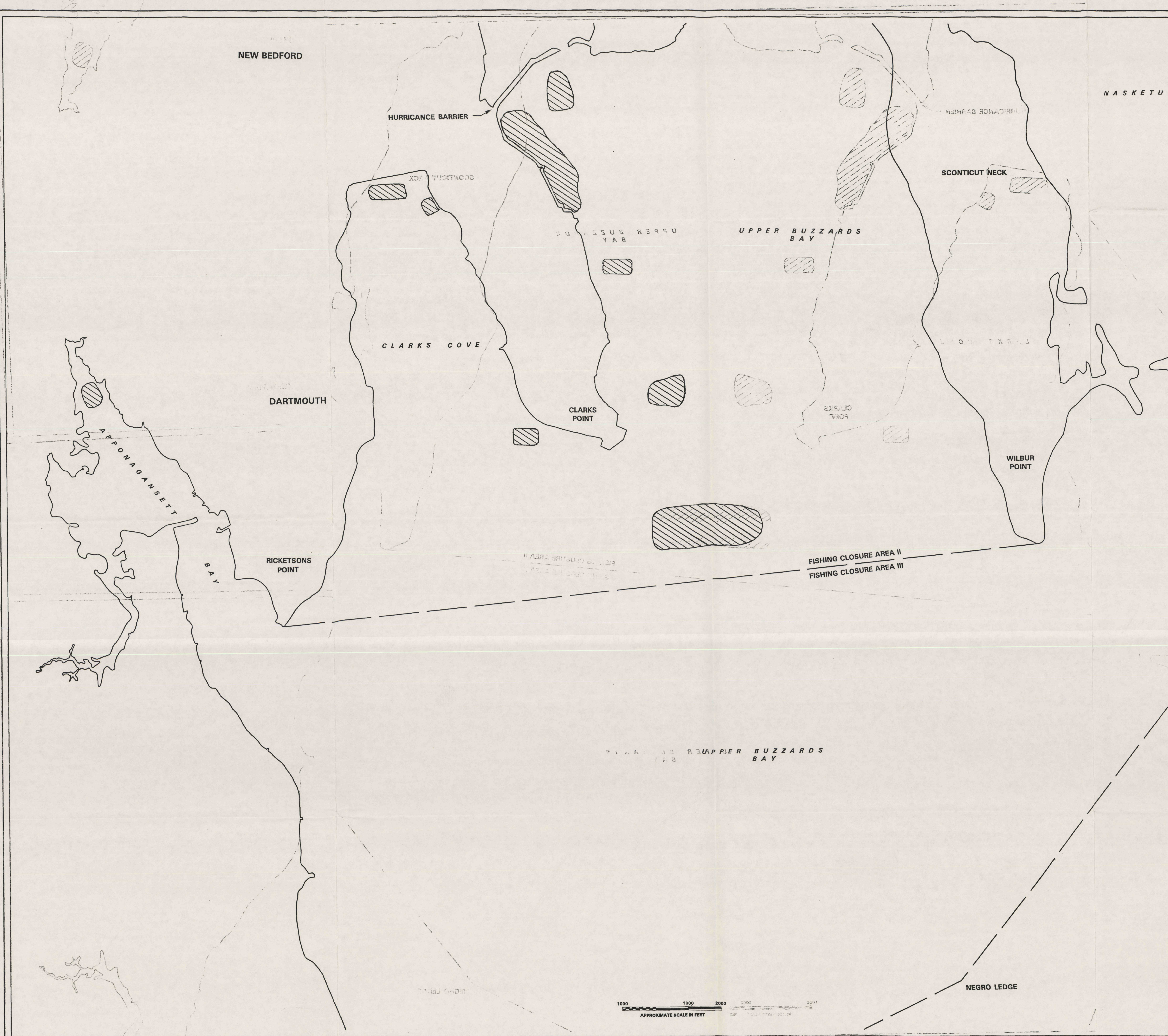
APPENDIX E

AREAS POTENTIALLY EXCEEDING 10 ppm PCB IN UPPER BUZZARDS BAY



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NEW BEDFORD HARBOR RI/FS
SUPPLEMENTAL FEASIBILITY STUDY
EVALUATION FOR UPPER BUZZARDS BAY

AREAS POTENTIALLY EXCEEDING 10 ppm PCB IN UPPER BUZZARDS BAY

EBASCO SERVICES INCORPORATED

SCALE: AS NOTED	ARCS I CONTRACT NO. 68-W9-0034	DATE: MAY 1992
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