Acushnet River Estuary PCB Commission

Status Report

September 1982

Commonwealth of Massachusetts
Edward J. King, Governor

ACUSHNET RIVER ESTUARY PCB COMMISSION:

STATUS REPORT

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Executive Summary

This document is an initial report prepared by the Acushnet River Estuary PCB Commission established by Governor Edward J. King under Executive Order No. 216 on May 5, 1982. This report defines the extent of PCB (polychlorinated biphenyl) contamination in the Acushnet River Estuary and New Bedford Harbor, the status of efforts being made by federal, state, and local agencies to deal with the problem and includes a series of recommendations made by the Commission to improve and expedite remedial action efforts.

PCB contamination of the Acushnet River Estuary was first documented in 1974 by scientists at Woods Hole Oceanographic Institution and confirmed in a 1976 study by the U.S. Environmental Protection Agency. Two industrial operations, Aerovox and Cornell-Dubilier, were found to have discharged wastewaters containing PCBs to the Acushnet River Estuary directly and via the New Bedford municipal sewage treatment plant. Although the direct discharge of PCBs to the Harbor has since been significantly curtailed, in certain areas the concentration of PCBs in harbor sediment is extremely high due to the chemical stability and persistence of PCBs.

The presence of PCBs in the environment raises major public health and economic concerns. Contamination of the Acushnet River Estuary and the Harbor area has resulted in the accumulation of PCBs in many edible marine species. To protect the public from the health effects associated with the consumption of contaminated fish, on September 25, 1979, the Massachusetts Department of Public Health promulgated emergency regulations prohibiting the harvesting of shellfish, finfish, and lobsters in portions of the Acushnuet River, New Bedford Harbor and certain areas of Buzzards Bay.

This necessary action to protect public health has resulted in severe financial losses to the lobster and fishing industries, has severely curtailed recreational fishing and has delayed necessary transportation and harbor related development in the New Bedford area.

Federal, state, and local agencies have all made significant efforts towards gathering information and data about the extent of the contamination and have taken initial steps toward its management.

Most significant among these efforts was the successful attempt in July of 1982 to include the site on the Federal "Superfund" list.

The Superfund Program, created by Congress in 1980, authorizes federal funding for cleanup of abandoned hazardous waste sites and chemical spills which threaten public health or the environment.

As part of the Superfund process EPA in concert with a Technical Task Force appointed by Secretary of Environmental Affairs, John Bewick, is preparing a Remedial Action Master Plan (RAMP) which will serve as the basic planning document for site management and control. The preparation of this plan will greatly facilitate efforts to coordinate on-going activities to deal with the PCB problem in the Acushnet River Estuary.

To date, two preliminary health studies have been conducted in the New Bedford area. Although results indicate that persons eating fish from the Acushnet River and occupationally exposed persons have elevated PCB levels in their blood serum, analysis of the data have failed to reveal any significant correlation between elevated PCB blood serum levels and other health problems.

Although much data has been collected on the levels of contamination in the Harbor, EPA and an inter-agency task force of state agencies have identified several areas where additional data is needed before a course of action can be determined. Generally, the required data include:

1) a precise delineation of PCB sediment concentrations in the New Bedford area profiled with depth;

2) an elucidation of the physical transport of PCBs in the Harbor and out to Buzzards Bay, and;

3) data on bio-accumulation of PCBs by shellfish and finfish from both sediments and the water column.

In addition, the Department of Public Health feels that additional health studies are needed.

It appears that plans presently exist for the collection of necessary data. Funding constraints, however, have delayed, and may continue to delay, some data gathering efforts.

In a report prepared for the Department of Environmental Quality Engineering, Malcolm Pirnie, Inc. estimated that cleanup costs may range from $30 to $130 million depending on the extent of remedial action taken. Although this is only a preliminary estimate, cleanup costs will be substantial and probably will not be completely covered by Superfund monies. As a result other funding sources are being pursued. Before any cleanup can take place a feasibility study including an assessment of costs and benefits of various options under consideration must be carried out.

The Commission is convinced that the continuing presence of PCBs in the waters and sediments of the Acushnet River Estuary and New Bedford Harbor pose a potential threat to the health of area residents, to the economic well being of a major sector of the area's economy, and to the continued necessary economic development of this area. It is essential therefore that data gathering proceed quickly so that remedial action may be taken as soon as possible. In order to expedite the process and ensure that the health and economic well being of the citizens of New Bedford are protected the Commission recommends that:

1) The $1,033,000 required to conduct the necessary epidemiological and blood studies recommended by the Department of Public Health be obtained immediately from EPA/Superfund;

2) the Massachusetts legislature pass the proposed legislation to establish a $25 million Massachusetts Superfund to cover any remedial action not covered by Superfund or other Federal funds;

3) all data gathering efforts necessary to initiate dredging for Fairhaven Bridge and other development projects be given top priority so that these activities can begin without unnecessary delay;

4) each cleanup action phase be accompanied by an evaluation program to assess environmental impacts and provide data for future remedial action decisions;

5) the Department of Marine Fisheries and the Department of Public Health establish a workable guideline for opening and closing areas to the harvesting of shellfish, finfish and lobsters;

6) the Division of Law Enforcement continue to enforce all fishing bans that remain in effect; and

7) the life of the Commission be extended for at least six months to allow review of the EPA Remedial Action Master Plan, reconciliation of the budgets and tasks presented by various agencies, and preparation of a final report.

STATUS REPORT

I. INTRODUCTION

Recognizing the hazards posed to human health and the environment by polychlorinated biphenyls (PCBs), on May 5, 1982 Governor Edward J. King issued an Executive Order creating a Special Commission to investigate the severity of the PCB contamination in the Acushnet River Estuary and to develop recommendations and seek funding for its cleanup. On June 11, 1982 the Special Commission was appointed. Since that time the Commission has met three times; hearing presentations from scientists from Woods Hole Oceanographic Institution, local, state and federal agencies, as well as reviewing numerous documents on the subject.

This document is an initial report from the Commission. It defines the extent of the contamination and describes the status of efforts being made to deal with the problem. It further includes a series of recommendations from the Commission. These may be found on page 34. Principal among these recommendations is the request that the Commission be allowed to continue its work for another six months and at that time issue a final report.

BACKGROUND

PCBs are polycyclic chlorinated hydrocarbons composed of chlorine, carbon and hydrogen. There are over 200 isomers of PCBs, each containing a different number or arrangement of chlorine atoms. The chlorine content of PCB mixtures formerly sold in the U.S. ranges up to 68 percent. Evidence exists to suggest that the higher the chlorine content, the more toxic and persistent the PCB compound.

PCBs are fire-resistant, good conductors of heat, but poor conductors of electricity. Because of their chemical and thermal stability, PCBs have been used widely as insulation fluids in the manufacture of capacitors and transformers. In this context, PCBs contributed greatly to public safety by reducing the risk of accidental fires or explosions.

Before 1971, PCBs were used in a great variety of manufacturing processes. They were added to adhesives, plastics, paints, varnishes, sealants, and other surface coatings, and they were used widely as a component of carbonless carbon papers.

The generic name for the fire-resistant PCB fluids is Askarel although companies that manufactured electrical transformers and capacitors with PCBs may have used a different trade name. The Monsanto Company was the principal manufacturer of PCBs, trademarked Aroclor, in the United States. The Company began the production of Arochlors in 1935. From 1935 through the early 1970's production steadily increased to meet the demand. In the early '70s, Monsanto voluntarily restricted the sale of chlorinated biphenyls. By 1977, Monsanto ceased all manufacture of PCBs.

The chemical properties of PCBs, which make them nearly ideal for many industrial uses, allow PCBs to bio-accumulate and persist in the environment creating a potential hazard to human health and the environment. Studies have shown that PCBs are toxic to animals and man. Short term direct exposure to PCBs by humans has resulted in chloracne, nausea and vomiting, abdominal pain, swelling, jaundice and fatigue. Accumulation of PCBs in the human body can occur by ingestion of contaminated food or drinking water, by breathing contaminated air, or through the skin by physical contact with articles that have been contaminated.

PCBs have been associated with a variety of other health effects including:

- neurological abnormalities (observed in animals given PCBs)
- impaired growth and development in both animals and humans
- impairment of protein and fat metabolism, with associated goiter and hypothyroidism in some cases
- cancer of the liver (in animal studies) and
- hyperplastic changes in the gastrointestinal tract.

Additional health concerns regarding PCBs include delayed health effects and effects on reproduction. Long term exposure to small amounts of PCBs may weaken the body's ability to recover from other illnesses by affecting the immune defense mechanisms of the body.

Once in the body PCBs have a very long residence time. The biological half life of a PCB in the human body is 10-20 years. Industrially exposed groups have had blood levels as high as 343 ppb (parts per billion). Ninety-nine percent of the U.S. population has blood levels of PCBs of 30 ppb or less. The average PCB serum level is between 3 and 5 ppb.

Animal studies have shown that continuous feeding of small amounts of PCBs are toxic and that a safe level of consumption has not yet been established.

Limited data are available on the health effects of PCBs on New Bedford residents. Two small studies have been conducted and are described in Section III of this report.

PCB contamination of the Acushnet River Estuary was first documented in 1974 by scientists at Woods Hole Oceanographic Institution and confirmed in a 1976 study by the U.S. Environmental Protection Agency (EPA). During a PCB survey in New England, EPA found high levels of these chemicals in several locations within the Estuary and the Harbor. Two industrial operations, Aerovox and Cornell-Dubilier, were found to be actively discharging wastewaters containing PCBs to the New Bedford Harbor by both direct discharge and indirect discharge through the New Bedford municipal wastewater treatment facility and combined sewer overflows.

Exhibit 1 shows the New Bedford Harbor area. PCB users, disposal areas and sites of contamination are noted.

Since the EPA survey in 1976, the direct discharge of PCB contaminated wastewater from the two industries cited has been significantly reduced, but in certain areas sediments underlying the entire 985 acre New Bedford/Fairhaven Harbor contain high levels of PCB. Concentrations range from a few parts per million to over 100,000 ppm (parts per million). Portions of Buzzards Bay are also contaminated, with concentrations of PCB occasionally exceeding 50 ppm. (Sediment containing over 50 ppm of PCB is considered a hazardous waste under the Massachusetts General Laws, C.21C). The water column in New Bedford Harbor has been measured to contain PCB levels higher than the 0.03 ppb (24 hour average) criterion established by EPA for protection of salt water aquatic life.

suggested by EPA for interim short term use water source. (The 1 ppb guideline is the level determined by EPA by generate no adverse response if consumed for a limited time period.)

Contamination of the Acushnet River Estuary and the Harbor area has resulted in the accumulation of PCB in many marine species. Samples of lobster and finfish have revealed PCB levels of greater than 5 ppm (wet weight). (Five ppm is the FDA standard for levels in edible fish; it should be noted that the FDA has promulgated a level of 2 ppm (wet weight) of PCB in edible portions of fish and lobsters, but presently there is a court ordered stay on this action.) As a result, to protect the public from consumption of contaminated fish, on September 25, 1979 the Massachusetts Department of Public Health promulgated a regulation prohibiting the harvesting of shellfish, finfish, and lobsters in portions of the Acushnet River, New Bedford Harbor and certain areas in Buzzards Bay. Exhibit 2 identifies the areas subject to closure.

Economically, the closure of the Harbor and sections of Buzzards Bay to fishermen has resulted in financial losses to the lobster, shellfish and finfish industries as well as to recreational fishing. In 1977 the Massachusetts Division of Marine Fisheries estimated that the loss to the lobster industry was approximately $150,000 per year. (It must be noted that eradication of the PCB problem will not necessarily make these resources available; there are other problems of chemical and bacterial contamination that would still have to be overcome.) Further development of the harbor such as a new bridge connecting Fairhaven and New Bedford and a marine park have been delayed as a result of the PCB problem. These delays in harbor development have also cost the city in terms of the opportunities lost for economic development and jobs for the area.

Additional data on health impacts as well as on PCB levels in the Harbor are necessary before a cleanup strategy can be developed. In this report available health and environmental data are given. Additional data needs are described as well as considerations in developing both long term and short term plans for PCB management in the Acushnet River Estuary. (1)

II. HISTORY OF FEDERAL, STATE AND LOCAL EFFORTS TO DEAL WITH THE PROBLEM

The PCB contamination in the Acushnet River Estuary has received considerable federal, state and local attention. This section reviews the involvement of each of the major participants.

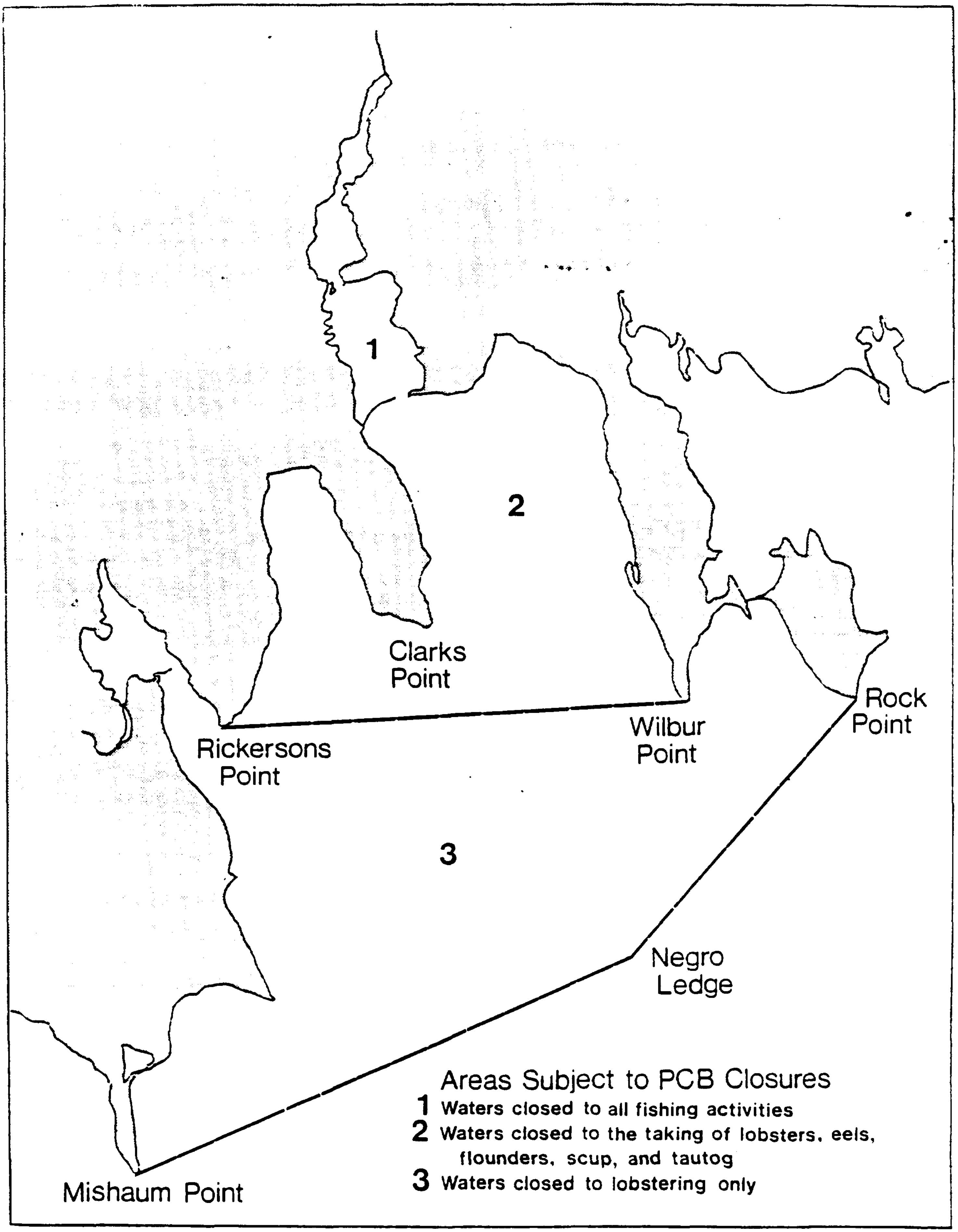


Exhibit 2: Fishing Closure Areas established by the Massachusetts Department of Public Health.

A. Federal Efforts

The federal agencies that have been involved in the Acushnet River Estuary contamination problem are the Environmental Protection Agency (EPA), the U.S. Coast Guard (USCG), the Centers for Disease Control CDC), and the National Oceanic and Atmospheric Administration (NOAA).

As mentioned in Section I, the contamination was brought to national attention in 1976 when EPA, through its investigation of PCB in the Northeast, recorded high levels of PCB in the Acushnet River Estuary and New Bedford Harbor. Subsequent to this discovery, EPA became involved in identifying the industrial sources of the contamination and collecting data to document the pollution sources for enforcement purposes.

In 1981 EPA began utilizing the services of Metcalf and Eddy, Inc. to manage and coordinate data collection efforts and identify additional data needs. In July 1982 EPA hired GCA, Inc. to collect additional data needed for enforcement efforts.

EPA has also been involved in the New Bedford site in its administration of the Superfund Program.

The Superfund Program created by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) authorizes federal funding for cleanup of abandoned hazardous waste sites and chemical spills which threaten public health or the environment. The Act makes notification of hazardous releases mandatory and authorizes EPA to arrange for remedial action according to priorities to be outlined in a National Contingency Plan. The Act assigns liability for the costs of this response; the government is authorized to recover costs of remedial action and to seek punitive damages of up to three times these costs where the liable party fails to take remedial action ordered by the government.

Funding for federal remedial actions is to be drawn from a special "Superfund" generated primarily by taxes on oil and chemical production. Where a site is found to be eligible for funding, Superfund will provide 90 percent of the cost of clean up, provided that the state contributes the remaining 10 percent and the action is consistent with the National Contingency Plan. Federal funding is limited to 50 percent for long-term cleanup of publicly-owned sites such as municipal landfills. Before Superfund money can be used for cleanup, however, the state must first attempt to force site cleanup through enforcement action. Superfund money is to be used primarily in those cases where the party responsible for the site cannot be identified or is incapable of financing cleanup.

One of the central elements of the Superfund program is the development of a priority list of sites needing cleanup. In October 1981 EPA published an interim priority list of 115 sites which had been culled from a much larger list of suggestions made by the states.

Massachusetts had requested that the Acushnet River Estuary site be included on the Superfund list but it was not selected in the first round. In July 1982 the list was expanded and the Acushnet River Estuary was added. The national priority list may eventually exceed 400 sites. Inclusion of a site on the priority list does not signify that cleanup of that site will definitely be financed by Superfund. In addition, EPA is required to perform "fund balancing" or evaluation of the cost effectiveness of funding attached to competing sites on the list.

Now that the Acushnet River Estuary site has made the Superfund list there are a series of specific steps that must be taken by EPA and responsible state agencies. Generally, they include:

1) Development of a Remedial Action Master Plan (RAMP)

2) Determination of a Funding Request (based on the RAMP)

3) Allocation of Funds

4) Development of either a Cooperative Agreement between the State and Federal Government or a State-EPA contract for management of cleanup

5) Obligation of Funds

6) Initiation of Work

EPA is now in the process of developing a RAMP. The purpose of the RAMP is to provide a general planning document for sites on the Interim Priority List. The RAMP should be an effective site management tool for the Region to monitor the progress of remedial work at the site. The RAMP will assist EPA headquarters with general program oversight and the development of cash flow requirements. This will be particularly important when fund balancing decisions have to be made in the future.

The RAMP will summarize available information on the site and scope out remedial activities. Based upon this information, the RAMP will identify initial remedial, source control and/or off-site remedial measures with an integrated work schedule for each course of action. "Fast-tract" opportunities will also be identified. Work statements will be developed for the initial phase of activity with cost estimates and project schedules. Future phases will be described and order of magnitude cost estimates (ranges) provided when practical. (2)

The preparation of this plan will greatly facilitate efforts to coordinate on-going activities to deal with the problem. Prior to the New Bedford site making the Superfund list, the U.S. Coast Guard was substantially involved in data collection in the New Bedford area.

Results of their recent sediment sampling program appear in Section III.) Now that the Acushnet River Estuary has made the Superfund list EPA will be the lead federal agency involved in the project. The Centers for Disease Control will continue to play a part in health studies and NOAA will continue to be involved as a consultant to EPA in the evaluation of oceanographic studies.

B. State Agencies

The principal state agencies involved in the PCB problem in New Bedford have been the Department of Environmental Quality Engineering (DEQE), the Department of Public Health (DPH), the Office of Coastal Zone Management (CZM), the Division of Marine Fisheries (DMF), the Department of Public Works (DPW) and the Division of Law Enforcement. The DEQE has been involved extensively through the preparation of an application to include the Acushnet River Estuary site on the Superfund list, through enforcement action taken against Aerovox and Cornell Dubilier, and has collected and analyzed a substantial amount of the currently available data on PCB contents of sediments, water column, and sewers. The Department of Public Health has been involved in two health studies in the area: one of fish eaters and workers exposed to PCBs on the job and one of leukemia victims in Fairhaven. DPH is also the agency responsible for the closing of Areas I, II and III to fishing under its authority to protect the public from the consumption of contaminated fish. CZM has been involved in the preparation of a report entitled PCB Pollution in the New Bedford, Massachusetts Area: A Status Report. This is the most comprehensive report published to date on the PCB contamination in the Acushnet River Estuary (see Appendix I). CZM has also funded several collection and analysis efforts. The Division of Marine Fisheries has been taking lobster tissue samples in the area and is working with DPH to establish criteria for reopening the closed areas. The Division of Law Enforcement is responsible for the enforcement of the DPH regulations which have banned shellfishing and bottom fishing in Areas I, II, and III. DPW's involvement has been principally with regard to the proposed Fairhaven Bridge connecting Fairhaven and New Bedford.

In order to coordinate efforts of various state agencies in dealing with PCB contamination in the Acushnet River Estuary and the New Bedford Harbor, in 1981 Secretary John A. Bewick of the Executive Office of Environmental Affairs established an inter-agency task force.

The Task Force, headed by Thomas C. McMahon, Director of the DEQE Division of Water Pollution Control, is composed of representatives of city, state, federal, and private agencies and institutions currently involved in PCB-related research and issues in the New Bedford-Fairhaven area.

Agencies and groups currently represented in the Interagency Task Force include:

Executive Office of Environmental Affairs
Coastal Zone Management
Division of Water Pollution Control/DEQE
Division of Waterways/DEQE

Criteria and Standards/DEQE
Southeast Region DEQE Office
Division of Hazardous Waste/DEQE
The Massachusetts Department of Public Health
Division of Law Enforcement/Dept. of Fisheries and Wildlife
Lawrence Experiment Station
Mass. Division of Marine Fisheries/Dept. of Fisheries and Wildlife
Mass. Environmental Policy Act Unit (MEPA)
U.S. Environmental Protection Agency
United States Coast Guard
U.S. Army Corps of Engineers
The City of New Bedford
Woods Hole Oceanographic Institution

Liaison is also maintained with the offices of Senator William MacLean and Representative Roger Goyette at the state level and Senator Kennedy and Congressman Studds at the federal level.

The purpose of the Task Force is to coordinate the work of each of the agencies and institutions represented to ensure that:

1) the groups involved are informed as to the nature of the research being conducted by other groups in the Task Force and have access to each other's data;

2) cooperation between agencies with different expertise can occur; and

3) the direction in which research efforts are moving is the most expeditious route possible towards the alleviation of the PCB problem in the Acushnet River Estuary.

Past efforts of the Task Force have focused on the following major categories of work:

1) a characterization of the extent of PCB contamination and its circulation in soils, air, water, sediments, and biota;

2) human health studies;

3) fishery closure/reopening;

4) funding search;

5) litigation;

6) special projects (e.g., the Fairhaven leukemia study and the DPW's Rt. 6 Bridge Environmental Assessment).

With the recent addition of the New Bedford area to EPA's list of "Superfund" sites, the Interagency Task Force, considering its long experience with PCB in that area, should become a vital element in both the planning and execution of the clean-up program in the Acushnet River Estuary.

C. State/Local Efforts

On January 16, 1980, Representative Roger Goyette of New Bedford established an Ad Hoc Committee on the Acushnet River Estuary Disaster to help coordinate efforts at the state and local level. The committee, composed of scientific experts and public officials, was formed to oversee, coordinate and advocate all efforts to resolve PCB contamination in the Acushnet River Estuary. To date, the committee has coordinated independent studies by the Woods Hole Oceanographic Institution, the Massachusetts Department of Environmental Quality Engineering, the Masachusetts Department of Public Health, the U.S. Environmental Protection Agency, the U.S. Coast Guard and others.

The Ad Hoc Committee has also worked with several state agencies to develop a planning budget to begin cleanup of the Estuary. Rep. Goyette and the Committee continue to advocate for additional funds to complete the necessary studies and begin remedial measures.

D. Local Efforts

In 1976, the New Bedford City Planner, Richard Walega, met with then Secretary of Environmental Affairs, Evelyn Murphy, to form a committee to deal with the local PCB problem. A task under consideration was an evaluation of the presence of chemical(s) in the Estuary in order to permit local dredging to occur, thus allowing marine interests of the area to pursue development options that they felt were necessary to the economy of the area.

In 1980, the City Planner appointed a staff person to investigate the issue in a comprehensive manner. This research effort did not materialize due to the establishment of Representative Roger Goyette's committee. It was felt that an in-house effort would have been redundant.

For the last few years, the City has worked with the EPA and State in respect to the testing of PCB in the sewers and in the wastewater treatment plant. Considerable effort has been expended in evaluating the adequacy of the present treatment plant, and what type of plant would be appropriate for the City's future needs. The City's consultant, Camp, Dresser McKee (CDM) has been active in this matter. Considerable testing has also been done at the inland waste disposal site. The City currently has made application for a waiver of the federal requirement to install a secondary wastewater treatment facility.

New Bedford has also expended considerable staff time in the analysis of the issue. Research needs identified by the City and a budget for local activities appear in Appendix II.

III. EXISTING DATA DESCRIBING PCB LEVELS

A. Inputs to System:

1. Industrial

Two industries historically account for the majority of PCB usage within the New Bedford area: Aerovox Incorporated and Cornell Dubilier Electronics Incorporated.

Aerovox Incorporated (presently a subsidiary of R.T.E. Corporation) produces capacitors of various sizes and types. From 1947 to October 1978 PCBs were used as impregnation fluids in the manufacture of electronic components such as capacitors. During that period considerable amounts of reject capacitors and other PCB contaminated materials were disposed of at the New Bedford Landfill. Reject capacitors have also been found along the banks and in the intertidal zone of the Acushnet River adjacent to the Aerovox plant. Wastewater from the Aerovox plant presently goes into the sewer system, however there is a trough to the north of the building that historically was noted to be contaminated by PCBs. That trough has been cleaned and presumably no longer contributes contamination. Soil tests around the company site have shown the presence of contaminated material. The company is presently working with federal EPA and state DEQE officials to prevent PCBs from these soils from reaching the estuary.

Cornell Dubilier (a wholly owned subsidiary of Federal Pacific Electric, which is a wholly owned subsidiary of Exxon) also produces capacitors. This operation historically sent considerable amounts of materials containing PCBs to the landfill. Soils sampled at the Cornell Dubilier site in 1981 showed elevated levels of PCBs; the company is presently removing or sealing these areas under direction of state and federal officials. An existing permit continues to allow a limited volume of PCBs to be discharged to Buzzards Bay. Tests show that less than a half pound per year of these chemicals are discharged through this route.

2. Wastewater Treatment Plant

New Bedford's primary treatment plant was constructed in the early 1970's and became operational in 1975, shortly before the use of PCBs by the two industrial firms was discontinued. Tests dating back to 1975 indicate that PCBs were being discharged with treated effluent in volumes extrapolated to between 200 and 700 pounds per year. Extrapolation of preliminary results of tests done by Massachusetts Department of Environmental Quality Engineering (DEQE) in March of 1982 puts these levels at approximately 240 pounds per year.

From these data it has been suggested that the sewer lines have been contaminated by discharges from the two industrial concerns. Recent tests, results still pending, have been conducted to determine the extent and levels of such contamination.

3. Airborne

Historical tests have indicated four areas of potential airborne input: the New Bedford Landfill, Aerovox, Cornell-Dubilier and the sludge incinerator of the sewage treatment plant.

A 1978 EPA report concluded that it is likely that PCBs are volatilized and transported from the landfill. While there are currently no federal standards for PCB concentrations in ambient air, samples taken at that time indicated that the summertime atmosphere level exceeded the National Institute of Safety and Health (NIOSH) recommended eight hour exposure level. In 1980 the University of South Carolina made air quality tests at the landfill and found upwind levels of 25-53 nanograms/m3. No atmospheric tests have been done since that period although they are proposed under the EPA "Superfund" full field investigation. Since 1978 an estimated 10' of material has been added to the landfill, possibly reducing or eliminating atmospheric input from the landfill. The current input from this source will be tested as part of upcoming EPA Superfund activities.

Testing in March of 1977 by NIOSH at the Aerovox facility approached or exceeded recommended upper limit exposure in several instances. Similar testing at Cornell Dubilier in September of 1978 showed levels between 77-87% of NIOSH limits.

Tests in 1977, funded by EPA, showed that during the incineration of sludge at the sewage treatment plant only 50% of the PCB content was destroyed. It was concluded that release to the atmosphere was in the range of 3-10.6 ug/m3. Other tests have shown lower levels. This subject will also be more clearly defined through the use of Superfund monies.

4. Other

It has been noted that considerable amounts of PCBs have been disposed of at the New Bedford landfill. Another suggested area for disposal is Sullivan's Ledge. In neither case has there been any evidence that PCBs have migrated off site through groundwater. This possibility will be assessed further using Superfund monies.

B. Existing Data

Large amounts of data have been collected by various agencies on the PCB levels in the Acushnet River Estuary and the Harbor area. In order to coordinate and manage data collection efforts and avoid duplication EPA has hired Metcalf & Eddy, Inc. to compile all sampling and analysis information available and establish a preliminary data quality assurance program. Metcalf & Eddy have developed a data retrieval system to facilitate the search for specific information. Data collected includes samples taken of water, air, sediment, waste from the sewage treatment plant and 24 species of aquatic biota as well as human health data.

For each sample the source of the data, the dates of collection and analysis, the results in standardized units, the laboratory where each analysis was performed, and the agency responsible are available. Appendix III describes the data retrieval system in more detail.

In addition to the information cited above, the data bank will include an evaluation of the quality of the data. This will facilitate comparing data and interpreting data results.

The Commission has asked the Environmental Impact Office of EPA (the office managing the Metcalf and Eddy contract) for existing data describing PCB levels in samples taken of:

1) sediment

2) air

3) water column

4) lobster

5) finfish

6) shellfish, and

7) discharge from the sewage treatment plant.

For each item listed the Commission requested the following:

1) results of sampling (where appropriate - range, mean and median)

2) dates the samples were taken

3) identification of agency responsible for the sample

4) a list of what types of tests were done, and

5) the quality of the data.

This material was submitted to the Commission on August 11, 1982 and is available for review.

More recent data provided by the U.S. Coast Guard, which does not yet appear in the EPA data bank, appears in Appendix IV.

Between April 14 and April 21, 1982 the Coast Guard collected sediment core samples at 33 locations within Area 1 of the Estuary. Three cores were taken of varying depths at each location.

Results of these samples indicate that of the three depths sampled the highest PCB concentrations in the sediment are not on the surface but 5½-6½" below the surface. At the greater depths sampled (8½-26") the concentrations were significantly lower. The results also indicate a pattern of PCB dispersion with the higher concentrations very close to the Aerovox Plant. The concentrations are mapped in Appendix IV. From this mapping one can clearly observe a "hot spot" at the Aerovox plant with the center slightly to the south of the plant. It also appears from the mapping that the PCBs are drifting out towards the Harbor, as would be predicted given the flow of the river.

In June 1982 the Coast Guard took 10 additional samples within the same area to further define the hot spot boundaries. Results of that sampling also appear in Appendix IV.

Research in this area is being conducted by scientists from Woods Hole Oceanographic Institution's (WHOI) Coastal Research Center, Dr. Judith Grassle of the Marine Biological Laboratory, Woods Hole, with research support from the Sea Grant Program of WHOI, the office of Marine Pollution Assessment of NOAA, EPA, and the Andrew W. Mellon Foundation. Current efforts focus on biogeochemical transport processes of PCBs in the estuary and Buzzards Bay, general circulation studies, and studies of effects on marine organisms. Background data on current rate, wind velocity and tidal movement has been collected by WHOI and appears in Appendix V. High resolution analytical chemical methods are also being applied to selected samples as a complementary effort to monitoring measurements of state and federal laboratories and contract laboratories. A prototype monitoring program using the common blue mussel has been successfully tested and is part of the U.S. Mussel Watch Program.

An estimated $150,000 in research effort has been focused in several areas in order to provide information useful to definition of the PCB problem and an effective solution. Several of these efforts will continue through 1982-1983. (3)

C. Health Studies

In the greater New Bedford area PCBs are found in certain segments of the population through exposure from occupational sources as well as eating contaminated fin fish and shellfish caught in the Acushnet River Estuary. In February 1981, a collaborative blood testing program was carried out by the Division of Environmental Health

Assessment of the Department of Public Health in which twenty-one persons volunteered to have their blood serum tested for PCBs. In this volunteer group there were persons with occupational exposure to PCBs, as well as exposure from eating contaminated fish and lobsters. The highest level of serum PCBs was in a woman with no known occupational exposure who had frequently eaten fish caught from the Acushnet River. Her serum level was 101 parts per billion (ppb).

In November 1981, the Division of Environmental Health Assessment studied an additional 51 persons (including most of the original 21 persons sampled) for the presence of PCBs in blood serum. In addition, other clinical studies were done to look for a possible relationship between clinical parameters and blood PCB levels. PCB serum levels ranged as high as 343 ppb (due to occupational exposure) with the highest level in a fish eater reported to be 64 ppb.

Analysis of the data failed to reveal any unusual relationships between PCB serum levels and clinical studies, other than a weak association between PCB levels and blood pressure in persons less than 45 years of age.

Table 1 gives a summary of the PCB levels in this group of 51 persons. Sixteen persons had PCB levels above 30 ppb, mostly due to occupational exposure among males. Table 2 emphasizes the latter point by showing that 100% of persons reporting occupational exposure had PCB levels in excess of 30 ppb. The Centers for Disease Control have reported that 99% of the U.S. population have less than 30 ppb of PCB in the blood serum.

Table 3 indicates that persons eating fish from the Acushnet River have an elevated PCB serum level, while Table 4 shows there may be a relationship between blood pressure and PCB serum levels for persons less than 45 years of age. However, due to too few subjects, these data are not corrected for the effect of age on blood pressure. Additional health data needs are described in Section IV.

IV. ADDITIONAL DATA NEEDS

A. Environmental Data

In February of 1982, the Inter-Agency Task Force with the assistance of Representative Roger Goyette's Ad Hoc Committee and Dr. John Farrington of the Woods Hole Oceanographic Institution put together a list of additional data needed before a cost-effective sediment removal program on the Acushnet River Estuary could proceed. These required data include:

1) a precise delineation of PCB sediment concentrations in the New Bedford area, profiled with depth;

2) an elucidation of the physical transport of PCBs in the harbor and out to Buzzards Bay;

3) data on the bio-accumulation of PCBs by shellfish and finfish from both the sediments and the water column.

TABLE 1

SUMMARY OF PCB RESULTS

	MALES	FEMALES	ALL SUBJECTS
Number	39	12	51
Average Level (ppb)	41.7	18.5	36.2
Median Level (ppb)	17	9	15
Range (ppb)	2-343	4-64	2-343
N (%) ≥30 ppb	13 (33%)	3 (25%)	16 (31%)
N (%) ≥100 ppb	3 (8%)	0 (0%)	3 (6%)

TABLE 2

SUMMARY OF PCB LEVELS AMONG SPECIFIC OCCUPATIONAL GROUPS

	ELECTRONIC MANUFACTURING	NEW BEDFORD WASTE WATER TREATMENT PLANT
Number	9	10
Average Level (ppb)	126	13
Median Level (ppb)	68	10
N (1%) ≥ 30 ppb	9 (100%)	1* (10%)
Average Length (years) of Employment (range)	22 (5-38)	5 (1-9)
Range	41-343	6-41

*Worked both capacitor manufacturing plant and waste water treatment plant.

TABLE 3

SUMMARY OF PCB LEVELS AMONG THOSE REPORTING EVER/NEVER EATING SEAFOOD FROM THE ACUSHNET RIVER

	REPORTED EATING ACUSHNET RIVER SEAFOOD	REPORTED NEVER EATING ACUSHNET RIVER SEAFOOD
Number	30	18
Average PCB Level (ppb)	44	26
Median PCB Level (ppb)	17	12
N (%) ≥ 30 ppb	10 (33%)	5 (28%)

	REPORTED EATING ACUSHNET RIVER SEAFOOD	REPORTED NEVER EATING ACUSHNET RIVER SEAFOOD
Number *	26	14
Average PCB Level (ppb)	21	12
Median PCB Level (ppb)	15	10.5
N (%) ≥ 30 ppb	6 (23)	1 (7)
Range	6-68	2-32

*2 persons did not respond to the question. Both had PCB levels of 6 ppb.

TABLE 4

RELATIONSHIP BETWEEN PCB LEVELS AND HYPERTENSION

<45 Years of Age

HYPERTENSION CATEGORIES

	NORMAL	BORDERLINE	DEFINITE	ALL SUBJECTS
Number	17	4	5	26
Average PCB Level	11	19	30	16
Median PCB Level	9	12	18	10
N (%) ≥30 ppb	0 (0%)	1 (25%)	2 (40%)	3 (12%)

>45 Years of Age

	NORMAL	BORDERLINE	DEFINITE	ALL SUBJECTS
Number	9	10	5	24
Average PCB Level	78	52	41	60
Median PCB Level	42	16	41	32
N (%) ≥30 ppb	6 (67%)	3 (30%)	4 (80%)	13 (54%)

NORMAL - Systolic <140 mm, Diastolic <90 mm

BORDERLINE - Systolic 140-159 mm or Diastolic 90-94 mm

DEFINITE - Systolic ≥160 mm or Diastolic ≥95 mm

A more detailed list of the data needs identified by the Task Force appears in Appendix VI. This list identifies generally what types of data are needed; a more specific list will be defined by EPA through its consultant, Metcalf & Eddy after all the available data is evaluated.

EPA has also identified the following additional information needs and has contracted with GCA, Inc. to provide:

1) stack test results of the New Bedford Municipal Sewage Treatment Plant incinerator;

2) a complete profile of harbor bottom sediments of PCBs, metals, PCDDs (polychlorinated dibenzodioxins) and PCDFs (polychlorinated dibenzofurans) detailing concentrations of each chemical at locations chosen by EPA;

3) biomonitoring and sampling results of selected organisms to determine availability of contaminants within the estuary environment.

4) a complete evaluation of the environmental impact of the New Bedford Sewage Treatment Plant;

5) an ambient Air Monitoring Program for PCBs and PCDFs;

6) a description of physical transport processes of the Inner and Outer Harbor areas worthy of further studies;

7) a cost estimate of a feasibility study to evaluate remedial action alternatives; and

8) case support for enforcement efforts including a review of documents and development of mass balances for PCBs leading to an appointment by responsibility among disposers, comparison of source inventories permits and other documents necessary to locate additional sources of heavy metals and PCBs.

The EPA research will satisfy several of the data needs identified by the interagency task force.

B. Health Data

Up to the present, health studies in New Bedford have been limited to volunteers. The data cannot be considered representative of the population of greater New Bedford. The Department of Public Health feels that studies of health effects due to PCBs should include a prospective study of the outcomes of pregnancies of women with known PCB exposure. Such a study would evaluate the infants at birth and follow them through their early growth and development.

The evaluation would also include fertility and chromosome studies in an effort to relate unfavorable birth outcome to possible parental and genetic factors, levels of blood serum PCBs in both the mother and child, as well as PCBs in breast milk of nursing mothers.

The Department of Public Health also proposes to conduct an investiga tion of relationships between certain diseases and PCB exposure. In particular, the greater New Bedford area has a significantly high incidence of diabetes, hypertension and cancer of the stomach. The latter is of interest since PCBs are known to stimulate the lining cells of the stomach and this may represent a carcinogenic stimulus. Other health effects studies have been proposed and are described briefly in Exhibit 5.

Presently, the DPH has underway a small study to estimate the percent of pregnant women in greater New Bedford who may have been exposed to significant levels of PCBs. Funding is being sought for the more elaborate studies mentioned above.

C. Other

An initial assessment of the available data and present plans to acquire additional information reveals that before the "PCB problem" in the Acushnet River Estuary can be resolved, considerable further information is necessary. In summary the information needs can be classified as follows:

1) Clarification of the existing condition and continuing inputs into the system

2) Effects of the contamination within and entering the system have on the human population living nearby and interacting with the system

3) Design considerations for remedial action

It appears that plans presently exist for the collection of the necessary data. Funding constraints, however, have delayed and may continue to delay some data gathering efforts.

V. COST-EFFECTIVE OPTIONS FOR REDUCING PCB CONTAMINATION IN THE NEW BEDFORD HARBOR

The goals of any program to manage PCBs in the estuary and harbor areas should include the following:

A) reduction of human exposure to PCBs

B) reduction of PCB concentrations in the Estuary, Harbor, and Buzzards Bay ecosystems to minimize impacts on commercially valuable fishes, crustaceans, shellfish, and on species valuable to sports fishing.

C) elimination of major obstacles to harbor development

These goals can be achieved through a variety of different management options, however, substantial differences exist in the costs of various options for the control of PCBs. Although cleanup efforts have been initiated in several areas of the country that have been heavily contaminated by PCBs, complete removal may not be either technically or economically feasible. For this reason a variety of management options must be considered.

Information on cost effective options for reducing PCB contamination in the Acushnet River Estuary and New Bedford Harbor is limited primarily due to incomplete data necessary to accurately determine the effectiveness of various options identified.

The Department of Environmental Quality Engineering has hired Malcolm Pirnie, Inc. to evaluate alternative methods of remedial dredging. In a draft report submitted to DEQE on June 19, 1981 (Appendix VII) Malcolm Pirnie, Inc. presented four alternative remedial programs and their expected benefits and costs. The four options identified are:

1) Removal of 50% of the PCBs in the inner and outer harbor (80,000 cu. yds.) (Areas 1 and 2 of Exhibit 2).

2) Removal of PCB contaminated material required for implementation of channel improvement dredging, excavation for Fairhaven Bridge and initiation of small scale harbor development projects (120,000 cu. yds.).

3) Removal of PCB contaminated material required for implementation of channel improvement dredging, excavation for Fairhaven Bridge and initiation of larger scale harbor development (300,000 cu. yds.).

4) Removal of 90% of the PCBs in the inner and outer harbor (900,000 cu. yds.).

Table 5 provides rough estimates of costs for each of the options defined. However, recent conversations with Malcolm Pirnie, Inc. indicate that these alternatives and costs are likely to change substantially in the final report as a result of new data from the U.S. Coast Guard regarding the distribution of PCBs in the harbor sediment.

As indicated in Section III, the data on PCB sediment concentrations, provided by the U.S. Coast Guard, reveal that there is a very well defined "hot spot" (area with very high levels of PCBs) in the estuary which may be the source of PCBs being dispersed throughout the harbor. If this is the case, it may be most cost effective to remove only that hot spot.

In their draft report Malcolm Pirnie, Inc. concluded the following regarding the effectiveness of various options proposed:

1) remedial dredging programs to recover PCBs are technically feasible;

2) existing data are not sufficient to make a reliable assessment of the effects of remedial dredging programs on the PCB levels of commercially and recreationally important species;

3) dredging to remove and contain contaminated harbor sediments as part of harbor development programs can be undertaken separately or in conjunction with remedial dredging programs; and

4) additional sampling and analysis are needed before the effectiveness of any remedial dredging program can be assessed.

TABLE 5

CONCEPTUAL DREDGING PROGRAMS

(1981 Dollars)

Alternative	Dredged Material Volumes, Cu.Yds. Harbor Area	Outer Harbor	Harbor Development	Total	Cost $ Millions
1. 50% PCB Recovery	400,000	900,000	-	1,300,000	35
2. Initiation of Small Scale Harbor Development	-	-	300,000	300,000	15
3. Initiation of Large Scale Harbor Development	-	-	900,000	900,000	25
4. 90% PCB Recovery (includes initiation of large scale harbor development)	4,500,000	1,500,000	-	6,000,000	150

Notes:

Initiation of harbor development projects refers to removal of 3 ft. of harbor muds at sites to be developed.

Small-scale harbor development includes channel improvement dredging, bridge excavation and 35 acres of new harbor development area.

Large-scale harbor development includes channel improvement dredging, bridge excavation and 170 acres of new harbor development area.

Much of the information necessary to assess the effectiveness of dredging options has been identified as data needs by the inter-agency task force and by EPA. DEQE expects a final report from Malcolm Pirnie, Inc. in the fall of 1982, however, due to limited funds the additional information necessary to fully assess the cost-effectiveness of various options will not be complete.

As indicated in Section II, regarding the Superfund process, before any cleanup can take place in the New Bedford Harbor, a feasibility study of the various options under consideration must be carried out. The Malcolm Pirnie report should provide a base of information for the feasibility study and expedite its preparation (which EPA estimates may take anywhere from 6 months to 2 years).

One option not evaluated by Malcolm Pirnie, Inc. is that of no action. This option will be fully evaluated, however, in the feasibility study required for Superfund.

An initial assessment of the consequences of "No Remedial Action" by Dr. John Farrington, Director, Coastal Research Center, Woods Hole Oceanographic Institution indicates that if no action is taken:

A) long term reduction of PCB concentrations in the ecosystem, such that contamination levels are sufficiently reduced to allow shellfishing inside the hurricane barrier, could be as long as twenty years; (4)

B) the harbor would continue to be a source for PCB input to Buzzards Bay and organisms in the outer harbor and western Buzzards Bay would continue to be subjected to contamination and long term pollution stress;

C) controversy over the contamination would continue to require a significant expenditure of administrative and legal personnel time and funds; and

D) the population of the area would be subject to continued and increasing uncertainty regarding health effects.

These factors should be incorporated into any assessment of the "no action" alternative.

EPA has also identified options other than dredging that must be assessed. These include in situ impoundment and in situ treatment. These alternatives have been included in the scope of the Metalf & Eddy contract.

VI. SEDIMENT REMOVAL AND CLEANUP OPTIONS

In determining the most technically and economically feasible option for management of PCBs in the New Bedford Harbor several issues must be addressed:

A) dredging vs. in situ treatment or impoundment

B) appropriate dredging technology and impacts of each

C) large or small scale dredging and areas to dredge

D) dredge disposal sites

Dredging alternatives were considered by the New York State Department of Environmental Conservation in their Environmental Impact Statement for PCB Hot Spot Dredging in the Upper Hudson River. A summary of those alternatives, the status of their technological development and their potential constraints and environmental problems appear in Exhibit 3. A more detailed description of the alternatives appears in Appendix VIII.

Based on the negative environmental and economic impacts posed by the level of PCBs in the Acushnet River Estuary and the Harbor it is likely that at least some dredging will be necessary. Most of the alternatives are either at the conceptual or laboratory stage of development. Although removal of PCBs in the harbor is likely to lower the concentrations of PCBs in the ecosystem, the environmental effects associated with dredging must be considered in any evaluation of dredging alternatives.

The environmental effects of dredging are both physical and chemical. Dredging PCB contaminated sediment would re-suspend PCBs in the water column, allowing it to become more available for uptake of aquatic organisms. The chemical effects occur as a result of increasing the rate of transfer of PCBs to the water.

Various dredging technologies are described in Appendix IX. They fall primarily into three categories: mechanical, hydraulic and pneumatic. Each has benefits and limitations:

Mechanical dredges utilize steam shovel type buckets and remove bottom material by shearing forces. The material is then placed into barges and towed to a disposal area, most often an open water site. Disadvantages of using mechanical equipment include increased cost due to double handling, and need for an open water site. Use of an open water site is essentially ruled out due to the Marine Protection Research and Sanctuaries Act and the Clean Water Act. These Acts, as well as the implementation of the London Ocean Dumping Convention, limit ocean dumping of materials adversely affecting the marine environment, or human health, welfare, or amenities. (5)

Hydraulic dredges remove material by suction of water and sediments through a pipeline with disposal at an adjacent site or into hoppers on the dredge vessel. If a hopper dredge with pump-out capabilities is used, then the disposal area is not limited by pipeline length. The handling of a slurry containing PCBs will require special dewatering techniques. Settling basins and/or flocculants would need to be employed to restrict or limit the release of PCBs back to the receiving water. A technique has also been developed in Japan where pollutants are locked into the dredge material, solidifying the disposed dredged material within a few days. (6)

The pneumatic dredge also called the "Pnuema", uses hydrostatic head pressure and compressed air to remove contaminated sediments. An innovation of the "Pneuma" is the Oozer dredge. The Oozer was developed by applying a vacuum to a pneumatic dredge. With this innovation the Oozer can be used in shallow water, thereby eliminating the constraint of needing high hydrostatic head pressure. (7)

Exhibit 3

METHODS OF MANAGING PCB-CONTAMINATED SEDIMENTS IN THE HUDSON RIVER

Alternatives	Status of Technologic Development	Potential Constraints or Environmental Problems
<u>In-Situ Control</u>		
Degradation by ultraviolet ozonation	Developed for closed system applications	Treatment requires closed reaction vessel
Chemical treatment	Conceptual	Possible ecological side effects
Erosion control of river bottom	Conceptual	Interference with navigation
Covering PCB-contaminated sediments	Conceptual	Massive disturbance of ecosystem. Rupture of seal or ballooning of plastic due to gas formation. Placement and stabilization of cover difficult
<u>Removal</u>		
Bioharvesting	Conceptual	The time and costs involved with harvesting enough fish are prohibitive. Tremendous ecological side effects
Activated carbon adsorption	Laboratory	Technology for application and retrieval has not been proposed
Dredging	Demonstrated on small scale, Fort Edward Channel	Untested on a large scale

Exhibit 3
(Continued)

METHODS OF MANAGING PCB-CONTAMINATED SEDIMENTS
IN THE HUDSON RIVER

Alternatives	Status of Technologic Development	Potential Constraints or Environmental Problems
On Land Control		
Containment in disposal site	Demonstrated at new Moreau site	Lont-term monitoring and maintenance
Incineration	Demonstrated on small scale	Large scale incinerator, extensive use of fuel, wet sediments
Chemical detoxification	Laboratory	Best results with high PCB concentrations
Biodegradation	Laboratory	Aerobic reaction only, with potential undesirable byproducts

Modified from: Horstman (1977) and Hetling et al. (1979)

An alternative to traditional dredging technlogy is the Lightnin Sludge Monster System marketed by Enviro-Process Systems, Inc. of Bronxville, New York. This system can be utilized in rivers or waterways to remove PCB settled sludge without the limitation of conventional dredging systems. Advantages of the system include the following:

A) No operator is required to identify the exact location of the sludge in the bottom, and

B) No disturbance of bottom or re-suspension of PCBs to the top layer of water will occur as will take place with conventional systems.

A more complete description of this process appears in Appendix X.

The feasibility of each of various dredge technologies as well as the effectiveness of dredging different amounts of contaminated sediment is being evaluated by DEQE, through their contract with Malcolm Pirnie, Inc. (8) and through a small scale study undertaken by the New England Governors' Conference.

The New England Governors' Conference study is intended to assess various concerns related to dredging within the harbor area. This includes testing for physical and chemical parameters of the sediments in the northern portion of the Estuary where Coast Guard tests have shown levels of PCB contamination to be particularly high, the so-called "hot-spot". These tests will not address PCBs per se but will report on other considerations required in undertaking dredging activity such as sediment size and sedimentation rates, contamination of the sediments by heavy metals and oils, elutriate tests, E.P. toxicity tests and a bioassay. Using this data, and other literature on the harbor, the study will then address some of the questions that will have to be considered in deciding on a particular technique to be used in sediment removal and disposal.

A major factor in evaluating sediment removal options is finding an appropriate treatment method or site for disposal or long term storage of the contaminated dredge material. Sediment containing PCB concentrations of less than 50 ppm is considered a special waste and can be disposed of in a sanitary landfill with the approval of the local board of health and the Department of Environmental Quality Engineering. However, sediment containing PCB concentrations of 50 ppm or more is considered hazardous under Massachusetts and EPA regulations and must be disposed of in an approved incinerator, a secure chemical waste landfill or in a manner approved by the appropriate EPA Regional Administrator and, if in Massachusetts, by DEQE.

As of this date there are 2 offsite and 7 onsite incinerators and 9 chemical waste landfill sites approved in the U.S. for PCB disposal. The offsite incinerators are:

A) ENSCO, Inc. of El Dorado, Arkansas, which operates the only commercial incineration facility in the U.S. that handles PCB contaminated solids; and

B) Rollins Environmental Services, Inc. of Deer Park, Texas.

Recent conversations with ENSCO indicate that they would be able to handle sediment highly contaminated with PCBs at a price of approximately $1.00/lb. bulk rate.

The Rollins facility at present accepts only PCB liquids but the company expects to receive a permit to incinerate solids this fall.

The seven onsite facilities that EPA has approved include: two General Electric Co. facilities in Waterford, New York, and Pittsfield, Massachusetts; three Dow Chemical facilities in Freeport, Texas, Oyster Creek, Texas, and Placquemire, Louisiana; the LaPorte Chemical Corp. plant in La Porte, Texas; and the Merton Associates facility in Chicago Heights, Illinois.

These onsite facilities are only able to handle liquids.

The approved landfills are:

A) CECOS International Waste Systems, Inc., Niagara Falls, New York

B) SCA Chemical Services, Inc., Model City, New York

C) Waste Management of Alabama, Inc., Emelle, Alabama

D) CECOS International Chemical Waste Systems of Ohio, Inc., Williamsburg, Ohio

E) Casamalia Disposal, Santa Barbara, California

F) Nuclear Engineering Co., Inc., Beatty, Nevada

G) Chem-Nuclear Systems, Inc., Arlington, Oregon (do not take dredge spoils)

H) Wes-Con, Inc., Grand View, Idaho (do not take dredge spoils)

I) Waste Management, Inc., Kettleman Hills, California

In New York State, contaminated sediment from the Hudson River will be encapsulated in a special secure landfill approved by the EPA administrator for Region II. The proposed site in Washington County consists mostly of clay which is relatively impermeable. A clay cap will top the landfill providing complete enclosure. A pilot encapsulation site located in Saratoga County was constructed in 1978. It has been successfully containing contaminated river bed dredgings within its clay enclosure since that time.

NEWLY DEVELOPED TECHNOLOGY FOR PCB DESTRUCTION

The number of PCB disposal/treatment technologies has increased significantly in the past few years, however, most of them do not address PCB contaminated sediment. M.D. Dillon, Ltd. of Toronto, Ontario, recently completed a report for Environment Canada that identifies 81 different PCB destruction systems that have either already been proven or that merit consideration. These processes fall into four categories: conventional incineration, variations on incineration, chemical detoxification, and physical-chemical technologies. A complete list of these processes, including their operating features, the levels of destruction they achieve, the location of faciliites at which they have been used, and the cost of applying them will be available from Environment Canada in late August.

A recent trend in PCB incineration is the develpment of mobile incinerators. These facilities would eliminate waste transportation costs and may encounter less public opposition than permanent facilities. EPA is now planning field tests of a unit developed by MB Associates of San Ramon, California, to incinerate pure PCBs. Pyro-Magnetics Corp. of Whitman, Massachusetts has also developed a mobile unit which, in test burns, has achieved PCB destruction efficiency of 99.999943 percent for PCB liquid. The unit has already been approved by EPA Region I and Pyro-Magnetics expects the unit to be approved by all 10 EPA regions in the near future. PyroMagnetics is also constructing a second mobile unit -- a rotary kiln incinerator -- which would incinerate solids. The company expects that this unit will have completed its tests in early 1983. ENSCO, Inc. is also negotiating a contract with a Japanese firm to produce a mobile PCB incinerator using ENSCO technology. (9)

Another type of mobile unit is the ocean incinerator ship, Vulcanus, owned by Chemical Waste Management (CWM). On July 16, 1982 CWM conducted a test burn of 700,000 gallons on the Vulcanus, in the Gulf of Mexico and is waiting for approval from EPA to burn an additional 2.8 million gallons. The Vulcanus can burn 4,000 gal./hr. and has a holding capacity of 85,000 gallons, however, the waste must be liquid and pumpable. CWM has announced that in 1983 it will launch the Vulcanus II, a second incinerator ship that will burn solids. (10)

Although technically and environmentally possible, incinerating PCB contaminated sediment is an expensive undertaking. Fuel costs alone in 1978 were calculated to be over $10/cu. yd. (11)

Wright-Malta Corporation of Ballston Spa, New York has devised a gasifier-gas turbine system that can generate electric power from solids and liquid wastes. A one megawatt pilot plant could be constructed with operation to commence within two years. It could handle a mixture of 20 tons of solid waste and 30 tons of sewage sludge per day or 15 tons of solid waste and 35 tons of dredge spoil per day. Approximately 10,000 tons (11,000 cu. yd.) of dredged material would be treated per year at an estimated total annual operating cost of $650,000. Revenues from electricity generated would cover the costs of operation and amortization of equipment over a period of approximately 10 years. This project is still in the development state, however, but is expected to be available for use in 2 years. A more detailed description of the process appears in Appendix XII. (12)

Acurex Waste Technologies, Inc. of Mountain View, California, Sun Ohio of Canton, Ohio and Goodyear Tire and Rubber Co. of Akron, Ohio have received EPA approval for mobile treatment units that use a sodium based chemical dechlorination process. These processes can treat transformer oil containing up to 17,000 ppm PCBs in a manner that does not produce any hazardous emissions or by-product and that does not destroy the treated liquid. Chemical detoxification process for PCBs cost between $2 and $10 per gallon. At this time there have been no chemical treatment processes developed to deal with PCB contaminated sediment. (13)

A possible option in dealing with PCB contaminated sediment is to leach the PCB oil out of the soil and destroy the PCBs in an incinerator which can destroy PCB liquids. Petrotrap of Westport, MA has developed such a process using a selective membrane which can leach out organics and catch them in a "trap". The process can even be used underwater to prevent migration of PCBs while dredging. The costs are approximately $135/40 ft. of the reusable membrane (petrotrap).

More study is needed of the various options described before an informed decision can be made regarding a cleanup strategy for the New Bedford Harbor. This will be carried out by EPA in the feasibility study required by Superfund.

VII. BUDGET FOR MANAGEMENT OF THE PCB CLEANUP PROGRAM

In February 1982 the inter-agency task force developed a budget for the management of PCB control efforts in the Acushnet River Estuary and the New Bedford Harbor. The budget included funding for four areas:

A) project management and consulting services ($1,200,000)

B) health effects studies ($333,710)

C) physical, chemical and biological characterization and monitoring ($1,037,560), and

D) law enforcement and local coordination ($651,000)

The complete budget totaled $3.2 million and appears in Appendix VI. Since that time some of the specific tasks listed have been completed and new tasks have been identified. As a result, a new, more complete, budget has been developed and submitted to EPA as a preliminary Phase I Funding Allocation Request under Superfund procedures. This funding request appears in Appendix VIII. This represents only interim projects to be worked on while the EPA RAMP and feasibility studies are being completed and as such make up only a portion of the total project costs.

Total cost estimates for cleanup have ranged from $30M for 50% PCB removal to $130M for 90% removal of the contaminated sediment. (14)

It is probable that Superfund will not be able to cover the total costs of cleanup. As a result, funding sources must continue to be explored and tapped as soon as possible.

VIII. POTENTIAL FUNDING SOURCES FOR CLEANUP

Potential funding sources for cleanup of the Estuary and the Harbor were developed by the Interagency Task Force and appear in Appendix XIV.

From the original list of 22 possible resources, the list was narrowed down to the half dozen most likely sources of successful funding, based largely on past experiences of other states with similar problems. The list includes the following:

A) USEPA, Superfund: a fund for the federal government to effec tively deal with threats to public health and the environment from uncontrolled hazardous waste sites. In late July 1982, EPA selected New Bedford Harbor as a Superfund site thus making it eligible for such monies. Superfund, however, is limited in the amount of monies that can be dispensed for one site. Secondly, there is a time element when monies for this site actually become available. To have the site make the list is an initial success. To receive the monies from the funds is the next hurdle.

B) USEPA, Clean Water Act Amendment: Special projects can be attached to the Act as an Amendment. Funding for the New York Hudson River PCB problem site was successfully obtained with such an amendment. Congress in September 1980 authorized extension of $20 million for this project. This sum was one half of what the state requested.

New Bedford Harbor may be similarly considered with adequate support.

C) USEPA, Clean Water Act-special legislative appropriation. The environmental impact statement of the Waukegan Harbor, Illinois site was funded by this source. This action was before Superfund legislation existed. New Bedford Harbor, with proper support, may be able to obtain similar funding.

D) USEPA, Clean Water Act Construction Grant, Section 201. These grants address the collection and treatment of water. This avenue was explored for funding for the Hudson River, New York PCB contaminated site. It was rejected by EPA. This does not automatically disqualify New Bedford Harbor, however. With adequate support this source of funding may be possible.

E) USEPA and others, Research and Development grants. Portions of the New Bedford Harbor budget may be applied for under this category. If a research grant to study the problem can help define the problem better, this type of grant should be examined for possible funding. This funding option under the Clean Water Act was explored for the Hudson River, New York site. It was rejected because there was not enough money in the fund and the award system included a competition for the funds.

F) FEMA, Disaster Relief Grant. A Presidential disaster declaration is necessary before funds can be obtained under this option. To obtain such a declaration, the Governor would have to make a request to the President for such and would have to prove that the disaster is beyond the scope of the state or local government to handle.

IX. GUIDELINES TO BE ADOPTED FOR CLOSING AND REOPENING OF AREAS WITHIN THE ACUSHNET RIVER ESTUARY FOR COMMERCIAL FISHING, SHELLFISH HARVESTING AND OTHER MARINE RELATED ACTIVITIES.

The Massachusetts Department of Public Health and the Dept. of Fisheries, Wildlife and Recreational Vehicles/Division of Marine Fisheries have recently developed a sampling protocol for lobster in order to obtain consistent and meaningful data with which to develop guidelines for the closing and reopening of harbor areas for fishing and shellfish harvesting. This sampling protocol appears in Appendix XV.

Any guidelines must account for several factors in the variability of sampling results. These variations are a result of the difficulty in arriving at representative samples and include variation due to seasonal migration of the lobsters and differences in abilities of lobsters to metabolize PCBs.

Guidelines have recently been proposed by the Dept. of Public Health and are being reviewed by the Dept. of Environmental Quality Engineering and the Division of Marine Fisheries. A final version should be available by the fall of 1982.

X. NECESSARY LAW ENFORCEMENT RESOURCES TO CONTROL ACCESS TO AREAS WITHIN THE ESTUARY AND BUZZARDS BAY

Although the Massachusetts Department of Public Health has closed areas I, II and III of the Estuary and the harbor to fishing, commercial and recreational fishing for shellfish, finfish and eels persists. Adequate enforcement action is necessary to ensure that the health of local residents is protected.

The Division of Law Enforcement of the Department of Fisheries, Wildlife, and Recreational Vehicles is responsible for the enforcement of the fishing bans. The Division recently lost two of its boat officers due to legislative cuts of the state budget. This places a severe burden on the Division's ability to ensure that unlawful harvesting of fish from areas contaminated with PCBs will be curtailed.

In order to provide the degree of protection necessary the Division of Law Enforcement recommends that the two boat officer positions cut by the legislature be restored and that 2 new positons for land based Natural Resource Officers be created. The Division estimates that the cost for these 4 positions is approximately $120,000/year including salary, vehicles and equipment. Three years of enforcement are expected at this time so that the total estimated costs for enforcement come to $360,000. (This figure represents a more current assessment of enforcement needs than the $561,000 estimate included in the interagency task force budget.)

In addition to the need for additional personnel and resources, the Director of the Division of Marine Fisheries recommends that the areas subject to closure be designated a fisheries management area. This would give the Division much more power to enforce the laws by giving them the authority to remove gear and make arrests. Presently, they do not have this authority.

XI. STATUS OF ENFORCEMENT ACTIONS TAKEN BY STATE AND FEDERAL AGENCIES

EPA and DEQE have issued administrative/enforcement orders for Aerovox and Cornell-Dublier to clean up PCB residues at the site of generation and to eliminate any PCB discharge. The orders have been assented to by the companies. The consent agreements do not include settlements for any off-site cleanup. This is still being negotiated.

XII. TIME FRAME FOR ADDITIONAL MATERIALS

A time frame for data that is presently being collected by EPA through its contract with GCA appears below. This will greatly facilitate planning efforts.

TASK	PROPOSED DATE*
A) STP Stack Test	
1) Prepare Test Plan	Sept.
2) Plan Review	Sept.
3) Sampling	Sept.
4) Analysis	Nov.
5) Submit Report	Dec.
B) Ambient Air Monitoring	
1) Prepare Test Plan	Aug.
2) Plan Review	Aug.
3) Sampling	Sept.
4) Analysis	Oct.
5) Submit Report	Nov.
C) Sediment Profile	
1) Chart Existing Data	Completed
2) Collect 1st Set of Samples	Completed
3) Analysis	Sept.
4) Collect 2nd Set of Samples	Sept.
5) Analysis	Oct.
6) Submit Report	Nov.
D) Physical Transport	
1) Prepare Test Plan	Sept.
2) Conduct Study	Nov.
3) Submit Report	Dec.
E) Landfill Monitoring	
1) Prepare Test Plan	Oct.

*As of August 12, 1982

XIII. RECOMMENDATIONS

Cooperation among the multiple agencies involved in this issue is essential in order to avoid duplication of efforts, unnecessary expenditures and further delays. An overall roadmap or plan is clearly needed to provide direction to the local, state and federal agencies involved. The plan would also be used to measure progress made and to provide accountability of actions to be taken by the responsible parties.

The Remedial Action Master Plan (RAMP) to be developed by EPA in conjunction with state environmental and public health agencies, should fill this need.

At this point, without additional data, more specific recommendations are limited. However, in general the Commission recommends that:

1) The $1,033,000 required to conduct the necessary epidemiological and blood studies recommended by the Department of Public Health be obtained immediately from EPA/Superfund;

2) the Massachusetts legislature pass the proposed legislation to establish a $25 million Massachusetts Superfund to cover any remedial action not covered by Superfund or other Federal funds;

3) all data gathering efforts necessary to initiate dredging for Fairhaven Bridge and other development projects be given top priority so that these activities can begin without unnecessary delay;

4) each cleanup action phase be accompanied by an evaluation program to assess environmental impacts and provide data for future remedial action decisions;

5) the Department of Marine Fisheries and the Department of Public Health establish a workable guideline for opening and closing areas to the harvesting of shellfish, finfish and lobsters;

6) the Division of Law Enforcement continue to enforce all fishing bans that remain in effect; and

7) the life of the Commission be extended for at least six months to allow review of the EPA Remedial Action Master Plan, reconciliation of the budgets and tasks presented by various agencies, and preparation of a final report.

The Commission firmly believes that the problem of PCB contamination of the Acushnet River Estuary is a significant one that requires cooperation of local, state and federal governments as well as of private institutions. Unless efforts are coordinated unnecessary delays and expenditure will result.

Although remedial action should proceed as quickly as possible all options should be carefully evaluated before any decisions are made and any management strategy should consider, first and foremost, the health and welfare of the citizens of New Bedford and surrounding areas.

FOOTNOTES

(1) For more background on PCB contamination in the Acushnet River Estuary see Appendix I: "PCB Pollution in the New Bedford, Massachusetts Area: A Status Report", June 1982.

(2) Memorandum from William N. Hedemen, Jr., Director, EPA Office of Emergency and Remedial Response to Regional Superfund Coordinators, June 22, 1982.

(3) Memorandum from Dr. John Farrington, Woods Hole Oceanographic Institution, August 16, 1982.

4) It should be noted, however, that all of New Bedford Harbor from Ricketson's Point north except Clark's Cove has been closed to shellfishing for 20 to 30 years because of bacterial contamination resulting from sewerage effluent. As long as municipal and industrial discharges continue it is impossible to predict when shellfish areas may be reopened and, in fact, may be totally unrelated to PCB contamination.

(5) Tomczyk, R., "A Report on the PCB Data Needs and Dredge Techniques for the Acushnet River - New Bedford Harbor Area", Mass. Division of Water Pollution Control internal report, Boston, MA. (August 17, 1981).

(6) Ibid.

(7) Hetling, L. et al., "Summary of Hudson River PCB Study Results". New York State Department of Environmental Conservation Technical Paper No. 51, Albany, New York (July 1978).

(8) The scopes of work for the Metcalf and Eddy, GCA, and Malcolm Pirnie contracts appear in Appendix XI.

(9) "Disposal and Treatment Technologies for Hazardous Wastes", Hazardous Materials Intelligence Report (Special), 23 July 1982, Vol. III, No. 30.

(10) Ibid.

(11) Hetling, L. et. al.

(12) Ibid. (cost figures from conversation with Wright-Malta, Inc. on August 12, 1982.)

(13) "Disposal and Treatment Technologies..."

(14) Draft Report - Malcolm Pirnie Inc. (as stated in Section V these cost estimates are subject to change in the Final Report).

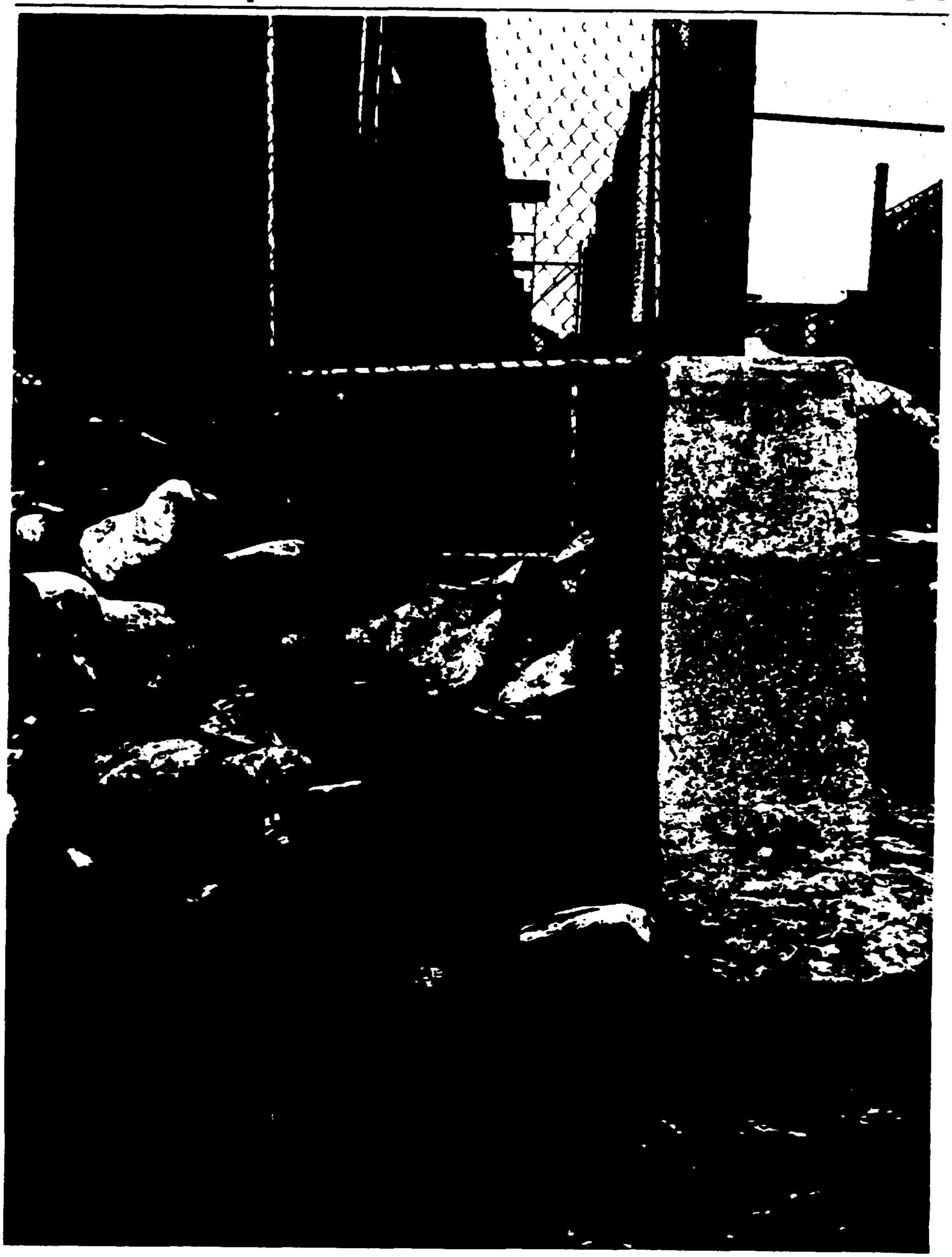
APPENDIX I:

"PCB Pollution in the New Bedford, Massachusetts Area: A Status Report", June 1982

PCB Pollution in the New Bedford, Massachusetts Area:

A Status Report

June 1982



grant weaver, environmental engineer
Massachusetts Coastal Zone Management

PCB POLLUTION IN THE NEW BEDFORD, MASSACHUSETTS AREA

A STATUS REPORT

- June 1982 -

Commonwealth of Massachusetts

Edward J. King, Governor

Executive Office of Environmental Affairs

John A. Bewick, Secretary

Office of Coastal Zone Management

Richard F. Delaney, Director

Submitted to the

Massachusetts New Bedford PCB Task Force

Thomas C. McMahon, Task Force Chairman

John A. Bewick, Secretary of Environmental Affairs

Edward J. King, Governor

Grant Weaver, Environmental Engineer

Massachusetts Coastal Zone Management

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ABSTRACT

A Summary of PCB Contamination in the New Bedford, Massachusetts Area

* The area of PCB contamination extends from the northernmost extreme of the Acushnet River Estuary to the sediments in the vicinity of the New Bedford municipal wastewater outfall, a distance of over six miles.

* Harbor sediments contain PCBs in levels up to 190,000 parts per million, or 19 percent. Concentrations in the thousands of ppm are common in the tidal flats near Aerovox Incorporated. These sediments exceed the federal hazardous waste criteria by several orders of magnitude.

* 18,000 acres of a large, productive lobstering ground are closed to fishing. Lesser, yet significant, areas are closed to the taking of finfish and shellfish.

* Finfish have been found to contain PCBs at concentrations exceeding one hundred parts per million.

* Sampling at two industrial properties has documented the existence of high levels in upland sediments: 24,000 ppm (dry weight) at Aerovox and 99,000 ppm (dry weight) at Cornell Dubilier.

* The municipal wastewater treatment plant sludge, grit and effluent contain elevated levels of PCBs.

* The New Bedford municipal landfill is believed to contain one-half million pounds of PCBs.

* Other dump sites are suspect.

* Limited human blood analyses suggest that the blood of heavy fish eaters and industrially exposed individuals contain elevated levels of PCBs. No associated health effects have been documented.

INTRODUCTION

What is a PCB?

Polychlorinated biphenyls (PCBs) are industrial compounds which were commercially manufactured and marketed in the United States during the years 1929 to 1977. The Monsanto Corporation of St. Louis, Missouri, the United States' only industrial producer of PCBs, marketed PCB blends under the trade name "Aroclor". In recent years, all American made PCBs were manufactured at the Sauget, Illinois factory (1). Although approximately 210 different PCB molecules may exist, only about ten commercial blends, or Aroclors, have been widely marketed in the United States.

The total production of PCBs by Monsanto during the approximately fifty years of manufacture is believed to have totaled approximately 1.4 billion pounds. In the years 1970 to 1977, 35 to 40 million pounds were produced annually (2,3). 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 (4).

The chemically stable, non-flammable nature of PCBs together with their high boiling point, low solubility and high dielectric constant make these chemical compounds nearly ideal for many industrial uses. Unfortunately, these same properties allow PCBs to persist in the environment and bioconcentrate, creating a potential hazard to the environment.

In New Bedford, PCBs have been used by Aerovox Incorporated and Cornell Dubilier Electronics Incorporated (and possibly Acushnet Capacitors, Inc.) in the production of electronic capacitors.

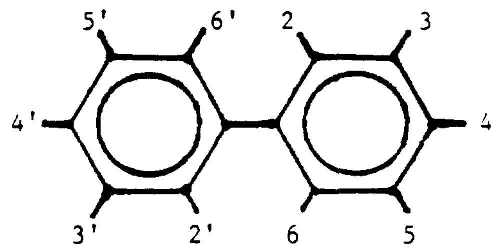
Nationally, PCBs have been used as liquid coolants in transformers, as flame retardants, lubricants, machine tool cutting oils and hydraulic fluids. PCBs at one time were used in the production of carbonless reproducing paper, food packaging materials, printers' ink, recycled paper, floor tiles, waxes and asphalt.

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. Two other Aroclors, 1254 and 1252, were used in lesser quantities by Aerovox and Cornell Dubilier. All use of PCBs in New Bedford stopped in 1977 (4).

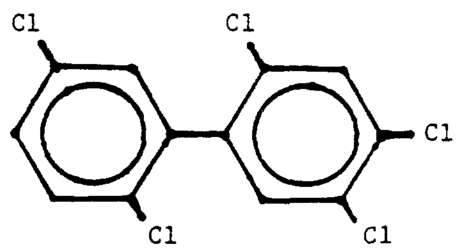
Aroclors are manufactured as mixtures of various PCBs. The four digit number which follows the trade name Aroclor characterizes the blend of polychlorinated biphenyls. Except for Aroclor 1016 which was not named according to protocol, the first two digits identify the product as a biphenyl. The final two digits express the approximate percentage of chlorine (by weight) in the

PCB blend. For example, Aroclor 1254 is a blend of biphenyls with an average chlorine content of fifty-four percent. Aroclor 1016, the exception to this rule, is a biphenyl blend containing 41 percent chlorine.

The physical characteristics of PCBs vary according to the mixture. As the chlorine content increases, the Aroclors change from a colorless oil to a sticky resin to a white powder and their persistence in the environment increases (5). The general chemical structure of a PCB molecule (1,6) is shown below. Chlorine atoms are substituted for hydrogen at any numbered location on either benzene ring.



As an example of a specific PCB isomer, the structure of 2,2',4,5,5' - Pentachlorobiphenyl is diagrammed below.



Although 2,2',4,5,5' - Pentachlorobiphenyl is 54 percent chlorine by weight, this molecule is not the sole constituent of Aroclor 1254, nor is Aroclor 1254 composed entirely of molecules with five chlorine atoms. Instead, as shown in Table 1, Aroclor 1254 is a blend of biphenyls containing three to seven chlorine atoms.

Table 1.
Typical Percentage Composition of
Polychlorinated Biphenyl Products*

Number of Chlorine Atoms per Molecules	Aroclor 1221 (21 % Cl)	Aroclor 1016 (41 % Cl)	Aroclor 1242 (42 % Cl)	Aroclor 1254 (54 % Cl)
0	11	LT. 0.1	LT. 0.1	LT. 0.1
1	51	1	1	LT. 0.1
2	32	20	16	LT. 0.5
3	4	57	49	1
4	2	21	25	21
5	LT. 0.5	1	8	48
6	ND	LT. 0.1	1	23
7	ND	ND	LT. 0.1	6
8	ND	ND	ND	ND

LT - less than
ND - none detected, i.e., less than 0.01 percent

* this table was taken from Tucker, et al. (7), page 707.

How are PCBs Measured?

Very small concentrations of polychlorinated biphenyls can be detrimental. Therefore it is important to use extremely sensitive analytic procedures in measuring PCBs. Precise measurements of PCBs in concentrations of parts per billion (ppb) are commonly required. In fact, EPA has recommended a water quality standard slightly below 1 part PCB per trillion parts of water to protect marine aquatic life (8).

PCB analyses are generally conducted utilizing a gas chromatograph (GC). A known standard is injected into the GC and a fingerprint of the standard is produced. A fingerprint chromatogram of Aroclor 1242 is shown in Figure 1. The sample to be analyzed is extracted with a solvent, cleaned on a column and is similarly injected into the gas chromatograph instrument to produce a chromatogram such as that shown in Figure 2.

Representative peaks from the standard chromatogram are matched with those from the sample chromatogram to determine the presence of the various Aroclors. The concentrations of the Aroclors are quantified by comparing the areas under the peaks of the sample with those of the standard. Figure 3 shows a chromatogram of herring gull eggs with Aroclor 1016/1242 and Aroclor 1254 representative peaks noted. The eggs from which this sample was taken contain approximately 5 parts per million (ppm) total PCBs. Note: Aroclors 1016 and 1242 are difficult to distinguish and are often reported together as Aroclor 1016/1242.

A more sensitive measurement of discreet PCB compounds (as opposed to blends) can be obtained by coupling a mass spectrometer (MS) with a conventional gas chromatograph instrument. When GC/MS is used, a vast amount of data is generated which when recorded, processed and displayed by a small or medium-sized laboratory computer produces a mass chromatogram such as that shown in Figure 4. As in conventional gas chromatography analyses, the product of GC/MS testing is a fingerprint which can be matched against a standard fingerprint to quantify the sample concentration. Through the use of computer analogs this process can be conducted accurately and automatically.

Gas chromatograph / mass spectrophotometer analyses are too expensive to allow for widespread use. It is not uncommon, however, to verify conventional gas chromatography results with occasional GC/MS measurements. what is cost approximately (?)

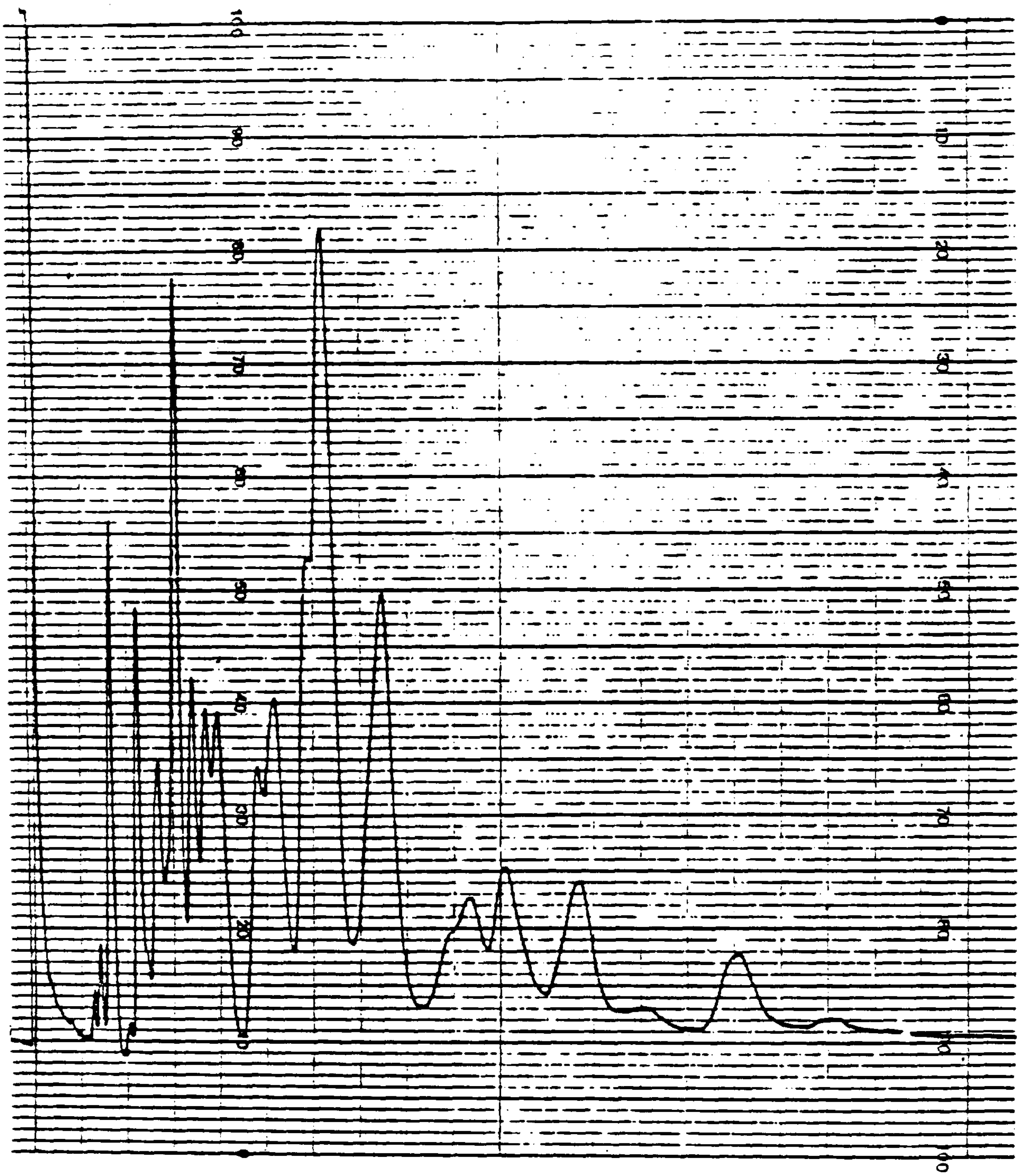


Figure 1. Chromatogram of an Aroclor 1242 standard.
from: Stratton, et al. (9), page 31.

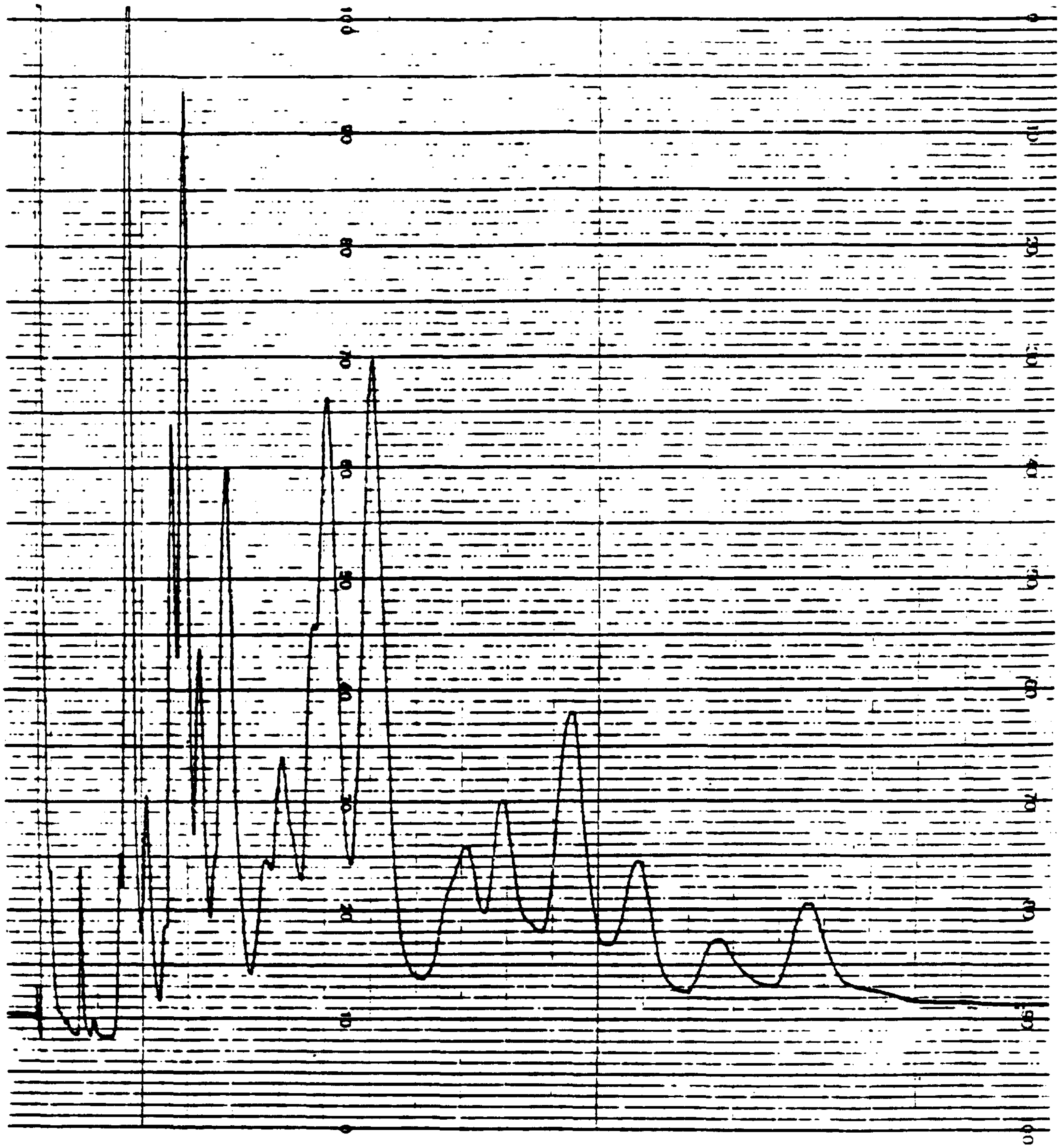


Figure 2. Chromatogram of a One Hour Ambient Air Sample Taken at the New Bedford Municipal Landfill.
from: Stratton, et al. (9), page 30.

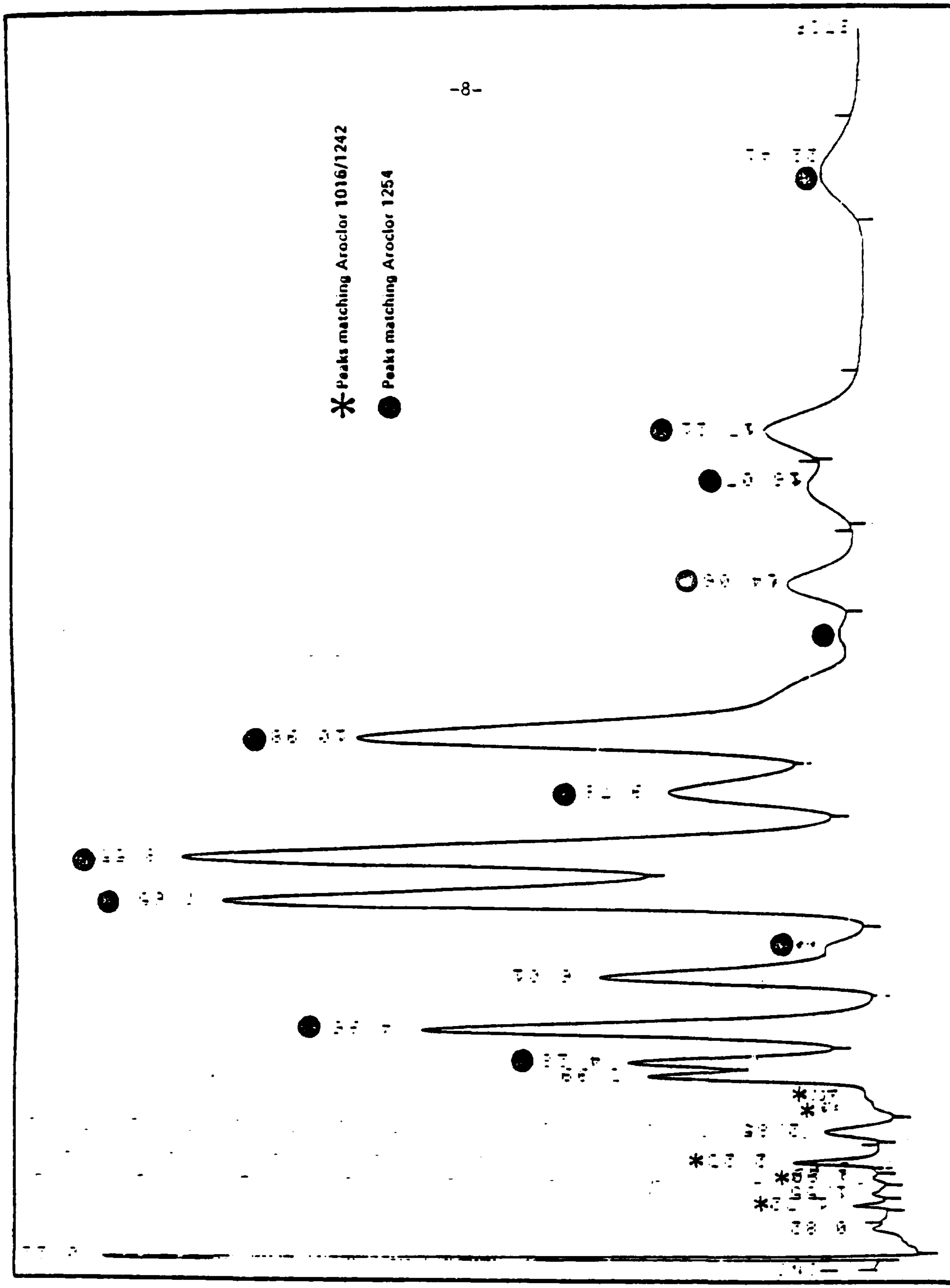


Figure 3. Chromatogram of a Herring Gull Egg.
from: Stratton, et al. (9), page 29.

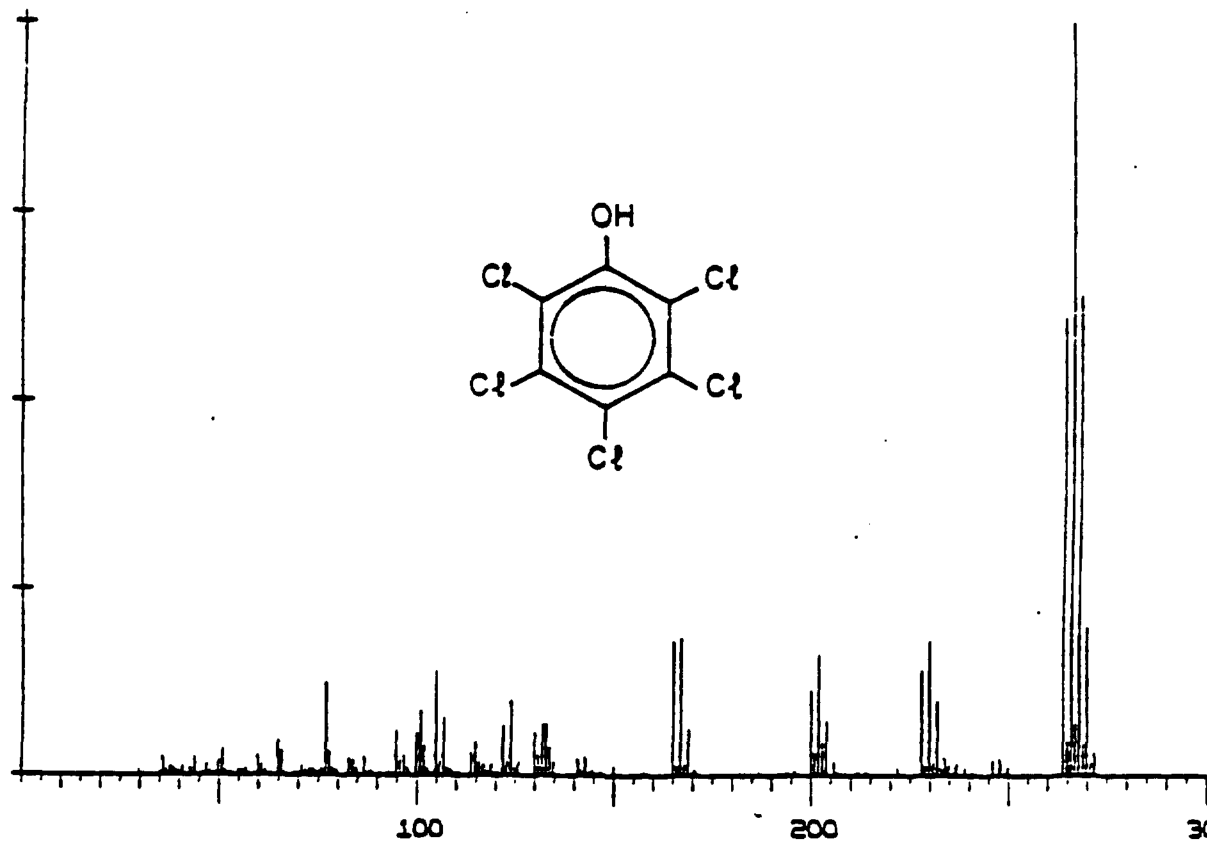


Figure 4. Gas Chromatograph / Mass Spectrophotometer Analysis of Pentachlorophenol. from: Biemann (10).

HEALTH AND ENVIRONMENTAL EFFECTS OF PCBs

PCBs are the only class of chemical compounds whose manufacture has been banned by the U.S. Environmental Protection Agency (11). Scientific studies have documented the toxicity and biological hazard of PCBs to many organisms. Several studies are referenced in this section.

First recognized as a problem by scientists in 1954 (12), PCBs came to world-wide attention in 1968 when over 1,000 individuals in Yusho, Japan became ill after consuming rice bran oil which had been contaminated with Kanechlor 400, a Japanese brand of PCB containing 48 percent chlorine (by weight). The average amount of PCB consumed by affected individuals was 2 grams (2,000 milligrams), with symptoms appearing at doses as low as 500 milligrams. As a result of this incident Japan subsequently banned all import and production of PCBs (2).

PCBs made big news in this country when it was discovered that high levels of these compounds were present in Lake Michigan salmon. Today these compounds are found all over the globe and in such diverse locations as Arctic polar bears, New York State chickens, England's rainfall, the world's oceans and human milk (2).

Severe injury from short-term exposure to PCBs is unlikely, however scientists are concerned about the effects caused by long-term, low level exposure to these compounds.

PCBs have a low solubility in water and due to their low volatility in air they are not normally found in these media at concentrations greater than one part per billion (water) and nanograms per cubic meter (air). These low concentrations may nonetheless be significant. Thus, even though PCBs may be present at levels too small to be detected without sophisticated laboratory equipment, such concentrations can cause concern.

PCBs contained in sediments are generally not directly available for biotic uptake. The primary pathway of terrestrial PCB pollution occurs as PCBs enter the atmosphere and attach to fine particles and deposit on vegetation to enter into the food chain. In aquatic environments, PCBs enter the water column and attach to single celled organisms which are ingested, thereby entering the food chain. It is believed that PCBs polluting the air can be inhaled and directly enter the body. Also, fisheries studies have shown that aquatic organisms can directly absorb PCBs from the water column (13).

Relatively few measurements of ambient air PCB concentrations have been made in this country. The information that is available indicates that atmospheric PCB levels for oceanic and rural areas range from 0.002 to 1.6 ng/m3. Measurements from urban metropolitan areas are also quite variable and range from 0.5 to 36 ng/m3 with an average of 4 ng/m3 (1).

The concentration of PCBs in fresh water is generally in the range of 1-3 ng/l (parts per trillion). The waters of Lake Michigan are believe to contain an average PCB level of 31 ng/l (1).

There is great regional variation in the degree of PCB contamination in freshwater sediments throughout the U.S. The highest PCB levels are in industrial areas, particularly in the eastern part of the country. The area from the Pacific coast to the Continental Divide has the lowest PCB level in sediments ranging from 2-20 ppb. The highest "background" values reported are in the Appalachian Mountain-Atlantic coast region where values of 100-200 ppb are found to be common (1).

Data on PCB levels in oceans are very limited. Existing data indicate generally higher PCB levels in the waters of the North Atlantic than in the Pacific Ocean and Gulf of Mexico. Surface water values in the New England coastal region range from 0.8 to 8 ng/l (parts per trillion) (1). Surveys of marine sediments in the North Atlantic Ocean vary considerably. For example, off Nova Scotia values were undetectable; off Long Island and New Jersey, PCB levels were 10 and 40 ug/kg (or ppb) respectively (1); and in an area of the Acushnet River estuary in New Bedford, Massachusetts, samples measured several thousand parts per million PCBs (14,15).

PCBs are not generally detected in agricultural soils. The estimated average soil concentration for metropolitan areas in the U.S. is about 2 ug/kg (ppb) (1).

The extent of PCB contamination in foods has been monitored by the U.S. Food and Drug Administration and the U.S. Department of Agriculture since 1969. Their surveys indicate that the incidence and levels of PCBs have dropped in nearly all food classes. By 1975, the only significant sources were fish, meat, and dairy products; and fish was by far the most significant source. Comprehensive fish surveys conducted by the USFDA in 1973 and 1974 indicated a drop in the incidence of PCB detection in fish from less than 30 percent in 1973 to less than 20 percent in 1974. Even though the incidence dropped, however, the fraction of fish found to contain PCBs at levels exceeding 5 ppm increased. These surveys provided no information about sport fish per se, yet indicated that high levels of PCBs do not generally occur in saltwater fish (16).

The Environmental Protection Agency has estimated that half of the U.S. population contains 1-2 ppm of PCBs in their adipose (fat) tissue (8). Human PCB exposure generally occurs through environmental exposure. PCBs are commonly found in the fat of people who have not been occupationally exposed. PCBs concentrate mainly in fat, although they have also been found in the kidney, liver, brain, muscle and blood.

Because human milk is largely fat, compared to other body fluids it contains relatively high levels of PCBs. The average PCB concentration found in a 1977-78 study of human milk in Michigan women was 1.5 ppm, measured as a fat basis (17). Breast fed infants may receive more than 50 times the concentration of PCBs that is in the food eaten by their mothers (2).

Human Health Effects

Human exposure to PCBs can occur through a number of different routes: occupational exposure, ingestion of contaminated foods or water, exposure to contaminated air, soil or water, as well as transmission from mother to child through breast feeding. Because of the low concentrations and the subtle nature of the toxic effects, it is extremely difficult to correlate changes in the health of human and animal populations with environmental exposure to PCBs.

Although a large percentage of the human population has been exposed to PCBs, there are only a few well documented cases of health problems associated with such environmental exposures. Therefore, a detailed evaluation of the effects on human health in the general population is not currently available.

The largest recorded case of "PCB poisoning", which occured in Yusho, Japan in 1968, serves as a good example of the complications encountered when attempting to correlate cause and effect. The typical clinical findings of "Yusho" disease included chloracne with increased pigmentation of the skin, increased eye discharge, transient visual disturbances, feeling of weakness, numbness in limbs, headaches, and disturbances in liver function (2,16). Follow up research revealed that infants born to women exposed were born with brown pigmentation of the skin and were smaller than normal. These health effects slowly regressed as the infants aged.

Because PCBs are slowly excreted in breast milk, infants born up to 3 years after the mother's exposure had abnormal skin pigmentation, presumably caused by suckling on contaminated breast milk. While many of the clinical effects of PCBs are reversible, it may take several years for the symptoms to disappear. This phenomenon is probably a result of the long biological half-life of the contaminant (1,18).

Originally, the effects seen in the Yusho incident were attributed to PCBs. However, subsequent measurement by gas chromatography indicated that the rice oil contained not only 1,000 ppm PCB (19), but also 5-8 ppm of polychlorinated dibenzofurans (PCDFs) and polychlorinated quaterphenyls (PCOs). These contaminants amounted to one to three and one-half times the concentration of PCB in the oil (20,21).

Uncertainty about the confounding effects of PCBs, PCDFs and PCOs make it difficult to determine from the Yusho data exactly what effect, or effects, exposure to PCBs alone could have on humans. The toxicity of PCDFs are considered to range from 200 to 500 times that of PCBs (22) and PCDFs have been associated with embryonic mortality and birth defects observed in experiments conducted on birds. There is presently little information available on PCO toxicity. However, fat and blood samples taken from Yusho patients demonstrated that PCOs were elevated in the tissues of the exposed individuals.

PCBs have been found to be easily absorbed through the gastrointestinal tract, respiratory tract and skin. They are initially stored in liver and muscle tissues and then redistributed primarily to fat tissues. The degree to which PCBs are stored in the body or excreted depends upon the degree of chlorination of the PCB isomers. PCB isomers having a higher number of chlorine atoms are metabolized and excreted more slowly and accumulate to a higher extent in fat tissue. It is likely that metabolized PCBs are excreted in bile, urine and milk. Unmetabolized PCBs may be excreted in the feces, milk, hair and urine. Excretion in the urine is most prominent for the least chlorinated, while the bile becomes the more significant route of excretion for more highly chlorinated isomers. PCBs can be transferred to the fetus transplacentally and to infants by breast feeding (1,23).

PCBs have profound toxic effects on human health, particularly when repeated exposures occur. PCBs are accumulated in the body and metabolized for long periods of time, resulting in the induction of liver microsomal enzymes (23). Some of the effects on health that may be attributed to low-level exposure to PCBs are abnormal fatigue, abdominal pain, numbness of limbs, swelling of joints, chronic cough, menstrual irregularity, and headaches. Abnormal tooth development, hyperpigmentation, and low weight in newborn children may also be complications resulting from PCB exposure. Abnormalities in blood lipids, anemia, lymphocytosis and adrenocortical hypofunction have been recorded in a number of chronic diseases associated with PCB intoxication. In addition to dermatological abnormalities, such as acne and hyperpigmentation, there have been suggestions of increased incidence of cancer in some of the Japanese who were exposed to PCB through contamination of cooking oil (16,24).

Follow up studies of the Japanese who suffered "Yusho" disease noted that of the deaths that occurred up to five and one-half years after the first exposure to PCBs and other contaminants, nine of 22 (41 percent) were due to malignant neoplasms. Three of the tumors occurred in the stomach, one in the liver (with cirrhosis), two in the lungs and one in the breast, and two were malignant lymphomas. An additional liver cancer was mentioned in connection with one of the stomach cancers, but it is not clear whether this was an additional primary cancer or a metastasis from the stomach. Whether these cancer deaths represent an elevated incidence rate is uncertain because no baseline estimate of the numbers or types of tumors that could be expected in this group has been established (24).

Studies of individuals in other situations support the notion that PCBs are human carcinogens. These results are, however, inconclusive. In a study of chemical workers, two malignant melanomas were diagnosed in thirty-one workers exposed heavily to Aroclor 1254 (and also exposed to other chemicals). Among forty-one other workers less heavily exposed to Aroclor 1254, one additional melanoma was diagnosed. Among the 31 heavily exposed workers, three other individuals developed four cancers at other locations in their bodies, including two pancreatic cancer cases (24).

There is experimental evidence of a carcinogenic effect of certain PCBs in rodents (i.e., Aroclor 1260, 1254 and 1242) (24). However, no clear cut conclusions regarding possible human carcinogenic effects can be drawn from these studies.

The International Agency for Research on Cancer (IARC), an agency within the World Health Organization, after reviewing the animal and human findings concluded that the data provide "suggestive evidence" of a relationship between PCBs and the development of malignant melanoma. Thus, until confirmatory evidence is produced the IARC believes that PCBs should, for practical purposes, be regarded as carcinogenic to humans (24).

The potential for reproductive abnormalities occurring as a result of chronic exposure of PCBs has been suggested by the results of controlled experiments using nonhuman primates. In addition to alterations in the menstrual cycle and births of abnormally small infants, experimental monkeys experienced a greater frequency of early abortions following low-level exposure to PCBs (5 ppm Aroclor 1248 in the diet for six months). Infants born to mothers exposed to PCBs during gestation and lactation also showed some loss of immunological competence as well as learning and behavioral deficiencies. These abnormalities persisted indefinitely (2,25).

Research sponsored by the Wisconsin Sea Grant program and conducted by James Allen, a pathologist with the University of Wisconsin - Madison Medical School and the Regional Primate Research Center, involved the feeding of PCBs to monkeys and subsequent monitoring of reproductive effects. The results of these experiments possess implications for humans since humans have metabolic pathways similar to those of monkeys.

Allen fed eight female Rhesus monkeys 2.5 and 5 ppm Aroclor 1248 in their diet for six months during which time they were mated to unexposed males. Six of the eight females fed at 5.0 ppm conceived but only one was able to carry to term. All of the eight animals fed at 2.5 ppm conceived and five gave birth. PCB levels in milk during nursing ranged from 3.85 - 9.9 ppm on a fat basis. Within two months following birth, the infants experienced loss of facial hair, acne, swelling of the eyelids and pigmentation of the skin. Three of the six infants died during their first year of life.

To evaluate any potential prolonged effects on female primates, the same females were mated to control males (i.e. males maintained on a PCB-free diet) one year after the females had been taken off the PCB diet. The infant monkeys showed considerable weight variation and the infants from the 5 ppm group were generally smaller than historical control infants. The experimental monkeys were exposed to PCB levels of from 0.9 to 1.25 ppm (on a fat basis) in milk and showed signs of PCB poisoning (25,27).

Allen's findings demonstrate that PCBs may be toxic to primates over a wide dose range. Although the possibility of man consuming a steady diet containing these concentrations of PCBs is remote, these findings point out that small amounts of PCBs are toxic and that a safe level of consumption has not yet been established.

Environmental Effects / Findings

"In early 1960, mink ranchers began noticing reproductive complications and excessive kit mortality among their stock. An acute problem was evident by 1967, resulting in an unprecedented 80 percent increase in newborn mortality. Subsequent investigation indicated a strong relationship between kit mortality and the percentage of coho salmon in the mother's diet, as well as the duration of feeding with a salmon diet. Factors such as rancidity, pesticide contamination and mercury poisoning were suspected but were shown not to contribute to the problem. Experiments with the mink diet were conducted, and the results indicated that diets of 30 percent salmon produced the reproductive problems." From: NAS (1), page 119.

The coho salmon were found to contain elevated levels of PCBs and the kit mortality was attributed to the ingestion of PCBs. Later studies showed that mink fed a diet containing 5 ppm Aroclor 1242 suffered complete reproductive failure. Aroclor 1016 was also found to impair reproduction, but not as dramatically as 1242 (28).

"In 1977, a poultry firm began noticing high chemical levels in tissue samples taken from their chickens. The feed supplier was asked to help in pinpointing the cause, and the culprit was found to be fish meal contaminated by PCBs that had been used in formulating the chicken feed. The fish meal had been prepared and stored in Puerto Rico at a Ralston Purina plant warehouse where two electrical transformers containing PCBs were stored also. Contamination of the meal occurred during a fire in April 1977, which damaged the electrical equipment and allowed PCBs to leak out. Water from fire hoses evidently mixed with the PCB fluid and soaked into the stored fish meal. The contamination was not detected and the fish meal was subsequently sold. As a consequence, 400,000 chickens and 15,000 dozen eggs were destroyed. Some of the contaminated feed did not actually contain the PCB fish meal, but the feed had been processed with the same machinery as the fish meal." From: NAS (1), page 121.

PCB levels in wildlife may be increasing. First noticed in birds in 1966, PCBs have subsequently been detected in all organisms examined in the North and South Atlantic (2). Elevated levels of PCBs have been observed in New York State snapping turtles (29), bald eagle eggs collected in Alaska and several continental U.S.A. locations (30), game birds (31) and Ascension Island green turtles (32).

"The effects of PCBs are more severe in birds and higher mammals than they are in lower vertebrates and invertebrates. The most serious consequence in birds is reproductive failure, although other symptoms such as kidney, heart and liver damage can also occur. Fish take in PCBs both through the food chain and directly from the surrounding water through gills and skin. Fish can contain very high concentrations of PCBs without being severly affected although it may affect their reproduction. Shellfish, oysters and shrimp, on the other hand, are highly sensitive to PCBs - only very small concentrations in the water can kill them.

..."Fish can take up PCBs through their gills, fins and skin. PCBs also adhere to small particles in the water and thus are taken in by lower forms of aquatic life and passed up through the food chain to the top predators, fish and fish-eating birds and mammals. Scientists have found that some fish contain concentrations of PCBs that are 100,000 to a million times greater than the concentrations in surrounding waters.

"Scientists are not yet sure whether PCBs are significantly reducing wildlife populations, but there are indications that they may be. As is the case with DDT, birds and mammals high on the food chain, especially those consuming fish, are hard-hit. High PCB concentrations have been found in herons and scaups in New York, petrels and peregrine falcons in California, eagles in Sweden and the U.S., terns in Florida and gulls on the Great Lakes, to mention a few. Like DDT, PCBs degrade Vitamin D and estrogen in birds, resulting in eggshell-thinning and reproductive failure." From: Wisconsin Sea Grant (2), pages 2,4.

A summary of the chronic toxic effects of PCBs is presented in Table 2.

(?)

Table 2. Summary of Chronic Toxic Effects of PCBs*

TEST	EFFECTS
Chronic Feeding	
Aquatic Species	Threshold effects in egg hatchibility of vertebrates and invertebrates at levels of 2 to 5 mg/l
	Embryo toxicity evident at 50 mg/l
Terrestrial Species	Mouse - some liver change with exposure to highly chlorinated products; 300-500 mg/g
	Rat - some liver changes, minimal reproductive effects; 100-500 mg/g
	Monkey - Yusho symptoms, altered reproduction cycles, hyperplastic gastritis and ulceration; 2.5-5 mg/g
	Chicken - some morphologic deformity, reproduction decline, subcutaneous edema; 20-50 mg/g
	Mink - dose response relationship in growth and reproduction; 10 mg/g
	Dogs - reduced growth, some liver changes; 100 mg
	Pelican - some hepatocellular changes; 100 mg
	Wildfowl - some reproduction changes, varies with species; 50-200 mg/g
Teratogenicity (birth defects)	Effects seen in avian species; 50-200 mg/g
Mutagenicity (genetic alterations)	Chromosomal abnormalities - negative results
	Dominant lethal mutations - negative results
	Ames test - Aroclor 1221; significantly mutagenic
Oncogenicity (tumor causing)	Highly chlorinated compounds produced tumors in rats and mice, relationship with PCB not always clear

*taken from: NAS (1), page 123.

PCB LIMITS AND STANDARDS

To protect American consumers from PCB related illnesses, the U.S. Food and Drug Administration has established limits for various foods. The limit for fish and shellfish is 5 parts per million (wet weight) of total PCBs in the edible portion of the foodstuff. Canada has established a fisheries limit of 2 ppm, and this level has been recommended as the new United States standard (16). All of the U.S. FDA limits on PCBs currently in effect are presented in Table 3 below.

Table 3. USFDA Limits on PCB Concentration in Foodstuffs*

FOOD	CONCENTRATION (wet weight)
Fish and Shellfish	5.0 ppm (edible portion)**
Milk and manufactured dairy products	1.5 ppm (fat basis)
Poultry	3.0 ppm (fat basis)
Red meat	3.0 ppm - action level (fat basis)
Eggs	0.3 ppm
Infant and Junior foods	0.2 ppm
Paper food package in direct contact with foodstuff	10.0 ppm - action level
Animal feed components of animal origin	2.0 ppm
Feed for food producing animals	0.2 ppm (except concentrates, supplements and premixes)

* source: Federal Register (26).

**USFDA recommended lowering this standard to 2 ppm in 1977, however challenges by the seafood industry have resulted in the courts ordering a temporary stay on any changes.

The 1973 USFDA tolerance level of 5 ppm in fish and shellfish is based on an evaluation of all available animal and human toxicological data. The key human study used to determine an acceptable daily PCB intake was the incident in Japan where over 1,000 persons consumed rice bran oil contaminated with PCBs (Kanechlor 400). The average dosage of PCBs that caused overt health effects was 2,000 milligrams. Although this dosage was received in approximately fifty days, 2,000 mg was divided into a 1,000 day exposure period. A safety margin of 10 was applied to this value to determine that 200 ug/day would be an acceptable PCB intake (26).

Considering average fish consumption, the FDA calculated that a 5 ppm PCB level in fish in addition to all other dietary sources of PCBs would not exceed the 200 ug/day intake. Nonetheless, when this tolerance level was established by the FDA in 1973, it was termed "temporary" because: (a) it was calculated as a 1,000 day, not a lifetime, exposure and (b) it was assumed that PCB levels would decrease with time. Thus, when the temporary tolerance level of 5 ppm was set, the FDA planned to reevaluate the standard during the next few years.

In 1977, the U.S.FDA proposed that the tolerance level for fish be reduced from 5 ppm to 2 ppm when it was found that the PCB levels in fish had not decreased since 1973. The FDA proposed to reduce the tolerance level to more adequately protect the public health after further toxicological testing demonstrated potential mutagenic, carcinogenic and reproductive effects at low levels. The FDA concluded that a no-effects threshold, and thus an allowable PCB intake, could not be conclusively determined.

Since a zero tolerance level would be impractical, the FDA evaluated the possibility of lowering the guidelines by taking into account economic factors. A 1 ppm guideline was considered, but was not proposed because the FDA decided that the public health protection afforded, at least theoretically, did not justify the greater loss of food that would result. It was calculated that there would be an economic loss of $16 million per year in landings associated with this standard. Instead, the FDA chose 2 ppm as the tolerance level necessary to protect public health even though this guideline would cause an estimated economic loss of about $5.7 million per year (26).

Following the announcement of the 2 ppm PCB tolerance level, implementation of the new regulation was stayed in 1978 as a result of objections by the National Fisheries Institute (NFI). A hearing is scheduled for 1982 and will consider only the magnitude of human food loss from reducing the tolerance level from 5 ppm to 2 ppm. The 5 ppm concentration will remain as the enforceable tolerance level for total PCBs in fish until the courts settle this matter.

At this time, there are no federal standards for PCB concentrations in ambient air or drinking water.

In 1977, the National Institute for Occuational Safety and Health (NIOSH) recommended a 1 ug/m3 PCB concentration in workroom air. This concentration is judged adequate to protect the health and provide for the safety of employees for up to a 10 hour workday, 40 hour workweek, over a working lifetime.

This 1 ug/m3 PCB atmospheric level was based on findings of adverse reproductive effects, potential human carcinogenicity and the failure to demonstrate the existence of a "no effects" level for injury to the liver. Although NIOSH recommended changing the occupational atmospheric standard to 1 ug/m3 (23), OSHA has not altered its federal standard of 1 mg/m3 for Aroclor 1242 and 0.5 mg/m3 for Aroclor 1254 (33).

Wastewater discharges of PCBs are regulated by the USEPA under 40 CFR s.129.105. This regulation is implemented through the National Pollution Discharge Elimination System (NPDES) permitting program. PCBs are prohibited in any discharge from any electrical capacitor manufacturer (34).

The disposal of PCB contaminated oils, soils, sludges, et cetera is regulated by the USEPA under 40 CFR s. 761 (35). Oils which contain PCBs in concentrations exceeding 500 ppm (dry weight) must be disposed in an incinerator which complies with specific EPA "Annex I" guidelines. 40 CFR s.761.10 allows for the disposal of oils contaminated to a lesser degree - 50 to 500 ppm - by chemical waste landfilling or incineration in either a high efficiency boiler or Annex I incinerator.

All non-liquid wastes in the form of soil, rags, or debris must be disposed in an Annex I incinerator or chemical waste landfill if the PCB content exceeds 50 ppm dry weight. All dredge spoils and municipal sewage sludges containing PCBs in excess of 50 ppm (dry weight) must be disposed in an Annex I incinerator, chemical waste landfill or in a specially approved disposal site (35).

On October 30, 1980 the U.S. Court of Appeals for the District of Columbia required EPA to revise the 50 ppm limit, after ruling that insufficient scientific evidence had been presented to support it. The limit does, nonetheless, remain in effect on a temporary basis while EPA proceeds with the process of establishing a new standard.

THE NEW BEDFORD PCB PROBLEM

New Bedford, Massachusetts is a port city located on Buzzards Bay approximately 55 miles south of Boston. With a population of 98,500, New Bedford is Massachusetts' fourth largest municipality (36).

New Bedford is nationally know for its role in the development of the whaling industry and as the largest revenue producing fishing port on the East Coast. New Bedford can accurately be referred to as "the scallop capital of the world." Surpassing Nantucket as the world's largest whaling port in 1830, New Bedford has historically been inextricably linked to the sea. In 1845, New Bedford was the nation's fourth largest port, surpassed only by New York, Boston and New Orleans.

The discovery of oil in Pennsylvania in 1860 signaled the beginning of the end for the whaling industry. Ironically, it was on New Bedford's own Fish Island that the process of refining petroleum was perfected. The decline of the whaling industry already hurt by new found oil reserves, accelerated during the Civil War when Confederate raiders, most notably the Shenandoah and the Alabama, sank some fifty New Bedford whaling ships on the high seas.

The whaling industry's decline continued after the end of the war. The destruction of twenty-one whalers in the northern ice of Point Barrow in 1871 virtually signaled the end of New Bedford's whaling industry, although a few whalers sailed from New Bedford until 1920.

As the whaling industry decayed, the textile industry flourished. During the half century following the Civil War, 26 cotton textile mills were constructed along the New Bedford shore of the Acushnet River. New Bedford's textile industry concentrated on the production of fine cotton goods and became the world's leading producer in the late 1800's. The economic prosperity based on the textile industry lasted until the 1930's when the Great Depression dealt the industry a blow from which it never recovered.

Since the end of World War II, the City has attempted to broaden its economic base through the creation of an industrial park and other incentives designed to encourage the movement of new industry into the area. Two of the mainstays of the New Bedford economy, Aerovox Incorporated and Cornell Dubilier Electronics Incorporated are housed in old textile mill houses located on the banks of the Acushnet River estuary. Their use of polychlorinated biphenyls has brought a new series of problems to the New Bedford community.

Contamination of New Bedford Harbor was first documented in 1976 when the Environmental Protection Agency conducted a New England wide PCB survey and found high levels of PCBs in various harbor locations. Testing revealed that two industrial operations, Aerovox and Cornell Dubilier were discharging wastewaters containing PCBs to New Bedford Harbor by both direct discharge and indirectly via the New Bedford Municipal wastewater treatment facility (37).

COMMONWEALTH OF MASSACHUSETTS

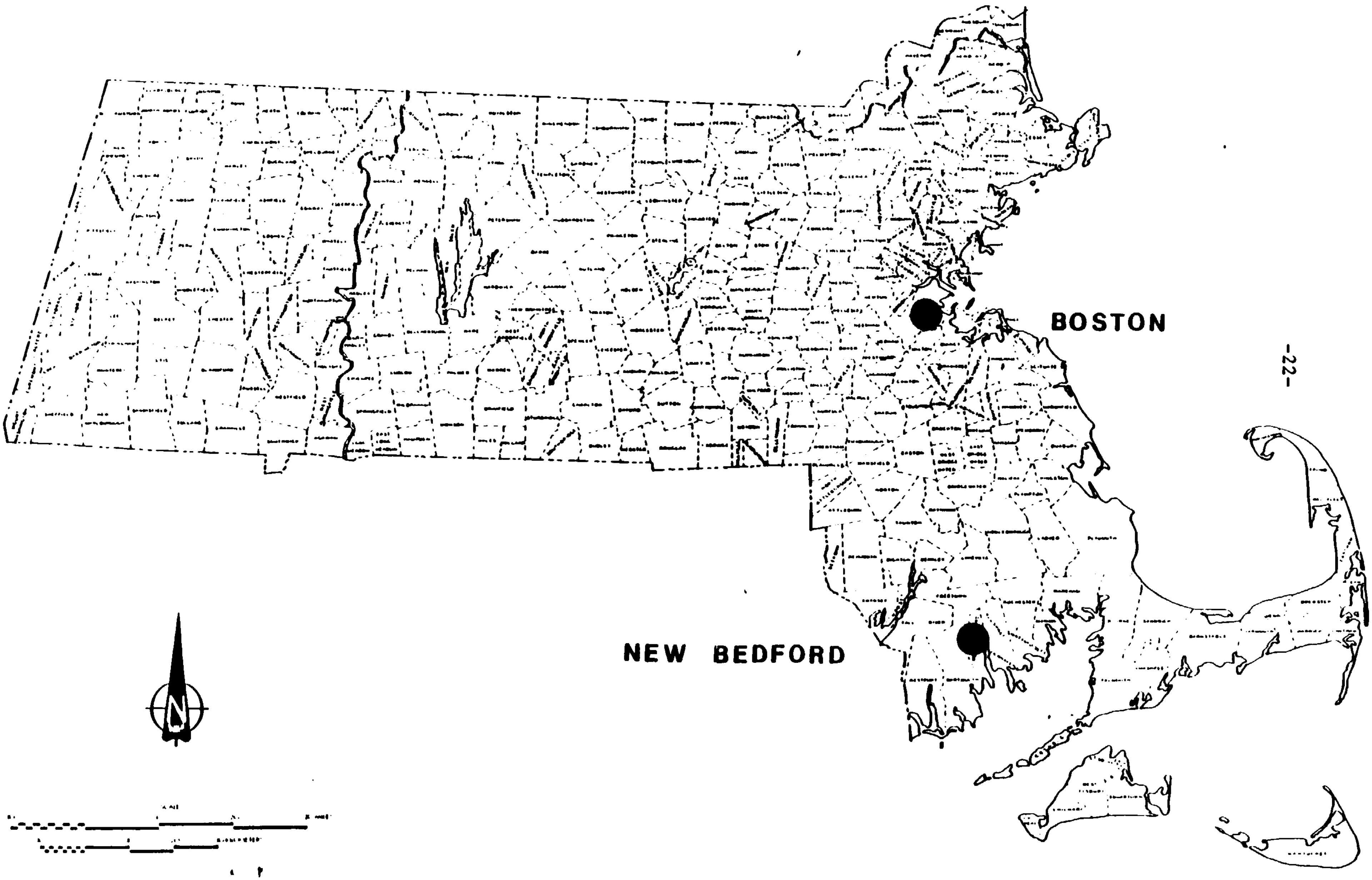


Figure 5. Locational Map

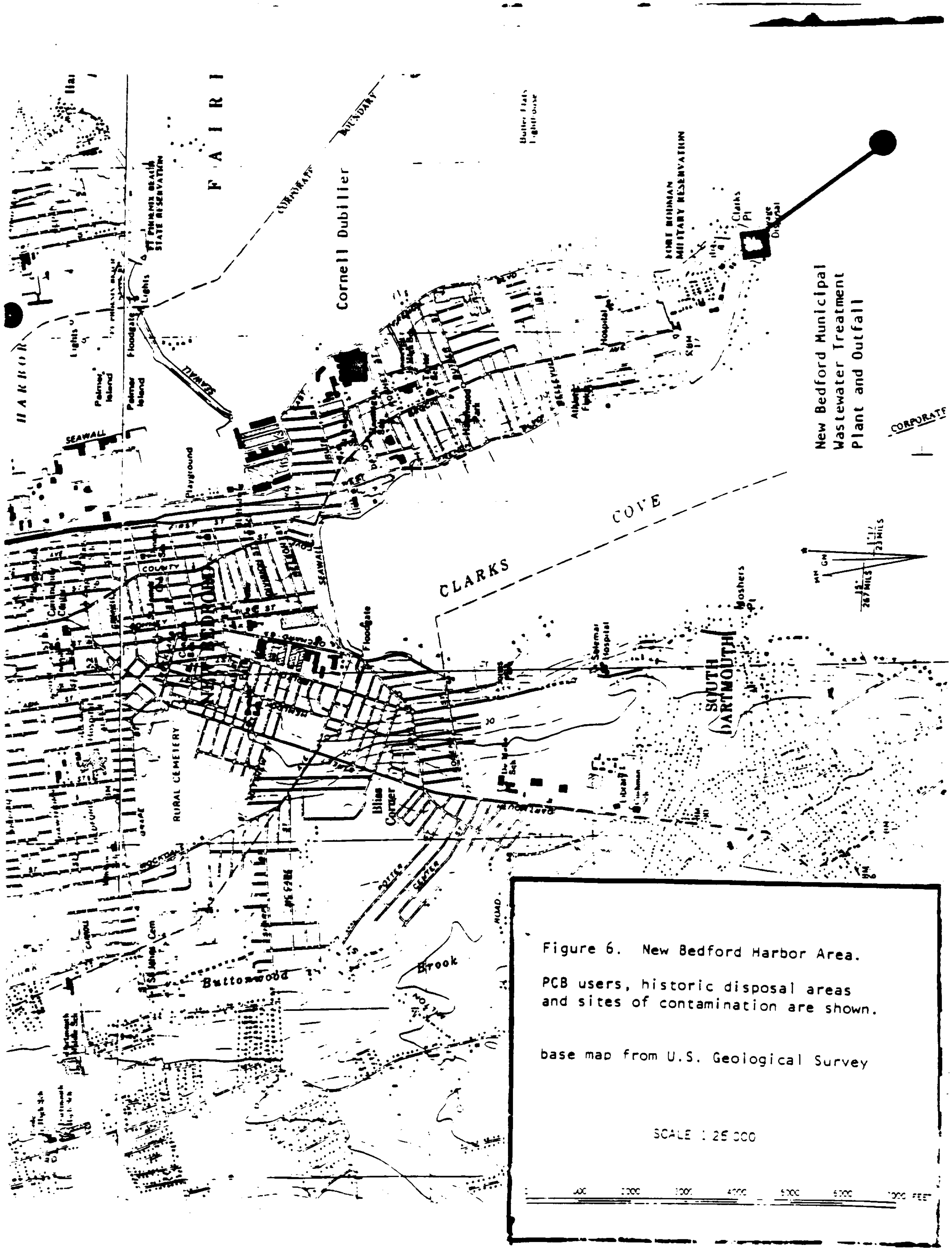


Figure 6. New Bedford Harbor Area.

PCB users, historic disposal areas and sites of contamination are shown.

base map from U.S. Geological Survey

Since this initial survey of the New Bedford area, a much better (although not yet complete) understanding of the extent of PCB contamination has been gained. The direct discharge of PCB contaminated wastewater from Cornell Dubilier has been significantly reduced while the Aerovox discharge has been nearly eliminated. The discharge of PCBs from New Bedford's municipal wastewater treatment plant however, remains significant. Recent studies have shown that 300 to 700 pounds of PCBs are being discharged per year (38,39,40, 41).

The sediments underlying the entire 985 acre New Bedford/Fairhaven Harbor contain high levels of PCBs. Concentrations range from a few parts per million to over 100,000 ppm. Portions of Buzzards Bay are also contaminated, with concentrations occasionally exceeding 50 ppm. The water column in New Bedford Harbor has been measured to contain PCBs in the parts per billion range (42), well in excess of EPA's 1 part per trillion guideline (43).

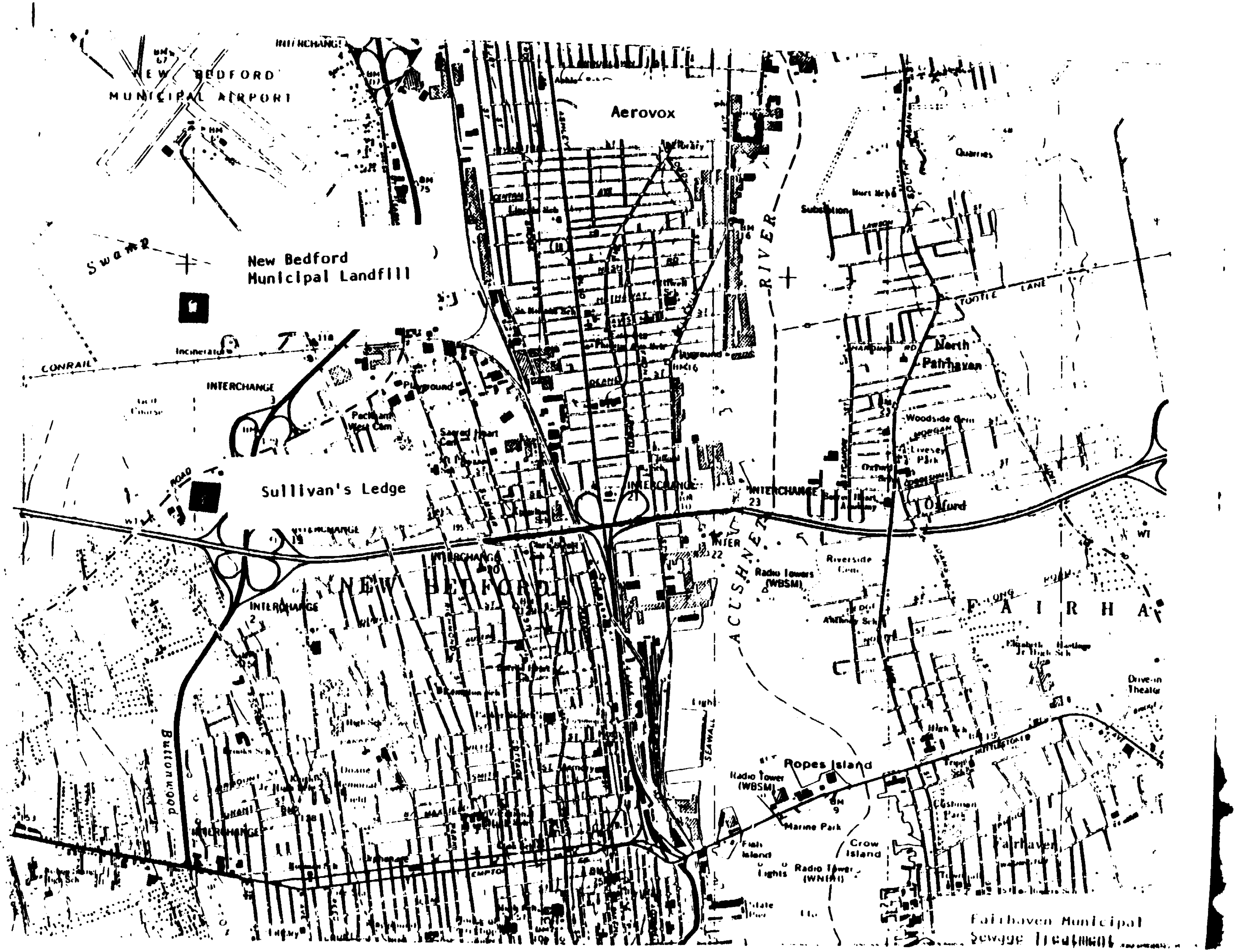
Widespread contamination of the Acushnet River estuary environs has resulted in the accumulation of PCBs in many marine species. Thousands of acres have been closed to the harvesting of shellfish, finfish and lobsters because of PCB pollution. Figure 7 shows the three closure areas established by the Massachusetts Department of Public Health on September 25, 1979 (44). Area I (New Bedford Harbor) is closed to the taking of all finfish, shellfish and lobsters. Area II is closed to the taking of lobster and bottom feeding finfish (eels, scup, flounder and tautog). Area III is closed to the taking of lobsters. Responsibility for enforcement of these closures is entrusted to the Massachusetts Division of Law Enforcement.

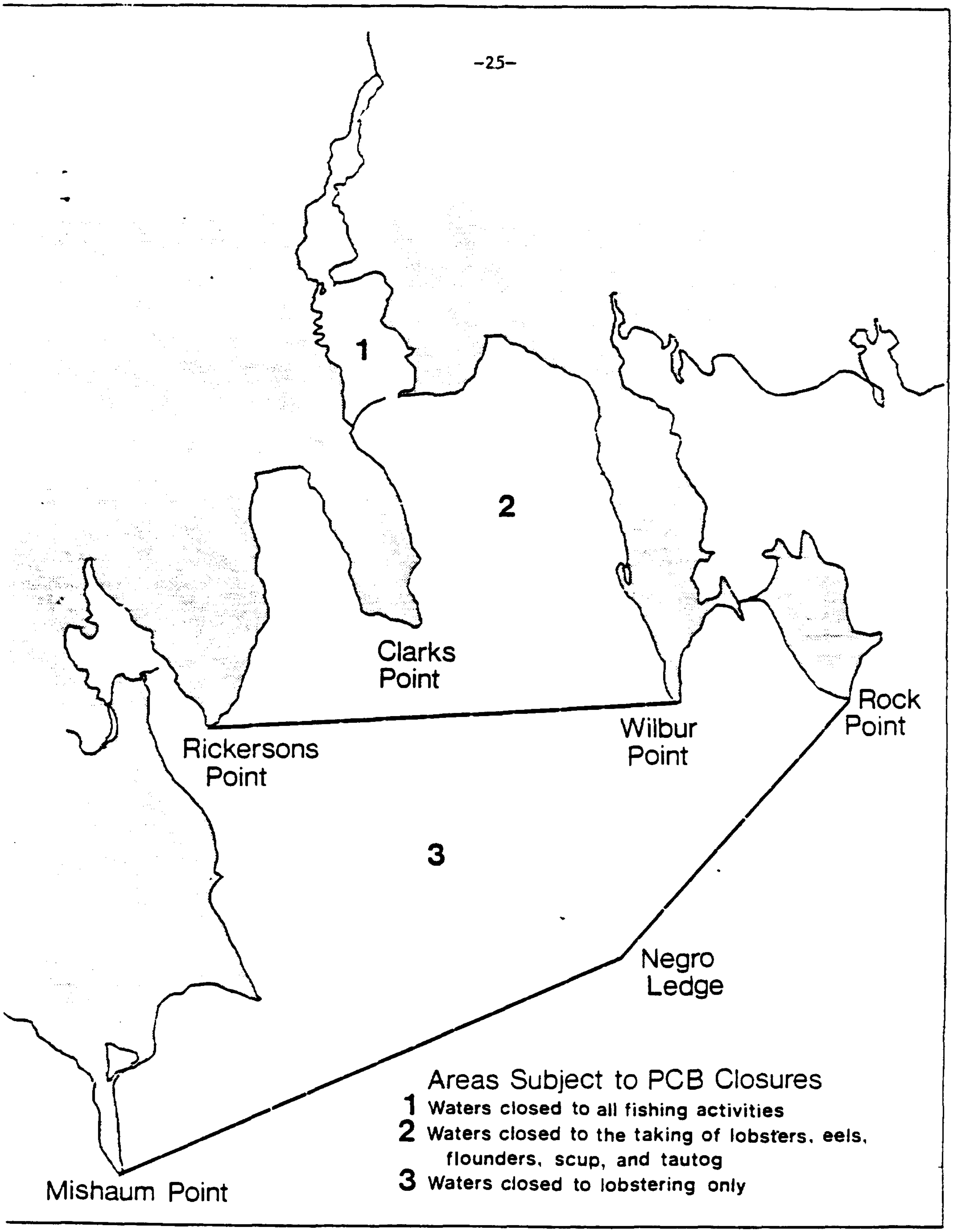
Much of the PCB sampling done before 1980 was analyzed for only one PCB blend, Aroclor 1254. Woods Hole Oceanographic Institute scientists have presented evidence suggesting that the PCB contamination is often understated by factors of three to five. If so, the extent of PCB contamination in New Bedford Harbor and Buzzard's Bay is much greater than much of the historical data indicate.

Considering only Aroclor 1254, the PCB levels in five finfish species have been found to exceed the U.S. Food and Drug standard of five parts per million. Of 183 lobsters sampled between 1976 and 1980, a median concentration of 4.9 ppm was found in edible tissues. The average value was 8.7 ppm, the maximum 84 and the minimum 0.1. These values include all lobsters analyzed in Areas I, II, III and beyond, thereby representing lobsters captured in a twenty-eight square mile, or 18,000 acre, area.

Table 4 presents data on the finfish results. The most recent lobster data (46) appears to document a lowering in the PCB contamination level. However, since these data were collected during winter months and season fluctuations are believed to exist, this finding may be misleading.

The New Bedford Municipal landfill contains over 500,000 pounds of PCBs (9,37). Waste products from Aerovox, Cornell Dubilier, and the New Bedford sewage treatment plant have been disposed in this landfill. Most of the PCBs disposed at the landfill are contained in reject capacitors from Aerovox and Cornell Dubilier.


NEW BEDFORD
MUNICIPAL AIRPORT
INTERCHANGE
Aerovox
Swamp
New Bedford
Municipal Landfill
CONRAIL
INTERCHANGE
3
Sullivan's Ledge
RIVER
TOOTLE LANE
North Fairhaven
Quarries
INTERCHANGE
21
INTERCHANGE
23
Woodside Cem
ACUSHNET
NEW BEDFORD
INTERCHANGE
2
Riverside Cem
Radio Towers (WBSM)
F A I R H A
Buttonwood
SEAWALL
Ropes Island
Radio Tower (WBSM)
Marine Park
Crow Island
Fish Island
Radio Tower (WNBH)
Drive-in Theater
Fairhaven
Fairhaven Municipal
Sewage Treatment



'igure 7. Fishing Closure Areas established by the Massachusetts Department of 'ublic Health.

Table 4. PCB Concentrations in New Bedford Area Finfishes (1976-1980).
pp—(?)

Species	Median	Mean	High	Low	No. Sampled
American eel	24	131	730	11	32
Cunner	38	38	57	20	2
Summer flounder	7.4	9.3	22	0.2	10
Window pane	5.5	8.8	14.3	3.1	30
Winter flounder	6.8	6.4	22	0	44
Silver hake	3.5	3.5	6.4	0.7	2
Scup	2.3	2.1	11.4	0	50
Bluefish	0.3	2.1	16.5	0.2	11
Tautog	0.9	1.7	11.0	0.1	17
Striped bass	0.9	1.2	3.0	0.1	8
Fourspot flounder	0.8	0.8	—	—	1
Butterfish	0.5	0.5	0.9	LT 0.1	4
Black sea bass	0.4	0.4	—	—	1
Dogfish	0.2	0.2	—	—	1
Red hake	LT 0.1	LT 0.1	—	—	1

LT = less than

Data compiled from Kolek and Ceurvels (45).

Contaminated waste oils and other materials from these industries were, it is believed, also disposed at the landfill. The residuals removed in the wastewater treatment process including grit, sludge and ash are the major remaining source of PCBs entering the New Bedford landfill.

Two other areas known to contain substantial quantities of PCB wastes are the properties of Aerovox and Cornell Dubilier. Landfilling at these two sites has taken place over the years and some of the materials used as fill were apparently contaminated with PCBs. Even today capacitors containing concentrations of PCBs in the thousands of parts per million litter the New Bedford Harbor foreshore behind the Aerovox factory. Upland sediments in the vicinity of Cornell Dubilier contain up to 99,000 ppm (dry weight) PCBs (47). This is nearly equivalent to 10 percent PCB by weight.

Other sites in New Bedford are suspected to contain substantial quantities of PCBs. One, Sullivan's Ledge, is located on Hathaway Road near the municipal landfill. This site, a former quarry is now a vacant lot. The filling of the quarry occurred when the City of New Bedford used the area as a dumpsite for brush, rubble, demolition and industrial wastes (48).

Waste oils containing PCBs were used by New Bedford and possibly other municipal public works departments in the oiling of local roadways (49). In summary, past activities in New Bedford have created an environment in which PCBs may be found throughout the community.

The few New Bedford area residents who have been studied have been found to contain high levels of PCBs in their blood. Recently, two small scale epidemiology studies were conducted by the Massachusetts Department of Public Health, Harvard's School of Public Health and the Centers for Disease Control in Atlanta, Georgia. Heavy fish eaters and occupationally exposed individuals were selected. The results of the blood testing presented in Table 5 indicates that those residents tested are among the most highly contaminated in the United States (50,51).

Discussions of the known and suspected sources of New Bedford area PCB contamination follow. Based on information gathered to date, efforts have been made to quantify the level of PCBs released to the environment from the various sources.

Table 5. Summary of Blood Serum Testing*
(analyses conducted for Aroclor 1260)

	MALES	FEMALES	TOTAL
Number of people sampled:	39	12	51
Average PCB level (ppb):	42	18	36
Median PCB level (ppb):	17	9	15
Range (ppb):	2 - 343	4 - 64	2 - 343
Number (percentage) greater than 30 ppb:	13 (33%)	3 (25%)	16 (31%)

* Only one percent of the American population contains blood serum PCB levels in excess of 30 ppb (50). What is Avg? Mean?

source of table: MDPH (51).

Aerovox Incorporated

"Aerovox Incorporated, (a subsidiary of R.T.E. Corporation) is located at 740 Belleville Avenue, New Bedford, Massachusetts. Aerovox's sole product is capacitors, (which) are used in a wide variety of electrical applications ranging from ballasts used in flourescent light fixtures to atomic energy research... All capacitors produced are used as components in other electrical products.... The physical size of (these products) ranges from units of approximately 1 cubic inch to units of 5,000 cubic inches." From: Santos (4), page 161.

The Aerovox facility used PCBs as impregnation fluids from 1947 to 1977 (52). During this period, capacitors were manufactured containing paper, paper foil and mica. "Aroclor 1242 was used until 1971 when Aroclor 1016 was introduced...(completely replacing) 1242 as the impregnation fluid. Aroclors 1254 and 1252 (were also used) but the quantities are unknown. Between January 1973 and December 1975, Aerovox used more than four million pounds of PCB impregnation fluid in its manufacturing process.

"Sources of PCB contaminated solid wastes included reject capacitors, diatomaceous earth from Aroclor filtration,...chemical resistant gloves, air duct filters and absorbent material used to clean small PCB spills and drippings"... From: Santos (4), page 162.

According to Santos, Aerovox estimated that more than 164,000 pounds of PCBs were contained in capacitors sent to the New Bedford landfill during 1973, 1974 and 1975. Santos estimates that approximately 6,000 pounds (dry weight) of diatomaceous earth used to filter PCB oil at the Aerovox factory were also disposed in the landfill. Estimates of the quantity of other PCB contaminated solid wastes generated by Aerovox are not available.

"Sources of PCB contaminated liquid wastes included residue from the trichloreothylene distillation process...(and) the contents of drip pans... At the time of an EPA plant inspection in December 1975, the storage area for contaminated Aroclor was located in the basement of Aerovox's facility, away from the fresh Aroclor storage area. The (area formally used for storage) is concrete and contains no drains." From: Santos (4), page 164.

During the years 1971 through 1977 when PCBs were used at Aerovox, contaminated fluids were stored in capped 55 gallon steel drums. During these years, the drums were periodically trucked to Bridgeport, New Jersey for incineration. Prior to 1971 the exact method of disposal used is unknown (4). It is suspected that large quantities went to Sullivan's Ledge and to the New Bedford landfill for disposal.

Aerovox currently has two potential wastewater discharges; direct discharge to the Acushnet River estuary and an indirect discharge via the New Bedford Wastewater Treatment Plant located on Clark's Cove. On the north side of the plant an external trough runs the length of the building and leads directly to

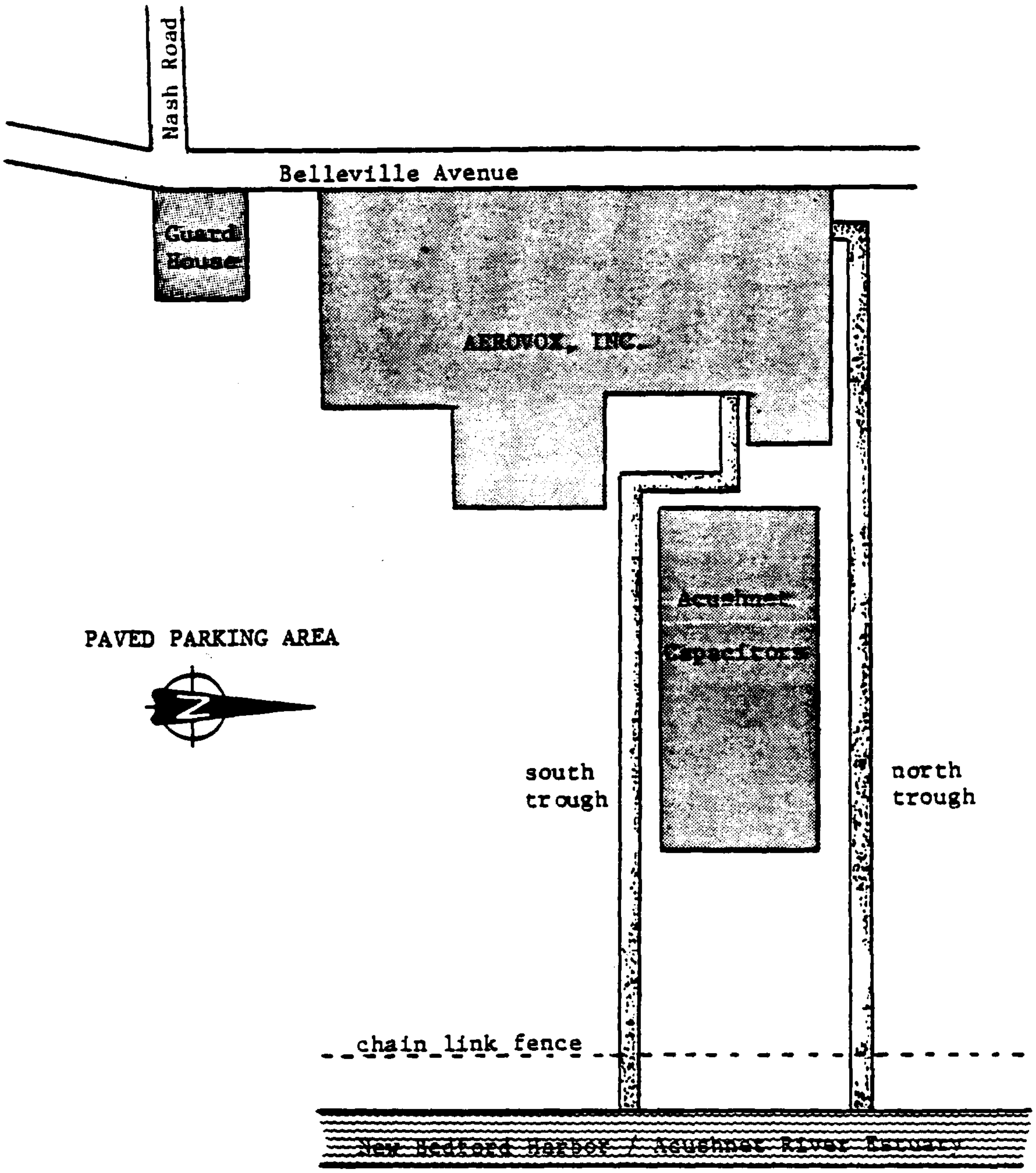


Figure 8. Schematic of Aerovox Incorporated; New Bedford, Massachusetts. figure from: Versar (52), page 3.

the Acushnet River (see Figure 8). At one time, the trough received multiple discharges of non-contact cooling water from vacuum pumps. In December 1975, the trough flow was estimated at 650,000 gallons per day (gpd). Since that time, the National Pollution Discharge Elimination System (NPDES) permit for this discharge has expired. A closed cycle cooling system has been installed, but occasional discharges from this trough may nonetheless occur.

In January 1976, the sanitary waste discharges from Aerovox to the New Bedford wastewater treatment plant via the municipal sewer system contained from 72 to 400 ppb of PCBs (53). Two wastewater grab samples collected by DEQE in 1981 failed to identify any PCBs in the pipeline leading from Aerovox to the New Bedford wastewater treatment plant (41). Further sampling efforts will be conducted by state and federal agencies to accurately document the current situation.

In 1976 the north trough effluent contained 29 to 51 ppb PCBs (53). After an EPA sampling effort in June 1981, which documented the presence of sediments containing from 40 to 22,000 ppm PCBs (52), Aerovox cleaned the north and south troughs and disposed of the contaminated materials in accordance with state and federal laws.

This and other sampling studies undertaken by EPA and DEQE have documented the presence of high levels of PCBs in all soils tested on the Aerovox property. Soils inside the chain link fence which surrounds the property were sampled and found to contain up to 24,000 ppm (52). Seaward of the fence, sediment sampling revealed levels of 680 to 190,000 ppm (40,54).

The National Institute for Occupational Safety and Health (NIOSH) performed an extensive industrial hygiene survey of the Aerovox facility in March 1977. As part of this survey, both "personal" and "area" air samples were collected throughout the facility and analyzed for PCB content. Results indicated that the 29 personal and 25 area air samples which had been collected and analyzed for PCBs ranged from 0.17 mg/m3 to 1.26 mg/m3 (33). The current Occupational Safety and Health Administration (OSHA) standard for Aroclor 1254 is 0.5 mg/m3. The standard for Arolcor 1242 is 1.0 mg/m3. In a recent criteria document, NIOSH has recommended an upper limit of 1.0 microgram total PCBs per cubic meter of air (1.0 ug/m3) as a time weighted average throughout a ten hour workday or 40 hour week (23,33).

Cornell Dubilier Electronics Corporation

Cornell Dubilier is located at 1605 East Rodney French Boulevard, New Bedford, Massachusetts and is engaged in the manufacture and sale of capacitors for use in consumer products. Cornell Dubilier Electronics Incorporated is a wholly owned subsidary of Federal Pacific Electric, which is in turn wholly owned by Exxon.

Most of the capacitors manufactured by Cornell Dubilier prior to mid-1977 contained PCBs. A relatively small number, however, were produced using mineral oil and no PCBs. Aroclor 1016 was in use from 1971 to 1977 while Aroclor 1242 was used prior to 1971 (4).

"Relatively small amounts of Aroclor 1254 had (also) been used as an impregnation fluid until early 1975. It is estimated that between January 1971 and January 1976, Cornell Dubilier...used more than 3.1 million pounds of Aroclor 1016 and 24,000 pounds of Aroclor 1254.

"In December 1976, EPA Region I performed an on-site inspection of Cornell Dubilier's facilities. At that time, information was obtained about the generation and disposal of liquid and solid PCB wastes.

"Sources of PCB contaminated solid wastes included reject capacitors, contaminated solder from sealing operations, diatomaceous earth from filters, absorbent material used to clean small spills and drippings, wiping rags and gloves. The exact quantity of PCB solid wastes generated by Cornell Dubilier is not known, however it has been estimated that from January 1971 through January 1976, more than 270,000 pounds of Aroclor have been sent to the New Bedford landfill. (Most of this as reject capacitors).

"Records were not maintained by Cornell Dubilier on the total (pounds) of PCBs disposed in the New Bedford landfill, nor were records kept on the breakdown by (Aroclor). Cornell Dubilier has estimated that 99% of the PCBs disposed in the New Bedford landfill were in hermetically sealed capacitors with the balance being contained in absorbent materials." From: Santos (4), pages 157 and 158.

"Sources of PCB contaminated liquid wastes generated by Cornell Dubilier (included)... residue from (the) trichloroethylene distillation operation, drippings from valves and connections, unreclaimable PCB drippings from capacitors and racks after impregnation, and contaminated vacuum oil. These contaminated PCB liquid wastes were put in 55 gallon color coded drums, placed on pallets, and stored in an open area at the rear of the building... Typically, wastes were allowed to accumulate in this area until (their quantity warranted shipment to) a disposal company for incineration. In 1971, an estimated 180,000 pounds of PCBs were shipped via railroad tank car and sent to... St. Louis, Missouri for incineration.

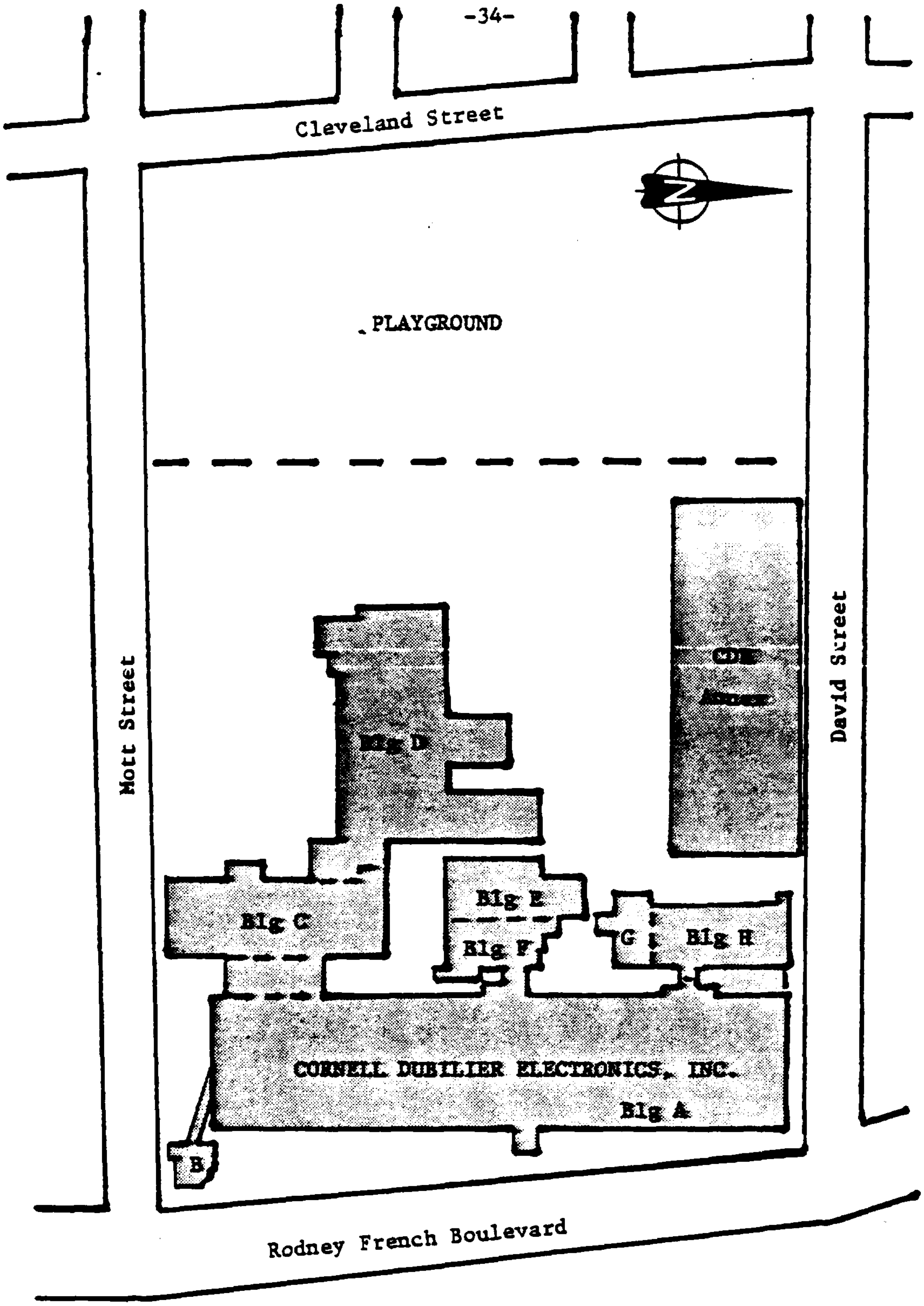
During 1973 and 1974,... 489,060 pounds of PCBs were shipped to... Model City, New York for incineration... There are no accurate records on the (quantity) of PCBs incinerated before 1973 or on the type of PCB compound incinerated during any period." From: Santos (4), pages 158 and 159. Liquid wastes may have been disposed at the New Bedford landfill, Sullivan's Ledge or elsewhere.

Cornell Dubilier Electronics Corporation wastewater discharges go (a) to the municipal wastewater treatment plant via the City of New Bedford's sewers and (b) to the Acushnet River via a city storm sewer. Cornell Dubilier's direct discharge permit, NPDES #MA0003930, allows for limited discharge of PCBs to Buzzard's Bay. Monitoring conducted by the Corporation and the state Divison of Water Pollution Control (DWPC) reveal that less than one-half pound of PCBs are annually discharged in this manner. EPA sampling in 1976 found up to 110 ppb PCBs in this discharge (53). The PCB concentration is now generally maintained at or below 5 ppb (56).

Cornell Dubilier's discharge to the municipal wastewater system has proven somewhat difficult to monitor. The presence of combined sewer overflows which apparently allow some seawater to enter during high tides confuses the sampling effort. Nonetheless, EPA sampling in 1976 located one discharge containing up to 2900 ppb PCBs (53). Three grab samples taken by the Commonwealth of Massachusetts in 1981 show that the wastewater in the municipal sewer line downstream of the factory still contains as much as 118 ppb PCBs (41). Sediments removed from the city sewer line were found to contain 660 ppm (47).

September 1978 air monitoring conducted at several sites in New Bedford documented the atmospheric PCB level at Cornell Dubilier to be 767 to 862 ng/m3 (57). These values approach the NIOSH recommended standard of 1.0 ug/m3 (i.e., 1000 ng/m3).

Soils sampled on the Cornell Dubilier property during a June 1981 EPA inspection contained from 4400 to 99,000 ppm PCBs (47). That is, the soil at the Cornell Dubilier property has been found to contain up to 10% PCBs. The playground area immediately west of Cornell Dubilier was filled with dredge spoils during the construction of the nearby hurricane barrier in the mid-1960s. Sediment samples taken in this area reveal that the soils contain PCBs at concentrations below 5 ppm (58).



Cornell Dubilier Electronics Incorporated plant layout.
figure from EG&G (55), page 2.

New Bedford Municipal Wastewater Treatment Plant

Located at the southern terminus of Clark's Cove, the New Bedford Wastewater Treatment Plant discharges a daily average of 26.5 million gallons of primary treated wastewater to Buzzards Bay. The historical discharge of PCBs by Aerovox and Cornell Dubilier into the municipal treatment plant has apparently resulted in the contamination of the sewer lines and the treatment facility. Recent monitoring by the Commonwealth of Massachusetts and the city's present consultant, Camp Dresser and McKee, reveals that the facility discharges approximately 200 - 700 pounds of PCBs per year. Wastewater sampling results are presented in Tables 6 through 8.

New Bedford's primary treatment plant was constructed in the early 70's and became operational in 1975. Although Robert Charles Engineering, Inc. designed the facility to remove 50 percent of the solids from the incoming wastewater, it has failed to remove one-half of this amount (25 percent) during all but five of the months during its first five years of operation (October 1975 - July 1980). Self monitoring reports submitted by the treatment plant chemist show that the plant discharged more solids than it received as raw sewage during thirty-one of these fifty-eight months (59).

As depicted in Figure 10, wastewater entering the facility passes through coarse screens to remove bottles, cans, sticks and rags. These screenings are raked, collected and transported to the municipal landfill for disposal. The wastewater next flows through a grit chamber where gravel and coarse sand are removed. This grit is also trucked to the City landfill for disposal.

The wastewater is then pumped to sedimentation tanks where settling of the heavier solids occurs. The liquid effluent from these tanks is chlorinated and discharged to Buzzards Bay via a 3,300 foot long outfall pipe. The sludge which settles to the bottom of these basins is thickened and pumped to centrifuges for dewatering. The dewatered sludge is incinerated on the premises in a multiple hearth incinerator and the residual ash is taken to the landfill where it is dumped with the screenings and grit.

Wastewater treatment plant sludge, incinerator flue gas and residual ash have all been found to contain measurable amounts of PCBs. The only analysis of wastewater grit which has been conducted (in 1981) revealed a concentration of 30 ppm (40). Grease and scum have never been tested for PCBs. Information on PCB levels in sludge and ash is presented in Tables 6 and 7.

In 1977, EPA contracted with GCA Corporation to study the atmospheric release of PCBs during sludge incineration. GCA concluded that the release of PCBs to the atmosphere during incineration ranged from 3 to 10.6 ug/m3. About fifty percent of the PCBs fed into the New Bedford incinerator were destroyed during combustion (60). Other EPA sampling efforts found atmospheric PCB levels in the area of the incinerator to range from 13 to 240 ng/m3 during March 1977 and January 1978 (2,61).

Although the level of contamination is below EPA hazardous waste criteria, the wastewater, sludges and other residuals contain PCB levels much higher than those encountered at most municipal treatment facilities. Local, state and federal entities are presently expending funds to study and design changes to improve the wastewater treatment facility and to accomodate the City's needs.

The wastewater collection system contains approximately thirty combined sewer overflows (CSOs) and these overflows may, during periods of wet weather, release PCB contaminated wastewaters. Monitoring of the CSOs for PCBs and an evaluation of their magnitude, if any, will be addressed in future sewage system studies. An evaluation of industrial discharges and the level of industrial pretreatment needed to protect the municipal facilities and the waters of Buzzards Bay from contamination will also be undertaken in the near future.

The City applied for a waiver of the National secondary wastewater treatment requirement in late 1979 (38). Although the state has not supported this application, the EPA has neither approved nor rejected the City's request. According to the findings of a 1977 EPA study, secondary treatment assists in PCB removal (62). Some questions remain as to the cost effectiveness of secondary treatment and there exist some concerns about how to dispose of the additional quantities of sludge produced (especially if the incineration process is ever terminated).

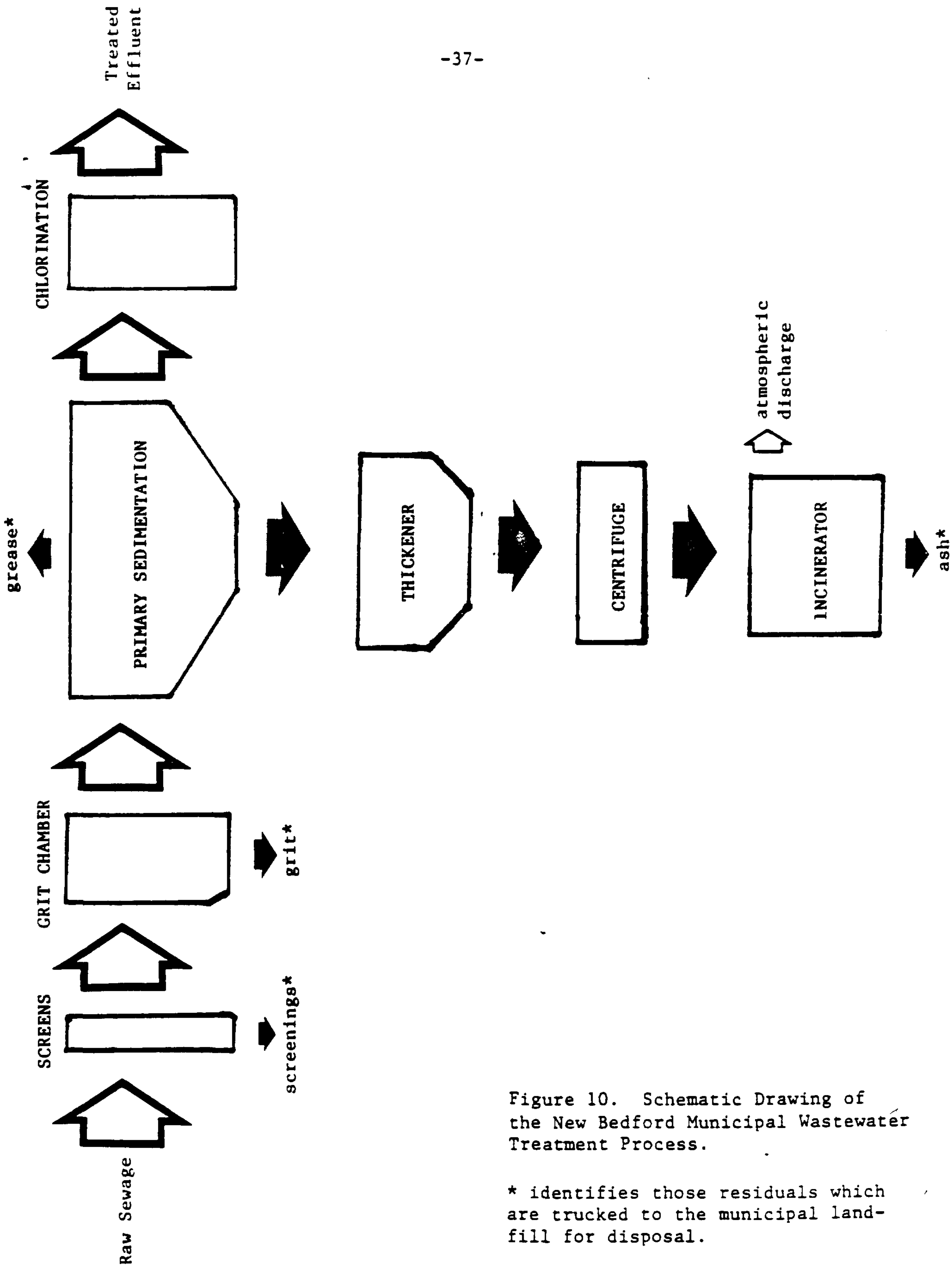


Figure 10. Schematic Drawing of the New Bedford Municipal Wastewater Treatment Process.

* identifies those residuals which are trucked to the municipal landfill for disposal.

Table 6. New Bedford Wastewater Treatment Plant Analyses for PCBs in Wastewater

Date	Laboratory	Raw Sewage PCBs (ppb)	Treated Sewage (ppb)
7/14/76	EPA (53)	106	119
2/9/77	GCA (60)	NR	3.50
3/1/77	GCA (60)	NR	8.25
	GCA (60)	NR	3.00
	GCA (60)	NR	20
	GCA (60)	NR	5.75
4/79	CDM (38)	NR	21
5/79	CDM (38)	NR	9.3
3/80	DWPC (63)	NR	0.1
2/23/81	DWPC (41)	1.28	8.16
2/24/81	DWPC (41)	ND	1.43
2/25/81	DWPC (41)	7.61	ND
	CDM (39)	6.2	8.1
2/26/81	DWPC (41)	ND	ND
3/2/81	DWPC (41)	ND	ND
3/3/81	DWPC (41)	ND	ND
3/4/81	DWPC (41)	ND	ND
	CDM (39)	2.6	5.6
3/5/81	DWPC (41)	ND	ND
6/81	EPA (40)	43	33
3/10 -	DWPC (64)	1.6	3.2
3/15/82*	DWPC (64)	0.7	1.8
3/16 -	DWPC (64)	2.6	5.7
3/20/82*	DWPC (64)	5.8	4.3
3/21 -	DWPC (64)	2.4	3.9
3/25/82*	DWPC (64)	2.0	3.8

ND = none detected
NR = not reported
* = composite samples, run in duplicate

Table 7. New Bedford Wastewater Treatment Plant Analyses for PCBs in Sludge

Date	Laboratory		Dry weight (ppb)	Wet weight (ppb)
3/26/76	EPA	(53)	73,600	
4/76	EPA	(53)	30,800	
2/9/77	GCA	(60)	5,400	
	GCA	(60)	80,000	
3/1/77	GCA	(60)	2,250	
	GCA	(60)	2,200	
3/3/77	GCA	(60)	1,400	
2/26/81	DWPC	(41)	330 *	114
	CDM	(39)	1,526	
3/2/81	DWPC	(41)	2,900 *	1,016
3/3/81	DWPC	(41)	520 *	181
	DWPC	(41)	490 *	173
3/4/81	DWPC	(41)	410 *	142
	CDM	(39)	391.6	
6/81	EPA	(40)	70,000	
9/12/81	DEQE	(58)	9,000	
9/13/81	DEQE	(58)	14,000	
9/15/81	DEQE	(58)	29,000	
	DEQE	(58)	16,000	
9/16/81	DEQE	(58)	17,000	
9/17/81	DEQE	(58)	12,000	
10/6/81	DEQE	(58)	9,900	
10/7/81	DEQE	(58)	16,000	
10/8/81	DEQE	(58)	16,000	

*calculated assuming 35% solids.

Table 8. New Bedford Wastewater Treatment Plant
Analyses for PCBs in Incinerator Ash

Date	Laboratory	Ash Dry Weight (ppb - PCB)
2/9/77	GCA (60)	2,000
3/1/77	GCA (60)	950
	GCA (60)	2,350
	GCA (60)	1,000
3/3/77	GCA (60)	1,700
2/26/81	DWPC (41)	ND
	CDM (39)	100.5
6/81	EPA (40)	ND

ND = none detected

New Bedford Municipal Landfill

Located north of Hathaway Road and west of Route 140, the New Bedford Municipal Landfill has been used as a repository for domestic, commercial and industrial wastes since the early 1920's. The landfill is located one-half mile southeast of the Paskamanset River near the southern end of a large glacial lake deposit that extends from the Apponagansett Swamp to the northern limit of the Acushnet Cedar Swamp. The landfill includes 40 acres of marshland, 24 of which (as of 1978) were filled with refuse and cover material. The geology of the area consists of a layer of freshwater peat varying from 7 to 10 feet thick, underlain by a thin layer of silty fine sand, and then layers of stratified silts and clayey silts with thin layers of silty clay. The sand and silt layers vary from 8 to 36 feet deep (9).

Originally operated as an open dump, the site is now maintained as a landfill in accordance with state and federal regulations. For decades, Aerovox Incorporated and Cornell Dubilier Electronics Incorporated reportedly disposed reject capacitors and other wastes at this site. Historically, over one-half million pounds of PCBs have been disposed in the municipal landfill (9). Prior to 1970, Aroclor 1242 was the predominant PCB material disposed. From 1970 to 1977, Aroclor 1016 replaced 1242 as the PCB most commonly used in Aerovox's and Cornell Dubilier's capacitors and presumably in the waste products disposed at the New Bedford landfill.

Monitoring for PCBs has revealed no significant groundwater contamination problems in the area of the landfill. The discharge of PCBs to the atmosphere may, however, be significant. Data compiled by EPA in 1978 (9) revealed that the summertime atmospheric level of PCBs exceeded the NIOSH (National Institute of Safety and Health) recommended eight hour workplace exposure limit of 1 ug/m3. No atmospheric monitoring has been conducted since 1978. Lately, some concerns have been raised over the placement of monitoring wells at the landfill and the results of the 1978 groundwater leachate study are now being questioned.

EPA's 1978 study of New Bedford municipal landfill concluded that "volatilization is a likely and possibly principal mode of transport of PCBs from the landfill" (Stratton, et al. (9), page 39). This finding is supported by the results of landfill studies in the Upper Hudson River Basin by the New York Department of Environmental Conservation. In New York, it was found that PCBs disposed in dumps, landfills and contaminated dredge disposal sites were primarily released to the air and that only small amounts of PCBs were leached out with groundwater (65).

Sullivan's Ledge

Locally known as "Sullivan's Ledge", approximately ten acres of land located on Hathaway Road abutting the New Bedford Holiday Inn was formerly managed by the City of New Bedford as a dump. Preceeding its use as an industrial dump, a quarry was located on this site. After the quarry filled with water, Sullivan's Ledge became a neighborhood swimming hole. Today the site is completely covered over and has been graded nearly level. Rubble, brush and other demolition materials are evident. A brook flows along the southern and eastern borders of the property under Hathaway Road through a municipal golf course to the Appponagansett Swamp in the vicinity of the New Bedford municipal landfill.

Although not presently utilized as a dumpsite, in years past the City of New Bedford used Sullivan's Ledge as an industrial dump. Rubber tires were the primary waste product disposed, but industrial waste oils and sludges were also disposed at Sullivan's Ledge (48). According to landfill operators and one local official (quoted in an EPA memorandum (66)), PCBs were disposed at this site. It is possible that large volumes of PCBs are buried in Sullivan's Ledge. Unfortunately, little at this time is known about the extent of contamination.

Only two PCB samples have been collected at Sullivan's Ledge. No detectable levels of PCBs were found in the one water sample obtained from the brook adjoining the property. The sediments underlying this brook were found to contain PCBs at a concentration of 288 parts per billion (9). No air monitoring has been conducted.

Other / Suspected PCB Sources

In addition to the direct discharges of PCB containing wastewaters from the New Bedford Wastewater Treatment Plant, Aerovox and Cornell Dubilier, other yet unidentified discharges of PCB contaminated waters may be entering New Bedford Harbor. Numerous combined sewer overflows (CSOs) and storm sewer outfalls discharge into the estuary. It is very likely that PCBs are discharged from those CSOs immediately downstream of Aerovox and Cornell Dubilier during storm events. These CSOs are located at the Coggeshall Street Bridge and at the head of Clark's Cove. Other CSOs may also contribute to the PCB contamination.

Urban storm drains in New Bedford, Acushnet and Fairhaven may carry measurable levels of PCBs into the harbor. The source of these PCBs - if present - could be atmospheric fallout and/or residual PCBs remaining on the roadways from years of oiling the roads with PCB contaminated waste oils. Urban runoff from the Aerovox and Cornell Dubilier properties may contain PCBs as may runoff from railroad sidings where PCBs were transferred from railcar to tank truck for delivery to the factories.

Sampling conducted in the vicinity of the Fairhaven municipal wastewater treatment plant outfall pipe has revealed high concentrations of PCBs in the sediments (67). The cause of this pool of PCB contamination is unknown. A 1981 EPA testing of the Fairhaven wastewater revealed a PCB concentration of 26 ppb (40); however, subsequent studies conducted by the Massachusetts DEQE have found the discharge concentration to be below detection.

In the mid-1970's Camp Dresser and McKee, under contract to the Southeastern Regional Planning and Economic Development District (SRPEDD), produced a report documenting the historical solid waste disposal practices in New Bedford, Acushnet, Fairhaven and Dartmouth. In addition to Sullivan's Ledge and the present municipal landfill, several sites were discussed (48). Any number of these locales may contain PCBs.

Although there exists no evidence to support the belief that scrap dealers may have inadvertently contaminated their properties by accepting PCB containing materials for metal recycling, this situation was found to exist in the Upper Hudson River Valley. It may be the situation in the New Bedford area as well.

Any area near the Aerovox and Cornell Dubilier factories which received fill between 1930 and 1977 could possibly be contaminated with PCBs. Sediments dredged from New Bedford Harbor anytime during the last fifty years probably contained PCBs. In a proposal to study PCBs in old dredge disposal sites, ten sites where dredge disposal materials were used as fill were identified. These sites are given in Table 9.

Runoff from the North Dartmouth Mall, according to research conducted by Gidlab (68), is believed to contribute PCBs to the Paskamanset River. This mall is located in North Dartmouth at the junction of Route 6 and Faunce Corner Road.

Table 9. Historical Upland Dredge Material Disposal Sites

Upland Disposal Site	Contractor	Location Dredged
Fairhaven landfill	Fairhaven Marine	Fairhaven Marine
Route 195 crossing	Mass. DPW	
Popes Island		North Terminal
Disposal area off Mt. Pleasant St. behind the New Bedford airport	Joe Perry Construction Co.	Quaker Oats Plant
North Fort Phoenix Beach	Mass. Waterways/ Mass. DPW	
South Terminal/Standard-Times site; behind dike at playing fields	New Bedford Redevelopment Authority	
Merrill's Warf	New Bedford Redevelopment Authority	Merrill's Warf
West Island Dump, Fairhaven		Various Locations in the harbor
Acushnet Co., Plant "A" parking lot		
North side of Coggeshall St. in Fairhaven		

Source: Tibbetts (69), page 5.

CHRONOLOGY

New Bedford Area PCB Contamination and Control

1941	Cornell Dubilier Electronics Incorporated begins operations in New Bedford. PCBs are used in the manufacture of electronic capacitors.
1947	Aerovox Corporation first uses PCBs as an impregnation fluid in the commercial manufacture of electronic capacitors.
1971	Aroclor 1016 is substituted for Aroclor 1242 in the manufacture of electronic capacitors at both Aerovox and Cornell Dubilier.
1973	Aerovox Corporation is sold to Belleville Industries, Inc. which subsequently changed its name to Aerovox Incorporated.
1973	Camp Dresser and McKee, under contract to the Southeastern Regional Planning and Economic Development District (SRPEDD), prepares a "Greater New Bedford Solid Waste Study" (48). A number of industrial waste dump sites in New Bedford, Acushnet, Dartmouth and Fairhaven are listed.
1974	New England Aquarium report documents the presence of low level PCB contamination throughout Buzzard's Bay (70).
1976	EPA sampling of Aerovox, Cornell Dubilier and the New Bedford Wastewater Treatment Plant reveal significant levels of PCBs in the industrial and municipal discharges. High levels of PCBs are also found in harbor sediments and marine life.
1976	EPA publishes report titled "New England PCB Waste Management Study" (37). Aerovox and Cornell Dubilier were identified as users of PCBs and the New Bedford Municipal landfill was documented as a disposal location.
1976	Woods Hole Oceanographic Institute initiates PCB sampling of sediments and marine life in New Bedford Harbor and Buzzard's Bay.
1976	Massachusetts Division of Marine Fisheries (DMF) initiates sampling of Buzzard's Bay finfish and shellfish for PCBs.
1977	Monsanto (the only American producer of PCBs) ceases the production and sale of PCBs.
1977	Massachusetts DMF initiates sampling lobsters for PCBs.

1977 Massachusetts Department of Public Health (DPH) issues warnings that lobsters and bottom feeding finfish from a defined area in Buzzard's Bay should not be consumed after learning the foodstuffs contain PCBs in concentrations exceeding 5 ppm. USFDA determines that the situation constitutes an intrastate matter and therefore is not within Food and Drug's jurisdiction.

1977 GCA Corporation prepares a report under contract to EPA titled "PCB Compounds Emanating from the New Bedford Municipal Wastewater Incinerator" (60). The study concludes that only two to three percent of the PCBs present in sewage sludge before incineration are released with the flue gas. The scrubber water effluent was found to contain 16 to 37 percent of the PCB input, the ash contained up to fourteen percent.

1977 EPA publishes a report entitled "PCBs Removal in Publicly-Owned Treatment Works" (62). This document states that PCB removal in municipal treatment processes is strongly correlated with solids removal, i.e., typical secondary treatment plants can be expected to remove 80-90 percent of the PCBs present in the wastewater, typical primary plants up to 50 %.

1977 Aerovox develops a process to remove a large percentage of PCB impregnating fluid from faulty capacitors. Company submits proposal to DEQE requesting approval for the disposal of evacuated capacitors in the New Bedford Municipal landfill. DEQE disallows practice after determining that each ton of evacuated reject capacitors would contain 13 pounds of Aroclor 1016.

1977 An industrial hygiene survey conducted at Aerovox by the National Institute for Occupational Safety and Health (NIOSH) finds high levels of PCBs in the factory's atmosphere. All 54 air sampling results exceeded the recommended NIOSH limit of 1 ug/m3. The range (measured as Aroclor 1016) of atmospheric PCB concentrations was found to be 10-1260 ug/m3 (33).

1977 Aerovox and Cornell Dubilier cease the production of PCB containing capacitors. Dioctyl phthalate (DOP) fluid is substituted for PCB. Contamination of DOP fluid in at least one factory, however may have allowed for the continued manufacture of PCB contaminated electronic capacitors into the 1980s.

1978 Massachusetts DEQE initiates an annual sediment sampling program with over 20 stations in New Bedford Harbor and Buzzard's Bay.

1978 U.S. EPA Region I prepares a summary report of all PCB data in New England titled, "Polychlorinated Biphenyls in New England" (71).

1978 Southeastern Massachusetts University conducts a study of PCB levels in Buzzard's Bay shellfish (72). Oysters in the Slocum's River exhibit relatively low levels of PCB contamination.

1978 U.S. EPA study titled "Environmental Assessment of Polychlorinated Biphenyls (PCBs) Near New Bedford, Massachusetts, Municipal Landfill" (9) concluded that atmospheric release of PCBs from the landfill is most likely the principal mode of their escape. Sampling conducted during the summer of 1977 found atmospheric PCB levels in excess of 1 ug/m3, the NIOSH recommended eight hour exposure limit.

1978 Tibbetts Engineering Corporation submits an unsolicited proposal to DEQE titled "PCBs Analysis of Materials Dredged from the New Bedford Harbor Bottom from 1-30 Years Ago and Subsequently Used as 'Fill' on Dry Land for Various Projects" (69). Ten upland sites which have been filled by materials dredged from New Bedford Harbor during the years 1948 to 1978 are identified in this report.

1979 Massachusetts Department of Public Health exercises its legal authority to close areas of Buzzard's Bay to the taking of lobsters, finfish and shellfish because of PCB contamination (44).

1979 Massachusetts Representative Roger Goyette forms an ad hoc committee to assess the PCB contamination problem in New Bedford.

1979 Camp Dresser and McKee, on behalf of the City of New Bedford, submits an application for a waiver of the secondary municipal wastewater treatment requirement to EPA (38). Data on PCBs in harbor sediments, shellfish and wastewater are included.

1980 Aerovox's wastewater discharge permit (NPDES #MA0003379) expires.

1980 Gidley Laboratories, Inc. under contract to the Dartmouth Conservation Commission publishes a report on PCB monitoring (68). Gidlab concluded that the PCBs in New Bedford's municipal landfill are not polluting the Dartmouth town wells.

1980 University of South Carolina graduate students test a PCB air sampler at the New Bedford municipal landfill. Sampling conducted during June detected 25-53 ng/m3 PCBs (Aroclor 1016 plus 1254) upwind of the landfill (73). No downwind results were obtained.

1980 DEQE and EPA designate New Bedford Harbor PCB problem as a priority issue in the 1980 State - EPA agreement.

1981 A report on the PCB Data Needs and Dredge Techniques for the Acushnet River - New Bedford Harbor Area is prepared by Richard Tomczyk, DEQE, in compliance with 1980 State - EPA Agreement (74).

1981 Secretary Bewick of the Massachusetts Executive Office of Environmental Affairs establishes a PCB task force. DEQE chairs committee and holds monthly meetings to coordinate activities.

1981 Malcolm Pirnie, Inc. under contract to DEOE/DWPC prepares a Draft "Acushnet River Estuary PCB Study" (75). PCB contaminated areas of New Bedford Harbor and Buzzard's Bay are identified. Additional sampling of sediments, marine life, air and water is recommended. An estimated project cost for removal of 90 percent of the PCB contaminated sediments is given as $130 million.

1981 Small scale epidemiology study of New Bedford residents is undertaken by Massachusetts Department of Public Health, Harvard's School of Public Health and the Centers for Disease Control in Atlanta, Georgia (50). Results of the limited blood testing study reveals that those tested are among the highest PCB contaminated in the United States. Fish eaters and industrially exposed workers were selected for study.

1981 Massachusetts Division of Marine Fisheries prepares a comprehensive "Polychlorinated Biphenyl (PCB) Analyses of Marine Organisms in the New Bedford Area, 1976-1980" (45). The report concludes: "Review of the data collected to date indicate that sampling results are insufficient to establish definitive PCB trends in the biota of New Bedford Harbor." DMF subsequently petitions the Massachusetts Department of Public Health to reopen one area closed to the taking of lobsters due to PCB pollution.

1981 EPA coordinates the inspections of four sites in the New Bedford area for compliance with PCB regulations under the Toxic Substance Control Act (TSCA): Aerovox, Cornell Dubilier, the New Bedford Municipal Wastewater Treatment Plant and the Fairhaven Municipal Wastewater Treatment Plant.

1981 EPA and State officials meet with representatives of Aerovox and Cornell Dubilier to discuss TSCA sampling results. Both firms prepare limited site clean up and monitoring proposals.

1981 Representative Roger Goyette of New Bedford chairs ad hoc/PCB task force meeting at Woods Hole.

1981 Enforcement of Massachusetts Department of Public Health's lobster closure is fully enacted for the first time since its issuance in 1979. Bureaucratic snafus are overcome and two Environmental Affairs agencies (Division of Marine Fisheries and Division of Law Enforcement) assist DPH's enforcement effort.

1981 EPA and Massachusetts Coastal Zone Management personnel visit PCB contamination sites in Bloomington, Indiana; Waukegan, Illionois; and the Upper Hudson River region in New York state.

1981 Massachusetts Divison of Water Pollution Control (DWPC) Technical Assistance Branch collects over 100 sediment samples and fourteen harbor water column samples for PCB analyses by Cambridge Analytical Associates. Results document sediment concentrations in 1000's ppm in the upper reach of the estuary (42).

1981 DWPC undertakes New Bedford municipal sewer sampling program.

1981 Versar, under contract to EPA, prepares a voluminous report titled "Comprehensive List of Industrial Facilities located Within Region I which May Handle or Use PCB Materials" (76). Ten New Bedford area companies are listed, however neither Aerovox nor Cornell Dubilier are cited. The firms noted include two bakeries, three fish processors, three rubber products manufacturers, an equipment rental firm and a welding equipment manufacturer.

1981 DMF conducts additional lobster sampling and again appeals to DPH for a reopening of Area III to commercial lobstering. DMF's most recent sampling of 42 lobsters captured in November 1981 contain an average PCB concentration of 1.0 ppm.

1981 Massachusetts DEQE nominates New Bedford Harbor as a priority federal Superfund site.

1982 EPA Environmental Impact Office initiates a regional New Bedford PCB Environmental Impact Study.

1982 U.S. Coast Guard joins state and federal agencies in the sampling of harbor sediments. USCG posts a warning sign in the heavily contaminated area seaward of Aerovox.

1982 Massachusetts Department of Public Health, in cooperation with the Centers for Disease Control in Atlanta, publishes the results of a second PCB blood test conducted on New Bedford area residents. Findings support the 1981 results which show that heavy fish eaters and industrially exposed persons generally contain high PCB levels (50,51).

CASE HISTORIES OF PCB POLLUTION

Waukegan Harbor, Illinois

The area of contamination encompasses a 37 acre Lake Michigan harbor, an adjacent upland industrial area and a lengthy drainage ditch.

PCB concentrations up to 250,000 ppm (or 25%) have been observed in upland and submerged harbor sediments.

Fish containing PCBs at levels exceeding 100 ppm have been captured within the harbor. Immediately outside Waukegan Harbor, the fish exhibit PCB levels characteristic of Lake Michigan fishes (ie., averaging and occasionally exceeding the 2-5 ppm range).

EPA has prepared a plan for Waukegan Harbor cleanup for implementation as a result of court action or under Superfund. As indicated in EPA's Waukegan Harbor Report (5), one-third of the harbor area is proposed to be dredged. 50,000 cubic yards of dredge spoils would be dewatered in a lagoon on vacant property adjoining the harbor and disposed in an offsite landfill. An additional 100,000 cubic yards or more of contaminated upland soils may be removed for disposal. Alternative approaches being considered include inplace confinement.

OMC-Johnson Motors, which apparently used PCBs in hydraulic fluids, and Monsanto Corporation, the former manufacturer of PCBs, are being sued by EPA for the total cost of the cleanup which may equal or exceed $40 million.

Bloomington, Indiana

PCB contamination of the City's "Winston Thomas" wastewater treatment plant has resulted in the stockpiling of six years accumulation of sludge. This amounts to about 34,000 cubic yards of PCB contaminated material averaging 100-500 ppm.

About two drums of wastewater grit with PCB levels exceeding 1 ppm is collected daily. Transporting and disposing this grit at an EPA approved hazardous waste landfill costs the City $60 per drum. An equal amount of grit (less than 1 ppm PCB) is disposed at the county landfill at no charge to the City.

Thousands of wastewater PCB samples have been collected and analyzed by City personnel since 1975. Bloomington owns two gas chromatographs for the sole purpose of PCB analyses and employs a half-time technician to operate this equipment.

A five mile stretch of municipal sewer lines was cleaned to remove PCB contaminated sediments at a cost of approximately $45,000.

Several Westinghouse capacitor dump sites have been located in and around Bloomington, including one uncontrolled dump on City property.

Westinghouse, a large employer in Bloomington, is being sued by the City for over $300 million.

Upper Hudson River, New York

Forty "hot spots" located in a 35 mile stretch of the Upper Hudson River have been identified. Approximately one million cubic yards of sediments containing PCB levels in excess of 50 ppm are to be removed and disposed in a specially engineered encapsulation site according to the federally funded Environmental Impact Statement.

River sediments have shown concentrations of PCBs up to one thousand ppm. Fish have been found to contain up to 100 ppm.

All fishing is prohibited in the Hudson River from Fort Edward (the location of two G.E. factories) to Troy. In addition, the commercial harvesting of several species of fish (e.g. striped bass) has been prohibited from Troy to New York City. The NYSDEC has determined that these areas will remain closed to fishing until PCB levels fall below 5 ppm in the edible portion of marketable fish for two consecutive years.

Thousands of sediment and biota samples have been collected and analyzed for PCBs by consultants under contract to the NYSDEC. Although some municipal wastewater treatment facilities have been found to discharge measurable levels of the pollutant, little has been done to control these sources.

General Electric and New York State have contributed millions of dollars to studies and the company has proposed several remedial plans.

A staff of NYDEC professionals works full time on the Hudson River PCB reclamation project.

G.E. has agreed to fund engineering studies and to generate remedial action plans for the control of PCBs found at seven dump sites. This may require the construction of clay lined containment facilities.

GLOSSARY

Index to abbreviations and acronyms

CDM	- Camp Dresser & McKee, Inc.
CFR	- Code of Federal Regulations
Cl	- chlorine
CSO	- combined sewer overflow
CZM	- Massachusetts Coastal Zone Management
DDT	- 1,1,1 - trichloro - 2,2 - bis (p-chlorophenyl) ethane
DEQE	- Massachusetts Department of Environmental Quality Engineering
DMF	- Massachusetts Division of Marine Fisheries
DOP	- dioctyl phthalate
DPH	- Massachusetts Department of Public Health
DPW	- Massachusetts Department of Public Works
DWPC	- Massachusetts Division of Water Pollution Control
EPA	- United States Environmental Protection Agency
FDA	- United States Food and Drug Administration
GC	- gas chromatograph
GCA	- GCA Corporation
GC/MS	- gas chromatograph/mass spectrometer
G.E.	- General Electric Corporation
gpd	- gallons per day
IARC	- International Agency for Research on Cancer
kg	- kilogram
LT	- less than
MDPH	- Massachusetts Department of Public Health
mg	- milligrams
mg/g	- milligrams per gram, generally equivalent to parts per thousand
mg/l	- milligrams per liter, generally equivalent to parts per million
mg/kg	- milligrams per kilogram, generally equivalent to parts per million
MS	- mass spectrometer
NAS	- National Academy of Sciences
ND	- none detected
NFI	- National Fisheries Institute

ng/l	- nanograms per liter, generally equivalent to parts per trillion
ng/m3	- nanograms per cubic meter
NIOSH	- United States National Institute for Occupational Safety and Health
NPDES	- National Pollution Discharge Elimination System
NR	- not reported
NYSDEC	- New York State Department of Environmental Conservation
OMC	- Outboard Marine Corporation
OSHA	- United States Occupational Safety and Health Administration
PCB	- polychlorinated biphenyl
PCDF	- polychlorinated dibenzofuran
PCO	- polychlorinated quaterphenyl
ppb	- parts per billion
ppm	- parts per million
RTE	- RTE Corporation
SRPEDD	- Southeastern (Massachusetts) Regional Planning and Economic Development District
TSCA	- Toxic Substance Control Act
ug/day	- micrograms per day
ug/kg	- micrograms per kilogram, generally equivalent to parts per billion
ug/l	- micrograms per liter, generally equivalent to parts per billion
ug/m3	- micrograms per cubic meter
USCG	- United States Coast Guard
USEPA	- United States Environmental Protection Agency
USFDA	- United States Food and Drug Administration

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APPENDIX II:

Local Efforts to Deal with PCB Problem

RESEARCH NEEDS

(rev.)*

A Point of View

Prepared by Robert B. Davis
N.B. Planning Department

August, 1982

*Revision of 1981 statement, submitted as an Attachment to Mayor's Letter and a prelude to the Local Budget.

RESEARCH NEEDS*

INTRODUCTION & SUMMARY

In general, the City believes the PCB issue merits a comprehensive analysis. The impact on public health is unclear, and a review of the literature shows that there exist many confounding variables that have not been sorted out. The scope of the problem could be reduced significantly if those variables (causes) were ascertained. This would not only serve the local interest, but it could also clarify considerably the general problem, and hence serve the national interest.

It is the point of view of the author that long-term research needs should also be met, since a short-sightedness in this regard can lead to an analysis not commensurate to the options for action. This can be seen in respect to the Yusho incident, in which the analysis overlooked some essential variables (through limited analytic techniques at the time), which are now receiving recognition. But this is after the institution of a regulatory framework which may be missing the mark. Part of the pending local analysis could lead to a reevaluation of the national standards, with a consequent revision of the regulations.

In summary, it is the author's contention that the barebone minimum research plan should entail:

#1 - An in-depth health analysis

#2 - Experimental testing of the local Aroclor

- a) through analysis to evaluate the toxic isomers (congeners)
- b) on animals
- c) as biodegradative

#3 - A Circulation Survey.

Whether the first should be a full-scale epidemiologic survey or entail a limited sample is unclear. The situation in New Bedford lends itslef to a fruitful epidemiological study, since there exists a sister city comparable to New Bedford that has no noted record of exposure (Fall River). Minimally, an in-depth health analysis, though limited in numbers, should be undertaken. To the extent effects can be measured, they should be, admitting limits. But those limits have not been determined, and this is the basis for the analysis. It can be a basis for the full-scale study.

The 2nd requirement is threefold, i.e., an analysis of the presence and toxicity of the Aroclor's constituent compounds, as well as the testing of them on animals, not to exclude the testing of the environmental Aroclor at select levels -- part of which is interim and correlative to human consumption. There has been very little testing of the environmental Aroclor. It is this which people consume.

Since the costs of remedial action are prohibitive, it only makes sense to test whether degradability is an option, since there have been good laboratory results (unfortunately, only in fresh waters) indicating high reductive rates with the lower chlorinated Aroclors. The natural but simulated ecosystem laboratory at URI (MERL) lends itself to this experimentation. The faculty at WHOI is familiar with this tool.

It goes without saying that a circulation survey is necessary since the migration of the chemical into open waters prolific in marine life is of concern. Such knowledge is a gain in any event, since Buzzards Bay has not been surveyed since 1931, and then in a very limited manner with instruments inferior to today. The contribution to the State's knowledge of its waters and fisheries will be substantial.

The following was submitted to Commissioner Cortese in February of 1982, as a prelude to the local budget submission. The document will only be revised in respect to select addenda. They will be noted.

RESEARCH NEEDS

The City is willing to be party to the grant for the tasks specified (see local budget), though it is outside its competence and resources to do so independently of a funding source.

Is the application to the Superfund seeking funds for remedial purposes, namely dredging, or is it to provide funds in order to determine exactly the impact, and from that point direct remedial measures? The monies for dredging will then be contingent on the recommendations of the research.

Based on my experience with governmental and private sector funding sources dealing with complex problems of this type, an explicit attempt is often made to precisely limit the scope of a project. This is necessary in order to place a limit on costs, but what is not necessary, and even foolhardy, is to attempt to be precise at every level of analysis for problems of this type. An application of this type has to be open to these levels and consequently the total amount specified in the application should give consideration to the satisfaction of research needs that can make an essential contribution in the resolution of the problem. Since the problem we are trying to resolve is serious, permit me to elaborate on this topic.

The precision should be in the end, not the means. We are dealing with the unknown, and consequently it is impossible to know the essential parameters to be defined, and so our anticipation of them is conjectural. There then has to be an openness at levels of research so that researchers can follow a variety of leads as ongoing research dictates variability. It is a simple matter to be precise with the end (assess impact on human health), but it is not in terms of the amount necessary to attain the end since the means are uncertain. An application that specifies this amount in terms of contingent results, would seem to be the only way to solicit funds if the problem is to be dealt with in a comprehensive manner. You should establish an upper limit and budget contingent on varied performance standards. There is need of a stratified data approach (in marine life: blood, viscera, muscle; in humans: blood, adipose tissue) so that analysis can be comprehensive when select data suggest leads to the 'secrets' at the root of the problem. A research package cannot be exact in its approach or package a list of samples. It is only a guideline and has to be open to flexibility.

While much has been made of elevated levels in the locality.* the nation itself (to be exact, U.S. population groups, & environmental) exists at an elevated level, to so-called

*In context, the New Bedford levels do not appear to be extraordinary. Excluding eels and based on samples of 8 or more finfish tested from 1976-1980, (of the 15 finfish samples in New Bedford, for 6 finfish the number sampled per finfish was 2) the finfish mean (median) for 7 finfish is 3.1 (2.3) ppm, the range from 0-22 ppm (hereafter all values ppm). (Cunner, a finfish, 2 samples, had a range from 20-57 ppm.) For striped bass, mean (1.2), median (0.9), range (0.1-3.0), sample of 8. (See CZM, MA, PCB Status Report, 1982). Striped Bass is of interest since it has very high levels in the Hudson River, and also in coastal waters, including the West Coast and a large inland lake (See NMFS, infra). For those locally over the FDA limit: Summer flounder, 9.3 (7.4), 0.2-22; Window Pane, 8.8 (5.5), 3.1-14.3; Winter Flounder 6.4 (6.8), 0-22. For lobsters, the average concentrations in Areas 2, 3, & 4 (outer harbor, closure areas #2, 3), 1977 (5.6 ppm, mean) #2, (3.9) #3; 1978 (2.9) #3; 1979 (21.7) #2, (8.8) #3, (3.8) #4; 1980 (4.3) #3, (3.9) #4. More recent sampling indicates a decline in levels, but with seasonal fluctuations. (See Kolek, "PCBs," DMF, 1981, p.8-10; it is noteworthy that the crustaceans sampled (Blue crabs) were from the inner harbor (area #1), and 11 of the 12 sampled were under the FDA limit of 5 ppm (p.8).) The mean PCB levels in whole raw fish in Lake Michigan from 1972-1974 were 13, 19 & 23 ppm for troupt; 11, 12 & 10 ppm for coho salmon. (In cooked fish; the L.M. levels were much lower

(Footnote continued on page 4.)

national body burden. The NAS estimates a range of 5 to 20 ppb for U.S. population groups (NAS, PCBs, 1979, p.120), while an industrial community of volunteers had over 43% of the sampled population at measurable levels for a non-

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Footnote from page 3 cont'd.
(1.03-4.67, trout; 0.48-5.38 salmon). However, the mean PCB level of fish in Triana (Ala) was about 2 ppm, similar to N.B. (See Kreiss, op.cit., p.2508).

Also, the no known exposure group in the New Bedford sample had PCB values similar to an inland MA community for the same exposure group (NKE, Canton, MA).

Levels in fish in U.S. industr. rivers are higher (1-213 ppm), e.g., catfish in Ala. (811 ppm). While catfish is similar in habit to eels, catfish in the Great Lakes had levels about 1/2 those of eels from the same area (See below). While local eels have high PCB levels, except for the very upper part of the N.B. estuary (730 ppm, max.), they are lower than in the Hudson River. The typical value appears comparable to levels in Canadian waters. (See Canadian report, infra). In N.B. waters, American Eel, average values (sample #, parenth), from the inner harbor (most southernly, #1; #2, in between; #3, most northerly), from 1976-1980: inner harbor #1, 329 (12 samples); I.H. #2, 14 (1); I.H. #3, 22 (15); outer harbor (in a southerly direction), 3 stations about the east side of the peninsula: 38 (1); 13 (2); 38 (1). A range of 13-38 for the outer parts of the inner and inner parts of the outer harbor. (See CZM, Finfish table, compiled 1981.) For Canadian waters: offshore (Maritime Provinces) 0.56 (10 samples(s); St. Lawrence River 7.94 (216s); Lake Ontario (the only cited Great Lake tested for eels) 17.14 (3s), the highest level of 13 different species. The next highest mean level for L. Ontario was catfish (9.63). Of the 13 species tested, 9 had significant levels. (See Canadian report, infra, p.165-169. Excluding extremes, N.B. eels average about 22 ppm, Can. eels about 17 ppm. For the Hudson River, ____________________. Unfortunately, the author is unable to compare sediment levels. However, it is clear that sediment levels are low compared to some other exposed areas (the upper Hudson River: from 22% to 58% of the samples exceeded 50 ppm, cores measured to a depth of 90 cm. See NAS, op.cit., 1979, p.34.), excluding the estuary north of the Coggeshall Street Bridge (Route 195), the so-called hot spot. The sediment values indicate a clear gradient from north to south, with levels decreasing to the south. All stations sampled south of Route 195 are under 50 ppm, the threshold value of the EPA to classify substances as hazardous, with the exception of a pocket

(Footnote continued on page 5.)

exposed and 'healthy' people. (Finklea et al, "PCB Residues, Expose a Major Urban Pollution Problem," Amer. Journal Public Health, 1972.) While the above data are not representative samples, they are valuable as preliminary indicators. If anything, the levels would appear to be higher in our area, since the location is more industrial than the South.

I personally hold the level is tolerable (and almost inevitable in an industrial society). But note the term I use--'tolerable'. Consequently, it would appear to me the problem in New Bedford is generic as well as local. It should also be noted that though the 'availability' of PCBs to man has significantly declined in the last few years (Fed. Register, FDA,________19___; though there has been a 'dramatic drop' of levels in the Great Lakes region. See Moolenaar, "Recent Advances in Exposure, Health & Environmental Effects Studies of PCBs" (Abstracts), EPA Symposium, MD, ICAIR Life Systems Div.,_________Ohio, 1982), the availability in nearshore and offshore waters has not declined. And of all waters, the North Atlantic basin is a primary sink (NAS, op.cit., p.65; see also NMFS, infra.)

While the New Bedford basin does not appear to be a pathway to the at-large basin, its relatively high levels and accessibility afford us the means to study the marine pathway for the ecosystem. The different between the national and local levels may be one of degree, but there is a point when degree turns to kind, as many animal experiments have indicated. The point is noone knows that point, including whether 'the point' is within the national range.

Footnote from page 4 cont'd.
near the proposed bridge. While it is valuable to designate a numerical constant as a limit to determine action, numbers should not be so fixed that the purpose of the designation is lost sight of, namely the correlation of the substrate value to marine life and then to man. For a locality the number may be too high or too low. (The British use a generic criteria and decide upon a constant after the evaluation of a site. Generic values are ordered to an adaptable to site-specific impacts). The question we have to ask is: what are the levels in marine life, the likely edibility of the fish, and the amount consumed under unrestricted conditions, and in what manner are the sediments the base that contributes to the levels in fish consumed by man? Given the closure of fishery areas, with the possibility of encroachment upon an at-large basin, then the determination of the point-source(s) of distribution is a critical question to be answered.

Consequently, research has to proceed at two levels--generic and site-specific. It is my opinion this is acceptable since it is relatively feasible. The costs for research relative to remedial action are a pittance, from 1 to 3 million dollars (research) to 150 million dollars (dredging, 90% recover), even higher if one considers landed facilities. The remedial action total is about $200 million, which would be higher at the time of implementation due to inflation.

Since it is only throuhg understanding that causes can be determined, it is only through understanding that the effects of causes can be controlled. Dredging only admits that our creative capacities are not creative. What is necessary is to foster the conditions to understand the problem and hence we may end up with a creative solution. Not one that simply puts the problem in the backyard, and probably somebody else's, if they will let you. (This is such a great problem that in practice there appear to be no solutions.)

Permit me to cite some research findings in the hope of illustrating its value and why we should sustain it in the application for funds.

I note that current research indicates that the toxic PCB cause may be a particular metabolite(s). (See M.S. Wolff, A. Fischbein, et al, "Disposits of PCB Congeners in Occupationally Exposed Persons," Toxicology & Applied Pharmacology 62, p.294-306, 1982.) I note further that the lower chlorinated Aroclors (primarily used in New Bedford) are biodegradable (to an extent, and it appears, to a large extent), unlike the highers (See Moolenaar, op.cit., 1982). I note further that mixed cultures biodegrade Ar. 1242 (1241 is used extensively in New Bedford) at a high rate.* This seems to be a viable line of research (There exist a ready-made facility to determine this (MERL, see infra)).

There is evidence of a rapid metabolism of the less chlorinated isomers of Aroclor 1242 (Ahmed & Focht Can. J. Microbiol 19, 1973), and the degradation of the less chlorinated biphenyls of Ar 1242 (Kaiser & Wong, "Bacterial Degradation of PCBs...from Ar. 1242," Bull. of Envir.

*Similar by chlorinated weight and isomeric structure to 1241 (1016). See R.B. Clark et al, "Degradation of PCBs by Mixed Microbial Cultures," Applied & Environmental Microbiology, Vol. 37, #4, April, 1979, p.680-685.

Contamination & Toxicol., Vol. 11, #3, 1974). Also, Ahmed & Focht in a later study ("Oxidation of PCB...," Bull. Env. Contamin. & Toxicol., Vol. 10, #2, 1973) note that increasing chlorine substitution renders the biphenyl molecule more resistant to microbial attack. Rhesus monkey experiments have indicated the same. Thus, "it is likely that the lower chlorine isomers were rapidly metabolized and were not detected on GLC analysis while a large percentage of higher chlorine isomers were deposited primarily in the adipose tissue of these animals." (J.R. Allen, et al, "Responses of Rats and Nonhuman Primates to 2, 5, 2', 5-Tetrachlorobiphenyl," Env. Res. 9, 1975). The same results appear in experiments on rats (Matthews & Anderson, "Effect of Chlorination on the Distribution & Excretion of PCBs," Amer. Soc. for Pharmacology..., Vol. 3, #5, 1975). Studies indicate that less than 10% of the total dose is excreted unmetabolized and metabolism was greatly affected by the degree of chlorination. Less than 20% of a higher chlorine isomer (hexa.) would ever be excreted in a normal diet. The hexa isomer appears to be the most prevalent PCB in human tissue. According to Burse et al ("PCBs," Arch. Env. Health, 29, 1974) Ar. 1016 is eliminated more rapidly in rats than 1242, after discontinuing exposure, and both 1016 and 1242 are less persistent with less of an effect on the liver than 1254 or 1260.

It is indeed significant that most of the PCBs used in New Bedford were low chlorinated Aroclors. It is significant in assessing the scope of the toxic potential and possible outcomes in the distribution and concentration of the chemical. It can explain the low levels of 1016's in the measurements within the harbor (a similar assessment was made by the Canadians. (See infra), though their presence may exist in altered form, since only in this manner can the high levels of the harbor be explained. Recent precise measurements have identified Aroclor 1242 as a dominant type in the total Aroclor count of the sediments. 1242 is similar to 1241 (1016), and the measurement of 1242 appears to indicate an environmental modification of the commercial Aroclor.

While the above biodegradative mechanism may not be locally applicable, neither would I deny it. And neither should you and neither should anyone else. My point in citing the above is that you cannot engage in research to a local problem of this type and exclude research to provide a generic solution: to find with exactness the toxic cause, to remove the chemical by natural than mechanical means if possible. Every problem occurs in a locality, every large problem starts in a locality. Moving stuff around is not a solution. It is simply further localization. I agree it is necessary. It is important that localized dredging be permitted. This meets a critical local need. But it is also important to couple this with a comprehensive attempt at a solution. There is nothing else we can do now than to dredge if there is a health impact. But unless we try to understand the problem and determine the causes, this is all we shall ever be able to do. Unless you want the tomorrows to be more of the nows, then you have to foster the conditions so that dedicated researchers can be comprehensive as they follow leads that go nowhere, so that someday they will follow one that goes somewhere. It is my opinion that in funding this project, the funding source has an obligation to include a range of potential research possibilities as a necessary cost in the resolution of a problem, when there exists a potential impact on human health. There exists no cost ratio between this cost and the other costs (dredging). And a resolution that can lead to a reevaluation of national standards can also lead to cost-savings substantially beyond the scope of the locality.

Consequently, an essential part of the Superfund application has to include this task. Permit me to cursorily list some research items. In brief, the following appear to be essential components of a study:

1) whether migration of the chemical is occurring, and hence there is a need of a circulation survey

2) the pathway of the chemical and its relation to the food chain leading to higher trophic levels and man

3) an assessment of the other chemicals (trace metals) and their impact (synergestic effect)

4) an assessment of the toxicity of Aroclor 1016 and whether it measures different as an environmental PCB

5) the determination of a regional theshold value

6) the disparity between the high discharge levels and the low measurements (absence of) of 1016

7) high level chemical analyses of the compounds to permit a partitive analysis to, hopefully, explain the structural causes of varying toxicities and their absence

8) to research and apply, if possible, microbial cultures in the harbor and/or at MERL*

9) to test the ingestion of local environmental PCBs on research animals to assess both toxicity and rate of intake and retention, at MERL for finfish, at other laboratories for mammals

10) the full use of the literature in order to determine the horizons that can serve as starting points, to place the matter in context and not reinvent the wheel

11) provide and communicate a comprehensive statement to the public

12) to determine methods of disposal and disposal sites

13) to measure levels in the adipose tissue, since there is no established correlation of blood and adipose concentrations. (See Strassman, supra) (Levels in the blood of local finfish may also be an appropriate measure to indicate the partitioning of PCBs into the body system.)

14) to permit localized dredging, to determine the extent of sediment transport, and meet critical developmental needs

15) to appoint either a coordinator who understands the many facets of the issue, to assure that quality performance standards are met, or a technical committee to guide the research as stated. The committee should include consultants (proposed by the industry) familiar with the issue.

Pardon my belaboring the issue, but one last question. What if the impact on health is negligible and the remedial costs are not feasible? Should we not forego studies to determine the former, especially in view of the latter? There are three replies to this. First, the elevated levels of the inner harbor are high, though it is unclear relative to other affected areas; the chemical is persistent and bio-accumulates; and lastly, fetii and infants through lactation are susceptible, as well as the singular person who has a disposition and affinity to the effects of the chemical. There also remains the national body--burden or additive. The impact of this is unknown.

*MERL Microcosm Ecosystem Research Lab., URI, is a research tool that can aid in part of the research. The costs run from $300,000 to 1 million, depending on the amount of research. (Pers. comm., C. Oviatt, MERL, 1981).

The latter reasons appear to warrant research commensurate to understanding the implications of the problem in spite of the question about remedial feasibility. Exact answers can provide clear guidelines for what future action to take.

To be redundant. We do not know now whether the effects are negligible, though it is natural and realistic to assume that they are. However, the assumption should also entail the effort to find out whether they are. This is not a contradiction. It points out the distinction between the way in which we know and the way in which things are. It is an optimistic assumption that does not preclude the possibility of its opposite and hence commits us to determine the truth of the assumption. It is a necessary assumption since there is no evidence of local harm, but the possibility of the truth of its opposite makes it as necessary to test for the opposite. It is realistic but tentative since it is based on the intuition of many local people and no conclusive determination has been made. It is an assumption that is far removed from hysteria but not with an awareness of fear, for it recognizes the gravity of its opposite, and this commits us to treat it as an assumption whose accuracy has to be determined. This is the task we have to execute, and execute properly. It is, so to speak, the order of the day.*

Robert B. Davis
ROBERT B. DAVIS

RBD:rc

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*It is with some hesitation I have submitted the above. I tend to be cautious and do not wish to unqualifiedly endorse a course of action unless it is clear to do so. So let me state a strong case against the above recommended research plan and then reply to the difficulty raised. There indeed may be minimal impacts such that there is no remedial feasibility. Rather than engage in the above study, it may be more proper to either follow-up on Dr. Telles' recent health sample of New Bedford residents if analysis warrants it, by an in-depth clinical analysis of those with elevated levels; and/or proceed with a full-scale epidemiological study. Further, the DPH of Michigan is currently engaged in an in-depth health survey, a follow-up on their 1974 study. This is scheduled to be finished by 1983. Thus, some would say (a Federal agency), it is more appropriate to await the results of this survey and a local in-depth health analysis or epidemiological survey before committing the State and Federal government to engage in extensive research, as well as dredging.

(Footnote cont'd. on page 11)

Footnote from page 10 cont'd.
However, there appears to be one decisive counterargument. While admitting the possibility of a natural degradability and relative dilution in respect to Aroclor 1016, its extent may not be significant. Further, the measured PCBs, 1242, 1248 and 1254, are high for the inner harbor. Their persistence is much greater than 1016. It may be that the resistant compounds (constituents) of 1016 are what is being measured. In any case, what exists is persistent. The inner harbor PCBs can also migrate to the outer harbor. While there is evidence (conjectural) that there exists a net inward sediment exchange from the outer to the inner harbor, there is an exchange, which may be significant, but there is also the recent additive closure outward over time of commercial lobster fishing areas. This suggests an outward migratory impact. (However, recent measurements by DMF indicate a reduction, but which may be seasonal.) And recent sediment analyses (DEQE, 1981) indicate a clear gradient from the inner to the outer harbor.

If this is the case, then deferred research contingent on the results of health studies may find that the migration of the chemical has even gone further upon completion of the health studies, which then means possibly further migration upon the completion of the research. Further, it is unlikely that the health studies will qualify the observation that mothers with elevated local PCBs do not pose risks to fetii or infants through nursing. The evidence is too strong to deny their susceptibility. For example, 7.8% of a national survey on PCB levels in human milk had levels over the 2.5 ppm (fat basis) FDA tolerance for commercial milk. The mean PCB concentration in the survey was from 1-1.1 ppm. In Lake Michigan only one fish eater was available for measuring human milk levels. The level was quite high (4 ppm, fat basis). This is 4 times the average level of PCBs in human milk. (But note, Kreiss' observation (op.cit., p.2506): "nursed children of parents with elevated levels did not have significantly higher levels than bottle-fed children, in contrast with DDT exposure and levels.") Further, the PCB blood level of children who nurse over 3 months had levels higher than their mother. The determining factor was <u>not the age of the child at the time of measurement, but the length of time the child spent nursing</u>. (FDA, "An Assessment of Risk Associated with...PCBs" 1979). While it may be true that it is very unlikely that sporadic recreational fishing can lead to elevated levels, it is of concern that an active marine basin poses risks to subpopulations, without trying to determine the scope of the risk.

It would appear then that research is necessary if only to assess the potential impact on the very young. But also---it is now owed to the public, since the issue has been communicated in a manner disproportionate to the context of the evidence that is my opinion.

(Footnote continued on page 12)

Footnote from page 11 continued.

However, let me to one step further in this analysis since it is the prerogative of the funding source to make an allocation that is not duplicative of research, that is only obligated to provide monies to the extent the problem requires it.

In view of the national problem and a host of studies on the matter, and since PCBs are no longer being discharged in New Bedford and recent lobster measurements weree low and since the New Bedford situation has not been put in context, a Federal agency may have basis to qualify the research proposal, though it appears appropriate as a test case for marine waters.

As a practical mater, the dredging costs are prohibitive, and since a primary source of input into the ecosystem has been identified (the hot spot area, North of the Route #195), the only possible action in this area. Eliminating or substantially mitigating this source, means the environ can live with sediment values less than the EPA threshold norm, since over time degradation and a flushing action will reduce the levels further.

But evn in view of these qualifications, there still appears to be three essential pieces of information: whether the local environmental PCB is toxic, and if so, to what extent; what is the health impact on those with past exposure, and in particular fish eaters (future exposure); and what is the distribution pattern and rate from closed areas with elevated levels into open waters prolific in edible marine life. While there are definite limits to dredging in view of costs, a primary purpose of the feasibility study is to understand the potential effect, to give scope, or perspective to what it means, and then advise the public, including those that frequent Buzzards Bay. It is to determine whether there is an exposure, the level and risk of it, in order to determine the future use of the natural resources. In view of the very high costs for remedial action, a feasibility study appears to be feasible. It would appear the following are matters that have to be studied, the barebone minimum:

1) - An in-depth health analysis of those with elevated levels,* in particular the offspring and the correlation of PCB levels and blood pressure

2) - An assessment, through testing, of the toxicity of local environmental PCBs
   a) by analysis
   b) on animals
   c) as biodegradative

3) - A circulation survey of the inner harbor relative to Buzzards Bay.

*This is in spite of a similar survey in Mich., since there is a paucity of research in this area. There exists none for marine waters.

Footnote from page 12 continued

The first assesses whether there is a health impact, also assessing the possibly unique impact of local Aroclors. The second is explicit in determing this and also answers an important question missing in the literature (an assessment of environmental Aroclors). The third assesses the long-term distribution pattern of PCBs from sediments with highly elevated levels in closed waters to waters that are open to an extensive migration of the PCBs.

The three points are of such a nature that it would appear to be necessary for the funding source to commit itself to assure their determination. It is my opinion that a Federal funding source could go beyond this and fund the complete research program described earlier, since the amount of money is within its discretionary capabilities.

Further, a group of Federal scientists have recommended that a population of fish eaters be identified and studied in detail. They also recommended the same for an industrial population. The City combines both aspects.* The recommendation of the City for a study appears applicable. An application before a Federal agency appears appropriate. (See Final Report of the Sub-committee, On the Health Effects of PCBs, HEW, on file with FDA, 1976, p.31-32.).

Further, it is recommended by medical scientists that a community with an incidence of hypertension and elevated PCB levels be studied.**As noted before, there exists

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*In general, based on the Lake Michigan Study, there is a proportion between elevated PCB levels and the consumption of fish. However, there is one anomaly in the data. The elevated PCB levels in the 'heavy' fish eaters of Mich. were higher than for the heavy fish eaters of Conn. But the heavy fish eater in Conn. consumed more than the exposed Mich. fish eaters by a factor of 2 to 3, but with a PCB level less than 1/2. (See comparative table: fish consumed, 6 lbs/mo. for Conn. (males) with a PCB level of 32.6 ppb for males, and 2-3 lbs/mo for Mich. with a PCB level of 73-75 ppb.) Aside from the anomaly, the data suggest that the N.B. fish eater either consumes less fish or the chemical passes through (metabolism, secretion). This is consistent with the presence of the lower chlorinated Aroclors.

**See K. Kreiss, R.D. Kimbrough, et al, "Associations of Blood Pressure & PCB Levels," JAMA, Vol. 245, #24, June 26, 1981, p.2509. See also A.P. Alvares et al, "Alterations in Drug Metabolism in Workers Exposed to PCBs," Clin. Pharm. Therap. 22, 1977, p.140-146, in R.D. Kimbrough, "op.cit." (Halogenated Biphenyls, etc.) p.384. She cites Alvares & notes an effect of 1016, i.e., 'plasma antipyrine half-life was significantly lower than in matched controls.' The meaning of this is not clear to the author at this time but the effect is on the capacity of the organism to relieve fever, pain & rheumatism, i.e., a suppression of the body's immunological defenses.

Footnote from page 13 cont'd.

a correlation between PCB levels and blood pressure for a community from the south, and neither the Connecticut or Lake Michigan studies attempted to determine whether there was a correlation between the two variables. There is an incidence of hypertension in the City, though Fall River, a control City, is also high relative to other communities.* But the MA DPH indicated a weak assocation for the younger age cohorts (45 years). See also Smith's observations (ftn. #2). At any rate, there appears to be need of future studies.

Permit me to quote from the JAMA article on the need of future studies:

> "Our preliminary findings of associations between the serum PCB level and blood pressure, liver function and cholesterol concentrations merits further medical study...(the) PCB burdens in Triana (Ala) are probably similar to those of any population consuming fish downstream from an industrial population center. Given the uncertainties of the consequences that PCBs may have on human health...similar studies of groups with higher exposures are needed to provide a firm basis for regulation of our environmental and food chain."

In the abstract of the article, the authors say,

> "PCB blood pressure assocation...must be confirmed in other exposed populations." (underlines mine).

It is the position of this writer that steps #1-3 should be funded. Authorities on PCBs provide ample documentation to conclude to the same.

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*See Mass. Standardized Mortality Ratios, 1969-1978, part I. According to a source cited in Kreiss, op.cit., p.2509, a recent study of the causes of death in a cohort of 2,567 PCB workers, indicated no excess of nervous or circulatory causes of death. While the hypertension mortality ratio (SMR) of the City is high, it is common to other MA communities not exposed to PCBs. The cause appears to be dietic. Also, according to Dr. A. Smith of NIOSH, Cincinnati, Ohio (Pers. commun., August, 1982), there was no correlation of elevated PCB levels & blood pressure in 2 sources of occupational exposure (St. Louis, MO, & Ind.). At both locations the PCB levels were higher than in Triana, Ala. The source appears to be dietic. (See also A. B. Smith, et al, M.D., M.S., Chief, Epidemiology Section, Industrywide Studies Branch, Hazard Evaluations & Field Studies, Cinn., Ohio, "Metabolic & Health Consequences of Occupational Exposure to PCBs, pre-publ.: British Jnl. of Indust. Medicine, submitted, Nov., 1981, p.12 of the MSS.

NOTES

PCB LEVELS IN COASTAL & OFFSHORE WATERS (& SOME LAKES)

Eels, Striped Bass, White Perch et al

(MARINE SAMPLING, LOCAL BUDGET (rev.))

To test marine species favored at local sites by local residents. They have been overlooked by testing officials, e.g., the 'lowly' periwinkle, a delicacy of some locals. The tests per sample are 3-fold: adipose, muscle & visceral tissues. Each test will be for a range of Aroclors, since the liver can partition and metabolize different PCBs differently. For example, in mammals, the higher chlorinated isomers tend to accumulate in the adipose tissue, while the lower chlorinated isomers are secreted. Any variance in content may be useful in projecting the future distribution of PCBs as well as providing useful information on edibility. Testing should also identify the individual isomers, since they appear to be the source of toxicity. I shall defer this task to WHOI and evaluate the selection of species with WHOI & DMF. According to the FDA, the tested tissue excludes trimmable fat from the fillet. This has to be clarified for local species, since some species in Lake Michigan (e.g., carp) are estimated to contain significant amounts of fatty tissue. Great Lake officials estimated that by removal of the fat from the fillet, there will be a 40% reduction in the amount of PCBs. However, the regional FDA laboratory believes either most of the fat is removed or there is very little in the local fillet, e.g., flounders, scup. The tamale (part of the viscera) in lobsters is high in fatty content and is measured as part of the PCB count.

In short, the purpose of the 3-fold testing is 2-fold: guideline information on edibility and general scientific information to make precise the pathway of PCBs and permit estimates of future PCB retention and distribution.

ON EELS

Since the eel has very high levels in the very upper part of the inner harbor, as well as relatively high levels elsewhere, and since striped bass favor eels as well as have the highest level of PCBs elsewhere, permit me to elaborate on the 2 species. While the eel has high PCB levels, except for the very upper part of the estuary, the levels are lower than in the Hudson River. The levels appear comparable to eels in Canadian waters (See ftn., supra, & "Regulation of PCBs in Canada," Ottawa's Tech. Report 76-1, 1976, p.165+ N.B., about 22 ppm; Canada, 17 ppm). The fat of the eel can range from 20% (or much less) to 40% (when the eel is ready to journey to the Sargosso Sea) of body weight.* In contrast, the percentage of fat is higher per unit area. Contrary to some views, the fat can be filleted (Belgian fillet). The FDA and other agencies include the fat in the PCB count.

Eels are soft-organism predators and thus favor viscera (liver). If this is distinctive relative to other predators, over and above the high fat content, it can at least partially explain the high PCB levels in the species. It can also explain the occasional high level in bass, since they love eels, i.e., omnivorously. At any rate, questions of this sort (rate of uptake retention and body partitioning) could be quickly resolved at MERL (Marine Ecosystems Research Laboratory, URI) in conjunction with the adjacent EPA lab, the latter providing personnel for histopathological analyses.

In respect to the latter, the DMF (See Koleck, 1981) has grossly observed no abnormalities or disease in all of their samples, including the internal examination of finfish, the eggs of lobsters over time, and the spawn of the winter flounder. A similar observation has been made about the winter flounder by Dr. Phelps of the EPA in Narragansett, R.I. (Pers. Comm., 1982)

It should also be noted that toxic effects were observed in bioassay tests and chronic tests of 1242 on fatted minnows. Mortality occurred at exposure above 8.3 ppm (g/l), while reproduction occurred at or below the same value. (See Stalling, et al, Toxicities of PCBs to Fish..., "Environmental Health Perspectives, 1972.")

The point I wish to make in all of this is the need for precision, an area in which the capability exists.

It should also be noted that dredging by itself will not eliminate the levels in eels if sediment levels through contact or as a residue are the primary pathway (lobsters are known to utilize sediment in supposedly the grazing of food to aid ingestion; see Cobb & Phillips, "The Biology & Management of Lobsters," Academic Press, 1980, p.40) since their habitat is mostly protective, favoring crevices, reefs, piers, etc. Dredging is precluded from these areas, though tidal action would reduce the levels.

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*The above section on eels is based on a communication with a fishery biologist who specializes in eels. Very few are knowledgeable with the species. The estimates are crude and not quantified. However, the DMF (1981) cites a fat content of 26% for the body tissue of eels (F.W. Tesch, "The Eel...," Chapman & Hall, London, 1977).
(Footnote continued on page 17.)

Footnote from page 16 cont'd.

STRIPED BASS

While PCB levels in local Striped Bass are not above threshold levels, observations of the species are informative since Striped Bass have very high levles in the Hudson River & coastal waters. I shall also briefly review offshore & coastal levels of PCBs in marine life in order to provide some context for levels in marine waters.

The highest measurement of PCBs in Striped Bass in local waters is 2 ppm (the others: .9, .4 ppm). While bass are voracious foragers, eels appear to be incidental to their diet. A common staple are baitfish, esp. in schools. But note that many bass are caught in Plymouth Harbor, especially off Eel Creek (Bigelow & Schroeder, infra @ Bibl., 1953, p.396). Aside from New Bedford, bass appear to be a species affected by PCBs. According to an FDA review of fish levels, the highest in whole fish was 17 ppm, a Striped Bass caught in the New Jersey area (Federal Register, 1977, Vol. 42, #63, p.17490).

...& WHITE PERCH

Further, according to a recent (1979-1980) "Survey of PCBs in Selected Finfish Species from U.S. Coastal Waters" (D.F. Gadbois, NMFS, Gloucester, 1981), 2 species had the highest levels, Striped Bass and White Perch. 22% of the Bass in New York and New Jersey area had levels over 2 ppm (high 3.6 ppm), while 50% of the White Perch had values over 2 ppm (high 22 ppm). Interestingly, 1.3% of the Striped Bass from the West Coast were over the 2 ppm level, the only species over the limit from that area. Fat content ranged from 2-8% for the Bass, while it ranged from 2-11% for the White Perch. There was a correlation of PCB levels and fat for the Perch (low: 1.9 ppm @ 2.56% fat to 22 ppm @ 10.7% fat from 30 & 10 samples, resp.). The Perch were from the lower Hudson River, the Bass from the same location but also from the New York Bight area. The latter had the highest PCB level for Bass for 1 sample of 5, 3.6 ppm, and it also had the highest fat content, 8.38%. (Other samples ranged from 2-4%.). Striped Bass in the Hudson River are known to contribut to the stocks in the L.I. Sound, New York Bight area. (Clayton, infra)

The West Coast Striped Bass had fat content from near 1% to 6%. The highest PCB value, 4 ppm, had a fat content of 3.53%. It should be noted that White Perch are a member of the Bass family, and according to Bigelow & Schroeder, resembles the Striped Bass, but it is a deeper bodied fish, and a resident species, especially in estuaries. The feeding habits are small fish fry of all kinds, young squid, shrimp, crabs and other invertebrates, as well as spawn. They also feed on eels, and levels of the chlorinated hydro-carbons (DDT) were relatively high compared to other species. (Clayton et al, "Marine Fishes of MA, 1978.) According to Phil Goodyear (currently studying S. Bass), U.S. Fish & Wildlife, VA, W. Perch are benthic feeders.

(Footnote coct'd on p.18)

Footnote from page 17 cont'd.

OFFSHORE FISH

According to an FDA review (op.cit.) of ocean fish, the average PCB levels for most species (other than anadromous fish) were less than 0.5 ppm for whole fish and the levels for edible portions (excludes head, tails, scales, entrails) were lower, at an average of a few tenths of 1 ppm. Assuming few tenths at .3 and most of the difference is located in the entrails, 40% of the PCBs are in the viscera and 60% in the fat and other edible flesh. It is tempting to offer the following conjecture on the distribution of PCB content: 40% viscera, 40% fat, 20% non-fat flesh. But the determining factor is the proportion of the part's weight to total weight (see lobster, below).

What seems clear is that species with high fat content that frequent areas with elevated sediment levels will have proportionately higher levels of PCBs. What is not clear, but suggestive, are higher levels for species that are soft-organ predators and resident species in areas with elevated sediment levels.

Hunter hypothesizes 2 mechanisms of PCB contamination: a base-load obtained from PCB partitioning into body lipids and a 2nd level obtained from ingestion. Both sources are maximized near the sediment-water interface inhabited by the detrivores (emphasis added). The author bases his view on a review of recent literature, and a recent study of PCB burdens in 307 fish of 7 species and 3 trophic levels collected from 9 Oklahoma lakes. The finfish in the lakes with known PCB inputs had significantly higher PCB levels. R.G. Hunter, (Corps of Engineers, Tulsa, Oklahoma) "Environmental Effects of PCBs: Important Ecological Effects," in Abstracts, op.cit., EIA Symposium, Bethesda, MD, ICAIR, Ohio, 1982, pg.24).

In respect to offshore waters, a recent survey (1980) by NMFS ("Gulf & Atlantic Survey for Selected Organic Pollutants in Finfish & Benthic Animals," PHC, PCBs, DDT, Sandy Hook, 1980) has updated the FDA values mentioned above. The survey indicated low levels compared to coastal waters. PCB levels were higher in the No. East, with Silver Hake at highest levels for finfish. So. Atlantic and Gulf values tended to the lower part of the range in the No. East, somewhat verifying NAS' estimates (see supra). Lobster, off the New York Bight and Rhode Island, had the highest value of all species (muscle: 0.15 ppm).

While the origin and distribution of the chemicals is unclear, the contribution of coastal sources is not precluded from consideration. A gradient from the New York Bight is observed for Silver Hake by the investigators. The lobster samples are too small in number and sites to be definite, but the high values are near coastal sources (N.Y.B. & R.I.).

(ftn. cont'd. p.19)

Footnote from page 18 cont'd.

The deep sea scallop has very low levels, but almost all species have levels, which is significant. Concentrations in the liver were higher over the muscle by about a factor of 10, similar to the WHOI depuration lobster experiments (since the tamale is about 1% of body weight and the FDA measure of total PCB value; over 97% if calculated as an equal part by weight). One species, Scad, off Western Texas, had 30 ppb in the muscle, but 11,400 ppb in the liver. This was the highest liver level in all of the species tested. Hake and Flounder from the So. East Gulf Region had liver concentrations over muscle by factors of 4 and 14 respectively. Applying this to unpublished upper range data for flounder on the East coast, we have a value of 4.9 ppm (4900 ppb).

It should also be noted that sediment levels in the New York Bight area had levels of both 1016 & 1254, but the fish with high PCB levels (S. Hake & flounder) only manifest the PCBs as 1254. The investigators offer an uncertain hypothesis to explain the 'missing substance,' namely the solubility of 1016 at resuspension and the intake by fish through this means (For an observation on levels in other waters (fresh and foreign), see the footnote.)*

It becomes clear upon reviewing the above studies that sediment and water column particulates should be measured in order to correlate the levels and aid in the determination of the pathways of the chemicals. The NMFS investigators also recommend that the PCB measurements should include specific chlorinated HCs: i.e., monoclor, etc., in lieu of the Aroclor formulations. It seems clear, however, that visceral, fat, and muscle levels should be determined for a representative sample of most species, not to exclude some blood measures. This will determine the pathway of the chemical within the organism.

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*For U.S. industrialized rivers, the mean PCB level in fish runs from 1-213 ppm: (Catfish in Ala. contained up to 811 ppm.) The mean level in Lake Michigan & Ontario is 20 & 19 ppm, respectively. Levels from 0.5-2 ppm have been reported in food fish, including cod in Sweden and the No. Atlantic. Japanese inshore fish commonly have 1-16 ppm. (See N. Nelson et al, "PCBs--Envir. Impact," Env. Res. 5, 1972, p.293, 296-7, 302; see also Federal Scientists report on Health Effects of PCBs, HEW, to FDA, 1976, p.148-150. They provide a list of areas with fish above the 5 ppm value. See supra, for ref., and an earlier footnote on levels in finfish.

LOCAL BUDGET

(Summary of Cost-Estimates)

	1)	Permit Prerequisites	$30,000
	2)	Marine Tests	26,500
	3)	Health Data	10,000
	4)	Personnel	25,000
		TOTAL	$ 91,000
ALTERNATE	5)	Circulation Survey*	80,000
		TOTAL **	$171,500

*NOTE:

#1 - Item #5 is to be deleted as a local project on the assumption that WHOI is including the inner harbor as part of their circulation survey of Buzzards Bay. According to my review of WHOI's proposal, this item is not part of their survey.

#2 - Narration will be incorporated into the budget in order to give context to the items.

#3 - It is assumed that the costs will be borne by the Federal funding source or appropriate State agency. The City is willing to be a delegated agency for the specified tasks since most of the tasks are not within its native responsibilities and competence. Strictly speaking, the local responsibility resides in item #1.

**See p.9, end of footnote, for a barebone minimum total research project along with a cursory cost-estimate, $500,000-$900,000 or $600,000 (if the circulation survey is provided by NOS).

LOCAL BUDGET

Cost-Estimates of Items & Tasks

1) Permit satisfaction for localized dredging: $30,000 for 2 sites @ $15,000 per site.

The sites are: North Terminal and the Fairhaven channel. The No. Terminal is a prime undeveloped waterfront industrial site of the City, and so is the Fairhaven channel (already approved with money available by the U.S. Corps, if permits can be obtained and a site for dredge disposal).

The steps involved are:
  a) physical site evaluation
  b) sediment sampling & analysis
  c) environmental assessment
  d) permit/license satisfaction
  e) dredging/deposition technique evaluation to satisfy the permit regulations.

The cost-estimate is based on an estimate submitted to the CZM office for 1 site (see attachment).

2) Marine sampling and analysis:* $17,000

To test marine species favored at local sites by local residents. They have been overlooked by testing officials, e.g., the 'lowly' periwinkle, a delicacy of some locals. The tests per sample are 3-fold: adipose, muscle & visceral tissues. Each test will be for a range of Aroclors, since the liver can partition and metabolize different PCBs differently. For example, in mammals, the higher chlorinated isomers tend to accumulate in the adipose tissue, while the lower chlorinated isomers are secreted. Any variance in content may be useful in projecting the future distribution of PCBs as well as providing useful information on edibility. Testing should also identify the individual isomers, since they appear to be the source of toxicity. I shall defer this task to WHOI and evaluate the selection of species with WHOI & DMF. According to the FDA, the tested tissue excludes trimmable fat from the fillet. This has to be clarified for local species, since some species in Lake Michigan (e.g. carp) are estimated to contain significant amounts of fatty tissue. Great Lake officials estimated that by removal of the fat from the fillet, there will be a 40% reduction in the amount of PCBs. However, the regional FDA laboratory believes either most of the fat is removed or there is very little in the local fillet, e.g., flounders, scup. The tamale (part of the viscera) in lobsters is high in fatty content and is measured as part of the PCB count.

*See footnote on next page

In short, the purpose of the 3-fold testing is 2-fold: guideline information on edibility and general scientific information to make precise the pathway of PCBs and permit estimates of future PCB retention and distribution.

Since the eel has very high levels in the very upper part of the inner harbor, and since striped bass favor eels as well as have the highest level of PCBs elsewhere, permit me to elaborate on the 2 species. While the eel has high PCB levels, except for the very upper part of the estuary, the levels are much lower than in the Hudson River. The levels appear comparable to eels in Canadian waters (See "Regulation of PCBs in Canada," Ottawa's Tech. Report 76-1, 1976). The fat of the eel can range from 20% (or much less) to 40% (when the eel is ready to journey to the Sargosso Sea) of body weight.* In contrast, the percentage of fat is higher per unit area. Contrary to some views, the fat can be filleted (Belgian fillet). The FDA and other agencies include the fat in the PCB count.

Eels are soft-organism predators and thus favor viscera (liver). If this is distinctive relative to other predators, over and above the high fat content, it can at least partially explain the high PCB levels in the species. It can also explain the occasional high level in bass, since they love eels, i.e., omnivorously. At any rate, questions of this sort could be quickly resolved at MERL (Marine Ecosystems Research Laboratory, URI) in conjunction with the adjacent EPA lab, the latter providing personnel for histopathological analyses. In respect to the latter, the DMF has grossly observed no abnormalities or disease in all of their samples, including the internal examination of finfish, the eggs of lobsters over time, and the spawn of the winter flounder. It should be noted that toxic effects were observed in bioassay tests and chronic tests of 1242 on fatted minnows. Mortality occurred at exposure above 8.3 ppm (μg/l), while reproduction occurred at and below the same value. (See Stalling, et al, Toxicities of PCBs to Fish..., "Environmental Health Perspectives, 1972.") The point I wish to make in all of this is the need for precision, an area in which the capability exists.

It should also be noted that dredging by itself will not eliminate the levels in eels if sediment levels through contact or as a residue are the primary pathway (lobsters are known to utilize sediment in, supposedly, the grazing of food to aid ingestion; see Cobb & Phillips, "The Biology & Management of Lobsters," Academic Press, 1980, p.40) since their habitat is mostly protective, favoring crevices, reefs, piers, etc. Dredging is precluded from these areas, though tidal action would reduce the levels.

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*The following section on eels is based on a communication (footnote cont'd. on page 15)

50 samples, 3 tests per sample: 150 tests

Collection:	$4,000	- 2 weeks of sampling @ $400/day
Analysis:	22,500	- @ $150 per GLC test. Economies of scale are not factored in.
TOTAL	$26,500	

To be coordinated with WHOI, DMF & DPH. (Note: According to WHOI, isomeric analysis can be made at a feasible cost after an initial capital cost ($25-$35,000) for instrumentation; the State labs may benefit through acquisition of this facility. WHOI and other places already have the instrumentation and according to WHOI's schedule, it should be available for PCB use as part of WHOI's analysis for the project.)

3) Statistical Analysis and Comparison of Health Data, c. $5,000-$10,000.

Comparison of hospital discharge rates, primary and secondary discharge diagnosis, and tertiary, or other contributing conditions as available, by patient origin, locality (New Bedford, Fall River, coastal towns, State) zip code localization, and census tract and blocks. The analysis can be made as part of an epidemiological study, or independently if the latter is not commissioned.

Possible incorporation of data base on file with Mass. Health Data Consortium (Waltham, MA) into New Bedford data base to correlate the data to more precise boundaries (Census tract, block); or utilization of the DIME file (Geographic Base File) by the Consortium to attain the tract and block localization. The DIME file has tract and block locii for the coastal towns.

This item is to be coordinated with State and local DPH (Dr. Telles, M. Lahey).

Footnote from page 14 cont'd.
with a fishery biologist who specializes in eels. Very few are knowledgeable with the species. The estimates are crude and not quantified. However, the DMF (1981) cites a fat content of 26% for the body tissue of eels (F.W. Tesch, "The Eel...," Chapman & Hall, London, 1977).

While PCB levels in local s. bass are not above threshold levels, observations of the species are informative. I shall also briefly review offshore & coastal levels of PCBs in order to provide some context for levels in marine waters. The highest measurement of PCBs in bass in local waters is 2 ppm (the others:, .9, .4 ppm). While bass are voracious foragers, eels appear to be incidental to their diet. A common staple are baitfish, esp. in schools. But note that many bass are caught in Plymouth Harbor, especially off Eel Creek (Bigelow & Schoeder, infra @ Bibl., 1953, p.396). Aside from New Bedford, bass appear to be a species affected by PCBs. According to an FDA review

(continued on page 16)

4) Personnel: $25,000

Staff person to research, review, analyze and coordinate local projects, as well as general literature of the topic. Salary: $21,000 for staff person; $4,000 for secretarial services, travel, literature, duplication (copy) and communication costs. Staff will prepare a comprehensive report on the topic. (As an aside, there is need of a comprehensive researcher who can coordinate the many facets of the project and assure that research is directed in a comprehensive manner).

5) Inner harbor circulation relative to outer harbor: $80,000*

a) water column circulation
b) sediment migration
c) effect of hurricane barrier on both water and sediment migration

according to ? WHOI, numerical analysis can det effects of barrier by considering the variable.

The study is also historical since circulation pre-construction of the barrier can explain PCB levels in the outer harbor. Basis of cost is a circulation survey of the Providence River by URI (L. Spaulding). Though the Providence River is longer than the Acushnet River, the need for historical analysis may make the costs equivalent. A model can be constructed since there exists a detailed bathymetric survey of continuous data in an E-W direction. MIT personnel may be contracted for the latter task since they have considerable experience with circulation models.

NOTE: Item #5 is to be deleted from the budget on the assumption that WHOI will be including the inner harbor in their circulation survey of the outer harbor (Buzzards Bay). It is my understanding that WHOI intends to do this survey, though my reading of the WHOI proposal notes its exclusion.

Footnote from page 15 cont'd.
of fish levels, the highest in whole fish was 17 ppm, a striped bass caught in the New Jersey area (Federal Register, 1977, Vol. 42, #63, p.17490).

Further, according to a recent (1979-1980) "Survey of PCBs in Selected Finfish Species from U.S. Coastal Waters" (D.F. Gadbois, NMFS, Gloucester, 1981), 2 species had the highest levels, striped bass and white perch. 22% of the bass in New York and New Jersey area had levels over 2 ppm (high 3.6 ppm), while 50% of the white perch

(footnote cont'd. on page 17)

*The costs for this & Buzzards Bay may be avoided. See p.9, footnote.

Footnote from page 16 cont'd.

had values over 2 ppm (high 22 ppm). Interestingly, 1.3% of the S. Bass from the West Coast were over the 2 ppm level, the only species over the limit from that area. Fat content ranged from 2-8% for the Bass, while it ranged from 2-11% for the white perch. There was a correlation of PCB levels and fat for the perch (low: 1.9 ppm @ 2.56% fat to 22 ppm @ 10.7% fat from 30 & 10 samples, resp.). The perch were from the lower Hudson River, the Bass from the same location but also from the New York Bight area. The latter had the highest PCB level for Bass for 1 sample of 5, 3.6 ppm, and it also had the highest fat content, 8.38%. (Other samples ranged from 2-4%.) S. Bass in the Hudson River are known to contribute to the stocks in the L.I. Sound, New York Bight area. (Clayton, infra)

The West Coast S. Bass had fat content from near 1% to 6%. The highest PCB value, 4 ppm, had a fat content of 3.53%. It should be noted that white perch are a member of the Bass family, and according to Bigelow & Schroeder, resembles the S. Bass, but it is a deeper bodied fish, and a resident species, especially in estuaries. The feeding habits are small fish fry of all kinds, young squid, shrimp, crabs and other invertebrates, as well as spawn. They also feed on eels and levels of the chlorinated hydrocarbons (DDT) were relatively high compared to other species. (Clayton et al, "Marine Fishes of MA, 1978.) According to Phil Goodyear (currently studying S. Bass), U.S. Fish & Wildlife, VA, W. Perch are benthic feeders.

According to an FDA review (op.cit.) of ocean fish, the average PCB levels for most species (other than anadromous fish) were less than 0.5 ppm for whole fish and the levels for edible portions (excludes head, tails, scales, entrails) were lower, at an average of a few tenths of 1 ppm. Assuming few tenths at .3 and most of the difference is located in the entrails, 40% of the PCBs are in the viscera and 60% in the fat and other edible flesh. It is tempting to offer the following conjecture on the distribution of PCB content: 40% viscera, 40% fat, 20% non-fat flesh. But the determining factor is the proportion of the part's weight to total weight (see lobster, below).

What seems clear is that species with high fat content that frequent areas with elevated sediment levels will have proportionately higher levels of PCBs. What is not clear, but suggestive, are higher levels for species that are soft-organ predators and resident species in areas with elevated sediment levels.

In respect to offshore waters, a recent survey (1980) by NMFS ("Gulf & Atlantic Survey for Selected Organic Pollutants in Finfish & Benthic Animals," PHC, PCBs, DDT, Sandy Hook, 1980) has updated the FDA values mentioned

(Footnote cont'd. on page 18)

Footnote from page 17 continued.
above. The survey indicated low levels compared to coastal waters. PCB levels were higher in the NoEast with Silver Hake at highest levels for finfish. So. Atlantic and Gulf values tended to the lower part of the range in the No.East, somewhat verifying NAS' estimates (see supra). Lobster, off the New York Bight and Rhode Island, had the highest value of all species (muscle: 0.15 ppm).

While the origin and distribution of the chemicals is unclear, the contribution of coastal sources is not precluded from consideration. A gradient from the New York Bight is observed for Silver Hake by the investigators. The lobster samples are too small in number and sites selected to be definite, but the high values are near coastal sources (N.Y.B & R.I.). The deep sea scallop has very low levels, but almost all species have levels which is significant. Concentrations in the liver were higher over the muscle by about a factor of 10, similar to the WHOI depuration lobster experiments (Since the tamale is about 1% of body weight and the FDA measure of total PCBs mixes the parts in proportion to weight, then the tamale averages about 9% of total PCB value; over 97% if calculated as an equal part by weight). One species, Scad, off Western Texas, had 30 ppb in the muscle, but 11,400 ppb in the liver. This was the highest liver level in all of the species tested. Hake and Flounder from the So. East Gulf region had liver concentrations over muscle by factors of 4 and 14 respectively. Applying this to unpublished upper range data for flounder on the East coast, we have a value of 4900 ppb. It should also be noted that sediment levels in the New York Bight area had levels of both 1016 & 1254 but the fish with high PCB levels (S. Hake & flounder) only manifest the PCBs as 1254. The investigators offer an uncertain hypothesis to explain the 'missing substance,' namely the solubility of 1016 at resuspension and the intake by fish through this means.*

4.9 ppm

It becomes clear upon reviewing the above studies that sediment and water columnparticulates should be measured in order to correlate the levels and aid in the determination of the pathways of the chemicals. The NMFS investigators also recommend that the PCB measurements should include specific chlorinated HCs: i.e., monocloro, etc., in lieu of the Aroclor formulations. It seems clear, however, that visceral, fat, and muscle levels should be determined for a representative sample of most species, not to exclude some blood measures.

*For U.S. industrialized rivers, the mean PCB level in fish runs from 1-213 ppm. (Catfish in Ala. contained up to 811 ppm.) The mean level in Lake Michigan & Ontario is 20 & 19 ppm, respectively. Levels from 0.5-2 ppm have been reported in food fish, including cod in Sweden and the No. Atlantic. Japanese inshore fish commonly have 1-16 ppm. (See N. Nelson et al, "PCBs--Envir. Impact," Env. Res. 5, 1972, pg.293, 296-7, 302; see also Federal Scientists report on Health Effects of PCBs, HEW, to FDA, 1976, p.148-150. They provide a list of areas with fish above the 5 ppm value. See supra, p.10 for ref

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APPENDIX III:

EPA Data Retrieval System

May, 1982

DATATRIEVE "EPA 1" DEFINITIONS

SAMPLE NUMBER - (5 alphanumeric characters)
Assigned by M&E, with subscripts for replicate samples or analyses.

Original Sample Number - (14 mixed characters)

Original Station Number - (14 mixed characters)

Original Lab Number - (10 mixed characters)

LATITUDE & LONGITUDE - (6 numeric characters each)
Based on U.S.G.S. 1000-meter Universal Transverse Mercator Grid

XX	-	XX	-	XX
(100,000) M		(1,000) M		(10) M

SAMPLE TYPE (6 alphanumeric characters)

		CODE
MISCELLANEOUS		MIS
WATER		WTR
AIR		AIR
SEDIMENT		SED
WASTE (WATER & SOLIDS)		WST
HUMAN		HUM
AQUATIC BIOTA:		AQB___
American eel	Anguilla rostrata	AQBARO
Cunner	Tautogolobrus adspersus	AQBTAD
Summer flounder	Paralichthys dentatus	AQBPDE
Windowpane	Scophthalmus aquosus	AQBSAQ
Winter flounder	Pseudopleuronectes americanus	AQBPAM
Silver hake	Merluccius bilnearis	AQBMBI
Scup	Stenatomus chrysops	AQBSCH
Bluefish	Potamus saltatrix	AQBPSA
Tautog	Tautoga onitis	AQBTON
Striped bass	Morone saxatilis	AQBMSA
Fourspot flounder	Paralichthys oblongus	AQBPOB
Butterfish	Peprilus triacanthus	AQBPTR
Black seabass	Centropristis striata	AQBCST
Black dogfish	Centroscyllium fabricii	AQBCFA
Red hake	Urophycis chuss	AQBUCH
Northern lobster	Homarus americanus	AQBHAM

Long-finned squid	*Loligo pealer*	AQBLPE
Blue crab	*Callinectes sapidus*	AQBCSA
Quahog	*Mercenaria mercenaria*	AQBMME
Blue mussel	*Mytilus edulis*	AQBMED
Common Oyster	*Crassostrea virginica*	AQBCVI
Softshell clam *Mya orenaria*	AQBMAR	
American smelt	*Osmerus mordox*	AQBOMO
(Polychaete worm)	*Nepthys incisa*	AQBNIN
Miscellaneous		AQBMIS

SAMPLE SOURCE (3 alphanumeric characters)

GROUNDWATER	GWR
RIVER	RVR
INNER HARBOR	IHB
OUTER HARBOR	OHB
BUZZARDS BAY	BZB
CLARKS COVE	CLC
NASKETUCKET BAY	NAS
MATTAPOISSITT HARBOR	MAT
LITTLE BAY	LIB
RAW DRINKING WATER	RDW
FINISHED DRINKING WATER	FDW
COOLING WATER	COO
COMBINED SEWER OVERFLOW	CSD
RUNOFF	RNO
RAW WASTEWATER	RWW
TREATED WASTEWATER	TWW
INDUSTRIAL WASTEWATER	IWW
GENERAL WASTEWATER	WWR
SLUDGE	SLG
GRIT	GRT
ASH	ASH
LAND	LND
AMBIENT AIR	AMB
EMISSIONS (AIR)	AMB
FLESH	FLE
VISCERA	VIS
EDIBLE MEAT (e.g. loster claw)	EDI
WHOLE ORGANISM	WHO
BLOOD	BLO
MISCELLANEOUS	MIS

EXACT SOURCE (3 alphanumeric characters)

SURFACE	SUR
SHALLOW	SHA
DEEP	DEP
DOWNWIND OF SOURCE	DNW
UPWIND OF SOURCE	UPW
AT SOURCE	SRC

EXACT SOURCE - Continued	CODE
FEMALE	F
MALE	M
JUVENILE	JU
MATURE	MA
(leg. mature female)	(FMA)

DATES OF COLLECTION & ANALYSIS (6 numeric characters) — MMDDYY

TIDES (5 mixed characters)

SLACK, EBB BEGINS (HIGH TIDE)	SEB
SLACK, EBB BEGINS + 1 HOUR	SEB+1
SLACK, EBB BEGINS + 2 HOURS	SEB+2
SLACK, EBB BEGINS + 3 HOURS	SEB+3
SLACK, EBB BEGINS + 4 HOURS	SEB+4
SLACK, EBB BEGINS + 5 HOURS	SEB+5
SLACK, FLOOD BEGINS (LOW TIDE)	SFB
SLACK, FLOOD BEGINS + 1 HOUR	SFB+1
SLACK, FLOOD BEGINS + 2 HOURS	SFB+2
SLACK, FLOOD BEGINS + 3 HOURS	SFB+3
SLACK, FLOOD BEGINS + 4 HOURS	SFB+4
SLACK, FLOOD BEGINS + 5 HOURS	SFB+5

TIME
(IN MILITARY NOTATION) — XXXX

PARAMETER (3 numeric characters)
(See code numbers attached) — XXX

CONCENTRATION (11 mixed characters, 3 decimal places)

NOT DETECTABLE	.ND
TRACE	TR

UNITS (8 mixed characters)

PARTS PER MILLION	PPM
PARTS PER BILLION	PPB
MILLIGRAMS PER LITER	MG/L
MILLIGRAM PER KILOGRAM	MG/KG
GRAM/GRAM	G/G
NANOGRAM/METER	NG/M3
MICROGRAM/LITER	UG/L
WEIGHT WEIGHT	WW
DRY WEIGHT	DW

LAB: (4 alphanumeric characters)

	CODE
EPA - REGION I	EPA
CAMP, DRESSER & McKEE	CDM
WOODS HOLE OCEANOGRAPHIC INSTITUTE	WHOI
FDA - BOSTON DISTRICT OFFICE	FDAB
MASS FOOD & DRUG	MFD
LAWRENCE EXPERIMENTAL STATION (DEQE)	LES
CAT COVE MARINE LAB (DMF)	CATC
SOUTHEASTERN MASS. UNIVERSITY	SMU
UNIVERSITY OF SOUTH CAROLINA	USC
ENVIRONMENTAL SCIENCE & ENGINEERING	ESEI
WOODSON - TENET LABORATORIES	WOTE
MONSANTO CORP.	MONS
NEW ENGLAND ANAL. & TESTING LAB	NEAT
LYCOTT ENVIRONMENTAL RESEARCH, INC.	LYCO
TIBBETTS ENGINEERING CORP.	TIBB
VERSAR	VERS
CAMBRIDGE ANALYTICAL ASSOCIATES	CAA
GCA CORPORATION	GCA
GIDLEY LABORATORIES	GIDL

STUDY (AGENCY & YEAR): (7 mixed characters)

FOOD & DRUG ADMINISTRATION	FDA
MASS DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING	DEQE
DIVISION WATER POLLUTION CONTROL	DWPC
ENVIRONMENTAL PROTECTION AGENCY	EPA
WOODS HOLE OCEANOGRAPHIC INSTITUTE	WHOI
DIV. MARINE FISHERIES	DMF
MASS. FOOD & DRUG	MFD
CAMP, DRESSER & McKEE	CDM
SOUTHEASTERN MASS. UNIVERSITY	SMU
FAIRHAVEN MARINE	FAIR
AEROVOX INCORPORATED	AVOX
CORNELL - DUBLIER ELECTRONICS	CODU
MASS. DEPT. PUBLIC WORKS	MDPW
ARMY CORPS OF ENGINEERS	ACE
MASS. COASTAL ZONE MGMT.	CZM
GIDLEY LABORATORIES	GIDL
TOXIC SUBSTANCE CONTROL ACT	TSCA
UNIVERSITY OF SOUTH CAROLINA	USC

REFERENCE NUMBER (4 numeric characters)

See attached List of References

METHODS NUMBER (2 numeric characters)

See attached List of Methods

COMMENTS (50 mixed characters)

DATATRIEVE "EPA 1" PARAMETER CODES

VOLATILE ORGANICS

100	
101	Chloromethane
102	Dichlorodifluoromethane
103	Bromomethane (methyl bromide)
104	Vinyl Chloride
105	Chloroethane
106	Methylene Chloride
107	Acrolein
108	Trichlorofluoromethane
109	Acrylonitrile
110	1, 1 - Dichloroethylene
111	1, 1 - Dichoroethane
112	Trans - 1, 2 - dichloroethylene
113	Chloroform
114	1, 2 - Dichloroethane
115	1, 1, 1 - Trichloroethane
116	Carbon Tetrachloride
117	Bromodichloromethane
118	1, 2 - Dichloropropane
119	Trans - 1, 3 - Dichloropropylen
120	Trichloroethylene
121	Benzene
122	Cis - 1, 3 - - dichloropropylene
123	Dibromochloromethane
124	1, 1, 2 - Trichloroethane
125	Bromoform
126	1, 1, 2, 2 - Tetrachloroethane
127	1, 1, 2, 2 - Tetrachloroethylene
128	Tolvene
129	Chlorobenzene
130	Ethyle Benzene

ACID EXTRACTABLES

200	-
201	2 - Chlorophenol
202	2 - Nitrophenol
203	Phenol
204	2, 4 - Dimethylephenol
205	2, 4 - Dichlorophenol
206	2, 4, 6 - Trichlorophenol
207	4 - Chloro - 3 - Cresol
208	2, 4 - Dinitrophenol
209	4, 6 - Dinitro - 2 - Cresol
210	Pentachlorophenol
211	4 - Nitrophenol

BASE - NEUTRAL EXTRACTABLES

300	
301	Dichlorobenzenes
302	1, 4 - Dichlorobenzene
303	1, 2 - Dichlorobenzene
304	Hexachloroethane
305	Bis (chloromethyl) ether
306	Bis (chloroethyl) ether
307	Bis (2 - chloroisopropyl) ether
308	N - Nitrosodimethylamine
309	Nitrosodi - N - propylamine
310	Nitrobenzene
311	Hexachlorobutadiene
312	1, 2, 4 - Trichlorobenzene
313	2 - Cloroethyl vinyl ether
314	Bis (2 - Chloroethoxy) Vethane
315	Naphthalene
316	Isophorone
317	Hexachlorocyclopentadiene
318	2 - Chloronaphthalene
319	Acenaphthylene
320	Acenaphthene
321	Dimethyl phthalate
322	2, 6 - Dinitrotoluene
323	4 - Chlorophenyl phenyl ether
324	Fluorene
325	2, 4 - Dinitrotoluene

326	Diethyl phthalate
327	1, 2 - Diphenylhydrazine
328	N - Nitrosodiphenylamine
329	Hexachlorobenzene
330	4 - Bromophenyl phenyl ether
331	Anthracene/Phenarithrene
332	Phenanthrene
333	Di - N - Butyl phthalate
334	Fluoranthene
335	Pyrene
336	Benzidine
337	Butyl Benzyl Phthalate
338	Bis (2 - Ehtyhexyl) Phthalate
339	Di - N - Octyle Phthalate
340	Chrysene
341	Benzo (A) anthracene
342	3, 3 - Dichlorobenzidine
343	Benzo (B) fluoranthene
344	Benzo (K) fluoranthene
345	Benzo (A) Pyrene
346	Indeno (1, 2, 3 - C, D) Pyrene
347	dibenzo (A, H) Anthracene
348	Benzo (G, H, I) Perylene)
349	TCDD
350	

PESTICIDES & PCBS

400	
401	Alpha - BHC
402	Gamma - BHC
403	Heptachlor
404	Beta - BHC
405	Delta - BHC
406	Aldrin
407	Heptachlorepoxide
408	Endosulfan I
409	DDE
410	Dieldrin
411	Endrin
412	DDD
413	Endosulfna II
414	DDT
415	Endrin aldehyde

416	Endosulfan Sulfa
417	Chlordane
418	Toxaphene
419	PCB - Aroclor 1221
420	PCB - Aroclor 1232
421	PCB - Aroclor 1242
422	PCB - Aroclor 1248
423	PCB - Aroclor 1254
424	PCB - Aroclor 1260
425	PCB - Aroclor 1016
426	PCB - Aroclor non-specific
427	PCB - Aroclor 1262
428	PCB - Aroclor 1268
429	PCB - Aroclor 1242/1016

METALS

500	
501	Antimony
502	Arsenic
503	Beryllium
504	Cadmium
505	Chromium
506	Copper
507	Lead
508	Barium
509	Mercury
510	Nickel
511	Selenium
512	Silver
513	Thallium
514	Zinc
515	Cobalt
516	Iron

INORGANIC & PHYSICAL ANALYSIS

601	Chemical Oxygen Demand
602	Redox potential
603	Oil & Grease

MISCELLANEOUS ORGANICS

800	
801	Monochlorobenzene
802	Trichlorobenzenes
803	Tetrachlorobenzenes
804	Pentachlorobenzenes
805	Monochlorotoluenes
806	Dichlorotoluenes
807	Monochlorobenzotrifluoride
808	Octachlorocyclopentene
809	Trichlorophenols
810	M - Chlorobenzoic Acid
811	O - Chlorobenzoic Acid
812	Hexachlorocyclohexanes (BHC)
813	Mirex
815	

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Explanatory Note

The attached printout lists the information stored in the New Bedford PCB Data Management System pertaining to all of the data generated by your agency, which we currently have on file. Field definitions, explanation of the abbreviations and codes used, a list of references, and identification of the information missing are also attached. Please note that since analytical methodology was not documented in most of the reports reviewed, a List of Methods has not yet been prepared. This list will be compiled and coded as the information is provided.

Several of the columns listed on the printout contain information stored in two data fields or categories. This information is printed on two separate lines; where one or both of the lines are blank, that information was not available. Grid locations have been assigned to each sample but, due to space limitations, are not listed on this printout.

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
1	1		AIR	AMB DNW		429	259 NG/M3	EPA,78	72		DOWNWIND OF AEROVOX
1A	1		AIR	AMB DNW		423	9 NG/M3	EPA,78	72		DOWNWIND OF AEROVOX
2	2		AIR	AMB SRC		429	703 NG/M3	EPA,78	72		LANDFILL SITE
2A	2		AIR	AMB SRC		423	23 NG/M3	EPA,78	72		LANDFILL SITE
3	3		AIR	AMB DNW		429	18 NG/M3	EPA,78	72		DOWNWIND OF LANDFILL
3A	3		AIR	AMB DNW		423	ND NG/M3	EPA,78	72		DOWNWIND OF LANDFILL
4	4		AIR	AMB UPW		429	27 NG/M3	EPA,78	72		APPROX.VALUE, UPWIND OF LANDFILL
4A	4		AIR	AMB UPW		423	ND NG/M3	EPA,78	72		APPROX.VALUE, UPWIND OF LANDFILL
5	5		AIR	AMB UPW		429	41 NG/M3	EPA,78	72		UPWIND OF AEROVOX
5A	5		AIR	AMB UPW		423	ND NG/M3	EPA,78	72		UPWIND OF AEROVOX
6	7		AIR	AMB DNW		429	21 NG/M3	EPA,78	72		DOWNWIND OF LANDFILL
6A	7		AIR	AMB DNW		423	ND NG/M3	EPA,78	72		DOWNWIND OF LANDFILL
7	8		AIR	AMB SRC		429	334 NG/M3	EPA,78	72		LANDFILL SITE
7A	8		AIR	AMB SRC		423	33 NG/M3	EPA,78	72		LANDFILL SITE
8	9		AIR	AMB SRC		429	ND NG/M3	EPA,78	72		LANDFILL SITE
8A	9		AIR	AMB SRC		423	ND NG/M3	EPA,78	72		LANDFILL SITE

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
9			AIR	AMB		429	ND		72		DOWNWIND OF AEROVOX
	10			DNW			NG/M3	EPA,78			
9A			AIR	AMB		423	ND		72		DOWNWIND OF AEROVOX
	10			DNW			NG/M3	EPA,78			
10			AIR	AMB		429	301		72		DOWNWIND OF AEROVOX
	11			DNW			NG/M3	EPA,78			
10A			AIR	AMB		423	9		72		DOWNWIND OF AEROVOX
	11			DNW			NG/M3	EPA,78			
11			AIR	AMB		429	18		72		UPWIND OF CORNELL-DUBLIER
	12			UPW			NG/M3	EPA,78			
11A			AIR	AMB		423	ND		72		UPWIND OF CORNELL-DUBLIER
	12			UPW			NG/M3	EPA,78			
12			AIR	AMB		429	824		72		DOWNWIND OF CORNELL-DUBLIER
	13			DNW			NG/M3	EPA,78			
12A			AIR	AMB		423	38		72		DOWNWIND OF CORNELL-DUBLIER
	13			DNW			NG/M3	EPA,78			
13			AIR	AMB		429	743		72		DOWNWIND OF CORNELL-DUBLIER
	14			DNW			NG/M3	EPA,78			
13A			AIR	AMB		423	24		72		DOWNWIND OF CORNELL-DUBLIER
	14			DNW			NG/M3	EPA,78			
14			AQBPSA		100777	423	4.7	CATC	48		CAPE COD CANAL
	15						MG/KG DW	EPA,77			
14A			AQBPSA		100777	423	1.2	CATC	48		CAPE COD CANAL
	15						MG/KG WW	EPA,77			
15			AQBPSA		100777	423	1.3	CATC	48		CAPE COD CANAL
	16						MG/KG DW	EPA,77			
15A			AQBPSA		100777	423	0.5	CATC	48		CAPE COD CANAL
	16						MG/KG WW	EPA,77			
16			AQBPSA		100777	423	2.5	CATC	48		CAPE COD CANAL
							MG/KG DW	EPA,77			
16A			AQBPSA		100777	423	0.6	CATC	48		CAPE COD CANAL
							MG/KG WW	EPA,77			

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
17			AQBPSA		100777	423	1.8 MG/KG DW	CATC EPA,77	48		CAPE COD CANAL
17A			AQBPSA		100777	423	0.5 MG/KG WW	CATC EPA,77	48		CAPE COD CANAL
18			AQBPSA		101877		1.6 MG/KG DW	EPA,77	48		SOUTHSIDE, MARTHA'S VINEYARD
18A			AQBPSA		101877		0.5 MG/KG WW	EPA,77	48		SOUTHSIDE, MARTHA'S VINEYARD
19			AQBPSA		101677		1.3 MG/KG DW	EPA,77	48		SANDY NECK, BARNSTABLE
19A			AQBPSA		101677		0.4 MG/KG WW	EPA,77	48		
20			AQBPSA		081077	423	2.2 MG/KG DW	CATC EPA,77	48		CAPE COD BAY
20A			AQBPSA		081077	423	0.9 MG/KG WW	CATC EPA,77	48		
21			AQBPSA		101877	423	4.8 MG/KG DW	CATC EPA,77	48		SOUTHSIDE, MARTHA'S VINEYARD
21A			AQBPSA		101877	423	1.2 MG/KG WW	CATC EPA,77	48		
22	P-61		AQBMSA		102677		1.9 MG/KG DW	EPA,77	48		
22A	P-61		AQBMSA		102677		0.5 MG/KG WW	EPA,77	48		
23	P-62		AQBMSA		102677		1.8 MG/KG DW	EPA,77	48		
23A	P-62		AQBMSA		102677		0.5 MG/KG WW	EPA,77	48		
24	P-63		AQBMSA		102677		0.3 MG/KG DW	EPA,77	48		
24A	P-63		AQBMSA		102677		0.1 MG/KG WW	EPA,77	48		

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
25	P-64		AQBMSA		102677		1.6 MG/KG DW	EPA,77	48		
25A	P-64		AQBMSA		102677		0.4 MG/KG WW	EPA,77	48		
26	P-65		AQBMSA		102677		1.0 MG/KG DW	EPA,77	48		
26A	P-65		AQBMSA		102677		0.3 MG/KG WW	EPA,77	48		
27	P-66		AQBMSA		102677		0.4 MG/KG DW	EPA,77	48		
27A	P-66		AQBMSA		102677		0.1 MG/KG WW	EPA,77	48		
28	P-67		AQBMSA		102677		0.3 MG/KG DW	EPA,77	48		
28A	P-67		AQBMSA		102677		0.1 MG/KG WW	EPA,77	48		
29	543-332		AQBHAM		063077	423	0.10 MG/KG WW	EPA,77	47		MARTHA'S VINEYARD
30	543-337		AQBHAM		071177	423	0.32 MG/KG WW	EPA,77	47		CAPE COD CANAL
31	543-338		AQBHAM		071177	423	0.13 MG/KG WW	EPA,77	47		CAPE COD CANAL
32	543-339		AQBHAM		071177	423	0.06 MG/KG WW	EPA,77	47		CAPE COD CANAL
33	543-340		AQBHAM		071177	423	0.02 MG/KG WW	EPA,77	47		CAPE COD CANAL
34	543-341		AQBHAM		071177	423	0.05 MG/KG WW	EPA,77	47		CAPE COD CANAL
35	543-342		AQBHAM		072877	423	0.04 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
36	543-343		AQBHAM		072877	423	0.03 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
37	543-344		AQBHAM		072877	423	0.03 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
38	543-345		AQBHAM		072877	423	0.06 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
39	543-346		AQBHAM		072877	423	0.02 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
40	543-347		AQBHAM		072877	423	0.04 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
41	543-348		AQBHAM		072877	423	0.70 MG/KG WW	EPA,77	47		WESTPART, GOOSEBERRY NECK
42	543-349		AQBHAM		072777	423	0.05 MG/KG WW	EPA,77	47		PLYMOUTH
43	543-350		AQBHAM		072777	423	0.01 MG/KG WW	EPA,77	47		PLYMOUTH
44	543-351		AQBHAM		072777	423	0.01 MG/KG WW	EPA,77	47		PLYMOUTH
45	D-1		AQBMME		092376	423	3.1 MG/KG DW	ESEI EPA,76	55		MIDDLE, APPONAGAMSETT BAY
45A	D-1		AQBMME		092376	423	0.20 MG/KG WW	ESEI EPA,76	55		MIDDLE, APPONAGAMSETT BAY
45B	D-1		AQBMME		092376	423	1.32 MG/KG DW	CATC EPA,76	55		MIDDLE, APPONAGAMSETT BAY
45C	D-1		AQBMME		092376	423	0.20 MG/KG WW	CATC EPA,76	55		MIDDLE, APPONAGAMSETT BAY
46	D-2		AQBMME		092376	423	3.6 MG/KG DW	ESEI EPA,76	55		MOUTH, APPONAGAMSETT BAY
46A	D-2		AQBMME		092376	423	0.20 MG/KG WW	ESEI EPA,76	55		MOUTH, APPONAGAMSETT BAY
46B	D-2		AQBMME		092376	423	1.33 MG/KG DW	CATC EPA,76	55		MOUTH, APPONAGAMSETT BAY
46C	D-2		AQBMME		092376	423	0.17 MG/KG WW	CATC EPA,76	55		MOUTH, APPONAGAMSETT BAY

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT., ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
47	D-3		AQBMME		092376	423	5.0 MG/KG DW	ESEI EPA,76	55		BUZZARDS BAY
47A	D-3		AQBMME		092376	423	3.38 MG/KG DW	CATC EPA,76	55		BUZZARDS BAY
47B	D-3		AQBMME		092376	423	0.47 MG/KG WW	CATC EPA,76	55		BUZZARDS BAY
48	NB-1		AQBMME		051176		9.49 MG/KG DW	CATC EPA,76	55		NEAR STP OUTFALL OFF CLARK PT.
48A	NB-1		AQBMME		051176		1.30 MG/KG WW	CATC EPA,76	55		NEAR STP OUTFALL OFF CLARK PT.
49	NB-2		AQBMME		051176		2.78 MG/KG DW	CATC EPA,76	55		INNER CLARK COVE
49A	NB-2		AQBMME		051176		0.35 MG/KG WW	CATC EPA,76	55		INNER CLARK COVE
50	NB-3		AQBMME		051176		5.37 MG/KG DW	CATC EPA,76	55		MOUTH OF CLARK COVE
50A	NB-3		AQBMME		051176		0.72 MG/KG WW	CATC EPA,76	55		MOUTH OF CLARK COVE
51	NB-4		AQBMME		051176		11.1 MG/KG DW	CATC EPA,76	55		BUTLER FLATS NEAR CORNELL-DUBLIER
51A	NB-4		AQBMME		051176		1.81 MG/KG WW	CATC EPA,76	55		BUTLER FLATS NEAR CORNELL-DUBLIER
52	NB-5		AQBMME		051176		3.29 MG/KG DW	CATC EPA,76	55		BUZZARDS BAY
52A	NB-5		AQBMME		051176		0.41 MG/KG WW	CATC EPA,76	55		BUZZARDS BAY
53	NB-6		AQBMME		051176		3.08 MG/KG DW	CATC EPA,76	55		BUZZARDS BAY
53A	NB-6		AQBMME		051176		0.44 MG/KG WW	CATC EPA,76	55		BUZZARDS BAY
54	F-1		AQBMME		051176		7.0 MG/KG DW	CATC EPA,76	55		NEAR POPE BCH.

SAMP. NO.	ORIGINAL SAMP.NO.	STATION AND LAB NO.	SAMPLE TYPE	SOURCE AND EXACT SOURCE	DATES COLLECT.; ANALYSIS	PARAM. CODE	CONCENTRATION AND UNITS	LAB AND STUDY	REF. NO.	METH. NO.	COMMENTS
54A	F-1		AQBMME		051176		0.7 MG/KG WW	CATC EPA,76	55		NEAR POPE BCH.
55	F-2		AQBMME		051176		18.0 MG/KG DW	CATC EPA,76	55		WEST SIDE OF SCANTICUT NECK
55A	F-2		AQBMME		051176		3.5 MG/KG WW	CATC EPA,76	55		WEST SIDE OF SCANTICUT NECK
56	F-4		AQBMME		051176		0.44 MG/KG DW	CATC EPA,76	55		LITTLE BAY

APPENDIX IV:

Coast Guard Study Results

COAST GUARD NEWS

ease No. 10/82 | Date: 10 March 1982
ntact | Time of Release:

The Coast Guard has been advised by EPA that recent sediment samples taken from the Acushnet River showed very high concentrations of PCB's. I am advised that these concentrations are significantly higher than revealed by previous sampling. While this problem is an old one, this is new information. The area identified is on the western side of the Acushnet River approximately 400 yards south of the Woods Street Bridge.

The Coast Guard in concert with other agencies, intends to take additional bottom sediment samples to further define the problem. Once this information is available we will see what measures, if any, be instituted to insure that people will be protected from these areas, such as by fencing or posting of signs. As the boating season approaches this becomes more important.

The Coast Guard role in this matter is governed largely by the Comprehensive Environmental Response, Compensation and Liability Act(CERCLA) and the National Contingency Plan. As the pre-designated On Scene Coordinator I feel it is my responsibility to respond to this new information and take the above mentioned measures necessary in the interest of public welfare.

In perspective, so far as we know, these higher concentrations are localized in the tidal area and away from usual public access. The city of New Bedford further advised that the surrounding air is within safe limits and continues to be periodically sampled.

By this announcement I do not mean to raise peoples expectations regarding PCB removal. We intend to work closely with EPA and the State Department of Environmental Quality Engineering and continue to share information to solve this problem. Our objective now, very simply, is to identify 'hot spots' and to take appropriate action regarding them.

US Department of Transportation
United States Coast Guard

150 Causeway Street
Boston, MA 02114
(617) 223-6915

RECEIVED
JUN 4 1982
OFFICE OF THE SECRETARY
OF ENVIRONMENTAL AFFAIRS

RECEIVED
JUN 07 1982
COASTAL ZONE MANAGEMENT
Exec. Office of Environmental Affairs

5090
28 May 1982

Dear RRT Member:

As you recall, we met on 12 March 1982 to discuss the New Bedford/Acushnet River PCB incident. Extremely high concentrations of PCB's were found in the sediment near the AEROVOX plant on the Upper Acushnet River. At that time, I told you that the Coast Guard had initiated an Immediate Response Action which would include the following:

(a) Public Notification.

(b) Securing/Posting the immediate AEROVOX plant area.

(c) Continue sampling for problem definition.

I would like to share with you the results of the most recent sample program (enclosure (1)). The sampling plan was put together with the assistance of U.S. EPA and MASSACHUSETTS Department of Environmental Quality and Engineering. The samples were analyzed by the Coast Guard Research & Development Center in Groton, Connecticut. I will send you a complete report shortly.

From the preliminary data, it is obvious that we have not sufficiently delineated the area of high PCB concentrations. More sampling is necessary. To reduce our turn around time, we plan to utilize a mobile laboratory to process the new samples on site commencing 7 June 1982. I will keep you advised of our progress.

Our goal remains to identify the extent of the high level PCB concentrations in the sediment of the harbor and tidal areas. Any technical or scientific assistance or advice you wish to offer would be appreciated. Contact LCDR Allen BOETIG or me at the above telephone number.

Sincerely,

R. Barry Eldridge

R. BARRY ELDRIDGE
Captain, U. S. Coast Guard
Co Chairman, Regional Response Team
Federal Region One

ENCL (1) PCB SAMPLE RESULTS

MARINE SAFETY OFFICE
JUN 1982
PROVIDENCE, RHODE ISLAND
U.S. COAST GUARD

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

	INFO	ACT		I..O	ACT
XO	✓		MIB		
ACI			MIB		
P/O		✓	DCC		
SIP			SEC		
APX			YN		
MIH			SK		

MAILING ADDRESS:
COMMANDING OFFICER
USCG R&D CENTER
AVERY POINT
GROTON, CT 06340

724154.3
11 JUN 1982

From: Commanding Officer, CG Research and Development Center
To: Commanding Officer, CG Marine Safety Office, Providence, RI

Subj: Acushnet River sediment sample analysis report

Ref: (a) COMDT (G-DMT-4/54) ltr 3913 Ser: 4-1202V of 11 Ma. 1982

1. Reference (a) directed the R&D Center to provide chemical analytical support to MSO Providence which was involved in an emergency investigation concerning polychlorinated biphenyl (PCB) contamination in the Acushnet River estuary. Six sediment samples were received at the R&D Center on Friday, 12 March 1982 for determination of PCB concentrations. Chemical analyses were completed on 14 March 1982. Chemical analytical methods used and PCB concentration levels found were reported to MSO Providence by message on Monday, 15 March 1982. As a follow on to our initial quick turn-around response, continued support for the PCB contamination investigation was provided to MSO Providence.

2. Sediment core samples collected between 14 April and 21 April 1982, from the Acushnet River at 33 sampling locations, 3 cores per each location (A,B,C) were analyzed for their PCB contamination by liquid chromatography (LC), thin-layer chromatography (TLC) and gas chromatography (GC).

3. Prior to analysis, the samples were prepared in the following manner. The top inch, the slice between 5½ and 6½ inches and the bottom 2 inches of the 3 core samples from each of the 33 sampling locations were combined and homogenized. The resulting samples were then air dried for approximately 24 hours. Eight (8) mL of solvent were added to 4 g of dried sediment from each sample and sonified for 3 minutes in a test tube. Methanol was used as the solvent to extract PCB from the sediment for LC and TLC; a mixture of 10% acetone in hexane was used as the solvent to extract PCB from the sediment for GC.

4. The chemical analyses were conducted in the following manner.

a. For GC, the samples were analyzed on a 2 foot 3% OV-101 column by electron capture detection. The separation was conducted isothermally at 165°C for 15 minutes, followed by temperature programming at 10°/min to 215°C with a 1 minute hold to bake out the column. Sulfur-containing impurities which interfered with the GC analysis were readily removed with tetrabutylamomium sulfite reagent prior to [illegible].

b. For TLC analysis, 5 µL aliquots of methanol extracts were spotted on thin layer chromatographic plates coated with silica gel. Ten (10) samples, [illegible], 3 reference standards at concentration levels from 200 ppm to 1000 ppm and [illegible] sediment samples, were applied to each plate. The plates were air dried for [illegible] minutes and then developed for 30 to 35 minutes in a vertical chamber containing hexane. The dried plates were then analyzed using a Farrand Optical, Inc. VIS/UV Chromatographic Plate Analyzer in the absorption mode at a fixed wavelength of 235 nm. All plates ere measured at a scan speed of 1 cm per minute. Quantitative values for environmental samples were determined by comparing the response to that of the calibration standards present on each plate.

c. LC analysis was carried out on a ODS Zorbax (DuPont) column with a Whatman guard column at 1 mL/min flow rate with methanol. 20µL standard injection volumes were used measuring UV absorption at 254 nm. All components eluting between 3.5 and 10 minutes were quantitated by measuring peak areas using an electronic integrator.

5. The standards employed for all three analytical methods was Aroclor 1254. Therefore, the tabulation which is attached as Enclosure (1), lists the PCB concentration as ppm 1254 levels. Only one value per sample is reported even though three different analytical methods were applied. The reported concentrations represent a consensus value of the three methods. The depth of the bottom slice analyzed from each core sample varied and is indicated in the last column of the table. (Sediment material for the bottom slice was not available from all core samples.)

6. In order to evaluate the capability of our mobile laboratory to respond in real time on scene to provide chemical analytical support, a field deployment to the Acushnet River in the New Bedford, MA area commenced on 7 June 1982. This deployment is in accordance with project plan 4154, "Sampling, Chemical Classification and Quantification for Pollution Response". The same analytical techniques are applied for this field test as were used in the laboratory investigation, the only difference being the real world environment of a remotely-located field condition on scene. Results of this study will benefit our research endeavor as well as the operational investigation by MSO Providence. Results will be reported when completed.

U. R. BRESLAU
By direction

Encl: (1) PCB Concentration In PPM

Copy: COMDT (G-DMT-4/54)
COMDT (G-WER-2/12)
Commander, First CG District (m)

PCB CONCENTRATION IN PPM

(Calculated against Aroclor 1254 as standard)

SAMPLE NO.	0-1"	5½-6½"	Bottom	Depth of Bottom Slice in Inches
1	1880	2150	830	11-12 (B, C)
2	1920	30700	40	14-15 (A, C)
3	2720	1000	49	16-17 (A,C)
4	1790	670	13	13½-14½ (A,B,C)
5	620	340	26	11-13 (C)
6	850	370	13	12-13 (A,B,C)
7	2520	4150	20	24½-25½ (A)
8	3550	11750	275	13½-14½ (B)
9	16700	38370	no sample	------------
10	4250	5870	19650	8½-9½ (A,B)
11	1200	320	28	11-13 (A)
12	670	260	78	6½-7½ (C)
13	670	1750	44	11-12 (A,B,C)
14	710	620	6	11-12½ (C)
15	910	600	3	14-15 (B,C)
16	190	20	2	10-12 (A)
17	1910	5180	69	10½-11½ (A,C)
18	1280	1060	20	10-11 (A,B)
19	1250	950	14	12½-13½ (B,C)
20	450	760	420	9-10 (A,C)
21	750	1290	150	8½-9 (A,B,C)
22	600	2770	48	11-12 (B,C)
23	1200	42	79	10½-11½ (B,C)
24	1070	480	---	10½-11½ (A,B,C)
25	1690	4740	200	12½-13½ (A,B)
26	1440	7230	810	11-12 (B,C)
27	1980	66500	27	12-13 (A,B,C)
28	1920	47000	25	13½-15½ (C)
29	1130	1430	9	25-26 (B)
30	1920	490	25	12-14 (A,C)
31	2900	1860	2	9-10 (A,B,C)
32	780	5100	3810	8-10 (A,B,C)
33	830	4350	20	11-12 (A,B)

	190 - 16,700	20 - 66,500	not detectable - 19,650
	1947	19,702	838
	1200	1430	

Enclosure (1)

SAMPLES TAKEN

7 June 82

Southern
Boundary

PCBs - ACUSHNET RIVER

RECEIVED BY PHONE
14 June 82

	0 - 1"	5y2 - 6y2"	7 - 8"
1.	300	55	25
2.	400	150	10 - 11" 5
3.	300	160	8y2 - 9y2" 35
4.	top 50		(2-4" Bottom) 45
5.	70	95	15 - 17" 50
6.	70	10	8 - 9" 10
7.	60	30	16 - 18" 10
8.	190	320	7 - 9" 85
9.	50	330	8 - 9" 125
10.	110	70	7 - 8" 30
	50 - 400	55 - 300	5 - 125
	160	92	42


Wamsutta Mills
ACUSHNET
RIVER
Oxford
CUPOLA
Popes Island
FAIRHAVEN
NEW BEDFORD
CHART #

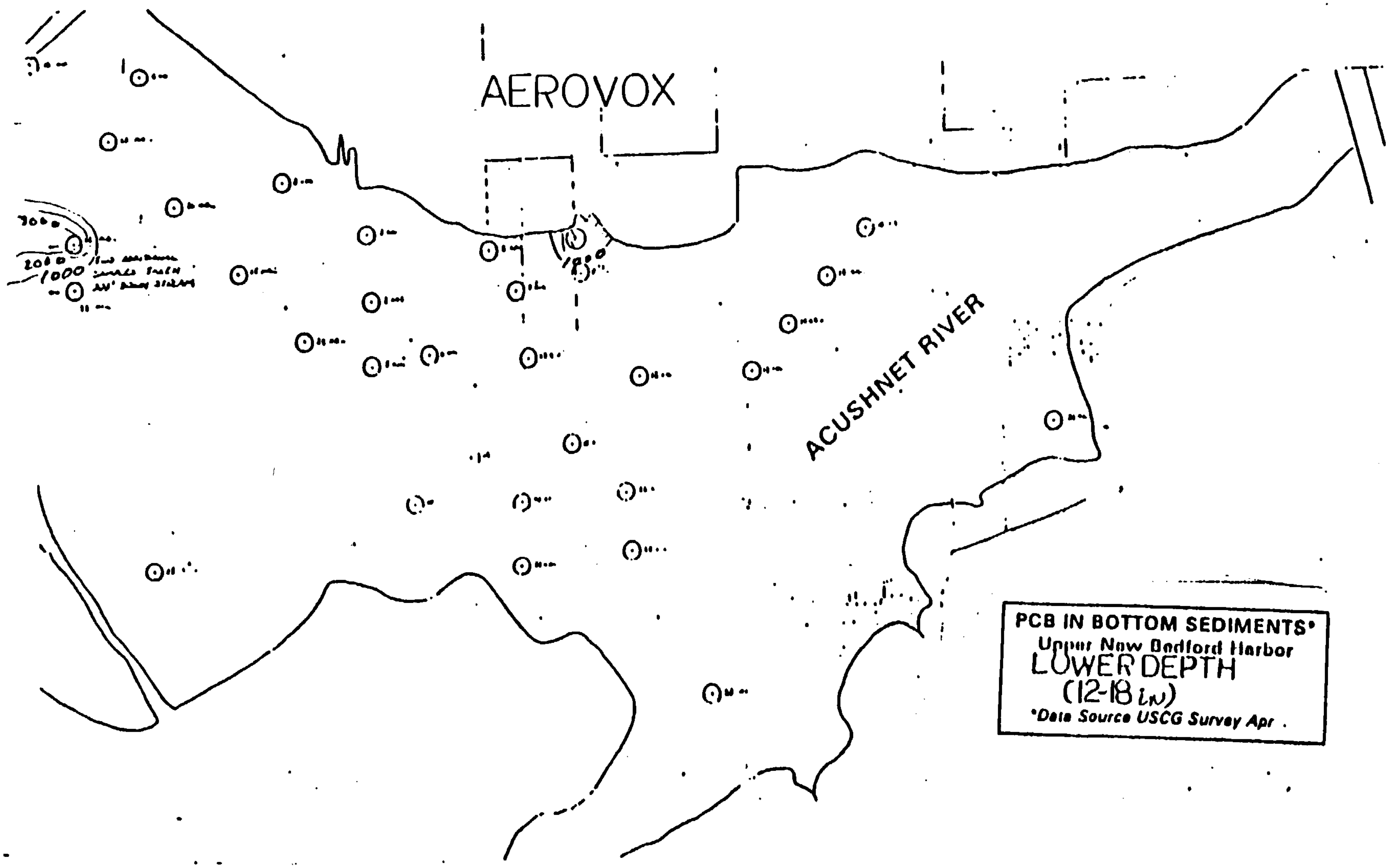


Exhibit 3: Coast Guard Data
PCB in Bottom Sediments (ppm)

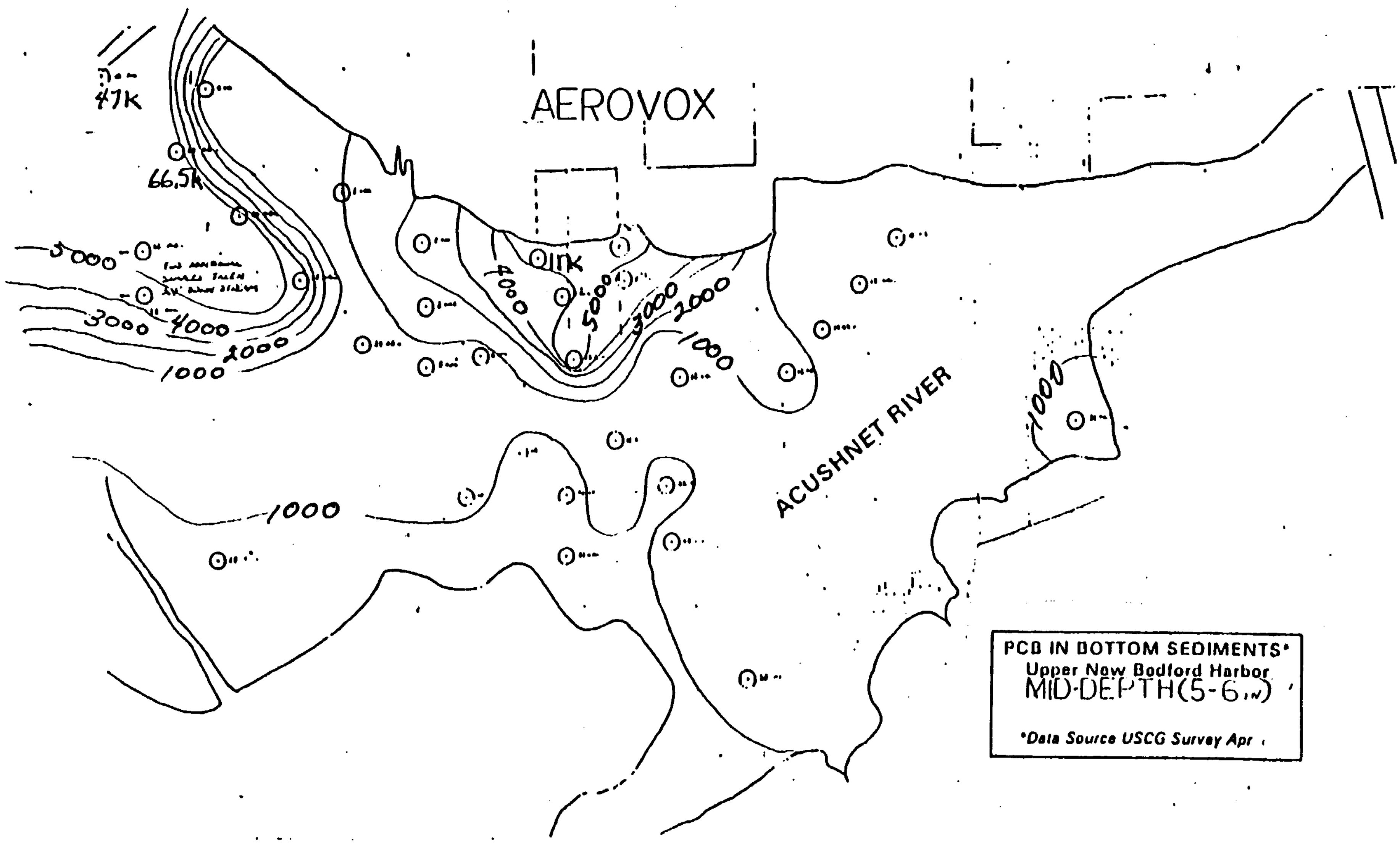


Exhibit 3: Coast Guard Data
PCB in Bottom Sediments (ppm)

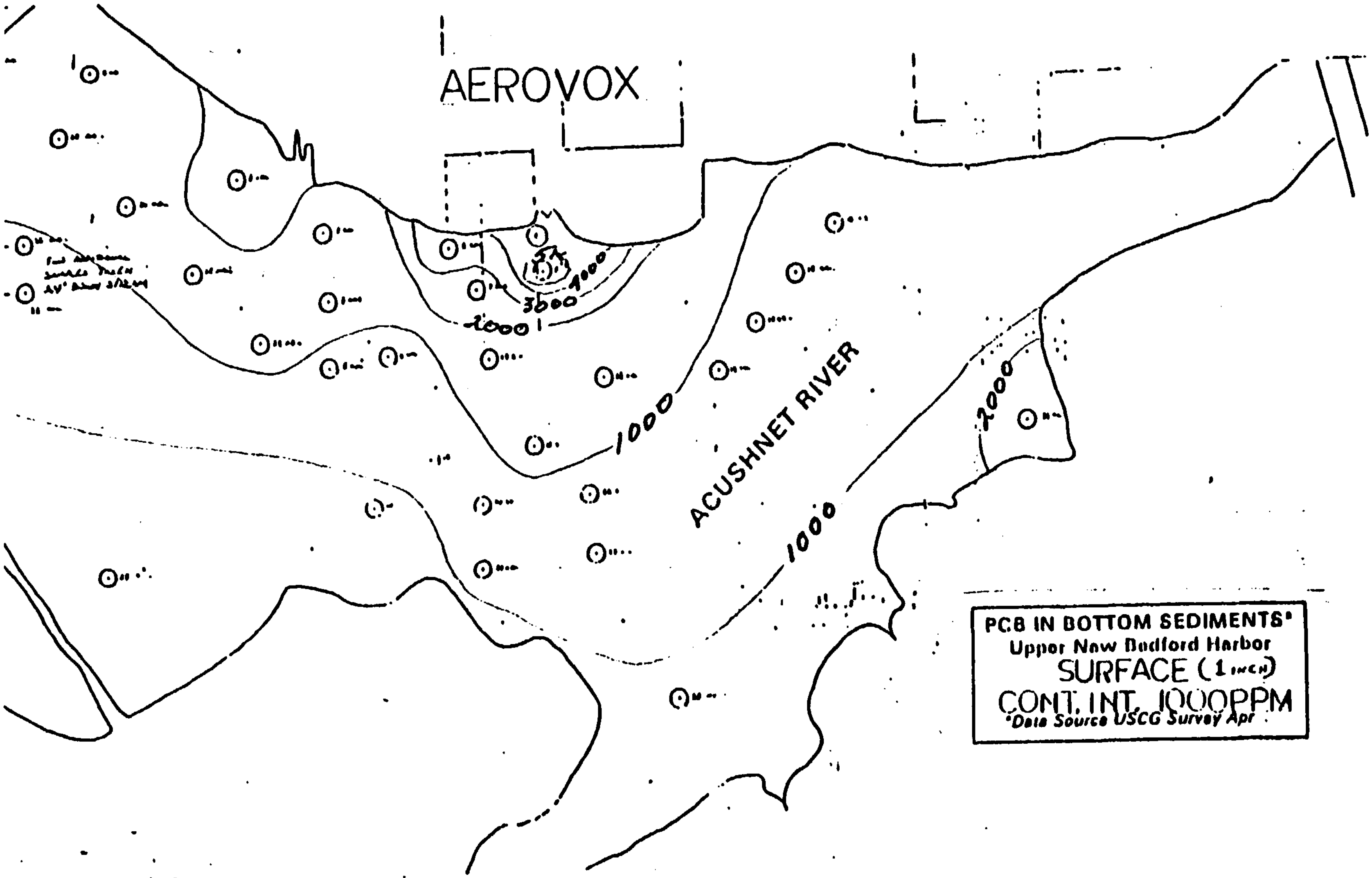


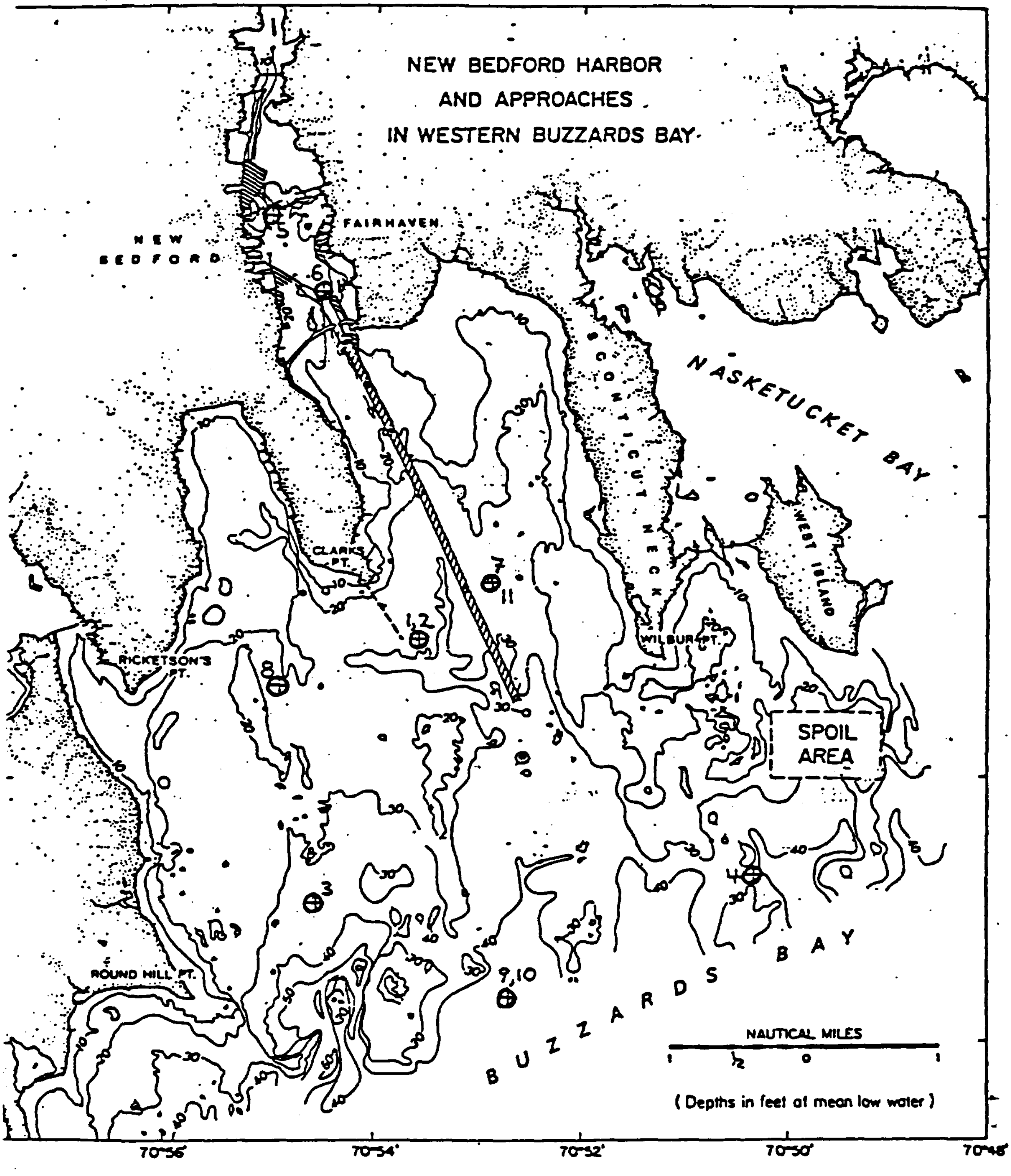
Exhibit 3: Coast Guard Data
PCB in Bottom Sediments (ppm)

APPENDIX V:

Background Data on Current Rate, Wind Velocity, and Tidal Movement in the New Bedford Harbor Area

I.D. NO.	LOCATION	WATER DEPTH (m)	INSTRUMENT DEPTH (m)	TYPE OF DATA	PERIOD OF RECORD	STUDY
1	41°34'57"N/ 70°53'31"W	8.7	4.3	4 min. off/ 1 min. on avg.	7/17/73- 8/17/73	EGG
2	41°34'57"N/ 70°53'31"W	8.7	4.3	4 min. off/ 1 min. on avg.	9/11/73-10/12/73	EGG
3	41°32'42"N/ 70°54'23"W	12.0	6.0	4 min. off/ 1 min. on avg.	7/17/73- 8/17/73	EGG
4	41°33'14"N/ 70°50'13"W	9.6	4.8	4 min. off/ 1 min. on avg.	9/11/73-10/12/73	EGG
5	41°33'16"N/ 70°55'00"W	9.0	each 1.5	Profile every hour	6/8/76 - one tide cycle	WHOI
6	41°37'40"N/ 70°54'30"W	9.0	each 1.5	Profile every hour	6/8/76 - one tide cycle	WHOI
7	41°35'17"N/ 70°52'42"W	7.9	6.1	.5 hr. avg.	7/28/79-8/29/79	CDM
8	41°34'50"N/ 70°54'55"W	6.4	6.1	.5 hr. avg.	7/28/79-8/13/79	CDM
9	41°32'12"N/ 70°53'00"W	12.8	4.7	.5 hr. avg.	7/28/79-8/18/79	CDM
10	41°32'12"N/ 70°53'00"W	12.8	9.3	.5 hr. avg.	7/28/79-8/18/79	CDM
11	41°35'17"N/ 70°52'42"W	7.9	6.9	*burst @ 1 Hz NBIS	7/23/82-7/27/82	WHOI

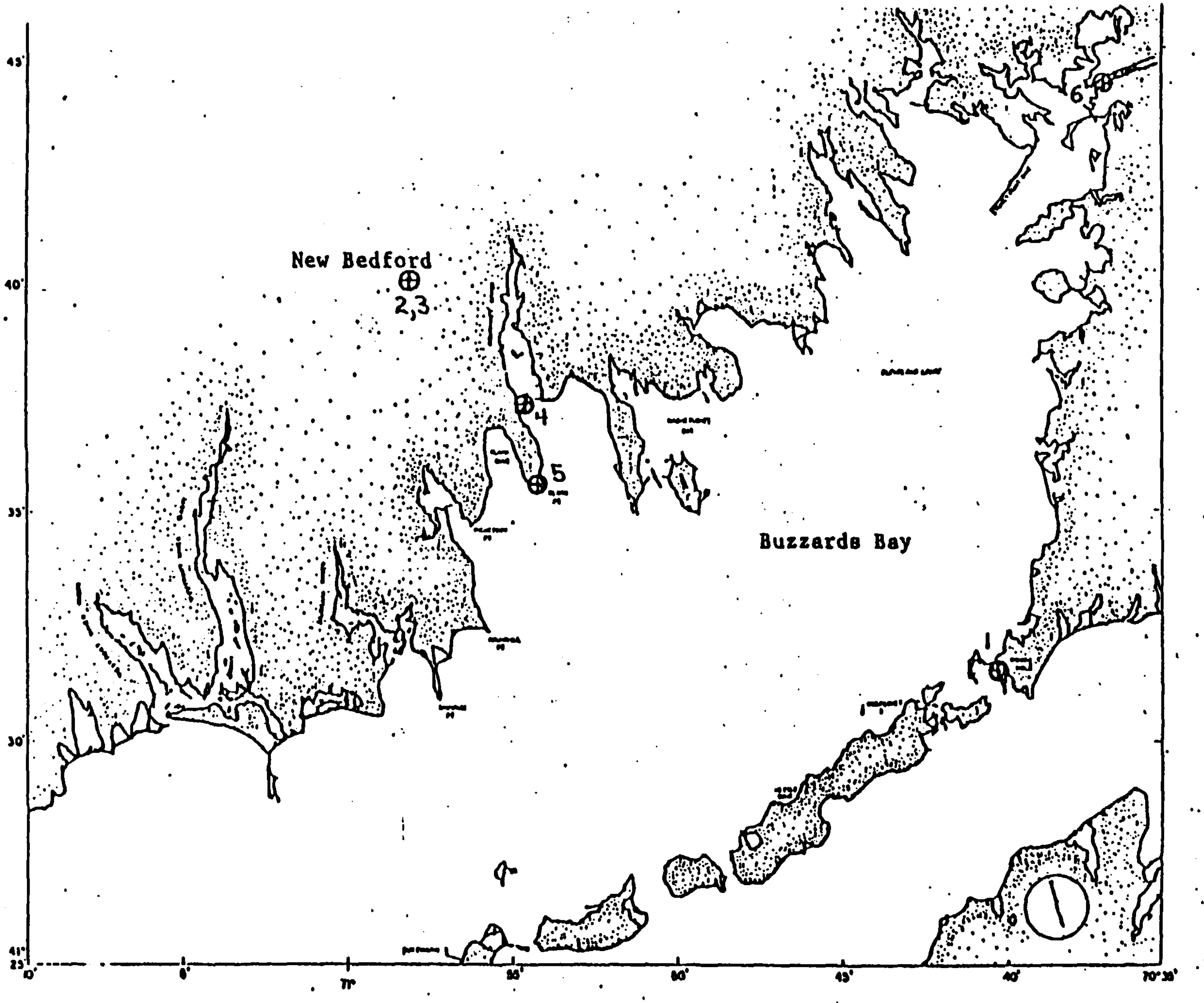
* current meter mooring included tide guage



NEW BEDFORD HARBOR
AND APPROACHES
IN WESTERN BUZZARDS BAY
NEW BEDFORD
FAIRHAVEN
NASKETUCKET BAY
SCONTICUT NECK
WEST ISLAND
CLARKS PT.
WILBUR PT.
RICKETSON'S PT.
ROUND HILL PT.
SPOIL AREA
BUZZARDS BAY
NAUTICAL MILES
1 ½ 0 1
(Depths in feet at mean low water)
70°56'
70°54'
70°52'
70°50'
70°48'

WIND VELOCITY DATA

I.D. NO.	LOCATION	TYPE OF DATA	PERIOD OF RECORD	STUDY
1.	Woods Hole, MA (WHOI, Smith Bldg.)	Recorded daily (10:00 AM)	1960's - to date	WHOI
2.	New Bedford, MA (New Bedford Airport)	Recorded hourly	1960's - to date	City of New Bedford
3.	New Bedford, MA (New Bedford Airport)	continuous record. avg. hr.	Oct. 1981 to date	City of New Bedford
4.	New Bedford, MA (Hurricane Barrier)	continuous record. avg. hr.	Oct. 1981 to date	City of New Bedford
5.	New Bedford, MA (Clarks Point)	continuous record. avg. hr.	Oct. 1981 to date	City of New Bedford
6.	Cape Cod Canal (Clarks Point)	recorded every four hours	1950's - to date	NED

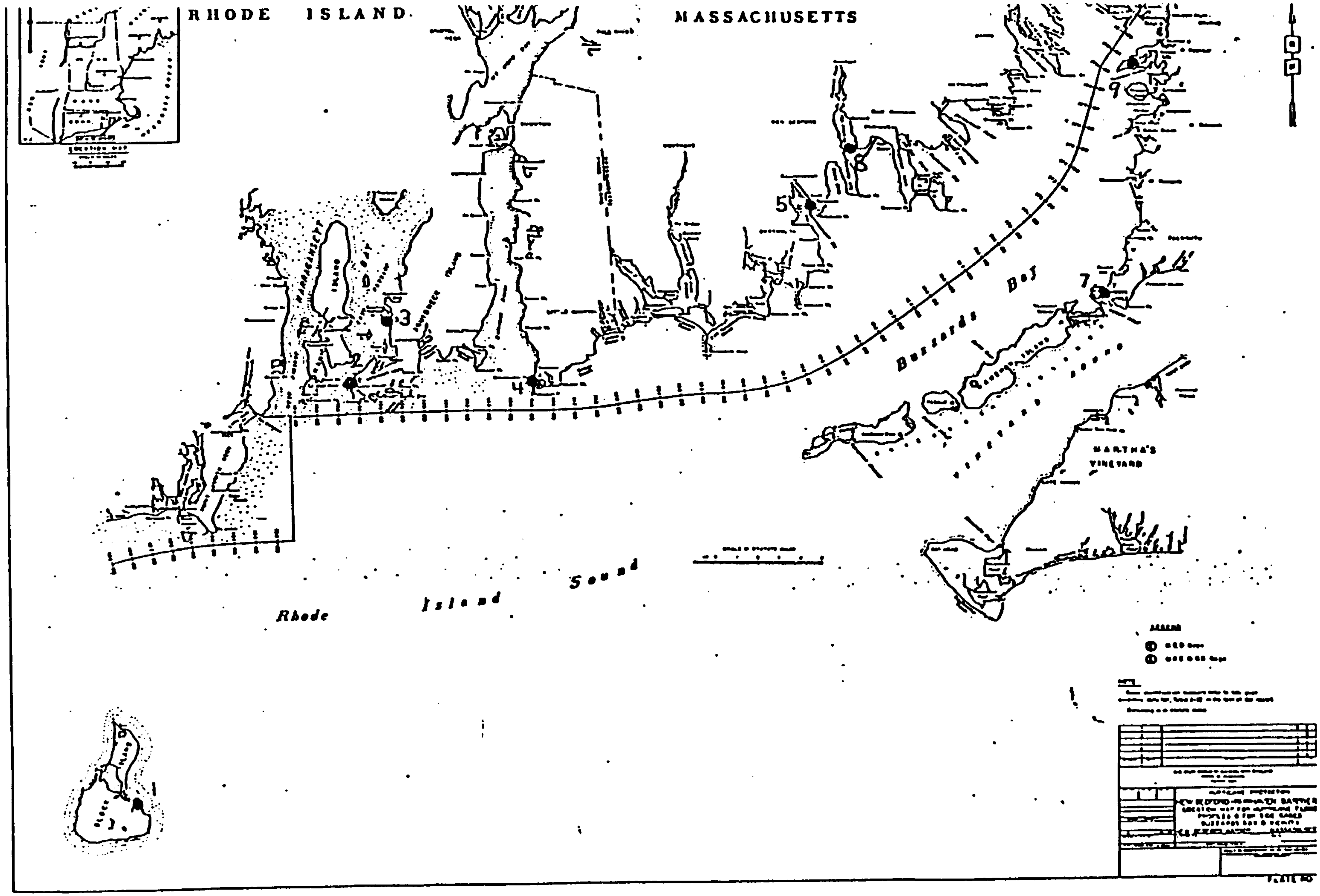


WIND

TIDE GAGE INVENTORY DATA
BUZZARDS BAY AND VICINITY

I.D. NO.	LOCATION	TYPE OF GAGE (1)	PERIOD OF RECORD	AGENCY
1.	Block Island, RI (Old Harbor, Ballards Inn)	A,B,C	Nov. 16, 1955 - to date	NED
2.	Newport, RI (Castle Hill Life Boat Station)	A,B,C	Oct. 10, 1955 - to date	NED
3.	Newport, RI (Coasters Harbor Island) (Constellation Dock)	A,B	Sept. 10, 1930 - to date	USGS
4.	Little Compton, RI (Sakonnet, Holder Wilcox Dock)	A,B,C	Sept. 27, 1956 - to date	NED
5.	South Dartmouth, MA (Davis & Tripp Inc. Dock)	A,B,C	Oct. 19, 1956 - to date	NED
6.	Cape Cod Canal (West End) (Buzzards Bay), MA	A,B	May 1955 - to date	USGS
7.	Woods Hole, MA	A,B	July 16, 1932 - to date	USGS
8.	New Bedford, MA (Hurricane barrier)	A,C	July 21, 1962 - to date	NED
9.	Wings Neck, MA	A	Jan. 15, 1971 - to date	NED

(1) Type of Gage: (A) Recorder; (B) Staff Gage; (C) Maximum Level Gage


RHODE ISLAND
MASSACHUSETTS
Buzzards Bay
MARTHA'S VINEYARD
Rhode Island Sound

TIDE GAGES

APPENDIX VI:

Interagency Task Force Budget for

Management of PCB

Remedial Action Program

APPENDIX VI: Interagency Task Force Budget

(1) Project Management and Consulting Services (DEQE)

a. Project Management

The coordination of the PCB clean-up program in New Bedford will require a full-time commitment of several professionals over its duration. The project will be divided into two phases:

Phase I:

- A review of dredging specifications
- Preparation of applications for dredging funds
- Project management for studies of disposal areas
- Additional field work for the characterization of disposal sites

Personnel: One full-time Biologist or Engineer will be needed for this work, which will cover a span of approximately two years

Total Cost of Salary plus benefits for 2 years = $ 60,000.

Phase II:

- Issue bid requests for dredging
- Oversee dredging contracts
- Site inspection for dredging operation
- Coordinate information exchange between other agencies involved in New Bedford PCB studies

Personnel: One Sanitary Biologist/Ecologist, One Coastal Geologist, and two Principal Sanitary Engineer/Civil Engineers will be needed for a duration of approximately 2½ years. Salaries and benefits at $30,000/person - year = $300,000.
Laboratory, Secretarial and Drafting support for both phases = $140,000.

b. Consulting Services

A need for the following consulting services has been identified:

- A detailed evaluation of dredge spoils contamination sites and recommendations for sitings
  Cost $200,000.
- A cost/benefit evaluation of various dredging schemes, using models of PCB Transport from sediments and water column to the biota. Data from studies described below will be used in this evaluation.
  Cost $100,000.

- Design of the dredging program. This design will utilize data on sediment concentrations and physical transport of sediments, generated by studies described below, to predict the most environmentally sound and cost-effective dredging program $100,000.
- Environmental Impact Report $100,000.
- Contract drawings and specifications, supervision of construction and resident inspections $200,000.

Management and Consulting Services, Grand Total of Costs: $1,200,000.

(2) Human Health Effects (Massachusetts Department of Public Health)

The extent to which edible fish taken from the Acushnet River over the past four decades may have caused New Bedford area residents to have elevated PCB levels in their blood and body tissues is unknown. A limited blood sampling program is currently underway but a more comprehensive examination of the human health effects of PCB's in New Bedford is necessary.

A suggested approach to this evaluation is to develop a series of health effects studies designed to give information about possible long term PCB effects by evaluating the exposed population for changes in parameters such as cancer mortality, as well as to look for changes in the most biologically sensitive segments of the population; namely, the fetus and new-born infant. Such a series of studies is outlined below:

a. Three Decade Mortality Study

It is proposed that mortality data for the greater New Bedford area for 3 decades be examined for all causes of death with the objective of establishing mortality patterns, especially for cancers, during and after the period in which PCB dumping into the Acushnet River took place.

The cost of this study including personnel, outside services and travel has been estimated at $104,500.00

b. Analysis of Miscarriages, Neonatal Deaths, Congenital Defects and Birth Weights

The purpose of this study is to conduct a survey of miscarriages, neonatal deaths, congenital defects and birth weights in a 20 year period for the city of New Bedford, and to compare these findings to a similar study of the city of Fall River. New Bedford and Fall River are comparable in terms of demographic characteristics as well as physical geography, industrialization, and socioeconomic characteristics including delivery of medical care.

It is felt by many investigators that the most sensitive group of individuals exposed to toxic environmental agents is the group of children who are exposed during their in utero period. When the toxicity is severe enough, the anomaly can be incompatible with survival of the fetus and in utero death and miscarraige result.

The total cost of this study has been estimated at - $104,000.00

c. Blood Studies for PCB Levels and Related Changes

The purpose of this study is to collect and analyze a series of blood specimens obtained from residents of greater New Bedford who have a history of PCB ingestion and to compare these with a control group.

The rationale for these studies is the recognition that PCB's may adversely affect the liver, nervous and blood systems. Part of the rationale also lies in the fact that some dose-response relationships may exist between PCB levels and alterations in blood indices. This may provide a basis for selecting individuals for more extended studies and may also provide a basis for selecting persons for long-term studies.

The total cost of this study has been set at - $125,660.00

Grand Total for Human Health Effects Studies - $333,710.00

(3) Physical, Chemical and Biological Characterization and Monitoring (Woods Hole Oceanographic Institution and the Massachusetts Bureau of Marine Fisheries)

In order to coordinate a cost-effective sediment removal program and concurrently be assured that this program will achieve the desired effect (i.e. reduction of PCB levels in the biota), the State must have access to the following information: 1) a precise delineation of PCB sediment concentrations in the New Bedford area, profiled with depth; 2) an elucidation of the physical transport of PCB's in the harbor and out to Buzzard's Bay; 3) data on the bioaccumulation of PCB's by shellfish and finfish from both the sediments and the water column.

Dr. Farrington, the Director of the Coastal Research Center at the Woods Hole Oceanographic Institution, has agreed to coordinate the following work and has provided the estimates of sampling efforts and costs given below. Responsibility for sections a-h will lie with Woods Hole, while section b.1 will be the responsibility of the Massachusetts Division of Marine Fisheries.

a. Sediments

PCB's tend to associate with fine-grained sediments. Because previous studies of the sediment types in the harbor, trace metal contents and bothymetry have clearly defined areas of fine-grained sediment, the more traditional transect or random-sampling approach will be modified to emphasize the areas of known or suspected fine-grained sediment accumulation.

A combination of grab samples and cores provides for areal coverage and investigation of depth of contaminated sediments. This will allow an estimate of the total amount of PCB contaminated sediment to be dredged and the location of sediments with varying levels of contamination

The total costs for one year of pre-dredging studies and two years of past dredging studies has been estimated at - $ 89,000.00

b. Organisms

Analyses of mussels, lobsters (to be conducted by DMF - see below), oysters, eels and finfish will be conducted. Shellfish studies will provide the State with a point in time and space valves (as these organisms have limited mobility) while the lobsters and finfish will provide the State with an estimate of PCB's in commercially valuable species. Eels, the most intensively contaminated organisms analyzed to date, gave us a "worst-case" measurement.

The total cost for one year of pre-dredging studies, one year of studies while dredging is in operation and three years of follow-up studies has been estimated at - $135,000.00

b.1. Lobsters

Lobsters are the most economically important fisheries in the New Bedford area and has been hit the hardest by fishing closures. A two-part study of lobsters from the New Bedford has been prepared by the Division of Marine Fisheries:

a) To investigate in detail the depuration of PCB's in lobsters transferred from New Bedford Harbor waters to clean (non-PCB contaminated) laboratory holding aquaria with controls being maintained at site of capture (inner N.B. harbor and
b) A three-year monitoring study with 20 stations ir designated areas fishery closure areas in New Bedford Harbor.
Expenditure totals for a three year program are estimated at - $136,600.00

c. Water and Suspended Particulate Matter Sampling

These measurements are needed to provide val es for dissolved or water accommodated PCB concentrations and PCB concentration in particulates transported in and around Buzzard's Bay. If these numbers are obtained, a crude model of PCB transport through the system can be constructed of these val es are inserted into physical circulation models (see later section).

The total cost for this study has been estimated at - $ 17,800.00

d. Air (rain, vapor phase and particulates)

It iswell known that a significant, chronic source of PCB's in ocean areas is air-borne PCB input. Thus, in construction of single but dynamic models of PCB biogeochemistry in Buzzard's Bay, we may encounter problems in fitting data to the model or making a viable model or making a viable model without atmospheric data. These measurements would also go a long way towards establishing levels in the atmosphere to which people in the area are exposed.

The total cost for this study has been estimated at - $ 17,000.00

e. Physical Oceanography Survey and Research Program

The objective of this study is to better define the circulation in Buzzards Bay and in particular, water exchange between outer New Bedford Harbor and Buzzards Bay. Information about the physical oceanography of Buzzards Bay will provide much needed information for harbor development and will provide basis for PCB transport modeling.

The total estimated cost for two years of research is - $300,000.00

f. Trace Metals and Selected Organic Pollutants

In all of these estimates, we have to keep in mind that no provision has been made for trace metal analyses or analyses for other organic pollutants. New Bedford Harbor sediments in addition to having a PCB problem, are known to be contaminated by heavy metals. Almost certainly there will need to be some of these measurements made to meet legal requirements of regulations.

The total cost of this work is estimated to be about 10% of the current costs for PCB analyses, or $ 42,000.00

g. Research Component

Past experience has suggested strongly that about $50,000 per year for three years be reserved as a contingency for research in support of or along with the measurements and monitoring program. This would cover such items as experimental verification of sediment/water/organism partition coefficients for PCB's; high resolution measurements for the very toxic environmental reactions products and impurities in PCB's; unexpected hot spot verifications; and measurements during or after a severe storm.

Total costs for this work have been estimated at - $150,000.00

h. Administration Costs

The total cost for general and administrative duties over the course of the study has been estimated at 20% of the above effort, or - $150,160.00

Grand total for all phases of physical, chemical, and biological monitoring and characterization comes to - $1,037,560.00

Law Enforcement

Although the Massachusetts Department of Public Health has closed New Bedford Harbot and an adjoining section of Buzzards Bay to fishing, both commercial and recreational fishing for shellfish, finfish and eels persists. Enforcement action is needed immediately so that the health of local residents can be protected. Unfortunately, due to recent cuts to the State budget, law enforcement has lost 12 of its land officers and 6 of its boat officers, as well as suffering the docking of one of its two patrol boats. Under these conditions the Division of Law Enforcement cannot ensure that unlawful harvesting of fish from areas contaminated with PCB's will be curtailed.

In order to provide the degree of protection needed for New Bedford the Department of Law Enforcement will require support costs for patrol boat salaries and support for boat bond and land based natural resource officers and two police cruisers. The costs estimated for enforcement has been estimated at $187,000 per year. Depending on the length of closure of the harbor, DLE will require this funding on a per annum basis. Three years of enforcement are expected at this time. Total costs estimated for enforcement come to $561,000.00

Local Coordination

A coordinator at the local State Government level will be needed for at least three years to work with city and state environmental groups, and legislature and to disseminate public information.

The total cost of salary plus benefits for 3 years = $ 90,000.00

Summary of Expenditures for Proposed PCB Studies:

Project Management and Consulting Services	$1,200,000.00
Human Health Effects	333,710.00
Physical, Chemical and Biological Characterization and Monitoring	1,037,560.00
Law Enforcement	561,000.00
Local Coordination	90,000.00
Grand Total for all Studies:	$3,222,270.00

cgh

APPENDIX VII:

"Draft Report: The Commonwealth of Massachusetts

Acushnet River Estuary PCB Study"

by Malcolm Pirnie, Inc., June 1981

DRAFT COPY

June 19, 1981

Malcolm Pirnie, Inc., "Draft Report:
The Commonwealth of Massachusetts Acushnet
River Estuary PCB Study." Massachusetts
Division of Water Pollution Control,
Boston, Massachusetts (June 1981).

Dear Mr. McMahon:

Pursuant to the terms of our agreement dated January 12, 1981 we are pleased to submit our report on the Acushnet River Estuary PCB Study.

The report presents an evaluation of the existing PCB problem on the basis of available information. Four alternative remedial programs and their expected benefits and costs are presented.

We recommend that additional sampling of the study area be carried out in order to make reliable estimates of the effects of remedial dredging programs. The recommended implementation stages for remedial dredging and harbor improvement programs are also outlined.

We appreciate the opportunity to participate in this important undertaking. We will be pleased to discuss this report at your convenience.

Very truly yours,

MALCOLM PIRNIE, INC.

John B. Zondorak, P.E.
Vice President

Richard F. Thomas, P.E.
Project Manager

DRAFT REPORT

THE COMMONWEALTH OF MASSACHUSETTS
ACUSHNET RIVER ESTUARY PCB STUDY

JUNE 1981

SUMMARY

The objective of this PCB Study is to:

a) characterize the nature of the PCB contamination problem and;

b) evaluate alternative programs to recover PCB from the estuary in order to reduce environmental contamination and to relieve existing constraints on dredging for harbor improvement and development.

The study area is divided into five zones (see Figure 1-1):

Zone A: Upper Acushnet River Estuary (above New Bedford-Fairhaven Bridge)

Zone B: Inner New Bedford Harbor (above hurricane barrier)

Zone C: Outer New Bedford Harbor

Zone D: Inner Buzzards Bay

Zone E: Outer Buzzards Bay

Basis of Study

Evaluations contained in this study are based upon available data and existing reports which are listed under References in Section 7. Recommendations have previously been made to obtain more extensive data in order to refine present understanding of the nature and extent of PCB contamination and to provide for more reliable estimates of remedial program costs.

This report presents evaluations which are judged to be suitable for making a decision as to whether feasible remedial or harbor improvement programs exist. The next phases of work would include additional sampling and detailed studies of all aspects of a selected program.

Nature of PCB Contamination

Available data indicate that the sediments and aquatic biota in the Acushnet River and New Bedford Harbor area contain elevated levels of PCB. Median PCB values of sediment samples taken in Zones A and B exceed 5 micrograms per gram (ug/g) dry weight. A maximum value of 620 ug/g has been measured in Zone A, with several other samples also exceeding 100 ug/g. The biota exhibit the highest PCB levels in the harbor area and decreasing levels seaward. The median PCB values of lobsters sampled in Zone C and bottom feeding fish in Zone B are greater than the FDA limit of 5 ug/g wet weight. Outside the harbor area, median PCB values generally drop below the FDA limit, although many samples still exceed 5 ug/g. Because of the limited data, calculations of statistical confidence levels could not be made.

Extent of PCB Contamination

Although available data is limited, a reasonable estimate of PCB contamination can be made as a basis for determining a future course of action. Areas of PCB contamination have been outlined (see Plate 3) on the basis of available data and after reviewing the Woods Hole Oceanographic Institution report entitled Fine-Grained Sediment and Industrial Waste Distribution and Dispersal in New Bedford Harbor and Western Buzzards Bay, Massachusetts (1977).[2] A recommendation has been made to collect an additional 140 bed sediment samples in Zones A, B and C to augment the 78 samples now available in these areas. This additional sampling would be part of the detailed technical studies required prior to carrying out a remedial program.

Dredging Volumes

Several current studies of PCB-contaminated waterways have shown removal of contaminated material as the only technically and economically feasible action.[12,26] Estimates of contaminated bed material volumes in the Acushnet River-New Bedford Harbor area are based on a depth of contamination of 2 feet and a depth of removal of 3 feet in areas dredged. Dredged material volumes and PCB recovery for Inner and Outer Harbor dredging (Zones A, B and C) are indicated in Table S-1. Brief statements describing the basis of estimates contained in Table S-1 are given in footnotes to the table.

Dredged Material Containment Sites

Two available reports have presented evaluations of potential containment sites for dredged material.[24,25] Two site categories are of interest:

a) Sites which are suitable for contaminated harbor muds and which are not needed for harbor facilities.

b) Sites desirable for harbor development needing structurally sound fill but requiring containment areas for contaminated material removed during site development.

Sites identified in the two reports are shown on Plate 4. A review of possible contaminated dredged volumes and a comparison with identified containment areas suggests that available sites may limit otherwise feasible dredging programs. Further evaluation of shoreline sites and possible upland sites can be made if necessary.

TABLE S-1

CONTAMINATED VOLUMES AND PCB RECOVERY

Characterizations Based Upon Available Data

Typical PCB Concentration in Dredged Area ug/g		Cumulative Volume of Dredged Material cu. yds.	Percent of Total PCB ~~in Place Recovered from~~ removed ? (1) Zones A and B	Zone C (2)
	1. HARBOR AREÀ (Zones A and B)			
>30		400,000	50	-
>20		500,000	55	-
>10		1,000,000	70	-
> 1		4,500,000	90	-
	2. OUTER HARBOR AREA (Zone C)			
45		900,000	-	65
30		1,200,000	-	75
15		1,500,000	-	90
	3. HARBOR DEVELOPMENT (ZONES A AND B)			
5	*Project A	80,000	1	-
5	Project B	120,000	1	-
5	Project C	300,000	2	-
5	Project D	900,000	10	-

(1) Percent of total PCB is based on total PCB estimated in that area (Zones A and B or Zone C).
(2) Total PCB in Zone C includes only the three identified contamination areas.

*Project A - Channel improvement dredging
Project B - Project A + bridge excavation
Project C - Project B + small scale harbor development
Project D - Project C + large scale harbor development

Conceptual Dredging Programs

The benefits to be expected from dredging programs are related to the two primary issues involved:

a) reduction in PCB levels in aquatic life generally, and specifically in organisms of commercial and sport fishing importance.

b) lifting of constraints on harbor development projects.

Reductions in PCB contamination levels in aquatic biota will be related to, among other factors, the extent to which PCB-contaminated bed materials are removed and to the levels of PCB in the remaining undredged bed areas. The potential benefits to aquatic life of a remedial dredging program cannot be accurately determined at this time. A discussion of various factors which must be considered is included in Section 4 of this report.

Constraints on harbor development projects would be reduced by the provision of containment area for the PCB-contaminated fraction of the bottom muds in areas being considered for channel improvement dredging and various construction projects.

Four remedial dredging program alternatives have been formulated:

1. Provide for recovery of 50 percent of the PCB in the Inner and Outer Harbor (Zones A, B and C). This action may not reduce PCB levels in aquatic life to an appreciable extent.

2. Allow implementation of channel improvement dredging, bridge excavation and initiation of small scale harbor development projects through removal and containment of the PCB-contaminated bed material volumes involved.

3. Allow implementation of channel improvement dredging, bridge excavation and initiation of larger-scale harbor development projects through removal and containment of the PCB-contaminated bed materials volumes involved.

4. Provide for recovery of 90 percent of the PCB in the Inner and Outer Harbor which may result in an appreciable reduction in PCB levels in aquatic life. This includes initiation of all harbor development projects.

Characterization of and program costs for these four alternative programs are indicated in Table S-2.

Combinations of the four alternative programs could be implemented to provide for varying degrees of harbor development and PCB recovery. Order of magnitude costs may be developed from the information in Table 4-2.

Conclusions

1. Remedial dredging programs to recover PCB are technically feasible. The order of magnitude costs given in this report must be compared to anticipated benefits to determine financial feasibility.

2. Existing data is not sufficient for making a reliable assessment of the effects of remedial dredging programs on the PCB body burden of commercially and recreationally important species.

3. Dredging to remove and contain contaminated harbor sediments as part of harbor development programs can be undertaken separately or in conjunction with remedial dredging programs.

4. A sampling and analysis program based upon the recommendations in Appendix B is the minimum program required to refine the present understanding of the extent of PCB contamination and the improvements to be expected from remedial dredging programs.

Recommendations

1. Implement a sampling program based, as a minimum, on Appendix B in order to provide reliable estimates of the effects of remedial dredging programs on PCB levels in biota.

2. If local interests wish to implement a program of harbor improvement dredging separately or in conjunction with remedial programs, the implementation stages identified in Item 4 should be initiated.

3. If it is determined that a remedial dredging program is financially feasible, the implementation stages identified in Item 4 should be initiated.

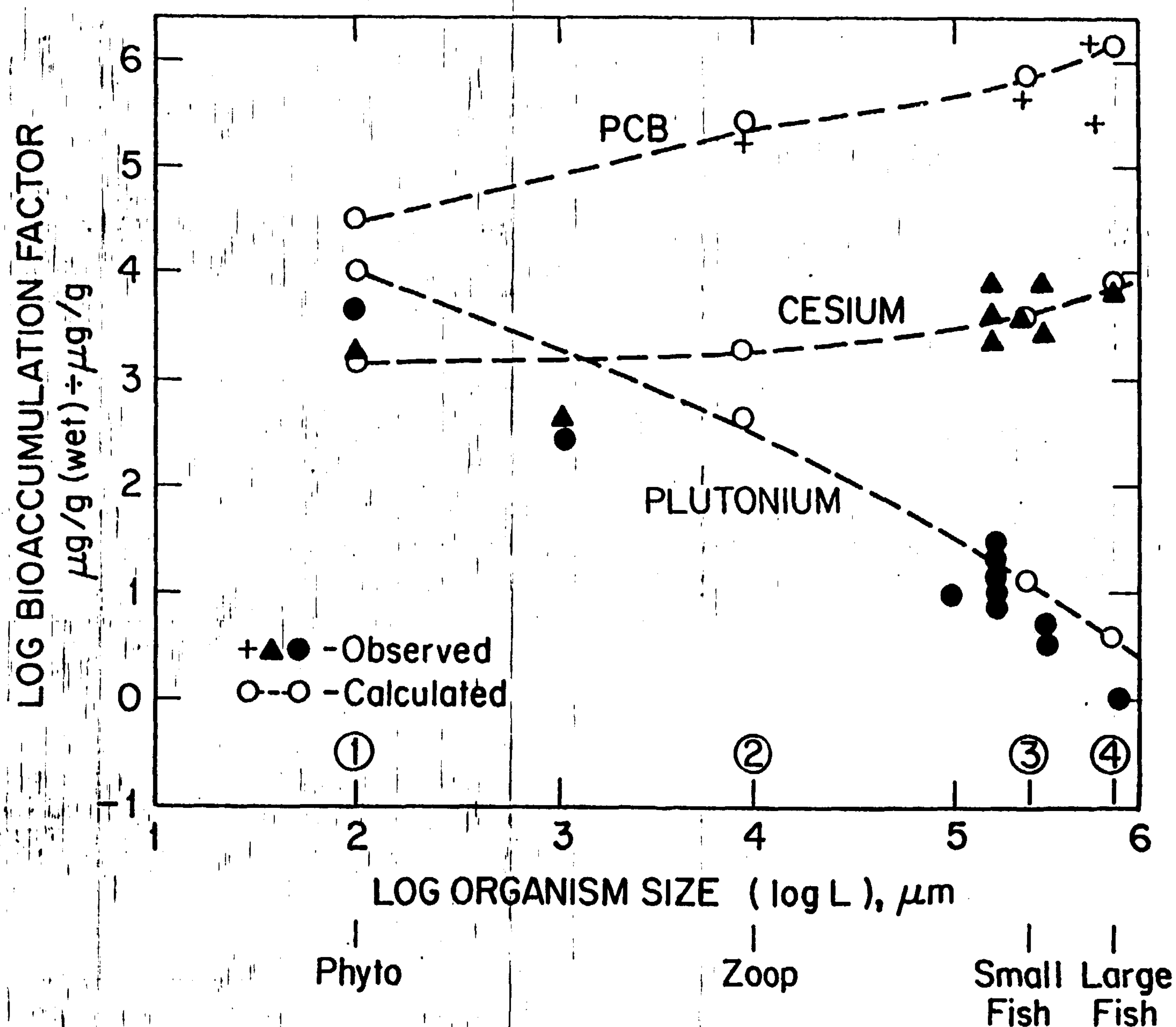
4. The following implementation stages are recommended as a basis for any remedial and/or harbor improvement programs undertaken. The scale and details of the stages would be tailored to the specific program adopted.

   a. Detailed planning and preliminary design of elements of the adopted program.

   b. Preparation of materials necessary to meet environmental and regulatory requirements.

   c. Preparation of final program plans.

   d. Carry out adopted program.


LOG BIOACCUMULATION FACTOR
μg/g (wet) ÷ μg/g
PCB
CESIUM
PLUTONIUM
+▲● -Observed
○--○ -Calculated
LOG ORGANISM SIZE (log L), μm
Phyto
Zoop
Small Fish
Large Fish