U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

Date: February 24, 1984

From: Michael R. Deland
Regional Administrator
Stephen F. Ells acting

To: Gene Lucero, Director
Office of Waste Programs Enforcement

Re: New Bedford, Massachusetts
Endangerment Assessment

Region I has performed an endangerment assessment (attached) for New Bedford, Massachusetts, pertaining to the widespread PCB contamination problem. The Region has determined that:

1. Area residents continue to be exposed to PCBs via multi-media pathways;

2. PCBs are ubiquitous in the area's ambient air and have significantly degraded the air quality at several specific sites;

3. Large areas of Acushnet River sediments have PCB concentrations in excess of 50 ppm, and are hazardous wastes when dredged.

4. PCBs are continuing to migrate in significant quantities from the Acushnet River Hot Spot;

5. PCB concentrations in Acushnet River Estuary waters often exceed the EPA ambient water quality criterion level for the protection of saltwater aquatic life; and,

6. Commercially and recreationally important fish and shellfish are contaminated with PCBs in excess of the US Food and Drug Administration's (FDA) action level*.

*The FDA action level of 5ppm is, in part, based upon economic considerations, not solely for maximum protection of human health.

Therefore, based upon these findings, and pursuant to Section 106 of CERCLA, the Region has further determined that there is an imminent and substantial endangerment to the public health or welfare or the environment because of the release, or the threat of release of PCBs to the Acushnet River Estuary and Buzzards Bay.

RECOMMENDATIONS

I recommend that you concur with the Region's determination that there is an imminent and substantial endangerment to public health or welfare or the environment because of the release, or threat of release of PCBs to the Acushnet River Estuary and Buzzards Bay. I am available to discuss this request in more detail at your convenience.

Concurrence _____

Nonconcurrence _____

Date _____

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

NEW BEDFORD, MASSACHUSETTS
Endangerment Assessment
February 1984

Introduction

New Bedford is located approximately 55 miles south of Boston in Bristol County, Massachusetts. With a population of 98,500 (1980 census), New Bedford is the Commonwealth's fourth largest municipality.

Two electrical capacitor manufacturers, the Aerovox Company, and Cornell-Dubilier Electronics (CDE), used polychlorinated biphenyls (PCBs) over a period of time spanning four decades through the late 1970's. As a result of poor handling and disposal practices, PCB contamination in the New Bedford area is widespread. Specific areas of contamination and/or impact include: The New Bedford Municipal Landfill; Sullivan's Ledge (an abandoned quarry used by the city as an industrial dump); New Bedford sewer lines and sewage treatment facility; at least 18,000 acres of the Acushnet River and Buzzards Bay; Aerovox's and CDE's plant yards; the area's ambient air; surface water; groundwater; and, biota.

A. Contaminants Found at the Site

The U. S. EPA, U. S. Coast Guard, Massachusetts Department of Environmental Quality Engineering (MA DEQE), and various other state regulatory agencies have conducted numerous studies relevant to the PCB contamination of New Bedford Harbor and adjacent environs. The most recent comprehensive and

stringently quality controlled investigation was conducted by EPA from August 1982 through the Spring of 1983. The studies included an areawide ambient air monitoring program, assessments of the New Bedford Landfill and Sullivan's Ledge, sampling and analysis of harbor sediments and biota, and a study of the New Bedford sewage system. The investigations document widespread, multi-media contamination by PCBs. Briefly summarized:

Ambient Air Study - A total of twenty-one sampling stations were located in the Towns of Dartmouth, New Bedford, Acushnet, and Fairhaven. Air samples at all stations were analyzed for PCBs. The data indicates that PCBs are ubiquitous in the test area's ambient air. Two areas in particular had significantly elevated PCB levels: Sullivan's Ledge, and the Acushnet River hot spot mudflats. With concentrations of about 200 to 300 ng/cu. m.†, Sullivan's Ledge PCB levels were approximately 40 times higher than background levels. The PCB concentrations near the mudflats ranged from 40 to 90 ng/cu.m., or 8 to 20 times higher than background.

Sullivan's Ledge Investigation - An assessment of PCB, and other organic chemical contamination of Sullivan's Ledge was conducted by EPA. Significant levels of PCBs, vinyl chloride, and chlorinated industrial solvents were found in soil and groundwater. High levels of PCBs were also detected in ambient air. The data shows that Sullivan's Ledge is a

†nanograms/cubic meter

source of contamination of hazardous compounds,including PCBs to the surrounding environment via several pathways.

New Bedford Landfill Investigation - From August 1982 through the Spring of 1983, EPA conducted an assessment of the New Bedford Landfill which contains an estimated 500,000 pounds of PCB waste. The studies indicated that previously high levels of PCBs in ambient air have been reduced to background levels. Also, only small amounts of PCBs were detected in groundwater from monitoring wells located at the perimeter of the landfill. The site will be continued to be monitored.

Sediment Profile of PCBs - During August 1982 and January 1983, a comprehensive sampling program was conducted to determine the occurrence and distribution of PCBs in Acushnet River Estuary and Buzzards Bay sediments. The data documents the presence of PCBs throughout the river and portions of the bay. PCB concentrations in the Acushnet River Hot Spot (north of the Coggeshall Street Bridge) were as high as 1,700 ppm (Figure 1).

Aquatic Biota Samples - In December of 1982, samples of aquatic biota were taken from the Acushnet River Estuary and Buzzards Bay. The most abundant species taken was Mercinaria mercinaria, commonly called quahogs. Approximately 300 quahogs were composited into 17 samples and were analyzed. PCB concentrations ranged from 0.1 ppm to 2.0 ppm (wet weight).

The data demonstrates that PCBs are being transported offsite, are biologically available, and are being bioaccumulated. Quahogs are a popular seafood, and hence, this represents a potential route of PCB exposure for humans.

New Bedford Sewer Line Study - In December 1982, sediment samples were collected from 19 locations in the New Bedford sewer lines and analyzed for PCBs. The data showed that portions of the sewer system were highly contaminated with PCBs. Specifically, lines in the southern end of the system in the vicinity of Cornell-Dubilier Electronics had PCB concentrations as high as 78,000 ppm. Sediment samples collected immediately outside of combined sewer overflows in Buzzards Bay also exhibited elevated PCB levels, indicating that PCBs are being transported from the sewer system into the bay.

In October of 1982, the Massachusetts Department of Environmental Quality Engineering released a study of the New Bedford Sewer System. Liquid samples were taken at 20 locations in the sewer system. The results of this study closely paralleled those of the EPA sewer line study, indicating that portions of the sewer system are highly contaminated, and, that 500 to 700 pounds per year of PCBs are discharged from the facility's primary outfall. This discharge represents a significant source of PCBs directly to Buzzards Bay.

In January 1983, the U. S. EPA and U. S. Coast Guard conducted a study of PCB mass transport from the Acushnet River Hot Spot. This joint investigation was undertaken to determine if PCBs were migrating offsite from the hot spot. The study concluded

that 1,000 to 2,000 pounds per year of PCBs are being transported from the hot spot to New Bedford Harbor. This represents a continuing significant source of PCBs to the Acushnet River Estuary/Buzzards Bay system. The Coast Guard also detected the highest sediment PCB concentrations found to date: 190,000 ppm.

In summary, these and other investigations clearly document widespread PCB contamination in the New Bedford, Massachusetts area. Current significant sources of PCBs to the aquatic ecosystem include the Acushnet River Hot Spot and the New Bedford sewer system. As a result of the chronic sources, PCBs are found in water, sediments, air and aquatic biota. These media present direct and indirect pathways of human exposure to PCBs.

B. Factors Affecting Migration

1. Hydrologic Factors

The major hydrologic forces affecting the Acushnet River Estuary are related to tidal flow, although the flow of the Acushnet River is also a minor force. The drainage basin of the river above the tidal limit is approximately 18.4 square miles. This results in an estimated mean annual discharge of 30 cfs[†]. This freshwater input only represents about 1 percent of the average tidal input.

The Acushnet River above the Coggeshall Street Bridge experiences diurnal tides with a mean tidal range of 3.8 ft. The mean spring tidal range is 4.7 ft. Recent flow data at the Coggeshall Street Bridge indicates that flow rates reached

[†]cubic feet per second

up to 1.68 knots on the flood tide and up to 3.64 knots on the ebb tide. The tidal prism (the volume of water which flows into and out of a basin in the course of a complete flood/ebb tidal cycle) of the river above the Coggeshall Bridge is 65,664,000 cubic feet.

2. Sediment Type

The major sediment type in the area of the Acushnet River Hot Spot (north of the Coggeshall Bridge) is sandy silts. The remaining inner harbor sediments are composed mainly of sandy silts and silty fine sands, with lesser amounts of clay being found.

The silt/clay characteristics of the surficial sediments are significant factors contributing to the accumulation and transport of PCBs for several reasons, including:

1) The high organic content and small particle size allows large amounts of PCBs to become associated with the particulates. For example, one sediment sample from the Acushnet River Hot Spot was nearly 20% PCB on a dry weight basis.

2) Fractionation, due to differential settling rates of the various sediment types, has resulted in the formation of a very thin, soupy layer of organically enriched material at the sediment-water interface. This layer is more mobile than the subsurface sediments and, hence, may act as a transport mechanism for PCBs.

3) These PCB enriched, mobile sediments may also act as a reservoir of PCBs to the overlying water column. The 1983 EPA/Coast Guard study indicated that significant amounts of

PCBs are being transported from the hot spot as soluble PCBs. Since, currently, there are no known significant discharges of PCBs to the river, the likely source of soluble PCBs is the highly contaminated surficial sediments.

3. Climate

The New Bedford area climate is characterized by frequent but relatively short periods of heavy precipitation. The average annual precipitation is approximately 45 inches per year.

The area experiences occassioned coastal storms. The impact of episodic storm events on the transport of PCBs per year is difficult to determine. However, the EPA/Coast Guard study estimates that about 900 pounds of PCBs per year are transported from the Acushnet River Hot Spot during rainfall events.

The mean annual temperature at New Bedford is about 50°F. Extremes in temperatures range from occasional highs near 100°F to infrequent lows in the minus teens. The significance of high summer temperatures is that the rate of volatilization of PCBs increases with increasing temperature. The prevailing winds carry PCB contaminated air directly to residential neighborhoods and commercial areas (See Section D 1).

4. Physical and Chemical Characteristics of Contaminants

Polychlorinated biphenyls are a class of aromatic organic compounds that are similar to many organochlorine pesticides in that they are persistent in the environment and have a high potential to bioaccumulate. PCBs have a very low solubility

in water (25-200 ug/l). However, PCBs have a high specific gravity and a high affinity for solids, including suspended particulates. As with other chlorinated hydrocarbons, PCBs are usually associated with micro-particulates of 0.15 um in diameter or less.

Although chlorobiphenyls have relatively low vapor pressures (10^{-4} to 10^{-5} mm/Hg), evaporative losses of PCBs is enhanced in aquatic environments. This phenomenon probably occurs in the vicinity of the Achusnet River Hot Spot mudflats where elevated levels of PCBs were detected in ambient air.

PCBs are very soluble in nonpolar organic solvents, lipids, and oils. Octanol/water partition coefficients in the range of 10,00 to 20,000 have been reported for tri-, tetra-, and pentachlorobiphenyls. Octanol/water partition coefficients have been demonstrated to correlate with ecological magnifiction factors in aquatic organisms,and have been utilized to estimate bioaccumulation potential.

C. Movement of Contaminants and Environmental Fate

1. Acushnet River Hot Spot

The persistence of PCBs and their preferential accumulation in sediments is significant in that it provides a reservoir of material that can migrate off-site and continue to contaminate overlying waters for long periods of time.

Sediment concentrations of PCBs in the Acushnet River Hot Spot area range from 500ppm to tens of thousands of parts per

million, with a reported maximum value of 190,000 ppm. The net quantity of chlorobiphenyls being transported from this area are significant. The EPA/Coast Guard Study concluded that 1,000 to 2,000 pounds per year of soluble and suspended PCBS are migrating from this area. This does not include PCBs which occur on the surface as oil slicks in relatively high concentrations.

2. New Bedford Wastewater Treatment Facility

Historically, the New Bedford Wastewater Treatment Facility received PCB contaminated waste from the companies via their wastewater discharges. Currently, an estimated 500 to 700 pounds per year of PCBs are being discharged from the Clark's point outfall because of residual contamination in the sewer lines. An unknown amount is contributed from approximately 27 combined sewer overflows which discharge to the Achusnet River and Buzzards Bay. There is concern that the wastewater treatment facility may also be the source of more toxic organic compounds resulting from the incomplete combustion of PCB contaminated sludge at the facility's incinerator. In particular, poly-chlorinated dibenzofurans (PCDFs) are potentially formed during low temperature incineration of PCBs.

The agency is currently conducting a stack test at the incinerator to determine if PCBs or PCDFs are being emitted in stack gases.

3. Biota

Although the ultimate environmental fate of PCBs in aquatic

systems is assumed to be bottom sediments, other fates are also significant. Specifically, PCBs residing in aquatic flora and fauna is of concern, in particular, when the target organisms are component parts of the food chain.

As a result of direct and indirect discharges of PCBs into the estuary, elevated levels of PCBs in fish tissue have been reported. This led to a fishing ban being imposed on over 18,000 acres of the harbor (Figure 2). The Food and Drug Administration (FDA) has set a maximum limit of 5 ppm in fish for human consumption†. Migratory fish taken from the area have levels as high as 16 ppm and bottom feeding fish, excluding eels, up to 57 ppm. Lobster samples have been reported as high as 51 ppm in the inner harbor.

D. Exposure Evaluation

To date, a comprehensive, quantitative assessment of human exposure to PCBs in the greater New Bedford area has not been conducted. However, the Massachusetts Department of Public Health (MA DPH) conducted a limited health survey in the area. The study reported that some area residents' blood had PCB levels higher than 99% of the general populations of the United States. Because of the widespread contamination and multiple pathways of exposure, all segments of the population are potentially exposed, and, therefore, at risk.

1. Routes of Exposure

The major routes for human exposure to PCBs include:

a. Ambient air - inhalation

b. Surface water - dermal contact and/or ingestion

†The FDA action level is based, in part, on economic considerations, not solely for maximum protection of human health.

c. Soils and sediments - dermal contact and/or dust inhalation

d. Food - ingestion.

° Ambient Air - An areawide ambient air monitoring program indicated that PCBs are ubiquitous in the test area. Significantly elevated levels of PCBs were found in the vicinity of the Acushnet River Hot Spot and at Sullivan's Ledge. Other areas with elevated concentrations of chlorobiphenyls are: The New Bedford Wastewater Treatment Facility; Marsh Island, in Fairhaven; and, the Acushnet Nursing Home. PCB levels at these sites ranged from 3 to 20 times higher than background stations.

° Surface Water - New Bedford Harbor and Fort Phoenix Reach are commonly used for recreational purposes. Recreational activities include swimming, water skiing, boating, and fishing. PCB concentrations in these waters commonly exceed levels estimated by EPA to result in an incremental increase cancer risk over the lifetime by 10^{-6}.

° Soils and Sediments - The Acushnet River Hot Spot, which includes tidal mudflats and marshy areas, extends a distance of approximately 1.5 miles. Shoreline property uses include commercial, industrial, residential, and recreational. There is a high potential for PCB exposure to the populace from the highly contaminated soils and sediments.

In addition to the hot spot, elevated levels of PCBs are found in soils and sediments at Sullivan's Ledge and the inner harbor.

° Food - Bioaccumulation, bioconcentration, and trophic transfers of chlorobiphenyls are of particular concern in New Bedford where the fishing industry is the economic base of the community. In June 1980, MA DPH issued a prohibition against certain fishing activities in New Bedford Harbor and adjacent areas.

In theory, the State imposed fishing ban should significantly decrease the potential exposure to PCBs from commercial and recreational fishing. However, there are serious administrative and logistic impediments that have resulted in extremely lax enforcement of the fishing ban. The net result is that PCB contaminated fish continue to be an exposure route to segments of the population.

2. Environmental Effects and Public Welfare Concerns

As previously noted in this assessment, the occurrence and distribution of PCBs is widespread in the New Bedford area. Multi-media contamination and degradation of the environment have been documented. Significant degradation of ambient air quality exists. PCB concentrations in surface waters exceed the EPA Ambient Water Quality Criterion for the protection of saltwater aquatic life. As a result of PCB concentrations in excess of 50 ppm, several miles of Acushnet River sediments and adjacent wetlands are classified as hazardous wastes when dredged.

In addition to these environmental impacts, the PCB contamination has had adverse impacts on public welfare, including:

a. economic damages due to the fishing prohibition;

b. constraints on planned harbor development projects due to high levels of PCBs in dredge spoils;

c. loss of recreational uses of the harbor;

d. probable decline in shoreline property values; and,

e. public concern about living adjacent to, and being impacted by, a major hazardous waste site.

E. Toxicologic Evaluation

1. Mammalian Toxicity and Human Health Effects

Polychlorinated biphenyls are readily absorbed through the gut, respiratory system, and skin. Although they are initially found in the liver and blood, long term storage in mammals occurs primarily in adipose tissue. Less highly chlorinated isomers are more readily metabolized and excreted. Highly chlorinated isomers are stored almost indefinitely in adipose tissue.

The more significant toxic effects of PCBs are observed when exposure occurs over an extended period of time. Chronic toxic effects include: liver damage; induction of liver microsomal enzymes; changes in the thyroid; and, immunosuppressive effects. Acute effects include chloracne and hyperpigmentation.

Of particular concern, in regards to human health, are potential reproductive and carcinogenic effects. PCBs can be transferred to the fetus transplacentally and to infants via breast milk. Infants and fetuses are more susceptible to adverse health effects perhaps because their immune response systems are not fully competent.

In September of 1983, the US EPA released a proposed quantitative risk assessment of reproductive risks associated with PCB exposure. In the worst case scenarios, some of which probably have occurred in New Bedford, reproductive risk of death prior to weaning was greater than 1 in 100,000.

The carcinogenic effects of PCBs has been evaluated utilizing animal models. EPA considers PCBs to be potential human carcinogens. There is also evidence showing that PCBs may be promoters. That is, they enhance the carcinogenic properties of other substances. This is probably the result of their ability to induce mixed function oxidases, particularly in the liver.

In summary, PCBs are toxic to humans; they are possible carcinogens; cause chloracne and hyperpigmentation; and, may have reproductive impacts. Their persistence in the environment and the human body and their areawide distribution in New Bedford places the population at risk.

2. Aquatic Life Toxicity

Polychlorinated biphenyls can bioconcentrate to high concentrations in aquatic organisms from concentrations in water that are extremely low. This phenomenon has been demonstrated in the laboratory, in field studies, and, in fact, shown to occur in New Bedford.

Laboratory investigations have shown that PCBs are toxic to salt

water fish and decrease the survivability of embryos and fry. Chronic exposure of fish to PCBs produce pathological effects not observed in acute tests. For example, pinfish exposed to 5 ug/l of Aroclor 1254 exhibited signs of poisoning including body lesions and ragged fins. Furthermore, chronic toxicity tests have shown that the toxicity of PCBs increases with increased duration of exposure. The water quality criterion to protect saltwater aquatic life is 0.030 ug/l as a 24 hour average. This value is commonly exceeded in the Acushnet River Estuary water column. For example, in 1982, Woods Hole Oceanographic Institute sampled harbor waters and reported 0.675 ug/l total PCBs, over 20 times above the criterion level.

F. Remedial Investigation/Feasibility Study (RIFS)

The investigations and assessments completed to date have documented that New Bedford is one of the worst cases of PCB contamination in the country. Given the magnitude of the problem, a comprehensive RIFS will be conducted to:

° Determine the impacts of the various sources and sites of contamination on the environment;

° Develop a series of viable remedial action alternatives;

° Investigate the feasibility and cost of each remedial action alternative;

° Select the most appropriate remedial action alternatives;

° Develop a conceptual design and implementation plan for the selected remedial alternatives.

The RIFS for New Bedford will require 18 to 24 months to complete, at a cost of approximately $3.4 million. Specific work tasks include:

- Ambient air sampling
- Hydrogeologic investigations at upland sites
- Sediment, water, and biota sampling
- Investigations of undisclosed sources/sites
- PCB transport/food chain model
- Investigate disposal sites and permitting requirements.

G. Conclusion

Polychlorinated biphenyls are highly persistent compounds which accumulate in the food chain. They are toxic to humans, possible carcinogens, may have reproductive effects, and are acutely and chronically toxic to aquatic organisms.

There are multiple pathways of PCB exposure from the harbor and upland sites to the general public, including: direct contact; ingestion of contaminated fish and shellfish; surface water uses; and, via ambient air. All segments of the population are exposed, and, therefore, at risk. The release and threatened release of PCBs poses an imminent and substantial endangerment to the public health, welfare and the environment.