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EXECUTIVE SUMMARY

DRAFT FEASIBILITY STUDY OF REMEDIAL ACTION ALTERNATIVES

ACUSHNET RIVER ESTUARY ABOVE COGGESHALL STREET BRIDGE NEW BEDFORD SITE BRISTOL COUNTY, MASSACHUSETTS

NUS PROJECT NO. 0725.16

AUGUST 1984

Superfund Records Center
SITE: New Bedford
BREAK: 4.6
OTHER: 222673

SDMS DocID 000222673

NUS CORPORATION

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Cliff Mine Road
Pittsburgh, PA 15275
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Authorization for Study

The United States Environmental Protection Agency (EPA), under authority promulgated by the Comprehensive Environmental Response, Compensation, and Liability Act (i.e., the Superfund Act), assigned the New Bedford Site in Bristol County, Massachusetts, to its National Priorities List of hazardous waste sites. The New Bedford Site was so assigned because the presence of polychlorinated biphenyls (PCBs) and other hazardous contaminants in the New Bedford Harbor pose a threat to public health, welfare, and the environment.

Under EPA Work Assignment No. 28-1L43, issued on August 24, 1983, the Remedial Planning Office of NUS Corporation (NUS) was authorized to prepare a Work Plan for a Remedial Investigation and Feasibility Study for the New Bedford Site. The Work Plan provided a detailed scope of work, cost estimate, and schedule to satisfy the overall objectives of the Remedial Investigation and Feasibility Study.

A critical element of the Work Plan was a fast-track Feasibility Study of remedial action alternatives for the highly contaminated mudflats and sediments of the Acushnet River Estuary north of the Coggeshall Street Bridge. This fast-track study was requested by the EPA and the Commonwealth of Massachusetts since the extremely high levels of PCBs and heavy metals in these locations (i.e., the "hot spots") are migrating from this area and appear to pose an immediate risk to public health, public welfare, and the environment. On October 18, 1983, NUS received interim authorization to proceed with the fast-track Feasibility Study.

Study Objectives

The objectives of the overall remedial action program for the hot-spot areas of the Acushnet River Estuary are the following:

- To decrease the risk to public health. The high levels of PCBs in the hot-spot areas currently pose a potential public health threat because of the possibility of direct contact with the contaminated mudflats and sediments, indirect uptake through the ingestion of contaminated fish and shellfish, and respiratory inhalation of PCBs in the volatile and particulate forms.

- To decrease the risk to aquatic and terrestrial organisms and resources. The animal and plant communities within the upper harbor have been heavily impacted by the high levels of contaminants, and will continue to be so until the contaminants are rendered unavailable to the food chain and plants.

- To decrease the risk of contaminant migration from the hot-spots to other areas. The progressive movement of contaminated sediments and surface waters out of the upper estuary into New Bedford Harbor and Buzzards Bay sustains the current water quality and related problems in these downstream water bodies.

The objective of the fast-track Feasibility Study is to evaluate potential alternatives for remediation of the hot-spot areas in relation to engineering feasibility criteria, environmental impacts, costs, and various other considerations, such as future risk, and community acceptability and impacts. No single alternative was found to be free of engineering constraints, adverse environmental effects, and potential community impacts. Therefore, several alternatives are developed in relation to the imposed evaluation criteria, so that the EPA, other involved Federal agencies, the Commonwealth of Massachusetts, and the affected communities can properly assess the alternative actions.

Sources of Information and Data

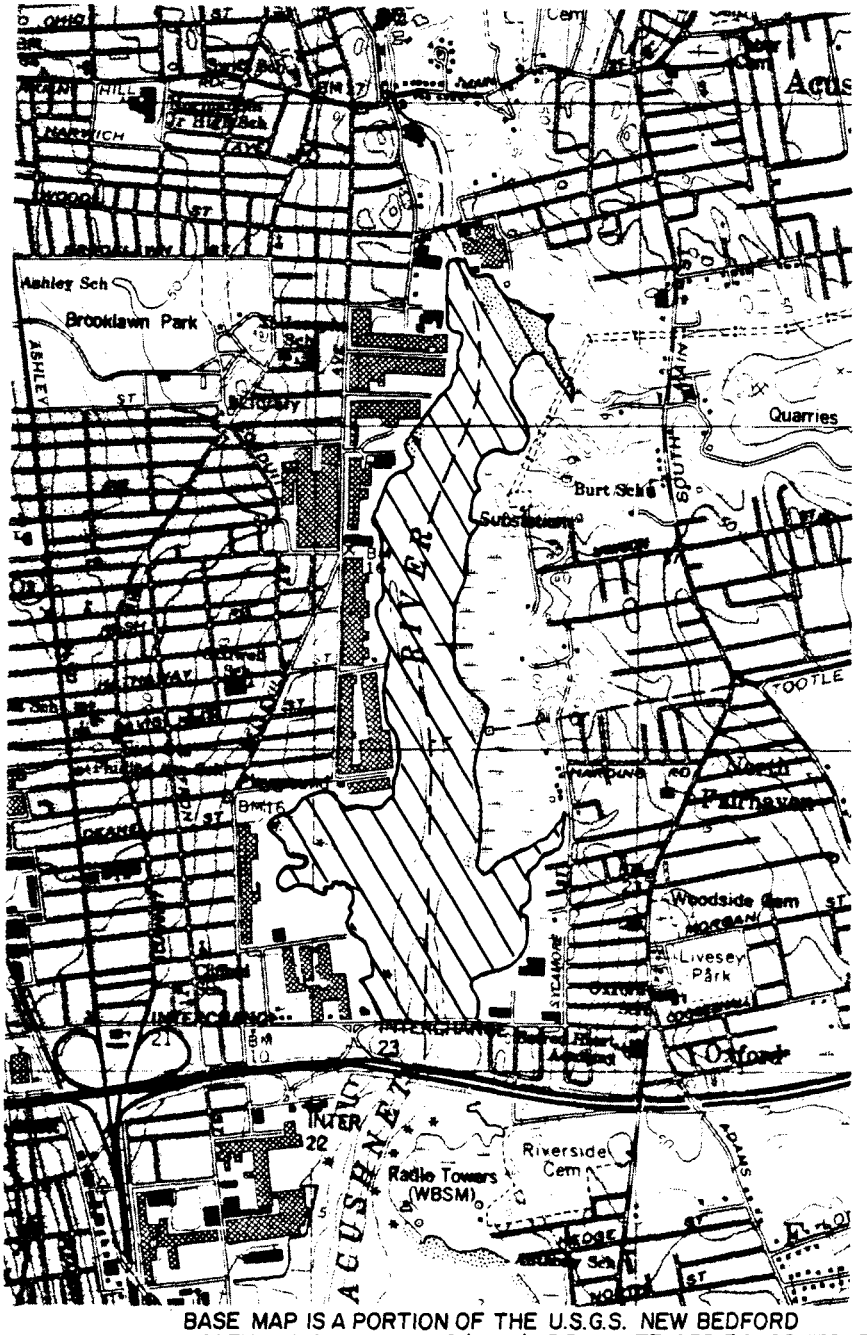
Because of the perceived urgency for remediation of the hot-spot areas, the fast-track Feasibility Study was to be based on the extensive informational base

currently available from previous engineering and scientific investigations and data collection efforts. Scores of studies related to the New Bedford Site have been completed and were reviewed during the course of this work. These range from particularly relevant investigations of potential remedial actions and data collection efforts to define the nature and extent of contamination, to more general studies of harbor development and regional resources. Although these studies did not focus on the hot-spot areas, most did provide some level of data or information used in the fast-track Feasibility Study. Numerous general references on PCBs and engineering issues were also used in the course of this study. Of particular note is a large collection of documents published by the Corps of Engineers as part of their ongoing research program on various aspects of dredging contaminated sediments.

The principal source of the chemical data used in the fast-track Feasibility Study was the data management system developed and managed by Metcalf and Eddy under a separate EPA contract. This chemical data base for the Acushnet River Estuary/New Bedford Harbor/Buzzards Bay system contains more than 5,000 individual data entries, representing approximately 3,700 PCB analyses and 1,400 analyses of other parameters, primarily heavy metals. The data base reflects the efforts of 21 data collecting agencies and 23 analytical labs over the past ten years. Almost all of the data contained in the file are from the Acushnet Estuary, New Bedford Harbor, and Buzzards Bay.

Project Setting

The study area for the fast-track Feasibility Study encompasses three geographical areas. The geographic focus is the hot-spot area itself, which for purposes of this study is considered to be the Acushnet River Estuary extending northward from the Coggeshall Street Bridge to the Tarkiln Hill Road Bridge (Figure 1). Of interest to the analysis of the problem and remedial actions are those areas currently affected by the presence of contaminants in the upper estuary. These areas include the remainder of New Bedford Harbor and Buzzards Bay, and the adjacent communities of New Bedford, Acushnet, and Fairhaven (Figure 2). A third geographic area,



BASE MAP IS A PORTION OF THE U.S.G.S. NEW BEDFORD NORTH, MA QUADRANGLE (1979), 7.5 MINUTE SERIES, CONTOUR INTERVAL 10'.

LEGEND

HOT SPOT AREA

(AS DEFINED FOR THIS STUDY)

FIGURE 1

HOT SPOT AREA

NEW BEDFORD SITE, NEW BEDFORD, MA

SCALE: 1" = 2000'

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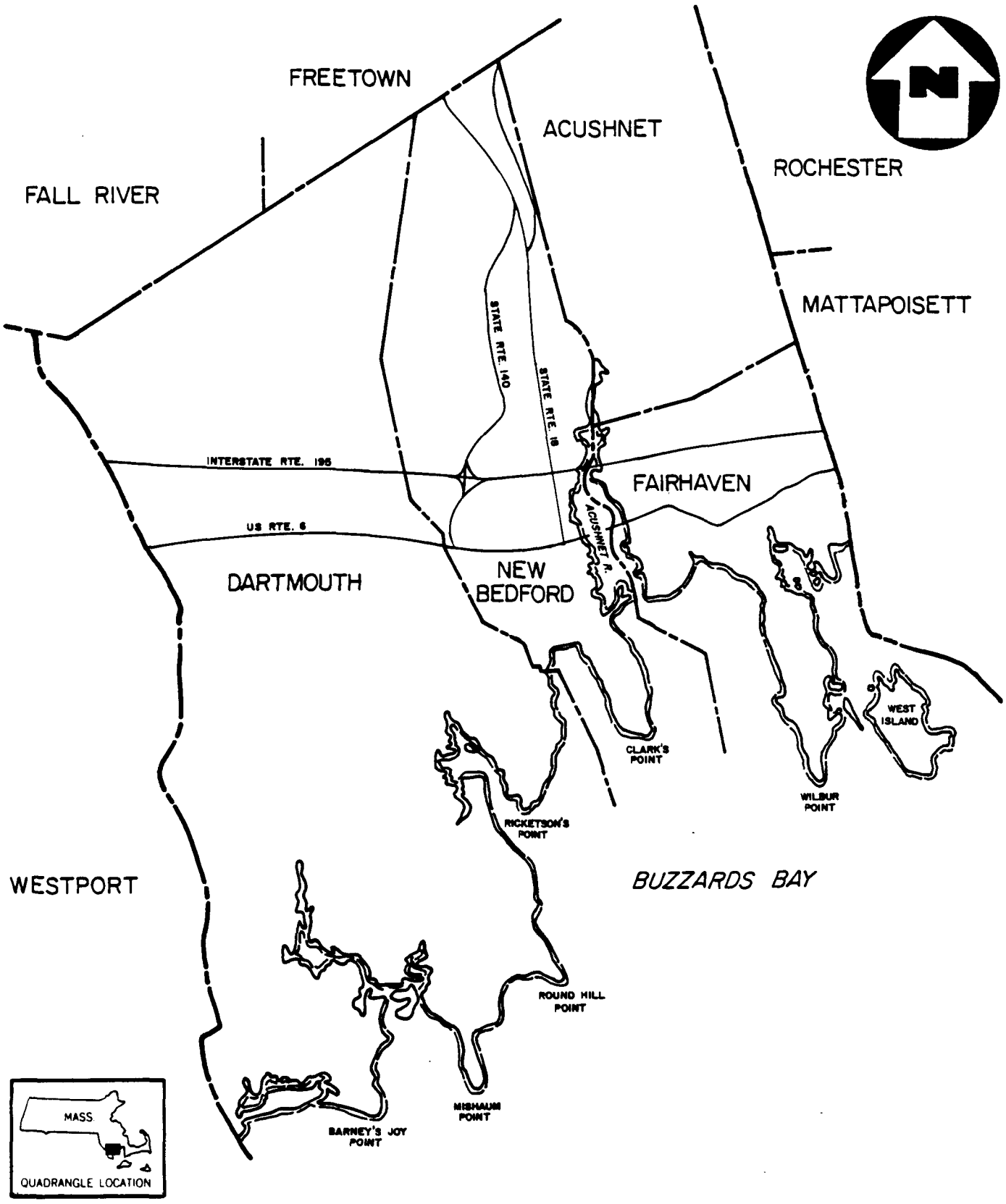

FIGURE 2

LIMITS OF STUDY AREA
NEW BEDFORD SITE, NEW BEDFORD, MA
SCALE: 1" = 2.2 MILES

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which includes the communities within an approximate 10-mile radius of New Bedford Harbor, is considered part of the study area only as it relates to the identification and analysis of potential disposal sites for contaminated sediments that would be dredged from the estuary under certain remedial action alternatives.

In 1929, the first of two major electrical component manufacturers, Cornell-Dubilier Electronics, began operation in New Bedford. The second, Aerovox Industries, Inc., began operation in the 1930's. These industries are housed in old textile mill houses located on the banks of the Acushnet River Estuary, and both remain in business today. Their use of PCBs in the manufacture of electronic capacitors has brought to the area a series of problems that were first documented by both academic researchers and the Federal Government between the years 1974 and 1976. The EPA conducted a New England-wide PCB survey and found high levels of the chemical in various harbor locations. Testing revealed that Aerovox and Cornell-Dubilier were discharging wastewaters containing PCBs to the estuary/harbor/bay system, both by direct discharge and through combined sewer overflows. Indirect discharges also occurred via the New Bedford municipal wastewater treatment facility and from surface water runoff.

Also, toxic heavy metals such as copper, chromium, zinc, and lead were released by metals manufacturing and textile dyeing operations over the past 80 years. The disposal of these wastes by industry has resulted in environmental contamination of the estuary and harbor.

Description of Contaminants

PCBs exhibit relatively unique physical and chemical properties. A description of PCBs will put both the problems and the subsequently developed remedial action alternatives in the proper perspective. PCBs belong to a broad family of organic chemicals known as chlorinated hydrocarbons. PCBs are produced by attaching chlorine molecules to a biphenyl molecule. The biphenyl molecule consists of two benzene rings and has a total of ten sites where chlorine atoms can be substituted for hydrogen atoms.

The industrial use of PCBs principally resulted from their chemical and thermal stability. The electrical industry took advantage of the relatively inert chemical behavior of PCBs and their excellent dielectric properties by utilizing PCBs in electrical capacitors, transformers, heat transfer systems, and hydraulic systems. PCBs are also fire resistant and have been used as flame retardants in a variety of products. Another use is as an additive to varnishes, waxes, sealants, glues, hydraulic fluids, lubricants, adhesives, and pesticides.

In New Bedford, PCBs have been used by Aerovox Industries, Inc., and Cornell-Dubilier Electronics, Inc., in the production of electronic capacitors. The usage of PCBs by New Bedford's industrial concerns peaked at about two million pounds per year during the years 1973, 1974, and 1975. Aroclor 1242 was the primary PCB used in New Bedford until 1971, when Aroclor 1016 became available for use in the manufacture of electronic capacitors. Aerovox and Cornell-Dubilier also used lesser quantities of two other Aroclors, 1254 and 1252. All use of PCBs in New Bedford stopped by 1978.

PCBs generally maintain their thermal and chemical stability when exposed to water or natural environmental conditions. They do not appreciably react with or solubilize in acids, alkalis, or water. On the other hand, PCBs can be readily soluble in a variety of organic solvents such as benzene, hydrocarbon oils, and certain alcohols.

PCBs are denser than water, and are strongly adsorbed onto suspended solids in an aquatic environment. As a result, PCBs are usually found at much higher concentrations in sediments than in the water column. A critical aspect of remedial action is therefore directed toward the control of sediment dispersal and transport, since PCBs will be concomitantly moved with the sediments to other locations and would be more susceptible to resolubilization where equilibrium conditions with the water have not been established. These same properties decrease the risk of acute or catastrophic releases of PCBs from engineered, controlled disposal sites.

A risk posed by PCBs bound in the sediments is their availability to the aquatic food chain. Because PCBs are persistent, stable chemicals, they tend to bioaccumulate in organisms as they are passed up through the trophic levels of the food chain, ultimately reaching fish and man. Through bioaccumulation, even low levels of PCB exposure in an uncontrolled environment can have serious environmental and public health consequences.

PCBs undergo limited volatilization under certain environmental conditions, and can also be released to the atmosphere adsorbed onto airborne particulates. These processes introduce an additional route of environmental exposure that can be controlled by proper containment of the contaminated sediments.

In addition to high PCB levels in the estuary and harbor sediments, data indicate that the sediments also contain significant concentrations of heavy metals resulting from industrial discharges. The principal metal contaminants are copper, chromium, lead, and zinc, although lower concentrations of other metals (e.g., cadmium) may pose a greater public health risk. Under existing conditions in the estuary and harbor, the metals are not significantly mobile. The anoxic, saline environment of the sediments favors the formation of insoluble metal sulfides. The affinity of the metals for adsorption onto the silty sediments also contributes to their immobilization.

The development of remedial actions must consider the potential for resolubilization of the metals. For example, long-term exposure of the metals to an oxidizing environment would oxidize the sulfides and release the metals. This would occur if oxygenated waters are brought into contact with the sediments for a period of time or if the sediments are allowed to dry in air.

Current Levels of Environmental Contamination

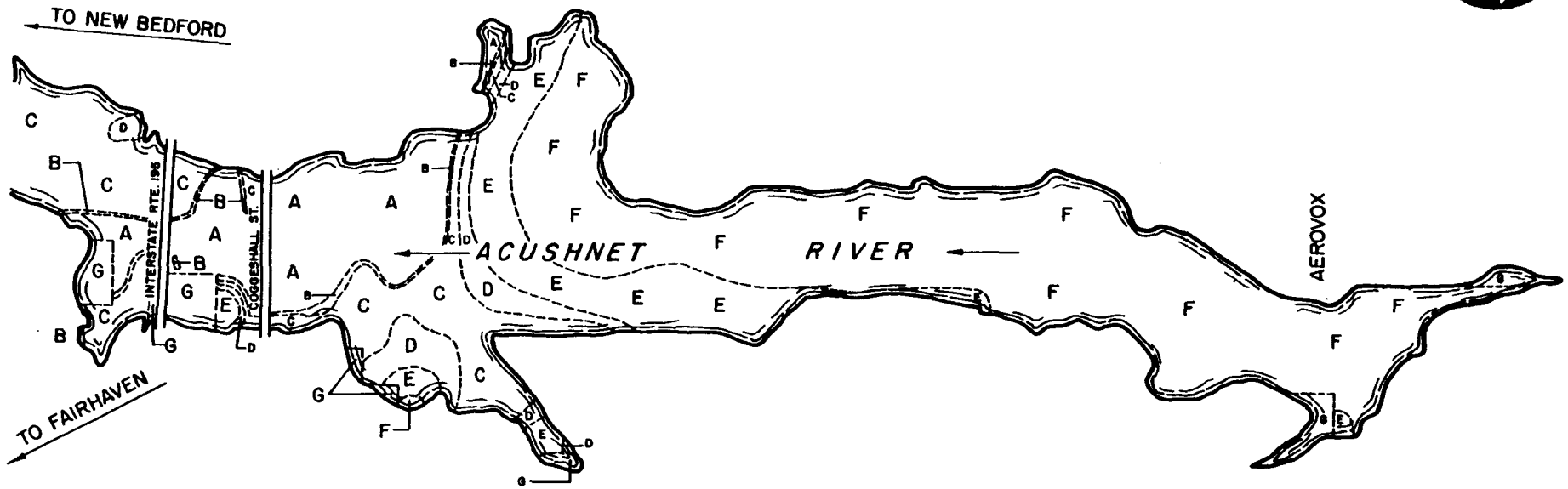
PCB and metal contamination has been found in several environmental media in the Acushnet River Estuary, including the biota, sediments, water and air. The biotic community of the Acushnet River Estuary and the overall harbor system has been

degraded by PCB and metal contamination. Closure of the estuary to all fishing by the Commonwealth of Massachusetts in September 1979 is one result of the contamination. Eels seem to be the most heavily contaminated species in the estuary. Tissue concentrations frequently exceed 500 parts per million (ppm) of PCB's. Lobsters are also heavily contaminated, with tissue concentrations often in excess of 50 ppm of PCB's. Median PCB concentrations for numerous species of finfish are also well above the recently lowered FDA action level of 2 ppm, which is the maximum PCB concentration considered safe for human consumption.

The most severe sediment contamination within the study area is the western and northern parts of the estuary, where PCB concentrations typically exceed 1,000 ppm (dry weight) and have been found to exceed 100,000 ppm in localized areas. These sediment PCB concentrations are shown in Figure 3. Elevated concentrations of toxic metals are also found in the sediments, including copper (>1,000 ppm), arsenic (>50 ppm), lead (300-500 ppm), zinc (>600 ppm), mercury (>2.5 ppm), chromium (400-500 ppm), nickel (>150 ppm), and cadmium (>20 ppm).

The depth of contamination in the sediment also varies with location in the upper and lower harbor. The highest concentrations in the upper estuary are in the shallow sediments, 2-4 inches deep. This is probably because PCB discharge to the estuary was ended in 1977, and the most contaminated sediments have been covered by cleaner sediments since then. Very little contamination has been observed at sediment depths greater than 2-3 feet.

In the short term, concentrations of PCBs in the water column and air are not as significant of a concern, but are elevated compared to background values. These media represent a continued long term source of contamination to the food chain and ambient atmosphere, respectively.



KEY TO CONCENTRATIONS (ppm dry wt.)

A - BELOW 2	E - 100 TO 500
B - 2 TO 10	F - ABOVE 500
C - 10 TO 50	G - UNDEFINED
D - 50 TO 100	

0 1000 2000

SCALE IN FEET

FIGURE 3

SEDIMENT PCB CONCENTRATIONS - ACUSHNET RIVER ESTUARY
NEW BEDFORD SITE, NEW BEDFORD, MA

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Overview of Methodology

The fast-track Feasibility Study for the New Bedford Site was conducted using a multilevel screening and evaluation process. Two levels of technology screening were carried out prior to the development and evaluation of remedial action alternatives. This approach was followed in order to select only the most feasible technologies for incorporation into the remedial action scenarios and thereby minimize the number of potential alternatives to be considered in the detailed cost-effectiveness evaluation.

The objective of the initial screening of technologies was the elimination of all technologies that are either infeasible or inappropriate to the problem under study. According to the National Contingency Plan, only established technologies should be relied upon when feasible and cost-effective (NCP 300.61(c)(4)). A principal criterion for elimination was, therefore, that only proven technologies should be considered for the remediation of the hot-spot areas. The other principal criterion was that the technology be applicable to the specific conditions in the upper estuary. This, for example, would eliminate technologies that apply only to PCB-contaminated transformer oils and not PCB-contaminated sediments.

The technologies remaining after the initial screening then entered a secondary level of screening. The objective of this phase of the study was to compare and evaluate individual technologies within each technology grouping (e.g., dredging, treatment, etc.) in order to retain only the most feasible technology for each grouping. The criteria used to evaluate the technologies in the secondary screening were specific to each grouping, and included cost and effectiveness measures.

The potential remedial action alternatives were developed as various combinations of the remaining technologies. Although the number of potential combinations is large, most were eliminated since they did not satisfy the established minimum cost-effectiveness criteria. The selected alternatives then underwent a detailed cost-effectiveness analysis. The most cost-effective alternatives for the remediation of the hot-spot areas in the Acushnet River Estuary were subsequently

identified and recommended, with due consideration given to the health risks and environmental impacts that would be eliminated or reduced by the remedial action and those that would be created or aggravated by the action.

Initial Screening of Remedial Action Technologies

The purpose of the initial screening was to identify and assess all existing technologies applicable to the remediation of PCB contamination, and to eliminate those technologies that are not technically feasible for the problem and the local conditions involved or that do not have a proven performance record in the application intended.

The identification and screening of technologies was based on an extensive review of the available literature; previous work completed at other PCB sites; direct contacts with process developers, manufacturers, etc.; meetings with EPA, State, and local officials; site visits; and discussions with experts in related disciplines.

The individual technologies identified for review can be organized into three general remedial action scenarios. The scenarios include the following:

- The no-action alternative (i.e., maintain the "as is" condition).

- Nonremoval actions, which involve technologies directed toward the reduction of contaminant risk without removing the contaminated material (i.e., the hot-spot sediments). An option under this category is the construction of hydraulic control structures to eliminate the transport of contaminants to New Bedford Harbor and Buzzards Bay, in possible conjunction with backfilling or capping the local sediments to reduce the public health and environmental risks. The other option is the in-situ treatment of the contaminated sediments by chemical fixation, biodegradation, or particle radiation.

- PCB removal actions that attempt to remediate the problem by taking actions only after the contaminants are removed from the source (i.e., from the estuary bottom). One option is to remove only the PCBs from the sediments using separation technologies, followed either by direct disposal in a controlled environment or by a PCB-destruction process. The available destruction processes include thermal destruction, chemical destruction, biodegradation, and particle radiation. The other type of removal action is to physically remove the contaminated sediments by excavation or dredging. Following removal, the sediments either can be directly disposed into a controlled environment, or can undergo various actions prior to disposal. The latter actions include PCB extraction followed by direct disposal or destruction, or a direct destruction of PCBs in the sediments. In either case, the treated sediments allow more flexibility in the disposal options, including their potential placement back into the estuary.

In addition to these remedial action technologies, several types of necessary support actions also had to be identified and evaluated. These include solids dewatering, sediment dispersal control, harbor dewatering, surface water control, and water treatment.

Even though each general category of alternatives (no action, nonremoval actions, and PCB removal actions) was retained, more than 60 percent of the individual options and technologies were eliminated in the initial screening process. All in-situ treatment technologies and PCB separation, removal, and extraction technologies were eliminated because they are still in the developmental or laboratory/pilot-scale stage and have not been demonstrated for the intended application. All but one of the PCB destruction technologies were eliminated either for the same reason or because they are not applicable to PCBs bound in a sediment matrix. The excavation options (dredging is not included in this category) for sediment removal were ruled out because the deep, unconsolidated sediment deposits will not provide adequate bearing support for equipment unless very costly support actions are implemented. Harbor dewatering was deemed inappropriate for

technical reasons, as was the use of a pipeline to convey the Acushnet River as a surface water control measure.

The potential remedial action alternatives and technologies that remained for consideration in the second phase of screening are summarized as follows:

- No-Action Alternative

- Non-Removal Actions: Hydraulic control using sheet piling or a bypass channel, in conjunction with in-situ containment of the contaminated sediments by capping with clean sediments or soil.

- PCB Removal Actions: Contaminated sediment removal by dredging with direct disposal or incineration before disposal into an upland landfill, a shoreline disposal site, or an existing, out-of-state chemical landfill.

- Support Actions: A reduced number of technologies for solids dewatering, sediment dispersal control, surface water control, and water treatment.

Secondary Screening of Remedial Action Technologies

In the initial screening of technologies, no consideration was given to a comparative evaluation of the technologies to determine the "most appropriate" among them. A secondary screening was therefore performed on the remaining technologies toward the objective of selecting only the most cost-effective technology in each grouping. The groupings requiring a secondary screening included the hydraulic control, solids dewatering, sediment dispersal, and sediment dredging technologies.

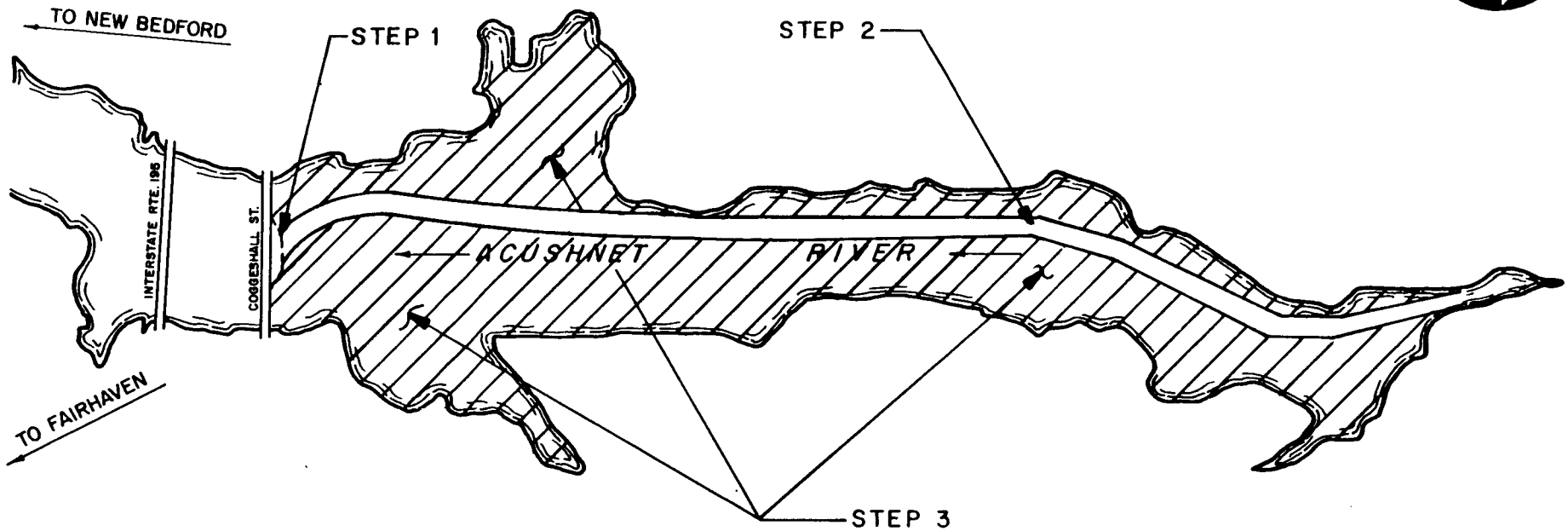
Based on the results of the secondary screening, the following technologies were selected as the most cost-effective for use in the development of remedial action alternatives:

- Hydraulic Control: Lined earthen and rockfill channel.
- Solids Dewatering: Settling lagoon.
- Sediment Dispersal Control: Sheet piling or double silt curtain (depending on intended use).
- Sediment Dredging: Cutterhead dredge (bucketwheel type).

Development of Remedial Action Alternatives

The screening processes focused on the applicability and comparative value of individual remedial technologies. The next step in the phased study approach was to combine the remaining technologies into remedial action alternatives. Four potential remedial action alternatives were developed in addition to the no-action alternative. These are:

Hydraulic Control and Sediment Capping (Estimated Cost: $24.6 million) - This alternative involves the construction of a lined earthen and rockfill channel along the western shoreline to bypass the freshwater flows of the Acushnet River Estuary from a point upstream of the hot-spot area to a point below the Coggeshall Street Bridge. The purpose is to isolate the contaminated sediments from the resuspension and transport action of the river flow. Embankment heights will be constructed to elevations suitable to prevent overtopping during flood conditions, except near the harbor opening beneath the Coggeshall Street Bridge, where the embankment height will be lowered to allow a tidal exchange between the lower harbor and the estuary. The harbor bottom in the remaining open-water areas will be covered with clean sediments in order to isolate the contaminated sediments from the water column. Sediment dispersal control will be implemented prior to construction. This alternative is illustrated in Figure 4 and Figure 5.



STEP 1- INSTALL SEDIMENT DISPERSAL CONTROL.

STEP 2- CONSTRUCT DOUBLE EMBANKMENT CHANNEL (APPROXIMATE ALIGNMENT INDICATED).

STEP 3- CAP SEDIMENTS.

0 1000 2000

SCALE IN FEET

FIGURE 4

PLAN VIEW OF HARBOR ILLUSTRATING HYDRAULIC CONTROL ALTERNATIVE NEW BEDFORD SITE, NEW BEDFORD, MA

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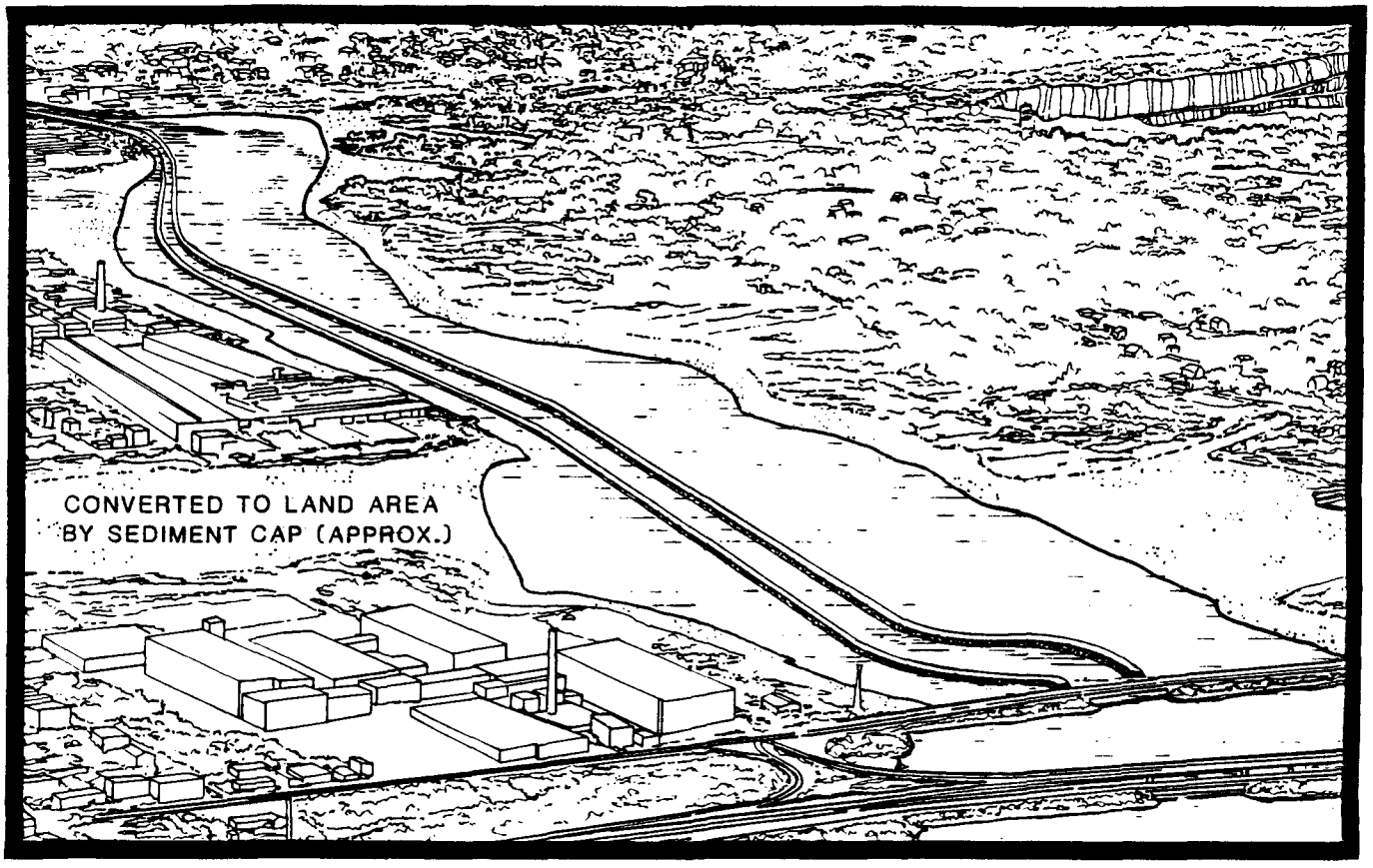
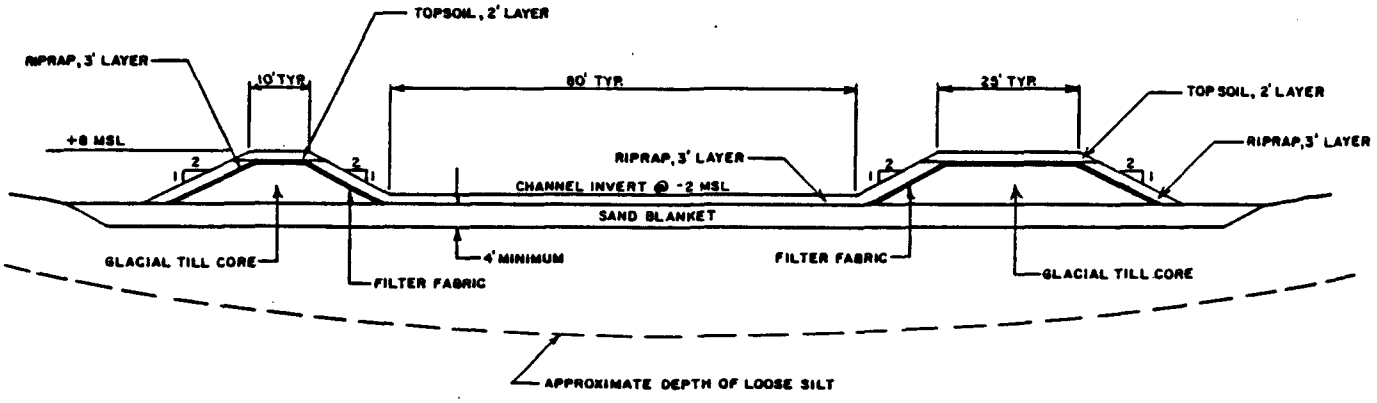
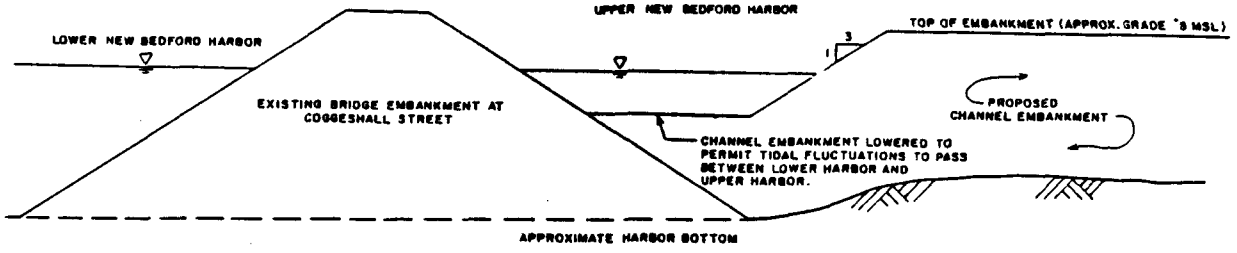




TYPICAL CHANNEL CROSS-SECTION



CHANNEL PROFILE NEAR BRIDGE

FIGURE 5

ARTIST'S CONCEPTION
AND TYPICAL CROSS-SECTIONS
HYDRAULIC CONTROL ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

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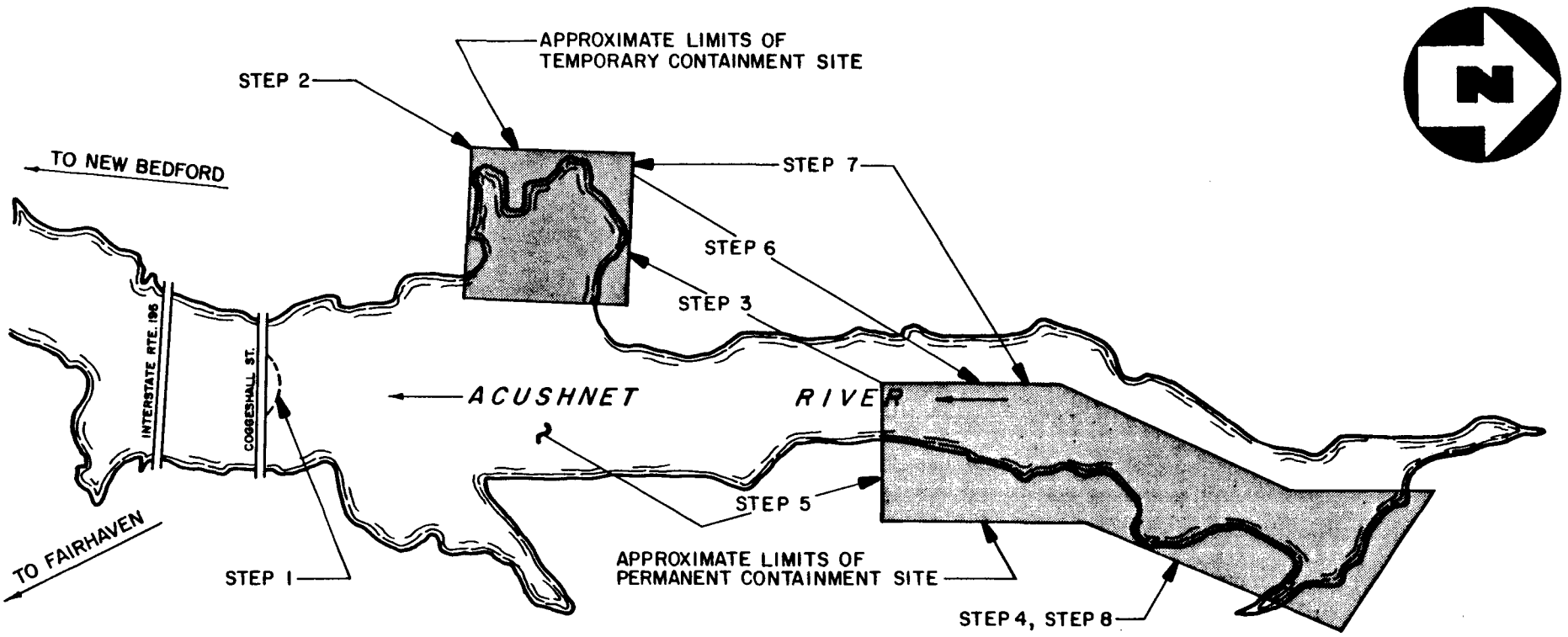
Dredging with Disposal in an Unlined, In-Harbor Containment Site (Estimated Cost: $27.8 million) - In this alternative, contaminated sediments will be dredged from the estuary and disposed in an in-harbor containment site along the eastern shore in the northern part of the estuary. Before dredging begins, sediment dispersal control will be installed at the harbor opening beneath the Coggeshall Street Bridge. The cove on the western shore of the upper harbor will be developed into a temporary containment site by construction of an earthen retaining embankment. Sediments from the proposed location of the in-harbor containment site embankment will be dredged and pumped to the temporary containment site. The in-harbor containment site embankment will next be constructed of earthen materials to isolate the contaminant area from the Acushnet River Estuary and harbor waters. The walls of the containment area will be lined; however, the bottom will be unlined and the existing contaminated sediments within the disposal area will be left in place. Dredging of the remaining areas outside of the embankment in the upper harbor will then proceed with the spoils being pumped to the permanent containment site; previously dredged sediments contained in the temporary site will be concurrently pumped to the permanent site. All supernatant water in both containment sites will be removed for subsequent treatment. Finally, the permanent containment site will be capped to further isolate the contaminants. A conceptual illustration of this alternative is shown in Figure 6 and Figure 7.

Dredging with Disposal in a Lined, In-Harbor Containment Site (Estimated Cost: $79.5 million) - This alternative is similar to that just described, except that an impermeable membrane liner will be placed beneath the containment site. Such an alternative will require that contaminated sediments beneath the proposed in-harbor containment site be removed and the site dewatered prior to liner placement. The material dredged from underneath the embankment and inside the containment area will be stored in the temporary containment site until completion of the liner placement. All contaminated sediments will then be disposed in the containment site, as above. The overall conceptual features are similar to those shown in Figure 6 and Figure 7. Figure 7 shows a typical cross section of the lined in-harbor containment site.



STEP 1 – INSTALL SEDIMENT DISPERSAL CONTROL.
STEP 2 – CONSTRUCT TEMPORARY CONTAINMENT SITE.
STEP 3 – DREDGE BENEATH EMBANKMENT. HOLD IN TEMPORARY CONTAINMENT SITE.
STEP 4 – CONSTRUCT PERMANENT CONTAINMENT SITE.
STEP 5 – DREDGE-DISPOSE IN PERMANENT CONTAINMENT SITE.
STEP 6 – TRANSPORT SEDIMENTS FROM TEMPORARY CONTAINMENT SITE TO PERMANENT CONTAINMENT SITE.
STEP 7 – TREAT WATER.
STEP 8 – CAP CONTAINMENT SITE.

0 1000 2000
SCALE IN FEET

FIGURE 6

PLAN VIEW OF HARBOR ILLUSTRATING IN-HARBOR CONTAINMENT ALTERNATIVE NEW BEDFORD SITE, NEW BEDFORD, MA

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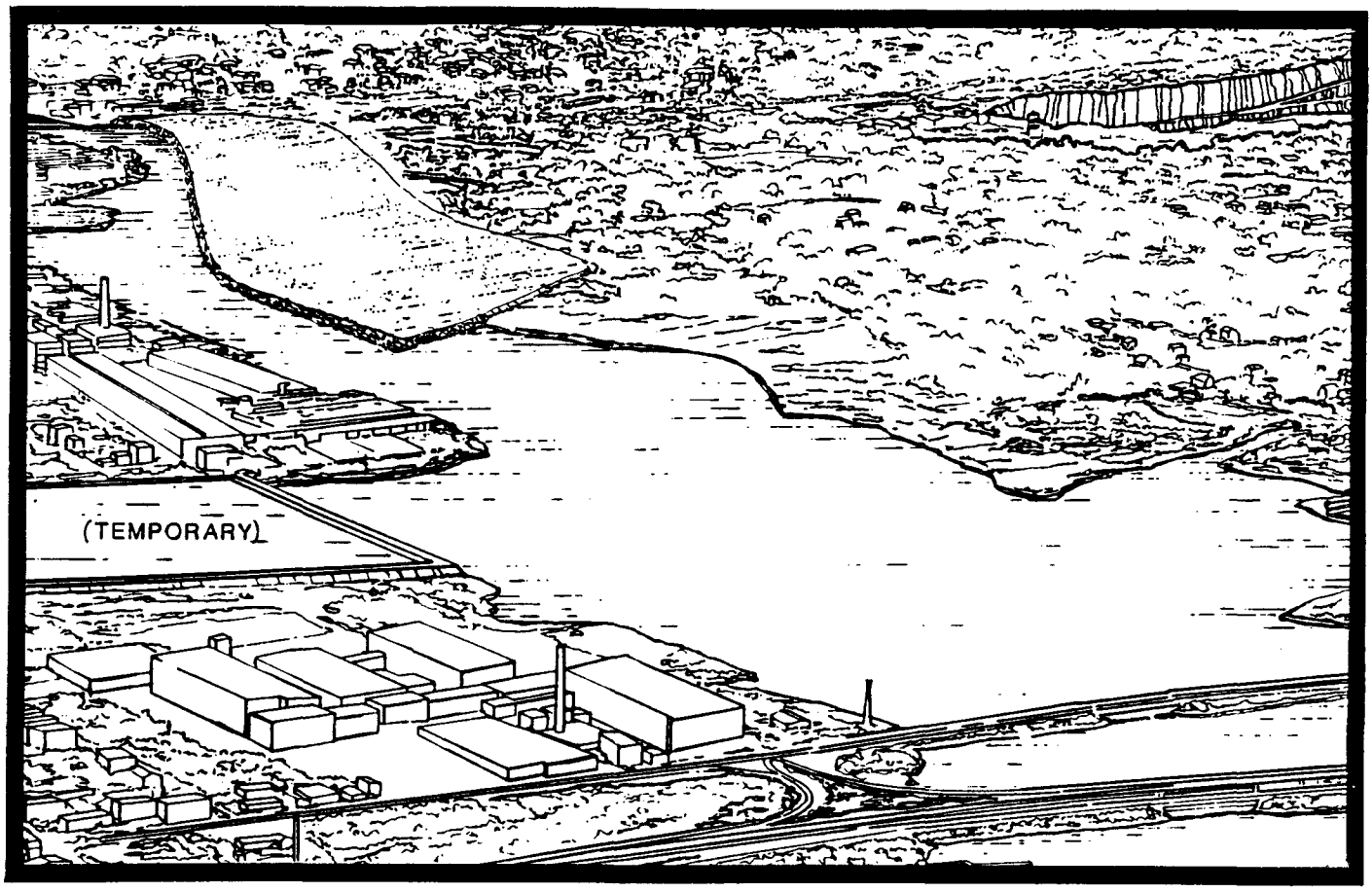
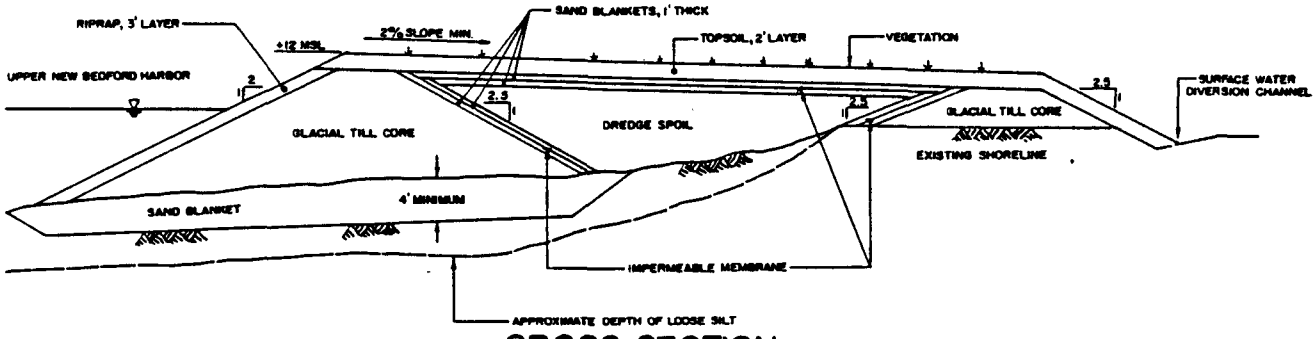
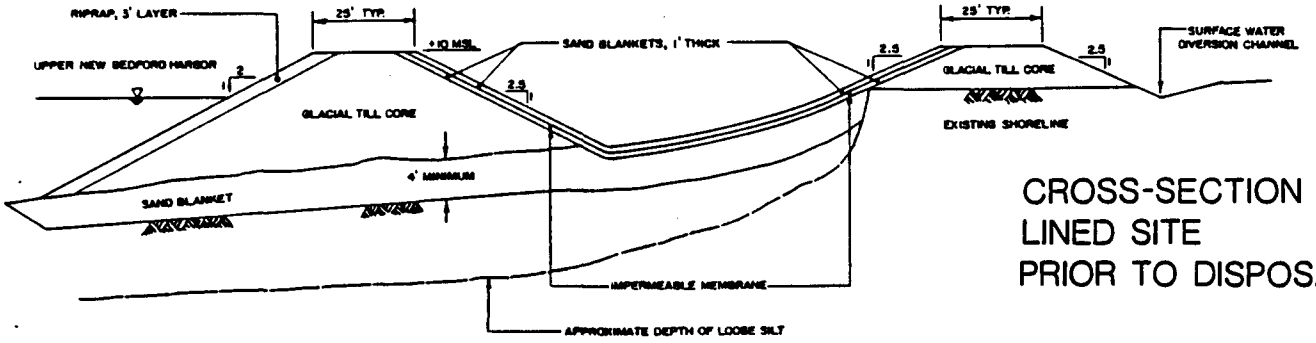




CROSS-SECTION
UNLINED SITE AFTER CAPPING



CROSS-SECTION
LINED SITE
PRIOR TO DISPOSAL

FIGURE 7

ARTIST'S CONCEPTION
AND TYPICAL CROSS-SECTIONS
IN-HARBOR CONTAINMENT ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

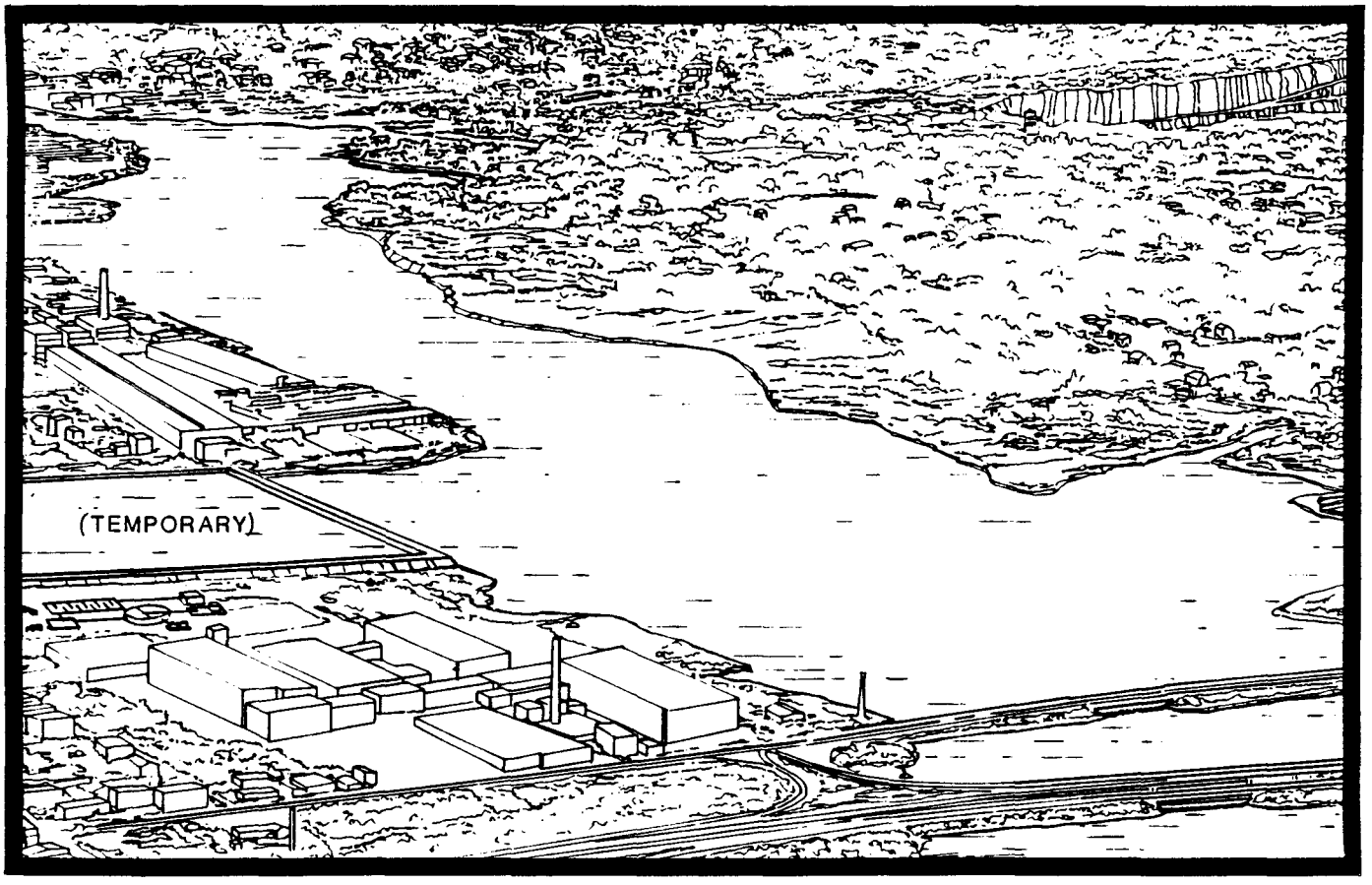
NUS CORPORATION
A Halliburton Company

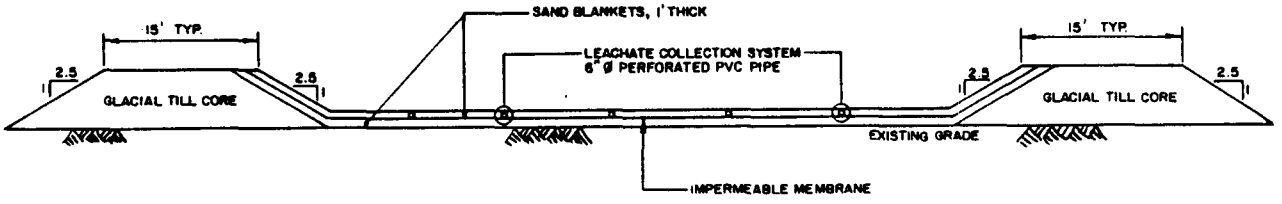
Dredging with Disposal in an Upland Containment Site (Estimated Cost: $44.0 million) - This alternative requires that the entire upper harbor be dredged to remove the contaminated sediments and the spoils disposed in an upland containment site. Initially, a containment facility for the final disposition of contaminated dredge spoils will be developed at a suitable upland location. As with the other dredging alternatives, sediment dispersal control will be installed at the mouth of the upper harbor before in-harbor operations begin. A temporary containment site will be constructed in the cove on the western shore of the upper harbor. Harbor sediments will be dredged and pumped into the temporary site. Upon adequate dewatering, the contaminated sediments will be removed from the lagoon and transferred to trucks for transportation to the upland disposal site. All decanted water will undergo treatment to remove residual contaminants. When all sediments have been disposed into the containment facility, the landfill will be capped. The upland disposal alternative is illustrated in Figure 8.

For the dredging alternatives, consideration was given to either incinerating all sediments with PCB concentrations exceeding 500 ppm prior to disposal, or removing such highly contaminated sediments to an existing, out-of-state landfill. Each of these options was ruled out because of the extremely high costs and the additional impacts and risks involved.

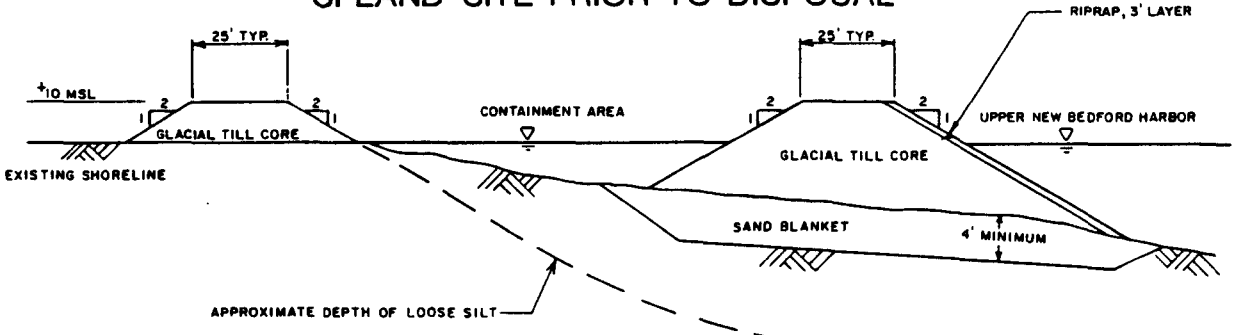
The No-Action Alternative

Under the no-action alternative, the current levels of environmental contamination will be sustained. Many species of fish and shellfish already exceed the FDA limit of 2 ppm PCBs in the edible portion, while several others have average concentrations close to the FDA limit. Whether concentrations in these species will increase, remain at current levels, or decrease under the no-action alternative depends on the relative rates of PCB uptake and depuration. It is expected that species within the hot-spot areas will continue to bioaccumulate PCBs and that concentration levels will progressively increase. The no-action alternative maylikewise cause a continued increase of PCBs and metals in birds, waterfowl,





CROSS-SECTION
UPLAND SITE PRIOR TO DISPOSAL



CROSS-SECTION
TEMPORARY CONTAINMENT SITE

FIGURE 8

ARTIST'S CONCEPTION
AND TYPICAL CROSS-SECTIONS
UPLAND CONTAINMENT ALTERNATIVE
NEW BEDFORD SITE, NEW BEDFORD, MA

NUS CORPORATION
A Halliburton Company

and other terrestrial animals that feed in the Acushnet River Estuary, along its tidal flats, and within the contiguous wetlands. The aquatic vegetation along the shorelines and within wetland areas are currently impacted by contaminants in the water column and sediments, and this problem is expected to remain for a long period of time. Volatization of PCBs and the release of PCBs and metals attached to particulates will continue from the hot-spot areas under the no-action alternative.

Because of the magnitude and uncontrolled nature of the existing environmental contamination in the Acushnet River Estuary, the no-action alternative represents the highest level of risk to public health among the remedial action alternatives. The potential pathways of human exposure to PCBs through the air, water, sediment, and biotic environments pose a persistent risk for an indefinite period if no remedial action is taken. The ingestion of fish and shellfish from the estuary and harbor (despite the current ban) would continue as a critical exposure pathway.

The official closure of the estuary to fishing represents a small economic loss due to a reduced sports fishery and related activities (e.g., boat rental) and the costs to community residents resulting from the absence of local catch in their routine diet. Other potential socioeconomic impacts that will be maintained under the no-action alternative include depressed property values in the vicinity of the harbor, the lack of impetus to redevelop waterfront properties, and a reduced recreation value. The principal economic effects of harbor contamination are associated with commercial activities in downstream areas. These include the closure of the harbor to fishing and the taking of lobsters, constraints on development plans because of the expense of disposal of heavily contaminated dredge spoils, and the potential long-term effects of similar limitations on maintenance dredging. Although these latter economic impacts may not be directly related to the hot-spot areas, the continued release of PCBs and metals to downstream areas under the no-action alternative will substain the existing conditions and associated impacts.

What the hell?

Evaluation of Remedial Action Alternatives

Each of the proposed remedial action alternatives can be considered to clean up or isolate the PCBs and metals in the hot-spot areas and to prohibit contaminant transport to the harbor and bay. A small percentage of the contaminants will remain in the sediments of the Acushnet River Estuary due to operational inefficiency, and in some localized areas low levels of contaminants may be present at a depth below that dredged. However, the average concentrations of PCBs remaining in the estuary sediments should be less than the target value of 1 ppm.

The implementation of each alternative will have significant beneficial impacts on the environment, public health, and public welfare. Upon project completion the following conditions should be satisfied:

- Contaminants will not be directly exposed to the atmosphere to contribute to airborne contaminant exposure.

- The upper sediments will either be removed or covered by a clean cap so that direct contact with highly contaminated materials will be prevented.

- The contribution of contaminants to the food chain that initiates in the benthic organisms and bottom feeders will be eliminated.

The risk to humans posed by contaminated fish and shellfish will continue for a period of time until the organisms cleanse themselves through natural processes. The rate of depuration is species-dependent, and is being investigated in a companion study. It is expected that at least several years will be required before the heavily contaminated species in the estuary will satisfy the current FDA level of 2 ppm PCBs.

As the overall contamination in the harbor and bay is reduced, progress can be made toward the mitigation of the economic impacts. In general, benefits would

include a better image of the New Bedford regional area to outsiders and would result in increased tourist dollars and possibly increased commercial and industrial revitalization. Each alternative will likewise result in improved environmental and water quality conditions to increase property values and to promote recreational and other usage of the estuary.

An additional economic benefit that is common to all remedial action alternatives is the employment opportunities created by the projects. These opportunities would temporarily reduce unemployment in the New Bedford area, even though it would return to a pre-cleanup level when the project is completed. Long-term permanent employment may result from increased economic activity resulting from estuary cleanup, but these jobs would develop slowly and may not be of significant quantity. A related issue is the potential large demand for construction materials found within the general New Bedford area.

Adverse community impacts created by each of the alternatives are increased noise levels and fugitive dust emissions. Noise would be produced by construction, dredging, and transportation activities. Excessively high noise levels can be expected to occur only periodically and in very localized areas of activity. Other than transportation, the only land-based activity that would produce persistent noise problems would be the transfer operation at the western cove if sediments had to be transported to an upland disposal site. Fugitive dust generated by construction activities may temporarily reduce air quality. However, the dust will primarily have its source in construction materials rather than the contaminated sediments.

The risk of long-term contaminant releases is low for any of the four alternatives if the physical components are properly engineered and constructed. The differentiation among the four alternatives is related primarily to the previously mentioned costs and the respective negative impacts. The hydraulic control and sediment capping alternative would most severely impact aquatic life because of the permanent channeling of the Acushnet River Estuary and the consequential disruption of migratory patterns. Capping of the sediments will destroy the

existing benthic community and will eliminate or otherwise impact the shallow water wetlands along the shoreline.

Sediment dredging imposes the risk of resuspending contaminated sediments, thereby increasing the potential for contaminant dispersal and downstream migration. Except for the possible resuspension of PCB-laden oily films, which can be at least partially controlled, there is a low probability that a significant contaminant release will occur. Dredging will destroy benthic organisms and will temporarily disrupt other aquatic species, but the ecological community will likely reestablish itself in a more favorable environment upon project completion.

The principal negative impact of an in-harbor disposal site is the permanent loss of salt marshes along the eastern shoreline. For the unlined site, groundwater will be free to move through the site, but it is unlikely that PCBs or metals will be mobilized. (Note that there is no known use of the groundwater in this area due to its saline nature.) During active site operations, contaminated sediments and supernatant water will be exposed to waterfowl and mammals, and an increased release of contaminants to the atmosphere could occur. The temporary sediment storage area will have similar impacts on the western cove.

Disposal in an upland site will not totally eliminate the impacts to the salt marshes, since these areas are likely to be heavily contaminated and will require dredging. Additional impacts of this alternative are the noise and risk associated with truck transport of the contaminated sediments, the introduction of contaminated materials to an environment currently removed from the problem, and the overall community impacts associated with an upland chemical landfill.

Conclusions and Recommendations

A phased evaluation of technologies was used to evaluate remedial action alternatives, and four remedial action alternatives were retained along with the no-action alternative for final evaluation in this fast-track Feasibility Study. The development and final selection of these alternatives were based not only on

technical merit and cost-effectiveness, but also in response to uncertainties as to how the policy and regulatory framework governing any remedial action of the hot-spot areas would be interpreted and applied. A strict interpretation of Federal, State, and local policies and regulations will make it difficult to implement any remedial action because of the nature and high levels of the contaminants involved and the environmentally sensitive coastal and regional areas that would be impacted by the remedial action.

Serious environmental, public health, and public welfare problems and impacts would persist under the no-action alternative. For this reason, the no-action alternative is not recommended for the hot-spot areas. Its inclusion in the final analysis has, however, provided an assessment of the current problem and impacts for use as a comparative baseline in the evaluation of the remaining alternatives.

The alternative of hydraulic control and sediment capping is the only option that isolates rather than removes the contaminated sediments. This alternative is the least costly of those evaluated, and has a lesser potential for resuspension of the contaminants and the associated risk when compared to the dredging alternatives. The beneficial effects of isolating the contaminants must be weighed, however, against the resultant permanent alteration of the hydrology and aquatic resources of the estuary above the Coggeshall Street Bridge. The need to extend the channel into the deeper portions of the estuary near the bridge opening and the placement of an effective underwater sediment cap introduce particularly difficult engineering features to this alternative. As a result, the long-term integrity of the isolation alternative may be reduced in comparison to the removal options. An additional negative feature is that the potential future need for the disposal of contaminated sediments from the lower harbor cannot be incorporated into this alternative. In conclusion, hydraulic control and sediment capping would most likely be the recommended alternative only if policy and regulatory constraints are found to prohibit or significantly reduce the cost-effectiveness of the removal and disposal of contaminated sediments in either an in-harbor or upland site.

The two dredging and in-harbor disposal alternatives achieve the study objectives by the physical removal of the sediments to an engineered and controlled environment. Such alternatives are more consistent with the objective to achieve a permanent remedy to prevent or mitigate the migration of contaminants and the associated risk. Numerous short- and long-term adverse impacts do exist for these alternatives, however. The most noteworthy are the permanent loss of wetlands and the increased potential for contaminant resuspension and migration during the active site operations.

The use of a liner would both reduce the potential risk of leakage from the disposal site and increase the acceptability of this alternative. These advantages would be offset, however, by adverse impacts associated with site dewatering and the temporary storage of additional contaminated sediments in shoreline areas (e.g., the cove on the western shore). The placement of a sand blanket (for bearing support) and liner over the extensive disposal area, in addition to the initial dewatering of this area, result in an estimated threefold increase in costs relative to the unlined disposal area alternative ($79.5 million versus $27.8 million).

The use of an upland disposal site eliminates many of the critical environmental impacts of the other alternatives, but introduces many new environmental, public health, and community impacts. This alternative involves the removal of the contaminated sediments to new areas and communities that currently are not directly affected by the hot-spot areas. This not only severely reduces the overall acceptability of the option, but may introduce a more stringent interpretation of the regulations for waste generation, hauling, and disposal than that associated with "onsite" (i.e., in-harbor) disposal and control of the contaminated sediments.

Each of the remedial action alternatives (less the no-action alternative) developed in this study is considered to be technically feasible and responsive to the study objectives. The chemical behavior of PCBs is particularly compatible with the isolation and containment schemes proposed. PCBs do not appreciably solubilize in water; they are strongly adsorbed onto solid particles such as organic and silty sediments; and they undergo only limited volatization. Other alternatives may

likewise achieve the study objectives with a variation in associated costs and impacts. Additional alternatives identified during the period of review and comment will be subequently considered as to their pertinency and cost-effectiveness.