REVIEW OF HISTORICAL DATA FOR CHARACTERIZATION OF QUINCY BAY CONTAMINATION

TASK I REPORT

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Prepared under:

U.S. EPA Contract No. 68-02-4357
Delivery Order No. 5

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QUINCY BAY STUDY

Overview

Report 99-731 of the 99th Congress, 2nd Session, U.S. House of Representatives, directed U.S. Environmental Protection Agency Region I (EPA) to undertake a study to determine the types and concentrations of pollutants and the extent of sludge in Quincy Bay. Congress directed that the study include an evaluation of the potential pathways of public health risk associated with Quincy Bay sediments. Congress defined the study area as the area between Nut Island and Moon Island, extending from the Quincy shoreline to a line between the easternmost points of Long Island and Peddocks Island. (See Figure 1.)

The following tasks, briefly summarized here, were designed to accomplish the above objectives:

- Task I - Review of available data for characterization of Quincy Bay contamination.
- Task II, A & B - Sampling and analysis for evaluation of sediment contamination.
- Task III - Sampling and analysis for evaluation of fish and shellfish contamination.
- Task IV - Analysis of fish and shellfish consumption and assessment of threat to public health.
- Task V - Preparation of Integrated Summary Report.

This report summarizes the results of Task I.

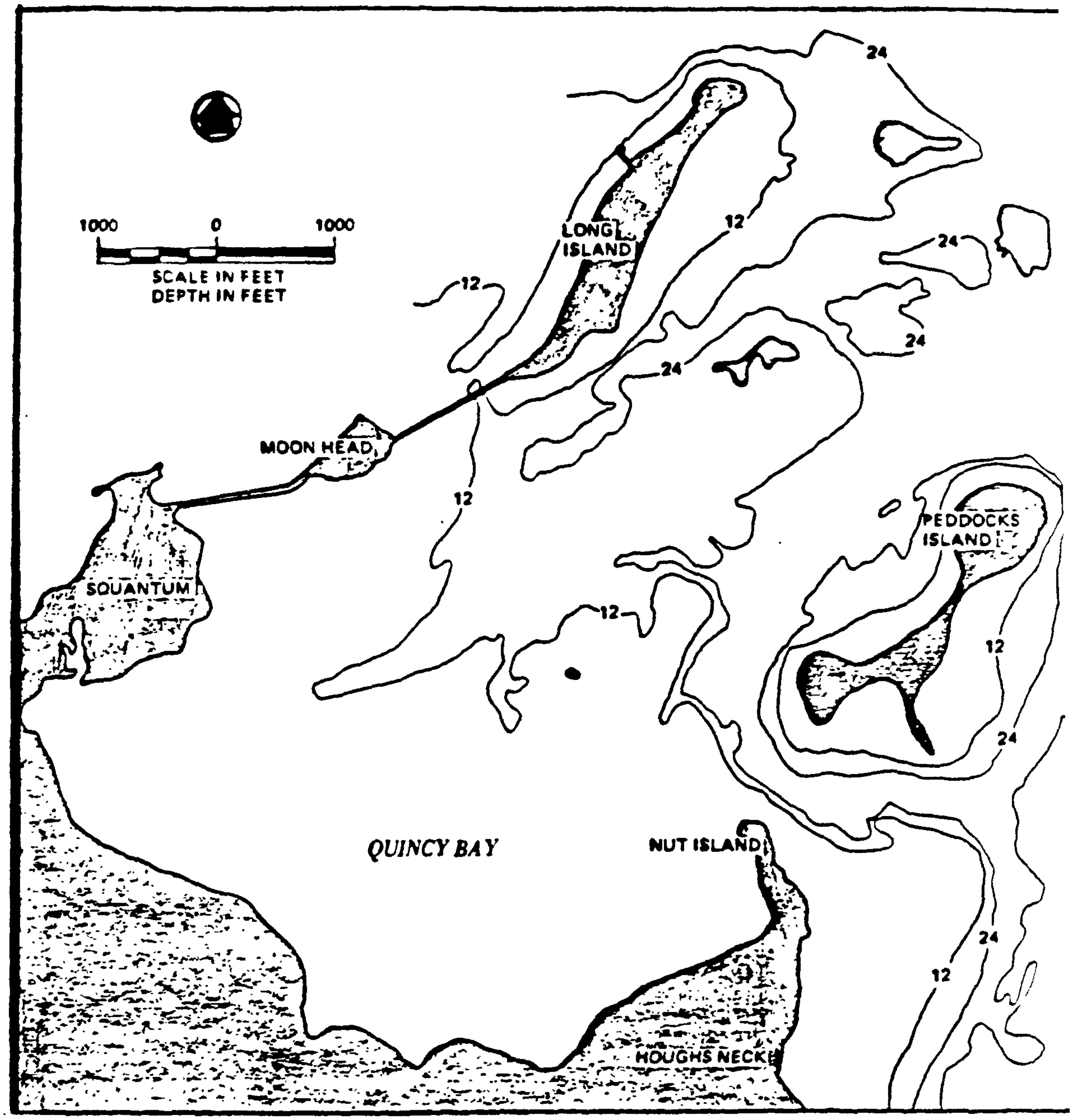


FIGURE 1. QUINCY BAY STUDY AREA USEPA 1987

TASK 1: REVIEW OF HISTORICAL DATA FOR CHARACTERIZATION OF QUINCY BAY CONTAMINATION

A. Approach

This report is the first in the series being conducted by the U.S. Environmental Protection Agency, Region 1, to investigate the types and concentrations of pollutants in Quincy Bay. The purpose of this task was to review published and unpublished reports on studies that could provide data characterizing Quincy Bay sedimentation and contamination. Specifically, reports were reviewed for data in the following areas:

- depth of sludge deposits;
- types and concentrations of pollutants in Bay sediments;
- information on contaminant levels, histopathological conditions, and other pertinent information regarding contamination of the fishery resource, focusing on winter flounder, lobster, and softshell clams.

Historical data on sediments were limited to the Quincy Bay area as defined by Congressional Report 99-731. Specifically, the study area was defined in that report to include ... "areas between Nut Island and Moon Island, extending from the Quincy shoreline to a line between the easternmost points of Long Island and Peddocks Island." Historical biological data emphasize collections from the designated Quincy Bay area, but also include data from greater Boston Harbor and Massachusetts Bay.

Data were gathered from several general sources. These were the "Boston Harbor Data Management" files located at Metcalf & Eddy, Inc., recent data collected for Metropolitan District Commission 301-h "Waiver" applications, and the data requested from agency and private groups involved in Boston Harbor research (see Table 1).

TABLE 1. SUMMARY OF AGENCY CONTACTS TO UPDATE AVAILABLE DATA ON QUINCY BAY

Agency Contacted

U.S. Department of Commerce
    National Oceanic and Atmospheric Administration
    National Marine Fisheries Service

  Status and Trends
  Estuarine Programs
  NMFS Organic Pollutant Study, 1984

U.S. EPA, Region 1
U.S. EPA, Region 1 Health Advisor
U.S. Department of Interior, U.S. Geological Survey - Woods Hole

Massachusetts Department of Environmental Quality Engineering
    Division Water Pollution Control, Shellfish

Massachusetts Department of Fisheries, Wildlife & Environmental Law Enforcement
    Division of Marine Fisheries

Massachusetts Institute of Technology
University of Massachusetts, Boston
New England Aquarium
Conservation Law Foundation
Woods Hole Oceanographic Institution
Marine Biological Laboratory, Woods Hole, Massachusetts

The "Boston Harbor Data Management" system is a computerized data file prepared by Metcalf & Eddy, Inc. for U.S. EPA, Region 1 in 1983. The data file is based on over 200 source documents.

These documents were searched for studies that provided characterization of Quincy Bay sediments, characterization of the Bay fishery resource, and data on sediment and/or fish contaminant concentrations. Data on pollutant concentrations in sediments and/or biota from MDC 301(h) waiver applications (Metcalf & Eddy. 1984a) were reviewed as well.

Data from recently completed or ongoing studies were collected by contacting Federal, State and local agencies, academic institutions, and other organizations conducting research in the Boston Harbor area (Table 1). Review of the additional studies thus collected focused on sediment quantity and quality in Quincy Bay, and sites of biotic contamination in Quincy Bay. Data on contaminant concentrations in fish and shellfish from outside the Bay were also noted.

Data on organic carbon and trace metal concentrations in sediments from the ongoing EPA sampling program for this study (Task II) were also reviewed as part of this Task 1 report. This review was designed to provide input for selection of areas for additional organic chemical analyses, as well as comparisons with the historical data base. Discussions of samples from this ongoing program include grab samples taken at 23 stations and four core samples.

The results of this task, the tasks summarizing 1987 sampling and analyses in Quincy Bay, and the public health implications of Quincy Bay seafood consumption, are all intergrated in a Task V summary report.

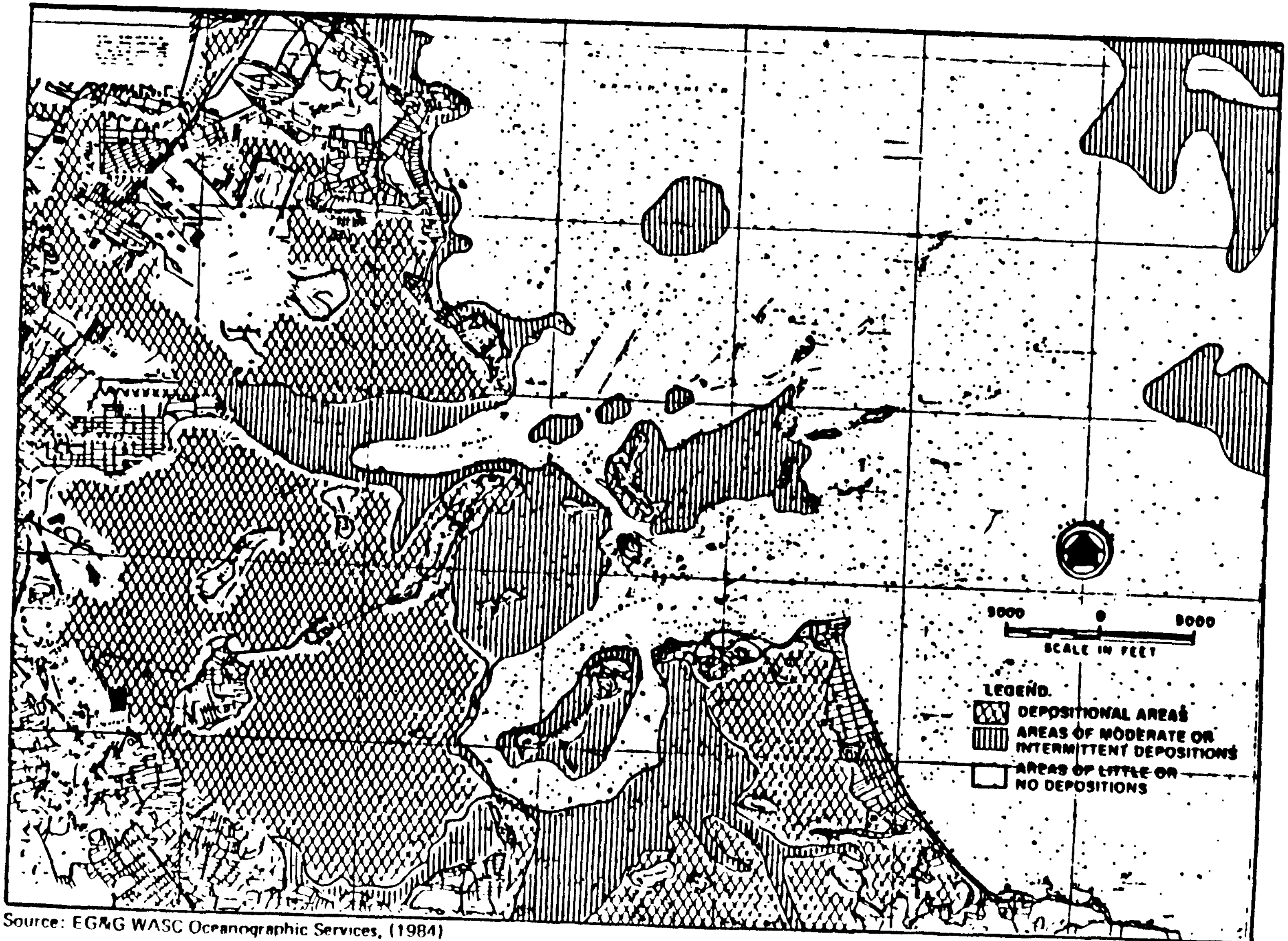
B. Historical Data Summary

1. Sediment Characterization Studies

Quincy Bay is a coastal bay that lacks a major freshwater river/estuary. Therefore, it has no major riverine input of both sediments and diluting freshwater. Sedimentation patterns are predominantly influenced by tides and currents, and where they occur, anthropogenic activities such as dredging and wastewater discharge. Open water connections do exist with greater Boston Harbor, Hingham and Hull Bays, and western Massachusetts Bay.

Several studies of sedimentation patterns within Quincy Bay were reviewed. One of the more recent, completed by EG&G in January, 1984, depicts depositional areas of Boston Harbor (Figure 2). Much of Quincy Bay from Nut Island to Moon Island, and including a band around Long Island, is represented in this study to be an area of high deposition. The rest of the Bay, except a reportedly nondepositional area around and offshore of Peddocks Island that includes Nantasket Roads and the shipping channel, is characterized as experiencing moderate to intermittent deposition. The Nut Island wastewater discharges, located in the Nantasket Roads area, appear to be located where little or no deposition occurs. (See also Appendix A, Figure A-4.) The Nut Island sludge outfall, off the northern end of Long Island, appears to be in or near an area of deposition.

Studies of silt and carbon distribution in the Bay, dating back to 1968, are illustrative of deposition patterns that generally concur with the 1984 EG&G survey. Mencher, Copeland



Source: EG&G WASC Oceanographic Services, (1984)

FIGURE 2. GENERAL LOCATION OF DEPOSITIONAL AREAS IN BOSTON HARBOR

and Payson, 1968, examined surficial sediments in Boston Harbor in a survey that included 152 grab samples. The finer grained sediments in Quincy Bay were found in the northern part of the Bay, with a pocket off Peddocks Island and Rainsford Islands (Figure 3). Sediment carbon content of >10 percent coincides with areas of finer sediments (Figure 4). The authors found correlations between finely divided organic matter in mud and predicted areas of high organic matter based on locations of sewage discharges and circulation of currents in Boston Harbor. Areas immediately adjacent to coastlines were shown to have coarser sediments, with organic content uncertain.

The results of sampling for organic carbon by Gilbert, et al. 1972, White. 1972 and Fitzgerald. 1980 show patterns of sediment organic content that are consistent with the above-noted results, although represented by fewer samples (see discussion below). Specifically, highest levels of organic carbon from each study were noted in samples from areas off Moon Island, with relatively elevated levels noted in samples off Peddocks Island, and several locations in the western half of the Bay. Samples from other studies have also tended to support this pattern. Ongoing studies for the MWRA may provide additional information on sedimentation processes in the Bay.

2. Sediment Contamination Studies

The data analyzed by White (1972) and Gilbert. et al., (1972) indicated reasonably good positive correlations between

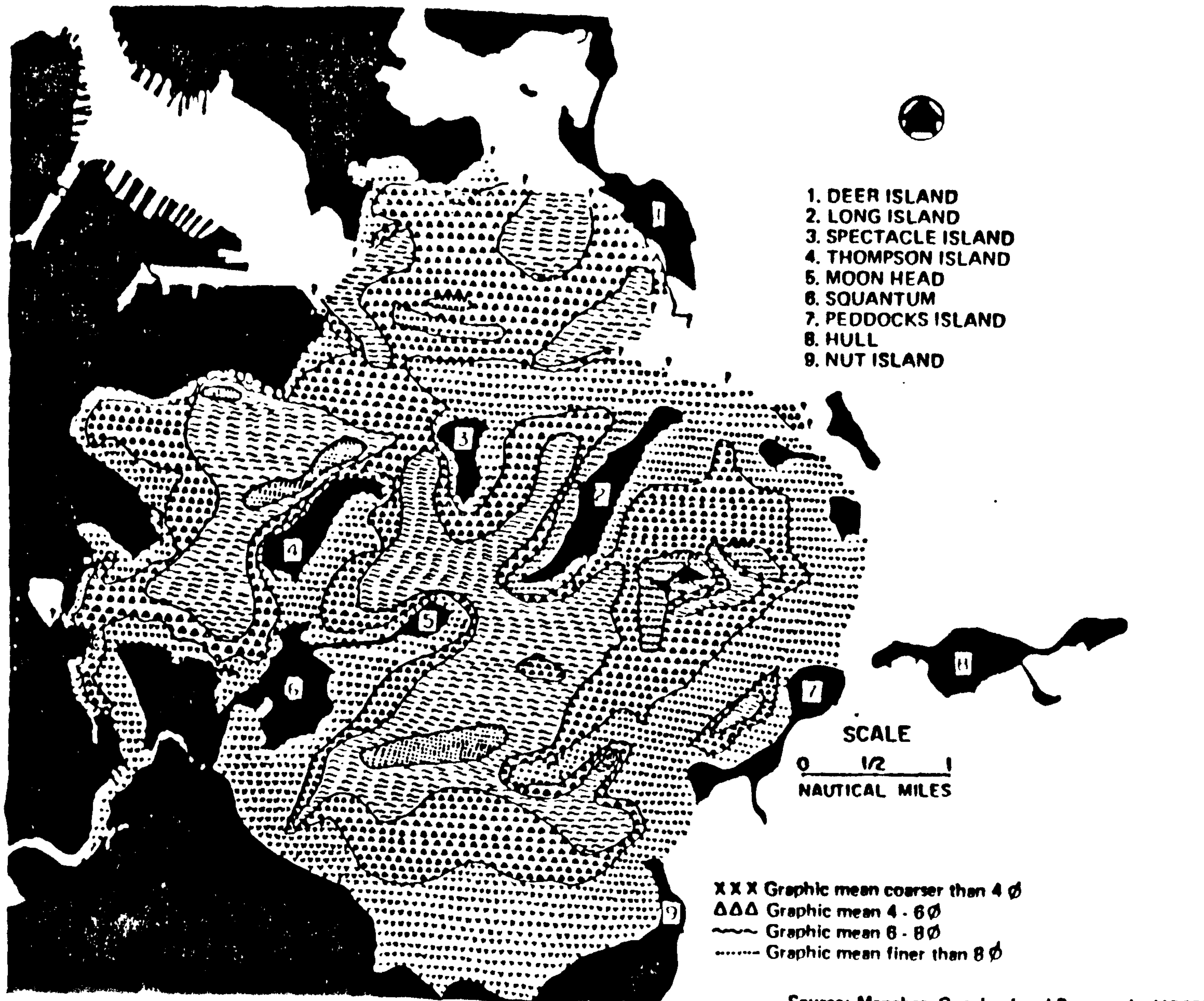
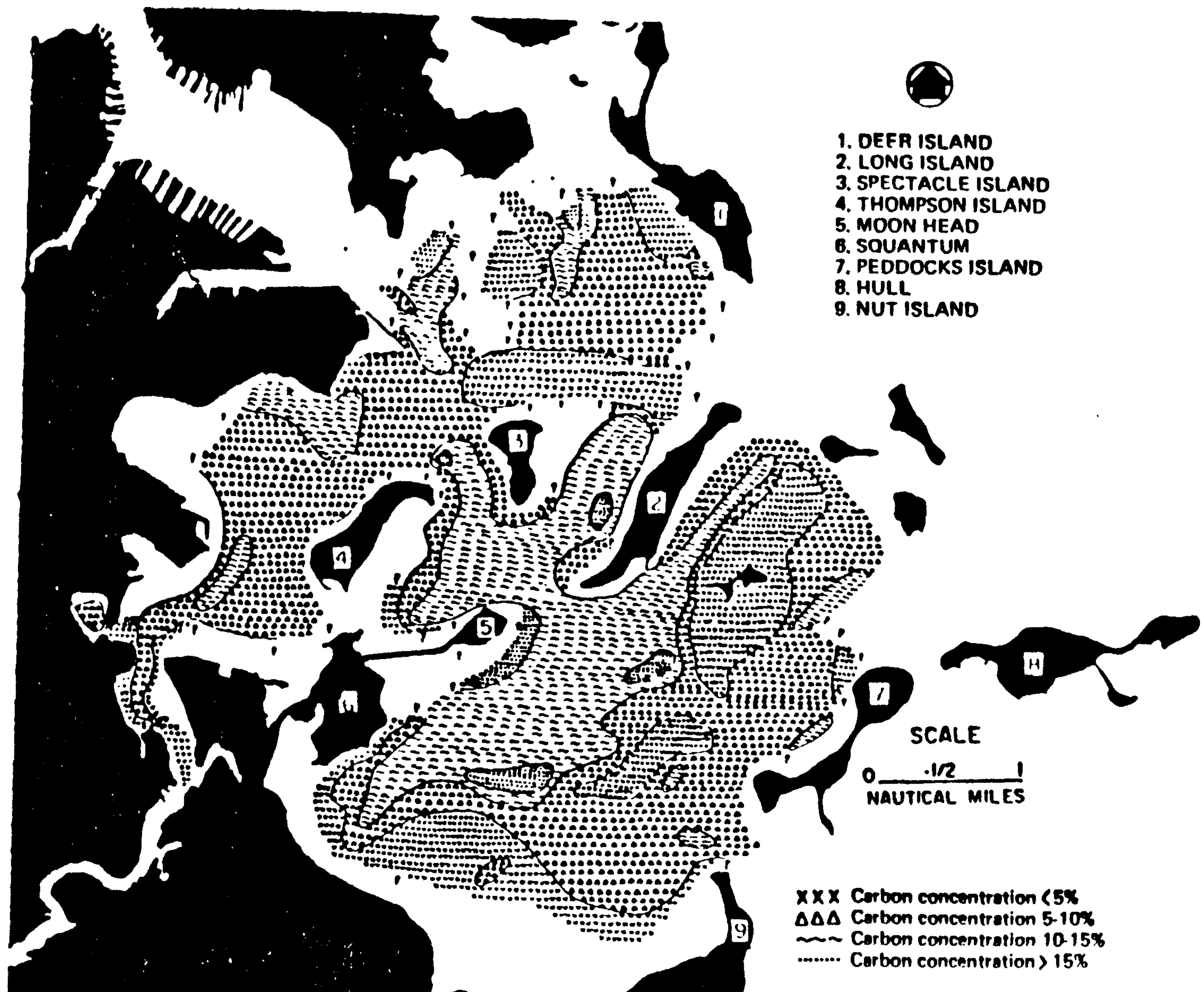


FIGURE 3. GRAIN SIZE DISTRIBUTION OF RECENT MUDS IN BOSTON HARBOR



Source: Mencher, Copeland and Payson, Jr. (1968)

the levels of some trace metals and the organic carbon content of sediments. These patterns appear to be a useful focus for organizing historical and current sediment sampling data for this study.

In the present task, the bay study area was initially divided into 24 cells, with the idea that all samples could be sorted among the cells and contaminant levels in different sedimentation regimes compared. It became rapidly apparent that this level of precision was inappropriate for this data base given the wide range of base map type, the variability in readily available station coordinate reporting and the potential for exaggerating inaccuracies. The study area was therefore divided into six cells, representing areas of somewhat different sedimentation, and typically one other potentially important environmental variable such as discharges or beach environment. These cells were sized as appropriate to serve the purpose of identifying important patterns in the data (Figure 5). Each area is described briefly below.

I. Long Island to Rainsford is an area of the Bay immediately west of but not including the Nut Island sludge outfall.

II. Rainsford and Peddocks Islands. This is reportedly a low sedimentation area with pockets of high sedimentation noted off Peddocks Island and, to a lesser degree, south of Rainsford. Also, the area is located east of sewage outfalls.

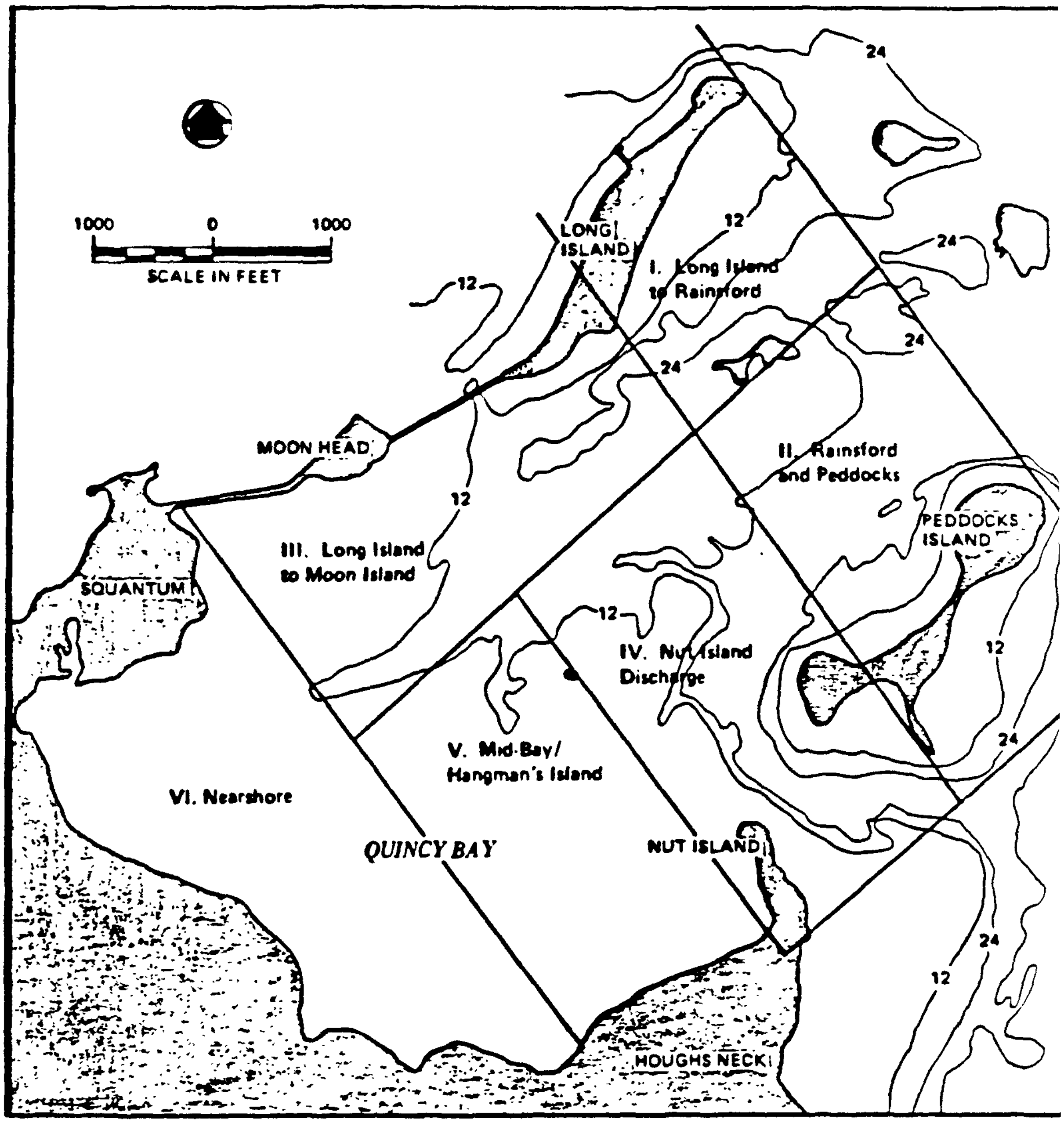


FIGURE 5. QUINCY BAY STUDY AREA SUBDIVISIONS FOR SUMMARY OF SEDIMENT DATA

III. Long Island to Moon Island (i.e., Moon Head). This is consistently reported as an area of high sediment carbon levels and/or fine sediment deposition.

IV. Nut Island Discharge. This area contains all four Nut Island sewage treatment discharges, and is reportedly an area of moderate sedimentation.

V. Mid-Bay/Hangmans Island. This is an area of reported high deposition, with pockets of high carbon content. It is also located west of the Nut Island sewage outfalls.

VI. Nearshore. Shallow areas, adjacent to beaches.

All of the available studies of sediment contamination were reviewed and stations assigned to one of the six cells described above (Table 2). The sediment chemistry data have been listed, under these assigned headings, in Appendix A. Mapped locations of sampling sites from each of these studies follow the tabulated summaries in Appendix A. U.S. EPA 1987 grab sample data from the ongoing Bay study are also listed with other data in appropriate cells in the tables in Appendix A. The completed Tasks II and III analyses of organic and inorganic constituents in sediments and biota are summarized in a separate report (Gardner & Pruell. 1987).

When all of the historical data are reviewed together even in a single cell, there are no obvious patterns of concentrations of contaminants. (The reader is directed to the original documents for evaluation of different analytical techniques and

TABLE 2
STATION NUMBER DESIGNATION AND
LOCATION OF SEDIMENT SAMPLING STATIONS
IN QUINCY BAY
FOR STATION LOCATION (see Figure 5)

Study Name	I Long Island to Rainsford	II Rainsford and Peddocks	III Moon Island to Long Island	IV Nut Island Discharge	V Mid-Bay/ Hangman Is	VI Nearshore
1. Gilbert 1972	01-3	01-4; 01-1	QB-1; 01-2	QB-5; HB-1	QB-3; QB-4	QB-2
2. Isaac, Delany, 1972	9	-	2	-	-	-
3. White, 1972	93	94,102,103,107	90,91,92	105,106	-	97,98,99, 100,101
4. 1979 Waiver	19	22,26,28	21	25,30	27,29	24
5. Fitzgerald 1980	6-9	6-21,6-19,6-8	6-15	6-10,6-17	6-16	none
6. 1982 Waiver Study	-	NO	-	NIC,NIB	-	-
7. 1983 EG & G	16	-	18	-	28,19	-

TABLE 2 (Continued)
STATION NUMBER DESIGNATION AND LOCATION OF SEDIMENT SAMPLING STATIONS IN QUINCY BAY
FOR STATION LOCATION (see Figure 5)

Study Name	I Long Island to Rainsford	II Rainsford and Peddocks	III Moon Island to Long Island	IV Nut Island Discharge	V Mid-Bay/ Hangman Is	VI Nearshore
8. 1984 Waiver	10	-	17	20,21	18,9	-
9. (Boehm, et.al.) Battelle (1984)	-	BH-5	BH-4	-	-	-
10. EPA 1987	S-7	S-12,S-13 S-22,S-23 SC-1	S-1,S-6,S-4, S-5,S-8,S-11	S-17,S-18, S-20,S-21, C-1,C-2, C-3,C-4 SC-2	S-14,S-15, S-16,S-19 SC-3, SC-4	S-2,S-3, S-9,S-10

See Appendix A Tables A-I through A-VI
Figures A-1 through A-6

information on "Quality Assurance" plans. The latter are more prominent in more recent studies). One cannot readily judge whether differences among data are due to their location and proximity to a pollution source, sampling and analysis methodology, timing of the study, or a combination of any of these. However, when each study is examined by itself, one or two areas of higher contaminant concentration can be noted. These appear in relatively similar locations in several of the six cells, and further, correspond to areas of generally higher sedimentation. Similar patterns were also noted in the EPA data collected during the summer of 1987. Specifically, these areas of elevated sediment contamination were noted off Peddock's Island, Hangman's Island and Long Island Shoreline. Table 3 summarizes values for selected parameters from the data in Appendix A. The stations near the three locations noted above are indicated by an asterisk on Table 3. Each area is discussed in more detail below, referring to the full set of data in Appendix A. As the discussion below illustrates, patterns of relative contaminant concentration do not track equally well for all parameters. But, review of this historical sediment chemistry database dating from 1972, grouped into these six designated areas, does show a remarkable degree of consistency considering the range of sampling techniques and the evolution of analytical methods over this period.

Long Island to Rainsford (Appendix A, Table A-1): The data from six of seven stations sampled in six studies from 1972 Table

TABLE 3

SELECTED PARAMETERS FROM SEDIMENT STUDIES (ug/g or ppm, dry weight unless otherwise indicated)**

(SEE APPENDIX A)

Study	I Long Island/Rainsford					II Rainsford and Peddock					III Moon Island/Long Island					IV Nut Island Discharge Area					V Mid-Bay/Hangman Island					VI Nearshore				
	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB
Gilbert 1972	7.9	0.1	112	3.01% organic	-	2.1	0.4	87	3.9% organic	-	*11.2	3.9	256	11.68% organic carbon	-	2.9	0.8	56	4.47% organic	-	2.7	3.5	241	11.23% organic	-	2.4	1.1	20	5.07% organic	-
						*7.9	2.3	112	7.92% organic	-	*-	2.0	82	7.17%	-	2.2	1.0	59	4.53%	-	1.0	0.9	72	3.55%	-	0.6	0.03	18	3.89%	-
Isaac & Delany 1972	1.0	0.8	55	4% volatile solids	-	-	-	-	-	-	*2.6	2.32	180	9.2% volatiles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White 1972	1.2	0.9	93	3.7% volatile	-	1.6	1.4	113	3.6% volatiles	-	*2.9	3.0	314	7% volatiles	-	1.1	1.3	102	6.3% volatiles	-	-	-	-	-	-	*2.8	5.4	125	6.5% volatiles	-
						1.6	1.0	137	9.4%	-	*2.0	2.4	164	9.7%	-	1.2	1.8	110	-							1.8	4.0	50	3.7%	-
						0.5	0.2	57	3.6%	-	*0.8	1.8	180	7.7%	-											2.0	4.5	62.5	4.5%	-
						0.4	0.7	47	2.3%	-																1.8	2.0	50	2.9%	
																										1.5	1.6	37.5	2.5%	
1979 Walver				7.2% organic carbon	-	1.0	4.7	70	5.6% organic carbon	.129	*3.0	9.4	234	8.3% organic carbon	-	1.3	1.7	65	6.8% organic carbon	.072				4.8% organic carbon						
						-	-	-	8.0%	-						2.5	6.0	74	11.7%	-	2.16	4.35	125	3.8%		1.8	3.7	59	4.3% organic carbon	-
						1.3	1.3	56	6.6%	-																				
Fitzgerald 1980				2.3% organic carbon	-				0.9% organic carbon 2.9% 3.0%	 -	*			3.7% organic carbon					3.3% organic carbon 0.6%	-				2.0% organic carbon	-	-	-	-	-	-

(continued)

TABLE 3 (Continued)
SELECTED PARAMETERS FROM SEDIMENT STUDIES (ug/g or ppm, dry weight unless otherwise indicated)**
(SEE APPENDIX A)

Study	I Long Island/Rainsford					II Rainsford and Peddock					III Moon Island/Long Island					IV Nut Island Discharge Area					V Mid-Bay/Hangman Island					VI Nearshore				
	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB	Cd	Hg	Pb	organic carbon	PCB
GCA for 1982 Waiver	-	-	-	-	-	0.2	0.92	<2	.194%	<1,100	-	-	-	-	-	0.1	0.59	<2	.112% organic compound	<1,100	-	-	-	-	-	-	-	-	-	-
																0.3	0.46	<2	.205%											
EG&G 1983	*11	5.2	500	12% volatiles	-	-	-	-	-	-	*0.04	2.9	260	7% volatiles	-	-	-	-	-	-	5.2	2.8	260	7% volatiles	.14	-	-	-	-	-
																					2.6	3.1	300	9% volatiles						
1984 Waiver	0.1	<0.12	<11	.67% organic compound	-	-	-	-	-	-	1.1	1.45	142	.69% organic compound	-	0.6	0.77	147	.41% organic compound	.0011	1.45	142	6900	-						
																0.6	0.48	87	.8%	.0006	1.58	226	5900	-	-	-	-	-	-	-
Battelle 1984	-	-	-	-	-	*			2.35% organic compound	.100	*			4.15% organic compound	.330	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPA 1987	0.56	-	48.65	1.17%	-	0.44	-	73.22	2.15% organic compound		*1.29	-	107.87	4.29% organic compound	-	0.26	-	46.97	1.28% organic compound	-	*0.29	-	29.84	3.02% organic compound	-	*1.03	-	97.48	2.17% organic compound	-
						0.20	-	33.97	8.18%	-	*1.29	-	164.51	4.79%	-	0.28	-	45.83	1.92%	-	0.61	-	55.92	1.18%	-	*0.95	-	93.18	2.11%	-
						*0.71	-	79.58	1.51%		0.97	-	112.16	3.12%	-	0.60	-	45.11	1.72%	-	0.95	-	69.91	1.53%	-	0.1	-	6.69	.832%	-
						*0.88	-	105.74	3.3%	-	0.72	-	146.52	2.72%		0.43	-	27.3	.87%	-	0.53	-	50.55	1.47%	-	0.2	-	9.61	2.06%	-
						0.47	-	39.72	9.16%		*1.06	-	117.82	3.15%																
											0.72	-	69.20	1.25%																

*"Hot spot" locations, see text.
**All data have been listed in comparable units. See Appendix A for original values.

3 through 1984, show a great deal of similarity. The exception is the data from one station in the 1983 EG&G study (in Metcalf and Eddy. 1984a). The levels of trace metals (eg. copper 650 µg/g, dry weight, zinc 1000 µg/g, lead 500 µg/g, mercury 5.2 µg/g) and volatile organics (12%) are the highest reported for any Quincy Bay location, including the areas that appear in other studies to be the most contaminated in the Bay. This sample appears to have been taken from an area almost adjacent to the sludge outfall at the northern tip of Long Island (see Appendix A, Figure A-7). Such close proximity to the outfall could explain the high levels of contaminants observed. The other six sampling stations in this area are located further away from the discharge. Results observed from analysis of sediments at these stations generally show moderate to high elevations in levels of contaminants compared with the rest of Quincy Bay (eg. copper up to 360 µg/g, zinc up to 200 µg/g, lead up to 200 µg/g, mercury up to 0.8 µg/g, and volatile organics up to 4%).

The one site sampled from this area in the 1987 EPA program reflected the results generally observed in the earlier studies. Data for trace metals from site S-7 are similar to the mean of values from all the Quincy Bay stations examined (See Appendix A, Table A-VII).

Rainsford and Peddocks Islands (Appendix A, Table A-II): Based on the studies evaluated, this area contains both regions of low sedimentation and areas of deposition and elevated carbon content. The thirteen stations sampled in seven studies from

1972 through 1984, generally reflect this sediment data. Samples taken in reportedly low depositional areas had organic carbon levels of less than 5%, and total organic carbon less than 2000 μg/g or 0.2% (GCA Corporation. 1982, Gilbert et al. 1972, White. 1972). Trace metals were generally in the moderate range compared with the rest of the Bay area (eg. copper up to 56 μg/g, zinc 80-100 μg/g). Organics, including chlordane, PCB s, and toxaphene were detected in this area in the 1982 GCA data for the "Waiver". (PCBs were found in a range from below detection to 1.1 mg/kg).

In the reported depositional area just north of Peddocks Island, samples show moderately high elevations for a number of measured trace metals and elevated organics relative to most Quincy Bay samples (copper up to 360 μg/g, Zn up to 200 μg/g, organic carbon, about 8%, TOC 23,000 μg/g or 2.3%). Specific organics, not widely measured in the bay, were measured in this area near Peddocks Island in a study for NOAA in 1984 by Battelle (Boehm et al. 1984). In addition to the high TOC levels, Battelle, 1984, found 2.5 ng/g or .0025 μg/g DDT, total PAH at 6 μg/g, total PCB's at 100 ng/g (.100 μg/g) and Coprostanol at 6.2 μg/g. This PCB level was within the range recorded in the 1982 "Waiver" study (GCA Corporation. 1982), although it was an order of magnitude lower than the 1.1 mg/kg (or 1.1 μg/g) upper end. However, it is higher than all but 2 stations reported in this Battelle study for Boston Harbor, Massachusetts Bay, and waters off Cape Cod.

The 1987 EPA data also support the historical data base for this area (Figure A-10). The two stations in reported low depositional areas (S-13, S-23) have trace metal concentrations in the lower range compared with the rest of the Quincy Bay samples. The two stations in reported depositional areas (S-12, S-22), have much higher levels of trace metals. The station off Peddocks Island has trace metal levels that are clearly elevated compared with samples from other parts of the Bay (Appendix A, Table A-VII). A core sample taken near Peddocks Island (SC-1) contained organic carbon levels (25,000 μg/g or 2.5%) similar to those found at S-22. This elevated level decreased below 8 inches in depth however.

Moon Island and Long Island (Appendix A, Table-III): Samples taken from the area near and offshore Moon and Long Islands most frequently contained the highest levels of organics and trace metals recorded in the studies reviewed. The one exception is the already noted 1983 EG&G sediment sample (Metcalf & Eddy. 1984) from the tip of Long Island (see above). For example, up to 11% organic carbon levels and up to 9.2% volatile organics were measured in sediments in several studies (Boehm et al. 1984, Gilbert et al. 1972, Isaac & Delany. 1972)

The 1984 Battelle study for NOAA (Boehm et al. 1984) found 330 ng/g PCBs in sediments off Moon Island, higher by a factor of at least three than levels found at any other location in Massachusetts Bay, Cape Cod, and all but one Boston Harbor station in their study. In that same study, 11.7 ng/g DDT, 6.5 μg/g PAH, and 1.2 μg/l coprostanol were found at the same location. The latter two values were low compared with some concentrations found elsewhere in the harbor (e.g. 880 μg/g PAH and 15.9 μg/l coprostanol found at a location near Deer Island flats). The 1984 "Waiver" sampling at a site off Moon Island found chlordane and DDE at less than 0.2 mg/kg, and toxaphene at less than 2.5 mg/kg (Metcalf & Eddy. 1984a). These toxaphene and chlordane levels are almost double those found in samples taken off Rainsford Island, although the reporting of these data is such that these differences may be due to changes in instrument detection limits. Similarly, trace metal levels tended to be higher at most stations in this area (Cu up to 360 μg/g, Zn up to 480 μg/g, and Hg >1 μg/g at all stations sampled), when compared with other locations within the same studies in Quincy Bay (see Appendix A).

The stations sampled for this study in 1987 by EPA reinforce the impression that levels of contamination are highest in this area of the bay. Four of the five stations sampled had the highest levels for many of the trace metals among all 23 locations examined. Stations S-8, located at the edge of the nearshore area, had more moderate elevations in trace metal concentrations. (See Table A-VII in Appendix A)

Area Around Nut Island Discharge (Appendix A, Table IV): In general, the results of samples from this area show levels of contamination in sediments that are moderate compared to samples from Quincy Bay as a whole. However, there is variability evident which could reflect either real differences in sediment quality (i.e. some stations are very near discharges, while others are well removed in distance) and/or intrinsic differences among methods used in the individual studies (sampling and analysis). Trace metals, with mercury the notable exception, are reportedly lower in this area than off Moon Head (e.g. copper up to 110 µg/g, zinc up to 320 µg/g, mercury 0.4-4.0 µg/g) (Appendix A, Table A-IV). Organic carbon levels were found in a range of 0.6% to over 11% in different studies and locations in this cell (Fitzgerald. 1980, ERCO. 1979). In one study pesticide levels were similar to those measured off Rainsford Island (GCA Corporation. 1982). Another study (ERCO. 1979) showed DDD and DDT apparently at twice the level observed off Moon Island, with other pesticides at similar levels.

Based on samples from four locations in this area, the 1987 EPA sampling suggests that this area is, with few exceptions, one of the less contaminated areas of the bay compared with other areas examined. (Appendix A, Tables A-IV and A-VII). The notable exception is the core sample, SC-2. Total organic carbon levels were reportedly 39,000 µg/g (or 3.9%) and remained nearly this elevated to a depth of nearly 12 inches. This location must represent an area of deposition. It is adjacent to the Moon Island area of higher contamination.

Hangman's Island/Mid-Bay (Appendix A, Table V): This area resembles the Nut Island discharge area in terms of sample variability. Single parameters in certain studies are found at levels as high or higher than the Moon Head area (Mencher, et al. 1968, Gilbert et al. 1972). Contaminant levels taken as a whole are moderately high compared to all reviewed data for Quincy Bay. For trace metals, up to 400 μg/g zinc, 270 μg/g copper, and mercury near or above 2 μg/g were recorded at all but one location (Gilbert et al. 1972). Most measures of organic carbon were also relatively high (1-11% organic carbon, 2.5-9% volatile organics). A larger number of organic pesticides were noted in sediments sampled in this area than from the Nut Island discharge area, but concentrations were generally similar (Metcalf & Eddy. 1984a).

Data from four stations in the 1987 EPA sampling program indicate that the area is very similar in the range of contaminant levels to that observed in this ongoing study for the Nut Island discharge area to the East. The trace metal levels observed were moderate for the bay as a whole (Appendix A, Table A-V and Table VII). The two core samples showed elevations of organic carbon. SC-4, near Hangman's Island, had high organic carbon levels for at least 12 inches. Organic carbon levels in SC-3 were somewhat lower and decreased faster with depth.

Nearshore Area (Appendix A, Table VI): This area can be distinguished from other areas inspite of the small number of studies represented (three studies [Gilbert et al. 1972, ERCO. 1979, White. 1972], six samples). Results from this area can be divided into two groups: those from nearshore areas in the northern corner of the Bay show some organic enrichment and somewhat elevated trace metal levels (Cu up to 110 µg/g, Zn up to 160 µg/g, Hg up to 3.7 µg/g, organic carbon 5%). More generally, however, samples from stations in the remaining majority of this cell have the lowest reported trace metal concentrations compared with other areas of Quincy Bay. There were no pesticide measurements reported for samples taken from this part of the Bay.

The 1987 EPA study samples also reflect this description. The two stations along the northwest shore (S-2, S-3) show definite elevations in trace metal parameters compared to samples from the rest of the bay. The other two more southern stations (S-8, S-9) have the lowest levels of trace metals reported for this survey (Appendix A, Table A-VI and Table VII).

3. Contamination Levels in Biota

Investigations of contamination of fish and shellfish in Quincy Bay, reviewed for this study, date back to 1966. Nonetheless, such data is patchy in its coverage of species, locations and chemicals. It is not of sufficient extent to analyze jointly with the previously discussed sedimentation/ sediment studies. With two exceptions, most studies in the historical data base were not designed for this purpose. Further, many of the studies looked at different organisms, analyzed different tissues, had somewhat different analytical techniques available, and thus require extreme caution in making comparisons among studies. The data summarized here can be found in Appendix B, Tables B-1 through B-6, with accompanying mapped locations.

The Massachusetts Division of Marine Fisheries (Jerome et al. 1966) examined pesticide residues in clam meats from 3 clamming beds along the western shore of Quincy Bay in 1964 (Table B-1). Levels of DDT and DDE were highest in samples from winter collections (0.046 ppm DDT, 0.27 ppm DDE, live body weight). The highest measured Heptachlor and Heptachlor Epoxide levels were below 0.01 ppm in all samples. A similar study of soft shell clams completed for Hingham Bay in 1973 (Iwanowitz et al. 1973, Table B-11) found DDT at levels up to 1.9 ppm (wet weight), DDD levels to 0.4 ppm, and DDE levels below 0.02 ppm. Heptachlor levels did reach 0.2 in one sample, otherwise levels were much lower. Results were similar for other chlorinated pesticides analyzed for Table B-11, in Appendix B also gives mud and water levels at a number of stations from which clams were removed.

A 1979 ERCO study of some priority pollutants in flounder and lobster for the 1979 Metropolitan District Commission "Waiver" report, (ERCO. 1979) illustrates the accumulation of contaminants in liver tissue in excess of concentrations found in edible tissue of the same organisms (see Appendix B, Table B-III). In summary, DDT was not detected in winter flounder at any Boston Harbor stations. PCB levels of 4-36 µg/g (dry weight) were found in liver tissue from fish caught off Nut Island. Levels of 5.7-15 µg/g were observed in "controls" taken off Nantasket Beach. The highest level (50 µg/g) was observed in fish from Dorchester Bay. PCBs did not exceed 1.55 µg/g in edible tissues from fish caught in President Roads and off Nantasket Beach. PCBs in lobster tissue from Dorchester bay did not exceed 0.16 ppm, and PCBs in samples from lobsters taken off Nut Island were below 0.1 ppm. All edible tissue analyzed contained below the FDA action limit of 2 ppm (wet weight) cited by the authors.

Trace metals were analyzed in liver tissue from flounder taken from various locations in Boston Harbor in this 1979 ERCO study (See Table B-3, in Appendix B). Trace metal levels were generally highest in fish livers taken from Dorchester Bay (mercury 0.04 ppm, cadmium 0.23 ppm, silver, 0.44, copper 12 ppm, lead 62 ppm), and these were the "fin eroded flounder". However, trace metal levels found in fish from the Nut Island area were higher in "normal" versus "fin-eroded" fish (mercury 0.5 ppm, silver 0.36 ppm, cadmium 0.07 ppm, copper 0.26 ppm, and lead 0.32 ppm). Only lead was higher from the fin eroded samples from Nut Island (0.69 ppm). It would be difficult to make a case for differences in uptake between fin eroded fish and normal fish based on this study. The edible tissue levels of trace metals, examined in a few samples, showed levels of trace metals well below those observed in liver tissue. The highest elevations observed were from President Roads collections (mercury 0.04 ppm, copper 2.6 ppm, lead 0.07 ppm), and none exceeded available FDA action.

This ERCO Study (1979) also examined trace metal concentrations in lobster tissue. The trace metal levels observed in these lobster samples were similar to concentrations found in fish liver tissue. Trace metals were similar to concentrations found in fish liver tissue. Trace metals levels in samples taken from the Nut Island area were among the lowest observed (copper, up to 9 ppm, silver 0.38 ppm, cadmium 0.01 ppm, lead, 0.05 ppm, and mercury 0.9 ppm). Samples from Dorchester Bay had the highest concentrations for most parameters measured, but the differences among samples were relatively small. The results of this study do suggest little difference in fish and lobster accumulation of PCBs at the study sites. Lobster accumulation of some trace metals (copper, silver and mercury) in edible tissue (not defined) appears to have been greater than that observed for edible portions of fish from approximately the same locations, but mercury concentrations were not above FDA action levels.

The Cat Cove Marine Lab of Massachusetts Department of Marine Fisheries examined trace metal levels in fish and lobster from a number of Boston Harbor locations in 1983 (Cat Cove Laboratories. 1987a). Cadmium, cobalt, chromium, copper and lead were not detected in any fish samples (Table B-IV, Appendix B). However, detection limits were high: 2 ppm, 5 ppm, 2 ppm, 2 ppm and 12 ppm wet weight respectively. A level of 92.8 ppm copper was found in a lobster from near Peddocks Island in that same sample zinc was 37 ppm and mercury 0.5 ppm. Mercury levels found in fish from around Boston Harbor did not exceed 0.6 ppm (found in a Quincy Bay bluefish). Nickel levels were at or below 1.5 ppm, and zinc levels in fish ranged from 7.4 ppm to 29 ppm. Although only one lobster was examined, the trace metal levels observed were higher than in fish from the same area.

Cat Cove Marine Labs have recorded PCB levels in fish, lobster, and soft shell clams from the Quincy Bay area since 1983 (Cat Cove Laboratories. 1987b). The 10 lobster analyzed from the Peddocks Island area had 4 ppm wet weight PCBs, as did a blue fish from Quincy Bay (see Table B-4 in Appendix B). Other fish analyzed had less than 0.5 ppm PCBs. 1984 and 1986 analyses of flounder found PCBs generally ranging from 0.1-1 ppm (wet weight). Levels of PCBs in flounder caught of Nut Island were slightly higher (0.34-1.3 ppm). PCBs in lobster caught off Long Island were 0.05 to 2.19 ppm, with a high degree of individual variability. Levels above 2 ppm, wet weight, exceed FDA action levels. Two soft shell clam samples contained 0.014 ppm PCBs. Lobster tissue levels of PCBs in these data appear higher on the whole than levels observed in fish. In more recent publication of these data (Schwartz. 1987) on PCBs in fish and shellfish from Quincy Bay and Boston Harbor (Schwartz. 1987), lobster had the highest average concentration of PCBs (1.17 ppm). These Cat Cove Marine Lab lobsters were analyzed with hepatopancreas. Concentrations of PCBs in samples from Quincy and Boston were similar.

A study conducted by Battelle Labs for the National Marine Fisheries Service (Boehm et al. 1984) examined sedimentation patterns, organic contamination in sediments, and sampled fish and shellfish for concentrations of some of the same organics at selected sediment sites. As shown in Tables B-5 and B-V.2 in Appendix B, PCB levels were 0.29 μg/g (wet weight) in crab tissue sampled from the Peddocks Island area. Fish tissue from samples from the same area had less than 0.1 μg/g PCBs. The levels for both crab and flounder from other non-Quincy Bay locations were similar. Levels from organisms taken from selected Massachusetts Bay sites and off Cape Cod were lower. The values found in this study are lower than levels observed in the above cited Massachusetts DMF studies. The crustacean (crab) contaminant levels were consistently, if slightly, higher than the winter flounder data from Boston Harbor samples. A similar pattern was observed for PCB levels in lobster and flounder (Schwartz. 1987).

Polycyclic aromatic hydrocarbons (PAH) were not detected in flounder examined from off Peddocks Island (see Table B-5, Appendix B). Levels of 1-3 ng/g of naphthalene, biphenyl fluorene and phenanthene were noted elsewhere in the harbor. Levels of PAHs in fish from the one Massachusetts Bay station were higher than in fish from the harbor. Total PAHs in crab were higher (457 ng/g) in individuals taken off Peddocks Island than other Boston Harbor locations (by about a factor of 4) and greater still than concentrations in crabs taken in Massachusetts

Bay or off Cape Cod (by factors of 7 to 60). Unfortunately, biological samples were not taken off Moon Head in Quincy Bay (Station BH-4), where sediment organic contaminant levels were the most elevated.

"Cage" experiments with *Mytilis edulis* (mussels), left for 34 days in 2 locations in Quincy Bay off the Nut Island discharges were conducted for the 1984 "Waiver" (Metcalf & Eddy. 1984b). Tissues from these organisms showed 0.24-0.59 ppm cadmium (wet weight), 0.64-0.7 ppm chromium, 2.9-3.4 ppm copper, 0.3 ppm mercury, and 2.1-2.4 ppm lead among other trace metals examined (see Appendix B, Table B-6). The metals noted above represented levels at or near double the levels found in mussels taken from a control location off Gloucester. PCBs from Quincy Bay samples were 0.5-0.7 ppm and methylene chloride up to 28 ppm.

In summary, these data do not as a whole present a consistent picture of biological contamination in Quincy Bay. This is due primarily to the relatively small number of samples from any given location and secondarily to differences in analytical techniques, and in tissues sampled. Data from individual studies do suggest that individual organisms captured can have high levels of certain contaminants (PCBs for example). The edible portions of crab and lobster do appear, from these data, to exhibit higher levels of organic contaminants than do the edible tissues from winter flounder, however, such elevated concentrations may be due to analyses of the edible tissue including the hepatopancreas. Comparable data for other species from these locations are too limited to use in drawing reliable conclusions.

C. A BOSTON HARBOR PERSPECTIVE

One finds limitations when comparing the Quincy Bay data for biological contamination with data for Boston Harbor or the New England coastal areas. These limitations are the same as those encountered when comparing only the Quincy Bay data from different studies and include: seasonal, spatial and methodological differences in the studies.

Capuzzo et al. (1986) evaluated the available data on chemical contamination in fish and shellfish from New England waters, recognizing the above limitations while assuming that results represent a basis for only a first order comparative approximation. Significance was attributed only to values that differed by factors of 5 or greater for all contaminants. They found that data for PCB levels, petroleum hydrocarbons and PAHs from several national surveys, taken together with data from localized studies, gave the best regional picture of trends in contaminant levels in fish and shellfish. PCBs were found consistently elevated (>0.01 ppm wet weight) in mussels (*Mytilus*) from coastal waters around Boston southwards to the Chesapeake. Samples taken from offshore areas had low but detectable levels of PCBs. New Bedford Harbor was an obvious "hot spot", with PCB levels 2 to 3 orders of magnitude higher than other coastal areas. Data on PCB levels in fish and crustaceans also showed elevations in samples from harbor areas and low levels in samples from offshore. A number of samples from Boston Harbor, summarized in this report (Capuzzo et al. 1986) were notable because PCB levels exceeded 1 ppm live weight. In fact, several samples of bluefish and lobster collected by Massachusetts DMF in Quincy Bay (See Appendix B), and flounder collected in Boston Harbor 1979 by Tetra Tech (Capuzzo et al. 1986) had PCB levels in excess of 2 ppm. This latter level represents the FDA action level for PCBs contamination in seafood. High PCB levels, in excess of 2 ppm, have been observed in a range of organisms from New Bedford, and in bluefish sampled from a number of areas along the east coast. (Capuzzo et al. 1986).

The data reviewed by Capuzzo et al. (1986) indicated that PAHs and petroleum hydrocarbons from nearshore organisms were higher than from organisms taken offshore. PAH levels in mussels were generally higher than levels observed in fish muscle tissue. Data from Boston Harbor showed higher concentrations than did the data from other New England Locations.

The "Mussel Watch" program (Farrington et al. 1982), is one national survey which contributed data to the review by Capuzzo et al. That program included one Boston Harbor station. Mussels were sampled from a rocky beach in the northwest corner of Deer Island from 1976-1978, as well as from three other Massachusetts locations (Cape Ann, Plymouth and Cape Cod Canal). The Deer Island station showed the effects of contaminants on elevated body burdens in *Mytilus* compared with mussels from the other Massachusetts coastal locations. Petroleum aeromatic hydrocarbons were as much as an order of magnitude higher in the Deer Island samples at 3.6 μg/g day weight. PCBs were 3 to 6 times higher in the Boston Harbor organisms (>0.6 μg/g dry weight) compared with the other Massachusetts locations. These levels are quite similar to PCB levels in caged mussels off the Nut Island outfall (see Appendix B, Table B-VII). Summer 1987 in situ bioaccumulation studies with *Mytilus* by MWRA include a Quincy Bay station. Heavy metal concentrations in mussels were also examined in the "mussel watch" study (Farrington et al. 1983). Samples from Boston Harbor and several other northeastern locations had noteworthy elevations in cadmium (>72 μg/g dry weight) and lead (>10 μg/g dry weight) compared with samples from other eastern coastal locations. These levels are higher than those observed in caged mussels off Nut Island by less than a factor of 5 (see Appendix B, Table B-VIII).

Boehm et al. (1984), documented that PCBs were elevated in Boston Harbor sediments, and especially Quincy Bay, compared with most studied areas of Massachusetts Bay (excluding the "foul area") and areas off Cape Cod. Moon Island off shore in Quincy Bay had the highest levels of sediment PCBs at 1200 μg/g. Sediment PAH concentrations in Boston Harbor were patchy (2.4 - 800 μg/g). The biological analyses found the highest levels of PCBs in crabs taken in Boston Harbor (>0.2 μg/g wet weight). However, none of the samples had PCB levels in excess of 1 μg/g, unlike the higher levels observed in some earlier surveys. Boehm et al. (1984) did not collect biological samples off Moon Head in Quincy Bay where sediment levels were highest. The PAH levels in crab were as much as two orders of magnitude higher than levels in flounder, and were higher in crab samples from Boston Harbor.

The National Status and Trends Program (NOAA. 1984a) also provides some limited perspective on Boston Harbor data relative to the east coast. Again, only one location has been studied in Boston Harbor (off Deer Island) and can only be considered representative of conditions at that location. Data from 1984 sediment sampling show that at that location Boston Harbor is one of 4 locations, out of 16 Northeast sites, where the highest average concentration of trace metals generally occurred. These levels at the Boston location included silver >6 μg/g, cadmium >200 μg/g and lead >120 μg/g (dry weight). There are a number of locations in Quincy Bay where samples collected in other studies have levels of one or more trace metals as high as these levels from Deer Island.

The first year of sampling in the status and trends program (NOAA. 1984b) also noted very high levels of petroleum aeromatic hydrocarbons (PAHs) in sediment at Deer Island flats (>26 μg/g dry weight) and total DDTs (>200 ppb, mostly DDE and DDD). These levels are higher than any observed in the data reviewed for Quincy Bay. The Deer Island site had the highest PCB levels observed in sediments (>17,000 ppb) (by a factor of 35 to 100 times greater) compared with other east coast harbor areas sampled. This level exceeds any observed in the data reviewed for Quincy Bay.

The Status and Trends Program (NOAA. 1984b) also examined winter flounder liver tissue burdens of the contaminants sampled in sediments. Boston Harbor flounder liver samples had PCB levels (ranging from 10 ppb to 487 ppb) three to more than ten times greater than other east coast sites examined in this study. DDT residues were also highest in liver from Boston Harbor flounder (827 ppb). There are no comparable Quincy Bay data available for comparison. Flounder liver concentrations of trace metals and PAHs are available for 1984 for this one sampling location (See Appendix B, NOAA. 1984a) but comparisons with other areas were not available in the referenced project report. Only the flounder liver trace metal data are comparable to a study from Boston Harbor. The data from the Status and Trends site off Deer Island and from the ERCO study (Appendix B-III) are roughly comparable for all similar parameters. This type of difference was cited by Capuzzo et al. (1986) as not necessarily significant of the differences among studies they reviewed. Levels of proliferative disorders (bilary hyperplasia, neoplasia) in fish taken from this Boston Harbor location ranged from 10-13% (Appendix B, Table B-VII).

D. SUMMARY AND DATA GAPS

In summary, the available historical data base for sediments in Quincy Bay illustrates that much of the western portions of the Bay as well as the perimeters of islands are depositional areas. Several studies also indicate high carbon content in sediments found in the areas of heaviest deposition.

While past studies of sediment chemical contamination were not necessarily designed to illustrate relationships with the sediment deposition pattern of the Bay, it is not surprising that the historical data base provides some support for suggesting that depositional areas in Quincy Bay contain higher levels of contamination. The areas off Moon Head and Long Island (Figure 6) and in the Mid-Bay contain sediments that generally have the highest levels of reported contamination (except the sample taken adjacent to the sludge outfall). Areas of deposition around other Bay islands (Peddocks, Rainsford) show sediment contamination as well. Much of the western shoreline (except the northern corner) contains the lowest levels of contamination of Quincy Bay sediments. While some studies suggest that this shore area is also one of high sedimentation, it is also the farthest removed from the various wastewater related discharges.

The historical data on contaminant residues in fish provide a basis for comparing the results with ongoing residue sampling and analyses in this study. At this point the historical data do not provide a consistently coherent picture of the level of fisheries contamination in the Bay. The degree of variability in analytical results across studies is doubtless due in part to the very small sample size, lack of replicate sampling at various

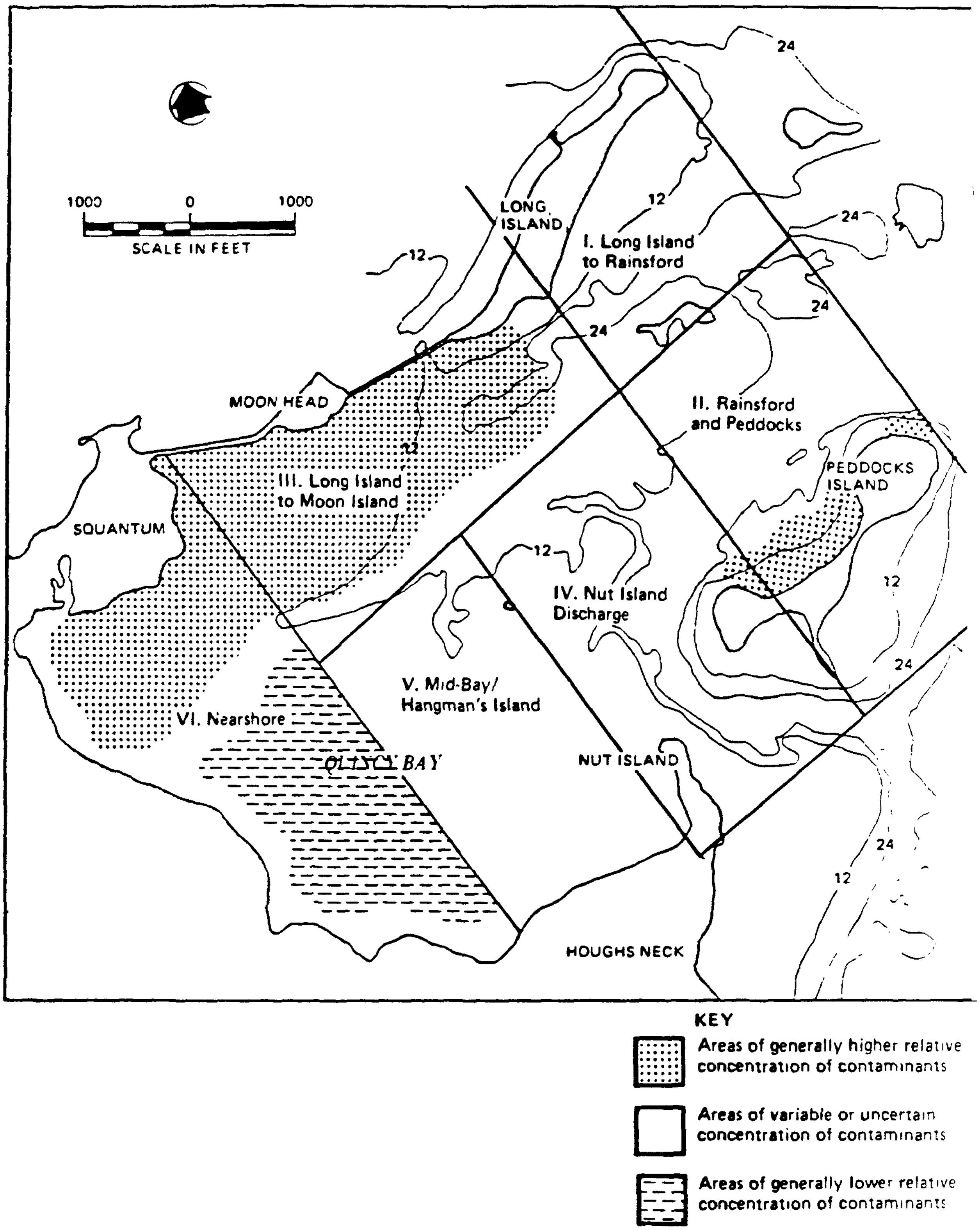


FIGURE 6. GENERALIZED PATTERNS OF SEDIMENT CONTAMINATION DATA FOR QUINCY BAY

locations, and varying analytical techniques. The historical data appear to be insufficient to provide any clear indication of the extent of the effects of contamination in Quincy Bay on the fishery. For example, data on biological contaminant levels are not available from the contaminated sediment area off Moon Island. There is a paucity of data available on biological contamination of organisms from the area corresponding to the Mid-Bay/Hangman's Island region. These areas contain the higher levels of sediment contamination, but corresponding biological sampling results are not available in the historical data base. The data that are available from organisms collected off Peddocks Island when compared with collections made in Massachusetts Bay, off Cape Cod, and off Gloucester, do suggest that there is correspondence between areas with higher sediment contaminant levels and contaminant levels in biota, especially crustacean shellfish.

Some of the studies do raise questions concerning contamination in Bay sediments. The study by Boehm, Steinhauer and Brown (Boehm et al. 1984) evaluated coprostanol, considered a sewage tracer, and its relationship with PCB levels. According to this report, coprostanol/PCB ratios have been used to relate the presence of PCBs with sewage related material, with values ranging from 0 (no sewage), to 100-200 (very high relationship). The coprostanol/PCB ratio for the area off Moon Island was 4. This would seem to indicate a low correspondence between sewage related material and the noted high PCB level (and also a high level of total organic carbon). The coprostanol/PCB ratio for sediments in the area sampled off Peddocks Island was 23, and accordingly, a higher degree of correspondence between PCBs and sewage material was suggested.

The results of this study (Boehm et al. 1984) raise the question of how these two areas of Quincy Bay differ. There are sewage related discharges in 3 separate locations that could directly influence Quincy Bay. The Nut Island wastewater treatment plant has 4 discharges located in waters to the north of Nut Island. Sewage sludge from Nut Island, however, is discharged off the northern end of Long Island, in the vicinity of President Roads. The Moon Island relief outlet discharges off the end of Moon Island. It is reportedly operated 40-60 times a year when hydraulic relief is required for the interceptor systems for the Deer Island Wastewater Treatment Plant (CDM Inc. 1985).

Drougue tracking studies by Camp Dresser and McKee Inc. in 1984, designed to examine movement of effluent plumes from the Nut Island and Moon Island discharges, indicate that while surface water flows may carry most of the effluent away from the western shores of Quincy Bay, portions of the northern and southern edges of the study area are within the surface path of effluent transport (Figure 7). The results also indicate that a potentially significant amount of the wastewater from Moon Island is carried between Moon and Long Islands and along Long Island.

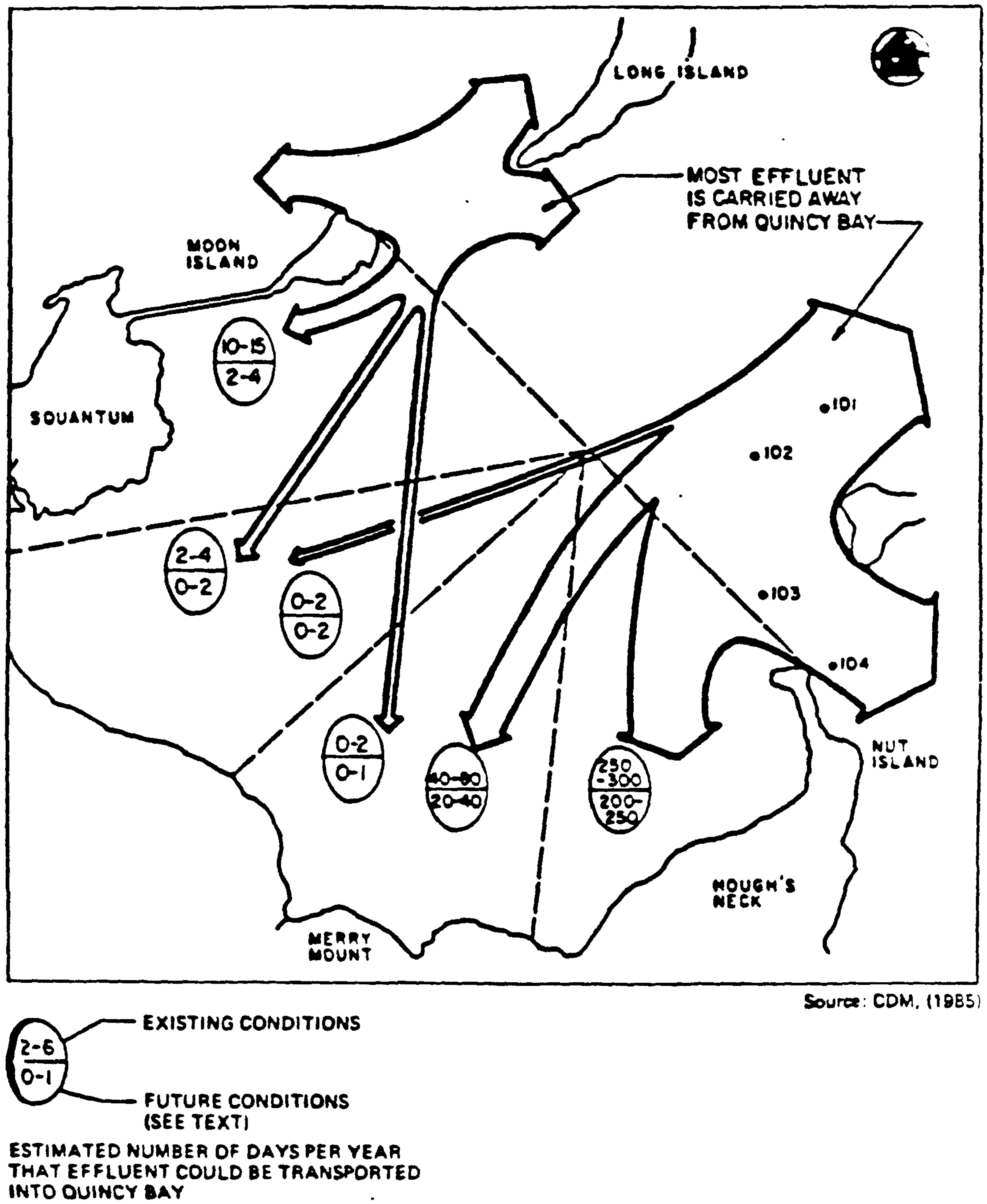


FIGURE 7. ESTIMATED EFFLUENT PLUME TRANSPORT PATHWAYS

A small proportion is reportedly carried along the Moon Island/Squantum shore. Similarly, a potentially significant proportion of the Nut Island discharge reportedly travels across both the Mid-Bay area and past Peddocks Island. It is reasonable to hypothesize that some of the material originating in these discharges, at least initially, settles out in the depositional areas in their path in Quincy Bay.

Several questions remain, however. Differences in water quality from the Nut Island effluent and Moon Island relief may explain the differences in the relationships among organic contaminants described by Boehm et al. (1984). Other possible sources of contamination requires documentation. Further examination of water/sediment exchange between Quincy Bay and adjacent water bodies is also required to better identify other possible sources of contaminated sediments in the Bay's depositional areas.

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APPENDIX A

SEDIMENT DATA

Conversions for Units Used in Tables

ug/kg =ng/g =ppb

mg/kg =ug/g =ppm

SUMMARY OF QUINCY BAY SEDIMENT DATA

STUDY	STUDY AREA (1)	FIGURE	SAMPLE DEPTH	STATION	METALS (ppm) (2) Ag	As	Be	Cd	Co	Cr	Cu	Fe	Hg	Mg	Mn	Ni	Pb	Sb	Se	Th	V	Zn	MISCELLANEOUS (ppm) (2) BIS(2-ETHYLHEXYL) PHTHALATE	CHLORDANE	COPROSTANOL	(4,4'DDE) 4,4 DDD	(DDT) 4,4 DDT	a-BHC	ENDRIN	HEPTACHLOR	METHYLENE CHLORIDE	TOC (%OC)	%VOC (%VS)	PAH	PCB	TOXAPHENE	FECAL COLIFORM	SPORES OF CLOSTRIDIUM PERFRINGENS
	LI/R	A-1	0cm	01-3				7.9	10	167	360		0.1	0.5		40	112				48	200										(3.01)						
	LI/R	A-1	10cm	01-3				1.4	13	21	28			2.1		20	16				14	44																
	R&P	A-1	0cm	01-1				7.9	10	167	360		2.3	0.5		40	112				48	200										(7.92)						
	R&P	A-1	10cm	01-1				1.4	13	21	28		0.1	2.1		20	16				14	44										(3.01)						
6	R&P	A-1	0cm	01-4				2.1	6	108	48		0.4	1.9		18	87				37	107										(3.90)						
I	R&P	A-1	10cm	01-4				1.00	8	28	9		0.03	4.6		21	11				26	51										(1.76)						
L	MI/LI	A-1	0cm	QB-1				11.2	37	422	363		3.9	4.9		57	256				48	455										(11.68)						
B	MI/LI	A-1	10cm	QB-1				2.9	7	30	25		0.1	7.3		31	50				8	57										(5.71)						
E	MI/LI	A-1	0cm	01-2						31	39		2.0	10.2		25	82				31	168										(7.17)						
R	MI/LI	A-1	10cm	01-2																																		
T	NIDA	A-1	0cm	QB-5				2.9	18	57	35		0.8	7.3		22	56				50	108										(4.47)						
	NIDA	A-1	10cm	QB-5																																		
I	NIDA	A-1	0cm	HB-5				2.2	9	88	33		1.0	3.9		18	59				45	81										(4.53)						
9	NIDA	A-1	10cm	HB-5																																		
7	MB/HIA	A-1	0cm	QB-3				2.7	24	312	212		3.5	8.0		51	241				100	312										(11.23)						
2	MB/HIA	A-1	10cm	QB-3																																		
	MB/HIA	A-1	0cm	QB-4				1.0	1.0	254	57		0.9	4.0		28	72				42	112										(3.55)						
	MB/HIA	A-1	10cm	QB-4				1.9	8	24	16		0.3	9.2		17	20				24	49										(3.91)						
	NA	A-1	0cm	QB-2				2.4	0.2	4	48		1.1	4.8		19	20				51	130										(5.07)						
	NA	A-1	10cm	QB-2				0.6	6	33	4		0.03	8.3		22	18				39	64										(3.89)						
I	LI/RA	A-2	0-2"	9		2.4*		1.0*		69*	44*		0.08*			23*	55*					97*											(4.0)*					
S	LI/RA	A-2	2-6"	9		1.4*		0.9*		26*	29*		0.2*			35*	22*					87*											(3.6)*					
A	LI/RA	A-2	6-11"	9		1.2*		0.9*		42*	34*		0.1*			41*	18*					86*											(3.6)*					
A	MI/LI	A-2	0-3"	2		6*		2.6*		170*	120*		2.32*			28*	180*					190*											(9.2)*					
C	MI/LI	A-2	3-7"	2		5*		2.4*		170*	100*		2.69*			27*	190*					180*											(9.2)*					
&	MI/LI	A-2	7-10"	2		4*		1.4*		90*	100*		3.6*			26*	220*					210*											(8.3)*					
D	MI/LI	A-2	10-12	2		2.6*		0.4*		54*	49*		1.9*			14*	77*					78*											(5.6)*					
E																																						
L																																						
A																																						
N																																						
E																																						
Y																																						
1																																						
9																																						
7																																						
2																																						

SUMMARY OF QUINCY BAY SEDIMENT DATA

STUDY	STUDY AREA (1)	FIGURE	SAMPLE DEPTH	STATION	METALS (ppm) (2) Ag	As	Be	Cd	Co	Cr	Cu	Fe	Hg	Mg	Mn	Ni	Pb	Sb	Se	Th	V	Zn
	LI/RA	A-3		93				1.2		129	55		0.9			20	93					92
	R&P	A-3		94				1.6		173	75		1.4			21	113					134
W	R&P	A-3		102				1.6		208	94		1.0			29	137					162
H	R&P	A-3		103				0.5		69	34		0.2			17	57					74
I	R&P	A-3		107				0.4		40	25		0.7			10.6	47					125
T	MI/LI	A-3		90				2.9		124	122		3.0			30.6	314					354
E	MI/LI	A-3		91				2.0		272	146		2.4			28	164					156
	MI/LI	A-3		92				0.8		272	113		1.8			32	180					154
1	NIDA	A-3		105				1.1		119	79.2		1.3			26.6	102					269
9	NIDA	A-3		106				1.2		138	85		1.8			27.5	110					293
7	NA	A-3		97				2.8		125	92.5		5.4			30	125					160
2	NA	A-3		98				1.8		50	36.5		4			15	50					82.5
	NA	A-3		99				2		62.5	45		4.5			22.5	62.5					82.5
	NA	A-3		100				1.8		42	31.2		2			12.5	50					65
	NA	A-3		101				1.5		25	20		16			10	37.5					45
M																						
&	LI/RA	A-4		19																		
E	LI/RA	A-4		22	3.8@			1@		0.054x	0.034x		4.7@				0.07x					0.107x
	LI/RA	A-4		26																		
W	LI/RA	A-4		28	3.6@			1.3@		0.018x	0.038x		1.3@				0.056x					0.098x
A	MI/LI	A-4		21	14.3@			3@		0.302x	0.192x		9.4@				0.234x					0.242x
I	NIDA	A-4		25	3.1@			1.3@		0.068x	0.046x		1.7@				0.065x					0.085x
V	NIDA	A-4		30	6.8@			2.5@		0.081x	0.061x		6.0@				0.074x					0.143x
E	MB/HIA	A-4		27									.									
R	MB/HIA	A-4		29	9.2@			2.16@		0.113x	0.087x		4.35@				0.125x					0.171x
	NA	A-4		24	7.0@			1.8@		0.07x	0.057x		3.7@				0.059x					0.105x
1																						
9																						
7																						
9																						
F																						
I	LI/RI	A-5		6-8																		
T	R&P	A-5		6-9																		
Z	R&P	A-5		6-19																		
G	R&P	A-5		6-21																		
E	NIDA	A-5		6-10																		
R	NIDA	A-5		6-17																		
A	MB/HIA	A-5		6-16																		
L																						
D																						

STUDY	STUDY AREA (1)	STATION	MISCELLANEOUS (ppm) (2) BIS(2-ETHYL-HEXYL) PHTHALATE	CHLORDANE	COPROSTANOL	(4,4'DDE) 4,4 DDD	(DDT) 4,4 DDT	@-BHC	ENDRIN	HEPTACHLOR	METHYLENE CHLORIDE	TOC (%OC)	%VOC (%VS)	PAH	PCB	TOXAPHENE	FECAL COLIFORM	SPORES OF CLOSTRIDIUM	PERFRINGENS
	LI/RA	93											3.7						
	R&P	94											3.6						
W	R&P	102											9.4						
H	R&P	103											3.6						
I	R&P	107											2.3						
T	MI/LI	90											7.0						
E	MI/LI	91											9.7						
	MI/LI	92											7.7						
1	NIDA	105											6.3						
9	NIDA	106																	
7	NA	97											6.5						
2	NA	98											3.7						
	NA	99											4.5						
	NA	100											2.9						
	NA	101											2.5						
M																			
&	LI/RA	19										(7.2)							
E	LI/RA	22						8@				(5.6)			129@				
	LI/RA	26										(8.0)							
W	LI/RA	28										(6.6)							
A	MI/LI	21										(8.3)							
I	NIDA	25						1@				(6.8)			72@				
V	NIDA	30										(11.7)							
E	MB/HIA	27										(4.8)							
R	MB/HIA	29										(3.8)							
	NA	24										(4.3)							
1																			
9																			
7																			
9																			
F																			
I	LI/RI	6-8										(3.0)							
T	R&P	6-9										(2.3)							
Z	R&P	6-19										(2.9)							
G	R&P	6-21										(0.9)							
E	NIDA	6-10										(3.3)							
R	NIDA	6-17										(0.6)							
A	MB/HIA	6-16										(2.0)							
L																			
D																			

SUMMARY OF QUINCY BAY SEDIMENT DATA

STUDY	SAMPLE AREA (1)	FIGURE	SAMPLE DEPTH	STATION	Ag	As	Be	Cd	Co	Cr	Cu	Fe	Hg	Mg	Mn	Ni	Pb	Sb	Se	Th	V	Zn	BIS(2-ETHYL-HEXYL) PHTHALATE	CHLORDANE	COPROSTANOL	(4,4 DDE) 4,4 DDD	(DDT) 4,4 DDT	@-BHC	ENDRIN	HEPTACHLOR	METHYLENE CHLORIDE	TOC (%OC)	%VOC (%VS)	PAH	PCB	TOXAPHENE	FECAL COLIFORM	SPORES OF CLOSTRIDIUM	PERFRINGENS
M&E WAIVER 1982	LI/RA	A-6			<2@	6@	7.4@	0.2@		35.7@	21@		0.92@			14.9@	<2@	<2@	<0.1@	<3.4@		82.4@		<0.16*							not>600$	1937@	4.25		ND- 1.1*	<1.6*			
	NIDA	A-6		NIB	<2@	<3@	5@	0.3@		52.9@	40.9@		0.46@			10.4@	<2@	<2@	<0.1@	<3.4@		94@	ND-17@	<0.16*							not>600$	2047@	5.97			<1.6*			
	NIDA	A-6		NIC	<2@	<3@	4.3@	0.1@		23.4@	15@		0.59@			7.3@	<2@	<2@	<0.1@	<3.4@		53.7@		<0.16*							not>600$	1120@	2.4		ND- 1.1*	<1.6*			
M&E 1983 E6&6	LI/RA	A-7		16				11@		470@	650@		5.2@				500@					1000@															770'	180'	85,000'
	MI/LI	A-7		18				0.04@		250@	210@		2.9@				260@					270@															30'	10'	23,000'
	MB/HIA	A-7		19				2.6@		320@	270@		3.1@				300@					340@											9@				50'	30'	10 000'
	MB/HIA	A-7		28		70@		5.2@		160@	210@		2.8@			52@	260@				150@	470@											7@		1.4@				14,900'
M&E WAIVER 1984	LI/RA	A-8		10	<0.1@	<3@	4.83@	0.1@		25.1@	7.3@		<0.12@			11.4@	<11@	<2@	<0.5@	<4@		44.1@		ND-<0.25*								6700@	(1.2)			ND-<2.5*			
	MI/LI	A-8		18	0.3@	2.2@	8.94@	1.1@		20.3@	126@		1.45@			24.8@	142@	<3@	<0.8@	<6@		177@		ND-<0.25*		(ND-<0.2)*						6900@	(2.5)			ND-<2.5*			
	NIDA	A-8		20	<0.3@	<9@	6.56@	0.6@		158@	79.1@		0.77@			22.6@	147@	<6@	<1.5@	<12@		112@				ND-<0.55*	ND-<0.59*		ND-<0.24*			4100@	5.9						
	NIDA	A-8		21	<0 1@	<3@	5.81@	0.6@		71.8@	42.9@		0.48@			23@	87@	<2@	<5@	<4@		109@		ND-<0.25*		ND-<0.55*	ND-<0.59*		ND-<0.24*			8000@	4.0			ND-<2.5*			
	MB/HIA	A 8		18	0.3@	2.2@	8.94@	1.1@		20.3@	126@		1.45@			24.8@	142@	<3@	<0.8@	<6@		177@		ND-<0.25*		ND-<0.55*	ND-<0.59*		ND-<0.24*			6900@	2.5			ND-<2.5*			
	MB/HIA	A 8		19	<0.3@	9.7@	6 32@	0.6@		186@	115@		1 58@			26.8@	226@	<6@	<1.6@	<12.9@		173@		ND-<0.25*		(ND-<0.2) ND-<0.55*	ND-<0.59*	ND-0.12	ND-<0.24*	ND-0.1*		5900@	8.4			ND-<2.5*			

METALS (ppm) (2); MISCELLANEOUS (ppm) (2)

SUMMARY OF QUINCY BAY SEDIMENT DATA

METALS (ppm) (2)

STUDY	STUDY AREA (1)	FIGURE	SAMPLE DEPTH	STATION	Ag	As	Be	Cd	Co	Cr	Cu	Fe	Hg	Mg	Mn	Ni	Pb	Sb	Se	Th	V	Zn
N																						
O	R&P	A-9		BH-5																		
A	MI/LI	A-9		BH-4																		
A																						
/																						
N																						
M																						
F																						
S																						
1																						
9																						
8																						
4																						
	LI/RA	A-10		S-7				0.560		68.20	57.40	107770			145.80	12.90	48.70					87.70
	R&P	A-10		S-12				0.440		99.80	71.80	136610			176.80	15.42	73.20					107.30
	R&P	A-10		S-13				0.20		41.60	28.90	8002.90			112.90	86.70	33.340					53.20
	R&P	A-10		S-22				0.710		1160	84.80	151870			190.80	18.20	79.60					116.90
			DUP	S-22				0.880		171.30	1010	241550			2950	25.80	105.70					160.80
			DUP	S-22				1.210		144.30	1000	183710			221.60	21.80	101.30					147.20
	R&P	A-10		S-23				0.470		45.80	42.70	109500			137.20	11.80	39.70					800
Q	R&P	A-10	0-2"	SC-1																		
U	R&P	A-10	2-4"	SC-1																		
I	R&P	A-10	4-8"	SC-1																		
N	R&P	A-10	8-12"	SC-1																		
C	MI/LI	A-10		S-1				1.30		69.20	1230	131560			155.10	15.90	164.50					2450
Y	MI/LI	A-10		S-4				1.060		166.50	1340	178720			224.70	22.60	117.80					176.30
			DUP	S-4				0.850		173.70	1270	177480			212.30	21.90	125.10					167.30
B			DUP	S-4				0.870		180.60	1310	184070			219.20	22.90	129.10					173.90
A	MI/LI	A-10		S-5				0.720		215.90	1360	196020			235.80	24.60	146.50					182.30
Y	MI/LI	A-10		S-6				1.30		1620	1420	205890			263.20	24.80	107.90					1850
	MI/LI	A-10		S-8				0.720		83.60	75.20	139000			154.80	14.70	69.20					119.40
1	MI/LI	A-10		S-11				0.970		1570	1150	194050			244.90	22.70	112.20					168.90
9	NIDA	A-10	S	C-1				1.620		88.20	1340	159910			1920	18.20	94.70					2070
8	NIDA	A-10	0-2"	C-1				1.680		73.30	3160	121080			1410	17.30	1470					2730
7	NIDA	A-10	2 4"	C-1				1.250		38.90	1210	83070			1100	9.90	1500					2220
	NIDA	A-10	S	C-2				0.480		48.30	410	127550			4570	13.60	33.20					86.20
	NIDA	A 10	S	C-3				0.570		28.30	290	8144.60			1040	9.150	33.30					66.80
	NIDA	A-10	0 2"	C-3				0.810		45.80	450	97680			1190	110	470					83.20
	NIDA	A-10	2-4"	C-3				1 60		73.50	710	127980			1570	14.90	710					113.60
	NIDA	A-10	4 8"	C-3				0 960		41.70	500	115010			1360	12.60	74.20					105.60
	NIDA	A-10	8 12"	C-3				0 870		46.90	710	158870			1710	16.10	1370					176.60
	NIDA	A-10	S	C-4				0.380		29.60	240	104620			2180	10.80	23 40					55.70
	NIDA	A 10	[illegible]	C 4				0 670		56 80	510	1[illegible]080			2000	14.10	43.80					840
	NIDA	A 10	[illegible]	C-4				[illegible]		62 50	570	1[illegible]050			2540	16.40	46.60					93 30

MISCELLANEOUS (ppm) (2)

STUDY	STUDY AREA (1)	FIGURE	SAMPLE DEPTH	STATION	BIS(2-ETHYL-HEXYL) PHTHALATE	CHLORDANE	COPROSTANOL	(4,4'DDE) 4,4 DDD	(DDT) 4,4 DDT	a-BHC	ENDRIN	HEPTACHLOR	METHYLENE CHLORIDE	TOC (%OL)	%VOC (%VS)	PAH	PCB	TOXAPHENE	FECAL COLIFORM	SPORES OF CLOSTRIDIUM PERFRINGENS
N																				
O	R&P	A-9		BH-5			6.20		(2.5)					23.5x		6.00	100			
A	MI/LI	A-9		BH-4			1.20							41.5x		6.50	330			
A																				
/																				
N																				
M																				
F																				
S																				
1																				
9																				
8																				
4																				
	LI/RA	A-10		S-7										117000						
	R&P	A-10		S-12										215000						
	R&P	A-10		S-13										81800						
	R&P	A-10		S-22										151000						
			DUP	S-22										330000						
			DUP	S-22										258000						
	R&P	A-10		S-23										91600						
Q	R&P	A-10	0-2"	SC-1										260000						
U	R&P	A-10	2-4"	SC-1										250000						
I	R&P	A-10	4-8"	SC-1										200000						
N	R&P	A-10	8-12"	SC-1										110000						
C	MI/LI	A-10		S-1										479000						
Y	MI/LI	A-10		S-4										315000						
			DUP	S-4										327000						
B			DUP	S-4										319000						
A	MI/LI	A-10		S-5										272000						
Y	MI/LI	A-10		S-6										429000						
	MI/LI	A-10		S-8										125000						
1	MI/LI	A-10		S-11										312000						
9	NIDA	A-10	S	C-1										208000						
8	NIDA	A-10	0-2"	C-1										146000						
7	NIDA	A-10	2 4"	C-1										69400						
	NIDA	A-10	S	C-2										57200						
	NIDA	A 10	S	C-3										81500						
	NIDA	A-10	0 2"	C-3										55300						
	NIDA	A-10	2-4"	C-3										174000						
	NIDA	A-10	4 8"	C-3										123000						
	NIDA	A-10	8 12"	C-3										310000						
	NIDA	A-10	S	C-4										82300						
	NIDA	A 10	[illegible]	C 4										1[illegible]8000						
	NIDA	A 10	[illegible]	C-4										72400						

SUMMARY OF QUINCY BAY SEDIMENT DATA

METALS (ppm) (2)

	Study Area (1)	Figure	Sample Depth	Station	Ag	As	Be	Cd	Co	Cr	Cu	Fe	Hg	Mg	Mn	Ni	Pb	Sb	Se	Th	V	Zn
	NIDA	A-10	0-2"	SC-2																		
	NIDA	A-10	2-4"	SC-2																		
	NIDA	A-10	4-8"	SC-2																		
	NIDA	A-10	8-12"	SC-2																		
	NIDA	A-10	12+"	SC-2																		
Q	NIDA	A-10	4-8"	C-4				0.54@		39.4@	38@	17703@			308@	21.5@	20@					75.7@
U	NIDA	A-10		S-17				0.26@		50.6@	44@	8636@			119@	10@	46.9@					67.1@
I	NIDA	A-10		S-18				0.28@		16.7@	20@	7803@			106@	7.6@	45.8@					38.8@
N	NIDA	A-10		S-20				0.60@		61.4@	60@	13186@			169@	14.6@	45.1@					90.9@
C	NIDA	A-10		S-21				0.43@		31.2@	35@	9213@			119@	9.63@	27.3@					54.9@
Y	MB/HIAA-10			S-14				0 61@		64.9@	61@	10693@			126@	12.2@	55.9@					98.4@
			DUP	S-14				0.54@		49.5@	49@	8931@			105@	10.1@	44.6@					83.3@
B			DUP	S-14				0.43@		37.9@	38@	7619@			92@	8.49@	36.19@					71.6@
A	MB/HIAA-10			S-15				0.53@		53.3@	52@	9761@			117@	10.9@	50.5@					99.1@
Y	MB/HIAA-10			S-16				0.29@		33@	40@	6412@			73@	7.84@	29.8@					61.8@
	MB/HIAA-10			S-19				0.95@		84.7@	86@	14668@			167@	16.7@	69.9@					120.6@
C	MB/HIAA-10		0-2"	SC-3																		
O	MB/HIAA-10		2-4"	SC-3																		
N	MB/HIAA-10		4-8"	SC-3																		
T	MB/HIAA-10		8-12"	SC-3																		
I	MB/HIAA-10		12+"	SC-3																		
N	MB/HIAA-10		0-2"	SC-4																		
U	MB/HIAA-10		2-4"	SC-4																		
E	MB/HIAA-10		4-8"	SC-4																		
D	MB/HIAA-10		8-12"	SC-4																		
	NA	A-10		S-2				0.95@		118@	106@	16000@			184@	18.2@	93.2@					146@
	NA	A-10		S-3				1.03@		103@	98@	14478@			171@	17@	97.5@					144.6@
	NA	A-10		S-9				0.20@		6.42@	6.9@	4312@			66@	4.3@	9.61@					24.5@
	NA	A-10		S-10				0.10@		5.65@	8.3@	4916	•		69.4@	4.4@	6.69@					19.6@

MISCELLANEOUS (ppm) (2)

Station	BIS(2-ETHYL-HEXYL) PHTHAL-ATE	CHLOR-DANE	COPROS-TANOL	(4,4 DDE) 4,4'DDD	(DDT) 4,4 DDT	@-BHC	ENDRIN	HEPTA-CHLOR	METHYL-ENE CHLORIDE	TOC (%OC)	%VOC (%VS)	PAH	PCB	TOXA-PHENE	FECAL COLI-FORM	SPORES OF CLOS-TRIDIUM	PERI-FRINGENS
NIDA A-10 0-2" SC-2										39000@							
NIDA A-10 2-4" SC-2										41000@							
NIDA A-10 4-8" SC-2										38000@							
NIDA A-10 8-12" SC-2										33000@							
NIDA A-10 12+" SC-2										22000@							
NIDA A-10 4-8" C-4										4890@							
NIDA A-10 S-17										12800@							
NIDA A-10 S-18										1920@							
NIDA A-10 S-20										17200@							
NIDA A-10 S-21										8670@							
MB/HIAA-10 S-14										11800@							
DUP S-14										13000@							
DUP S-14										8750@							
MB/HIAA-10 S-15										14700@							
MB/HIAA-10 S-16										30200@							
MB/HIAA-10 S-19										15300@							
MB/HIAA-10 0-2" SC-3										25000@							
MB/HIAA-10 2-4" SC-3										24000@							
MB/HIAA-10 4-8" SC-3										10000@							
MB/HIAA-10 8-12" SC-3										12000@							
MB/HIAA-10 12+" SC-3										17000@							
MB/HIAA-10 0-2" SC-4										36000@							
MB/HIAA-10 2-4" SC-4										43000@							
MB/HIAA-10 4-8" SC-4										31000@							
MB/HIAA-10 8-12" SC-4										29000@							
NA A-10 S-2										21100@							
NA A-10 S-3										21700@							
NA A-10 S-9										2060@							
NA A-10 S-10										832@							

FOOTNOTES

1. LI/RA = Long Island/Rainsford Area
   R&P = Rainsford and Peddock
   MI/LI = Moon Island/Long Island
   NIDA = Nut Island Discharge Area
   MB/HIA = Mid-Bay/Hangman Island Area
   NA = Nearshore Area

2. * = mg/kg
   x = mg/g
   @ = ug/g
   # = ng/g
   $ = ug/kg
   ' = counts/gm

TABLE A-1

LONG ISLAND/RAINSFORD AREA

NEA, Gilbert, et al, 1972 (See Figure A-1)
station 01-3, ppm

depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
0	200	360	112	10	7.9	40	167	48	0.5
10	44	28	16	13	1.4	20	21	14	2.1

	Hg	%org
0	0.1	3.01

Isaac and Delany, 1972 (Ma. DWPC) (See Figure A-2)
Sample 9
mg/kg (dry WT) for material passing through a #30 seive

Depth test	0-2"	2"-6"	6"-11"
Hg	0.80	0.20	0.10
Cd	1.0	0.9	0.9
Pb	55.0	22.0	18.0
Zn	97.0	87.0	86.0
Ni	23.0	35.0	41.0
Cu	44.0	29.0	34.0
Cr	69.0	26.0	42.0
As	2.4	1.4	1.2
%Vol. Solids	4.0	3.6	3.6

White, 1972 (See Figure A-3)
STATION 93, ppm ...

	%VOl	Cd	Cr	Cu	Hg	Ni	Pb	Zn
93	3.7	1.2	129	55	0.9	20	93	92

M&E 1979 Waiver Study Sediment samples (See Figure A-4)
New England Aquarium
Station 19.......7.2% organic carbon

Fitzgerald, 1980 (See Figure A-5)
Station G-9............2.3% organic Carbon

M&E 1982 Waiver Study Sediment Samples (Figure A-5)
No stations in this area

M&E 1983 EG&G Sediment Sample (See Figure A-6)
Station 16, μg/g (dry Wt)

% vol	Cu	Cr	Pb	Zn	As	Cd	Hg	Ni	V	PCB
12	650	470	500	1000	--	11	5.2	--	--	--

Station 16, counts/gm ww(sediment)

fecal coliform	spores of clostridium coliform	perfringens
770	180	85,000

M&E 1984 Waiver Study Sediment Samples (See Figure A-8)
Station 10, μg/g (dry wt)

% vol	% <74μ	TOC	Sb	As	Be	Cd	Cr	Cu	Pb	Ni
1.2	5	6700	<2	<3	4.83	0.1	25.1	7.3	<11	11.4

Se	Ag	Th	Zn	Hg
<0.5	<0.1	<4	44.1	<0.12

(mg/kg)
Chlordane ND-<0.25
Toxaphene ND-<2.5

EPA Sediment Data --Quincy Bay Study, 1987 (see Figure A-10)
Station S-7, μg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC
S-7	68.24	57.43	87.67	0.56	48.65	12.92	145.78	10777	11,700

TABLE A-11

RAINSFORD AND PEDDOCKS

NEA, Gilbert, et al, 1972 (see Figure A-1)
stations 01-4, 01-1, ppm

	depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
01-4										
	0cm	107	48	87	6	2.1	18	108	37	1.9
	10	51	9	11	8	1.0	21	28	26	4.6
01-1										
	0	200	360	112	10	7.9	40	167	48	0.5
	10	44	28	16	13	1.4	20	21	14	2.1

	depth	Hg	%org
01-4			
	0	0.4	3.90
	10	0.03	1.76
01-1			
	0	2.3	7.92
	10	0.1	3.01

Isaac and Delany, 1972 (Ma. DWPC) (See Figure A-2)
No stations at this location

White, 1972 (See Figure A-3)
stations 94, 102, 103, 107, ppm....

Sta	%Vol	Cd	Cr	Cu	Hg	Ni	Pb	Zn
94	3.6	1.6	173	75	1.4	21	113	134
102	9.4	1.6	208	94	1.0	29	137	162
103	3.6	0.5	69	34	0.2	17	57	74
107	2.3	0.4	40	25	0.7	10.6	47	125

M&E 1979 Waiver Study Sediment samples (See Figure A-4))
New England Aquarium

Sta	Cr	Cu	Zn	Pb	Ag	Cd	Hg	%oc	PCB	DDT
		mg/g				µg/g			ng/g	
22	0.054	0.034	0.107	0.070	3.8	1.0	4.7	5.6	129	8
26								8.0		
28	0.048	0.038	0.098	0.056	3.6	1.3	1.3	6.6		

Fitzgerald, 1980 (See Figure A-5)
Station G-21.....0.9% organic carbon
G-19.....2.9% organic carbon
G-8.......3.0% organic carbon

M&E 1982 Waiver Study Sediment Samples (See Figure A-6)
Sample ND, µg/g (dry Wt?)

Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Hg	Ag
<2	6	7.4	0.2	35.7	21	<2	14.9	82.4	0.92	<2

Se	Th	% vol	% <74µ	TOC
<0.1	<3.4	4.25	1.3	1937

Methylene Chloride... trace -600 µg/kg
(mg/kg)
Chlordane... <0.16
PCB1254....ND-1.1
PCB1260..ND-1.1
Toxaphene...<1.6

M&E 1983 EG&G Sediment Sample (see Figure A-7)
No stations in this area

M&E 1984 Waiver Study Sediment Samples (See Figure A-8)
No stations in this area.

Boehm, et al., NOAA/NMFS 1984- organics in sediments (See Figure A-9)

BH-5

PAH, total concentration(µg/g)............6.0_+1.3

PCB, total concentration(ng/g)........100_+23.7

Coprostanol(µg/g).........................6.2_+1.5

TOC (mg/g)..............................23.5_+4.7

DDT(ng/g)..............................2.5

EPA Sediment Data --Quincy Bay Study, 1987 (See Figure A-10)

Station S-12,S-13,S-22, S-23, µg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC	vol sol(g/kg)
S-12	99.79	71.97	107.32	0.44	73.22	15.42	176.78	13661	21500	
S-13	41.55	29.88	53.21	0.20	33.970	86.64	112.97	8002.9	8180	
S-22	116.04	84.79	116.88	0.71	79.58	18.23	190.83	15187.	15100	
DUPL	171.28	101.01	160.81	0.88	105.74	25.780	294.93	24155	33000	
"	144.32	100.38	147.16	1.21	101.33	21.78	221.59	18371	25800	
S-23	45.79	42.68	80.06	0.47	39.72	11.79	137.23	10950	9160	
SC-1										
0-2"									26,000	24
2-4"									25,000	28
4-8"									20,000	22
8-12"									11,000	19

TABLE A-III

MOON ISLAND/LONG ISLAND

NEA, Gilbert, et al, 1972 (See Figure A-1)
Station 01-2 QB-1, ppm

	depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
QB-1										
	0cm	455	363	256	37	11.2	57	422	48	4.9
	10	57	25	50	7	2.9	31	30	8	7.3
01-2										
	0	168	39	82	--	--	25	31	31	10.2
	10									

	depth	Hg	%org
QB-1			
	0	3.9	11.68
	10	0.1	5.71
01-2			
	0	2.0	7.17
	10		

Isaac and Delany, 1972 (Ma. DWPC) (see Figure A-2)
Sample 2
mg/kg (dry WT) for material passing through a #30 seive

Depth	0-3"	3"-7"	7"-10"	10"-12"
Test				
Hg	2.32	2.69	3.60	1.90
Cd	2.6	2.4	1.4	0.4
Pb	180	190	220	77
Zn	190	180	210	78
Ni	28	27	26	14
Cu	120	100	100	49
Cr	170	120	90	54
As	6	5	4	2.6
%Vol. Solids	9.2	9.2	8.3	5.6

. White, 1972 (See figure A-3)
stations 90, 91, 92, ppm ...

	%vol	Cd	Cr	Cu	Hg	Ni	Pb	Zn
90	7.0	2.9	124	122	3.0	30.6	314	354
91	9.7	2.0	272	146	2.4	28	164	156
92	7.7	0.8	272	113	1.8	32	180	154

M&E 1979 Waiver Study Sediment samples (see figure A-4)
New England Aquarium

Sta	Cr	Cu	Zn	Pb	Ag	Cd	Hg	%oc	PCB	DDT
		mg/g				µg/g			ng/g	
21	0.302	0.192	0.242	0.234	14.3	3.0	9.4	8.3		

Fitzgerald, 1980 (see figure A-5)
Station G-15.....3.7% organic carbon

M&E 1982 Waiver Study Sediment Samples (figure A-6)
No stations this location

(1983 EG&G Sediment Sample (See Figure A-7)

Station 18 µg/g (dry Wt?)

% vol	Cu	Cr	Pb	Zn	As	Cd	Hg	Ni	V	PCB
7	210	250	260	270	--	0.04	2.9	--	--	--

Station 18, counts/gm ww(sediment)

fecal coliform	spores of clostridium coliform	perfringens
30	10	23,000

M&E 1984 Waiver Study Sediment Samples (See Figure A-8)

Station 18, μg/g

% vol	% <74μ	TOC	Sb	As	Be	Cd	Cr	Cu	Pb	Ni
2.5	90.5	6,900	<3	2.2	8.94	1.1	20.3	126	142	24.8

Se	Ag	Th	Zn	Hg
<0.8	0.3	<6	177	1.45

(mg/kg)

Chlordane ND-<0.25

4,4'DDE ND-<0.2

Toxaphene ND-<2.5

Boehm, et. al., NOAA/NMFS, 1984, Organics STudy (See Figure A-9)

Station BH-4

PAH, total concentration(μg/g)............6.5±2.0

PCB, total concentration(ng/g).......330±119

Coprostanol(μg/g)........................1.2±0.2

TOC (mg/g)...............................41.5±11.9

EPA Sediment Data --Quincy Bay Study, 1987 (See Figure A-10)

Station S-6,S-1,S-11, S-5, S-4, S-8, μg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC
S-6	162.08	141.57	185.11	1.29	107.87	24.78	263.20	20589	42900
S-1	69.22	122.94	245.10	1.29	164.51	15.92	155.10	13156	47900
S-11	157.03	114.86	168.92	0.97	112.16	22.65	244.86	19405	31200
S-5	215.92	135.82	182.59	0.72	146.52	24.55	235.82	19602	27200
S-4	166.49	134.04	176.33	1.06	117.82	22.63	224.73	17872	31500
DUPL	173.7	127.25	167.30	0.85	125.12	21.92	212.32	17748	32700
"	180.6	131.09	173.88	0.87	129.10	22.89	219.15	18407	31900
S-8	83.6	75.2	119.40	0.72	69.20	14.72	154.8	13900	12500

TABLE A-IV

NUT ISLAND DISCHARGE AREA

NEA, Gilbert, et al, 1972 (See Figure A-1)
Stations QB-5, HB-1, ppm

	depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
QB-5										
	0cm	108	35	56	18	2.9	22	57	50	7.3
	10									
HB-1										
	0	81	33	59	9	2.2	18	88	45	3.9
	10									

	depth	Hg	%org
QB-5			
	0	0.8	4.47
	10		
HB-1			
	0	1.0	4.53
	10		

Isaac and Delany, 1972 (Ma. DWPC) (See Figure A-2)
No stations in this area

White, 1972 (See Figure A-3)
stations 105, 106, ppm .....

	%vol	Cd	Cr	Cu	Hg	Ni	Pb	Zn
105	6.3	1.1	119	79.2	1.3	26.6	102	269
106	--	1.2	138	85	1.8	27.5	110	293

M&E 1979 Waiver Study Sediment samples (See figure A-4))
New England Aquarium

Sta.	Cr	Cu	Zn	Pb	Ag	Cd	Hg	%oc	PCB	DDT
		mg/g				µg/g			ng/g	
25	0.068	0.046	0.085	0.065	3.1	1.3	1.7	6.8	72	1
30	0.081	0.061	0.143	0.074	6.8	2.5	6.0	11.7		

Fitzgerald, 1980 (SEe Figure A-5)
Station G-10...3.3% organic carbon
G-17......0.6 %organic carbon

(M&E 1982 Waiver Study Sediment Samples (See Figure A-6)
Samples NIC,NIB μg/g

	Sb	As	Be	Cd	Cr	Cu	Pb	Ni	Zn	Hg
NIC	<2	<3	4.3	0.1	23.4	15.0	<2	7.3	53.7	0.59
NIB	<2	<3	5.0	0.3	52.9	40.9	<2	10.4	94.0	0.46

	Ag	Se	Th	% vol	% <74μ	TOC
NIC	<2	<0.1	<3.4	2.40	0.8	1120
NIB	<2	<0.1	<3.4	5.97	4.5	2047

NIC Methylene Chloride... trace -600 μg/kg
(mg/kg)
Chlordane... <0.16
PCB1254....ND-1.1
PCB1260..ND-1.1
Toxaphene...<1.6

NIB Methylene Chloride... trace -600 μg/kg
(mg/kg)
Chlordane... <0.16
Toxaphene...<1.6
Bis(2-Ethylhexyl)phthalate...ND-17

1983 EG&G Sediment Sample (See Figure A-7)
No stations in this area

M&E 1984 Waiver Study Sediment Samples (see Figure A-8)

Stations 20,21 µg/g

	% vol	% <74µ	TOC	Sb	As	Be	Cd	Cr	Cu	Pb
20	5.9	50	4100	<6	<9	6.56	0.6	158	79.1	147
21	4.0	32	8000	<2	<3	5.81	0.6	71.8	42.9	87

	Ni	Se	Ag	Th	Zn	Hg
20	22.6	<1.5	<0.3	<12	112	0.77
21	23	<5	<0.1	<4	109	0.48

(mg/kg)

20	4,4'DDD	ND-<0.55
	4,4'DDT	ND-<0.59
	Endrin	ND-<0.24
21	Chlordane	ND-<0.25
	4,4'DDD	ND-<0.55
	4,4'DDT	ND-<0.59
	Endrin	ND-<0.24
	Toxaphene	ND-<2.5

EPA Sediment Data --Quincy Bay Study, 1987 (See figure A-10)
Station S-17,C3,C2, S-18, C4, C1,S-20,S-21 µg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC	vol sol g/kg
S-17	50.61	43.79	67.12	0.26	46.97	10.08	119.39	8636	12800	
C1s	88.19	133.97	206.96	1.62	94.73	18.19	191.98	15991	20800	
0-2	73.32	316.29	273.16	1.68	147.12	17.25	141.05	12108	14600	
2-4'	38.98	121.39	221.78	1.25	149.61	9.9	109.84	8307	6940	
C2s	48.3	40.99	86.22	0.48	33.16	13.62	452.38	12755	5720	
S-18	16.67	19.82	38.78	0.28	45.83	7.55	105.93	7803	1920	
C4s	29.63	23.81	55.69	0.38	23.94	10.83	218.25	10462	8230	
0-2'	56.78	51.28	84.07	0.64	43.77	14.1	199.63	13388	13800	
2-4'	62.5	57.28	93.28	0.71	46.64	16.42	255.6	15205	7240	
4-8'	39.41	37.95	75.73	0.54	20.03	21.5	307.82	17703	4890	
C1s	28.3	28.46	66.82	0.57	33.33	9.15	103.77	8144.6	8150	
0-2'	45.81	44.51	83.24	0.81	46.82	11.0	119.08	9768	5530	
2-4'	73.47	71.14	113.56	1.55	70.99	14.87	157.43	12798	17400	
4-8'	41.74	49.85	105.56	0.96	74.17	12.64	136.04	11501	12300	
8-12'	46.92	70.65	176.63	0.87	137.32	16.12	170.47	15887	31000	
S-20	61.36	60.41	90.85	0.60	45.11	14.59	168.77	13186	17200	
S-21	31.16	35.31	54.90	0.43	27.3	9.63	119.29	9213	8670	
SC-2										
0-2'									39000	32
2-4'									41000	22
4-8'									38000	30
8-12									33000	32
12+"									22000	27

TABLE A-V

Mid- BAY/HANGMAN ISLAND AREA

NEA, Gilbert, et al, 1972 (See Figure A-1)
Sample QB-3, QB-4 ppm

	depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
QB-3										
	0cm	312	212	241	24	2.7	51	312	100	8.0
	10									
QB-4										
	0	112	57	72	1	1.0	28	254	42	4.0
	10	49	16	20	8	1.9	17	24	24	9.2

	depth	Hg	%org
QB-3			
	0	3.5	11.23
	10		
QB-4			
	0	0.9	3.55
	10	0.3	3.91

Isaac and Delany, 1972 (Ma DWPC) (See Figure A-2)
No stations in this area

White, 1972 (see Figure A-3)
No stations in this area

M&E 1979 Waiver Study Sediment samples (See Figure A-4)
New England Aquarium

Sta.	Cr	Cu	Zn	Pb	Ag	Cd	Hg	%oc	PCB	DDT
		mg/g				µg/g			ng/g	
27								4.8		
29	0.113	0.087	0.171	0.125	9.2	2.16	4.35	3.8		

Fitzgerald, 1980 (see Figure A-5)
Station G-16.....2.0% organic carbon

M&E 1982 Waiver Study Sediment Samples (see Figure A-6)
No stations in this area

1983 EG&G Sediment Sample (see Figure A-7)
Station 28,19 µg/g

sta	% vol	Cu	Cr	Pb	Zn	As	Cd	Hg	Ni	V	PCB
28	7	210	160	260	470	70	5.2	2.8	52	150	1.4
19	9	270	320	300	340	--	2.6	3.1	--	--	--

Station 28,19, counts/gm ww(sediment)

sta	fecal coliform	spores of clostridium coliform	perfringens
28	--	---	14,900
19	50	30	10,000

M&E 1984 Waiver Study Sediment Samples (see Figure A-8)

Stations 18,19, µg/g

	% vol	% <74µ	TOC	Sb	As	Be	Cd	Cr	Cu	Pb
18	2.5	90.5	6900	<3	2.2	8.94	1.1	20.3	126	142
19	8.4	78	5900	<6	<9.7	6.32	0.6	186	115	226

	Ni	Se	Ag	Th	Zn	Hg
18	24.8	<0.8	0.3	<6	177	1.45
19	26.8	<1.6	<0.3	<12.9	173	1.58

		(mg/kg)
18	Chlordane	ND-<0.25
	4,4'DDD	ND-<0.55
	4,4'DDE	ND-<0.2
	4,4'DDT	ND-<0.59
	Endrin	ND-<0.24
	Toxaphene	ND-<2.5
19	a-BHC	ND-0.12
	Chlordane	ND-<0.25
	4,4'DDD	ND-<0.55
	4,4'DDT	ND-<0.59
	Endrin	ND-<0.24
	heptachlor	ND-0.1
	Toxaphene	ND-<2.5

EPA Sediment Data --Quincy Bay Study, 1987 (see figure A-10)

Station S-16, S-14, S-19, S-15 µg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC	Volsol g/kg
S-16	33.02	40.0	61.75	0.29	29.84	7.84	72.54	6412	30200	
S-14	64.9	61.22	98.37	0.61	55.92	12.2	125.51	10693	11800	
DUPL	49.46	49.09	83.33	0.54	44.57	10.11	105.25	8931	13000	
"	37.94	38.25	71.59	0.43	36.19	8.49	91.75	7619	8750	
S-19	84.73	85.84	120.58	0.95	69.91	16.70	166.81	14668	15300	
S-15	53.3	51.65	99.08	0.53	50.55	10.99	116.67	9761	14,700	
SC-3										
0-2"									25000	27
2-4"									24000	24
4-8"									10000	22
8-12"									12000	22
12+									17000	18
SC-4										
0-2"									36000	28
2-4"									43000	34
4-8"									31000	32
8-12"									29000	20

TABLE A-VI
NEARSHORE AREA

NEA, Gilbert, et al, 1972 (see Figure A-1)
Sample QB-2, ppm

	depth	Zn	Cu	Pb	Co	Cd	Ni	Cr	V	Mg
QB-2										
	0cm	130	48	20	0.2	2.4	19	4	51	4.8
	10	64	4	18	6	0.6	22	33	39	8.3

		Hg	%org
QB-2			
	0	1.1	5.07
	10	0.03	3.89

Isaac and Delany, 1972 (Me. DWPC)
No stations in this area

White, 1972 (see Figure A-3)
Stations 97,98,99,100,101, ppm

	%Vol	Cd	Cr	Cu	Hg	Ni	Pb	Zn
97	6.5	2.8	125	92.5	5.4	30.	125	160
98	3.7	1.8	50	36.5	4	15	50	82.5
99	4.5	2	62.5	45	4.5	22.5	62.5	82.5
100	2.9	1.8	42	31.2	2	12.5	50	65
101	2.5	1.5	25	20	1.6	10	37.5	45

M&E 1979 Waiver Study Sediment samples (See Figure A-4))
New England Aquarium

Sta	Cr	Cu	Zn	Pb	Ag	Cd	Hg	%oc	PCB	DDT
		mg/g				µg/g			ng/g	
24	0.07	0.057	0.105	0.059	7.0	1.8	3.7	4.3		

M&E 1982 Waiver Study Sediment Samples
No stations in this area

1983 EG&G Sediment Sample
No stations in this area

M&E 1984 Waiver Study Sediment Samples
No stations in this area

EPA Sediment Data --Quincy Bay Study, 1987 (See Figure A-10)
Station S-3, S-2, S-10, S-9, µg/g, dry weight

	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe	TOC
S-3	102.88	98.2	144.6	1.03	97.48	17.07	171.04	14478	21700
S-2	117.95	105.91	146.36	0.95	93.18	18.18	183.86	16000	21100
S-10	5.65	8.28	19.62	0.10	6.69	4.38	69.38	4816	832
S-9	6.42	6.86	24.53	0.20	9.61	4.26	66.44	4312	2060

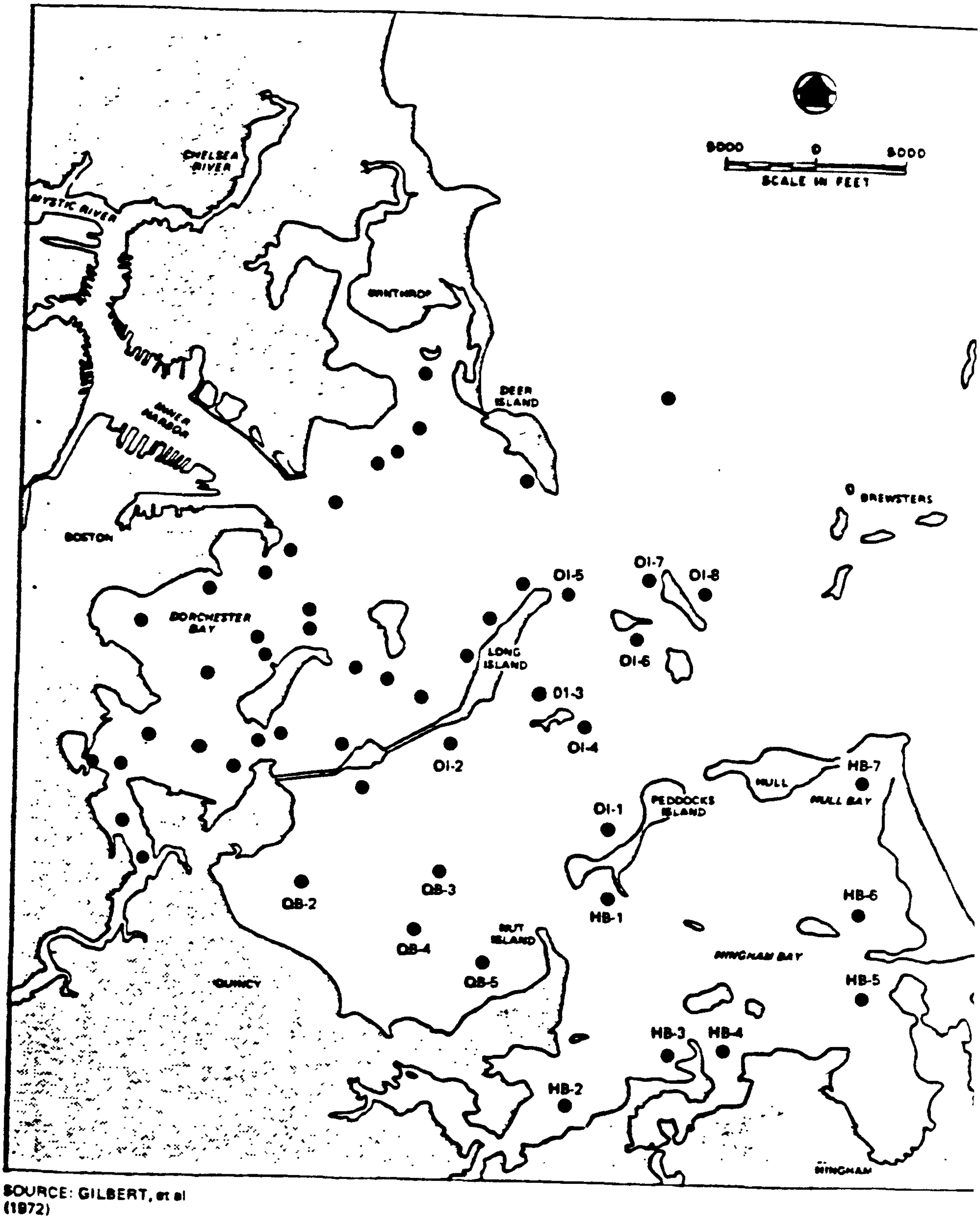
TABLE A-VII
RANKING OF TRACE METAL DATA FOR EPA QUINCY BAY SAMPLES
(Grab samples have been ranked from high to low for each metal:
Highest concentration is 1; Lowest concentration is 23)

Station #	Cr	Cu	Zn	Cd	Pb	Ni	Mn	
S1	11	4	1	1*	1	9	11	
S2	6	6	7	4*	8	6	6	
S3	7	8	8	2	7	7	8	
S4a								
S4b	2				3	4		
S4c		3	4	6			5	
S5	1	2	3	7*	2	2	3	
S6	3	1	2	1*	5	1	1	
S7	12	13	14	9	13	13	13	
S8	10	10	10	7*	11	11	12	
S9	22	23	22	18*	22	23	23	2
S10	23	22	23	19	23	22	22	2
S11	4	5	5	3	4	3	2	
S12	8	11	11	13	9	10	7	1
S13	18	20	20	18*	19	19	18	1
S14a								
S14b	16	15	15	10	17	16	20	1
S14c								
S15	14	14	12	11	12	15	17	1
S16	19	18	18	15	20	20	21	2
S17	15	16	17	17	14	17	15	1
S18	2	21	21	16	15	21	19	2

TABLE A-VII (Continued)
RANKING OF TRACE METAL DATA FOR EPA QUINCY BAY SAMPLES
(Grab samples have been ranked from high to low for each metal:
Highest concentration is 1; Lowest concentration is 23)

Station #	Cr	Cu	Zn	Cd	Pb	Ni	Mn	Fe
S19	9	9	9	4*	10	8	10	7
S20	13	12	13	8	16	12	9	11
S21	20	19	19	14	21	18	16	16
S22a								
S22b								
S22c	5	7	6	5	6	5	4	4
S23	17	17	16	12	18	14	14	13

Source: EPA, Region 1 (1987)



SOURCE: GILBERT, et al (1972)

FIGURE A-1. NEW ENGLAND AQUARIUM 1972 SEDIMENT STATIONS

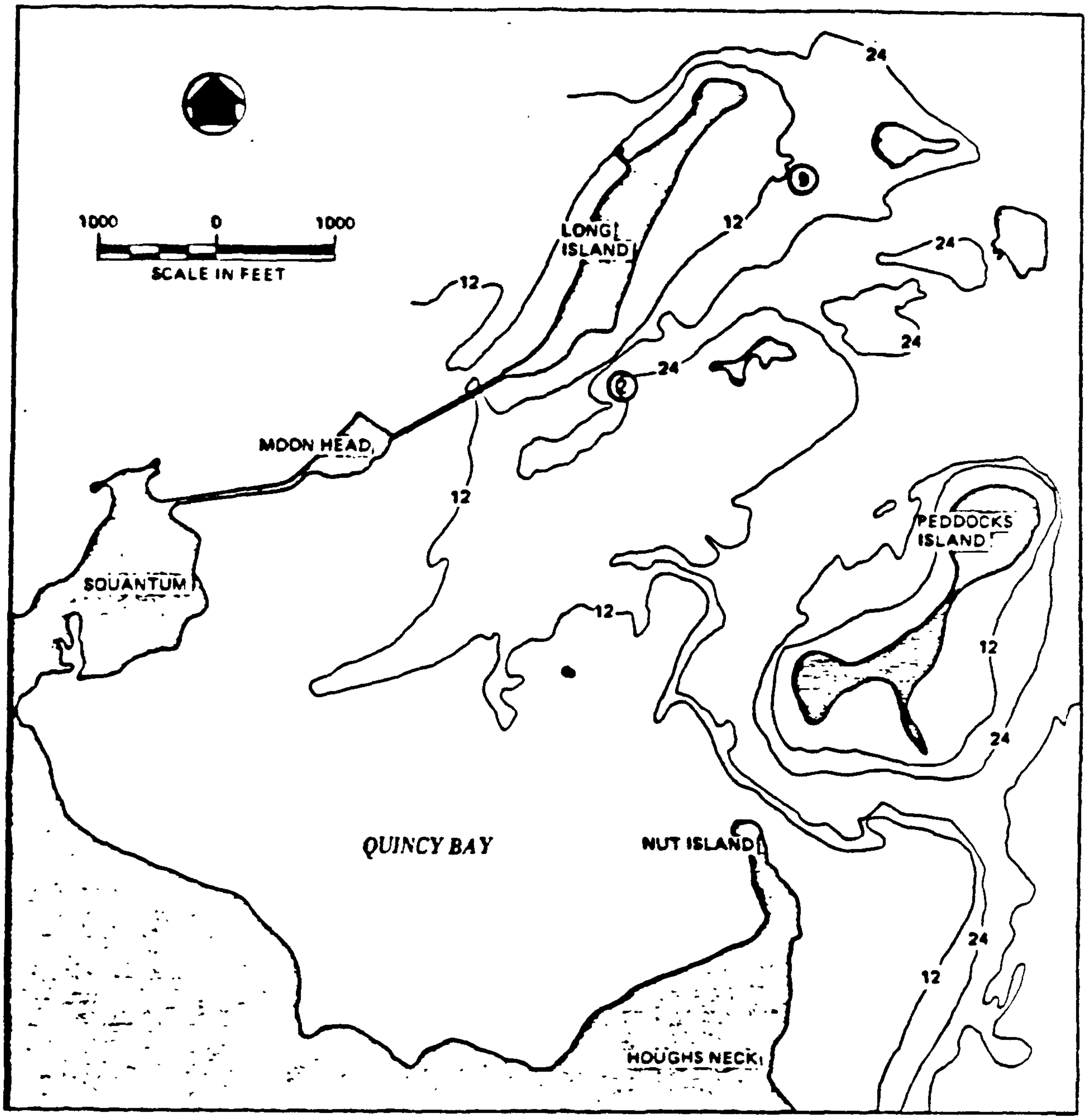
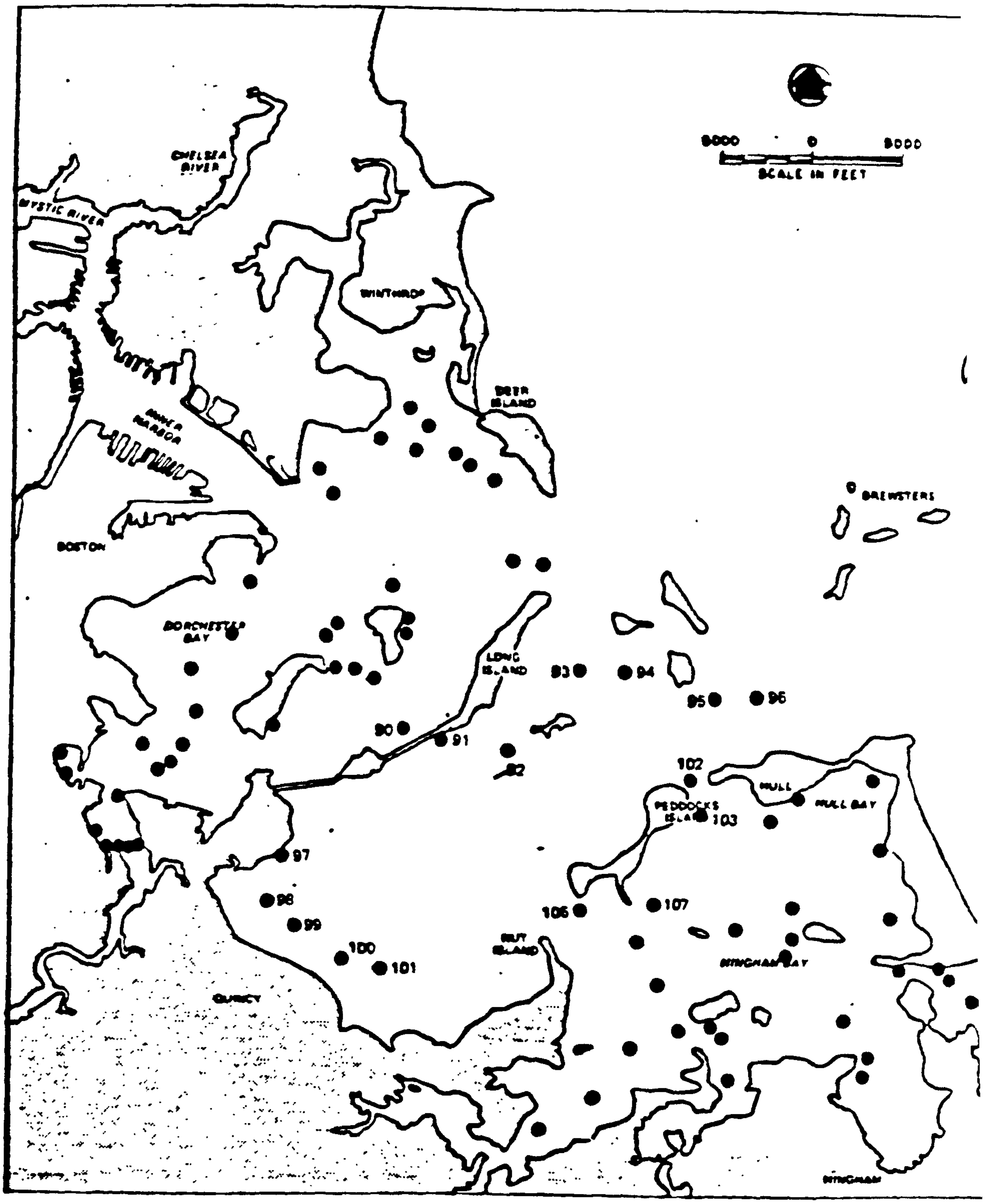


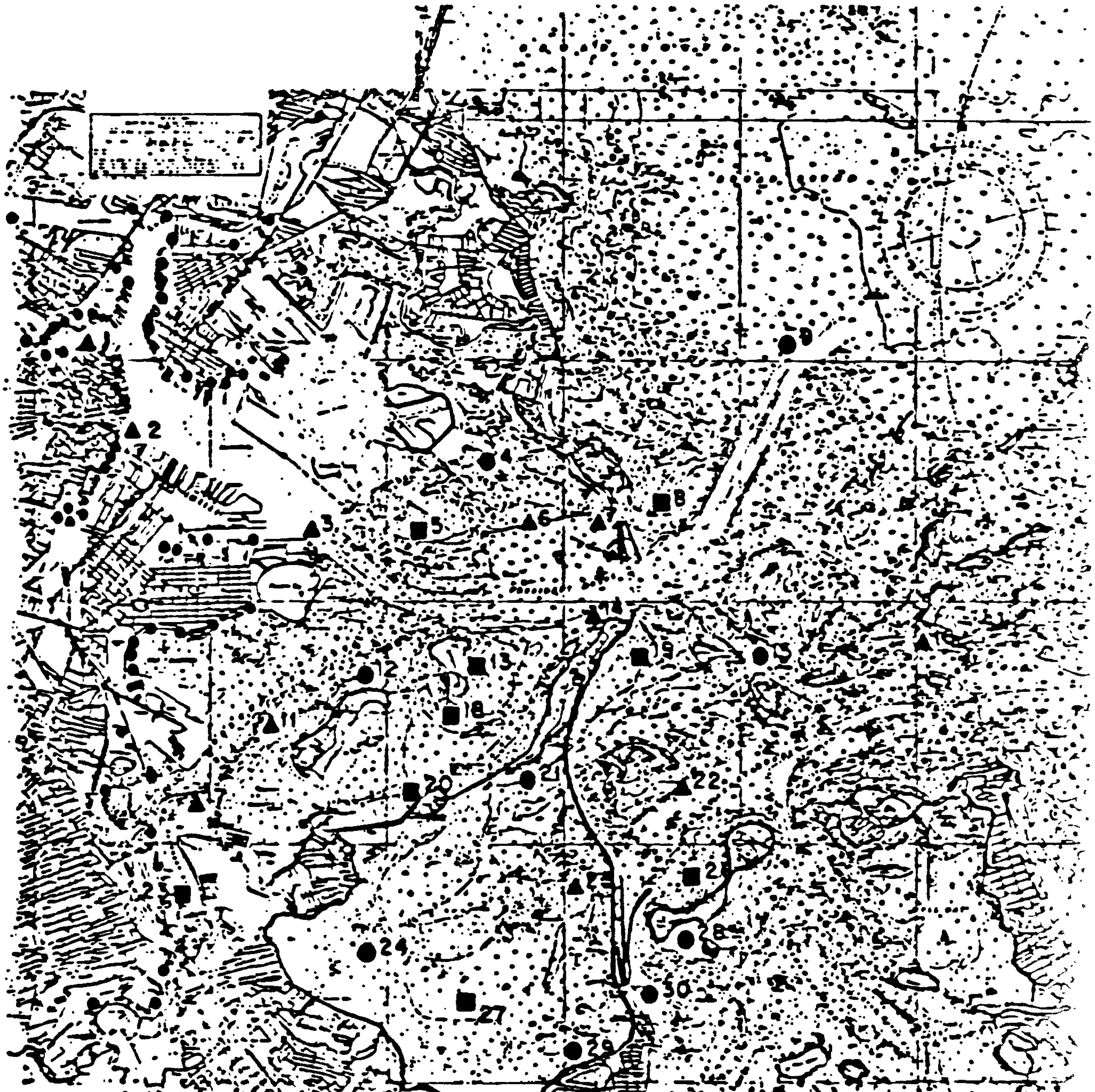
FIGURE A-2. QUINCY BAY SAMPLING STATIONS

SOURCE: ISAAC & DELANEY, DWPC (1982)



SOURCE. WHITE (1972)
as found in Application for Waiver
June, 1984

FIGURE A-3. SELECTED WHITE SEDIMENT STATIONS 1972



KEY

Source: Metcalf & Eddy, Inc. (1984), Figure II - B5.3

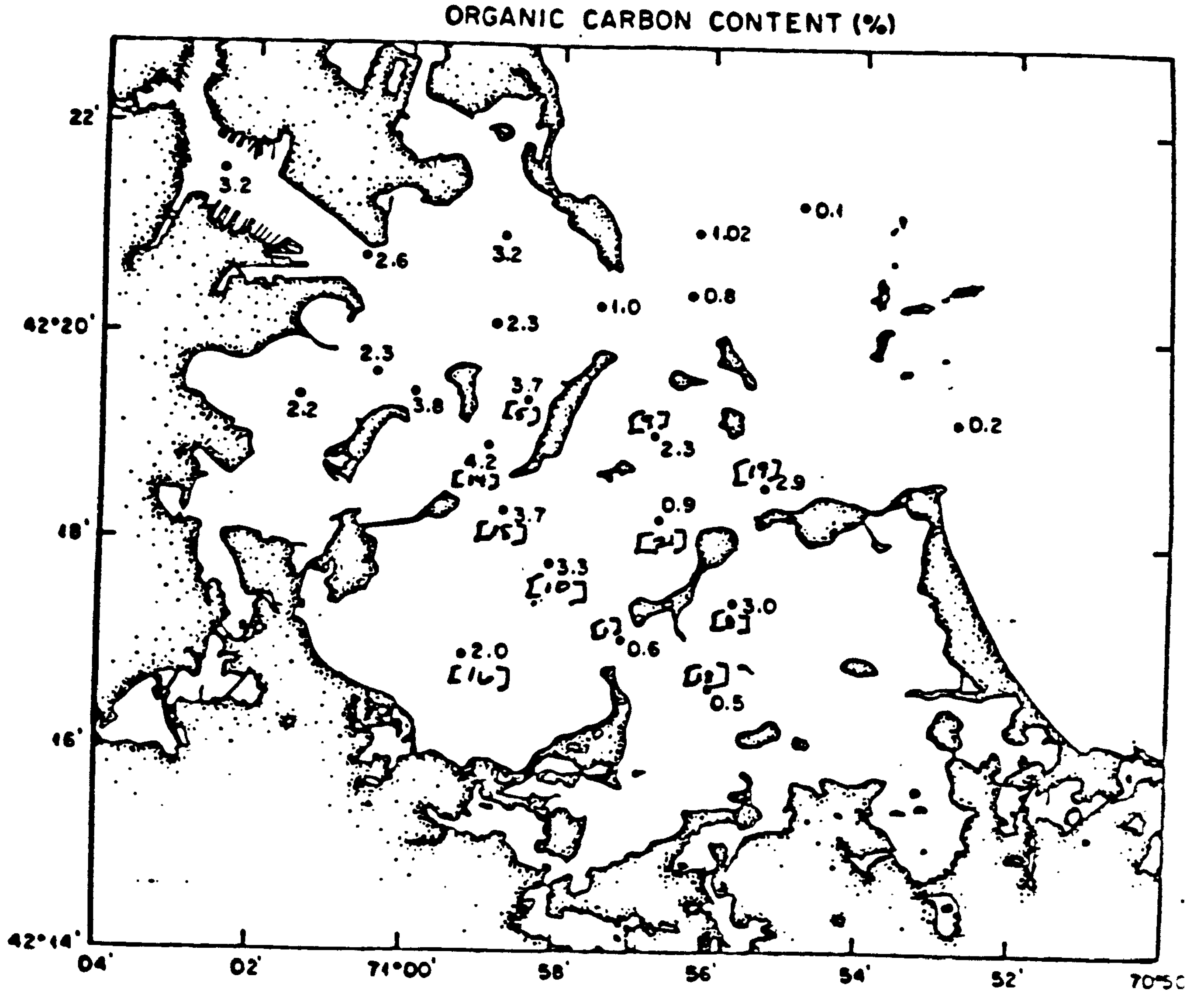
- ● Combined Sewer Outlets
- — Treatment Plant Discharges
- ▲ Sediment Sampling Stations

(Solid lines represent Deer Island and West Island outfalls)

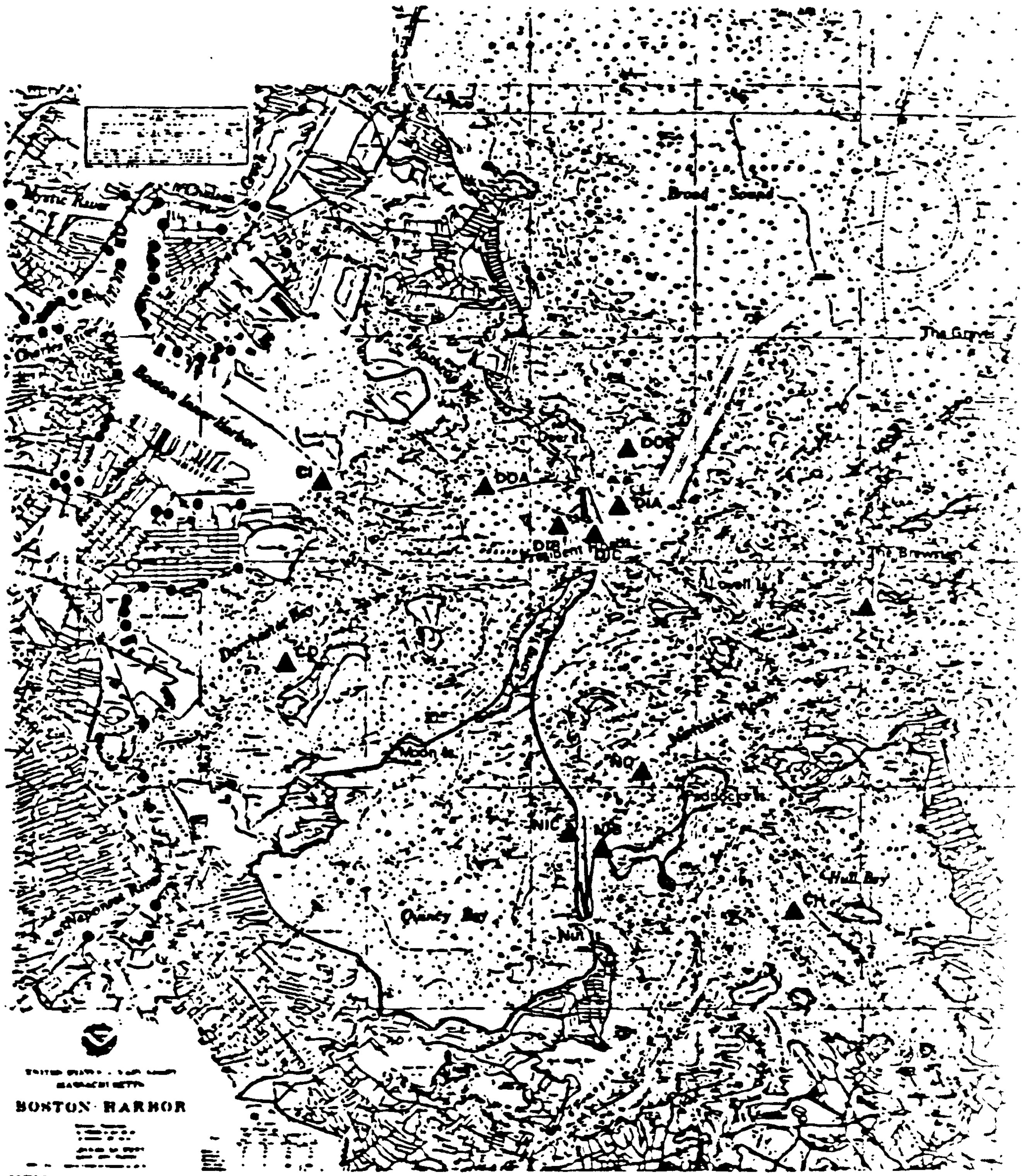
SCALE IN FEET

FIGURE A-4. 1979 SEDIMENT SAMPLING STATIONS

FIGURE A-5
[ ] Location of Quincy Bay Stations/Organic Carbon Content



SOURCE: Fitzgerald, M.G., 1980 (Figure 15).



KEY

Source: Metcalf & Eddy, Inc. (1984), Figure II - BE 4

- ● Combined Sewer Outlets
- — Treatment Plant Discharges
- ▲ Sediment Sampling Stations

(Solid lines represent Deer Island and West Island outfalls)

8000 0 8000

SCALE IN FEET

FIGURE A-6. 1982 SEDIMENT SAMPLING STATIONS

KEY

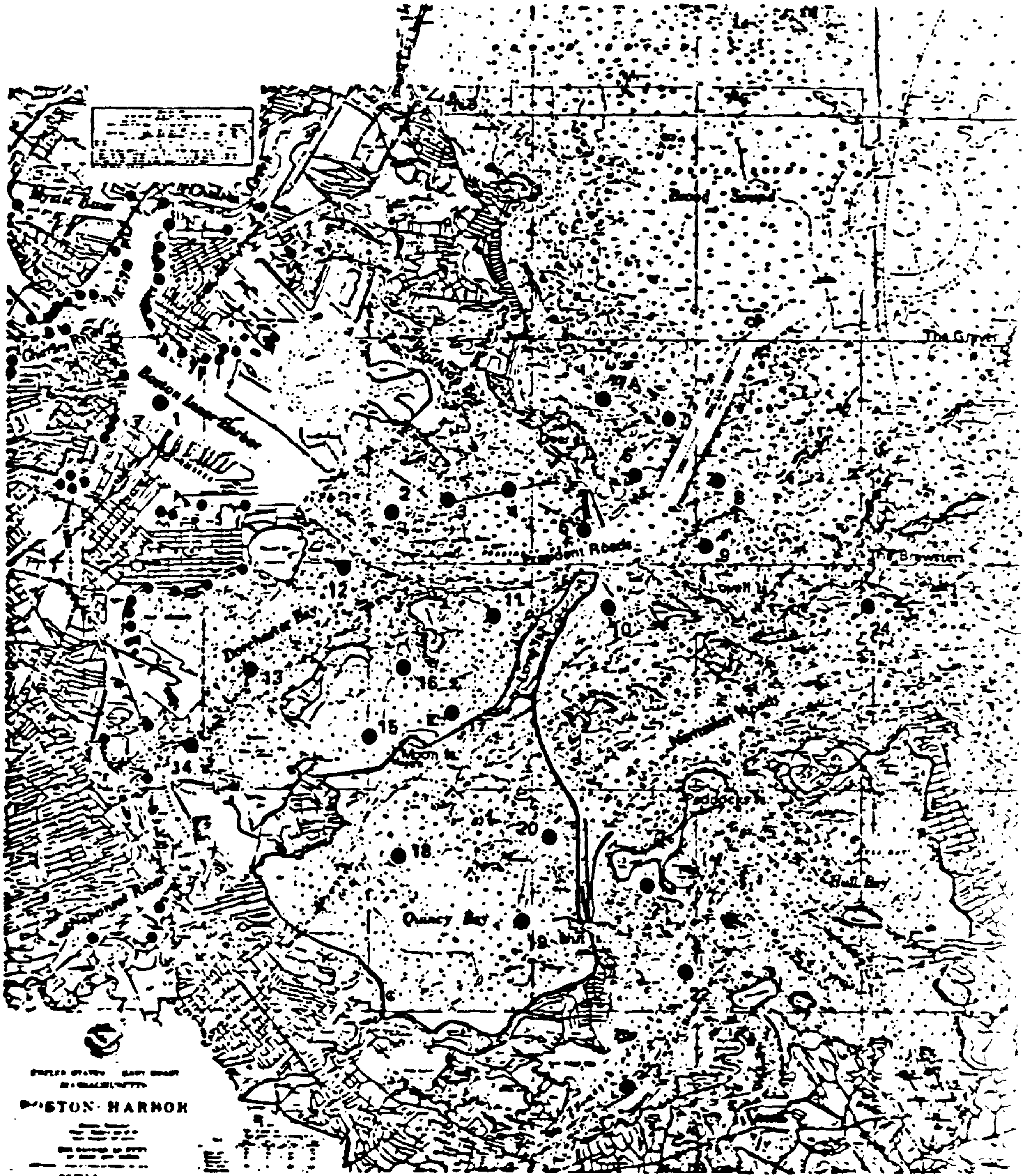
- ● Combined Sewer Outlets
- — Treatment Plant Discharges
- ⬤ Sediment Sampling Stations

(Solid lines represent Deer Island and West Island outfalls)

Source: Metcalf & Eddy, Inc. (1984), Figure II - B

SCALE IN FEET

FIGURE A-7. 1983 (EG&G) SEDIMENT SAMPLING STATIONS



KEY

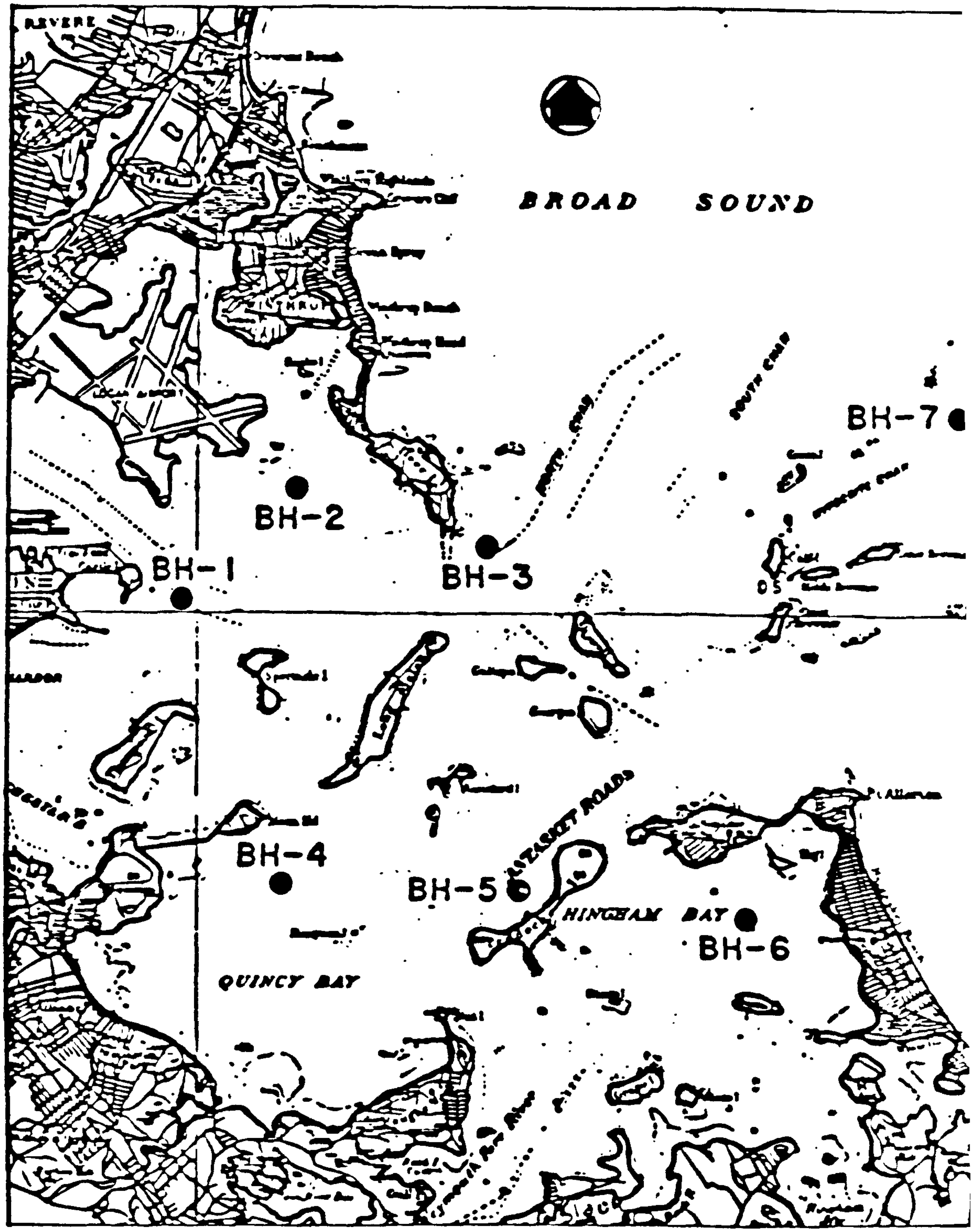
- ● Combined Sewer Outlets
- — Treatment Plant Discharges
- ⬤ Sediment Sampling Stations

(Solid lines represent Deer Island and West Island outfalls)

Source: Metcalf & Eddy, Inc. (1984), Figure II - B5.43

5000 0 5000
SCALE IN FEET

FIGURE A-8. 1984 SEDIMENT SAMPLING STATIONS



Source: Boehm, et al (1984)

FIGURE A-9. LOCATION OF BOSTON HARBOR SAMPLING STATIONS

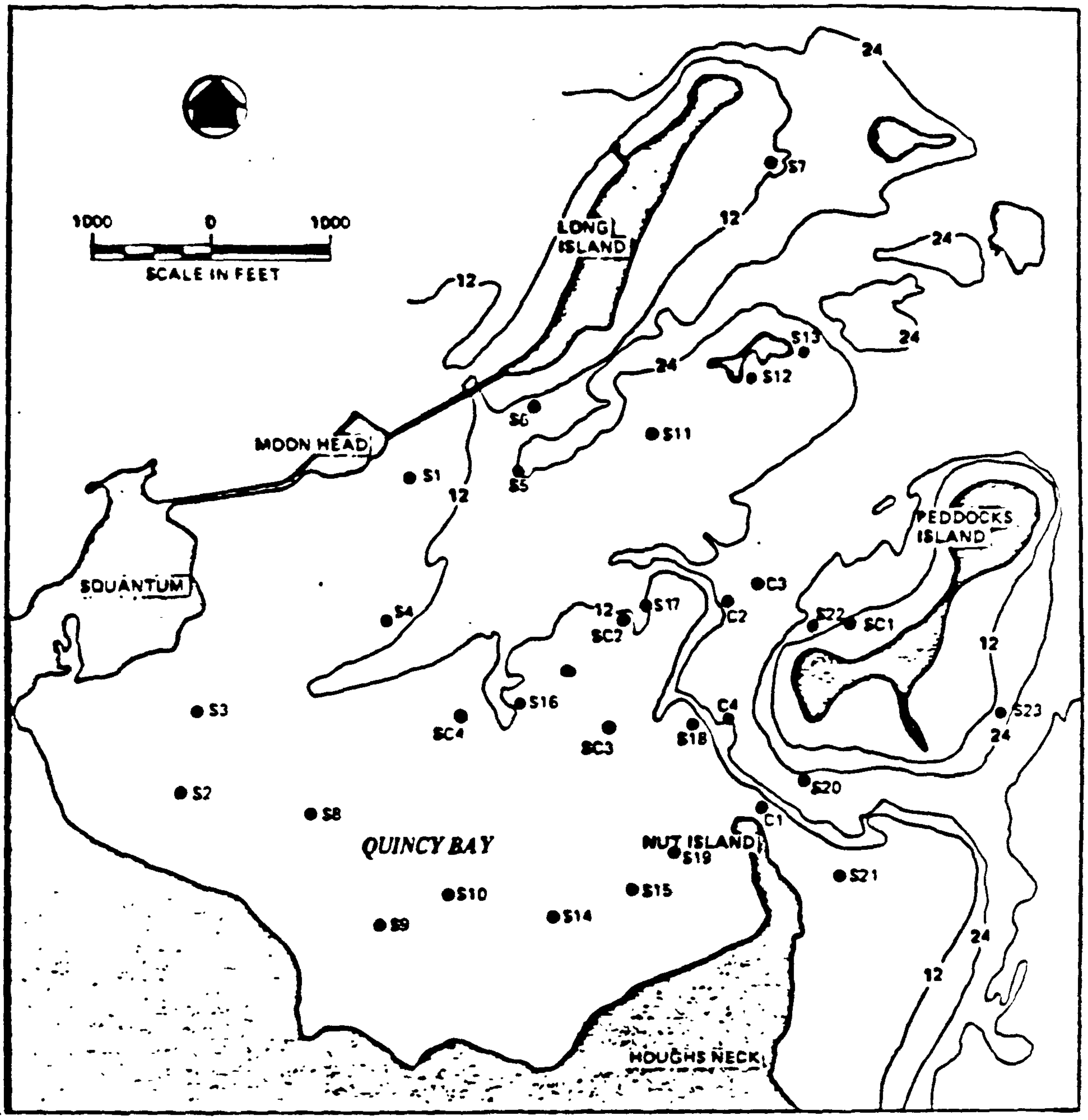


FIGURE A-10. QUINCY BAY STUDY AREA
LOCATION OF SEDIMENT SAMPLING SITES
USEPA, 1987

APPENDIX B

BIOLOGICAL DATA

Conversions for Units Used in Tables

ug/kg =ng/g =ppb

mg/kg =ug/g =ppm

TABLE B-1
(See Figure B-1)

"A Study of the MArine Resources of Quincy Bay"
Jerome,W.C., A.P. CHESMORE, AND CHARLES D. ANDERSON, Jr.

From Table 11: "Pesticide Concentrations in Clam Meat Samples Taken at Sites P_1, P_2, P_3, Quincy, Quincy Bay, in 1964."

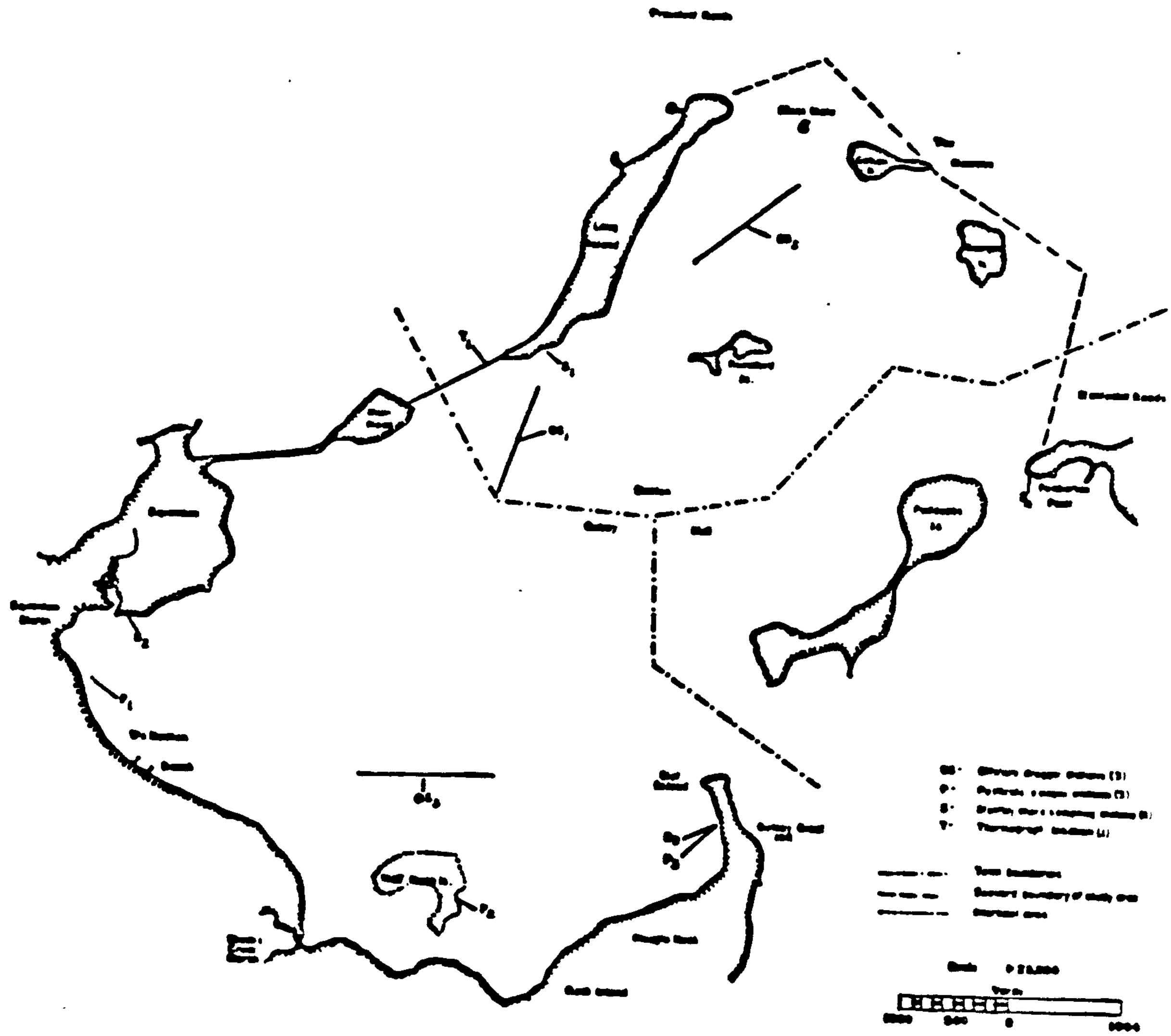
(ppm Live Body Weight)

Date Collected	Sample Site	Heptachlor	Heptachlor Epoxide	Dieldrin or DDE	DDT
2/24	P_1, P_2, P_3	none	none	0.027	0.046
7/31	P_1	0.013	0.079	0.020	0.030
	P_2	0.013	0.044	0.006	0.003
	P_3	0.088	0.011	0.014	0.013

Data taken from several areas of the Merrimack river during the month of July showed no Dieldrin , Heptachlor Epoxide from None to 2.8 ppm, Heptachlor ranges from 0.008-0.125, and DDT from none to o0.05ppm.

FIGURE B-1

Sampling station locations in Quincy Bay, 1964.



4

OURCE: Jerome, W.C., et.al. (1966)

Table B-11. *Pesticide Concentrations in Mud, Soft-Shelled Clam (Mya arenaria) and Water Samples from Hingham Bay, 1972***

Date	Station*	Lindane Mud	Lindane Clam	Lindane Water	Heptachlor Mud	Heptachlor Clam	Heptachlor Water	Aldrin Mud	Aldrin Clam	Aldrin Water	Malathion Mud	Malathion Clam	Malathion Water	Parathion Mud	Parathion Clam	Parathion Water
Jan 24	P_1	0.005												0.144	0.090	0.069
	P_2	0.022				0.004								0.625	0.125	
	P_3	0.030	0.001	0.012		0.003								0.438	0.035	2.160
Feb 9	P_1	0.012		0.167									1.667	0.313		3.330
	P_2														0.075	
Mar 7	P_1	0.004						0.003							0.100	
	P_2	0.002	0.002	0.009										0.081	0.100	0.400
	P_3	0.017				0.064			0.043			0.640		0.500	0.320	0.455
April 6	P_1												0.899	0.100		
	P_2												0.930	0.144		
	P_3											0.027	0.851	0.100		
May 8	P_1	0.016			0.007		0.010					0.325	0.525	2.750		0.075
	P_2	0.004										0.325		1.825		0.425
	P_3	0.024			0.003					0.009				0.333		
June 5	P_1	0.001	0.001	0.014	0.003	0.004	0.006					0.030		0.022	0.015	0.070
	P_2	0.003	0.002		0.002	0.004						0.040		0.006	0.015	
	P_3	0.003	0.001		0.004	0.003	0.019			0.009				0.028	0.015	
July 20	P_1				0.005	0.007					0.080		0.117			
	P_2			0.053	0.005	0.073					0.060		5.000			
	P_3				0.005	0.013							0.061			
Aug 17	P_1				0.002	0.005	0.029									
	P_2					0.012	0.029									
	P_3		0.188			0.227									1.244	
Oct 13	P_2						0.010									
	P_3				0.006		0.025					0.009				
Nov 15	P_1			0.065		0.020	0.143			0.113						
	P_2			0.571			1.018		0.008	0.650						
	P_3			0.014			0.082		0.017				1.336			
Dec 15	P_1	0.037			0.031			0.026				0.032	0.200			
	P_2											0.040	0.117			
	P_3											0.040				

Date	Station*	DDE Mud	DDE Clam	DDE Water	Heptachlor Epoxide Mud	Heptachlor Epoxide Clam	Heptachlor Epoxide Water	Dieldrin Mud	Dieldrin Clam	Dieldrin Water	DDD Mud	DDD Clam	DDD Water	DDT Mud	DDT Clam	DDT Water	Endrin Mud	Endrin Clam	Endrin Water
Jan 24	P_1						0.064		0.526	0.486					0.040				
	P_2		0.001									0.107			1.601				
	P_3														0.667				
Feb 9	P_1									0.067									
	P_2											0.353			0.707				
Mar 7	P_1	0.002							0.008			0.005		0.008	1.601	0.593			
	P_2											0.433			0.867				
	P_3					0.073													
April 6	P_1				0.050									0.039					
	P_2													0.125	0.062				
	P_3								0.045	0.053					1.123			0.011	
May 8	P_1	0.020	0.019		0.024			0.015	0.008					0.125	0.075		0.006		
	P_2	0.030	0.016											0.050	0.100		0.003		
	P_3	0.025				0.003		0.010	0.008	0.031				0.050		0.250			
June 5	P_1															0.504			
	P_2																		
	P_3																		
July 20	P_1													0.128	0.149	0.119			
	P_2					0.006			0.009					0.116	1.861	0.840			
	P_3													0.145	0.465				
Aug 17	P_1										0.047	0.140	0.600						
	P_2											0.008	1.200						
	P_3								0.010			0.090	0.200		0.053			0.009	
Oct 13	P_2													0.013		0.225		0.001	
	P_3																		
Nov 15	P_1														0.071	0.600			
	P_2															0.844			
	P_3																		
Dec 15	P_1													0.006					
	P_2																		
	P_3																		

SOURCE: IWANOWICZ et al. 1973

* P_1 Houghs Neck P_2 Weymouth Back River P_3, Weir River

** Where no data is reported, pesticide concentrations in mud and clam samples were <0.001 ppm (dry and wet weight, respectively) and in water samples were <0.001 ppb

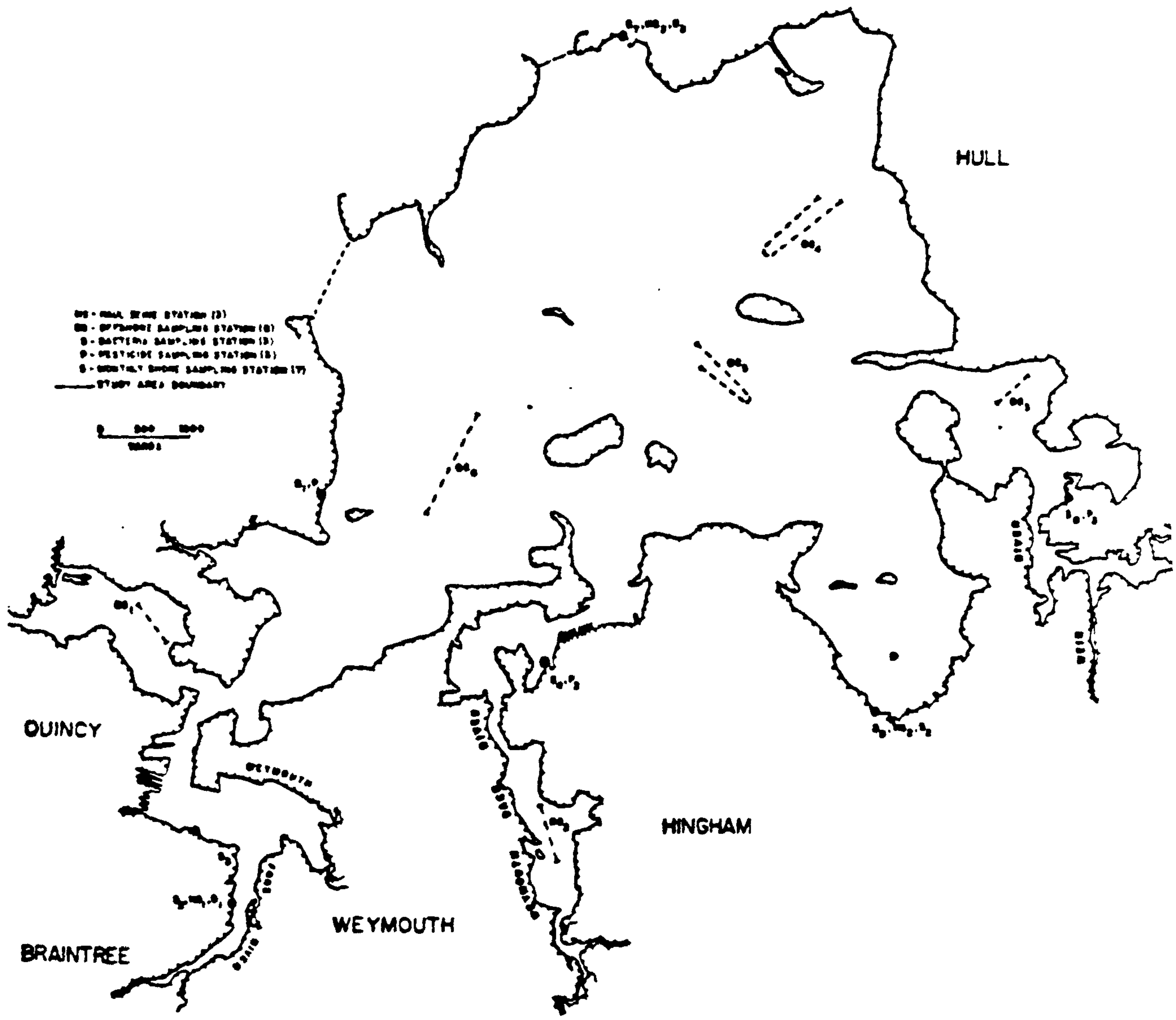


FIGURE B-2

Sampling station locations in Hingham Bay, 1970.

SOURCE: Iwandwitz,R., et. al. (1973)

TABLE B-III
See Figure B-3

ERCO DATA FOR "WAIVER...."--- 6/79-8/79 (see M&E, 1979)
From TABLE 34. PCB'S and DDT Measured in Boston Harbor Winter Flounder

Station	Set*	DDT ug/g (dry wt) in liver	PCBS, 1254 ug/g, liver (dry wt)	PCB's, 1254 ug/g, liver (wet wt)
NUT IS.	1	ND	4.21	1.45
NI	2	ND	10.84	3.18
NI	3	ND	21.93	6.80
NI	4	ND	36.30	15.60
DB	1	ND	5.03	1.68
DB	2	ND	26.55	7.70
DB	3	ND	50.89	10.71
DB	4	ND	37.69	10.95
IH	1	ND	17.28	5.20
IH	2	ND	7.21	3.61
IH	3	ND	6.58	2.82
IH	4	ND	4.51	1.23
PR	1	ND	14.68	3.98
PR	2	ND	20.73	6.40
		edible tissue ND	edible tissue 0.14	edible tissue 0.025
PR	3	ND	10.09	3.55
		edible tissue ND	edible tissue 0.77	edible tissue 0.15
PR	4	ND	10.64	4.09
		edible tissue ND	edible tissue 1.56	edible tissue 0.33
NB	1	ND	9.93	2.95
		edible tissue ND	edible tissue 0.56	edible tissue 0.01
NB	2	ND	12.25	4.57
		edible tissue ND	edible tissue 0.49	edible tissue 0.099
NB	3	ND	5.69	1.71
NB	4	ND	13.03	4.01

. The FDA action limit is 2ppm wet weight PCB for edible tissue.

FROM TABLE 37 in ERCO REPT

HEAVY METALS MEASURED IN LIVER AND EDIBLE TISSUE OF WINTER FLOUNDER

NORMAL FLOUNDER

Station	Concentration, ppm, wet weight				
	Ag	Cd	Cu	Hg	Pb
NI, liver	0.5	0.03	3.3	0.3	0.16
	0.36	0.03	16	0.5	0.22
	0.13	0.07	5.8	0.3	0.32
DB, liver	0.16	0.13	0.7	0.04	0.60
	0.31	0.10	0.9	0.05	0.35
IH, liver	0.25	0.15	9	0.08	0.65
	0.15	0.08	9.5	0.09	0.35
PR, liver	0.19	0.09	1.1	0.5	0.40
NB, liver	0.49	0.05	10	0.05	0.07
	0.20	0.10	3.9	0.09	0.400
	0.27	0.10	6.2	0.04	0.46
	0.69	0.05	6.6	0.04	0.530
NB, edible	0.02	<0.02	0.5	0.02	0.04
	<0.02	<0.02	1.0	0.02	0.015

FIN ERODED FLOUNDER

Station					
NI, liver	0.31	0.07	2.5	0.08	0.69
DB, liver	0.44	0.23	12	0.04	0.58
	0.16	0.12	11	0.03	0.62
IH, liver	0.10	0.05	3	0.09	0.06

	0.05	0.06	6	0.05	0.19
PR, liver	0.12	0.02	8.3	0.03	0.18
	0.02	<0.02	2.1	0.01	0.04
	0.09	15	5.1	0.02	0.26
PR, edible	0.02	<0.02	2.6	0.04	0.07
	<0.02	<0.02	0.23	0.02	0.05
	0.06	<0.02	1.1	0.02	0.06

NB no diseased fish

From Table 38 Trace contaminants in Boston Harbor Lobster

Station	Ag	Cd	Cu	Hg	Pb	PCB
	Concentration in ppm, wet weight					
NI	0.38	0.01	9.0	0.061	0.05	0.01
	0.23	0.008	6.6	0.087	0.04	0.09
DB	0.14	0.044	18	0.002	0.06	0.06
	0.18	0.009	8.7	0.130	0.04	0.16
IH	0.30	0.008	4.3	0.110	0.08	0.09
	0.26	<0.005	3.6	0.06	0.08	0.07
PR	0.47	0.013	13	0.085	0.02	0.06
	0.19	0.015	6.3	0.048	0.06	0.14
NB	0.22	0.018	14	0.084	0.08	0.14
	0.36	0.010	12	0.097	0.06	0.05

NO DDT DETECTED

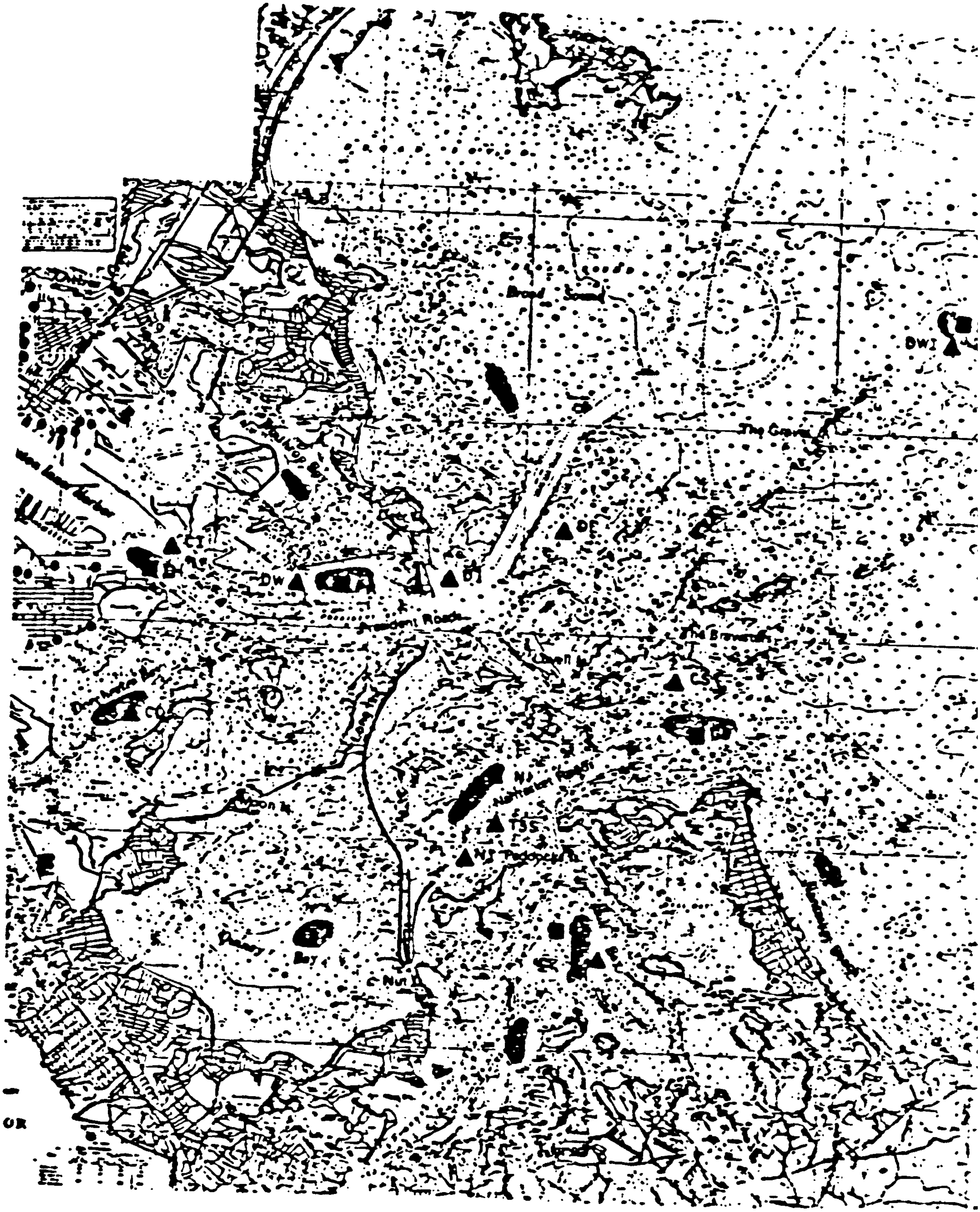


Figure B-3
1979 Boston Harbor Stations for Biological Sampling

SOURCE: Metcalf and Eddy, Inc., 1984
"Application for Waiver_")

TABLE B-IV

See Figure B-4

CAT COVE MARINE LABORATORY: Mass DMF

HEAVY METALS IN BOSTON HARBOR

(In ppm wet weight)

DATE	Lab#	Species	Cd	Co	Cr	Cu	Hg	Ni	Pb	Zn	AREA
5/83	P579	Eel	ND	ND	ND	ND	0.17	1.0	ND	28.9	Neponset R.
8/83	P609	Flounder	ND	ND	ND	ND	0.05	1.0	ND	10.1	Deer I.
	P610	Flounder	ND	ND	ND	ND	0.19	1.3	ND	8.8	Weymouth FR
	P611	Flounder	ND	ND	ND	ND	0.05	1.5	ND	8.5	Peddocks I.
	P612	Flounder	ND	ND	ND	ND	0.11	0.7	ND	17.8	Hull Gut
	P613	Pollock	ND	ND	ND	ND	0.09	0.5	ND	8.5	Dorchester B.
	P614	Pollock	ND	ND	ND	ND	0.06	0.5	ND	10.1	Deer I.
	P615	Pollock	ND	ND	ND	ND	0.04	0.7	ND	7.4	Bird I
	P616	Lobster	ND	ND	ND	92.8	0.47	1.5	ND	36.6	Peddocks I.
	P617	Flounder	ND	ND	ND	ND	0.14	0.8	ND	8.1	Bird I.
	P618	Pollock	ND	ND	ND	ND	0.09	1.0	ND	7.5	Long-Spec. I.
	P619	Bluefish	ND	ND	ND	ND	0.63	1.0	ND	13.4	Quincy B.

DETECTION LIMITS:

Cd 2.0ppm

Co 5.0ppm

Cr 2.0ppm

Cu 2.0ppm

Pb 12ppm

CAT COVE MARINE LABORATORY: Mass DMF

PCB DATA: BOSTON HARBOR

(IN PPM WET WEIGHT)

A.

Number	Date	Species	No. Samples	Site	Amount
P611	8/22/83	FLOUNDER	4	PEDDOCKS I.	0.30
P612			6	HULL GUT	0.10
P613		POLLOCK	14	DORCHESTER	0.00
P616		LOBSTER	10	PEDDOCKS I.	4.00
P618		POLLOCK	17	LONG I.	0.10
P619		BLUEFISH	1	QUINCY BAY	4.00
P684	8/20/84	W.FLOUNDER	1	LONG ISLAND	0.30
P685			1		1.00
P686			1		0.10

P687			1		0.40
P688			1		0.10
P689			1		0.20
P690			1		0.50
P691			1		0.60
P692			1		0.20
P693			1		0.50
P798	6/14/85	LOBSTER	1	X5-LONG I.	0.10
P798			1	X6-GALLOPS I.	1.40
P800			1	X7-LOVELL I.	1.20
P801			1	X8-LOVELL I.	0.80
P808	7/23/85	LOBSTER	1	X6A-GALLOPS I.	1.40
P809			1	X6B-GALLOPS	1.10
P812			1	X5A-LONG I.	0.50
P813			1	X5B-LONG I.	0.60
P814			1	X5C-LONG I.	1.00
P815			1	X5D-LONG I.	1.60
P822			1	X7A-LOVELL	1.10
P823			1	X8A-LOVELL	0.20
P824			1	X8B-LOVELL	1.10
P825			1	X8C-LOVELL	0.90
P805	7/31/85	LOBSTER	1	X8-LOVELL	0.50
PM981	6/23/86	LOBSTER	1	1-LONG I.	0.05
PM982			1	2-LONG I.	0.16
PM983			1	3-LONG I.	1.68
PM984			1	4-LONG I.	1.79
PM985			1	5-LONG I.	2.19
PM1028		SOFT SHELL CLAM	12	502- LONG I.	0.14
PM969		W. FLOUNDER	1	1B-LONG I.	0.76
PM970			1	2B-LONG I.	0.81
PM971			1	3B-LONG I.	0.59
PM972			1	4B-LONG I.	0.43
PM973			1	5B-LONG I.	0.15
PM974			1	6B-LONG I.	0.82
PM1029		SOFT SHELL CLAM	12	503-QUINCY B.	0.14
PM975		W.FLOUNDER	1	1C-NUT I.	1.30
PM976			1	2C-NUT I.	0.34

PM977	1	3C-NUT I.	0.34
PM978	1	4C-NUT I.	1.15
PM979	1	5C-NUT I.	0.25
PM980	1	6C-NUT I.	0.61

B.

Schwartz,J.P.(1987)
"PCB Concentrations in Marine Fish and Shellfish...", Cat Cove MArine Laboratory (From Table 2).

Average PCB concentrations (ppm, wet weight) in fish and shellfish from Boston Harbor, including standard error and sample size (in Parnthses)

	B1 Spring '86	B2 Spring '86	B3 Fall'85	B3 Spring '86
P. americanus (Flounder)	0. 67 ±0.18(6)	0.59±0.11(6)	0.24±0.07(5)	0.49±0.07(6)
H. americanus (lobster)	------------	1.17±0.44(5)	----	
M. arenaria (soft shell clam)	0.14(1)	0.14(1)	-------	

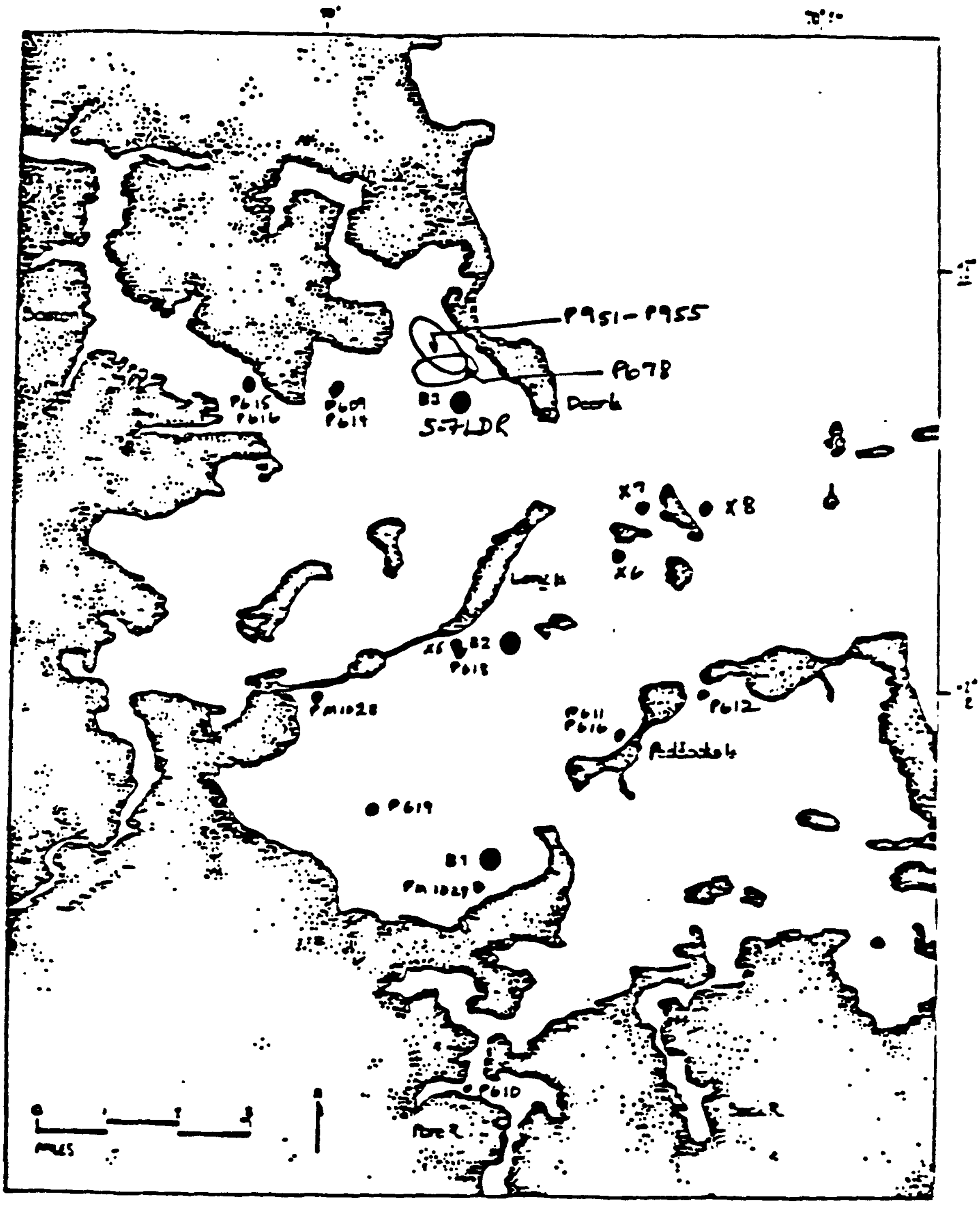


FIGURE B-4 Division of Marine Fisheries Boston Harbor sample sites.

SOURCE: Schwartz, J. ,1987; and Cat Cove Marine Laboratory (DMF) Unpublished Data, 1983-86.

TABLE B-V 1

(See Figures B-5 1 and B-5.2)

Boehm, et al (1984) "ORGANIC POLLUTANT BIOGEOCHEMISTRY STUDIES...... ."

FROM TABLE 9 "SUMMARY OF PCB DATA ON ANIMAL TISSUES" (pg32)

SPECIES	STATION	TOTAL PCB CONCENTRATION WET WEIGHT (µg/g)	DRY WEIGHT (µg/g)	LIPID WEIGHT (µg/g)
Cancer Crab				
(soft parts)	BH-2	0.242	0.982	200
	BH-5	0.279	1.25	238
	BH-6	0.235	0.876	256
	MB-1	0.065	0.278	178
	CC-1	0.143	0.461	92
	CC-2	0.140	0.650	110
Winter Flounder				
(edible flesh)	BH-1	0.135	0.613	37
	BH-2(triplicate)	.0941±.009	0.385±.035	18±1.6
	BH-5	0.093	0.337	17
	BH-6	0.090	0.353	15
	MB-1	0.065	0.116	14
Dab				
(edible flesh)	6,MB stations	0.01-0.034	0.045-0.134	2.1-6.6

TABLE B-V-1 PAH CONCENTRATIONS IN ANIMALS - CRABS (ng/g dry weight)

PAH Compounds	STATION					
	BH-2	BH-5	BH-6	MB-1	CC-1	CC-2
Naphthalene (N)	16	10	12	11	4	7
C_1N	2	44	7	3	nd	1
C_2N	31	28	9	15	1	1
C_3N	nd	nd	3	nd	nd	nd
C_4N	nd	nd	1	nd	nd	nd
Biphenyl	7	4	3	4	1	3
Fluorene (F)	nd	1	1	nd	nd	nd
C_1F	nd	8	nd	nd	nd	nd
C_2F	nd	13	nd	nd	nd	nd
C_3F	nd	4	nd	nd	nd	nd
Phenanthene (P)	5	25	30	3	1	4
C_1P	1	9	17	nd	nd	nd
C_2P	nd	5	9	nd	nd	nd
C_3P	83	280	nd	nd	nd	nd
C_4P	nd	nd	nd	nd	nd	nd
DBT (Dibenzothiophene)	nd	<1	1	nd	nd	nd
C_1DBT	nd	6	1	nd	nd	nd
C_2DBT	nd	4	nd	nd	nd	nd
C_3DBT	nd	3	nd	nd	nd	nd
Flouranthrene	nd	2	6	nd	nd	nd
Pyrene	nd	11	11	nd	nd	nd
Benzanthraocene	nd	nd	nd	2	nd	nd
Chrysene	nd	nd	nd	<1	nd	nd
Benzofluoranthene	nd	11	11	nd	nd	nd
Benzo(e)pyrene	nd	nd	nd	1	nd	nd
Benzo(a)pyrene	nd	nd	nd	22	nd	nd
Total PAH	145	457	111	61	7	16

nd = less than 1ng/g

(SEE FIGURE B-5.2)

SOURCE: Boehm et. al., 1984.

TABLE B-V-2 PAH CONCENTRATIONS IN ANIMALS - WINTER FLOUNDER (ng/g dry weight)

PAH Compounds	STATION BH-1	BH-2	BH-3	BH-5	BH-6	MB-1
Naphthalene (N)	3	1	nd	nd	nd	nd
C_1N	nd	nd	nd	nd	nd	nd
C_2N	nd	nd	nd	nd	nd	nd
C_3N	nd	nd	nd	nd	nd	nd
C_4N	nd	nd	nd	nd	nd	nd
Biphenyl	nd	2	nd	nd	1	2
Fluorene (F)	nd	nd	nd	nd	nd	nd
C_1F	nd	nd	nd	nd	nd	nd
C_2F	nd	nd	nd	nd	nd	nd
C_3F	nd	nd	nd	nd	nd	nd
Phenanthene (P)	1	1	1	nd	1	8
C_1P	nd	nd	nd	nd	nd	nd
C_2P	nd	nd	nd	nd	nd	nd
C_3P	nd	nd	nd	nd	nd	nd
C_4P	nd	nd	nd	nd	nd	nd
DBT (Dibenzothiophene)	nd	nd	nd	nd	nd	8
C_1DBT	nd	nd	nd	nd	nd	nd
C_2DBT	nd	nd	nd	nd	nd	nd
C_3DBT	nd	nd	nd	nd	nd	nd
Flouranthrene	1	nd	nd	nd	nd	8
Pyrene	nd	nd	nd	nd	nd	nd
Benzanthraocene	nd	nd	nd	nd	nd	8
Chrysene	nd	nd	nd	nd	nd	nd
Benzofluoranthene	nd	nd	nd	nd	nd	8
Benzo(e)pyrene	nd	nd	nd	nd	nd	nd
Benzo(a)pyrene	nd	nd	nd	nd	nd	nd
Total PAH	5	4	1	nd	2	10

nd = less than 1ng/g

(SEE FIGURE B-5.2)

:E: Boehm et. al., 1984.

TABLE B-V-3 PAH CONCENTRATIONS IN ANIMALS - DABS (ng/g dry weight)

PAH Compounds	STATION					
	MB-3	MB-4	MB-6	MB-10	MB-13	MB-
Naphthalene (N)	3	nd	nd	2	nd	5
C_1N	nd	nd	nd	nd	nd	nd
C_2N	nd	nd	nd	nd	nd	nd
C_3N	nd	nd	nd	nd	nd	nd
C_4N	nd	nd	nd	nd	nd	nd
Biphenyl	1	nd	nd	nd	nd	1
Fluorene (F)	nd	nd	nd	nd	nd	nd
C_1F	nd	nd	nd	nd	nd	nd
C_2F	nd	nd	nd	nd	nd	nd
C_3F	nd	nd	nd	nd	nd	nd
Phenanthene (P)	6	nd	nd	nd	1	nd
C_1P	2	nd	nd	nd	nd	nd
C_2P	nd	nd	nd	nd	nd	nd
C_3P	nd	nd	nd	nd	nd	nd
C_4P	nd	nd	nd	nd	nd	nd
DBT (Dibenzothiophene)	nd	nd	nd	nd	nd	nd
C_1DBT	nd	nd	nd	nd	nd	nd
C_2DBT	nd	nd	nd	nd	nd	nd
C_3DBT	nd	nd	nd	nd	nd	nd
Flouranthrene	nd	nd	nd	nd	nd	nd
Pyrene	nd	nd	nd	nd	nd	nd
Benzanthraocene	nd	nd	nd	nd	1	nd
Chrysene	nd	nd	nd	nd	nd	nd
Benzofluoranthene	nd	nd	nd	nd	nd	nd
Benzo(e)pyrene	nd	nd	nd	nd	nd	nd
Benzo(a)pyrene	nd	nd	nd	nd	nd	nd
Total PAH	12	nd	nd	2	1	6

nd = less than 1ng/g

(SEE FIGURE B-5.2)

SOURCE: Boehm et. al., 1984.

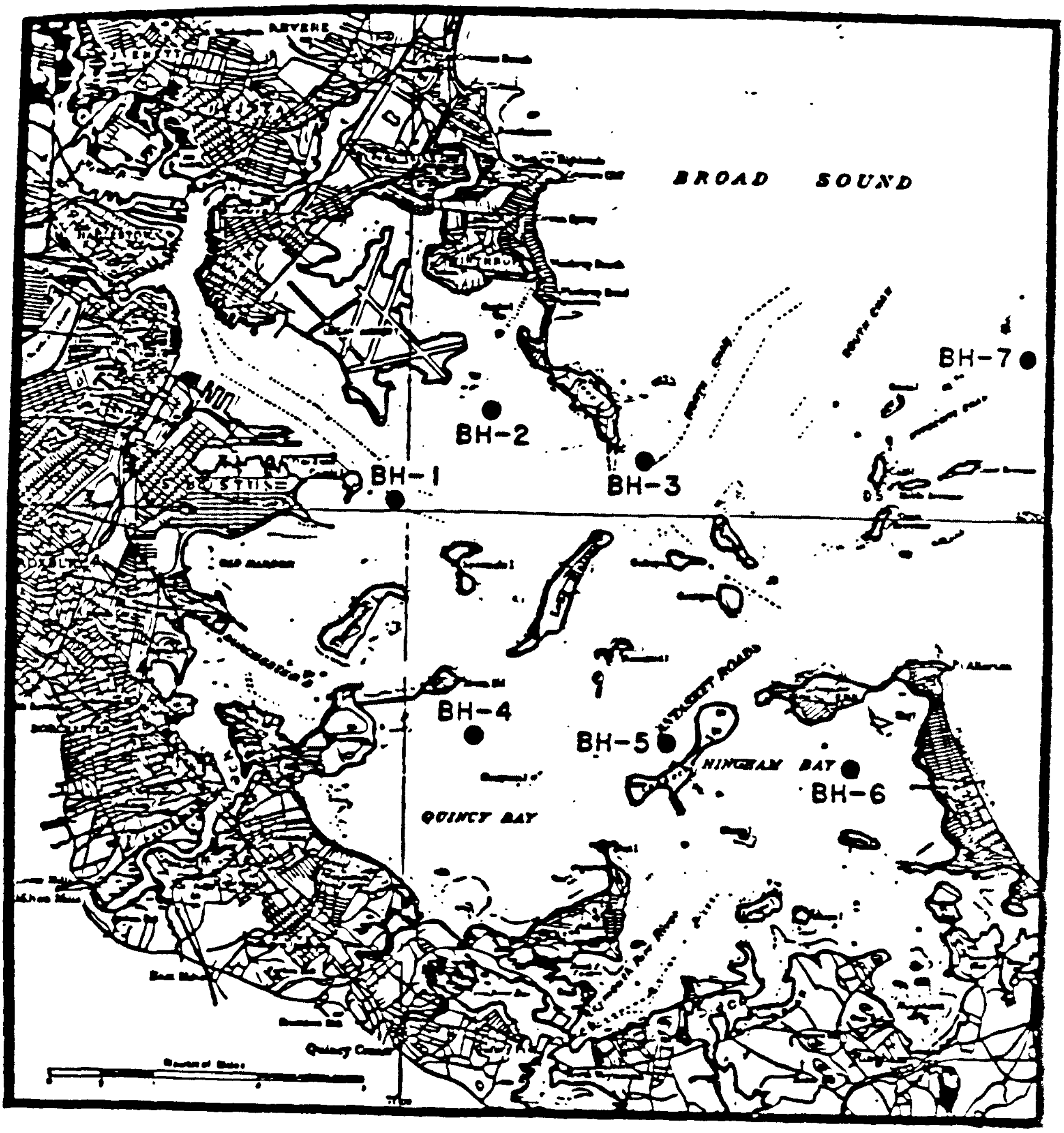


FIGURE B-5.1 Locations of Boston Harbor (BH) Sampling Stations.

SOURCE: Boehm et. al., 1984.

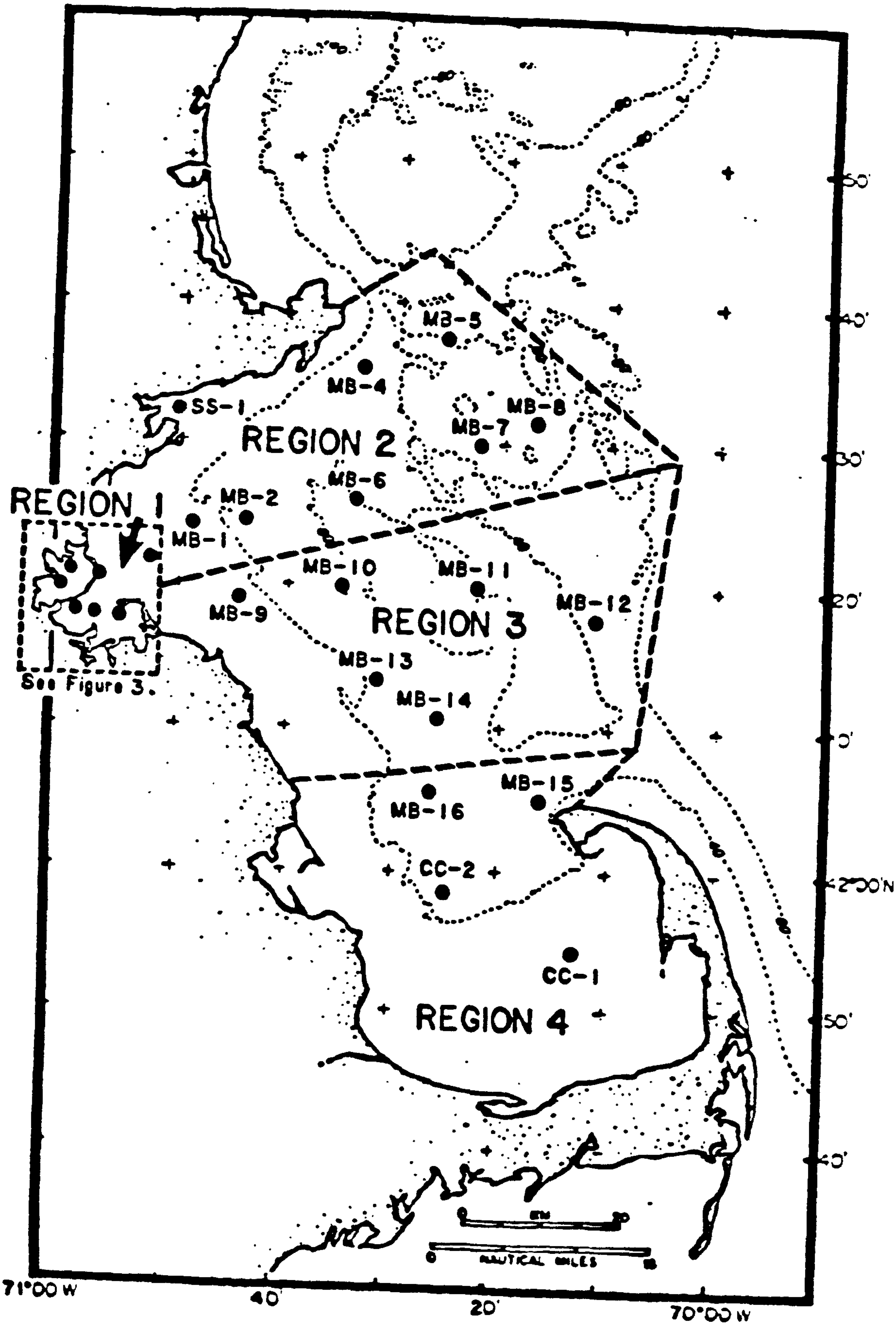


FIGURE B-5.2 Locations of Sampling Stations in Massachusetts Bay (MB) and Cape Cod (CC): R/V Mya 27 June- 6 July 1983.

SOURCE: Boehm et. al., 1984

Table B-VI.1 AVERAGE DRY WEIGHT CONCENTRATIONS (ppm) OF CONCENTRATIONS OF PRIORITY POLLUTANTS MEASURED IN *Mytilus edulis* EXPOSED FOR 34 DAYS AT NUT ISLAND OUTFALL AND AT CONTROL SITE, AUGUST 1984

	Ag	As	Be	Cd	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	Zn	PCB 1254	Methylene Chloride
Control site at start of exposure	0.37	2.37	<0.1	0.28	0.35	1.93	0.018	0.37	1.13	<0.8	0.99	<0.8	36	0.633	16
Control site at end of exposure	0.26	3.93	<0.16	0.22	0.19	1.67	0.013	0.39	0.75	<0.8	0.56	<0.8	27	0.133	25
Nut Island Outfall - inside ZID and inside plume	0.57	2.30	<0.1	0.59	0.70	3.37	0.035	0.42	2.36	<0.5	0.93	<0.6	44	0.700	24
One mile NE of Nut Island Outfall, at ZID Boundary	0.29	2.23	<0.1	0.24	0.64	2.87	0.032	0.35	2.13	<0.5	0.89	<0.5	47	0.500	28
Ratio of concentration inside ZID (in plume) at Nut Island to control site at initiation of exposure	1.5	0.9		2.1	2.1	1.7	1.9	1.1	2.1		0.9		1.2	1.1	1.4

SOURCE: Metcalf and EDDY, Inc. "Summer Supplement" for Waiver Application, 1984.

Table B-VI.2 AVERAGE CONCENTRATIONS OF METALS IN *MYTILUS EDULIS* EXPOSED FOR 34 DAYS - BIOMONITORING STUDY, NUT ISLAND OUTFALL JULY 1984
(ppm wet weight)

Station	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Control at initiation of exposure	0.188	1.200	0.143	0.177	0.97	0.009	0.287	0.59	0.500	18.3
Control at end of exposure	0.150	3.067	0.123	0.157	0.130	0.010	0.317	0.60	0.710	22.0
Nut Island ZID Boundary (Station NO)	0.183	1.467	0.160	0.417	1.87	0.021	0.230	1.40	0.590	31.3
Nut Island Outfall in Plume, in ZID (Station NIB)	0.377	1.467	0.177	0.450	2.13	0.022	0.270	1.53	0.597	28.0
Marine Invertebrate Concentration Factor, ppb (a)	3,330	333	250,000	2,000	1,670	100,000	259	200	400	100,000
Calculated Control Ambient Water Concentration, ppb (b)	4.5×10^{-2}	10.0	4.9×10^{-4}	7.8×10^{-2}	7.7×10^{-1}	1.0×10^{-4}	1.2	3.0	1.7	2.2×10^{-1}
Calculated in ZID Ambient Water Concentration, ppb (c)	1.13×10^{-1}	4.4	7.0×10^{-4}	2.2×10^{-1}	1.27	2.2×10^{-4}	1.0	10.0	1.5	2.8×10^{-1}
Salt Water Quality Criteria, ppb (d)	-	-	4.5	18	4.0	0.025	7.1	25.0	54	59

(a) = Callahan et al., 1979
(b) = Average metal concentration (expressed in ppb) in *Mytilus edulis* from Nut Island Outfall Plume Station divided by EPA marine invertebrate concentration factor.
(c) = Average Metal Concentration (expressed in ppb) in *Mytilus edulis* from Control (at end of exposure) divided by EPA marine invertebrate concentration factor.
(d) = U.S. EPA 24 hour Ambient Water Quality Criteria for the protection of salt water life (ppb).

SOURCE: Metcalf and EDDY, Inc. "Summer Supplement" for Waiver Application 1984

TABLE B-VII

Selected Data from "Status and Trends" Fish Liver Contaminant Analyses (NOAA,1984 Unpublished data. Trace Metal data believed to be µg/g) Boston Harbor station located off Deer Island.

Mean concentration , µg/g of trace metals in Flounder liver from Boston Harbor Station:

Cr	Ni	Cu	Zn	Se	Ag	Cd	Hg	Pb
0.26	0.29	15.10	86.08	3.02	0.7	0.14	0.12	0.63

Mean concentration of DDT residues in fish liver from Boston Harbor station: 827.23 ng/g

Mean Concentration of PCB's in fish liver from Boston Harbor station: 10,486.91 ng/g

Frequency of "proliferative disorders " in fish taken at Boston Harbor station in 1984(NOAA, National Status and Trensd Progress report, 1987):

Biliary hyperplasia :10%
Neoplasia : 13%