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ACUSHNET RIVER ESTUARY
NEW BEDFORD HARBOR SUPERFUND PROJECT
WETLANDS ASSESSMENT

Prepared for

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EXECUTIVE SUMMARY

The presence of high levels of PCBs and heavy metals in the New Bedford Harbor system and especially within the Inner Harbor and upper Acushnet estuary is generally viewed as the major environmental issue within New Bedford Harbor. Two remedial alternatives, (1) hydraulic control and (2) dredging with disposal in an in-harbor containment site, were proposed by NUS (1984) to eliminate the source of metal and PCB contamination in the Acushnet River estuary north of the Coggeshall Street Bridge. This work area is located within the communities of New Bedford, Acushnet, and Fairhaven. The hydraulic control alternative would attempt to contain contaminated sediments in-place by covering them with clean materials. The in-harbor containment alternative would require dredging contaminated sediments and isolating them within a controlled shoreline disposal site.

Physical and chemical measurements of selected biotic and abiotic features in the Acushnet River estuary and a nearby control site were examined. Sediment contaminant levels (PCBs, Cr, Cu, Pb, and Zn) within the tidal wetlands of the estuary and the tidal wetlands located at nearby Pope Beach were evaluated. Wetland vegetational and faunal communities within both areas were characterized.

Although heavy metal contaminant levels within the Pope Beach tidal wetlands were similar to those obtained for the Acushnet River estuary, PCB levels were substantially lower in tidal wetland sediments of Pope Beach (undetectable to 4.1 ppm) than in the estuary's tidal wetlands (0.15 to 1900 ppm). The concentration of heavy metals and PCBs were greatest within the sediments in the northern half of the estuary. A comparison of the Pope Beach and Acushnet River estuary wetlands suggests that

the structural characteristics of the estuary wetlands have not been altered by the PCB contaminant levels. The wetlands within the Acushnet River estuary appear to represent a diverse and productive system.

Samples for three selected food chains were collected and analyzed for selected contaminants. Levels of PCB in tissue samples collected in the upper Acushnet River estuary indicate that PCB materials and heavy metals (Cr, Cu, Pb, and Zn) are bioaccumulating within the tissue of selected organisms. Results suggest that biomagnification of PCBs is occurring within the three food chains studied, however, the heavy metals analyzed did not exhibit a similar trend.

Although information regarding the effects of quantitative amounts of PCBs on wildlife species is sparse, toxic effects from PCBs to terrestrial species located in the lower trophic levels is not anticipated. Aquatic organisms would be more susceptible due to exposure from contaminants within the water column and sediments. Species higher in the food chain may be presently exposed to adverse levels of PCBs within the estuary.

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1.0 INTRODUCTION

1.1 REPORT OBJECTIVES

Sanford Ecological Services (SES) has been directed by the U.S. Army Corps of Engineers, New England Division (NED), under Contract DACW33-85-D-0002 and Delivery Order No. 0026 to prepare a wetland assessment for the Acushnet River estuary, New Bedford Harbor, Massachusetts (Figure 1-1). Two remedial action alternatives have been prepared for the Environmental Protection Agency by NUS Corporation (NUS 1984) to address contamination within the Acushnet River estuary north of the Coggeshall Street Bridge. These remedial action alternatives are described in Section 2.0 of this assessment. Contaminants within the estuary include reportedly high levels of polychlorinated biphenyls (PCBs) and heavy metals, e.g., copper, chromium, lead, and zinc (Weaver 1982, NUS 1984).

Because the Acushnet River estuary wetlands are not isolated systems, but are components of the overall estuarine system, both wetland specific and system-wide information including physical, chemical, and biotic conditions must be examined (Section 3.0). An impact assessment of the NUS remedial action alternatives is described in Section 7.0; and actions which would lessen or mitigate for unavoidable impacts are listed in Section 8.0. Since the proposed remedial action plans would eliminate much of the wetland system within the estuary, it is appropriate to examine the functional integrity of the wetlands (see Section 6.0). Although the wetlands within the Acushnet River estuary may be contaminated, they may still function similarly to a less contaminated wetland. For example, do these wetlands support a viable and productive community of organisms when compared with a similar but less contaminated wetland (see Section 4.0 and 5.0). Since the remedial action alternatives will impact aquatic and wetland systems, they are evaluated under the Section 404(b)(1) guidelines of the Clean Water Act.

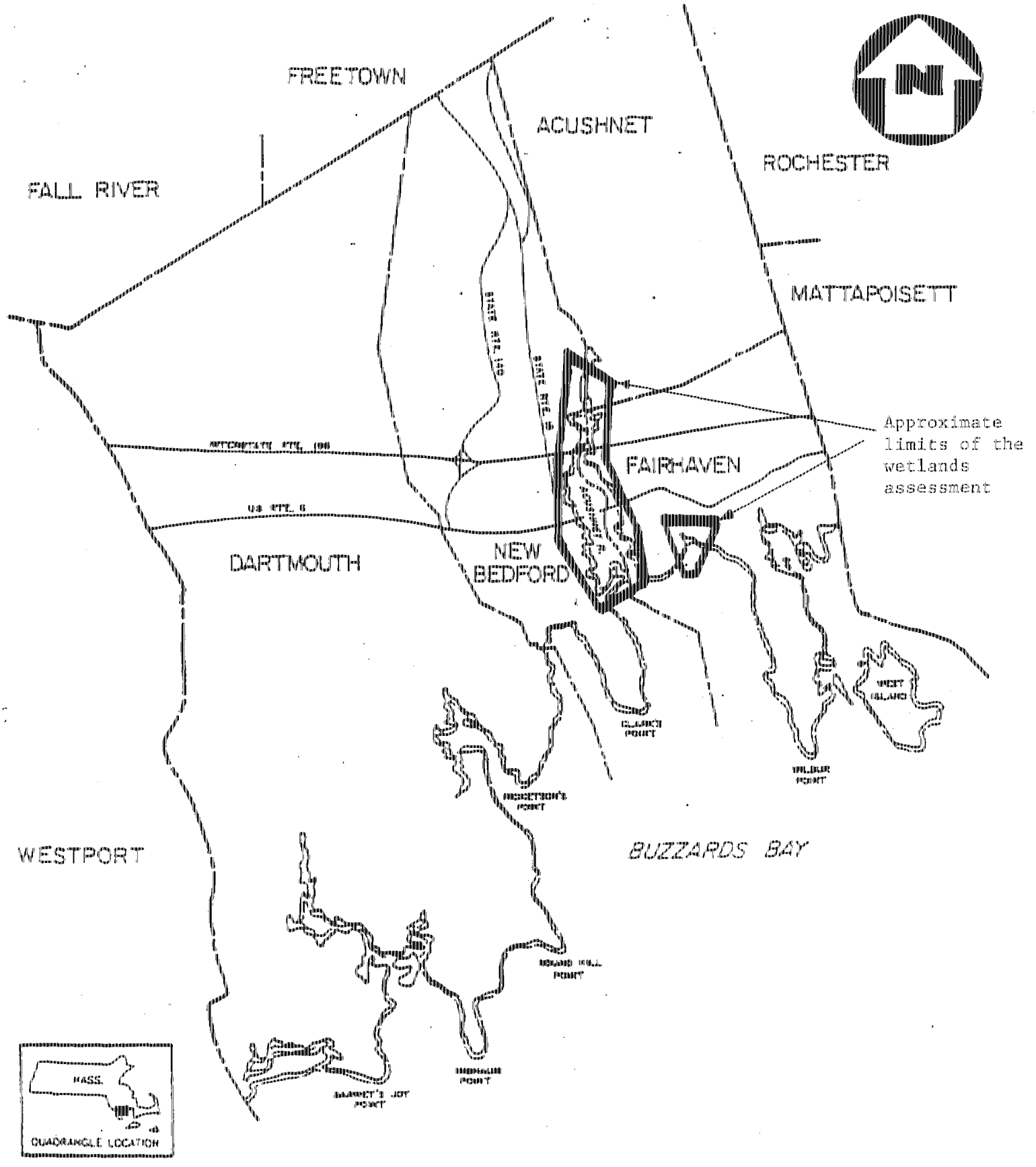


Figure 1-1. Limits of the Study Area - Acushnet, Fairhaven, and New Bedford, Massachusetts. (NUS 1984)

LIMITS OF STUDY AREA

NEW BEDFORD SITE, NEW BEDFORD, MA

SCALE: 1" = 2.2 MILES

1.2 PROJECT LOCATION, CHARACTER, AND PURPOSE

Remedial action is proposed for the upper Acushnet River estuary, extending northward from the Coggeshall Street Bridge to the Tarklin Hill Road Bridge. The proposed work area is located within the communities of New Bedford, Acushnet, and Fairhaven (Figure 1-1). Habitat investigated within the remedial action site includes open water, mudflats, wetlands, and some upland areas which extend into the wetland habitat.

In addition, two small tidal marshes located south of the I-195 bridge were also investigated (Figure 1-2). These marshes, however, are not within the most contaminated, "hot spot" area, of the Acushnet River estuary. For comparative purposes, a tidal marsh and mudflat system on Buzzards Bay was investigated. This inlet and associated tidal marsh is marked Pope Beach on USGS maps and lies southeast of Fairhaven and southwest of East Fairhaven.

Two remedial alternatives, (1) hydraulic control and (2) dredging with disposal in an in-harbor containment site, were proposed by NUS (1984) to eliminate the source of metal and PCB contamination in the Acushnet River estuary north of the Coggeshall Street Bridge (see Section 2.0). Both alternatives would attempt to isolate contaminated materials in a way that would eliminate or minimize the potential for human exposure and exposure to biotic communities. The "non-removal action" (hydraulic control alternative) would attempt to contain contaminated sediments in-place by isolating sediments from the resuspension and transport action of the Acushnet River estuary. The "non-removal action" would be accomplished by covering the contaminated sediments with clean materials. The "removal action" (in-harbor containment) would require dredging contaminated sediments and isolating them within a controlled shoreline disposal site.

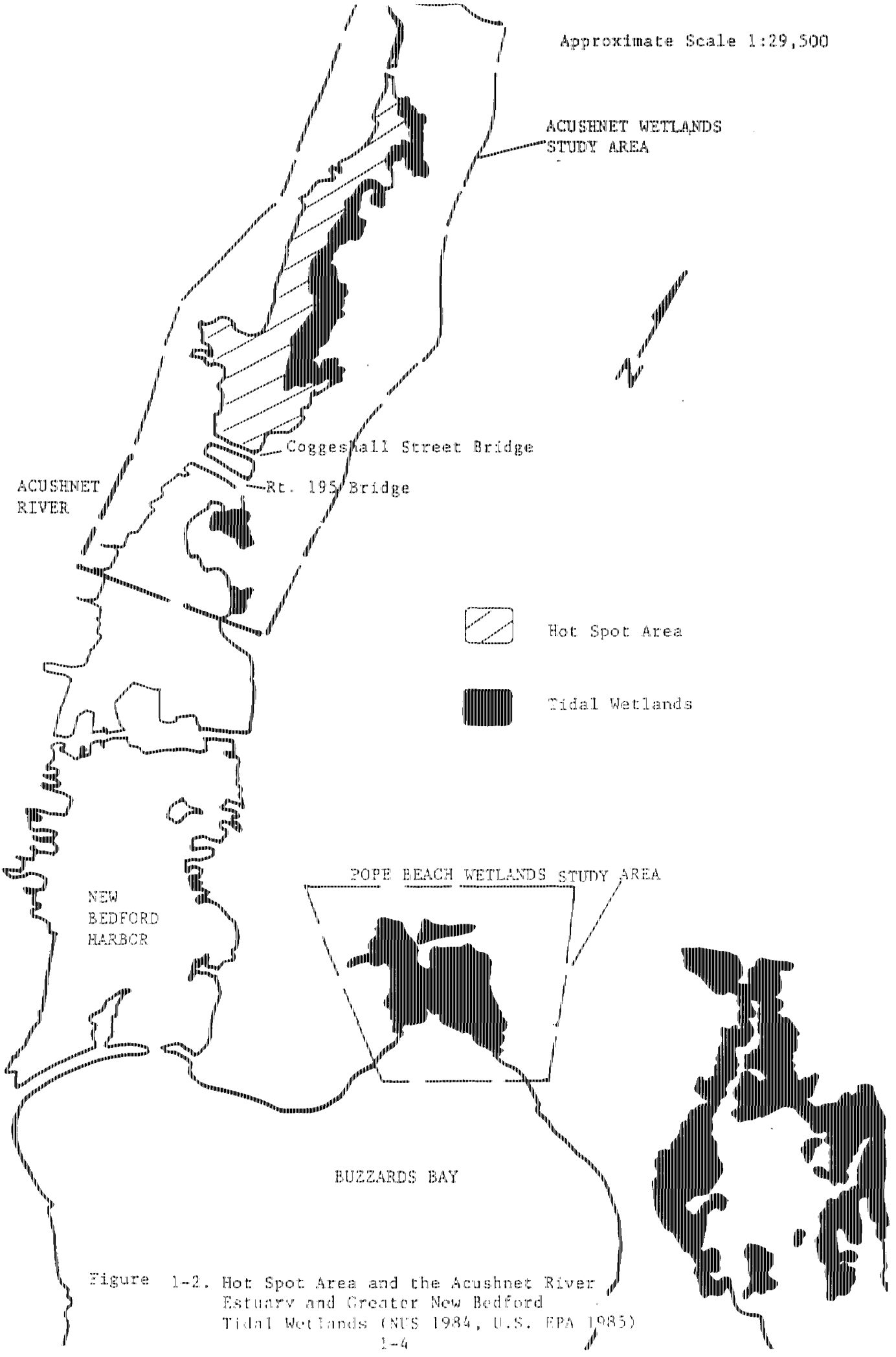


Figure 1-2. Hot Spot Area and the Acushnet River Estuary and Greater New Bedford Tidal Wetlands (NUS 1984, U.S. EPA 1985)

The Acushnet River estuary wetland assessment and associated 404 (b)(1) considerations have been structured to address the categories of information that must be considered in balancing the value of the wetlands with any adverse effects that may be associated with the proposed remedial actions.

2.0 PROJECT ALTERNATIVES

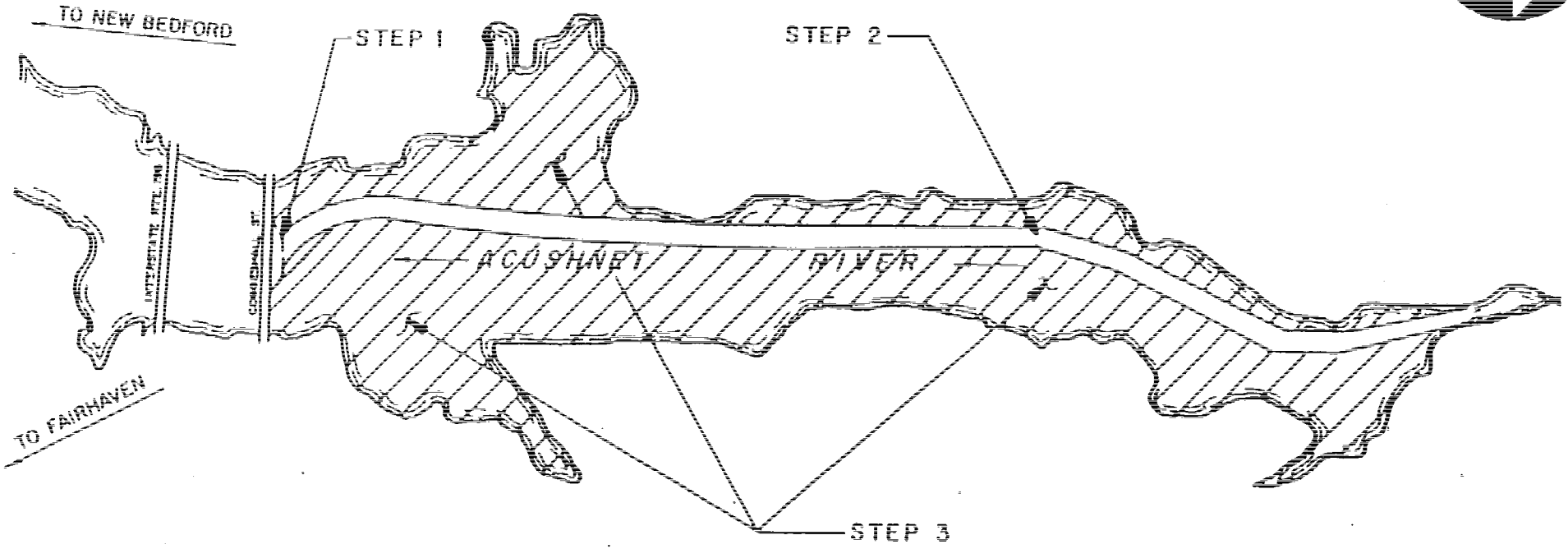
Project alternatives include no action, and two remedial alternatives - hydraulic control, and dredging with disposal in an in-harbor containment site (NUS 1984).

2.1 NO ACTION

Under the no action alternative, existing levels of PCB and heavy metal contamination would be present for an extended period of time in the sediment, water, biota, and air of the Acushnet River estuary. The migration of contaminants downstream and the potential for exposing humans and other biotic communities to these contaminants via the food chain would not be eliminated in the near future. Over time some isolation of the contaminated sediments within the estuary would occur due to the deposition of cleaner sediments from the Acushnet River. A substantial amount of cleaner sediment (>9 cm) would have to be deposited before the contaminated sediments were out of the zone of biologically induced sediment mixing (bioturbation) (Whitlach 1982). Bioturbation has the potential to greatly modify the chemical properties of surficial sediments and to re-expose contaminated sediments to the soil/water interface.

2.2 HYDRAULIC-CONTROL ALTERNATIVE

The hydraulic control alternative (non-removal) would use a lined earthen and rock fill channel to isolate the freshwater flows of the Acushnet River from the contaminated sediments north of the Coggeshall Street Bridge (Figures 2-1 and 2-2). The channel would be constructed to a height above the flood elevation to prevent overtopping. However, the height would be lowered south of the Coggeshall Street Bridge to allow tidal exchange with the lower harbor. The bypass channel would isolate the contaminated sediments from resuspension and

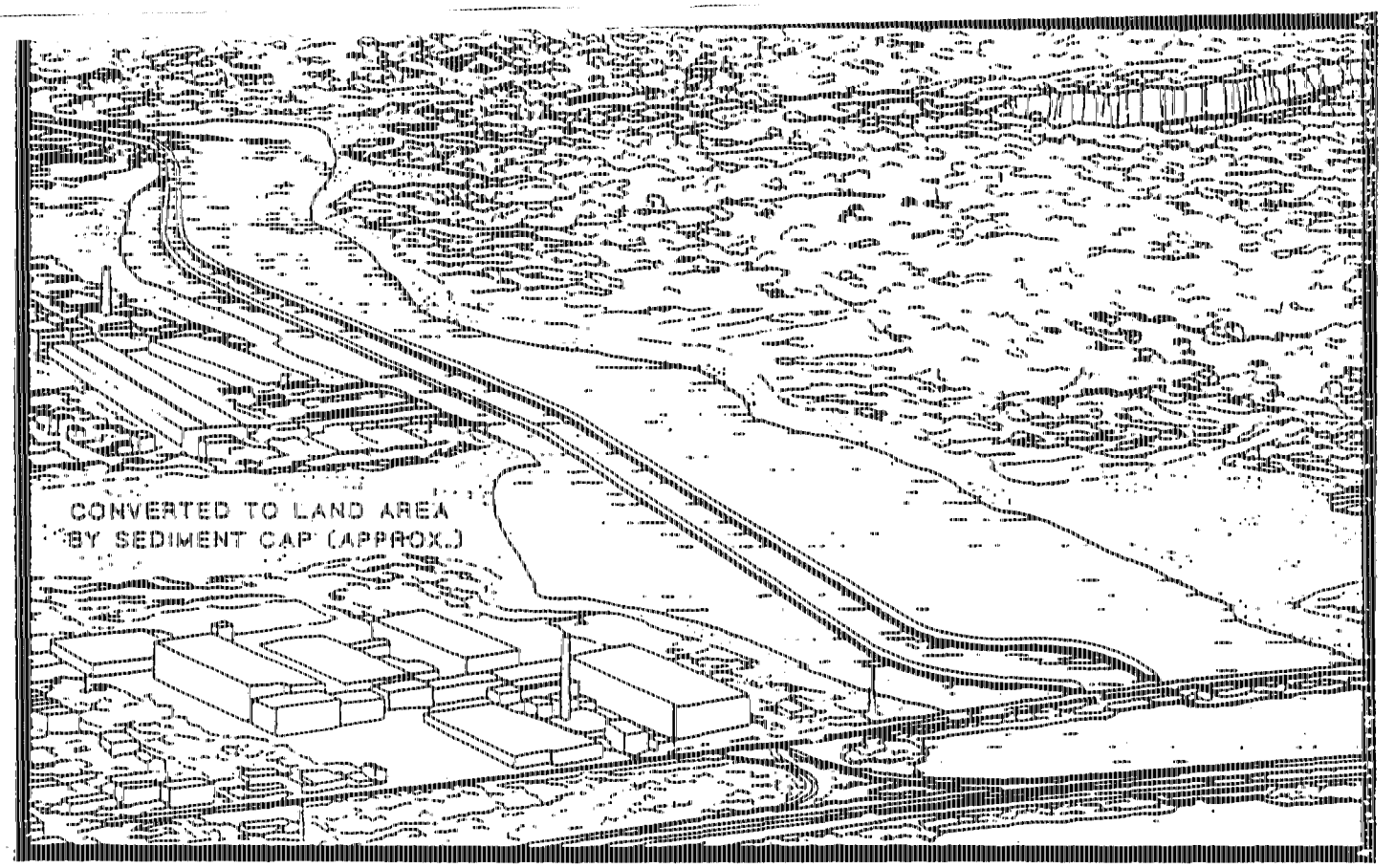


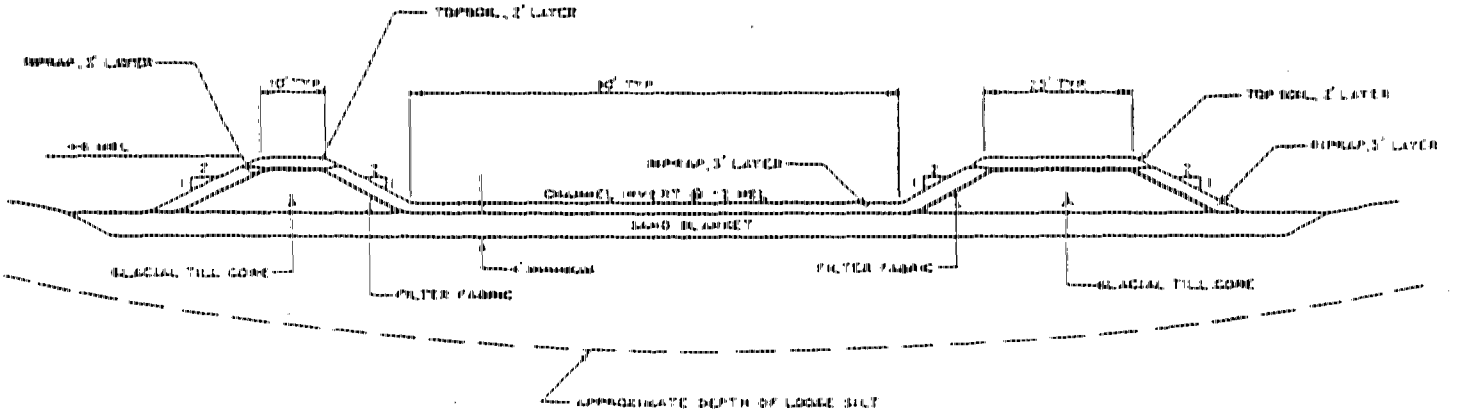
STEP 1- INSTALL SEDIMENT DISPERSAL CONTROL.

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

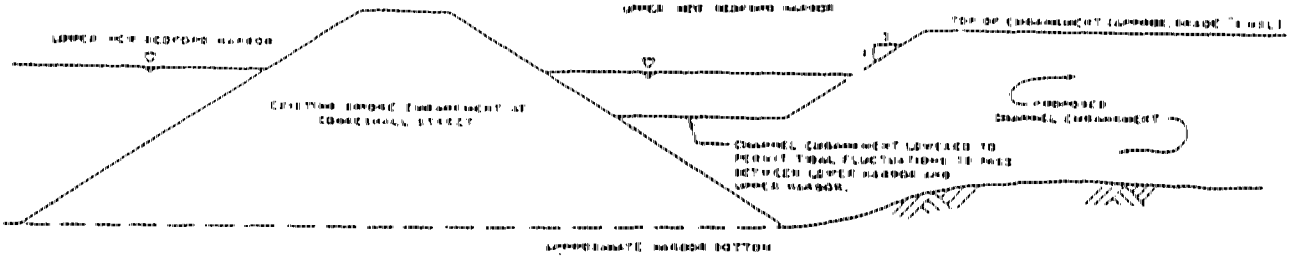
STEP 3- CAP SEDIMENTS.

Figure 2-1. PLAN VIEW OF HARBOR ILLUSTRATING HYDRAULIC CONTROL ALTERNATIVE NEW BEDFORD SITE, NEW BEDFORD, MA (NUS 1984)





TYPICAL CHANNEL CROSS-SECTION



CHANNEL PROFILE NEAR BRIDGE

Figure 2-2. ARTIST'S CONCEPTION AND TYPICAL CROSS-SECTIONS HYDRAULIC CONTROL ALTERNATIVE (NUS 1984)

transport by the river flow. The harbor bottom in the remaining open water areas (and wetlands) would be covered with approximately 1.2 meters (4 feet) of clean sediments to isolate the contaminated sediments from the water column.

2.3 DREDGING WITH DISPOSAL IN AN IN-HARBOR CONTAINMENT SITE

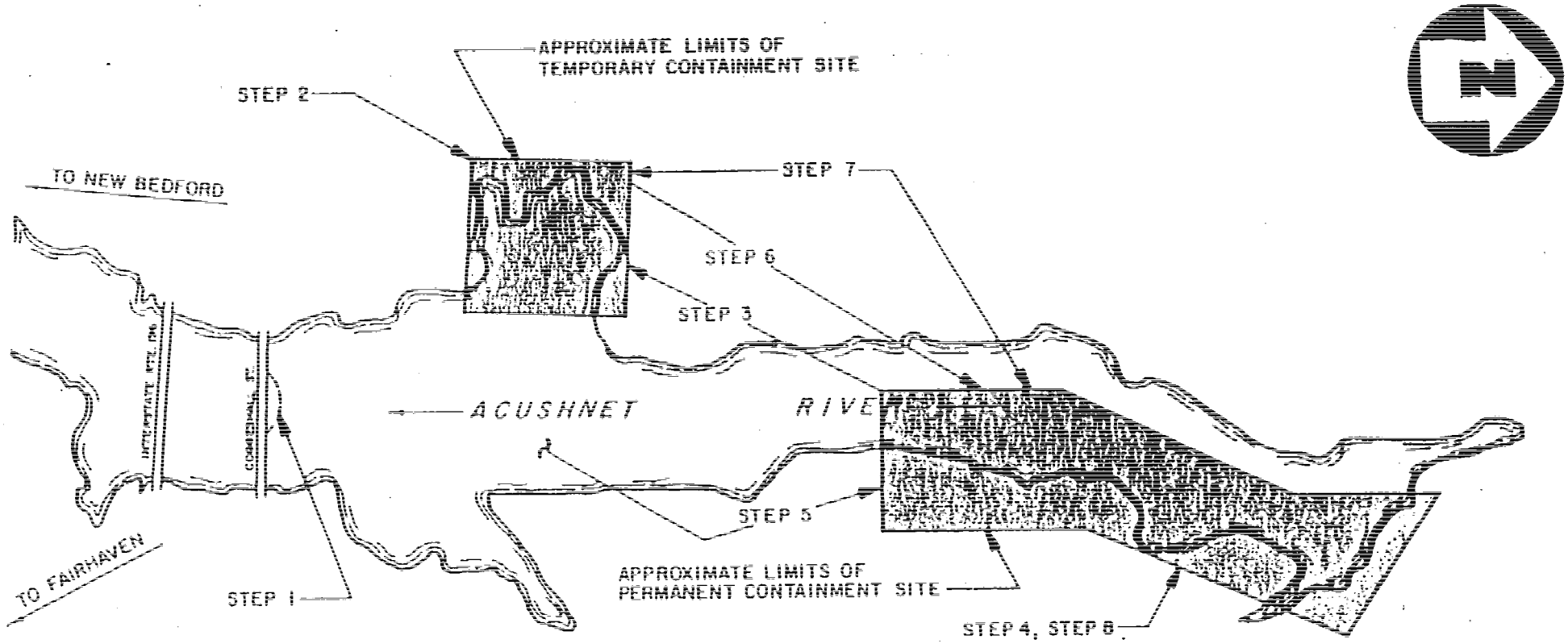
This remedial alternative would require dredging [all] sediments which contain 1 ppm or more of PCB (NUS 1984). A permanent in-harbor containment site would be constructed on the eastern shore of the upper estuary to isolate the contaminated sediments (Figure 2-3 and 2-4). The placement of an impermeable liner beneath the permanent containment site is an additional option with this alternative. Before hydraulic dredging operations commence, sediment dispersal control structures (e.g., sheet piling and a double silt curtain) would be placed just south of the Coggeshall Street Bridge.

2.3.1 Unlined, In-Harbor Containment Site

Sediments from the location of the proposed permanent containment site embankment would be pumped to a temporary containment site on the western shore of the upper estuary (Figure 2-3). An earthen embankment would be constructed around the permanent containment area located along the eastern shoreline of the upper harbor (Figure 2-4). Contaminated sediment (1 ppm PCB or greater) outside the embankment and the previously dredged sediment in the temporary containment site would then be pumped into the permanent containment site, dewatered, and capped with clean fill.

2.3.2 Lined, In-Harbor Containment Site

In addition to the procedures described above, this remedial alternative would place an impermeable membrane liner beneath



STEP 1 - INSTALL SEDIMENT DISPERSAL CONTROL.

STEP 2 - CONSTRUCT TEMPORARY CONTAINMENT SITE.

STEP 3 - DREDGE BENEATH EMBANKMENT. HOLD IN TEMPORARY CONTAINMENT SITE.

STEP 4 - CONSTRUCT PERMANENT CONTAINMENT SITE.

STEP 5 - DREDGE - DISPOSE IN PERMANENT CONTAINMENT SITE.

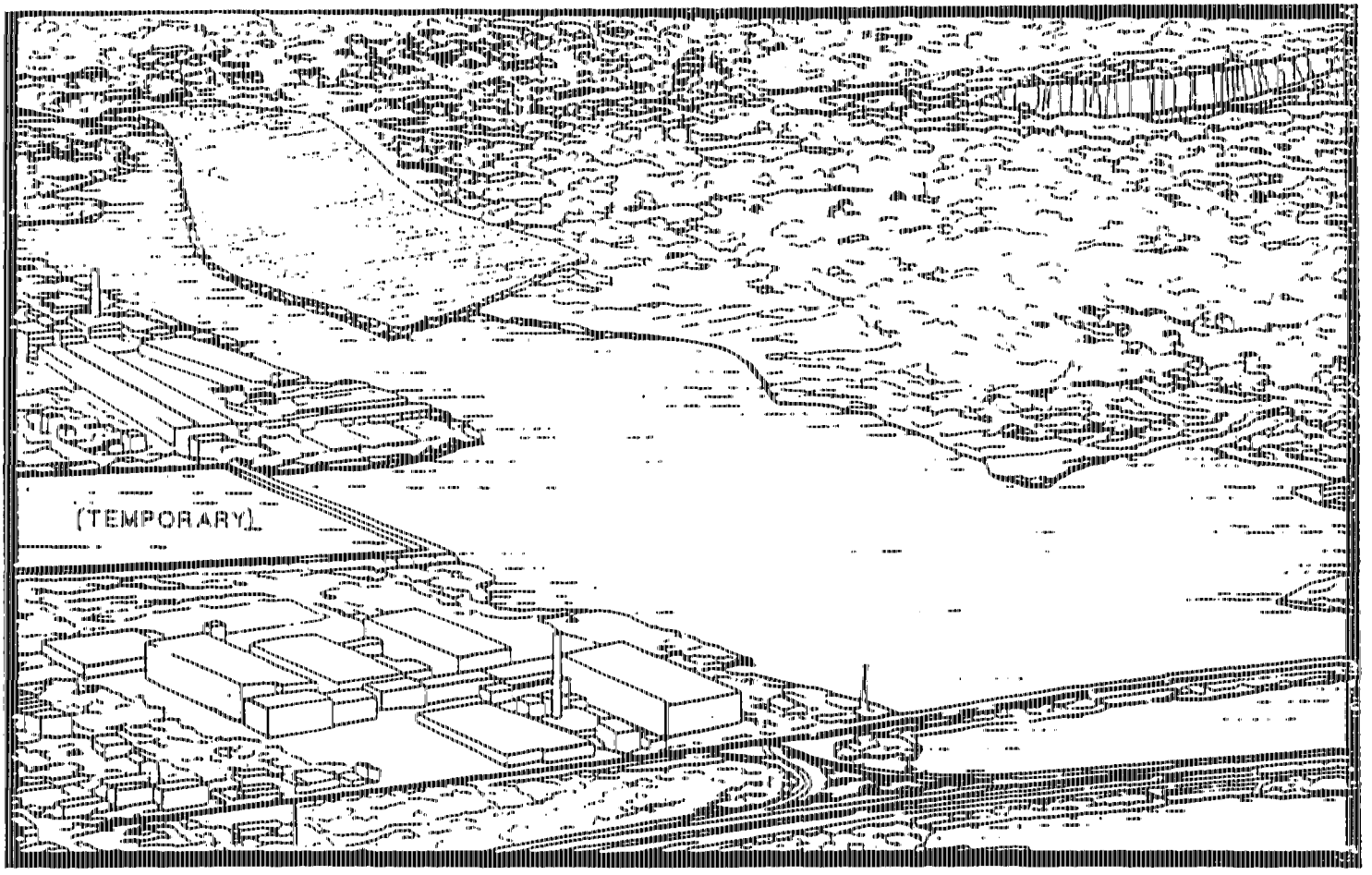
STEP 6 - TRANSPORT SEDIMENTS FROM TEMPORARY CONTAINMENT SITE TO PERMANENT CONTAINMENT SITE.

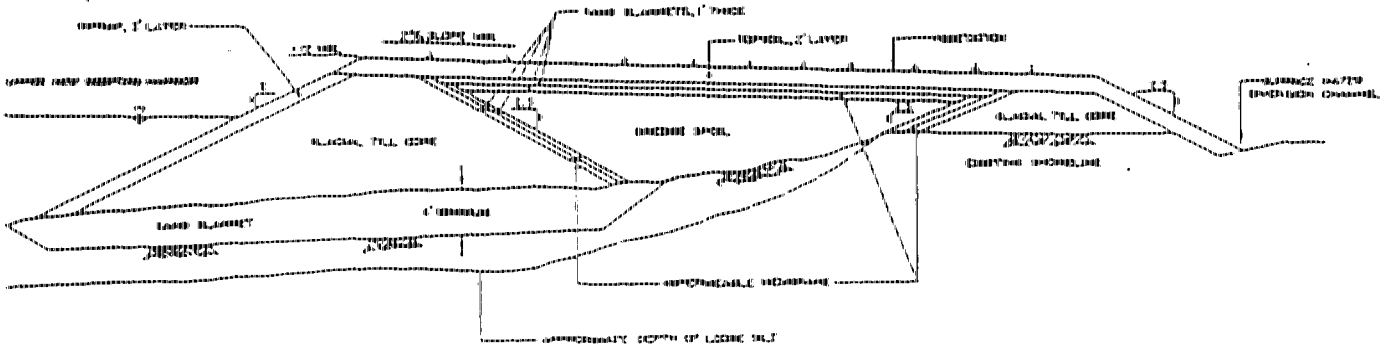
STEP 7 - TREAT WATER.

STEP 8 - CAP CONTAINMENT SITE.

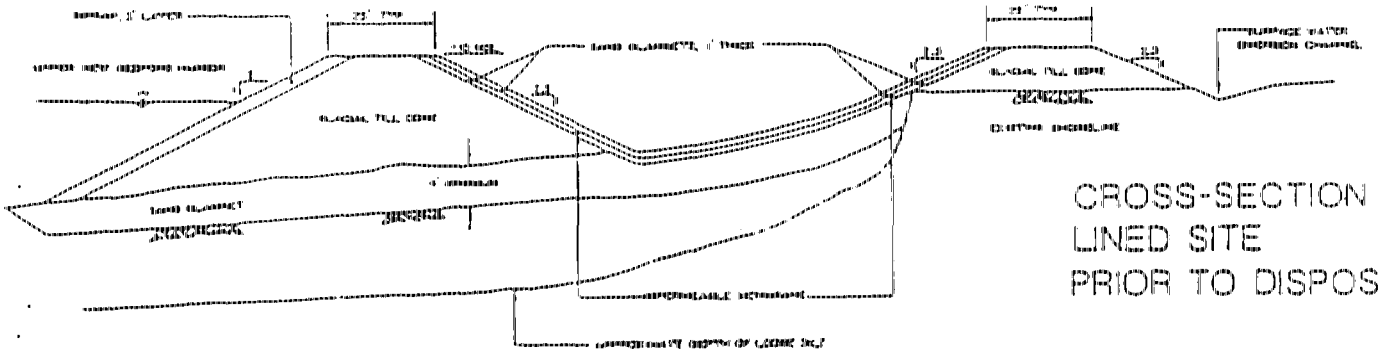
Figure 2-3.

PLAN VIEW OF HARBOR ILLUSTRATING IN-HARBOR CONTAINMENT ALTERNATIVE NEW BEDFORD SITE, NEW BEDFORD, MA (NUS 1984)





CROSS-SECTION
UNLINED SITE AFTER CAPPING



CROSS-SECTION
LINED SITE
PRIOR TO DISPOSAL

Figure 2-4.

ARTIST'S CONCEPTION
AND TYPICAL CROSS-SECTIONS
IN-HARBOR CONTAINMENT ALTERNATIVE (NUS 1984)

the permanent in-harbor containment site (Figure 2-4). All contaminated sediments beneath the in-harbor containment site would have to be removed and the site dewatered prior to placement of the liner.

3.0 AFFECTED ENVIRONMENT

3.1 PHYSICAL AND CHEMICAL CHARACTERISTICS

The principal water bodies in the greater New Bedford area include the Acushnet River estuary, New Bedford Harbor, and Buzzards Bay. The Acushnet River estuary is part of the Buzzards Bay coastal drainage area and is one of a series of estuaries and bays along the southern coast of Massachusetts (Figure 3-1). The mouth of the Acushnet River, a tidal estuary forming New Bedford Harbor, discharges into the northwestern side of Buzzards Bay. Due to the urbanized nature of New Bedford Harbor and the presence of numerous industrial and urban point and non-point discharges, the water and sediment quality of the Harbor are currently considered to be degraded to various degrees. The presence of high levels of PCBs and heavy metals in the New Bedford Harbor system and especially within the Inner Harbor and upper Acushnet estuary is generally viewed as the major environmental issue within New Bedford Harbor.

This section of the assessment summarizes information on the physical and chemical characteristics of the Acushnet River estuarine system. Information on physical characteristics of the estuary (Sections 3.1.1 and 3.1.4) was obtained from the 1984 draft NUS report unless otherwise referenced. Since the wetlands of the Acushnet River estuary are not an isolated system but part of an overall estuarine system, both site-specific and system-wide information were examined. It is the physical and chemical characteristics of the Acushnet River estuary and wetlands which ultimately influence the distribution of plant and animal species throughout the study area.

3.1.1 Bathymetry of the Upper Acushnet River Estuary

The area of the Acushnet River estuary above the Coggeshall Street Bridge is approximately 81.7 hectares (202 acres) at mean

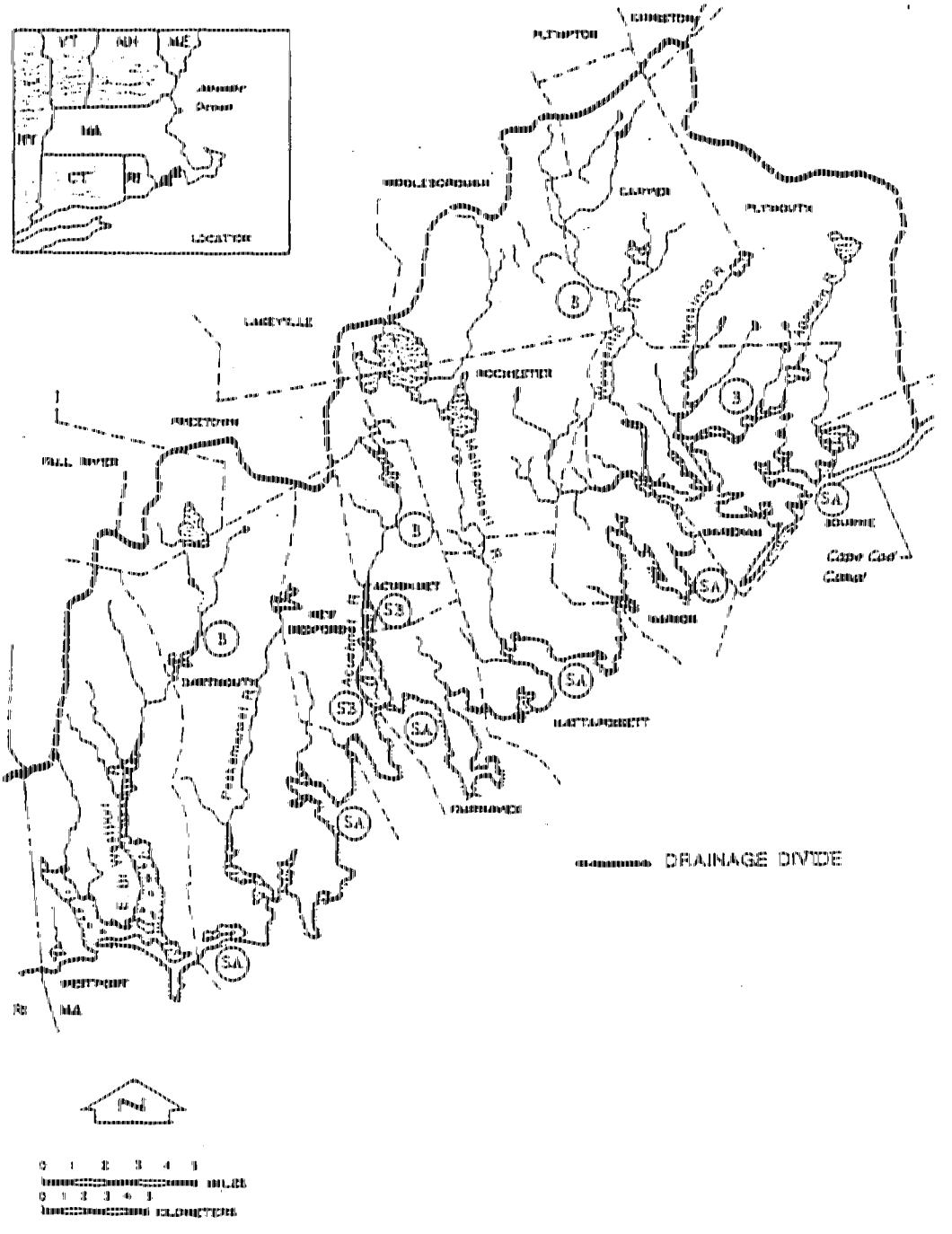


Figure 3-1. Portion of the Buzzards Bay Coastal Drainage Area.

Source: (Commonwealth of Massachusetts, Division of Water Pollution Control, 314 CMR 4.05, 1984)

B, SA, and SB are DWPC water quality classifications

high water (mhw). The width of this portion of the estuary averages 260 to 290 meters (850 to 950 feet), with a minimum width of 91 meters (300 feet) at the head and a maximum width of 670 meters (2,200 feet). The greatest depths are associated with the main channel of the Acushnet River. The main channel has a mean low water (mlw) depth of 5.5 meters (18 feet) at the constricted opening of the Coggeshall Street Bridge then quickly decreases to 1.8 meters (6 feet) and then to 0.6 meter (2 feet) at the head of the estuary. Depths rapidly become shallow both east and west of the main channel, as water depths are commonly less than 0.6 meter (2 feet) below mlw in these areas. Tidal flats are extensive in the upper estuary and are found from approximately -0.3 meter (-1 foot) mlw to +0.3 meter (+1 foot) mlw.

A one-foot contour map was prepared from U.S. Army COE/NED bathymetric data by SES for the most northerly portion of the upper estuary (Figure 3-2). The proposed in-harbor containment site is located along the eastern side of this shallow portion of the estuary and in the adjacent salt marsh (Section 2.3). Elevation contours within a portion of this salt marsh and a tidal creek are also illustrated on Figure 3-2.

3.1.2 Normal Water Fluctuations within the Estuary and Wetlands

Tidal energy influences a wide range of physiographic, chemical, and biological processes within tidal wetlands, including sediment deposition and erosion, the exchange of nutrients and organic matter, flushing of toxins, and the control of sediment redox potential. Subsequently, these physical factors influence the species that occur on tidal marshes and their productivity. The lower and upper limits of a tidal marsh are generally set by the tide range (Chapman 1960). Tidal creeks and mosquito ditches within tidal wetlands serve as conduits for material and energy transfer between the marsh and

Figure 3-2. Bathymetric Map of the upper Acushnet River Estuary.

(One-Foot Contour Lines)

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Site Name: New Bedford

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its adjacent water body.

3.1.2.1 Tides

The Acushnet River above the Coggeshall Street Bridge has mixed semi-diurnal tides with a mean tidal range of 1.2 meters (3.8 feet), a spring tidal range of 1.4 meters (4.7 feet), and a maximum inequality between successive tides of approximately 0.4 meter (1.2 feet) (NOAA 1981). However, this data was obtained prior to the construction of the hurricane barrier and may not be entirely accurate. The National Geodetic Vertical Datum (mean sea level) at this locality is equal to a local tide level of 0.5 meter (1.6 feet) above mlw. The time period is 6.5 hours ebb or flood tide, for a total cycle time of 13 hours. The tidal prism (volume of water which flows into and out of the basin in the course of a complete flood/ebb tidal cycle) of the Acushnet River above the Coggeshall Street Bridge is estimated to be 1,858,000 cubic meters (65,644,000 cubic feet) with the calculated mlw volume of the estuary estimated to be 722,000 cubic meters (25,524,000 cubic feet) (DEPR 1977). Using these two volumes with the Tidal Prism Method, the flushing time for the basin is estimated to be 1.4 tidal cycles, or approximately 18.2 hours.

The New Bedford inner harbor south of the Coggeshall Street Bridge has mixed semi-diurnal tides and a mean tidal range of 1.1 meters (3.7 feet), or 0.03 meter (0.1 foot) less than the Acushnet River estuary (NOAA 1981). The slightly greater tidal range in the northern estuary may be due to the geometry of that basin with respect to the tidal forcing at the mouth. A phase difference in the tides of approximately 30 minutes has been observed between the areas north and south of the Coggeshall Street Bridge. The Pope Beach marsh in Fairhaven on Buzzards Bay experiences a tidal range of about 1.1 meters (3.7 feet) which is comparable to the mean tidal range within the Acushnet

River wetlands (NOAA 1981). Mean sea level (msl) equals -0.5 meter (-1.8 feet) mean low water at the Pope Beach marsh.

The tidal fluctuations are of major importance in the estuarine environment because the tidal currents contribute significantly to vertical mixing and horizontal dispersion processes. As the tidal currents flow in the harbor, bottom friction creates small-scale eddies which result in a vertically well-mixed boundary layer near the bottom. In regions such as the Coggeshall Street Bridge where the tidal currents are small, the thickness of the well-mixed bottom boundary layer may be only a small fraction of the total depth. Suspended particulate material can also be horizontally dispersed by the advective character of the tidal currents.

3.1.2.2 <u>River Discharge</u>

The Acushnet River has an estimated mean annual freshwater discharge of 0.85 cubic meters per second (cms) (30 cubic feet per second (cfs)) (NUS 1984). During a 6.5-hour ebb or flood tide, this would amount to an average freshwater input to the estuary of 20,000 cubic meters (700,000 cubic feet), which is only 1% of the average tidal input (tidal prism). River flows vary throughout the year with dry periods (days in which no flow occurs) not uncommon. The 100-year storm flood is estimated at 38.2 cms (1,350 cfs). Other estimated storms include 50-year, 22.6 cms (800 cfs); 25-year, 20.5 cms (725 cfs); and the storm flow for the 10-year recurrence interval, 17.0 cms (600 cfs) (NUS 1984). Water-surface elevations of the Acushnet River estuary above the Coggeshall Street Bridge are summarized in Table 3-1.

Mean current velocities in the Acushnet River estuary are expected to be southward near the surface and northward near the bottom. This is a result of the entrainment of the cooler, higher salinity, near-bottom water by the near-surface

Table 3-1. Water-Surface Elevations, Acushnet River Estuary

Item	Water-Surface Elevation (feet above msl)
100-year Flood, 1,350 cfs	
Above Saw Mill Dam	12
Below Saw Mill Dam	7
Acushnet River Estuary	6
Tide	
Mean Spring Tide	3.1
Mean High Tide (mhw)	2.2
Mean Low Tide (mlw)	-1.6

Source: (NUS 1984)

freshwater discharge from the Acushnet River.

3.1.2.3 Storm Surges

Storm surges can cause extreme fluctuations in the sea level along the southeastern Massachusetts coast. However, the hurricane barrier at the mouth of New Bedford Harbor effectively insulates the inner harbor and Acushnet River estuary from storm-surge fluctuations along the coast of Buzzards Bay. Locally within the harbor extreme north/south oriented winds can cause minor fluctuations in sea level of a few centimeters.

3.1.3 Current Patterns And Water Fluctuations

3.1.3.1 Current Patterns Due to Tidal Forcing

Tidal currents in New Bedford Harbor are the result of a shallow water, semi-diurnal tidal action which propagates through the hurricane barrier into the inner harbor, and under the Coggeshall Street Bridge into the Acushnet River estuary. The tidal currents are generally oriented in a northward direction during the flood tide, and a southward direction during ebb with current velocities less than 0.6 knots. Direct current measurements near the north side of the hurricane barrier show the flood current to be jet-like in character with secondary eddy structures on either side of the jet. A similar jet and eddy structure may exist near the Coggeshall Street Bridge. Therefore, higher tidal current velocities (0.6K) and secondary eddy currents with smaller velocities (0.2K) are to be expected in the region of the two major constrictions to tidal flow in New Bedford Harbor.

Tidal currents in the immediate vicinity of the wetlands in the Acushnet River estuary are weak (0.2K) since the stronger currents are located above the deep channel along the central

axis of the estuary. At low tide, the mud flats adjacent to the wetlands are above sea level and thus insulated from the tidal currents. At high tide, the strongest tidal currents are found near the main channel at some distance from the wetlands.

3.1.3.2 Current Patterns Due to Wind Forcing

Currents are generated within New Bedford Harbor by local wind stress. The wind-forced current response is primarily a function of the wind direction and strength. Seasonal characteristics in the winds, such as moderate southwesterly winds in summer and strong northwesterly winds in winter, can lead to a seasonal wind-forced current response in the estuary. Southerly winds force a northward stress on the water surface in New Bedford Harbor and result in a northward wind-driven flow in the surface water. This northward flow is compensated by a return (southward) flow in the near-bottom water. At boundaries such as the head of the Acushnet River estuary, mixing and a vertical circulation pattern would be evident. The greatest wind-driven current response would be to winds which are oriented in a north/south direction. Near-surface, wind-driven currents are normally estimated to be 3% of the wind speed in a down-wind direction.

Winds also generate higher frequency currents due to wave action. The wind strength and direction are particularly important with respect to the fetch or direction the waves may travel unimpeded. Wind waves in New Bedford Harbor are generally small, however, an increase in wave velocities is found near the bottom in the shallow near-shore regions. In fact, the highest bottom velocities may be due to wind generated waves, especially during storms when these waves are breaking. Maximum wave periods are estimated to be less than 2 seconds. These waves will contribute significant bottom current velocities in areas where the depth is less than 6 meters (20 feet). Thus, storm induced waves can resuspend bottom sediments.

3.1.3.3 Current patterns due to freshwater discharge

Sources of freshwater to New Bedford Harbor include the Acushnet River, seepage and runoff from the surrounding hills, and surface-water runoff during storms. The Acushnet River discharges low-density freshwater into the northern estuary causing a vertical salinity stratification. The river flows southward in the near-surface, entraining the deeper, more saline bottom water, thus forming horizontal salinity gradients. The strength of these currents in the upper estuary is directly dependent on the strength of the river discharge. Strong surface currents (0.3K) are expected in the northern area of the Acushnet River estuary during high river discharge in the spring.

Numerous small freshwater streams flow through the wetlands in the eastern Acushnet River estuary. The combined discharge of these streams is estimated to be 1400 m^3 (50,000 ft^3)/day in fall. These streams have a direct influence on the salinity gradients within the estuary, but their influence on surface currents is small.

During periods of heavy rain, surface runoff from the hills and streets of New Bedford, Fairhaven, and Acushnet can contribute to currents in the estuary. Many roads run downhill and terminate at the Acushnet River estuary, thus having a funneling effect of storm runoff. Increased current velocities would be expected at the Coggeshall Street Bridge.

3.1.4 Ground Water

The Buzzards Bay region is located in the Coastal Lowlands Physiographic Province of New England. The present topography is a product of physical and chemical erosion and then subsequent glacial erosion and deposition. The area is

underlain by Proterozoic Eon (older than 600 million years) plutonic, intrusive, and metamorphic rocks. The rocks are moderately deformed and highly faulted. Faulting causes weaker zones in the bedrock to erode and, in many cases, watercourses reflect these areas where water flows along the path of least resistance. The geomorphic features in the region of Buzzards Bay indicate a north-south lineation in the underlying bedrock. Examples of these features include the Acushnet River, New Bedford Harbor, and the intervening highlands.

Surficial geology in the region is a result of glacial activity. Most of the urban New Bedford and Acushnet/Fairhaven area is covered by drumlin and ground moraine composed of basal till. The till contains mostly silt, sand, and boulders. The areas along the Acushnet River are covered by both kame deltas and outwash deposits. North of the Acushnet area, kame deltas, consisting of gravels, sands, silts, and clay, formed in temporary glacial lakes. The kame deposits generally overlie till. The river banks in New Bedford and Fairhaven consist primarily of outwash deposits of fine to coarse gravel.

Tidal marsh areas along the Acushnet River estuary are underlain by tidal peat deposits that consist of organic silt, silt, and sand. These organic deposits generally overlie the glacially deposited soils. Three ground water zones can be identified in such areas, including 1) ground water flow in the bedrock; 2) a water table and flow in the unconsolidated deposits; and 3) a perched ground water system that overlies the relatively impermeable, confining peat layers (i.e. older layers of peat are more decomposed and less permeable than the surface layers of peat). Ground water flow patterns in the bedrock are determined by the direction and extent of fracture patterns and are, thus, difficult to predict. It is probable that bedrock fractures extend to the harbor and, thus, the ground water system in the bedrock may be hydraulically connected to harbor waters.

The extent of human use of ground water from bedrock in the vicinity of the harbor is unknown but is not believed to be significant. Since the bedrock aquifer is overlain by tens of feet of unconsolidated deposits within the harbor, it is likely that PCBs and metals would be immobilized prior to reaching the bedrock zone.

The water table perched above the older layers of impermeable peat is expected to be within 3 meters (10 feet) of the surface in the wetlands surrounding the harbor. The depth of the water table is highly dependent on the annual hydrologic cycle, due to seasonal differences in the rate of ground water recharge and the relatively constant discharge. Most ground water recharge occurs during late winter or early spring, usually in March and April, as a result of precipitation and snow melt. The water table levels are expected to be lowest from late summer to early fall due to high evapotranspiration.

Water table elevations generally reflect patterns of surface topography. Thus, the regional ground water flow direction is expected to be toward the harbor from both the east and west. However, during dry periods when water table elevations have declined, the harbor can recharge the ground water through permeable bottoms. In addition, a "sloshing" effect can be created in the near-shore ground water zones from tidal fluctuations. During high tide, a negatively sloping gradient is established in an inland direction. At low tide, the gradient reverses direction with flow toward the harbor. A monitoring well study at the Aerovox site (GHR 1983) found that these tidal effects were barely distinguishable at a well located 91 meters (300 feet) from the river. It is unlikely that any ground water recharge from the harbor penetrates more than 300 meters (1,000 feet) east or west of the shoreline since any reversed gradient would not exceed the general regional gradient toward the harbor.

Perched water tables often form in areas underlain by a relatively impermeable peat layer or other impermeable material. The saturated thickness of the perched system depends on both the elevation of the impermeable peat layer and the tidal fluctuations. The same tidal effects with flow reversal have been observed in such perched ground water zones (GHR 1983).

Ground water withdrawn from outwash deposits along the Acushnet River estuary would be saline. Ground water in these deposits is not, therefore, the source of local water supplies. The New Bedford municipal water system serves New Bedford, Acushnet, and parts of Fairhaven with treated water from a surface-water source.

3.1.5 Water Quality Of The Acushnet River Estuary

Several chemical factors influence the development and zonation of tidal wetland vegetation. Two of the most important are the soil water salinity, which is linked with tidal flooding frequency; and the availability of nutrients, particularly macronutrients such as nitrogen. Similarly, chemical characteristics of the estuarine system also influence the distribution and abundance of tidal wetland fauna. The presence of PCBs and heavy metals in the sediment (see Section 3.1.6) and water of New Bedford Harbor and the upper Acushnet River estuary, their potential interaction with other chemical parameters, and their ultimate influence on the biota is generally viewed as the major environmental issue within New Bedford Harbor, especially the inner harbor and upper Acushnet River estuary.

3.1.5.1 Water Quality Classification

Although the waters of the Acushnet River estuary are

classified as SB by the Massachusetts Division of Water Pollution Control they do not meet the SB criteria because of problems with dissolved oxygen, coliform bacteria, heavy metals, and PCBs (J. Perry, Division of Water Quality, DEQE, pers. comm., January 21, 1987). According to 314 CMR, discharges to the Acushnet River estuary are restricted under Section 4.04 (3), the protection of low flow waters. 314 CMR 4.04 (3) states that low flow waters are protected due to their inability to accept pollutant discharges, and that new or increased discharges of pollutants to such waters are prohibited unless a variance is granted by the Division of Water Pollution Control as provided in 314 CMR 4.04 (b).

To attain the SB goal the water of the Acushnet River estuary must meet the following criteria from 314 CMR 4.03:

1) Dissolved oxygen

   Shall be a minimum of 85 percent of saturation or water temperatures above 77 degrees F (25 degrees C) and shall be a minimum of 6.0 mg/l at water temperature of 77 degrees F and below.

2) Temperature Increase

   None except where the increase will not exceed the recommended limits on the most sensitive water use.

3) pH

   Shall be in the range of 6.5-8.5 and not more than 0.2 units outside of the naturally occurring range.

4) Total Coliform Bacteria

   Shall not exceed a median value of 700 MPN per 100 ml and not more than 20% of the samples shall

exceed 1000 MPN per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

The water quality goal for the Acushnet River estuary is SB. SB waters are designated for the following uses: the protection and propagation of fish, other aquatic life and wildlife; for primary contact recreation (swimming and water skiing) and secondary contact recreation (fishing and boating); and for shellfish harvesting with depuration.

The Pope Beach tidal wetlands in Fairhaven are inundated by tidal waters of Buzzards Bay. The waters of Buzzards Bay are class SA. The designated uses for class SA waters include marine fishery, shellfishing, and primary and secondary contact recreation.

3.1.5.2 Salinity Gradients

Both horizontal and vertical salinity gradients exist within the estuary. These gradients are strongest at the northern region of the Acushnet River estuary where the river discharge has a salinity of less than 1 $^{o}/oo$. Salinities of approximately 31 $^{o}/oo$ have been observed at the hurricane barrier with seasonal fluctuations of ± 1 $^{o}/oo$. A horizontal surface salinity gradient of approximately 3-5 $^{o}/oo$ exists between the Coggeshall Street Bridge and the hurricane barrier. Vertical salinity gradients of 1-3 $^{o}/oo$ are common in spring and summer.

The salinity stratification is strongest in spring and early summer when the freshwater input to the estuarine environment is greatest. As freshwater flows southward from the river source into the northern estuary, deeper, higher salinity water is entrained in the southward near-surface flow. The result is a

localized horizontal gradient in the surface salinity, and a northward inflow of deep water. During periods of low river discharge in winter, the estuary loses heat to the atmosphere. This results in strong vertical mixing and a decrease in the vertical salinity stratification. However, horizontal salinity gradients also exist in winter.

3.1.5.3 Temperature Gradients

Thermal stratification in New Bedford Harbor is a direct result of the heat flux from the atmosphere across the water surface. Whereas the salinity stratification is a result of forcing at the freshwater source in the northern estuary, the thermal stratification is forced across the surface water of the entire estuary. As a consequence, the thermal stratification is mainly horizontal. Some horizontal gradients may exist between the shallower and deeper areas due to the surface heat flux concentration in the shallow water, but the strongest gradients are in the vertical direction.

Thermal stratification is strongest in late summer and nonexistent by early winter. This means that vertical circulation is inhibited by the thermal stratification during the summer, but occurs frequently in winter when the local water column is vertically well mixed.

3.1.5.4 Suspended Materials

Suspended particulate matter within the surface water of New Bedford Harbor is about 1-4 mg/l (Farrington et al. 1985), an amount similar to that found within Buzzards Bay. However, resuspension by tidal currents in the bottom waters of the harbor can create a 2-3 m thick boundary layer containing 10-35 mg/l of suspended matter (Farrington et al. 1985).

3.1.5.5 Heavy Metals and PCBs in the Water Column

Dissolved and particulate cadmium, copper, and lead concentrations within the water column at stations north of the Coggeshall Street bridge were measured by Battelle in 1985 and 1986 (Table 3-2). Most of the Cd, Cu, and Pb (97.6% to 99.9%) was bound to particulate matter. Total concentrations for copper and lead were 10 to 1000 times higher than the U.S. EPA marine water quality criterion of 2.9 ppb and 140 ppb respectively. Cadmium concentrations ranged from about 7 to 13 ppb, well below the U.S. EPA water quality criterion of 43 ppb. This data conflicts with the N.U.S. report (1984) which reports largely undetectable concentrations of contaminants other than PCBs in the waters of the Acushnet River estuary.

The chronic marine water quality criterion (U.S. EPA 1986) for total PCB is 0.03 ug/l (ppb). The 1984 N.U.S. Draft Feasibility Study of the Remedial Action Alternatives, reports levels of Aroclors 1248/1254 as high as 6.1 mg/l (ppm) in the water column of the Acushnet River estuary. Total PCB (Aroclor 1248/1254) concentrations near the Coggeshall Street Bridge and in the outer harbor just south of the hurricane barrier were measured over a full tidal cycle by Brownawell and Farrington (1985). Large differences in concentration over the tidal cycle were not observed, nor was there a large gradient between surface and bottom water samples (Table 3-3). Total PCB concentrations in the inner harbor ranged from 0.286 ug/l to 0.675 ug/l. PCB concentrations in the outer harbor were five to ten times lower. Battelle Laboratory (1985, 1986) also reported values of about 0.5 ug/l total PCB in the water column near the Coggeshall Street bridge, and from about 1 to 10 ug/l total PCB near Aerovox at the northwestern end of the estuary (M. Conners, Battelle, pers. comm., January 21, 1987).

Table 3-2. Comparison of Selected Metals and PCB Concentrations in the Water Column of the Acushnet River Estuary North of the Coggeshall Street Bridge with U.S. EPA (1986) Water Quality Criteria.

Metal	Range Within the Water Column[1] (ppb = ug/l)	E.P.A. (1986) Water Quality Criteria (ppb) Acute	Chronic
Cadmium		43.0	9.3
dissolved	0.11 - 0.31		
particulate	7 - 13		
Copper*		2.9	2.9
dissolved	2.3 - 2.9		
particulate	800 - 5000		
Lead*		140.0	5.6
dissolved	0.29 - 0.46		
particulate	300 - 1000		
PCB Total*		10.0	0.03
near Coggeshall Street Bridge	around 0.5		
near Aerovox	1 - 10		

*Total concentration for a constituent exceeds the EPA water quality criterion.

[1] Samples collected in 1985 and 1986.

Source: (personal communication, M. Conners, Battelle, January 21, 1987)

Table 3-3. Tidal Cycle Concentrations of Total PCBs (Aroclor 1248 and 1254) within the Acushnet River Estuary and Buzzards Bay - September 22, 1982.

SAMPLE — CONCENTRATIONS (ug/l)

Incoming Tide

Station 81 - near Coggeshall Street Bridge, Acushnet River estuary

	Particulates	Filtrate	Total
surface water	0.183	0.329	0.512
bottom water	0.134	0.152	0.286

Station 74 - just south of the Hurricane Barrier, Buzzards Bay

	Particulates	Filtrate	Total
surface water	0.028	0.052	0.080
bottom water	0.022	0.028	0.050

Outgoing Tide

Station 81

	Particulates	Filtrate	Total
surface water	0.386	0.289	0.675
bottom water	0.232	0.244	0.476

Station 74

	Particulates	Filtrate	Total
surface water	0.027	0.036	0.063
bottom water	0.030	0.041	0.071

U.S. EPA Water Quality Criterion for Total PCBs is 0.03 ppb.

Source: (Brownawell and Farrington 1985)

3.1.5.6 Nutrients

In a 1971 study by the Massachusetts Department of Environmental Quality Engineering (DEQE), ammonia nitrogen levels were as high as 0.4 ppm within the Acushnet River estuary (Table 3-4). Most ammonia nitrogen levels outside the hurricane barrier in Buzzards Bay were comparable to the estuarine values, except at station AR4 (near the sewage outfall on Clark's Point) where ammonia levels reached 22 ppm. Nitrate nitrogen was nondetectable in the inner harbor, and ranged from nondetectable to 0.2 ppm in the outer harbor. Total phosphate levels in the inner harbor ranged from 0.07 - 0.29 ppm. Total phosphate in the outer harbor ranged from 0.07 - 0.40 ppm. Highly elevated total phosphate levels of 17 ppm were measured at station AR4 in the outer harbor.

A water quality study was also conducted by DEQE in October 1986. This study had three sample stations located in the inner harbor; one at the hurricane barrier, a second at Main Street, Acushnet and a third at the Coggeshall Street bridge. Samples were taken on October 15 and 16 on an incoming and an outgoing tide. The ammonia concentrations near the Coggeshall Street Bridge were 0.58 mg/l and 0.63 mg/l, respectively. These values exceed the 0.4 mg/l maximum observed in 1971. Total phosphate concentrations near the Coggeshall Street Bridge were 0.13 mg/l and 0.14 mg/l, respectively.

3.1.6 Tidal Wetland Sediment Quality

The importance of sediment quality has received increasing attention within the last several years in recognition of the fact that sediments can serve as storage areas and potential sources of contaminants. Efforts have been underway to develop sediment quality criteria and testing procedures for evaluating the toxicity associated with chemicals in sediments. Agencies involved in this research include the U.S. Army COE, U.S. EPA,

Table 3-4. Nitrogen and Phosphorous Levels Within the Waters of the Acushnet River Estuary and Buzzards Bay from a 1971 study by the Massachusetts DEQE.

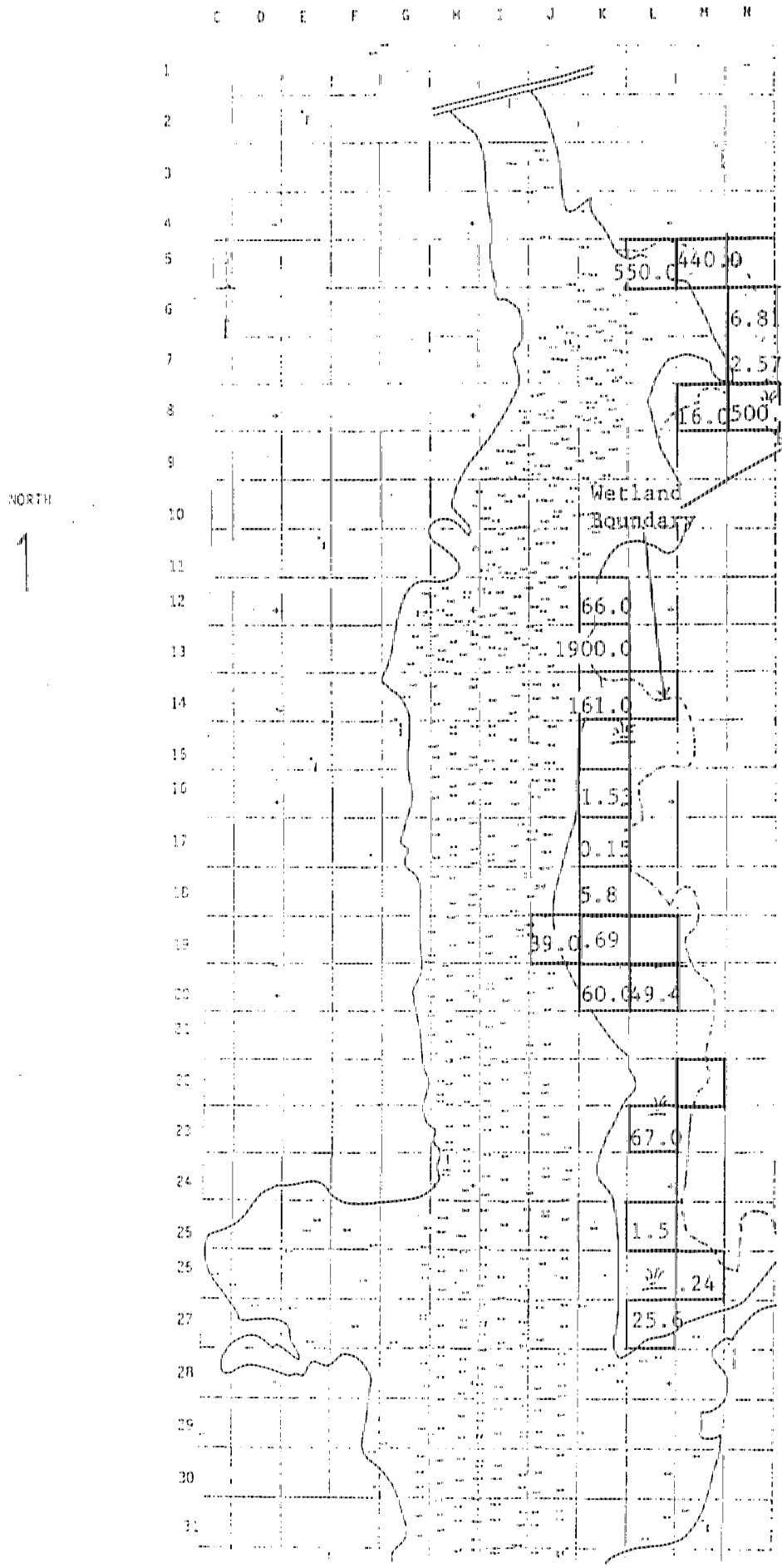
Parameter	Range in concentration within the inner Harbor (mg/l)	Range in concentration for the outer Harbor (mg/l)
Total Phosphate Phosphorous	0.07 - 0.29	0.07 - 0.40 (Station AR4 17)
Kjeldahl nitrogen	0.03 - 3.1	0.1 - 1.4 (Station AR4 25.7)
Ammonia nitrogen	0.1 - 0.4	0.01 - 0.38 (Station AR4 22)
Nitrate nitrogen	0.0	0.0 - 0.2

U.S. Fish and Wildlife Service, and NOAA. Although progress has been made on evaluating sediments, it is generally recognized that much work remains to be done. Therefore, while it is presently possible to give a qualitative assessment of sediment quality, it is difficult to quantify the significance of toxics in sediment from an ecological standpoint.

Sediments of the Acushnet River estuary have become contaminated with PCBs and heavy metals as a result of industrial discharges over many years. Remedial clean-up alternatives are being evaluated. One remedial alternative involves the construction of a lined permanent containment site on the eastern side of the upper estuary (NUS 1984, Section 2.3.2). This containment site is partially located within tidal wetland. All contaminated sediments (1 ppm or greater PCB) beneath the containment site would have to be removed and the site dewatered prior to placement of the liner. As a result, a chemical characterization of the tidal wetland sediments has been conducted.

The results of two separate sediment sampling efforts are discussed in this section. The first was conducted by the U.S. Army Corps of Engineers within the wetlands of the Acushnet River estuary in 1985 (Figure 3-3). The second sampling effort was conducted on December 12, 1986 by Sanford Ecological Services within the Pope Beach wetlands on Buzzards Bay south of Egypt Street in Fairhaven (Figure 3-4). The sediment sampling within the wetlands of the Acushnet River estuary was conducted to determine the extent of any PCB and select metal contamination. The purpose of the second sampling effort was to characterize the sediments in the Pope Beach, Fairhaven, tidal wetland on Buzzards Bay a distance from the "hot spot" area in the upper Acushnet River estuary.

Figure 3-3. Locations of sediment sample sites in wetland along the Acushnet River estuary and the spatial distribution of total PCB concentrations in the surface sediments (0 - 12 in.).



PCB values are in mg/Kg (ppm)

KEY:

PCB No.	Inorganic No.	Grid Location
AD570	MAB764	J-19
AD579	MAB773	K-12
AD576	MAB770	K-13
AD592	MAB786	K-14
AD600	MAB794	K-16
AD590	MAB784	K-17
AD565	MAB759	K-18
AD589	MAB783	K-19
AD586	MAB780	K-20
AD595	MAB789	L-5
AD599	MAB793	L-20
AD562	MAB756	L-23
AD598	MAB792	L-25
AD559	MAB753	L-27
AD582	MAB776	M-5
AD567	MAB761	M-8
AD596	MAB790	M-26
AD594	MAB788	N-6
AD593	MAB787	N-7
AD585	MAB779	N-8

Samples with No PCB Data:

AD591	MAB785	K-15
AD573	MAB767	L-14
AD588	MAB782	L-19
AD556	MAB750	M-22

All samples taken from within wetland boundary.

3.1.6.1 Sampling Methods

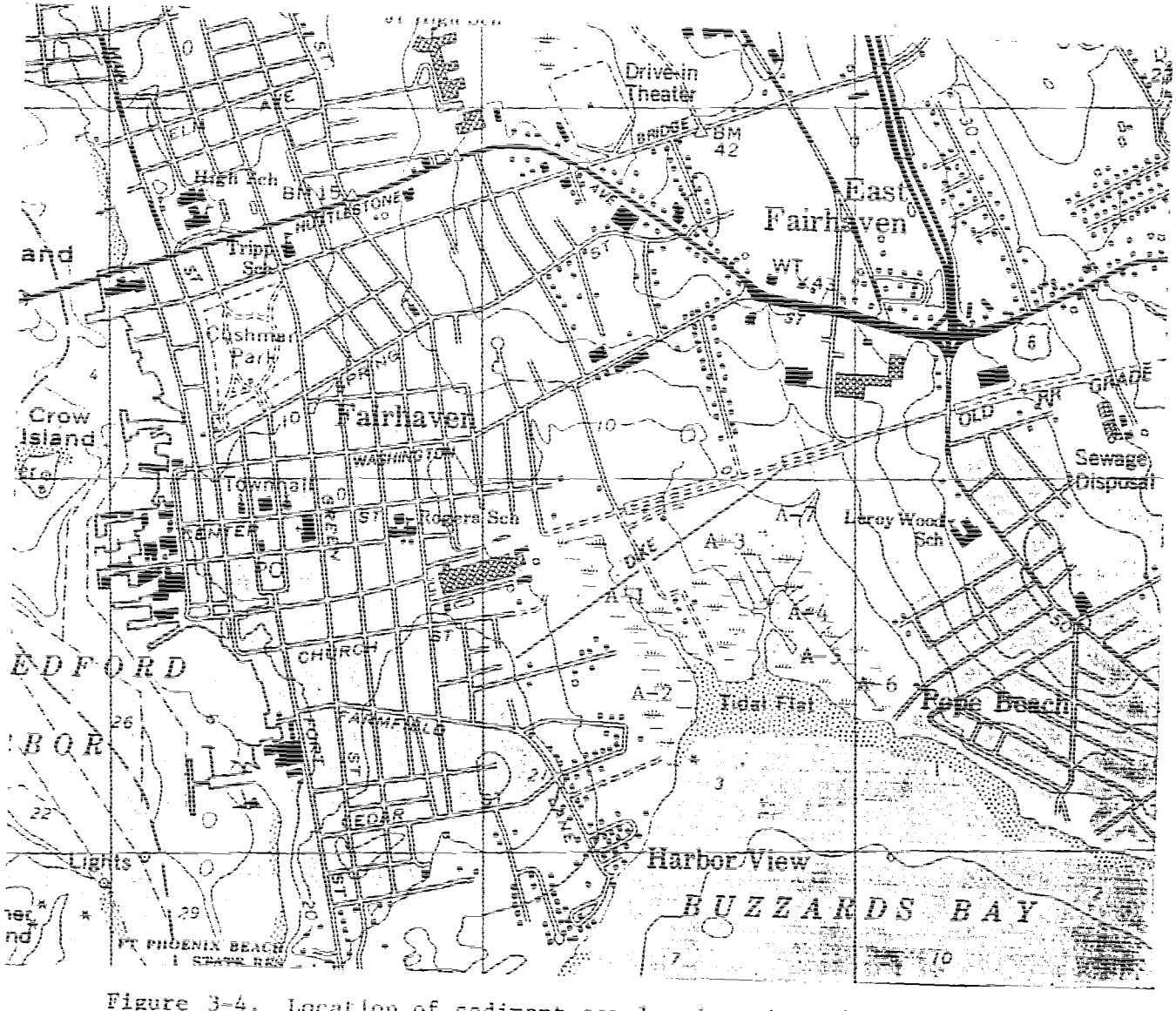
The sampling methods used by the U.S. Army COE/NED personnel are described by Condike (1986). The COE/NED sample locations are presented in Figure 3-3.

The sediment sampling conducted within the Pope Beach tidal wetland on Buzzards Bay utilized a random sampling approach. A grid of 23 possible sampling stations was established, of which seven stations were randomly selected as sampling sites (Figure 3-4). Soil cores were collected at two depth intervals (0 - 15 centimeters and 0 - 30 centimeters). This approach was implemented to provide an initial characterization of the surface sediments (0 - 15 centimeters) and provided the flexibility to analyze additional fractions of sediment at a latter date, if necessary.

The upper layer of sediment (0 - 15 centimeters) was collected using a soil auger. The samples were immediately transferred to pre-cleaned, teflon-lined glass containers. The deeper cores (0 - 30 centimeters) were collected by hand using plastic core tubes. Separate samples were collected for PCBs and metals (Cr, Cu, Pb, Zn). All samples were properly labelled and stored at approximately 4°C. Analyses were conducted using EPA approved methods (U.S. EPA SW846; Standard Methods-16th Edition).

3.1.6.2 Results

The results of the chemical analyses for PCBs, copper, chromium, lead, and zinc on the sediment samples collected by the U.S. Army COE/NED and Sanford Ecological Services are presented in Tables 3-5 through 3-8 and Appendix C. In addition, these data are summarized in Table 3-9 for comparison with each other and typical concentrations reported for uncontaminated soils.



KEY:

Station No.	Total PCB Concentration (ppm)
A-1	4.1
A-2	1.5
A-3	1.6
A-4	2.5
A-5	1.6
A-6	BDL
A-7	2.9

BDL - Below Detection Limit

Scale: 1:18,000

Figure 3-4. Location of sediment sample sites in tidal wetland at Pope Beach (end of Egypt Street), Fairhaven.

Elevated levels of PCBs, chromium, copper, lead, and zinc were detected at various locations within the wetland along the Acushnet River estuary. PCB concentrations in the surface sediments of the wetland ranged from 0.15 ppm to over 1,900.00 ppm. Stations AD595, AD592, AD585, AD582, and AD576, located along the northern half of the wetland system (Figure 3-3), contained over 100 ppm of PCB in the surface sediments. Elevated levels of selected metals (Cr, Cu, Pb, Zn) were detected in surface sediments (0-30 centimeters) throughout the wetland. Although no obvious spatial pattern in the distribution of PCBs and metals was observed, it is apparent that stations which contained elevated levels of PCBs also contained elevated levels of selected metals (e.g. Stations AD586, AD592, AD595, AD599).

Sediment samples collected within the Pope Beach, Buzzards Bay wetland also contained elevated levels of selected heavy metals, particularly copper and lead. However, the detected levels of PCBs within the Pope Beach wetlands on Buzzards Bay were orders of magnitude lower than those reported for the wetland system along the Acushnet River estuary (Table 3-9). The occurrence of relatively high concentrations of selected metals at locations within the Pope Beach and Acushnet River estuary wetlands suggests that metal contamination in this area is a geographically widespread phenomenon.

The data presented in the following tables indicate that not only are the Acushnet River estuarine bottom sediments contaminated with PCBs and heavy metals, but also sediment within the Acushnet River tidal wetlands.

3.2 BIOLOGICAL CHARACTERIZATION

In April 1985, the U.S. EPA environmental Photographic Interpretation Center (E.P.I.C.), Warrenton, Virginia, completed

Table 3-5. PCB content of wetland surface sediments (0-30 centimeters) at various sampling stations located within the Acushnet River estuary.

STATION No.	TOTAL PCB (mg/Kg)	AROCLOR (mg/Kg) 1242	1248	1254
AD559	25.60		5.60	20.00
AD562	67.00		18.00	49.00
AD565	5.80		1.60	4.20
AD567	16.00			16.00
AD570	39.00			39.00
AD576	1,900.00	700.00		1,200.00
AD579	66.00			66.00
AD582	440.00	140.00		300.00
AD585	500.00	230.00		270.00
AD586	60.00		30.00	30.00
AD589	0.69			0.69
AD590	0.15			0.15
AD592	161.00		31.00	130.00
AD593	2.57		0.47	2.10
AD594	6.81		0.81	6.00
AD595	550.00	380.000		170.00
AD596	0.24			0.24
AD598	1.50			1.50
AD599	49.40		8.40	41.00
AD600	1.53		0.23	1.30

Source: U.S. Army COE/NED 1985

Table 3-6. PCB content of surface sediments (0-15 centimeters) at various sampling stations located in the Pope Beach wetlands at the end of Egypt Street in Fairhaven on Buzzards Bay.

STATION No.	TOTAL PCB (mg/Kg)	AROCLOR (mg/Kg) 1242	1248	1254
A-1	4.1	*BDL	*BDL	4.1
A-2	1.5	BDL	BDL	1.5
A-3	1.6	BDL	BDL	1.6
A-4	2.5	BDL	BDL	2.5
A-5	1.6	BDL	BDL	1.6
A-6	BDL	BDL	BDL	**BDL
A-7	2.9	BDL	BDL	2.9

BDL - Below Detection Limit

* Detection Limit = 0.3 mg/Kg
** Detection Limit = 0.6 mg/Kg

Table 3-7. Heavy metals in the surface sediments (0-30 centimeters) from sample sites in the Acushnet River estuary (see Figure 3-3 for sample site locations).

Parameter (ppm):	Sample Site MAB750	MAB753	MAB756	MAB759	MAB761	MAB764	MAB767
Chromium	(J)36	(J)116	(J)149	(J)63	(J)14	(J)23	(J)7.8
Copper	(J)155	(J)505	(J)483	(J)172	(J)76	(J)108	(J)11
Lead	167	128	275	165	72	60	24
Zinc	45	100	92	136	102	57	24

Parameter (ppm):	Sample Site MAB770	MAB773	MAB776	MAB779	MAB780	MAB782	MAB783
Chromium	(J)227	(J)53	(J)41	(J)117	(J)111	(J)5.6	(J)25
Copper	(R)557	(R)287	(R)306	(R)333	(R)185	(R)9.2	(J)84
Lead	435	162	228	227	95	33	75
Zinc	(J)508	(J)395	(J)109	(J)391	(J)95	(J)22	(J)70

Parameter (ppm):	Sample Site MAB784	MAB785	MAB786	MAB787	MAB788	MAB789	MAB790
Chromium	(J)15	(J)4.9	(J)59	(J)19	(J)22	(J)46	7
Copper	(J)14	(J)8.1	(J)338	(J)20	(J)119	(J)167	39
Lead	(J)14	(J)4.8	273	203	153	375	(J)6.7
Zinc	(J)124	(J)16	(J)596	(J)117	(J)79	(J)1290	29

Parameter (ppm):	Sample Site MAB792	MAB793	MAB794
Chromium	38	20	5
Copper	358	128	23
Lead	(J)316	(J)154	(J)15
Zinc	79	199	298

R - Value Recommended For Rejection (see Appendix C)
J - Value Recommended For Estimation (see Appendix C)

Table 3-8. Results of heavy metal analysis in surface sediments (0-15 centimeters) at various sampling locations (see Figure 3-4) in the Pope Beach wetlands located at the end of Egypt Street in Fairhaven on Buzzards Bay.

	SAMPLE SITE (PPM)						
PARAMETER	A-1	A-2	A-3	A-4	A-5	A-6	A-7
CHROMIUM	180	31	63	67	24	3	41
COPPER	1400	280	270	240	60	8	88
LEAD	360	120	120	130	45	<5	430
ZINC	800	230	160	200	57	26	130

Table 3-9. Summary Table of selected chemical parameters.

Parameter	Pope Beach Buzzards Bay Wetland Site	Acushnet River Estuary Wetland (Study Area)	Reported Ranges In Soil and Sediment Samples
PCBs (ppm)	<0.03 - 4.1	0.150 - 1,900	0.005 - 3.2[a]
Chromium (ppm)	3 - 180	3.3(J) - 227(J)	50 - 100[b,c]
Copper (ppm)	8 - 1,400	3.2(J) - 557(R)	9 - 94[b,c,d]
Lead (ppm)	<5 - 430	4.8(J) - 440	8 - 146[b,c]
Zinc (ppm)	26 - 800	16(J) - 2,820(J)	39 - 160[b,d]

a - Crump-Wiesner et al. 1974.
b - Ragsdale and Thorhaug 1980.
c - U.S. EPA 1981.
d - Takematsu 1978.
(J),(R) - (See Appendix C)

an identification of the tidal wetlands in the greater New Bedford area and the Acushnet River estuary. Aerial photographs were the primary source of information for the E.P.I.C. study. The nine tidal wetlands (A-I) identified within a 6 kilometer (3.7 mile) radius of the Acushnet River estuary totaled 157.0 hectares (387.9 acres) (U.S. EPA 1985) (Figure 3-5). Approximately 25% of the total area within this 6 kilometer radius was open water (Acushnet River estuary, parts of Nasketucket Bay, Clarks Cove, and Buzzards Bay), 1.4% tidal wetlands, about 25% undeveloped upland, and the remaining 48.6% industrial or residential development.

Wetlands A and B are located north of the Coggeshall Street Bridge and would be directly affected by the proposed NUS remedial action plans. Wetlands C and D are relatively small and located south of the Coggeshall Street Bridge outside the area directly affected by any proposed remedial action. The Pope Beach wetlands E, F, and G are located on Buzzards Bay southeast of Fairhaven and southwest of East Fairhaven. Tidal wetlands H and I are located within Nasketucket Bay, and were not part of the present study. The approximate areas of wetlands A-I are presented in Table 3-10.

The following sections detail results of winter (February 22, 1985), early spring (April and May, 1985) and late summer (September 18 and 19, 1986) field surveys conducted by SES and Manomet Bird Observatory to evaluate the biological health of wetland resources within the Acushnet River estuary. The field surveys include observations of vegetative cover types, birds, mammals, terrestrial invertebrates, and aquatic organisms within the Acushnet River tidal marshes. For comparative purposes, characteristics of the Pope Beach tidal marsh located in the town of Fairhaven on Buzzards Bay were also noted. The Pope Beach wetland sediments are low in PCBs (i.e. below the detection limit to 4.1 ppm), however, like the Acushnet River estuary wetland sediments, have elevated concentrations of

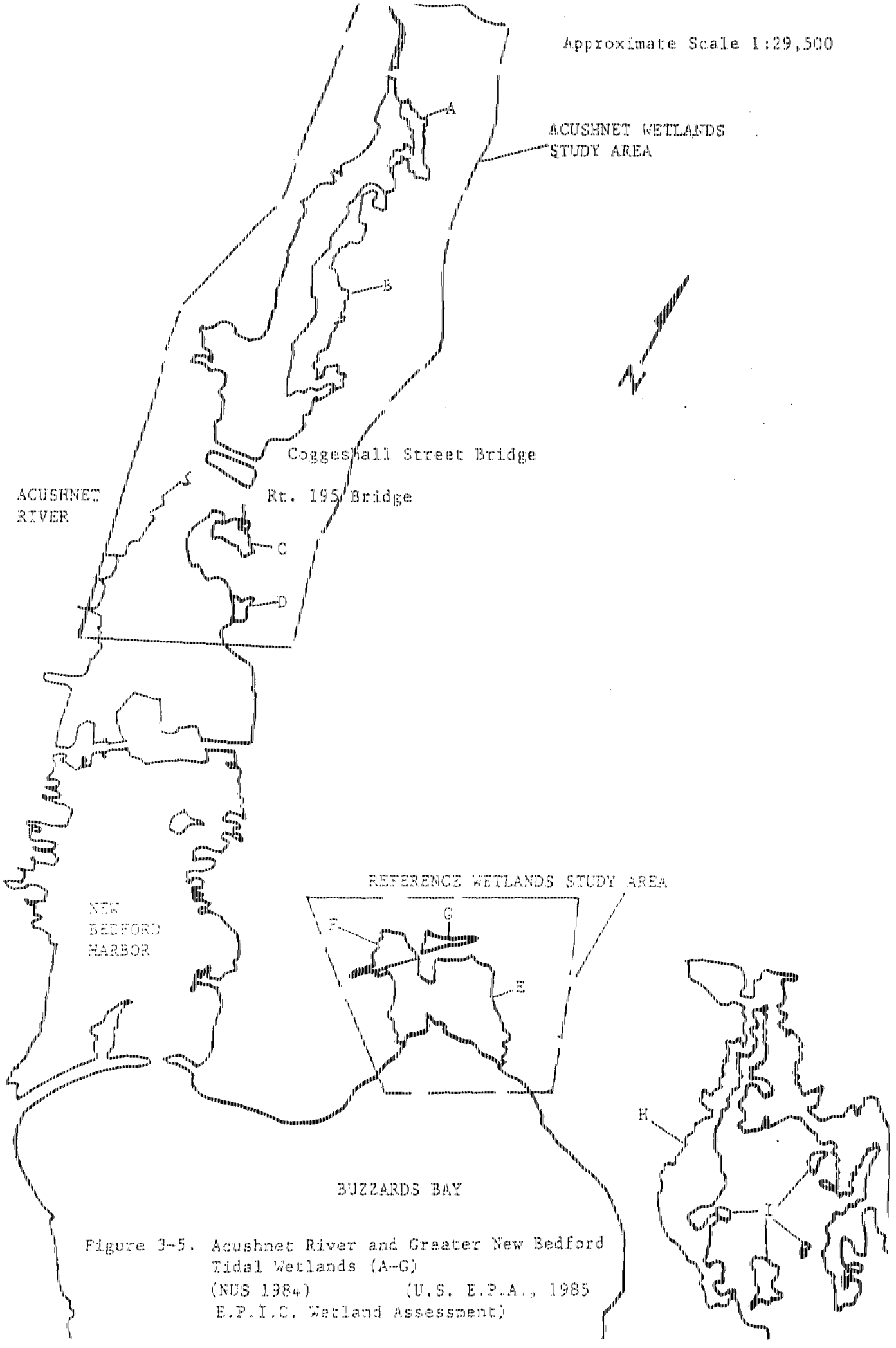


Figure 3-5. Acushnet River and Greater New Bedford Tidal Wetlands (A-G) (NUS 1984) (U.S. E.P.A., 1985 E.P.I.C. Wetland Assessment)

Table 3-10. Acres or hectares of different wetlands within the New Bedford Area. (U.S. EPA, EPIC, 1985)

Figure Symbol	Acres	Hectares	Wetland Description modified from U.S.EPA.EPIC 1985.
A*	7.4	3.0	High Salt Marsh
B*	42.6	17.3	High Salt Marsh
C*	8.1	3.3	Low Marsh and Reed Marsh
D*	2.7	1.1	High Salt Marsh
E	69.1	28.0	High Salt Marsh
F	10.2	4.1	Diked High Salt Marsh
G	5.3	2.1	Diked High Salt Marsh and Wooded Swamp
H	231.3	93.6	High Salt Marsh
I	11.2	4.5	Salt Marsh Islands
Total	387.9 Acres	157.0 Hectares	

* - Occurs in the Acushnet River estuary

metals (Cr, Cu, Pb, Zn) (Section 3.1.2.2).

In September 1986, SES and Norwood Engineering prepared a topographic plan of a representative portion of E.P.I.C. tidal wetland B on the Acushnet River estuary (Figure 3-6), and a profile through E.P.I.C. tidal wetland E at Pope Beach on Buzzards Bay (Figure 3-9). The presence and average canopy height of plant species were recorded at the spot elevations. Plant species distributions over the elevation gradient are illustrated in Figure 3-7. Mean plant species heights in wetlands B and E are reported in Table 3-13.

Appendix D contains the common and scientific names of plant and animal species observed during the wetland surveys. Audio/visual equipment was used during the late summer field survey to document the vegetation and wildlife present within wetlands A-G. A copy of this tape has been provided to the U.S. Army COE/NED and U.S. EPA/Region 1.

Qualitative statements made below with respect to habitat productivity, species diversity, wildlife, and appearance are made relative to the experience of the field biologists within similar but unpolluted habitats.

3.2.1 Tidal Wetland Flora

The tidal wetland vegetation along the Acushnet River estuary and Buzzards Bay consists primarily of salt marsh vegetation and a small amount of common reed (*Phragmites australis*).

Salt marshes in New England may be divided into low marsh and high marsh zones. Low marshes are younger, lower topographically, and more subject to changes that occur in estuarine or marine environments. High marshes are usually older, higher topographically, and are more influenced by

terrestrial conditions than low marshes. In Massachusetts, the low marsh environment generally corresponds to the upper-middle intertidal zone beginning between half-tide level and mean high-water neap (Redfield 1972). High marshes typically begin at about mean high water in Massachusetts. Low marsh is dominated by salt marsh cordgrass (Spartina alterniflora). The annual glasswort (Salicornia europaea agg.) may be found in low or high marsh where it forms patches in disturbed areas or is interspersed amongst the grass stems. High marsh vegetation includes a greater diversity of species. High marsh is usually a mix of salt meadow grass (Spartina patens) and spike grass (Distichlis spicata). Black grass (Juncus gerardi) and the shrub, marsh elder (Iva frutescens) are found on the higher parts of the marsh near the upland border. Marsh elder best characterizes the border between marsh and upland. A number of broad-leaved herbaceous plants may also be found within the high marsh. They include species such as sea lavender (Limonium carolinianum), sea orach (Atriplex patula), slender-leaved aster (Aster tenuifolius), and perennial glasswort (Salicornia virginica). Salt marshes have relatively low floral diversity but generally high rates of primary productivity.

3.2.1.1 Vegetation of the Acushnet River Tidal Wetlands (E.P.I.C. Wetlands A, B, C and D)

The tidal marshes of the Acushnet River estuary are dominated by high salt marsh vegetation, and are primarily located north of the Interstate Route 195 bridge (Figure 3-5).

No tidal wetlands were identified in the 1985 U.S. EPA, E.P.I.C. Wetland Assessment along the highly developed, steep-banked, western shoreline of the estuary. However, based on a site inspection of the Acushnet River estuary wetlands by SES in February 1985, some relatively narrow bands (about two to three meters in width) of tidal wetland vegetation do exist along the western side of the estuary (e.g., the cove north of the Coggeshall Street Bridge).

The 1985 E.P.I.C. wetland report identified four tidal wetlands (A, B, C, and D) along the eastern shoreline of the Acushnet River estuary (Figure 3-5). Wetlands A and B total 20.3 hectares (50 acres). Wetland A and the northern portion of wetland B are located within the proposed in-harbor containment site (see Section 2.3). Wetlands C and D are relatively small vegetated wetlands located south of the Coggeshall Street and the I-195 bridges. The approximate areas of these wetlands are 3.3 and 1.1 hectares (8.1 and 2.7 acres), respectively (Table 3-10).

Tidal wetlands A, B, C, and D contain low salt marsh, high salt marsh, and brackish/freshwater marsh dominated by common reed.

E.P.I.C. Wetlands A and B and Their Communities

A contour map was prepared for a representative area of salt marsh within wetland B (Figure 3-6). Unvegetated sand and mud tidal flats were located from -0.3 meter (-1 foot) mlw to 0.37 meter (1.2 feet) above mlw. Low salt marsh vegetation was found from 0.4 meter (1.3 feet) above mlw to 1.3 meters (4.2 feet) above mlw. The high salt marsh plant community was found from 0.85 meter (2.8 feet) above mlw to 1.8 meters (5.9 feet) above mlw (Figure 3-7).

Tidal flats adjacent to the salt marshes and brackish/freshwater marshes were frequently covered with filamentous algae (e.g., Enteromorpha sp.) and sea lettuce (Ulva lactuca). The sea lettuce growth was lush and green, an indication that inner harbor waters have enriched levels of nitrogen and phosphorous (Section 3.1.2.1). Enteromorpha spp. and sea lettuce are also likely to grow in areas where herbivores have been removed (Berrill and Berrill 1981). Unattached sea lettuce and filamentous greens covered from 10%

Figure 3-6. Topographic Plan of a Portion of the Acushnet River Marsh, Acushnet, Massachusetts.

US EPA New England
Superfund Document Management System
Image Target Sheet

SDMS Document ID# 51719

Site Name: New Bedford

File Number: 3.4. Wetlands Assessment

Purpose of Target Sheet:

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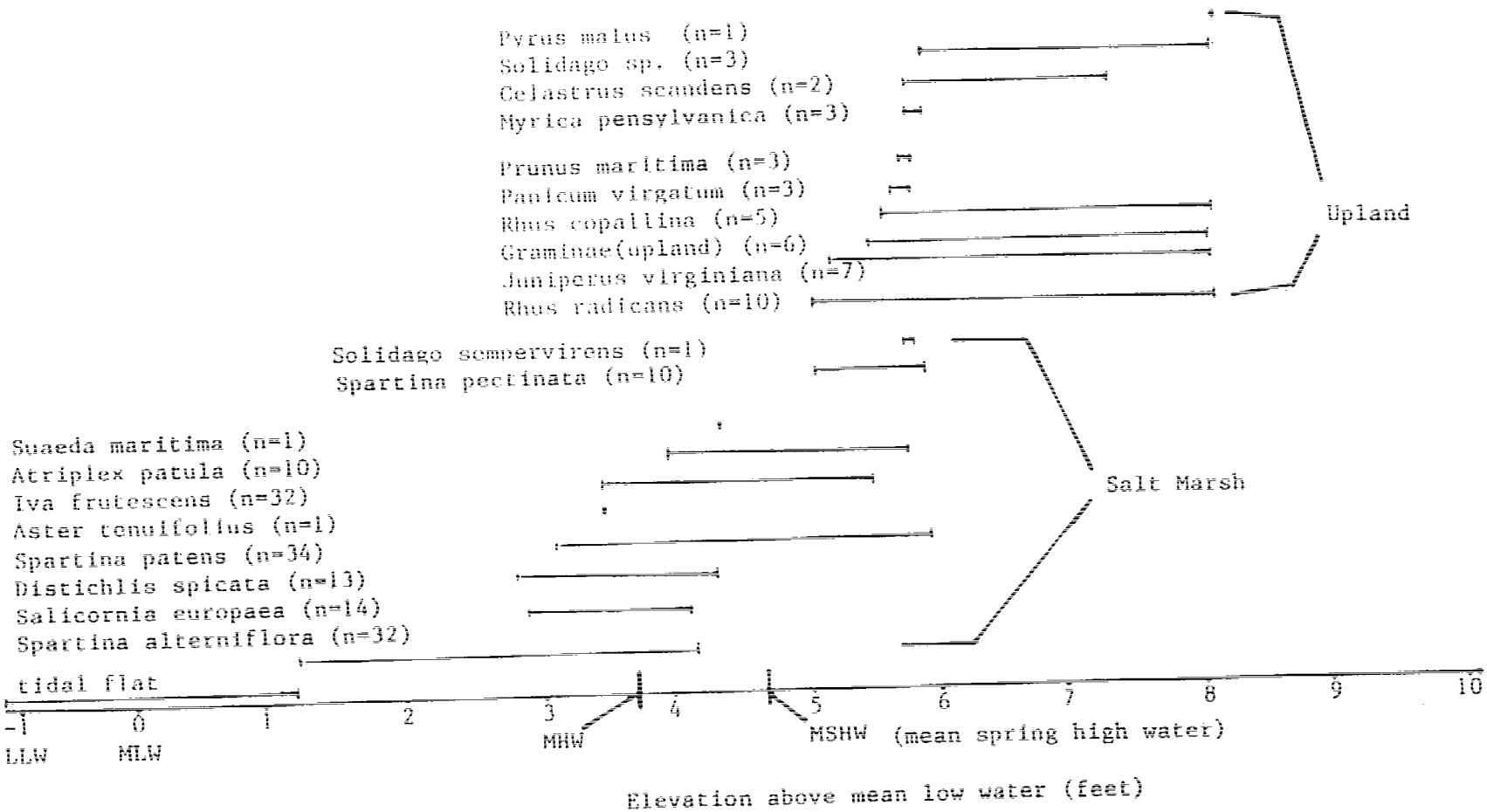

Figure 3-7. RECORDED ELEVATIONS FOR TWENTY PLANT SPECIES WITHIN THE ACUSHNET RIVER ESTUARY SALT MARSH (B), ACUSHNET, MASSACHUSETTS

to 20% of the tidal flat and creek bank substrate, partially as a result of shoreline accumulation.

Plant species found within the undeveloped uplands which fringe the salt marshes of wetland A and B included switchgrass (Panicum virgatum), little blue stem (Andropogon scoparius), common greenbrier (Smilax rotundifolia), grapes (Vitis spp.), winged sumac (Rhus copallina), poison ivy (Toxicodendron radicans), bayberry (Myrica pensylvanica), arrow-wood (Viburnum recognitum), red cedar (Juniperus virginiana), black cherry (Prunus serotina), and oaks (Quercus spp.).

Wetlands A and B are primarily high salt marsh, however, the 1985 E.P.I.C. wetland report divided them into 25 communities representing 12 community types (Figure 3-8). Information from the 1985 E.P.I.C. report was used to determine the area of these 25 communities and 12 community types (see Table 3-11). Based on observations made during the SES field surveys, the areas of community types as reported in the E.P.I.C. report were revised (Table 3-12). During the September 1986 field survey each community within wetland A and B was visited. Observations are presented below (see also Table 3-11 and Figure 3-8).

Wetland A (Communities 1-4)

Community 1

Community 1, located within wetland A at the northeastern end of the Acushnet River estuary is 1.19 hectares (2.94 acres) in area (U.S. EPA 1985). About 90% of community 1 contained a monospecific stand of common reed. The maximum height of the reed was 2.5 meters (7.5 feet) and most of the culms were flowering. Along the waters edge was a narrow two to three meter (six to nine foot) wide, band of flowering salt marsh cordgrass approximately 1.4 meters (4 feet) in height. This low marsh vegetation (i.e., salt

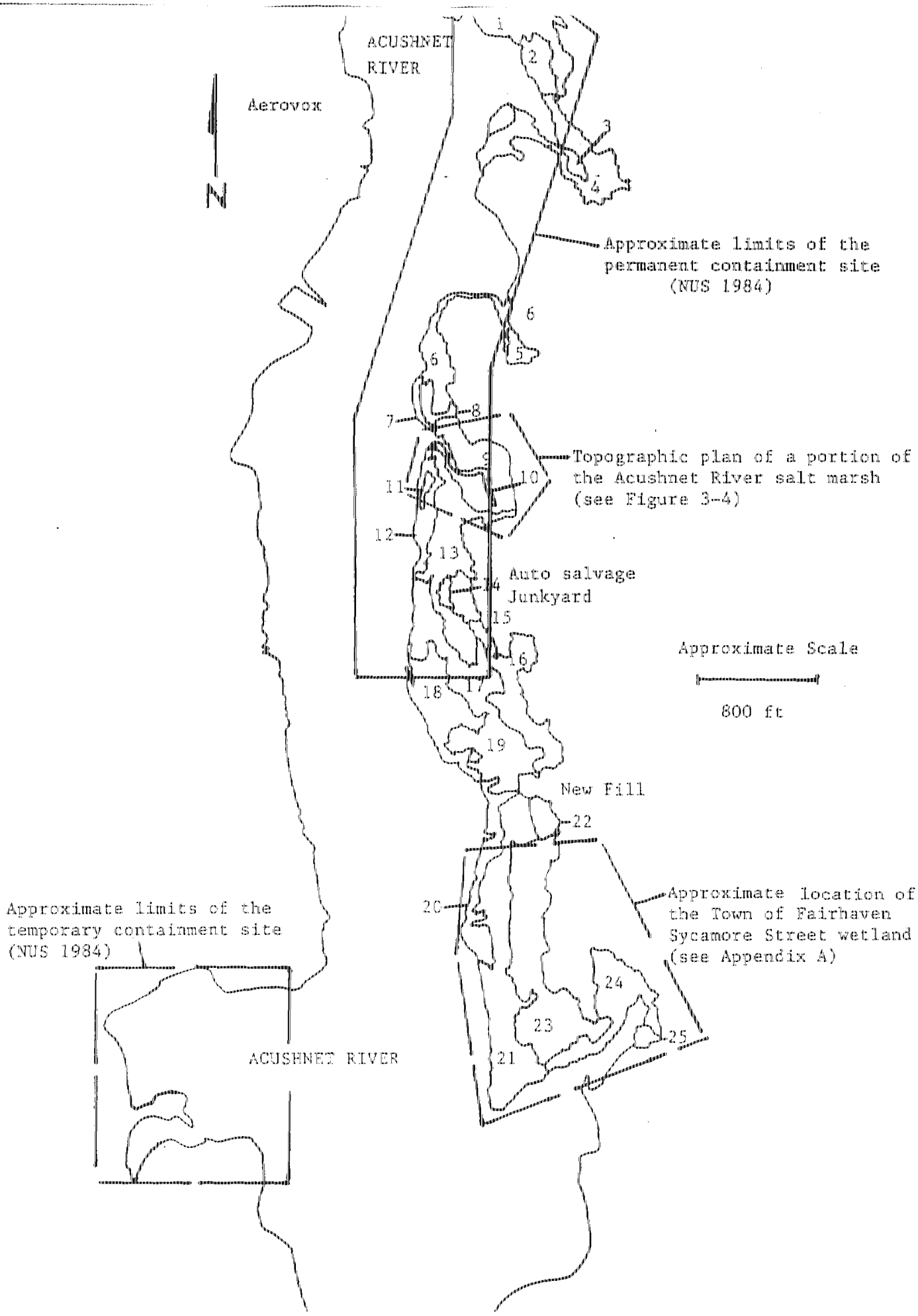

Figure 3-8. E.P.I.C. Community Areas (1-25) Within Acushnet River Wetlands A (1-4) and B (5-25) (U.S. EPA 1985, E.P.I.C. Wetland Assessment)

Table 3-11.

ACUSHNET RIVER WETLANDS COMMUNITY AREA MEASUREMENTS
(U.S. EPA 1985)

Figure 4-4 Community Number	Acres	Hectares
1	2.94	1.19
2	0.98	0.40
3	0.29	0.12
4	3.22	1.30
5	0.45	0.18
6	1.85	0.75
7	0.29	0.12
8	0.43	0.17
9	2.92	1.18
10	0.25	0.10
11	0.15	0.06
12	1.08	0.44
13	3.76	1.52
14	0.19	0.08
15	0.66	0.27
16	2.86	1.16
17	5.90	2.39
18	2.96	1.20
19	0.05	0.02
20	1.98	0.80
21	6.46	2.61
22	0.58	0.23
23	6.64	2.69
24	2.94	1.19
25	0.24	0.10
Total	50.07 acres	20.27 hectares

Table 3-12. Percent Cover and Total Area of Plant Community Types in the Acushnet River Wetlands A and B, North of the Coggeshall Street Bridge.

Wetland Community Type	Percent Cover	Area (acres)
Brackish/Freshwater marsh	6.4	3.19
Upland/Upland transition zone	2.4	1.19
Upland transition zone (switchgrass, freshwater cordgrass)	3.2	1.60
High salt marsh (marsh elder)	19.6	9.80
High salt marsh (spike grass, salt meadow grass)	48.5	24.30
Anthropogenically disturbed high salt marsh	1.3	0.66
Low salt marsh (salt marsh cordgrass)	16.9	8.49
Tidal pool	0.7	0.34
Tidal creek	0.5	0.25
Sandy shoreline	0.6	0.29

marsh cordgrass) covered about 3-5% of community 1. Filamentous green algae, sea lettuce, and rockweed (Fucus sp.) were draped on the creek bank and mud flat below the seaward edge of salt marsh cordgrass. The remaining area (about 5%) within wetland 1 was covered by the low shrub, marsh elder.

Reed stands are often indicative of freshwater input or areas of lower salinity within tidal wetlands. A tidal creek lies along the southern edge of community 1. Freshwater flow was observed within the creek during low tide.

Community 2

Community 2 located southeast of community 1 is 0.40 hectares (0.98 acres) in area. High marsh vegetation covered approximately 95% of community 2. About 50% of the high marsh was a mix of spike grass, black grass, seaside goldenrod (Solidago sempervirens), salt meadow grass, and scattered clumps of marsh elder. The spike grass was in flower. Randomly measured grass heights were about 51 centimeters (20 inches) for salt meadow grass and 58 centimeters (23 inches) for spike grass. The remaining 45% of high marsh was covered by marsh elder. The forbs, slender-leaved aster (Aster tenuifolius) and sea orach were also present within the high marsh. Along the estuarine edge of the salt marsh was a two to three meter (six to nine foot) wide band of tall-form salt marsh cordgrass. The cordgrass was about 155 centimeters (five feet) in height.

Community 3

Community 3 is a 0.12 hectare (0.29 acre) tidal inlet/pool whose mud flat substrate was exposed at low tide. This tidal pool was bordered by tall-form salt marsh cordgrass of community 4.

Community 4

Community 2 and 4 were contiguous and similar in species composition. Community 4 is 1.30 hectares (3.22 acres). The northern end of community 4 was dominated by the high marsh grass, salt meadow grass, and contained a few scattered marsh elder. Chair-maker's rush (Scirpus pungens = S. americanus) was found in small patches near the upland edge, and may indicate localized areas of lower salinity. At the eastern end of community 4 a mosquito ditch joined a tidal creek lined with tall-form salt marsh cordgrass. The mosquito ditch received discharge from a stream loaded with washings from a nearby cement company. The freshwaters flowed from the ditch southwest to the tidal creek and then northwest to the tidal pool/inlet (community 3), and the waters of the estuary. The tidal creek was lined with an extensive band of salt marsh cordgrass approximately 155 cm in height that was flowering profusely . Other marsh plants present included salt marsh bulrush (Scirpus robustus) and sea lavender. The southern end of community 4 was a high marsh/low shrub community of marsh elder with an understory of grasses including switchgrass.

Upland adjacent to wetland communities 1, 2, and 4 had a number of strata i.e. open meadow, tall shrub, and tree. Some common upland species included red cedar, black cherry, smooth sumac, poison ivy, and bayberry. Wildflowers such as evening primrose (Oenothera biennis), asters (Aster spp.), and thistles (Cirsium spp.) were found in the more open upland areas.

Wetland B (community 5-25)

Community 5

Community 5, located at the northern end of wetland B, is

0.18 hectares (0.45 acres) in size. Ninety percent of community 5 was dominated by common reed. Remaining areas contained marsh elder, switchgrass, salt meadow grass, and spike grass. Freshwater flowed northwest through a ditch within community 5 and discharged into the southeastern corner of an embayment adjacent to community 6.

Community 6

The total area of wetland community 6 is 0.75 hectares (1.85 acres). At the northern end of community 6 was high marsh containing spike grass, salt meadow grass, seaside goldenrod, switchgrass, and marsh elder. Adjacent to the extensive mud flat of the embayment was a band of salt marsh cordgrass. The cordgrass was about one meter (three feet) in height.

The low marsh band extended eastward and then south. Along this portion of community 6 the shoreline was composed of rocks and cobbles. Landward of the low marsh were a few marsh elders and the upland plants, red cedar and poison ivy.

Community 6 widened to the south. Salt marsh cordgrass continued to dominate along the shoreline but the majority of this portion of community 6 was dominated by high marsh vegetation, i.e. salt meadow grass, spike grass, marsh elder, and some scattered seaside goldenrod.

Community 7

Community 7 was not a vegetated wetland. It was a bare sand and cobble shoreline 0.12 hectares (0.29 acres) in area. Sea lettuce and rockweed had been washed ashore by tidal action. The bank landward of the sandy shoreline was eroded. Bare roots of upland transition zone species within

community 8 were exposed. Tidal currents or ice rafting may be responsible for the shoreline erosion.

Community 8

Community 8 is 0.17 hectares (0.43 acres) in size and contains little wetland vegetation. Some marsh elder high marsh was present, but the majority of the vegetation consisted of upland species, i.e. goldenrod, bayberry, poison ivy, winged sumac, and red cedar. A path ran from nearby power lines along the axis of community 8. It appears that fill was utilized during the construction of this path.

Community 9

Community 9 was included within the topographic plan of a representative portion of the Acushnet River wetlands (Figure 3-6). This community encompasses 1.18 hectares (2.92 acres) and was predominately covered (about 85%) by the high marsh grasses, salt meadow grass and spike grass. Flowering spike grass culms were about 56 centimeters (22 inches) in height. The remaining portion (15%) of community 9 was dominated by salt marsh cordgrass. Other salt marsh species present included black grass, and the forbs, annual glasswort (Salicornia europaea agg.) and slender-leaved aster.

Tall-form cordgrass (about 180 - 200 cm in height) lined a major tidal creek (community 10) which bisected community 9. Cordgrass also lined the narrow mosquito ditches that drained into the tidal creek.

A small patch of shorter-form salt marsh cordgrass (54 cm in height) and a tidal pool were present at the northwestern end of community 9.

Community 10

Community 10 is a major tidal creek 0.10 hectares (0.25 acres) in area. The creek was about 5 meters (15 feet) in width with banks approximately 1 meter (3 feet) high (Figure 3-6). Tall salt marsh cordgrass and an occasional annual glasswort covered the banks. This tidal creek carries flood waters from the Acushnet River estuary to the salt marsh community 9 described above. At low tide much of the creek bottom was exposed.

Community 11

Community 11 is included in the topographic plan (Figure 3-6). Community 11 was not a wetland. The densely vegetated 0.06 hectare (0.15 acre) community of upland transition zone and upland plant species contained the shrubs, beach plum (Prunus maritima), poison ivy, climbing bittersweet (Celastrus scandens), Virginia rose (Rosa virginianus), and red cedar trees.

Community 12

Community 12 is a 0.44 hectare (1.08 acre) area that encircles community 11. Its western border was the shoreline of the Acushnet River estuary. The majority of community 12 contained a high marsh/upland transition zone. Species within this transition zone included freshwater cordgrass, beach grass (Ammophila breviligulata), seaside goldenrod, and switchgrass. Scattered shrubs included marsh elder, poison ivy, bayberry, beach plum, and winged sumac.

The forbs sea orach and sea-blite were found along the eroded bank of the shoreline. Fragments of sea lettuce lay upon the adjacent sand and cobble beach.

The remaining vegetation (located at the southern end of community 12) was comprised of low marsh vegetation, primarily salt marsh cordgrass and sand-spurrey (Spergularia marina).

Community 12 was described in the 1985 E.P.I.C. report as "a sparsely vegetated sediment deposit, high marsh." In September 1986 the community was not sparsely vegetated. Open areas within the low marsh sward were colonized by the forb, sand-spurrey.

Community 13

Community 13 was a large (1.52 hectares/ 3.76 acres), dense, low shrub community of marsh elder that extended from the tidal creek (community 10) to south of the auto salvage yard (Figure 3-8). Interspersed between dense areas of marsh elder were patches of high marsh vegetation containing salt meadow grass, spike grass, and the forbs, annual glasswort, slender-leaved aster, and sea orach. An area of upland containing switchgrass and several red cedar trees was present in the northern portion of community 13.

Community 14

Community 14 was a small 0.08 hectare (0.19 acre) sward of high marsh grass near the auto salvage company. High marsh vegetation included spike grass, salt meadow grass, black grass, and sea orach. About 10% of community 14 was covered by flowering low marsh salt marsh cordgrass (about 90 centimeters or 3 feet in height).

Community 15

Community 15 was a 0.27 hectare (0.66 acre) area of high

marsh that had been disturbed by a construction vehicle associated with the auto salvage company. The community was unvegetated except for small patches of black grass and sea orach that remained at its southern end. The construction vehicle has created ruts and hollows in the marsh surface which trap water.

Community 16

Community 16, located south of the auto salvage yard, was another extensive (2.86 acres/ 1.16 hectares) high marsh low shrub community dominated by marsh elder. A few red cedar trees were also present with black grass dominant in the herbaceous understory. Other herbaceous species present included spike grass, switch grass, and seaside goldenrod.

Community 17

Community 17 is 2.39 hectares (5.9 acres) in area and extends from the shoreline near the auto salvage yard south to an area of recent fill material (Figure 3-8). The majority of community 17 was high marsh containing spike grass, salt meadow grass, and black grass. A number of forb pannes were found within the high marsh. The pannes contained perennial glasswort (Salicornia virginica), sea lavender, slender-leaved aster, annual glasswort, and sea orach.

At the northern end of community 17, and in and along tidal creeks, were stands of low marsh vegetation dominated by salt marsh cordgrass. The area of recent fill was partially vegetated by upland shrubs and grasses.

Community 18

The 1.20 hectare (2.96 acre) community 18 was an extensive

stand of low marsh salt marsh cordgrass that bordered the Acushnet River estuary. Along the shoreline, sea lettuce, filamentous greens, and rockweed were draped on the grasses and peat substrate. Forb pannes were found along the western edge of community 18. The pannes contained slender-leaved aster, perennial glasswort, sea-blite, annual glasswort, and sand-spurrey.

Community 19

Community 19 was a 0.02 hectare (0.05 acre) tidal pool contiguous with a tidal creek that brings flood waters to community 17. The tidal pool was surrounded by tall salt marsh cordgrass, and at low tide the muddy bottom sediment was strewn with sea lettuce.

Community 20

Community 20 was a 0.80 hectare (1.98 acre) low marsh and associated tidal flat. The salt marsh cordgrass of community 20 was contiguous with the cordgrass sward of community 18. The low marsh of community 20 along a tidal creek near the area of recent fill separated the large high marsh swards of community 17 and 21 (Figure 3-8).

Community 21

Community 21 was a large sward (2.61 hectares/6.46 acres) of high marsh grass that extended from the area of recent fill to the southern limit of wetland B. Species present in the high marsh included spike grass, salt meadow grass, slender-leaved aster, annual glasswort, sea lavender, and at the inland edge, black grass and marsh elder. High marsh grasses were about 50 cm (20 inches) in height. Tall salt marsh cordgrass lined the tidal creeks within wetland 21.

Community 22

Community 22 was a 0.23 hectare (0.58 acre) high marsh containing spike grass, salt meadow grass, and marsh elder. This community was located just south of the recent area of fill.

Community 23

Community 23 was an extensive area (2.69 hectares/6.64 acres) of marsh elder high marsh and upland transition species. The dense marsh elder low shrub community was about one meter (three feet) in height. Landward, the marsh elder was replaced by black grass, switchgrass, rose, bayberry, red cedar, and cherry.

Community 24

Community 24 is located at the southern limit of wetland B on a small embayment. This 1.19 hectare (2.94 acre) wetland contained low marsh salt marsh cordgrass along the water's edge. Landward, the low marsh was replaced by high marsh swards of spike grass and salt meadow grass, with smaller areas of marsh elder and common reed also present. The salt marsh cordgrass had a maximum height of 2 meters (6 feet), and many of the salt marsh grasses were in flower. The eastern (landward) edge of community 24 was in close proximity to a road.

Community 25

Community 25 was a small 0.10 hectare (0.24 acre) patch of tall salt marsh cordgrass located on the southern shoreline of a small embayment. This embayment was also bordered by community 24. At low tide, green algae were abundant on the mud flats.

E.P.I.C. Wetlands C and D

Wetlands C and D located south of the Coggeshall Street bridge would not be directly impacted by the remedial action alternatives. They were not separated by the E.P.I.C. wetlands assessment into community types. The E.P.I.C. report classified wetland C and D as 3.3 hectares (8.1 acres) of high salt marsh and 1.1 hectares (2.7 acres) of salt marsh respectively (U.S. EPA 1985) (Table 3-1). The SES September site visit revealed that wetland C is primarily low marsh and brackish/freshwater marsh, and wetland D a high salt marsh.

Approximately 50% of wetland C was dominated by short and tall form salt marsh cordgrass. The cordgrass encircled a tidal pool containing a large accumulation of sea lettuce. A small amount of sea lavender was also present. Common reed was co-dominant and a large stand was located at the western end of wetland C. Upland areas adjacent to wetland C contained little blue stem, asters (Aster spp.), chicory (Cichorium intybus), winged sumac, bayberry, black cherry, red oak (Quercus rubra), and poplars (Populus spp.). Sand fill had been previously placed immediately south of wetland C. These areas of fill are presently colonized by American beach grass. Further south of wetland C, the shoreline contained rocky intertidal areas. Slipper limpets (Crepidula fornicata), oysters (Crassostrea virginica), and periwinkles (Littorina littorea) were attached to the rocks and cobbles.

The shoreline adjacent to wetland D was rocky with many cobbles present. Wetland D contained about 85% high marsh vegetation. The high marsh was comprised of a mixture of salt meadow cordgrass and spike grass. Sea orach, sea lavender, and annual glasswort were also present. Approximately 10% of wetland D was dominated by marsh elder, black grass, and switchgrass. Common reed was found along the upland edge while

the upland itself contained winged sumac, bayberry, and oaks. Three mosquito ditches lined with salt marsh cordgrass were contained within the high marsh.

3.2.1.2 Vegetation of the Pope Beach, Buzzards Bay, wetlands (E.P.I.C. wetlands E, F and G)

The 1985 E.P.I.C. wetland report identified three wetlands, E, F and G, on Buzzards Bay southeast of Fairhaven and southwest of East Fairhaven (Figure 3-5).

Wetland E was a large (28 hectare/69.1 acre) tidal wetland on Buzzards Bay (Figure 3-3). A dike cut across the northern end of wetland E and separated it from wetlands F and G. An upland community of willows (*Salix* sp.), oaks, winged sumac, and bayberry was present near an area of fill on which a road had been built over the dike. A profile of wetland E was prepared by SES and Norwood Engineering (see Figure 3-9). The profile transect began at the dike and headed in a southerly direction towards Buzzards Bay. Elevations within a band of brackish/ freshwater marsh adjacent to the dike ranged from 1.4 meters above mlw to 2 meters above mlw. The remaining area of wetland was dominated by high marsh vegetation with low relief (i.e., elevations ranged from 1.3 meters to 1.4 meters above mlw). The high marsh was dominated by a mixture of spike grass and salt meadow grass, with marsh elder also present. A number of natural tidal creeks and mosquito ditches crossed the salt marsh. Low marsh vegetation dominated by salt marsh cordgrass was growing along the banks of the mosquito ditches.

The plant species composition of the wetland E tidal marsh was similar to the Acushnet River tidal wetlands (see Appendix D). However, the heights of salt marsh species in wetland E were generally shorter than in the Acushnet River estuary wetland B (Table 3-13). This height difference may be due to higher levels of available nitrogen and phosphorus in the

Figure 3-9. Profile Through Wetland E, Pope Beach.

Table 3-13. Salt Marsh Plant Heights (cm ± s.d.) recorded during the work at the Acushnet River estuary and the Pope Beach site (all plants flowering except for short-form *Spartina alterniflora*) (n = sample number).

		Wetland B Acushnet River Estuary	Wetland E Buzzards Bay
Salt Marsh Cordgrass	short-form	62	37
(*Spartina alterniflora*)	tall- form	143± 30 (n=22)	105± 16 (n=5)
Salt Meadow Grass (*Spartina patens*)		53± 7 (n=16)	43± 6 (n=7)
Fresh Water Cordgrass (*Spartina pectinata*)		130	
Spike Grass (*Distichlis spicata*)		52± 8 (n=12)	31± 6 (n=2)
Common Reed (*Phragmites australis*)		200	200
Black Grass (*Juncus gerardi*)		40	
Annual Glasswort (*Salicornia europaea* agg.)		58± 16 (n=4)	33± 5 (n=4)
Slender Aster (*Aster tenuifolius*)		62± 4 (n=2)	
Marsh Elder (*Iva frutescens*)		108± 8 (n=3)	80

Acushnet River estuary. The shoreline of wetland E was also sandier than the Acushnet River estuarine shoreline, with some dune vegetation (e.g., beach grass, sea-rocket (Cakile endentula), and seabeach knotweed (Polygonum glaucum) present near the Bay. The algae, sea lettuce and green fleece (Codium fragile), and eelgrass (Zostera marina) were scattered upon the shore.

The tidal creeks of wetland E were culverted under the dike thereby restricting tidal flow to wetlands F and G (Figure 3-3). Wetland F is 4.1 hectares (10.2 acres) in size. Approximately 60% of wetland F was high salt marsh that was criss-crossed by mosquito ditches. Tall-form salt marsh cordgrass lined the tidal creeks and mosquito ditches. Spike grass and salt meadow grass were co-dominant in the high marsh. High marsh grasses ranged in height from about 20 to 30 centimeters (8 to 12 inches). In comparison, the height of high marsh grasses in the Acushnet River estuary wetland B was about 50 centimeters (20 inches). Similarly, the forb, annual glasswort, was only about 10 centimeters (8 inches) in height in wetland F, compared to 58 centimeters (23 inches) in the Acushnet River wetland B (Table 3-13). This height difference may be due to reduced tidal inundation and lower nutrient (N and P) levels in wetland F (see Table 3-13). A fringe of common reed surrounded much of the wetland F salt marsh. However, adjacent to the road which separated wetland F and G, herbaceous high marsh graded into upland transition zone dominated by switchgrass, goldenrod (Solidago spp.), marsh elder, rose species, and red cedar.

The E.P.I.C. report describes wetland G as a high salt marsh (U.S. EPA 1985). The September 1986 SES site investigation revealed that wetland G contained a small amount of high salt marsh grasses, marsh elder shrubs, and brackish/freshwater marsh. However, the majority of the site was wooded and should be classified as wooded swamp and upland. The woodland of

wetland G contained poison ivy, willows, rose species, honeysuckle (Lonicera spp.), speckled alder (Alnus incana), and grape in the shrub layer, and red maple (Acer rubrum), poplars, and red cedar in the tree strata.

3.2.1.3 Summary of Wetland Vegetation Surveys

The majority of wetland within the Acushnet River estuary was located north of the Coggeshall Street Bridge and is labelled wetland A and B by the 1985 E.P.I.C. report. Approximately 70% of wetland A and B was high salt marsh composed of spike grass, salt meadow grass, marsh elder, and scattered forbs. Table 3-12 gives a complete list of the percentage for each community type.

The Acushnet River tidal marsh surface was characterized by rather dense vegetative coverage. Large barren areas that might suggest vegetative die-off due to contaminants were not observed.

Plant growth and flowering in the Acushnet River estuary wetlands appeared healthy (excepting some fungal ergot infestation of the developing seeds) and vigorous. The height of salt marsh grasses and forbs within wetland B was greater than for the Pope Beach, Buzzards Bay wetlands (Table 3-13).

The Acushnet River estuary wetlands and the Pope Beach, Buzzards Bay wetlands had similar species diversity. The only salt marsh species present in wetland F (Pope Beach) but not observed during field surveys at the Acushnet River estuary wetlands was Arrow Grass (Triglochin maritima).

3.2.2 Tidal Wetland Fauna

Many tidal marsh animals live in close association with tidal flats or the salt marsh substrata. Others (e.g.,

terrestrial mammals and birds) utilize the vegetated marsh and tidal flats as feeding grounds. A few birds (e.g., marsh wren (Cistothorus palustris)) and mammals (e.g., meadow vole (Microtus pensylvanica), eastern cottontail (Sylvilagus floridanus)) may use the higher reaches of the salt marsh to nest.

Consumers that live in tidal marshes can be divided into algae-detrital feeders and grazers that feed on the emergent vegetation. Detritus-algal feeders in the intertidal zone include bivalves (e.g., Geukensia demissa), green crabs (Carcinus maenas), fiddler crabs (Uca spp.), periwinkles (Littorina), mud snails (Nassarius), various oligochaete and polychaete worms, and immature insects. Detritus-algal feeders on the marsh include the marsh snail (Melampus bidentatus), amphipods (Orchestia), and isopods (Philosia). Grazers include katydids and grasshoppers (Orthoptera), plant hoppers (Prokelisia), meadow vole, and eastern cottontail. Secondary consumers include such mammals as the raccoon (Procyon lotor).

Northeastern salt marshes support significant populations of waterfowl (Niering and Warren 1977). The detrital feeding amphipods are important in the diet of some salt marsh birds. Many fish and shellfish also feed along marsh edges. Bait fish may move up into the marsh surface during high tides to feed on benthic macrofauna (e.g., insects, amphipods, and marsh snails) (Werme 1981).

A high animal diversity (especially insects and birds) can develop in salt marshes containing low plant diversity due to the availability of food and protection (Davis and Gray 1966, Neiring and Warren 1977).

3.2.2.1 Benthic Invertebrates

Benthic invertebrates live in close association with the

tidal flat substrate. These organisms are one of the main food sources for demersal fish (e.g., winter flounder) and small bait fishes (e.g., mummichogs) (Wiltse et al. 1984). Benthic invertebrates have been divided into two groups, epifauna and infauna, based upon life mode. Epifauna are organisms living on the sediment surface. Most are mobile arthropods or molluscs. Organisms that live in the sediment are termed infauna. Infaunal species include nematodes, annelids, crustaceans, and molluscs. Most live in the upper (0-10 cm) layer of the sediment.

Infauna

On September 8 and 9, 1986, SES collected bottom sediment (0.1 m^2 sample size) within the Acushnet River estuary (SES 1987). Four sample stations were located in the hot spot area north of the Coggeshall Street bridge (Figure 1-2). Macrobenthic species numbers ranged from 13 to 29 at these upper estuary stations. Species numbers for the inner harbor stations (5 through 13), south of the Coggeshall Street bridge, ranged from 24 to 40. The lowest diversity (species number) was found in the two most northerly stations 1 and 2. They had 13 and 14 species, respectively. The evenness was also low at station 1 and 2. Most of the individuals identified were the polychaete worm, *Streblospio benedicti*, a classic pollution indicator species. *S. benedicti* is an early colonizer of disturbed habitat, has several broods a year, early maturation, and high mortality rates (Whitlach 1982). Other polychaete worms detected in the benthic samples and observed during site visits to the upper Acushnet River mud flats were the trumpet worm (*Pectinaria gouldii*) and a nereid polychaete, *Nereis succinea*. The trumpet worm feeds at depth and deposits egested sedimentary materials on the surface. The suspension feeding bivalves, soft-shelled clam (*Mya arenaria*), hard shelled clam (*Mercenaria mercenaria*), and gem shell (*Gemma gemma*) were also present in the bottom sediments of the upper estuary. Shells of a bivalve littered the estuarine tidal flats in late summer 1986. This

small bivalve was probably the deposit feeding clam, Macoma balthica (J. Valois, Marine Resources Center, M.B.L., pers. comm., January 21, 1987). M. balthica, an abundant species on mud flats, feeds off the sediment surface with a long siphon. A set will live two to three years, die, and then the shells will often wash ashore in large numbers. The ribbed mussel (Geukensia demissus) was abundant at the salt marsh edge just below the tall salt marsh cordgrass. In the upper estuary, densities were about 20 individuals/0.01 m^2. The ribbed mussel was not observed north of E.P.I.C. community 6 (Figure 3-8).

Ribbed mussels were also observed at the base of salt marsh cordgrass stalks within the Buzzards Bay E.P.I.C. wetland E.

Epifauna

Common periwinkles (Littorina littorea), slipper limpets, barnacles (Balanus sp.), and common oysters were attached to the rocks of the shoreline south of the Coggeshall Street bridge near E.P.I.C. wetland C (Figure 3-5). Barnacles were also observed north of the Coggeshall Street bridge on areas of cobble shoreline near community 6. Tidal flat epifauna observed within the upper Acushnet River estuary included dense aggregations of the mudsnail, Ilyanassa obsoleta. The feeding habits of the mudsnail range from herbivory to carnivory. Unlike tidal flat gastropods, epifaunal arthropods of tidal flats migrate on and off the flats with the tidal cycle. The common green crab was observed in E.P.I.C. community 10, a tidal creek. Green crabs are molluscivores, deposit feeders, and scavengers. Mud fiddler crabs, Uca pugnax, were observed in all E.P.I.C. wetlands (B-F) except wetland A at the northern end of the Acushnet River estuary (Figure 3-5). E.P.I.C. community 13 was the most northerly location within wetland B where fiddler crabs were observed (Figure 3-8). Fiddler crabs were also sighted in the low marsh of communities 17 and 18 and within the

tidal pool of community 19. Wetland G at Pope Beach, Buzzards Bay, was not surveyed for fiddler crabs. Ubiquitous species within the Acushnet River wetlands included amphipods (Orchestia sp.), isopods, and the salt marsh snail, Melampus bidentatus.

The salt marsh snail, isopods, common periwinkles, and fiddler crabs were also observed in the Buzzards Bay wetlands.

3.2.2.2 Estuarine Fishes

Resident and migratory fish species, both pelagic and demersal, are expected to be present within the Acushnet River estuary. Silversides (Menidia spp.), killfish (Fundulus spp.), and bluefish (Pomatomus saltatrix) would be among the many pelagic species anticipated to utilize the study area.

The Acushnet River estuary also contains demersal fish such as American eel (Anguilla rostrata), winter flounder (Pseudopleuronectes americanus), scup (Stenotomus chrysops), summer flounder (Paralichthys dentatus), windowpane flounder (Scophthalmus aquosus), and tautog (Tautoga onitis).

Alewives (Alosa pseudoharengus) and blue back herring (Alosa aestivalis) migrate through the estuary to spawn in the freshwater of the Acushnet River estuary (G. Crouch, U.S. FWS, pers. comm., April 12, 1985). Juvenile stages of some fish use the salt marsh as a nursery. Most estuarine fish migrate onto tidal flats and into the tidal creeks and salt marsh vegetation during flood tides to feed. Mummichogs (Fundulus heteroclitus) were observed within the Acushnet River tidal creeks during ebb tide, and an alewife observed along the shoreline.

3.2.2.3 Salt Marsh Insects

A variety of insects live in salt marshes. During the late summer site inspection, crickets were found throughout the

Acushnet River wetlands. Other insects observed during early spring or late summer included katydids (Tettigoniidae), casebearers (Coleophora sp.), mantids (Tenodera aridifolia), and mirids (Miridae).

Mirids, crickets, and mantids were also observed at the Pope Beach, Buzzards Bay wetland.

3.2.2.4 Birds

Birds can be regarded as extremely efficient indicators, their species diversity and density being a convenient comparative index. Sampling is relatively easy due to their high visibility, ease of identification, and mobility. Their wide range of feeding habitats at different upper trophic levels adds to their value as indicators. Ornithological studies of the Acushnet River estuary and the Pope Beach, Buzzards Bay, marsh were conducted in the winter (February 22, 1985), early spring (April and May of 1985), and late summer (September 18 and 19, 1986). Flight allows birds a wide mobility in foraging and resting behaviors. Thus, the Acushnet River and Pope Beach wetlands were compared by dividing them into habitat types. The ornithological habitat types included: (1) Upland Shrubs, (2) Reed Marsh, (3) Salt Marsh, and (4) Mud Flat and Open Water.

During the preliminary survey (winter 1985), bird species were counted in the four ornithological habitats at the upper Acushnet River estuary (E.P.I.C. wetlands A and B) site and Pope Beach marsh site. No Pope Beach open water/mudflat site could be located where physical topography was similar enough to the study site to provide a valid ornithological comparison. Birds flying over a habitat were not recorded if there was no obvious connection with that area, e.g. hunting, display flight, landing, etc.

Early spring 1985 ornithological work included analyses investigating existing bird populations within the upper

Acushnet River estuary and, for comparison, bird populations within the Pope Beach marsh site on Buzzards Bay. The analyses include estimates of bird species densities and diversity.

Late summer (September 1986) ornithological work included additional observations within the Acushnet River estuary and Pope Beach marsh. A general bird census of the two tidal marshes just south of the Route 195 Bridge (E.P.I.C. wetlands C and D; U.S. EPA 1985) was also conducted. Qualitative assessments of bird species richness and distribution were made from these observations.

Open Water/Mud Flat Habitat

The Acushnet study area contains approximately 90 hectares (220 acres) of open water/mudflat habitat (NUS 1984). This includes the estuary from Tarkiln Hill Road Bridge south to the Coggeshall Street Bridge, and then south again to the estuary construction 1,500 meters (4,950 feet) south of the I-195 Road Bridge. This latter area of deeper water was used as a low-tide roosting area by many waterfowl which were otherwise noted as feeding within the principal study area (E.P.I.C. wetlands A and B) north of Coggeshall Street Bridge. Easy road access to the margins of the estuary made it possible for ornithologists to completely census this habitat during a several hour survey. Surveys were conducted at various tidal stages using binoculars and 20x telescopes. All birds using this habitat were recorded, but not those flying over it to reach other habitats. "Use" included resting, swimming, or feeding on or below the surface of mud or water, and also aerial feeding above this habitat. Table 3-14 presents numbers of each species counted on six dates within the sampling period (February 1985 - September 1986). In late summer (September 18 and 19, 1986) two complete censuses of the open water/mudflat habitat were conducted, one at low tide and one at high tide. The tidal range was at maximum (full moon) during the survey. The larger number of each bird species from the two censuses are reported in Table 3-14.

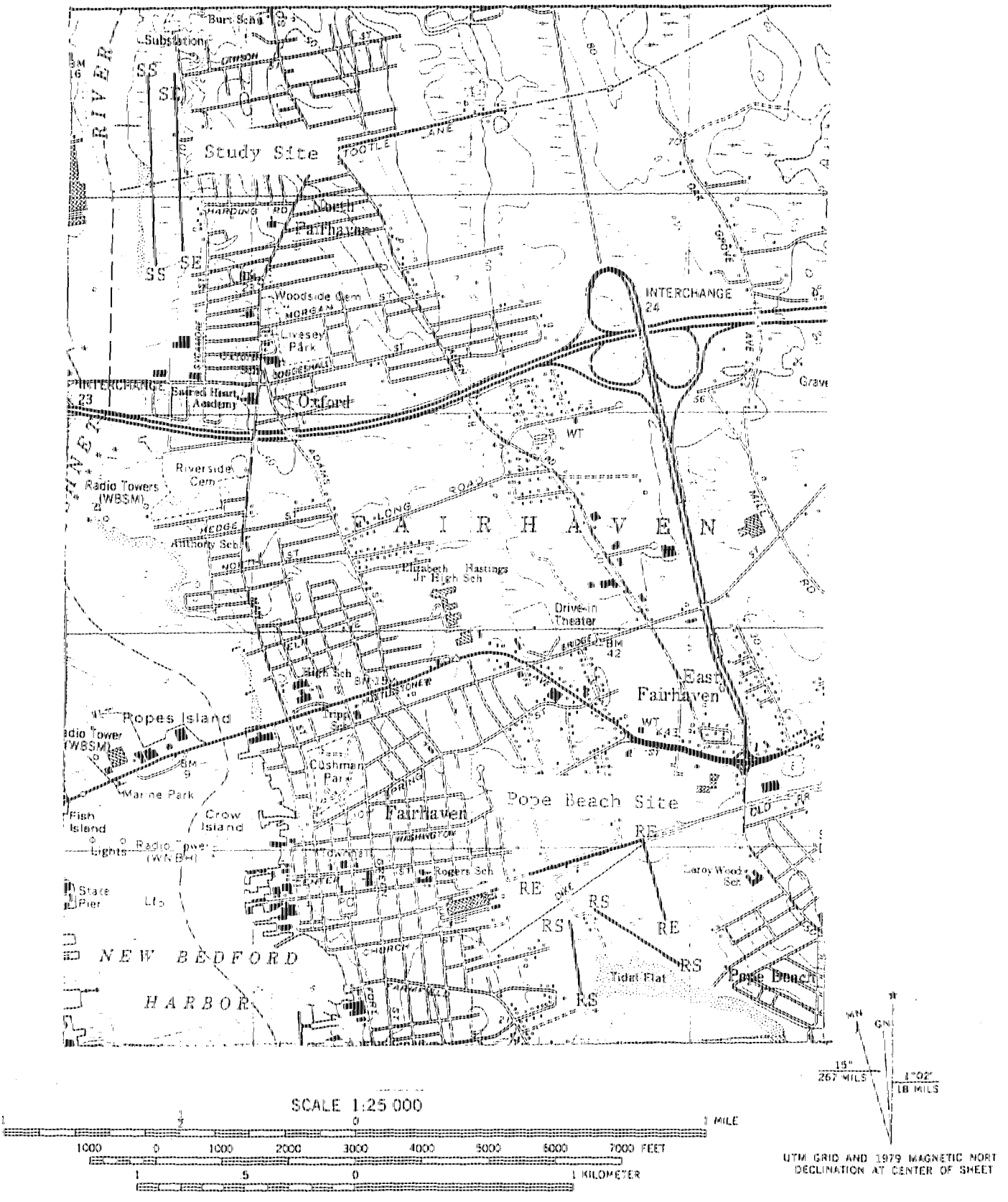

Figure 3-10. Study and Pope Beach locations, Acushnet River Estuary Avian Census.

Table 3-14. OPEN WATER/MUDFLAT BIRD CENSUSES - ACUSHNET RIVER ESTUARY

	Late Winter/Early Spring (1985)					Late Summer (1986)
	22 FEB	08 APR	14 APR	04 MAY	19 MAY	18,19 SEPT
Double-crested Cormorant	---	2	1	8	9	3
Great Egret	---	---	1	---	---	1
Mute Swan	6	6	4	7	6	1
Canada Goose	---	2	2	2	2	---
American Black Duck	24	11	---	---	---	---
Mallard	22	2	---	---	---	---
American Wigeon	23	---	4	---	---	---
Canvasback	4	---	---	---	---	---
Greater Scaup	10	5	119	---	---	---
Scaup sp.	140	410	---	---	---	---
Common Goldeneye	---	---	---	1	---	---
Bufflehead	14	60	13	2	---	---
Peregrine Falcon	1	---	---	---	---	---
Black-bellied Plover	---	---	---	---	2	---
Killdeer	---	---	2	---	---	---
Greater Yellowlegs	---	2	---	13	6	---
Spotted Sandpiper	---	---	---	---	1	1
Laughing Gull	---	---	---	2	---	25
Common Black-headed Gull	---	1	---	---	---	---
Ring-billed Gull	266	8	53	36	42	2
Herring Gull	295	14	11	20	2	9
Iceland Gull	1	---	---	---	---	---
Great Black-backed Gull	40	10	16	9	33	9
Least Tern	---	---	---	8	---	---
Rock Dove	3	---	---	2	10	+
Mourning Dove	---	---	---	---	2	---
Tree Swallow	---	---	---	2	---	---
American Robin	---	---	---	---	1	---
European Starling	---	---	7	8	2	---
Song Sparrow	---	---	---	2	1	---
Common Grackle	---	---	---	---	8	---
House Sparrow	---	---	8	---	---	---
Great Blue Heron	---	---	---	---	---	10
Snowy Egret	---	---	---	---	---	8
Lesser Yellowlegs	---	---	---	---	---	6
Forster's Tern	---	---	---	---	---	1
Belted Kingfisher	---	---	---	---	---	2
TOTALS #	849	533	241	122	127	78+
SPECIES	13	12	13	15	15	14

Generally, waterfowl and gull numbers decreased from the high levels recorded in February while shorebirds increased in spring. Numbers of all birds decreased from a high of 849+ (377/40 hectares or 100 acres) on 22 February 1985 to a low of 78+ (35+/40 hectares or 100 acres) on 18, 19 September 1986. Waterfowl numbers were lower in mid-September than in winter, since breeding waterfowl are few and many migrants arrive later. Late summer gulls were present in higher numbers than the spring average, but were well below winter numbers (Table 3-14). The shorebirds and wading birds present were mostly migrants. Numbers of species recorded remained similar throughout. This is a comparatively high density of water birds for the New England region at these dates. Active feeding was noted for most species within the contaminated study area (i.e., this was not merely a roost for birds which fed elsewhere). The February density of 377 birds/40 hectares (100 acres) is higher than bird densities recorded in either study of Pope Beach sites for the salt marsh and edge habitats.

A census conducted in September of 1986 at the Pope Beach, Buzzards Bay site recorded far fewer species and numbers of individuals than the Acushnet estuary September survey (Table 3-15). This was probably due to the smaller overall area involved, comparatively limited mud flats, and more marine aspect of the shore at this site. Gulls were observed roosting, some migrant transient shorebirds feeding on the mud flats, and loons and ducks diving offshore.

Salt Marsh Habitat

This habitat is dominated by the salt marsh grasses, *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*. During winter and early spring, salt marsh had the lowest bird-density of the three habitats observed. Salt marsh also exhibited a low species diversity, similar to that of the open

water/mudflat habitat. Two salt marshes were compared:

1. Acushnet River E.P.I.C. Wetland B. Transect SS on Figure 3-9.
2. Pope Beach (Buzzards Bay) E.P.I.C. Wetland E. Transects RS, RS on Figure 3-9.

In each salt marsh a 1,000 meter (3,333 feet) transit line was established on a compass bearing, the transit being in two sections at the Pope Beach site. Between 8-18 April 1985, each transit was surveyed 10 times using the variable-strip census method (Emlen 1971). Distances to each registration were recorded at 90° to the transit using range finders. A detection distance was established for each bird species, beyond which a greater than 5% drop in detection was noted. These inflection points on the plotted distance curves were then used to determine a species density specific to the habitat, time of year, and bird species detectability. Territorial song and other pertinent observations were recorded separately to refine the method (Franzreb 1981).

Table 3-16 presents individual species densities for both salt marsh transects. Records of birds flying over the habitat, but not observed utilizing it, were discarded from the analysis. The Mann-Whitney U-test or Wilcoxon two-sample test (Sokal and Rohlf 1969) were used to test the null hypothesis that the two samples came from populations having the same density distribution. No significant difference was detected between bird species densities in the study and Pope Beach marshes ($P < 0.2$). Thirteen species and a total bird density of 12.2 birds/40 hectares (100 acres) were noted within the Acushnet study site. Fifteen species and a total bird density of 12.9 birds/40 hectares (100 acres) were noted within the Pope Beach site. Song Sparrow was the most abundant bird at both salt marshes and eight species were common to both sites. Hence, the salt marsh at the study site showed no significant difference in

Table 3-15. Pope Beach Marsh - Open water/mud flat avian censuses late summer (September 1986).

Common Loon	2
White-winged Scoter	1
Lesser Yellowlegs	3
Laughing Gull	6
Ring-billed Gull	1
TOTALS #	13
SPECIES	5

TABLE 3-16. SALTMARSH BIRD DENSITIES (#/40 ha) RECORDED DURING EARLY SPRING TRANSECTS

Acushnet Study Area		Pope Beach Site	
American Black Duck	1.4	Great Blue Heron	0.5
American Kestrel	0.3	American Black Duck	0.4
Killdeer	0.6	Mallard	0.5
Greater Yellowlegs	0.9	American Kestrel	1.1
Mourning Dove	0.3	Killdeer	1.4
Tree Swallow	0.3	Greater Yellowlegs	0.4
American Crow	1.7	Ring-billed Gull	0.2
American Robin	0.6	Herring Gull	1.4
Savannah Sparrow	0.6	Great Black-backed Gull	0.2
Song Sparrow	4.0	Mourning Dove	0.2
Sparrow sp.	0.3	American Crow	1.3
Common Grackle	0.6	Northern Mockingbird	0.2
Eastern Meadowlark	0.6	Savannah Sparrow	0.4
		Song Sparrow	4.3
		Sparrow sp.	0.4
TOTAL: 13 species	12.2/40 ha	TOTAL: 15 species	12.9/40 ha

avian populations at this time of year when compared with similar habitat at the Pope Beach salt marsh.

Species diversity was calculated using the Shannon-Weiner index for both the estuary and Pope Beach salt marshes. Species diversity (H) for the study site was 3.158 compared with 3.228 for the Pope Beach site. Equitability (E) was 0.854 for the study site compared with 0.826 for the Pope Beach site. Both diversity and equitability measurements suggest highly similar bird communities.

Bird density in September along transit SS through the Acushnet River salt marsh (see Figure 3-9) was higher than observed in the spring (Table 3-16), and much higher than observed in the winter (Table 3-17). This increase in numbers was likely due to the abundance of seeds and invertebrate food in the fall. A flock of 80+ starlings were observed foraging in the Spartina, and twelve laughing gulls were observed hovering and feeding over the partially flooded salt marsh at high tide.

A greater number of species and individuals were recorded in late summer at the Pope Beach marsh than in early spring, partly due to gulls feeding on the salt marsh at high tide (Table 3-17). The mix of species was similar to the spring data except that song sparrows were not observed. A merlin was observed during the September survey. Merlin are more common as coastal migrants in fall than in the spring.

Tidal Marsh/Upland Edge Habitat

Two examples of marsh/upland edge were compared. Both had significantly higher bird populations than their adjacent salt marshes (approximately 20 times greater). These habitats cover a transition zone from the landward edge of the salt marsh to adjoining upland or fresh wetland habitats. A zone of shrubs and trees border the wetlands and also extends into the wetlands

Table 3-17. Avian abundance for salt marsh habitat at the Acushnet and Pope Beach study sites.

	Acushnet Study Area		Pope Beach Site
	February 1985	September 1986	September 1986
Great Blue Heron	-	-	2
Green-backed Heron	-	1	-
Black Duck	-	4	-
Red-tailed Hawk	1	-	-
Peregrine Falcon	1	-	-
Merlin	-	-	1
Osprey	-	1	-
American Kestrel	-	1	-
Laughing Gull	-	12	13
Herring Gull	-	-	1
Rock Dove	3	-	-
Belted Kingfisher	-	-	1
Northern Flicker	-	3	1
Tree Swallow	-	-	2
Barn Swallow	-	-	2
Blue Jay	-	-	1
American Crow	2	-	5
Northern Mockingbird	-	-	1
Gray Catbird	-	-	1
European Starling	-	80	1
House Finch	-	-	1
Savannah Sparrow	-	4	-
Song Sparrow	-	5	-
Red-winged Blackbird	5	-	-
Total # individuals	12	111	33
Species number	5	9	14

as tree/shrub peninsulas and islands. The transit locations were:

1. Acushnet Study Area (E.P.I.C. wetland B). Transect SE on Figure 3-9.
2. Pope Beach, Buzzards Bay, Site (E.P.I.C. wetland F and G) Transects RE, RE on Figure 3-9.

Methods, timing of field work (8-18 April 1985), and analyses were identical to those identified above in the Salt Marsh subsection on these two 1,000 meter (3,333 feet) transects through edge habitat. Tables 3-18 and 3-19 present individual species densities. No significant difference was detected between bird species densities in the study and Pope Beach edge habitats ($0.9 > P > 0.5$). Although the study site contained slightly more birds (281.4/40 hectares (100 acres) of 28 species) than the Pope Beach site (211.6/40 hectares (100 acres) of 26 species). Twenty-four of the avian species observed were recorded at both sites. Thus, the marsh/upland edge at the study site showed no significant difference in bird populations at this time of year when compared with similar habitat at the Pope Beach site. The bird densities of either edge habitat were significantly greater ($P < 0.002$) than that of either salt marsh habitat.

Species diversities were calculated using the Shannon-Weiner index for both the estuary marsh/upland edge community and the Pope Beach site edge community. The estuary marsh/upland edge community exhibited a diversity (H) of 3.906 compared to the Pope Beach site edge of 4.156. Equitability (E) was 0.813 for the estuary marsh/upland edge compared to 0.884 for the Pope Beach site edge. These data indicate that the marsh/upland edge communities are highly similar.

During fall (September 1986), a wide variety of fruits and seeds provide abundant bird food. The tidal marsh/upland edge

TABLE 3-18. MARSH/UPLAND EDGE BIRD DENSITIES (#/40 ha) RECORDED DURING EARLY SPRING TRANSECTS (8-18 APRIL) AT THE ACUSHNET STUDY AREA.

1. Acushnet Study Area

American Kestrel	0.4	Yellow-rumped Warbler	10.5
Rock Dove	4.9	Northern Cardinal	6.5
Mourning Dove	2.0	American Tree Sparrow	3.2
Downy Woodpecker	0.8	Field Sparrow	3.6
Hairy Woodpecker	0.6	Savannah Sparrow	0.7
Northern Flicker	3.4	Song Sparrow	35.9
Blue Jay	12.8	Swamp Sparrow	1.4
American Crow	2.9	White-throated Sparrow	14.5
Black-capped Chickadee	1.0	Red-winged Blackbird	13.1
Tufted Titmouse	2.9	Common Grackle	40.8
Carolina Wren	6.2	Brown-headed Cowbird	3.3
American Robin	33.1	House Finch	5.2
Northern Mockingbird	17.6	American Goldfinch	4.1
European Starling	44.6	House Sparrow	5.4

TOTAL: 28 species 281.4/40 ha

TABLE 3-19. MARSH/UPLAND EDGE BIRD DENSITIES (#/40 ha) RECORDED DURING EARLY SPRING TRANSECTS (8-18 APRIL) AT THE POPE BEACH SITE.

2. Pope Beach Site

Rock Dove	0.2	Yellow-rumped Warbler	18.6
Downy Woodpecker	4.7	Northern Cardinal	7.5
Northern Flicker	6.4	Field Sparrow	0.6
Tree Swallow	0.9	Savannah Sparrow	0.7
Blue Jay	1.0	Song Sparrow	27.8
American Crow	6.8	Swamp Sparrow	2.1
Black-capped Chickadee	11.0	White-throated Sparrow	13.1
Tufted Titmouse	9.2	Red-winged Blackbird	6.5
Carolina Wren	4.1	Common Grackle	5.1
American Robin	15.9	Brown-headed Cowbird	5.3
Gray Catbird	7.3	House Finch	13.1
Northern Mockingbird	4.1	American Goldfinch	23.1
European Starling	15.1	House Sparrow	1.4

TOTAL: 26 species 211.6/40 ha

at the Acushnet River estuary contained the greatest abundance and species range of songbirds. Even species normally insectivorous were observed eating fruits, an adaption for the rapid accumulation of pre-migratory fat. Most of the migrant species (recorded in the spring as probably breeding) were still present and a very similar range of permanent residents was also present. Many recently fledged juveniles were noted which may indicate successful breeding along the wetland edge. Detailed individual marking and nest location would be required to conclusively confirm this supposition. During site visits in September, dozens of individuals of the 25 species recorded were sighted (Table 3-20). Bird density was much greater than the sparse 25 birds of 8 species noted in February, but appeared similar to the 281 birds/40 hectares (100 acres) recorded in spring (Table 3-20).

The ornithological records for the Pope Beach, Buzzards Bay marsh area in September 1986 included observations along transit RE (Figure 3-9), and the uplands and fresh water wetlands south to the dike (i.e., E.P.I.C. wetlands F and G). Fruits and seeds provided abundant bird food as at the Acushnet River study site. In addition, juveniles of resident species were noted, and the total number of species and individuals were comparable to the Acushnet study site (Table 3-20).

Common Reed Tidal Wetland Habitat

At the Acushnet River estuary, *Phragmites australis*, an introduced species, grows in relatively pure stands. These reed stands were ornithologically barren in winter, spring, and fall. Song sparrows were noted foraging in the reed and droppings and molted feathers were present, indicating a small blackbird/starling roost. There was no indication that the paucity of wildlife observed in this vegetation type (within this region) was unusual.

Table 3-20. Salt marsh/Upland edge - Bird data from the winter (February 1985) and late summer (September 1986) survey.

	Acushnet Study Area		Pope Beach Site
	February 1985	September 1986	September 1986
Osprey	-	present	-
Northern Harrier	-	present	-
American Kestrel	1	present	1
Sharp-shinned Hawk	1	-	-
Rock Dove	-	present	+
Mourning Dove	5	present	-
Blue Jay	-	present	5
Common Crow	2	present	-
Black-capped Chickadee	-	present	1
Tufted Titmouse	1	-	5
House Wren	-	present	1
Carolina Wren	-	present	2
Northern Mockingbird	1	present	3
Gray Catbird	-	present	11
American Robin	-	present	3
European Starling	-	present	-
Tennessee Warbler	-	present	-
Bay-breasted Warbler	-	present	-
Blackpoll Warbler	-	present	1
Connecticut Warbler	-	present	-
Yellow-rumped Warbler	3	-	-
Common Yellowthroat	-	present	3
American Redstart	-	-	2
Northern Cardinal	-	present	6
Rose-breasted Grosbeak	-	present	-
Song Sparrow	11	present	4
Common Grackle	-	present	-
House Finch	-	present	-
American Goldfinch	-	present	+
Red-eyed Vireo	-	-	1
White-eyed Vireo	-	-	1
Solitary Vireo	-	-	1
Total # individuals	25	dozens of individuals of each species	33+
Species number	8	25	21

+ - several individuals observed

Only a few song sparrows were noted at the Buzzards Bay site in the common reed wetland. Common Reed tidal wetlands are occasionally visited by carolina wren, northern mockingbird, and common yellowthroat from the surrounding uplands and wetlands.

E.P.I.C. Wetlands C and D South of the Route 195 Bridge, Acushnet River Estuary

Finally, in late summer of 1986, a general avian census of the two tidal marshes just south of the Route 195 bridge was conducted. A brief description of ornithological observations in E.P.I.C. wetlands C and D follow. Wetland C is a small 3.3 hectare (8.1 acre) common reed and salt marsh cordgrass wetland bordered by sparsely vegetated, sandy uplands. At low tide, six gulls and one snowy egret were observed feeding on the mud flats. Other species were observed feeding aerially or foraging in the area. The American kestrel was observed to catch and carry off a small mammal (unidentified). Species and numbers recorded in September are listed in Table 3-21. Wetland D is comprised of 0.4 hectare (1 acre) of ditched high salt marsh with some common reed also present. It is surrounded by houses and situated just south of wetland C. This area is too limited to be of any ornithological significance. A ring-billed gull, a blue jay and an American robin were noted.

Summary of Avian Study Results

The open water/mudflat habitat had few bird species but a comparatively high density. Density declined as spring advanced and many winter residents migrated to breed elsewhere.

The reed stands were no more ornithologically barren in winter, spring and fall than is usual in this vegetation type.

Salt marshes had few species and low densities, except during fall when a large number of starlings were present. Such

Table 3-21. Acushnet River estuary tidal wetland C and D - Birds observed during the late-summer census.

19 September 1986	Wetland C (Reed and salt marsh)	Wetland D (salt marsh)
Snowy Egret	1	-
American Kestrel	1	-
Herring Gull	1	-
Laughing Gull	4	-
Ring-billed Gull	4	1
Mourning Dove	10	-
Northern Flicker	1	-
Tree Swallow	10	-
Blue Jay	1	1
Common Crow	1	-
Song Sparrow	1	-
American Robin	-	1
TOTALS #	35	3
SPECIES	11	3

conditions are typical of partially inundated saline areas.

The marsh/upland edge habitats were rich in species and had high bird densities. This cover type provided excellent cover, year round and abundant food in the fall.

Statistical comparisons of the study site with the Pope Beach site showed no significant reduction of bird species or density in the study site salt marsh and upland edge habitats.

No significant endangered species sightings were noted, although more data are needed on least terns, a Massachusetts breeding species of "special concern" observed feeding in the Acushnet estuary in May 1985. Scientific names of all bird species recorded are presented in Appendix D.

3.2.2.5 Terrestrial Mammals

Few mammals or mammal signs were detected during daylight hours on the winter, late winter/early spring, and late summer surveys. Mammal observations were made during the bird surveys and, therefore, observations are divided among the primarily ornithological habitats: (1) Upland Shrubs, (2) Common Reed Tidal Marsh, (3) Salt Marsh and (4) Mud Flat and Open Water. See Appendix D for a species list and their feeding guild.

Upland Shrubs

On the upper Acushnet River estuary, meadow vole and white-footed mouse (*Peromyscus leucopus*) runs were observed in the upland transition area adjacent to the salt marsh. A mouse nest was found underneath an old tire on E.P.I.C. wetland D located south of the I-195 bridge. Along the upland/salt marsh border Norway rat (*Rattus norvegicus*) holes and a domestic cat (*Felis domestica*) were observed during the winter site visit.

At E.P.I.C. wetland G (part of the Pope Beach site), a female white-footed mouse was observed suckling four or more young. In the taller woodlands of wetland G, several eastern gray squirrels (Sciurus carolinensis), an opposum (Didelphis virginiana) and an eastern chipmunk (Tamias striatus) were recorded.

Salt Marsh

The Acushnet River high salt marsh was dominated by low shrub (marsh elder) and herbaceous (spike grass, black grass, salt meadow grass) vegetation. Within this cover type rabbit (Sylvilagus floridanus), skunk (Mephitis mephitis) scat, meadow vole or white-footed mouse runs, and clipped vegetation were observed. Numerous white-footed mice were trapped during the early spring of 1985 (Section 4.0). An owl pellet containing a Microtus skull was found in E.P.I.C. wetland community 14 (Figure 3-8). No mammals or mammal signs were observed in the tidal flats or common reed cover type.

3.2.2.6 Endangered, Threatened, Rare, and Unique Species

On February 22, 1985 a peregrine falcon was observed flying over the Acushnet River estuary and salt marsh. Peregrine falcons are recognized as a Federally Endangered Species by the U.S. Department of the Interior and are listed as State Endangered by the Massachusetts Division of Fisheries and Wildlife. The falcon was an immature bird in its first winter. It was observed making several unsuccessful chases of gulls and rock doves. A local ornithologist had not seen this species at the site this winter. The bird was most likely an early spring migrant. The Massachusetts Natural Heritage Program has no record of peregrine falcons nesting near the Acushnet River estuary. In addition, they are not aware of any rare plant or animal species populations or ecologically significant natural communities in the study area (see Appendix A).

A single sharp-shinned hawk flying over edge and salt marsh habitats February 22, 1985, plus eight least terns observed fishing on May 4, 1985 in Acushnet estuary within the study site are worthy of comment. Both species are listed as of "special concern" in the state of Massachusetts Natural Heritage Program, Division of Fisheries and Wildlife. Further study of the status of least tern in the estuary is suggested.

3.3 EXISTING USES OF THE ACUSHNET RIVER ESTUARY AND WETLANDS

Currently, the Acushnet River estuary is closed to the taking of fish and shellfish (Figure 3-10). While such a measure reduces the probability of contaminant exposure to large segments of the population, the threat of exposure from illegal harvests is still present. New Bedford Harbor, located at the southern end of the estuary, is a major fishing port that ranks first nationally in value of catch landed. Current use of the upper estuary is primarily restricted to boating, recreation, and open space. The proximity of human activity to uncontrolled contaminant sources offers a continuing threat to human welfare.

The estuary and associated wetlands offer an opportunity for wildlife observation, educational and scientific endeavors, and the amenities of open space in an area which is otherwise highly developed. The Massachusetts Natural Heritage Program has identified a Fairhaven conservation area, which includes the Sycamore Street Wetland, located on the eastern side of the estuary within the designated "hot spot" north of the Coggeshall Street bridge (see letter from A. Sanders-Fleming/ Mass. Natural Heritage Program to C. Cogswell/ SES, dated April 19, 1985, Appendix A).

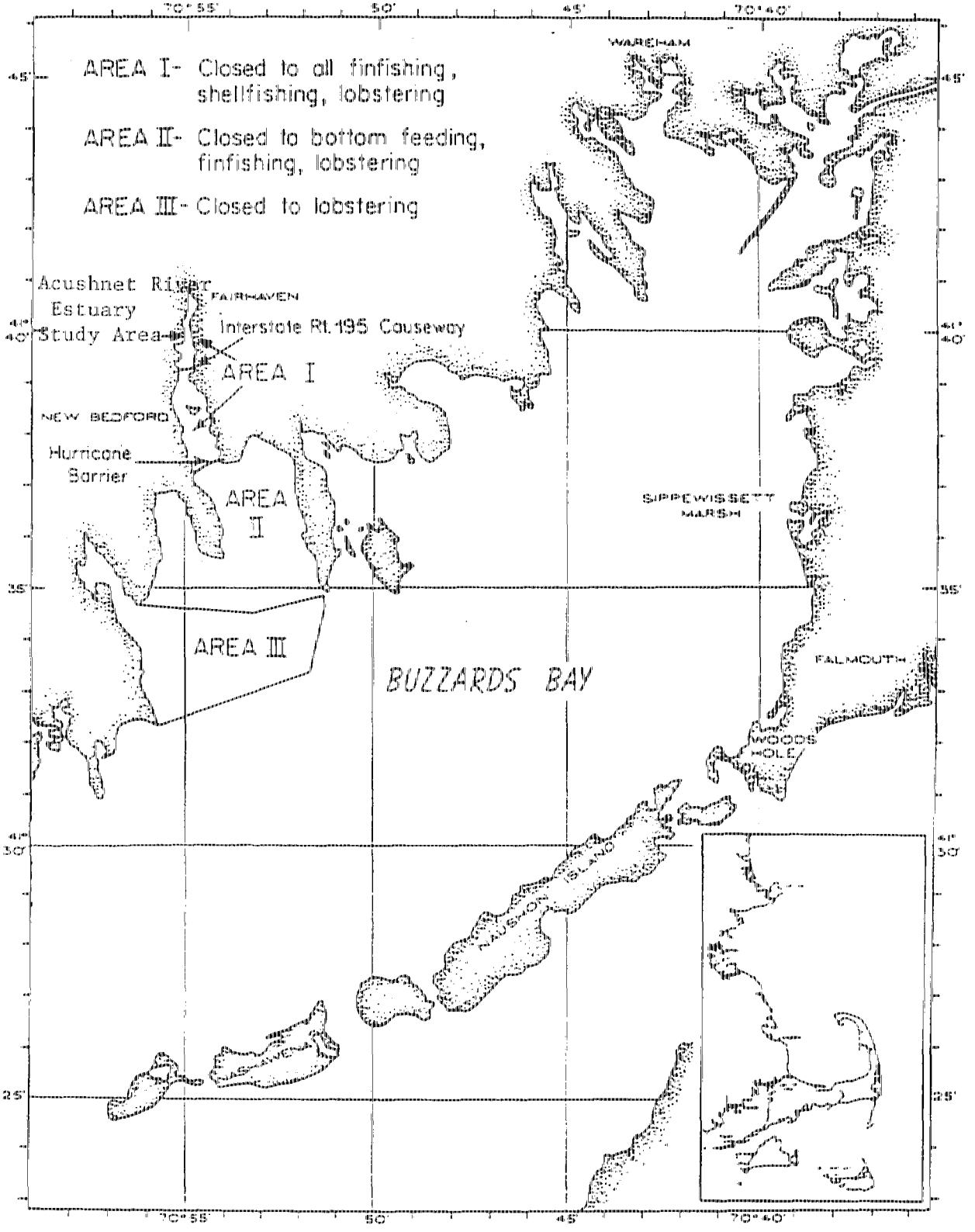

Figure 3-11. Fishing Closure Area Established by the Massachusetts Department of Public Health.

4.0 BIOCONCENTRATION/BIOACCUMULATION OF PCBS AND METALS (Cu, Cr, Pb, and Zn) IN THE ACUSHNET RIVER BIOTA

Sampling of three selected food chains that are present within the Acushnet River estuary was conducted in April 1985 and March 1987. Collection methodology is described in Section 4.1. A chain of custody and log sheet records were kept for all specimens collected. Samples were stored frozen until they could be analyzed for PCBs and metals (Cr, Cu, Pb, and Zn). The analytical methodology is presented in Section 4.2 and also in Appendix E.

PCBs enter the terrestrial environment primarily as particulate-associated matter. These particulates are deposited on vegetation and become available to the food chain through ingestion by herbivores. In the aquatic environment, however, PCB uptake is primarily due to direct absorption by organisms through gill membranes and other exposed tissue, or from the food chain via ingestion (Weaver 1982). Species that take up and store a contaminant faster than they can eliminate it are "bioaccumulators". If the contaminant is stored in a particular location (i.e., fatty tissue, liver, etc.) then "bio-concentration" occurs. "Biomagnification" is the increase in concentration of a particular contaminant within organisms with increasing or higher trophic levels in food chains. The most likely means of human exposure to PCBs from the Acushnet River estuary would occur through the ingestion of contaminated foods (e.g., shellfish or waterfowl), or contact with contaminated soil. The sampling procedure to determine existing contaminant levels within three food chains of the estuary is described in Section 4.1.

Studies on the uptake and accumulation of heavy metals by marsh vegetation indicate that vegetation plays a major role in retention of various metals including cadmium, copper, lead, manganese, nickel, iron and zinc (Windom 1977, Gambrell et al.

1980, Chan et al. 1982, Simpson et al. 1983, Taylor and Crowder 19813. Maximum uptake of metals in aboveground tissues of marsh plants apparently occurs during the growing season, prior to the production of peak aboveground biomass. During the dormant season, heavy metals are not translocated back to the roots and rhizomes, but remain in the stem and leaf parts. Studies have demonstrated correlations between metal contamination in the soil-sediment material and the uptake of various metals by marsh vegetation. Taylor and Crowder (1983) showed that the patterns of metal (Cu, Ni, Zn, Mn, and Mg) uptake by emergent vegetation were similar. Roots showed higher concentrations than the rhizomes and aboveground parts while young leaf tissue showed lower concentrations than the older tissue. Gambrell et al. (1980) determined that physiochemical parameters (e.g., Eh, pH, and salinity) play a major role in the availability of metals to salt marsh plants and that these effects should be considered in selecting environmentally sound disposal methods for contaminated sediments.

Biota within three food chains were sampled to help assess the potential for bioconcentration/bioaccumulation of PCBs and heavy metals (Cu, Cr, Pb and Zn) in organisms that feed in the upper Acushnet River tidal wetlands. Ring-billed gulls were collected along with selected food items (e.g. mussels, amphipods, and gastropods). Other major foods of the ring-billed gull not sampled as a part of this study include: fish, amphibians, insects, worms, and grubs; they also scavenge (DeGraaf and Rudis 1986, Martin et al. 1951). Ring-billed gulls breed near open beaches, mud flats, and harbors and winter near salt water.

White-footed mice and several of their likely foods were also collected along the eastern shore of the upper estuary. The diet of the white-footed mouse is very versatile and reflects the local availability of food. Animal foods include large insects, snails, centipedes, and small amounts of

carrion. Plant foods include seeds, fruits, acorns, tender green plants, and roots or tubers (DeGraaf and Rudis 1986, Martin et al. 1951). White-footed mice are most abundant within the upland border of the salt marsh and areas of the salt marsh shrub, marsh elder. During low tide, however, they may enter the lower reaches of salt marshes to feed. The white-footed mouse itself may be preyed upon by wild predators (i.e., raptors) or by domestic pets within the vicinity of the estuary.

Black ducks and two of their potential foods were collected during the late winter of 1987. Black ducks are a game duck, and if contaminated with PCBs or metals, pose a potential risk to humans via their consumption. Black ducks are known to breed in brackish marshes and winter exclusively in open marshes of the coast and interior. Their major foods include: mollusks (a coastal staple), submerged aquatic plants, algae, acorns, seeds of marsh plants, salt marsh grasses, crustaceans, worms, amphibians and fishes (DeGraaf and Rudis 1986, Martin et al. 1951). The two food items sampled were ribbed mussels and sea lettuce.

4.1 SAMPLE COLLECTION

4.1.1 Mussel - Ring-Billed Gull

To determine the bioaccumulation of PCBs in the mussel - ring-billed gull food chain, twenty ribbed mussels were collected on April 19, 1985 from each of five stations (1-4A) on the eastern shoreline of the upper Acushnet River estuary (Figure 4-1). At each station, mussels were collected at random points along a 15 meter transect (located 1-2 meters below the seaward limit of salt marsh cordgrass) and placed in quart glass jars. These specimens were transported back to the lab on ice, and one-half of the mussels collected from each station (i.e. 10) were immediately frozen for any additional analyses needed

in the future (e.g., histological). Whole wet weight, shell length, shell weight, and meat wet weight were measured on the remaining mussels. Mussel shells were scrubbed clean of any debris before weighing. Shell length was measured with a caliper (0.05 millimeter), and meats were placed on filter paper for two minutes before weighing. Ten mussels from each of the five stations were measured for a total of fifty mussels measured. Within each station, the meats of five mussels were pooled to form two replicate samples for analysis from each of the five stations. The pooled mussel meats were then frozen for later analysis.

Ring-billed gulls also feed on snails and amphipods. The salt marsh snail (Melampus bidentatus) was collected only at Station 4. Melampus is a small (up to 12 mm in length) pulmonate snail eaten by fish, birds, and small mammals. The snails were counted, weighed wet, and frozen for later analysis. The amphipod Orchestia grillus is abundant in the upper Acushnet River estuary. Orchestia were collected at Stations 1-5 (Figure 4-1) primarily under algal mats or wrack in the low salt marsh. An average of thirty-six Orchestia were collected at each of the five stations, stored in glass vials, transported to the laboratory on ice, and frozen pending later analysis.

Ten ring-billed gulls were collected by Manomet Bird Observatory on 15 April 1985. State and federal collecting permits were obtained in advance of this work and the use of a firearm (shotgun) was cleared with the police departments of Acushnet, Fairhaven, and New Bedford. Ring-billed gulls exhibit strong site tenacity and seldom, if ever, feed at nearby sanitary landfills as do herring gulls and great black-backed gulls. Thus, the likelihood of ingestion of PCBs from sources other than typical food chains in the Acushnet River estuary is small. Specimens were placed on ice upon collection and transported to the laboratory where the birds were sexed,

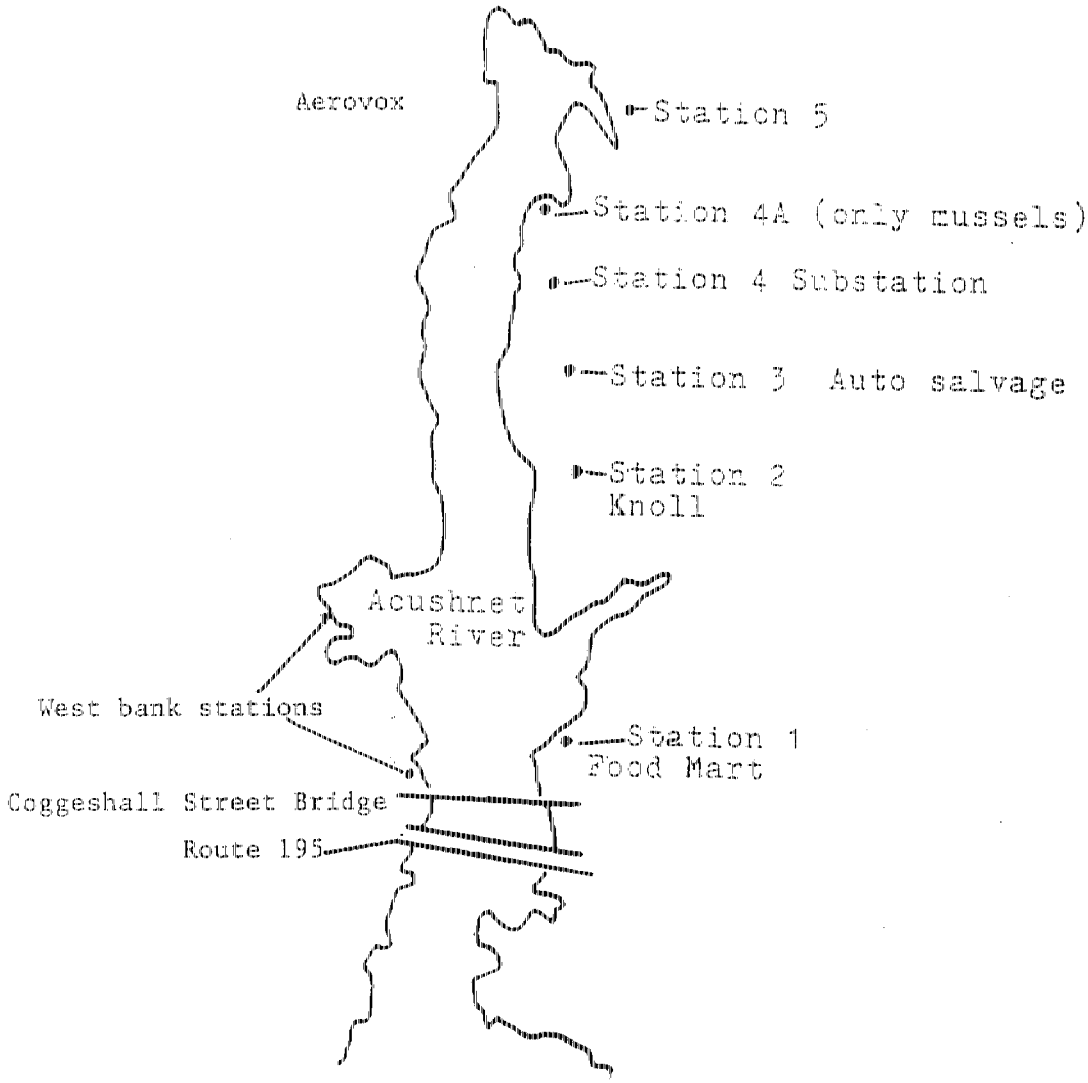

Figure 4.1. Collection Stations in Hot Spot Area - Upper Acushnet River Estuary, Massachusetts.

Figure 4-1. Collection Stations in Hot Spot Area - Upper Acushnet River Estuary, Massachusetts

measured, weighed, and the viscera preserved in 40% formaldehyde for possible future analysis. Breast muscle and subcutaneous fat fractions were separated, stored in pre-cleaned glass containers and frozen for later analysis.

4.1.2 Arthropods, Seeds, Nuts - White-Footed Mice

The collection of white-footed mouse food was concentrated at the upland-marsh border where the mice were trapped. On 29 April 1985, at Stations 2 and 4, bayberry (*Myrica* sp.), acorns, horse-brier fruits (*Smilax* sp.), rose, black grass shoots, insects (Orthoptera, Hemiptera, Coleoptera), isopods, and millipedes were collected and stored on ice in 2-ounce glass jars. The salt marsh snail was collected from Station 4. The number of specimens in each sample were counted (except bayberry fruits), sample wet weight determined, and the samples frozen.

On 19 and 20 April, 1985, 206 snap-traps were randomly laid out primarily on the east side of the Acushnet River estuary in Stations 1-5 along the salt marsh upland border of grass and shrubs (see Table 4-1 for more detail). Of these, 152 traps were baited with a mixture of oatmeal and peanut butter, and 50 with beef hotdogs. Traps were checked the following day, and captured mice were placed in 4-ounce glass jars. The mice were transported back to the lab on ice, sexed, and their whole body weight recorded. One female mouse from Station 4 was dissected to determine if sufficient quantities of adipose tissue were present in an individual mouse for PCB analysis. The adipose wet weight was only 0.2 gram, an insufficient amount for PCB analysis. Therefore, whole animals were frozen for later homogenization.

4.1.3 Sea Lettuce, Ribbed Mussels - Black Duck

A late winter sampling of the sea lettuce, ribbed mussels - black duck food chain was conducted in March, 1987. Sea lettuce

Table 4-1. Trapping Information, April 19, 20, 1985
(PO = Peanut Butter Oatmeal BH = Beef Hotdog)

Stations[1]	Trap Number and Bait	Animals Caught	Habitat
(East side of the estuary)			
1	80-PO	3 House Mice (*Mus musculus*)	Salt marsh - upland border
	30-BH	1 Norway Rat (*Rattus norvegicus*)	Garbage/bottom of rubble adjacent to Food Mart Parking lot
2	24-PO	3 White-Footed Mice (*Peromyscus leucopus*)	Upland-marsh border with little blue stem, sumac, marsh elder
	24-PO	4 White-Footed Mice	Upland-marsh border, upland grass, sparse shrubs above auto salvage
4	24-PO	7 White-Footed Mice	Marsh elder, salt marsh grass
5	24-PO	1 White-Footed Mouse	Marsh elder & salt marsh grass on marsh about 15 meters from upland
(West Side)			
	24-BH	0	Upland grass & shrub near factories, rubbish

[1] See Figure 4-1 for station locations.
Total trap nights = 206
The trapping success for small mammals = 19/206 = 9.2%

and ribbed mussels were collected at random locations along the shoreline within stations 1-4a (Figure 4-1). Two samples were collected at each of the five stations for a total of ten samples. Sea lettuce was collected in prewashed glass jars and transported to the laboratory where the samples were gently washed free of any sediment with sea water, blotted dry, and their wet weight determined. A black duck was collected with the use of a shotgun. The specimen was placed in a pre-cleaned glass container on ice for transport. Bird and mussel measurements and tissue preparation followed the procedures outlined in Section 4.1.1.

4.2 ANALYTICAL METHODS

This section describes the analytical methodologies used for PCB and metals analyses. Additional information regarding these procedures are presented in Appendix E. All concentrations of PCBs and metals in tissues are reported as ug/g (ppm) wet weight.

4.2.1 Polychlorinated Biphenyls in Tissue

A 5-10 gram sample is digested in a sealed 50 milliliter glass centrifuge tube by the addition of alcoholic potassium hydroxide and warmed in an oven at 60 degrees C for 2 hours. The digest is extracted with hexane on a rotary shaker three times. The extracts are combined, dried through sodium sulfate, and concentrated to one milliliter. The concentrate is passed through a florisil cleanup column, reconcentrated to one milliliter, and analyzed by electron capture gas chromatography. A detection limit of 0.2 ug/ml for most sample extracts is possible. This translates to a 0.04 ug/g detection limit for the tissue.

4.2.2 Metals in Tissue

A 1-2 gram sample is placed in a pyrex beaker with 25 milliliters of fuming nitric acid. The beaker is covered and warmed gently on a hot plate for several hours. The heat is then raised and the sample evaporated to near dryness. Several milliliters of 50% hydrogen peroxide are added, and the sample is again evaporated to near dryness to oxidize any remaining organic material. The peroxide is added several times if necessary to clear the solution. The sample is then dissolved in acid and diluted to volume as appropriate for the analyses required.

4.3. RESULTS AND DISCUSSION

PCB (Aroclors 1242 and 1254) and metals (Cr, Cu, Pb, and Zn) were detected in selected tissue samples collected from the study area. PCB and metals concentrations, expressed in terms of wet weight, are presented in Table 4-2 and 4-3, respectively. Replicate analyses were conducted on selected samples where allowed by sample size. The results of the quality control data are presented in Appendix F.

4.3.1 Polychlorinated Biphenyls in Tissue

Levels of PCB in tissue samples collected in the upper Acushnet River estuary indicate that PCB materials are bioaccumulating within the tissue of selected organisms (Table 4-2). Aroclors 1242 and 1254 were detected in all of the ribbed mussel, amphipod, and snail samples which comprise the lower trophic level of the mussel - ring billed gull food chain. PCBs were also identified in selected fruit and composite animal food samples which comprise the diet of the white-footed mouse. All of the sea lettuce and ribbed mussel samples which comprise the lower trophic level of the sea lettuce, mussel - black duck food chain also contained PCBs.

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Table 4-2. PCBs in Plant and Animal Tissues

Sample Designation (Collected 15, 19, 20, 29 April 1985)	PCB Aroclors PCB 1242 (ug/g wet wt)	PCB 1254 (ug/g wet wt)
Ring-billed Gull #1 Muscles	BDL*	2.00
Ring-billed Gull #2 Muscles	BDL	1.00
Ring-billed Gull #3 Muscles	BDL	9.30
Ring-billed Gull #4 Muscles	BDL	4.60
Ring-billed Gull #5 Muscles	BDL	12.00
Ring-billed Gull #6 Muscles	BDL	0.96
Ring-billed Gull #7 Muscles	BDL	25.00**
Ring-billed Gull #8 Muscles	BDL	27.00**
Ring-billed Gull #9 Muscles	BDL	20.00
Ring-billed Gull #10 Muscles	BDL	38.00
Ring-billed Gulls Composite #1-5 fat	BDL	88.00
Ring-billed Gulls Composite #6-7 fat	BDL	33.00
Ring-billed Gulls Composite #8-10 fat	BDL	340.00
Mussel Meat Stn 1-M Rep. 1	14.00	7.60
Mussel Meat Stn 1-M Rep. 2	20.00	10.00
Mussel Meat Stn 2-M Rep. 1	21.00**	11.00**
Mussel Meat Stn 2-M Rep. 2	20.00**	9.00**
Mussel Meat Stn 3-M Rep. 1	24.00	8.10
Mussel Meat Stn 3-M Rep. 2	17.00	6.20
Mussel Meat Stn 4-M Rep. 1	18.00	5.70
Mussel Meat Stn 4-M Rep. 2	24.00	8.40
Mussel Meat Stn 4a-M Rep. 1	69.00	23.00
Mussel Meat Stn 4a-M Rep. 2	58.00	17.00
Amphipods Orchestia Composite #1A-5A	17.00	29.00
Melampus Stn #4	2.40	3.20
White-footed Mice Stn 2-WFM Composite of 3	BDL	17.00
White-footed Mice Stn 3-WFM Composite of 4	BDL	11.00**
White-footed Mice Stn 4-WFM Composite of 6	BDL	5.30
White-footed Mice Stn 5 Single Individual	BDL	56.00
Mouse Food Bayberry Fruits Stn #2	0.08	0.05
Mouse Food Bayberry Fruits Stn #4	0.25	0.08
Mouse Food Acorns Stn #2	BDL	BDL*
Mouse Food Smilax Fruits Stn #2	BDL	0.05
Mouse Food Black Grass Stn #4	BDL	BDL
Mouse Food Composite of Isopods, Millipedes, Weevil, Hemipteran Stn #2	BDL	1.90
Mouse Food Composite of 10 Orthopteran and Isopods Stn #4	1.40	4.40

* Detection Limit = 0.04 ug/g.
** Average of duplicate values (See Appendix F).

Table 4-2 (...continued). PCBs in Plant and Animal Tissues

Sample Designation (Collected 20, 23 March 1987)	PCB Aroclors PCB 1242 (ug/g wet wt)	PCB 1254 (ug/g wet wt)
Black Duck (breast muscle)[1]	0.58	100.00
Black Duck (subcutaneous fat)[1]	42.00	5000.00
Black Duck (liver)[1]	5.10	420.00
Mussel Meat Stn #1A	10.00	5.50
Mussel Meat Stn #1B	7.30	3.80
Mussel Meat Stn #2A	7.20	4.20
Mussel Meat Stn #2B	5.80	3.70
Mussel Meat Stn #3A	17.00	9.50
Mussel Meat Stn #3B	21.00	14.00
Mussel Meat Stn #4A	28.00	10.00
Mussel Meat Stn #4B	3.90	1.50
Mussel Meat Stn #5A	40.00	14.00
Mussel Meat Stn #5B	47.00	17.00
Sea Lettuce Stn #1-1	1.90	0.81
Sea Lettuce Stn #1-2	2.20	1.00
Sea Lettuce Stn #1-3	1.20	0.51
Sea Lettuce Stn #2-1	0.76	0.35
Sea Lettuce Stn #2-2	0.93	0.43
Sea Lettuce Stn #3-1	1.70	0.68
Sea Lettuce Stn #3-2	2.10	0.94
Sea Lettuce Stn #4-1	0.44	0.24
Sea Lettuce Stn #4a-1	2.10	1.00
Sea Lettuce Stn #4-2	2.20	0.70
Sea Lettuce Stn #5-1	40.00	8.80

[1] One black duck sample analyzed.

Table 4-3. Metals in Plant and Animal Tissues

Field Identification (Collected 15, 19, 20, 29 April 1985)	Chromium	Copper	Lead	Zinc
	(in ug/g wet weight)			
Ring-billed Gulls #1 Muscles	1.1	5.1	0.8	24
Ring-billed Gulls #2 Muscles	3.1	5.6	1.3	86
Ring-billed Gulls #3 Muscles	1.7	5.2	0.6	26
Ring-billed Gulls #4 Muscles	3.1	5.4	3.0	78
Ring-billed Gulls #5 Muscles	2.8	5.9	0.8	20
Ring-billed Gulls #6 Muscles	2.8	5.0	0.6	26
Ring-billed Gulls #7 Muscles	2.0	6.7	1.2	22
Ring-billed Gulls #8 Muscles	1.5	6.3	1.7	20
Ring-billed Gulls #9 Muscles	1.7	4.6	0.9	68
Ring-billed Gulls #10 Muscles	2.5	5.0	5.0	42
Ring-billed Gulls Composite #1-5 fat	2.9	3.0	2.9	130
Ring-billed Gulls Composite #6-7 fat	1.8	2.3	1.1	60
Ring-billed Gulls Composite #8-10 fat	4.0	3.5	1.3	110
Mussel Meat Stn 1-M Rep. 1	3.7	8.8	1.9	24
Mussel Meat Stn 1-M Rep. 2	2.1	6.0	1.1	140
Mussel Meat Stn 2-M Rep. 1	3.5	5.3	1.1	36
Mussel Meat Stn 2-M Rep. 2	2.2	6.5	0.9	130
Mussel Meat Stn 3-M Rep. 1	2.5	5.8	1.1	110
Mussel Meat Stn 3-M Rep. 2	4.1	6.8	1.0	25
Mussel Meat Stn 4-M Rep. 1	2.7	5.8	1.7	60
Mussel Meat Stn 4-M Rep. 2	2.3	5.8	1.1	52
Mussel Meat Stn 4a-M Rep. 1	2.6	4.9	0.6	22
Mussel Meat Stn 4a-M Rep. 2	2.5	6.0	1.1	23
Amphipods Orchestia Composite #1A-5A	2.8	36.0	1.3	140
Melampus Station #4	2.5	25.0	9.0	630
White-footed Mice Stn 2-WFM Composite of 3	2.7	8.4	2.1	91
White-footed Mice Stn 3-WFM Composite of 4	3.7	6.9	3.9	49
White-footed Mice Stn 4-WFM Composite of 6	2.5	8.3	1.5	33
White-footed Mice Stn 5 Single Individual	3.0	5.5	1.5	56
Mouse Food Bayberry Fruits Stn #2	2.4	3.4	3.5	42
Mouse Food Acorns Stn #2	3.5	8.5	3.8	40
Mouse Food Black Grass Stn #4	2.2	6.8	0.7	37

Table 4-3 (...continued). Metals in Plant and Animal Tissues

Field Identification (Collected 20, 23 March 1987)	Chromium	Copper	Lead	Zinc
	(in ug/g wet weight)			
Black Duck (breast muscle)[1]	0.2	5.7	<0.9	9.8
Black Duck (liver)[1]	0.2	2.3	<0.7	15
Mussel Meat Stn #1A	0.4	3.8	1.1	11
Mussel Meat Stn #1B	0.3	4.2	1.5	12
Mussel Meat Stn #2A	0.4	4.8	1.7	19
Mussel Meat Stn #2B	0.3	4.7	1.2	11
Mussel Meat Stn #3A	0.3	3.5	1.2	13
Mussel Meat Stn #3B	0.2	2.9	0.7	13
Mussel Meat Stn #4A	0.3	3.5	<1.0	13
Mussel Meat Stn #4B	0.2	2.9	<0.8	12
Mussel Meat Stn #5A	0.3	3.1	<0.9	11
Mussel Meat Stn #5B	0.3	4.0	<0.9	13
Sea Lettuce Stn #1-1	3.6	24.0	18.0	87
Sea Lettuce Stn #1-2	3.9	26.0	21.0	110
Sea Lettuce Stn #1-3	3.0	22.0	17.0	80
Sea Lettuce Stn #2-1	2.4	7.8	6.1	27
Sea Lettuce Stn #2-2	3.3	18.0	9.3	28
Sea Lettuce Stn #3-1	4.2	20.0	17.0	49
Sea Lettuce Stn #3-2	3.7	18.0	11.0	23
Sea Lettuce Stn #4-1	3.3	27.0	12.0	45
Sea Lettuce Stn #4a-1	1.1	3.2	5.3	37
Sea Lettuce Stn #4-2	4.5	21.0	14.0	48
Sea Lettuce Stn #5-1	4.6	10.0	10.0	38

[1] One black duck sample analyzed.

4.3.1.1 Mussels - Ring-billed Gulls

The average PCB concentration of Aroclor 1242 and 1254 in ribbed mussels (1985 samples) was 28.5 and 10.6 ug/g (ppm), respectively, with the highest concentrations at station 4a. The concentration of Aroclor 1254 in the snail sample was 3.2 ppm, and in the amphipod sample 29.0 ppm. Only Aroclor 1254 was detected in the gull muscle and fat samples. Its average concentration in ring-billed gull muscle and fat samples was 13.99 ug/g and 153.67 ug/g, respectively. These results suggest that biomagnification of PCBs may be taking place within the mussel - ring-billed gull food chain.

4.3.1.2 Arthropods, Seeds, Nuts - White-footed Mice

The average PCB concentration of Aroclor 1254 in all mouse foods (including the snail) was 1.21 ug/g. Aroclor 1254 and 1242 levels in the green shoots of black grass and in upland acorns were below detection levels. Only Aroclor 1254 was detected in the mouse homogenate. The average concentrations of PCB for whole mouse (Aroclor 1254) samples was 22.33 ug/g, but ranged from 5.3 to 56.0 ug/g. The highest concentration of Aroclor 1254 (56.0 ug/g) was from a sample containing only a single mouse while the remaining three samples contained a composite of three to six mouse specimens. Localized food habits (i.e., proportion of animal matter eaten) within the habitats of the four sample locations may have influenced PCB uptake by the mice. Aroclor 1254 levels within all of the mouse homogenate samples were higher than contamination levels of the mouse food samples. These results also suggest that biomagnification of PCBs may be taking place within this food chain.

4.3.1.3 Sea Lettuce, Mussel - Black Duck

PCB concentrations observed within the sea lettuce samples

(average = 1.40 ug/g) were approximately ten-fold higher than PCB concentrations detected in the terrestrial vegetation analyzed as potential mouse food. PCB levels of Aroclor 1242 and 1254 present within the ribbed mussel samples averaged 18.7 ug/g and 8.32 ug/g, respectively. The highest PCB concentrations were obtained from black duck tissue where 5000 ug/g of Aroclor 1254 was detected within the one subcutaneous fat sample analyzed. The lower Aroclor 1254 levels present within the ribbed mussels strongly suggest that PCB biomagnification is also occurring within this food chain. Possible impacts resulting from the PCB contamination to wetland organisms is discussed in Section 5.

4.3.2 Metals in Tissue

Results of the metals (Cr, Cu, Pb, and Zn) analysis for tissue samples are presented in Table 4-3. Detectable levels of each metal were present in each sample. Concentrations of metals appear to be comparable throughout the samples with some exceptions. Relatively high concentrations of copper and zinc were detected in the amphipod (Cu=36.0 ug/g; Zn=140 ug/g) and snail (Cu=25.0 ug/g; Zn=630 ug/g) samples. The snail sample also contained relatively high concentrations of lead (9.0 ug/g). The levels of zinc detected in the muscle and fat portions of the ring-billed gull suggest that zinc may be concentrated in fat tissue. Subcutaneous fat of the black duck was not analyzed for metal concentrations, however, muscle and liver tissue levels were below metal concentrations detected for both the sea lettuce and ribbed mussel samples. Although these data do indicate that certain metals may be selectively concentrated, they do not suggest transfer within the three separate food chains or biomagnification as do the PCB data.

5.0 EFFECT OF CONTAMINATION ON THE ACUSHNET RIVER WETLANDS

Concentration levels of PCB and metal contaminants within sediments of the Acushnet River estuary and the Pope Beach, Buzzards Bay wetlands were discussed previously (see Section 3.1.6). In general, the concentration of heavy metals (Cr, Cu, Pb, and Zn) and PCBs in the surface marsh sediments (0-30 cm) was greatest in wetland A and the northern portion of wetland B (wetland communities 1 to 13) (Figure 3-3 and Tables 3-5 and 3-7). The range for Cr in the northern marsh sediments was 14 ppm to 227 ppm and for the more southerly marsh sediments (wetland communities 13 to 25) 4.9 ppm to 116 ppm. Copper ranged from 20 ppm to 557 ppm in the northern wetlands, and from 14 ppm to 505 ppm in the southern wetlands. Lead ranged from 72 ppm to 435 ppm in the surface sediments of the northern estuary wetlands and from 14 ppm to 316 ppm in the southern wetlands. Finally, zinc in the northern wetlands ranged from 79 ppm to 1290 ppm while in the southern portion of wetland B, zinc ranged from 16 ppm to 298 ppm. PCBs concentrations ranged from 2.6 ppm to 1900 ppm in the more northerly areas of the estuary, and from 0.15 ppm to 67 ppm in the more southerly areas of marsh.

PCB contaminant levels identified within the wetlands at the Pope Beach, Buzzards Bay site ranged from undetectable to 4.1 ppm while metal (Cr, Cu, Pb, and Zn) contaminant levels were similar to levels reported within the Acushnet River estuary sediments (see Section 3.1.6; Table 3-9). Impacts to the vegetation and fauna of the Acushnet River estuary wetlands is discussed in the following sections.

5.1 EFFECT ON WETLAND VEGETATION

There is no visual evidence of ecotoxicity in the tidal wetland vegetation of the Acushnet River estuary. In the fall of 1986, the tidal marshes were covered by dense stands of tall grasses, many of which were in flower. The only bare area of

marsh sediment was apparently due to disturbance from the operation of a heavy construction vehicle near the auto salvage yard. The only observable difference was an increased plant height at the Acushnet River salt marsh compared to the Buzzards Bay marsh (Table 3-13). The greater stature was likely due to the enriched levels of nitrogen and phosphorus in the waters of the estuary. Abundant sea lettuce and filamentous greens were draped on the tidal flats and banks of the salt marsh. These green algae are often abundant in enriched waters.

There are no visual signs of stress that may be a result of heavy metal or PCB toxicity in the vegetational community. PCBs in the marsh sediments were not as readily detected in the wetland vegetation samples (Table 4-2). However, elevated levels of metals (Cr, Cu, Pb, and Zn) were detected in the salt marsh vegetation (Table 4-3). A similar study (Kelly et al. 1982) found several times higher concentrations of Hg, Pb, Zn, Cu, Cd, and Cr in salt marsh vegetation growing in contaminated marshes than in vegetation from nearby control areas. The contaminated salt marshes did not have a lower productivity than the control marshes. The potential adverse effects of metals released from marsh sediments is the metal enrichment in salt marsh grass litter, an integral part of the detrital food web within salt marshes.

5.2 EFFECT ON WETLAND FAUNA

The most northern area of reed and salt marsh (wetland A) had no sign of ribbed mussels or fiddler crabs, and few mud snails were present on the adjacent tidal flats. Fiddler crab populations are known to decline when exposed to polychlorinated hydrocarbons (Krebs et al. 1974). The macrobenthic population in the estuarine bottom sediment at the northern most portion of the estuary was dominated by the opportunistic "pollution indicator", Streblospio benedicti (SES 1987). It is not known what factor(s) are regulating the distribution of these

organisms within the Acushnet River estuary. It may be a natural biological phenomenon or a combination of stresses including possible exposure to low salinity water, nutrient enrichment, and sublethal, toxic effects of heavy metals or PCBs. Shellfish are reported to be highly sensitive to PCB contamination (Weaver 1982).

The avian census did not reveal any decrease in bird diversity or abundance at the Acushnet River estuary when compared to a "control" site (for PCBs only) on Buzzards Bay (Section 3.2). However, birds are feeding on contaminated organisms within the Acushnet River estuary and accumulating PCBs in their tissues (Section 4.0). PCB concentrations were much higher within the black duck tissue than within the ring-billed gull tissue samples. This is likely a function of the different feeding habits between these two species as black ducks consume a greater proportion of molluscs during the winter than ring-billed gulls. PCBs degrade Vitamin D and estrogen in birds which results in eggshell-thinning and reproductive impairment (Weaver 1982). In addition, PCB contamination may result in secondary impacts to organisms, such as PCB-induced stress which alters the animal's physiology and subsequently increases its vulnerability to parasites, pathogens, or predators.

Currently, there is little scientific literature available which detail the effects of consuming quantitative amounts of PCBs on various wildlife species. In order to ascertain whether animal populations are in decline due to the presence of contaminants or other biotic or abiotic factors within the estuary, transplant experiments and experiments which expose organisms to known quantities of existing contaminants need to be performed. However, reproductive impacts to wildfowl that feed on contaminated foods containing 50 ppm to 200 ppm PCB have been reported (NAS 1979). Although vegetation and algae (sea lettuce) within the Acushnet River estuary are well below these levels, the ribbed mussel samples taken from the northern salt

marshes of the study area are within this range. Hence, bird species within the estuary that feed primarily on vegetation (herbivores, frugivores, granivores, etc.) are unlikely to be directly impacted by the high PCB levels within the estuary. Species that consume a high proportion of animal matter (particularly molluscs as this study indicates) in their diet may presently be exposed to "harmful" levels of PCBs.

Previous studies have shown liver and reproductive impacts occurring to mice and rats that were exposed to 100 ppm to 500 ppm PCB (NAS 1979). The mouse foods that were analyzed for this study contained PCB levels well below this range (see Table 4-2). Thus, although it would appear unlikely that small mammals inhabiting wetlands/uplands adjacent to the Acushnet River estuary are being negatively impacted by the presence of the high contaminant levels, further studies are needed to determine the threshold level of PCB exposure which results in toxic effects to white-footed mice. In addition, the level of PCB concentrations within the mice may adversely impact wildlife species (i.e. avian, mammalian, or reptilian carnivores) that feed upon them. Domestic pets (cats) may potentially consume mice contaminated with PCBs and also be adversely affected. Again, however, threshold levels concerning toxic effects need to be established.

In summary, toxic effects from PCBs to non-aquatic wildlife species located in the lower trophic levels (e.g. herbivores) would not be anticipated based on available literature and the data from this study. Aquatic organisms would be more susceptible due to the high concentrations of PCBs present in the wetland sediments (and within the water column). Biomagnification of the PCB contamination levels appears to be occurring within the wetlands of the Acushnet River estuary based on the results of this study. Hence, predators (and scavengers) of lower trophic level consumers (particularly on aquatic species located within the northern portion of the estuary where the highest concentrations of PCBs are present)

may be accumulating potentially hazardous levels of PCBs. Wildlife species most likely to be impacted would include those carnivorous species that have small foraging areas and feed primarily in the most contaminated portion of the estuary. Even if foraging is confined seasonally (as with the black duck), or limited to a few highly contaminated meals (as may be the case with raptors), exposure levels may be sufficient to result in adverse impacts. In addition to potentially contaminating their predators (or scavengers), the high PCB levels detected within the lone black duck sample analyzed may adversely affect human health. It is likely that black ducks wintering in Acushnet River estuary are exposed to duck hunters when migrating south from their northern breeding areas. The 100 ppm PCB level detected within the breast muscle of the black duck (5000 ppm PCB within the fat tissue) is considerably higher than the U.S. Food and Drug Administration poultry limit of 3.0 ppm (fat basis).

Heavy metals (particularly copper, lead, and zinc) appear to be bioaccumulating within the biota of the Acushnet River estuary (Table 4-3). Bioaccumulation of heavy metals can occur from the water column, suspended particles, sediments, and through food chains. The rate at which these contaminants accumulate within an organism depends on numerous biological, chemical, and environmental factors. The level of bioaccumulation obtained is determined by the ability of the organism to either excrete the contaminant or store it. Toxic effects from heavy metals to organisms varies widely as some species are able to store contaminants in non-essential tissue or adapt to elevated levels of contaminants. However, the data collected for this study (Table 4-3) showed little evidence that chromium, copper, lead, and zinc are being biomagnified within the Acushnet River estuary.

6.0 ACUSHNET RIVER ESTUARY WETLAND FUNCTIONS

This section discusses the upper Acushnet River estuary wetland functions outlined by the U.S. EPA in 40 CFR 230 Subpart E 230.41 ("Special Aquatic Sites"). Wetlands are considered "Special Aquatic Sites". "Special Aquatic Sites" are defined as, "geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important or easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the overall environmental health or vitality of the entire ecosystem or region". The U.S. EPA identifies six wetland functions: 1) habitat, 2) water purification, 3) aquifer recharge, 4) food chain production and nutrient exchange, 5) flood control, and 6) storm damage prevention.

6.1 HABITAT

6.1.1 Shellfish

Salt marsh along the upper Acushnet River estuary contains abundant ribbed mussels along its creek banks. Typically, the diversity of molluscs along most marsh tidal creeks is low, although certain populations of mussels may be abundant. Bivalves increase substrate coherence by the network of byssal threads they produce (Davis 1985). In addition, suspension feeders like the ribbed mussel extract organic and inorganic material from the water column and pellitize it. Average rates of biodeposition in the form of pseudofeces for the ribbed mussel is 549g feces/year (Davis 1985). Because much of the PCBs and metals in the water column is attached to fine organic particles, the deposition of pseudofeces by bivalves increases the levels of contaminants within the surface sediments of the marsh.

Adjacent tidal flats in the upper estuary contain soft-shelled clams, hard-shelled clams (Bourge, B., pers. comm.), gem (Gemma gemma), tellins (Tellina agilis), little surf clams (Mullina lateralis), and jingle shells (Anomia simplex) (SES 1987). These contaminated upper estuarine shellfish (e.g., ribbed mussels see Section 4.0) are a food source for avian species, crabs, and possibly mammals such as raccoons. The following factors are critical to the protection of resource areas containing shellfish: water quality, water circulation, and the natural relief, evaluation (sic) or distribution of sediment grain size (DEQE 1983).

6.1.2 Marine Fisheries

A number of fish species, including winter flounder, mackerel (Scomber scombrus), bluefish, and pollock (Pollachius virens), feed in the upper Acushnet River estuary. Numerous bait fish were observed by SES in the spring and late summer within salt marsh tidal creeks. In addition, numerous juvenile fish were observed at the waters edge amongst blades of salt marsh cordgrass within the proposed temporary containment site on the western shore of the estuary (G. Crouch, U.S. Fish and Wildlife Service, pers. comm.). Alewives and blue-back herring also migrate through the upper Acushnet River estuary to spawn in the Acushnet River.

The following factors are critical to the protection of these marine fisheries: water circulation, distribution of sediment grain size, water quality, the relief and elevation of the land, and the growth, composition, and distribution of salt marsh vegetation (DEQE 1983).

6.1.3 Wildlife

In addition to the many fish and shellfish that feed along the marsh edges and on the marsh surface, crabs, snails,

insects, birds, and mammals also inhabit the Acushnet River estuary tidal marshes (see Appendix D for a species list). The salt marshes of the Acushnet River estuary provide wildlife with open water, mud flat, swards of herbaceous vegetation (*Spartina* spp. and *Distichlis spicata*), low shrub habitat (*Iva frutescens*), and the transition zone at the upland edge of the salt marsh which contains a herbaceous, shrub, and tree strata. Food (albeit contaminated food) and protective cover are readily available in the Acushnet River estuary wetlands. The Acushnet River estuary, due to its location amidst abundant development, is a haven which provides food, shelter, and nesting sites for migratory waterfowl, wading birds, and year round resident wildlife species.

6.2 WATER PURIFICATION

6.2.1 Sediment Trapping

The frictional resistance provided by vegetation alters the hydrologic and sedimentary patterns in the Acushnet River estuary. Stems and leaves of salt marsh vegetation help trap suspended sediment by impeding current flow. Some plants may create chemical microenvironments that promote clay flocculation. Salts extruded from the leaves of salt marsh grasses may increase salinity within the vicinity of the plants which may in turn promote clay flocculation (Pestrong 1972). The large congregations of ribbed mussels along the Acushnet River estuary shoreline also help substrate coherence by their anchoring byssal threads. Ribbed mussels biodeposit filtered suspended organic and inorganic detritus in the form of pseudofeces (pellets) on the marsh surface.

6.2.2 Contaminant Removal

Wetlands (particularly the salt marsh) are generally

presumed to remove contaminants (e.g., uptake of nutrients, removal of suspended particulates, immobilization of heavy metals, etc.). However, the issue of whether there is net import or export of inorganic nutrients by salt marshes remains unresolved. Valiela et al. (1973) found that salt marshes can act as nutrient sinks when high-nutrient waters pass through them or when high-nutrient waste water is applied. The waters of the Acushnet River estuary are enriched with nitrogen and phosphorus (see Section 3.1.5.6). The Acushnet River salt marshes may help attenuate some of the nutrient enrichment within the estuary, at least during the growing season.

Metal contaminants, Cu, Cr, Pb and Zn, are of concern in the Acushnet River estuary and its associated wetlands (Section 3.1.5 and 3.1.6). Since salt marsh sediments are usually high in organic matter and sulfides, they are presumed to retain heavy metals. However, factors which tend to reduce metal retention such as increased redox and low sediment pH's are often overlooked. As much as 50 to 100% of the Zn, Cu, Cd, and Hg entering wetlands may subsequently be lost from the system while Fe, Mn, and Pb are retained to a higher degree (Kelly et al. 1982). The retention of metals may decrease under higher loading rates as the sorptive abilities of the sediments become saturated. In addition, there is an interaction between nutrient levels and heavy metal retention. Under eutrophic conditions, wetland sediments become more oxidized due to increased vegetative growth. The increased oxidation decreases sulfides in the sediment and increases the solubility of metals in the pore water (Kelly et al. 1982). The Acushnet estuary is partially eutrophied and has been exposed to high concentrations of metals for a number of years, therefore, metal retention by the Acushnet River estuary salt marshes is likely at or near their saturation levels.

Although PCBs are relatively stable with long half lives in the natural environment, there is some evidence to indicate that

transformation of PCBs is promoted under anaerobic conditions (Metcalf and Eddy 1983). Such conditions would prevail within wetland substrates. However, transformation of PCBs may lead first to more toxic compounds (polychlorinated dibenzofurans) prior to degradation to innocuous chemicals.

6.3 AQUIFER RECHARGE

The regional ground water flow is believed to be towards the estuary (see Section 3.1.4). However, during dry periods, the harbor can recharge the ground water through permeable bottoms. The underlying peat may also serve as a barrier between fresh ground water landward of the salt marsh and the ocean, thus helping to maintain the level of the ground water. Little information is available on the ground water exchange between the salt marsh of the upper Acushnet River estuary and adjacent upland ground water. However, it is believed that the influence of the estuary may extend 1,000 feet east or west of the estuary (NUS 1984). The presence of a perched ground water table on the peat is also possible (NUS 1984), although this is unconfirmed.

There is no known public or private consumption of the ground water in the upper Acushnet River estuary due to its high salinity. In addition, no potable water supplies are present which could be influenced by the tidal marsh. Although the estuary could be considered a water supply (e.g., source of process water), the tidal marsh does not affect the quantity of water in the estuary.

6.4 FOOD CHAIN PRODUCTION AND NUTRIENT EXCHANGE

Tidal marshes are among the most productive ecosystems in the world. Net primary productivity values reported for northeastern U.S. low marsh vegetation range from 507 to 840 g

dry wt/m^2 a year. High marsh values are about 430 g dry wt/m^2 a year (Mitsch and Gosselink 1986). The Acushnet River estuary marsh is a mature salt marsh comprised of approximately 68% high marsh and 17% low marsh vegetation. The average plant height for high marsh grasses was about 53 centimeters and for low marsh grass 143 centimeters. In general, plant heights were greater in the Acushnet River wetlands than the Pope Beach wetlands along Buzzards Bay (Table 3-13). The greater grass growth may be due to the elevated nitrogen and phosphorus levels in the waters of the estuary (Section 3.1.4.6). Based on plant heights, the Acushnet River wetlands appear very productive. The detritus (dead leaves and stems of the salt marsh grasses) is broken down by bacteria, fungi, protozoa, and nematodes which are then consumed by large deposit feeders (Weibe and Pomeroy 1972). Estuaries such as the upper Acushnet River that contain a constricted opening to the sea tend to trap and recirculate materials instead of exporting them.

6.5 FLOOD CONTROL AND STORM DAMAGE PREVENTION

Flood storage capacity is presently available within the estuary basin between sea level and the 100-year flood elevation (1.8 meters above msl). It is assumed that ocean flooding from hurricanes would be effectively minimized by the existing hurricane barrier.

Currently, the wetland resources around the perimeter of the estuary afford storm damage protection (wave erosion, etc.) to adjacent upland and developed areas. At the Acushnet River estuary wetlands, roots of the marsh vegetation help secure the substrate beneath the sediment-water interface and thus promote the accumulation of clayey, cohesive sediments. Above ground plant parts tend to damp the effect of wind-generated waves. Depending on the stage of the tide, salt marsh cordgrass may reduce wave heights by as much as 71% and wave energy by 92%

(Wayne 1976). Few major tidal creeks are present in the Acushnet River salt marsh and the small mosquito control ditches present contain dense vegetation which lessen erosive forces. Any nonstorm water mass moving over the general surface of the salt marsh along the eastern shoreline probably has extremely low velocity, due not only to the existing plants, but also because of the gentle slopes and lack of channelization within the marsh. In general, the potential for erosion is greatest along the Acushnet River shoreline and marsh creek channels rather than on the marsh surface. No signs of erosion were observed on the Acushnet River marsh surface, although signs of erosion (e.g., exposed roots) were noticeable along the Acushnet River estuarine shoreline.

7.0 IMPACT ASSESSMENT OF PROJECT ALTERNATIVES
404 (B) (1) Subpart C, D, E, F and G

The remedial action alternatives, hydraulic control and in-harbor containment (NUS 1984), involve dredging or filling in the Acushnet River estuary and its associated wetlands. Hence, they must be evaluated under the Section 404 (b) (1) guidelines prepared by the U.S. EPA. The potential impacts of taking no action and the potential impacts of the two primary alternatives are discussed in this section. Potential impacts on physical, chemical, and biological components of the environment are characterized with respect to short-term and long-term effects. Areas where data are lacking are identified and appropriate action is described.

7.1 NO ACTION ALTERNATIVE

The New Bedford Harbor estuary has a unique physical and hydrological environment. The estuary provides a viable buffer from flooding and would continue to do so under the no-action alternative.

The general area of the estuary may be considered slightly depositional with respect to sediments. Since the construction of the hurricane barrier, accretion rates in the upper Acushnet River estuary have ranged from 1.7 to 4.0 centimeters/year (0.7 to 1.6 inches/year) (NUS 1984). Based on these rates of accretion, 17 to 40 centimeters (0.6 to 1.3 feet) of sediment would accumulate on the bottom of the estuary within 10 years, covering existing contaminants. However, biologically induced sediment mixing (bioturbation) has the potential to modify the chemical properties of surficial sediments and re-expose contaminated sediments to the soil/water interface. This zone of bioturbation is primarily within the top 9 centimeters (3.5 inches) (Whitlach 1982). Hence, although a portion of the

contaminated bottom sediments might be effectively isolated within 10 years, a portion of the present contaminants would continue to be present near the surface due to bioturbation and periodic resuspension by bottom currents arising from tidal fluctuations (Section 3.1.2.1) and storm induced waves (Section 3.1.3.2).

The salt marsh and brackish/freshwater marsh sediments are also contaminated with PCBs and heavy metals (Section 3.1.5). The net accumulation of sediment in a Massachusetts salt marsh was 31 centimeters/100 years (12.2 inches/100 years) for the low marsh and 2-8 centimeters/100 years (0.8-3.1 inches/100 years) in the high marsh (Chapman 1960). These sediment accumulation rates are substantially lower than for the adjacent estuary bottom. Hence, it would take approximately one hundred years to partially isolate the contaminated surficial marsh sediments from biotic activity. Newly accreted cleaner sediments would have portions colonized and stabilized by encroaching salt marsh vegetation. However, if the roots of salt marsh vegetation are in contact with contaminated sediments, the plants can accumulate heavy metals (Section 4.0, Kelly, et al. 1982) and excrete these metals along with salts from their leaves (Kraus, et al. 1986). Rain or tidal waters can then wash the metals from the leaves and return them to the waters or sediments of the estuary. Although the chemical transformation of PCBs is promoted under anaerobic conditions which prevail in salt marshes, transformations of PCBs may lead first to more toxic compounds (polychlorinated dibenzofurans) prior to degradation to innocuous chemicals.

In summary, with the no action alternative, the marshes would continue to be a potential source of contaminants for many years to come. However, these marshes would continue to function as a diverse and productive system and, although contaminated, would provide many of the valuable wetland functions provided by unpolluted estuary wetlands.

7.2 IMPACTS ASSOCIATED WITH THE HYDRAULIC-CONTROL AND IN-HARBOR CONTAINMENT REMEDIAL ACTION ALTERNATIVES

7.2.1 Potential Impacts on Physical and Chemical Characteristics (Subpart C)

7.2.1.1 Impacts on Substrate

a. Hydraulic-control

The proposed action will involve the placement of at least 1.2 meters (4 feet) of fill (i.e. capping) over approximately 53 hectares (130 acres) of open water, 29 hectares (72 acres) of intertidal flat, and 19 hectares (47 acres) of tidal marsh (if PCB contamination is greater than 1.0 ppm). These area estimates were based on information from the U.S. COE bathymetric map for the estuary north of the Coggeshall Street Bridge; the revised wetland cover types from the U.S. EPA E.P.I.C. wetland report; and recorded elevations for plant species within E.P.I.C. wetland B. Approximately 38 hectares (94 acres) of the existing open water would be converted to an intertidal flat habitat and approximately 29 hectares (72 acres) of intertidal flat would be converted to low salt marsh and high salt marsh. The 15.8 hectares (39 acres) of brackish/freshwater marsh and high salt marsh would change to upland vegetation. Although capped, 14.5 hectares (36 acres) of open water habitat is anticipated to remain as this habitat. Finally, the 3.2 hectares (8 acres) of low marsh would be converted to high marsh and upland. These changes are presented in Table 7-1.

The placement (capping) of at least 1.2 meters (4 feet) of clean sediments over the existing substrate of open-water, intertidal flat, and wetlands outside the proposed lined earthen and rockfill channel will change the substrate from organic silt, sandy silts, and peat to sand or sandy gravel. Elevations along the proposed channel will also be increased via the

placement of a sand blanket and riprap (Figure 2-2). Because intertidal mud flats and wetlands are considered "Special Aquatic Sites", the evaluation of filling of these areas is given special consideration. This evaluation is provided in a subsequent section (7.2.3).

b. In-harbor Containment

The dredging activities associated with this alternative will alter the physiochemical characteristics of the surface sediments within the estuary. Dredging will not only change the physical characteristics of the sediments by altering its particle size distribution, but will change the pH and oxidation-reduction potential of the sediments. These changes can result in transformations of certain metals and organic compounds which will influence their solubility and/or bioavailability. The degree of alteration will depend on physical disruption caused by the dredging activities and the physical and chemical characteristics of the subsurface sediments. Information on circulation and currents within the estuary, as well as physical and chemical characteristics of sediments that will be exposed after dredging, will be required in order to evaluate long-term effects of these changes.

The substrate elevations within the open water and intertidal flats will decrease approximately 1.2 meters (4 feet) as a result of this alternative. Approximately 29 hectares (72 acres) of intertidal flat which contain PCB concentrations in excess of 1 ppm would also be lowered 1.2 meters (4 feet) and converted to open water. In addition, if the 19 hectares (47 acres) of tidal marsh require dredging, then this habitat would be expected to change to a tidal flat.

Elevations and sediment characteristics would also be altered within the temporary containment site. The permanent containment would impact about 8 hectares (20 acres) of dredged

tidal marsh and 6 hectares (15 acres) of dredged intertidal flat. This area would be filled to 2.4 meters (8 feet) above mean sea level and thereby converted to upland (Table 7-1). The proposed riprapped embankment around the permanent containment site will result in the creation of some rocky intertidal zone.

The dredging operation will cause some slumping or lateral displacement of sediments along the perimeter of the dredging limits. However, this slumping of sediments should be a temporary effect of the dredging operations.

7.2.1.2 Impacts on Suspended Particulates/Turbidity

a. Hydraulic-control

Implementation of this action will result in the resuspension of bottom sediments during construction of the lined earthen and rockfill channel along the western shoreline. The resuspended sediments would then be dispersed into the environment by the tides. It is not certain that the sediment-dispersal control would be effective in controlling these sediments (Palmero and Francingues 1985). The generation of suspended particulates and turbidity in the water column will be especially pronounced during the construction of the proposed channel and prior to the capping of the sediments in the open-water areas. The amount of sediment dispersed and the resulting effects will be largely determined by the time required to implement this alternative and the effectiveness of the sediment-dispersal control measures (Barnard 1976).

b. In-harbor Containment

Dredging of the estuary will increase suspended particulates and turbidity within the water column. The magnitude of this increase and its significance with respect to the biota in the inner and outer harbor will depend largely on the operational

Table 7-1. Estimated Changes in Wetland Habitat due to Hydraulic Control and Dredging with In-Harbor Containment within the Upper Acushnet River Estuary.

	Hydraulic Control Alterations hectares (acres)		Containment Dredging Alterations hectares (acres)	
Habitat	Impacted	Created	Impacted	Created
Open Water	38(94)	-	-	29(72)
Tidal Flat	29(72)	38(94)	35(87)	19(47)
Salt Marsh/Upland Transition Zone/ Brackish/Freshwater Marsh	19(47)*	32.2(80)	27(67)*	-
Upland	-	15.8(39)	-	14(35)

* Assuming that 19 hectares (47 acres) of Tidal Marsh containing greater than 1.0 ppm PCB are also capped or dredged.

conditions of the dredging (cutterhead revolution rate, operator training, timing, sediment type, etc.), as well as the expected efficiency of the proposed sediment dispersal control. However, as with the hydraulic-control alternative, the sediment dispersal control (weir and silt curtains) may be ineffective in controlling very small particulates that will account for the majority of the suspended matter resulting from the dredging operations. It is these small particulates, however, which may contain a large percentage of the existing PCBs (Metcalf and Eddy 1983).

This proposed action will not involve the direct discharge of fill or dredged material into open water. Although dredge material generated by the project will be disposed of behind a riprapped containment dike, local and short-term increases in turbidity would occur during construction of the permanent containment area.

7.2.1.3 Impacts on Water Quality

The Division of Water Pollution Control of the Massachusetts Department of Environmental Quality Engineering currently has a SB goal for the upper Acushnet River estuary (see Section 3.1.4). Any new or increased discharges of pollutants to such waters are prohibited by the State of Massachusetts unless a variance is granted by the Division of Water Pollution Control.

a. Hydraulic-control

Water quality will be affected by the increased levels of suspended solids and turbidity during the implementation of the hydraulic-control alternative. The placement of 1.2 meters (4 feet) of sandy sediments over the existing organic silt and silty sand will cause the resuspension of some particulate-associated contaminants (PCBs, metals). In addition, other temporary water quality changes, such as changes in dissolved oxygen demand, pH, and nutrients, are anticipated. In the

long-term, this alternative would isolate sediments contaminated with PCBs and heavy metals from resuspension and transport within the estuary.

b. In-harbor Containment

The dredging of the estuary will have an effect on the water quality of the estuary. In addition to the expected increases in suspended solids and turbidity, this action will also result in temporary changes in the levels of nutrients, dissolved oxygen, pH, metals, and PCBs in the water column. The environmental effects of such changes will depend upon the extent of these changes and the effectiveness of the control measures to minimize the impacts within the estuary during implementation and to prevent any contamination extending beyond the harbor opening.

7.2.1.4 Impacts on Current Patterns and Water Circulation

a. Hydraulic-control

The hydraulic-control alternative will in effect eliminate the present physical environment of the Acushnet River estuary and extend the Acushnet River to the Coggeshall Street Bridge. As stated in Section 3.1.3.3, numerous small streams presently contribute 1,400 cubic meters (50,000 cubic feet)/day of fresh water to the estuary (fall estimate). A new hydrological environment would be created in the estuary. The effect of this alternative on local water circulation would be considerable. The tidal prism within the proposed channel would be much less than presently exists in the estuary due to the reduced volume of water that would flow into the channel although the water current velocity is expected to increase within the proposed channel. The local wind-driven circulation and waves would be lessened due to the reduction in surface area of the exposed water in the estuary. The tidal currents in the immediate vicinity of the Coggeshall Street Bridge would also be reduced.

b. In-harbor Containment

The dredging with disposal in an in-harbor containment site alternative would deepen the overall estuary but reduce the areal extent of the estuary in the northeastern region. Thus, the volume of tidal water entering the estuary and the tidal currents at the Coggeshall Street Bridge would increase slightly. The current velocity increase would depend on the volume of sediment removed. In general, the circulation in the Acushnet River estuary would not be greatly affected since the volume of sediments dredged would represent a small percentage of the total volume of water in the tidal prism.

Presently, localized tidal and wind-driven currents at the edge of the Acushnet River estuary wetlands are small due to the shallow depths at the shoreline. Dredging adjacent to the wetlands would deepen the water at the shoreline and likely result in greater currents at these locations. These stronger currents and wave action could potentially result in erosion of the adjacent wetlands.

7.2.1.5 Impacts on Normal Water Fluctuations

a. Hydraulic-control

Changing the geometry of the Acushnet River estuary is expected to impact the tidal currents and elevations in the inner New Bedford Harbor. The effect that this change would have on the tidal range within the inner harbor cannot be ascertained without a predictive physical model, however, the amplitude change is expected to be less than 15 centimeters (0.5 foot) of elevation.

b. In-harbor Containment

The in-harbor alternative would also affect the tides in the New Bedford inner harbor, although to a lesser degree than the hydraulic-control alternative.

The development of the permanent containment site will result in the elimination of existing intertidal flats and tidal marsh and the creation of an upland system. Hence, the containment area would not experience any tidal exchange.

7.2.1.6 Impacts on Salinity Gradients

a. Hydraulic-control

The river discharge into the proposed channel would remain the same, thus, horizontal salinity gradients between the river water and harbor water would occur lower than currently exist. This lower salinity gradient is anticipated to extend nearly to the Coggeshall Street Bridge.

b. In-harbor Containment

It is expected that the proposed dredging will have only a temporary effect on the hydrographic characteristics (temperature, salinity) of the estuary.

7.2.1.7 Conclusions

In general, the hydraulic-control and the in-harbor containment alternatives would directly impact equivalent areas of wetland marsh and tidal flat within the Acushnet River estuary. However, the capping of tidal flat areas with the hydraulic-control alternative would result in an increase in the area of salt and brackish marsh and wetland/upland transition areas (Table 7-1). Tidal flat habitat is also anticipated to increase due to the capping of existing shallow areas of open water. The in-harbor containment alternative is anticipated to result in an increase in open water habitat and a decrease in tidal flat and wetland areas. The net area of estuary resources (i.e. wetlands, tidal flats, and open water habitats) anticipated to be converted to upland with the hydraulic-control and in-harbor containment alternatives is 15.8 and 14.0 hectares, respectively.

Dredging with disposal in an in-harbor containment site would be less disruptive to the hydrologic character of the estuary. A quantitative assessment of the two alternatives, particularly with respect to changes in the tidal response within New Bedford Harbor, would require an evaluation of: 1) a detailed bathymetric survey of the area; 2) water current and pressure measurements at key locations; and 3) a simple numerical model to predict the tidal response for different geometrical boundaries in the harbor in relation to the proposed remedial actions.

7.2.2 Impacts on Biological Characteristics (Subpart D)

7.2.2.1 Impacts on Threatened and Endangered Species

On February 22, 1985, an immature peregrine falcon was observed flying over the estuary and salt marshes (SES 1985). This species is currently recognized as a Federally Endangered Species by the U.S. Fish and Wildlife Service, and State Endangered by the Massachusetts Division of Fisheries and Wildlife. If the study area comprised part of the regular wintering range of this endangered species, the disturbance and habitat alterations proposed might be cause for concern. However, local ornithologists have stated that the peregrine falcon was not a winter resident - a likely conclusion in southern Massachusetts. In addition, the Massachusetts Natural Heritage Program has no records of peregrine falcon nesting activities near the estuary. Appendix A contains a letter from the Massachusetts Natural Heritage Program which confirms that there are no known threatened or endangered species, or ecologically significant natural communities within the project area.

A single sharp-shinned hawk flying over upland edge and salt marsh habitats, plus eight least terns fishing in the Acushnet estuary within the study area are also noteworthy. Each of these species is listed as of "special concern" by the

Massachusetts Division of Fisheries and Wildlife. Further consideration of least terns within the estuary is suggested as part of any remedial action.

7.2.2.2 Impacts on Fish, Crustaceans, Mollusks and Other Aquatic Organisms in the Food Web

a. Hydraulic-control

Hydraulic control and sediment capping will deposit about 1.2 meters (4 feet) of clean fill on estuarine surfaces (and potentially a portion of the existing wetlands) thus, eliminating non-mobile benthic species and severely impacting mobile forms (e.g., fish, aquatic birds). In the long term, a reduction in certain aquatic habitats will result from the channelized river and elevated underwater substrates (see Section 7.2.1.1). Approximately 53 hectares (130 acres) of existing open water, and 29 hectares (72 acres) of intertidal flat would be altered. In addition to reducing the open water habitat, this alternative would also isolate the remaining wetland habitat from the Acushnet River, thus reducing potential feeding and nursery areas for fisheries that spawn within the river. Other adverse impacts include construction disturbance, estimated at 1.3 years (NUS 1984).

Long-term benefits on the aquatic sites remaining after the proposed treatment principally arise from the isolation of PCB and heavy metal pollution from the water and biological communities.

b. In-harbor Containment

Dredging and associated containment construction will essentially eliminate existing benthic communities within proposed work areas. Recolonization may be expected for varying percentages of the disturbed areas. The type and extent of particular communities which develop will be largely dependent

upon substrate type and elevation. A greater amount of open-water habitat would result with the dredging action compared to the hydraulic-control alternative (Table 7-1). The proposed in-harbor containment site would convert up to 14.0 hectares (35 acres) of wetlands and mud flats (including salt marsh and brackish/freshwater marsh) to artificial uplands at least 2.4 meters (8 feet) above mean sea level.

Populations of fish, mollusks, and other aquatic organisms would be reduced due to the proposed dredging and/or aquatic sediment capping operations. Water turbidity may also cause reductions in some species (e.g., fish) if extreme turbidity occurs over prolonged periods. Mobile species may be able to recolonize aquatic habitat after construction ceases, depending on the degree of habitat alteration.

Both alewives and blue-back herring migrate through the estuary to spawn in the fresh water of the Acushnet River (Crouch, G., personal communication). Implementation of either remedial action could potentially impair this migration since both alternatives incorporate long-term placement (1.3 to 5.3 years) of silt curtains near the Coggeshall Street Bridge.

In addition, further cumulative impacts may result from in-harbor disposal if remedial actions are taken below Coggeshall Bridge. Wetland areas adjacent to the proposed containment site would be prime candidates for the disposal of dredged material from any additional remedial action. Other adverse impacts include those associated with construction disturbance, estimated at 2.7 to 5.3 years (NUS 1984).

Benefits to the aquatic sites remaining after the proposed treatment will result from the substantial reduction of further PCB and heavy metal pollution from the water and surface sediments.

7.2.2.3 Impacts on Wildlife

Areas of marsh would be eliminated by either alternative. The Acushnet River estuary marshes are currently breeding habitat for a limited number of bird and mammal species (e.g., red-winged blackbird, song sparrow, meadow vole). Transition zones above the high-water mark provide breeding habitat for many more species. Due to urbanization on both shores, the vegetated margins provide wildlife corridors along the estuary. The diverse flora provides varied wildlife food and cover at all times of the year. Marsh areas that are dredged and not within the permanent containment site could receive clean fill and be revegetated. However, the capped areas proposed with the hydraulic alternative may provide a suitable environment for the establishment of common reed, a vegetational form that provides little wildlife habitat value (see Section 3.2.2.4 and 3.2.2.5). A summary of anticipated changes in the existing habitats with both alternatives is presented in Table 7-1.

7.2.3 Impacts on Special Aquatic Sites (Subpart E)

7.2.3.1 Impacts on Wetlands

Either remedial alternative would lead to reductions in the extent of the existing wetlands (Section 7.2.1.1) although the in-harbor containment alternative would result in an larger direct loss of wetland area. However, the hydraulic alternative may result in a greater indirect alteration of wetlands due to their isolation from the Acushnet River channel.

Habitat: The wetlands present within the Acushnet River estuary provide habitat for a wide diversity of organisms (see Section 3.2.2). Both alternatives would result in a substantial modification of the existing habitat. Impacts to benthic species, shellfish, and fisheries are discussed in Section 7.2.2.2 while impacts to wildlife habitat are described in Section 7.2.2.3.

Each alternative will eventually result in the isolation of the contaminated sediments from resuspension and transport by the Acushnet River although the capping and dredging will increase and decrease, respectively, the elevation of the open-water areas and wetlands approximately 1.2 meters (4 feet). The capping and dredging is anticipated to have a pronounced effect on the habitat that will be present on these areas (Section 7.2.1).

Water purification: The reduction in the area of salt marsh (and the isolation between the remaining wetlands and the proposed channel with the hydraulic control alternative) is anticipated to reduce the sediment-trapping ability of the estuary. Current flow within the channel of the hydraulic control alternative is expected to be high with little impediment, hence, sediments are anticipated to flow into the lower estuary south of Coggeshall Bridge. Similarly, the reduction in vegetation with both alternatives is expected to result in a decrease in uptake potential, particularly with respect to nutrients (see Section 6.2.2).

Aquifer recharge: Little information is available on the ground water exchange between the salt marsh and adjacent uplands other than that the influence of the estuary may extend 300 meters (1,000 feet) east or west of the estuary (NUS 1984). Impacts to ground water associated with either of the remedial action alternatives is unclear. The presence of a perched ground water table on the peat is possible (NUS 1984) but is unconfirmed. The influence of peat dredging on the underlying aquifer is also unclear. Filling of the salt marsh may result in compaction of the peat and impede ground water movement. This data would be of importance in evaluating potential ground water movement through the contaminated sediments of the in-harbor disposal area.

Food chain production and nutrient exchange: The Acushnet River estuary is currently a productive environment (Section

6.4). It contains a constricted opening to the sea, thus detritus, etc. produced by the wetlands would have a greater likelihood to recirculate within the estuary rather than being exported. Both alternatives would eliminate areas of salt marsh vegetation, hence a corresponding reduction in food chain productivity would be anticipated. Invertebrate populations within the estuary would also be reduced with either alternative, thus resulting in a decrease in available prey for higher trophic level consumers. However, although there will initially be a direct loss in populations of benthic invertebrates, populations of benthic organisms are expected to recolonize these suitable habitats.

Flood control and storm damage prevention: Currently, the wetland resources around the perimeter of the estuary afford storm damage protection (wave erosion, etc.) to adjacent upland and developed areas. The hydraulic alternative would also protect adjacent areas from storm damage. However, an increase in velocity from existing conditions may occur within the proposed channel. This may result in scouring within the channel. The in-harbor disposal alternative would reduce the amount of wetlands, particularly salt marsh, available to reduce storm damage. The containment area, however, would be designed to withstand erosion and would itself act as a buffer zone to protect existing upland areas.

In-harbor disposal would displace some flood storage capacity. The hydraulic alternative would pass 100-year storm flows from the Acushnet River into the upper harbor, thus, reportedly decreasing flood levels within the estuary (NUS 1984). It is assumed that ocean flooding from hurricanes would be effectively minimized by the existing hurricane barrier.

7.2.3.2 Impacts on Mud Flats

Marshes and tidal flats in the upper Acushnet River contain oysters, soft-shelled clams, and hard-shelled clams (Bourge, B.,

shellfish habitat can be expected to reduce populations of fish and shellfish. Open-water fisheries habitat would increase following the implementation of the in-harbor containment alternative, however, reductions in shellfish habitat could result from the loss of tidal flat habitat.

7.2.4.3 Effects on Water-related Recreation

Recreational boating would be impacted by the remedial alternatives during construction and post-construction. A reduction in size of the boating area would occur and be most pronounced for the hydraulic alternative. The hydraulic alternative would create extensive areas of shallow water and a relatively deep river channel.

7.2.4.4 Effects on Aesthetics

The estuary and associated wetlands presently offer open space amenities within an otherwise developed setting. Either alternative would result in a reduction of aquatic and wetland resources which are currently protected from development by state and federal laws.

7.2.4.5 Effects on Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites and Similar Preserves

The Massachusetts Natural Heritage Program has identified the Sycamore Street wetlands north of the Coggeshall Street Bridge and south of the proposed containment site as a conservation area owned by the town of Fairhaven (Appendix A). The conservation area is potentially within the impact zone of either remedial alternative.

The Massachusetts Historical Commission (V. Talmage, March 12, 1985) has indicated that at least one known archaeological site occurs in the project planning area in Acushnet.

pers. comm.). Approximately 29 hectares (72 acres) of tidal flat are present north of the Coggeshall Street bridge.

Both remedial alternatives would eliminate existing shellfish beds either by covering them with fill or removing them through the dredging operation. However, in the hydraulic-control alternative, tidal flat habitat would increase by approximately 9 hectares.

The in-harbor containment remedial action would convert the approximately 29 hectares (72 acres) of existing intertidal flat to open water. If dredged, the 18.2 hectares (45 acres) of tidal marsh would be converted to tidal flat and low marsh vegetation. Although shellfish (e.g. *Mya arenaria* and *Mercenaria mercenaria*) may not be able to rapidly colonize the peaty substrate of the newly formed tidal flats, recolonization can be expected over the long term. In addition, the reduction/elimination of contaminants (i.e., PCBs and heavy metals) may allow additional invertebrate species (if presently precluded from inhabiting these areas by excessive contaminants) to recolonize areas of suitable habitat.

7.2.4 Effects on Human Use Characteristics (Subpart F)

7.2.4.1 Effects on Municipal and Private Water Supplies

The proposed remedial actions would not impact municipal and private water supplies.

7.2.4.2 Effects on Recreational and Commercial Fisheries

Currently the upper Acushnet River estuary is closed to fishing. Illegal taking of fish or shellfish may pose a hazard to a limited population. Implementation of either remedial alternative may result in a reduction in contaminant loading sufficient to reopen the area to fishing. If the hydraulic control alternative is implemented, the reduction in fish/

Additional, previously unrecorded sites may also be present. The Massachusetts Historical Commission has requested that an archaeological reconnaissance survey be conducted.

7.2.5 Evaluation and Testing of Dredged or Fill Material (Subpart G)

7.2.5.1 General Evaluation of Dredged or Fill Material

Sediment sampling was performed for areas proposed for dredging (in-harbor containment alternative). The clean fill proposed for capping the contaminated sediments within the Acushnet River estuary would consist of uncontaminated sand and were not evaluated.

7.2.5.2 Chemical, Biological and Physical Evaluation and Testing

Clean fill for capping purposes under the hydraulic alternative will be derived from sediments in Buzzards Bay. It has been assumed that this source would provide clean fill. The sediments within the proposed dredge area of the Acushnet River estuary were sampled and analyzed using accepted sampling and analytical procedures. Elevated levels of PCBs, chromium, copper, lead, and zinc were detected at various levels throughout this area with no discernible spatial pattern present.

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8.0 ACTIONS TO MINIMIZE ADVERSE EFFECTS
404 (B) (1) SUBPART H

The remedial action alternatives are, in themselves, proposals designed to minimize adverse environmental effects posed by the presence of heavily contaminated sediments within the estuary. These alternatives, however, will cause major disruptions to the existing ecosystems.

Steps proposed to minimize impacts of the alternatives are largely concerned with preventing the contaminants from migrating into the upper New Bedford Harbor (sediment control and water treatment). Palermo and Francingues (1985), however, have indicated that the sheet pile weir would be expensive and potentially ineffective, hence, it was not recommended. Palermo and Francingues also suggested the use of relatively inexpensive silt curtains only for aesthetic benefit.

Sediment analysis has confirmed the presence of contaminated sediments within the tidal wetlands of the Acushnet River estuary. Hence, in the lined in-harbor containment site alternative, the contaminated tidal wetland sediments beneath the contaminant site should be removed prior to placement of the liner. Borings should be taken within and adjacent to the containment site in order to evaluate ground water conditions in this area. If ground water conditions offer a potential contaminant transport mechanism, then its effect on the in-harbor containment site (particularly with the unlined alternative) and the hydraulic alternative should be further evaluated.

Mitigation measures which would minimize disruption of existing ecosystems deserve consideration. These measures would include the use of upland disposal sites or the consideration of alternative in-harbor disposal sites and configurations that would reduce wetland impacts. For example, deepening the containment site may result in a reduction of impacted wetland

area. In addition, the replacement of functional values lost due to the reduction in resource areas of the estuary (i.e. wetland, tidal flat, and open water areas) with each alternative, should be the intent of mitigative measures. The hydraulic-control and in-harbor alternatives will result in a net conversion of 15.8 and 14.0 hectares, respectively, of these habitats to upland. Mitigation should be focused on replicating the areas lost with either alternative.

The re-creation of dredged tidal marsh habitat or the creation of replacement wetland habitat from available upland areas should receive consideration. Although it would probably be infeasible to create tidal wetlands within the proposed channel, it would be possible to create tidal wetlands within the shallower areas of the estuary with the in-harbor containment alternative. Re-establishment of the dredged wetland habitats would require that pre-dredging elevations of the tidal wetlands be restored. Clean dredged material would likely provide a suitable substrate for wetland vegetation establishment. The proximity of future dredging projects would be an important component regarding the economics of a tidal wetland reclamation project.

Techniques utilized in the creation of wetlands with dredged material have been previously identified and published (U.S. Army Waterways Experiment Station 1978). In general, previous efforts at tidal marsh creation have been successful. However, a detailed plan should be prepared for each area proposed for wetland restoration. This plan should address desired wetland elevations (and their relation to estuary tidal fluctuations), vegetation establishment and planting details (including proposed species, planting schematic, and estimated timetable), as well as design features to obtain the wetland functions desired.

If the replication of the total estuary resource areas lost with either alternative is infeasible, then the increased area of upland may potentially be enhanced to provide additional value (e.g. planted with berry-producing shrubs to provide food and cover for wildlife) or flood storage area if located within the floodplain.

9.0 COORDINATION

This section contains a list of persons from local, State and Federal agencies contacted for this environmental assessment.

Mr. Gene Crouch 4/12/85
U.S. Fish and Wildlife Service
(603) (224-2585)

The depth of the sediment cap must be sufficient to keep deep burrowing species from entering the contaminated sediments. Species such as, Arenicola (polychaete) and razor clams (2 feet).

Fish utilizing the area are winter flounder, pollock in the summer, mackeral, blue fish, Fundulus, silversides, etc. Last year in the spring, Gene saw many juvenile fish on the west bank temporary containment site. The study area is important for anadromous fish (e.g. alewives and blue back herring). It is an area they would migrate through to get to the gravelly bottom freshwater areas in the Acusnet River where they spawn. Older fish and fry may be feeding in the upper Acushnet River estuary.

Birds (e.g. Scaup and Black ducks) eating the (contaminated?) shellfish are their major concern. PCB's have teratogenic effects on some birds. Heavy metals are also a concern.

Massachusetts Natural Heritage Program 4/12/85
(617) (727-9194)

No rare and endangered species are in the study area. No important nesting sites for the Peregrine Falcon.

Mr. Joel Hartley 4/12/85
DEQE
(617) (947-1231 ext. 680)

Talked with Joel Hartley, Elizabeth Koulcheres was not in. Hartley said in a similar case in Saugus, a Phragmites area adjacent to a salt marsh was classified as Bordering Vegetated Wetland.

Ms. Susan Mello Roe 4/12/85
National Marine Fisheries Service
(617) (281-3600 ext. 270)

Not in.

Mr. Brad Bourge 4/12/85
New Bedford Harbor Shellfish Officer
(617) (999-2931)

Mr. Bourge will help us obtain any shellfish we want for the analysis. Shellfish present are Mya arenaria, oysters, ribbed mussels and Mercenaria mercenaria. Lack of mussels at the most northerly station is very likely due to a drop in salinity. At the present time, the study area is closed to all fisheries activities (area 1). He has not been allowed to transplant any shellfish from area 1. If shellfish were transplanted, there may be as many as 16,000 one-hundred pound bags of quahogs. If fifty percent are marketable, the total would equal $800,000 at $1/lb.

Something must be done about the contaminated area. Eventually, people will take shellfish and fish illegally. He thinks the in-harbor containment idea is poor. It would resuspend too much of the contaminated sediments and further contaminate the

southern reaches of the harbor. The hydraulic control idea is better. Isolate the river flow, dry out the study area, and incinerate the spoil.

Mr. Larry Gill 1/30/87
DEQE
Dept. Water Pollution Control
Westborough, Mass.
(617) (366-8336)

Sent water quality information on the Acushnet River estuary.

Mr. John Farrington 1/21/87
W.H.O.I.
Biology Department
(617) (548-1400)

Few water column studies on the Acushnet River estuary have been done. He is sending a couple of articles on PCB levels in the water column.

Mr. John Valois 1/21/87
Marine Resources
M.B.L.
Woods Hole, Mass.
(617) (548-3705)

The bivalve seen along the shoreline is probably Macoma balthica. A set will die off and you can get large numbers washed ashore. They live about 2-3 years.

Mr. Mike Conners 1/21/87
Battelle Marine Research Lab
Duxbury, Mass.
(617) (934-5682)

Gave recent data on water column concentrations of Cd, Cu, Pb and PCB's.

Mr. Bruce Tripp 1/21/87
Massachusetts Coastal Zone Management
(617) (727-9530)

He is sending the Coastal Zone Management technical report on New Bedford Harbor.

Ms. Judy Perry 1/21/87
DEQE
Water Quality
Boston, Mass.
(617) (292-5655)

Waters of the Acuhnet River estuary are classified as SB, but they don't meet this criteria because of problems with dissolved oxygen, coliform bacteria, heavy metals, PCB's and sediment residuals.

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ACUSHNET RIVER ESTUARY

NEW BEDFORD HARBOR

WETLANDS ASSESSMENT APPENDICES

APPENDIX A - PERTINENT CORRESPONDENCE

APPENDIX B - SES SEDIMENT SAMPLING CHAIN OF CUSTODY RECORDS

APPENDIX C - RESULTS OF SES AND COE/NED WETLAND SEDIMENT CHEMICAL ANALYSES

APPENDIX D - COMMON AND SCIENTIFIC NAMES OF PLANT AND ANIMAL SPECIES OBSERVED DURING THE WETLAND SURVEYS

APPENDIX E - ANALYTICAL METHODS FOR BIOACCUMULATION/BIOCONCENTRATION (ACUSHNET RIVER SITE)

APPENDIX F - QUALITY ASSURANCE DATA

APPENDIX G - GAS CHROMATOGRAPH/MASS SPECTOPHOTOMETER CONFIRMATION OF PCBS

APPENDIX H - CHAIN OF CUSTODY DOCUMENTS

APPENDIX A

PERTINENT CORRESPONDENCE

Massachusetts
Natural Heritage
Program

April 19, 1985

Charlotte Cogswell
Univ. of Connecticut
Storrs, CT 06268

Dear Ms, Cogswell:

Re: Acushnet R. estuary,
Fairhaven wetland

As you requested, the Massachusetts Natural Heritage Program has reviewed the proposed containment site for PCB-contaminated sediments to be dredged from the Acushnet River estuary.

At this time, we are not aware of any rare plant or animal species populations or ecologically significant natural communities that would be adversely affected by this project.

We would like to inform you, however, that our ongoing inventory of Massachusetts conservation areas indicates that one of the tidal flats outlined in the map accompanying your March data request adjoins a Fairhaven town property, popularly known as "Sycamore Street Wetland". I have indicated its location, as we know it, on a copy of the above-mentioned map. You may have already contacted the town offices regarding possible affects of the containment site on this property.

Thank you for consulting the MNHP, and please feel free to contact us with any questions. Please note that our rare species inventory expands with ongoing field work and research, so that further information on this area may become available in the future.

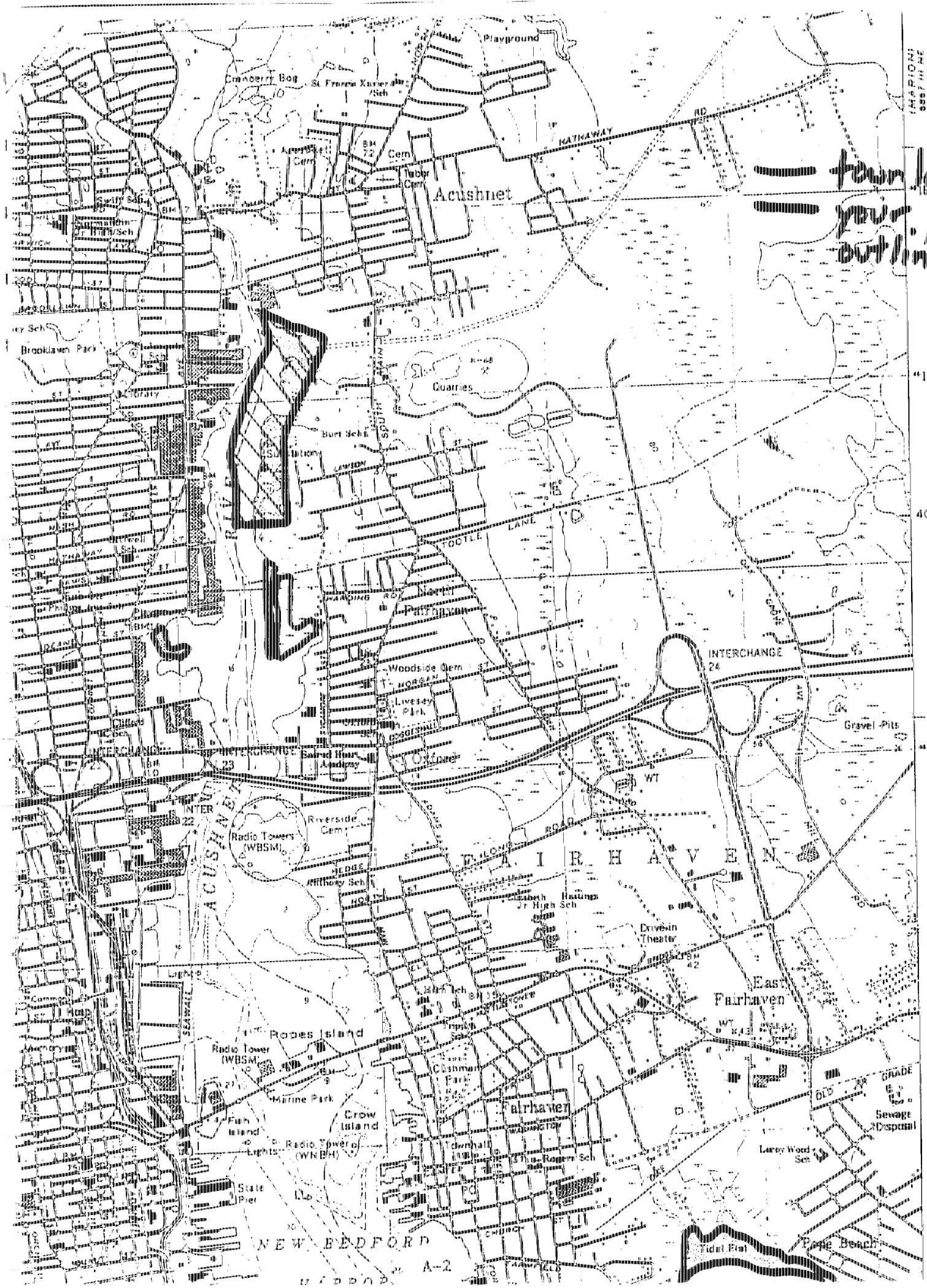
Yours sincerely,

Alison Sanders-Fleming

Alison Sanders-Fleming
Environmental Reviewer

ASF:phb

Division of Fisheries and Wildlife 100 Cambridge Street, Boston, Mass. 02202 (617) 727-3160,-3151



Base map is a portion of U.S.G.S. New Bedford North, MA Quadrangle (1979)

MANOMET BIRD OBSERVATORY
MANOMET, MASSACHUSETTS 02345 (617) 224-6521

Kathleen S. Anderson, Executive Director Emeritus

12 March 1985

Gary - for your information

Mr. James Sherriden
Special Agent in Charge
Division of Law Enforcement
U.S. Fish and Wildlife Service
One Gateway Center, Room 400E
Newton Corner, MA 02158

Dear Mr. Sherriden:

As indicated in our telephone conversation last week, I have been asked by the U.S. Army Corp of Engineers (New England Division) to apply for this permit on very short notice. The Massachusetts Division of Fisheries and Wildlife advised me to obtain this Federal Permit, then apply in person for the necessary State Permit which they would review immediately. I apologize for the rush, but would be very grateful if you could review this application as soon as possible.

Under sub-contract #DACW-33-85-D-0002-003, the Manomet Bird Observatory has been hired to conduct impact studies and assess levels of Poly-Chlorinated Biphenyls (PCB'S) at the top consumer level of two winter and two summer food chains. The study area is the Acushnet River and estuary, Bristol County, Massachusetts. Thus, up to 40 birds will be collected, stomach contents analyzed and lipid PCB levels determined by Sanford Ecological Services, 290 Corey Road, Brookline, MA 02146. Birds will be shot, trapped or netted. And contaminated materials will be disposed of properly and legally on advice from Sanford Ecological Services.

A field survey of the site (22 February 1985) showed Black Duck and Ring-billed Gull to be the top consumer species of the winter food chains. Summer food chains are predicted to end with Herring Gull, Snowy Egret, Red-winged Blackbird and Song Sparrow. Herring Gull and Snowy Egret are much preferred, but numbers in the polluted area may be too low; in that case, one or both of the reserve species may be used.

Winter populations of birds may leave at the end of March, hence the need for rapid action in this study.

Membership-supported Research and Education in Environmental Biology

Request Summary:

Black Duck	up to 10 specimens	(key species)
Ring-billed Gull	up to 10 specimens	(key species)
Snowy Egret	up to 10 specimens	(key species)
Herring Gull	up to 10 specimens	(key species)
Red-winged Blackbird	up to 10 specimens	(reserve species)
Song Sparrow	up to 10 specimens	(reserve species)

Total not to exceed 50 specimens

I would like to name as sub-permittee an experienced local hunter who would assist with any shooting necessary. We will also contact the local Conservation Commission and Police Department before collecting: William S. Brewster, Russell Mills Road, Plymouth, MA 02360.

I believe this research is necessary in evaluating the considerable human and wildlife hazards at this study site. Results are needed as part of a safe disposal plan for action by the U.S. Army Corp of Engineers.

Sincerely,

Trevor L. Lloyd-Evans
Senior Staff Biologist, MBO

TLE/np

cc: Dr. Gary Sanford, SES

OMB NO. 42-R1670

U.S. FISH & WILDLIFE SERVICE

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

FEDERAL FISH AND WILDLIFE LICENSE/PERMIT APPLICATION

1. APPLICATION FOR *(Indicate only one)*

[ ] IMPORT OR EXPORT LICENSE [X] PERMIT

2. BRIEF DESCRIPTION OF ACTIVITY FOR WHICH REQUESTED LICENSE OR PERMIT IS NEEDED.

Up to 10 individuals of 4 or 5 of six bird species, not exceeding 50 indiv--iduals, collected by shooting, trapping or netting for PCB monitoring under contract to the Army Corps of Engineers (New England Div.)

3. APPLICANT. *(Name, complete address and phone number of individual, business, agency, or institution for which permit is requested)*

Trevor L. Lloyd-Evans
Manomet Bird Observatory
Box 936, Manomet,
Mass. 02345. (617-224-6521)
(see sub-permit in attachment)

4. IF "APPLICANT" IS AN INDIVIDUAL, COMPLETE THE FOLLOWING:

[ ] MR. [ ] MRS. [ ] MISS [ ] MS.

HEIGHT	WEIGHT
5'11"	160 lbs.

DATE OF BIRTH	COLOR HAIR	COLOR EYES
24 May 1946	fair	brown

PHONE NUMBER WHERE EMPLOYED	SOCIAL SECURITY NUMBER
617-224-6521	013-50-9464

OCCUPATION
Biologist

ANY BUSINESS, AGENCY, OR INSTITUTIONAL AFFILIATION HAVING TO DO WITH THE WILDLIFE TO BE COVERED BY THIS LICENSE/PERMIT

Manomet Bird Observatory
for
U. S. Army Corps of Engineers

5. IF "APPLICANT" IS A BUSINESS, CORPORATION, PUBLIC AGENCY, OR INSTITUTION, COMPLETE THE FOLLOWING:

EXPLAIN TYPE OR KIND OF BUSINESS, AGENCY, OR INSTITUTION

N/A

NAME, TITLE, AND PHONE NUMBER OF PRESIDENT, PRINCIPAL OFFICER, DIRECTOR, ETC.

IF "APPLICANT" IS A CORPORATION, INDICATE STATE IN WHICH INCORPORATED

6. LOCATION WHERE PROPOSED ACTIVITY IS TO BE CONDUCTED

Southern Bristol County, Mass.,
in the vicinity of New Bedford

7. DO YOU HOLD ANY CURRENTLY VALID FEDERAL FISH AND WILDLIFE LICENSE OR PERMIT? [X] YES [ ] NO
(If yes, list license or permit numbers)

Federal Bird Marking & Salvage Permit #9859

8. IF REQUIRED BY ANY STATE OR FOREIGN GOVERNMENT, DO YOU HAVE THEIR APPROVAL TO CONDUCT THE ACTIVITY YOU PROPOSE? [ ] YES [X] NO – verbal only, will apply after receiving Federal Permit.
(If yes, list jurisdictions and type of documents)

9. CERTIFIED CHECK OR MONEY ORDER *(if applicable)* PAYABLE TO THE U.S. FISH AND WILDLIFE SERVICE ENCLOSED IN AMOUNT OF
$ N/A

10. DESIRED EFFECTIVE DATE
15 March 1985

11. DURATION NEEDED
Until 31 Dec. 1985

12. ATTACHMENTS. THE SPECIFIC INFORMATION REQUIRED FOR THE TYPE OF LICENSE/PERMIT REQUESTED *(See 50 CFR 13.13(b))* MUST BE ATTACHED. IT CONSTITUTES AN INTEGRAL PART OF THIS APPLICATION. LIST SECTIONS OF 50 CFR UNDER WHICH ATTACHMENTS ARE PROVIDED.

Migratory Bird Permit: Scientific Collecting (Section 21.23)

CERTIFICATION

I HEREBY CERTIFY THAT I HAVE READ AND AM FAMILIAR WITH THE REGULATIONS CONTAINED IN TITLE 50, PART 13, OF THE CODE OF FEDERAL REGULATIONS AND THE OTHER APPLICABLE PARTS IN SUBCHAPTER B OF CHAPTER I OF TITLE 50, AND I FURTHER CERTIFY THAT THE INFORMATION SUBMITTED IN THIS APPLICATION FOR A LICENSE/PERMIT IS COMPLETE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF. I UNDERSTAND THAT ANY FALSE STATEMENT HEREIN MAY SUBJECT ME TO THE CRIMINAL PENALTIES OF 18 U.S.C. 1001.

SIGNATURE *(In ink)*	DATE
Trevor L. Lloyd-Evans	12 March 1985

3-200
(5/74)

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

3-201
(2/76)

FEDERAL FISH AND WILDLIFE PERMIT

1. PERMITTEE

TREVOR L. LLOYD-EVANS
MANOMET BIRD OBSERVATORY
BOX 936
MANOMET MA 02345

2. AUTHORITY - STATUTES
16 USC 703-712

REGULATIONS (Attached)
50 CFR Part 13
50 CFR 21.23

3. NUMBER
PRT-691728

4. RENEWABLE
[X] YES
[ ] NO

5. MAY COPY
[X] YES
[ ] NO

6. EFFECTIVE
3/20/85

7. EXPIRES
12/31/87

8. NAME AND TITLE OF PRINCIPAL OFFICER (If #1 is a business)

9. TYPE OF PERMIT
SCIENTIFIC COLLECTING

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
SOUTHERN BRISTON COUNTY, MASSACHUSETTS
VICINITY OF NEW BEDFORD MASSACHUSETTS

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

D. Carry and display this permit upon request when conducting activity authorized herein.
E. Maintain records as required in 50 CFR 13.46.
F. Authorized to take no more than ten (10) each of the following species by shooting, trapping, or netting: black duck, ring-billed gull, snowy egret, herring gull, red-winged blackbird, song sparrow.
G. Authorized to transfer specimens to Sanford Ecological Services, 290 Corey Road, Brookline, MA, for residue analysis. Any remaining parts to be destroyed by burial or incineration.
H. Supermittee: William S. Brewster. Permittee and designated subpermittee must carry and display this permit upon request when conducting any activity authorized herein.
I. Not authorized to salvage threatened/endangered birds.

☐ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ON REVERSE ALSO APPLY

12. REPORTING REQUIREMENTS
FIRST ANNUAL REPORT DUE 1/10/86

ISSUED BY: Paul A. [signature]

TITLE: ACTING SPECIAL AGENT IN CHARGE

DATE: 3/20/85

ORIGINAL

APPENDIX B

WETLAND SEDIMENT CHAIN OF CUSTODY RECORDS

Record No: 1
Date: 12/12/86

CHAIN OF CUSTODY RECORD

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
A-1	PCB, Copper, Lead Zinc, Chromium	Comp	N/A	12/12/86		Kenneth J Thomson
A-2	" " " " "	"	"	"		"
A-3	" " " " "	"	"	"		"
A-4	" " " " "	"	"	"		"
A-5	" " " " "	"	"	"		"
A-6	" " " " "	"	"	"		"
A-7	" " " " "	"	"	"		"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
Kenneth J Thomson	[illegible]	12/14/86	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
	[illegible]	12/17/86 1332	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:

Method of Shipment:

APPENDIX C

RESULTS OF WETLAND SEDIMENT CHEMICAL ANALYSES

Sediment Data for Buzzards Bay Reference Wetland

Field Identification: A-1 Matrix: Solid
Laboratory Number: 8552-1

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	180
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	1400
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	360
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	800

Field Identification: A-2 Matrix: Solid
Laboratory Number: 8552-2

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	31
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	280
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	120
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	230

Field Identification: A-3 Matrix: Solid
Laboratory Number: 8552-3

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	63
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	270
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	120
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	160

Field Identification: A-4 Matrix: Solid
Laboratory Number: 8552-4

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	67
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	240
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	130
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	200

Field Identification: A-5 Matrix: Solid
Laboratory Number: 8552-5

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	24
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	60
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	45
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	57

Field Identification: A-6 Matrix: Solid
Laboratory Number: 8552-6

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	3
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	8
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	<5
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	26

Field Identification: A-7 Matrix: Solid
Laboratory Number: 8552-7

Parameter	Date Analyzed	Method/Ref.	Conc.
Chromium, recoverable (ug/g)	12/29/86	303A,3050/1,2	41
Copper, recoverable (ug/g)	12/23/86	303A,3050/1,2	88
Lead, recoverable (ug/g)	12/23/86	303A,3050/1,2	430
Zinc, recoverable (ug/g)	12/23/86	303A,3050/1,2	130

References:
1) Standard Methods, 16th Edition
2) EPA SW 846, 2nd Edition

Lab Number: 8552-1
Sample Designation: A-1
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	4.1	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-2
Sample Designation: A-2
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	1.5	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-3
Sample Designation: A-3
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	1.6	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-4
Sample Designation: A-4
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	2.5	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-5
Sample Designation: A-5
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	1.6	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-6
Sample Designation: A-6
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	BDL	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Lab Number: 8552-7
Sample Designation: A-7
Date Extracted: 12/30/86
Date Analyzed: 12/31/86

Results expressed on a dry (103 degrees C) basis.

POLYCHLORINATED BIPHENYLS	CONCENTRATION (ug/g)	DETECTION LIMIT (ug/g)
PCB-1242	BDL	.3
PCB-1254	2.9	.6
PCB-1221	BDL	.3
PCB-1232	BDL	.3
PCB-1248	BDL	.3
PCB-1260	BDL	.6
PCB-1016	BDL	.3

BDL = BELOW DETECTION LIMIT
METHOD REFERENCE: SW 846, 2ND EDITION
METHODS FOR EVALUATING SOLID WASTE
METHODS 3540 AND 8080

Sediment Data for the Acushnet River Estuary Wetland System

SUPERFUND-NEW BEDFORD, MA

Master Sample List - Soils

Grid No. ID **	Lab ID	Stratum (inches)	Date Sampled	C of C # History	Inorganic Sample No.	Organic Sample No.
J-19-0-1	0137	0-12	10-6-85	W/B/RM-A	MAB764	AD570
J-19-0-2	0138	12-24	10-6-85	W/B/RM-A	MAB763	AD569
J-19-0-3	0139	24-36	10-6-85	W/B/RM-A	MAB762	AD568
K-12-0-1	0121	0-12	10-6-85	W/B/RM-A	MAB773	AD579
K-12-0-2	0122	12-24	10-6-85	W/B/RM-A	MAB772	AD578
K-12-0-3	0123	24-36	10-6-85	W/B/RM-A	MAB771	AD577
K-13-0-1	0124	0-12	10-6-85	W/B/RM-A	MAB770	AD576
K-13-0-2	0125	12-24	10-6-85	W/B/RM-A	MAB769	AD575
K-13-0-3	0126	24-36	10-6-85	W/B/RM-A	MAB768	AD574
K-14-0-1	0127	0-12	10-6-85	W/B/RM-C	MAB786	AD592
K-14-0-2	0128	12-24	10-6-85	W/B	-	-
K-14-0-3	0129	24-36	10-6-85	W/B	-	-
K-15-0-1	0133	0-12	10-6-85	W/B/RM-C	MAB785	AD591
K-15-0-2	0134	12-24	10-6-85	W/B	-	-
K-16-0-1	9969	0-12	9-16-85	W/B/RM-C	MAB794	AD600
K-16-0-2	9970	12-24	9-16-85	W/B	-	-
K-16-0-3	9971	24-36	9-16-85	W/B	-	-
K-17-0-1	0135	0-12	10-6-85	W/B/RM-C	MAB784	AD590
K-17-0-2	0136	12-24	10-6-85	W/B	-	-
K-18-1-1	9972	0-12	9-16-85	W/B/RM-Y	MAB759	AD565
K-18-1-2	9973	12-24	9-16-85	W/B/RM-Y	MAB758	AD564
K-18-1-3	9974	24-36	9-16-85	W/B/RM-Y	MAB757	AD563
K-18-2-1	9975	0-12	9-16-85	W/B	-	-
K-18-2-2	9976	12-24	9-16-85	W/B	-	-
K-18-2-3	9977	24-36	9-16-85	W/B	-	-
K-19-0-1	0140	0-12	10-6-85	W/B/RM-C	MAB783	AD589
K-19-0-2	0141	12-24	10-6-85	W/B	-	-
K-19-0- 2.5	0142	24-36	10-6-85	W/B	-	-
K-20-0-1	0145	0-12	10-6-85	W/B/RM-C	MAB780	AD586
K-20-2-1	0151	0-12	10-6-85	W/B	-	-
K-20-2-2	0152	12-24	10-6-85	W/B	-	-
K-20-2-3	0153	24-36	10-6-85	W/B	-	-
L-5-0-1	0109	0-12	10-5-85	W/B/RM-C	MAB789	AD595

Grid No. ID **	Lab ID	Stratum (inches)	Date Sampled	C of C * History	Inorganic Sample No.	Organic Sample No.
L-5-0-2	0110	12-24	10-5-85	W/B	-	-
L-5-0-3	0111	24-36	10-5-85	W/B	-	-
L-14-0-1	0130	0-12	10-6-85	W/B/RM-A	MAB767	AD573
L-14-0-2	0131	12-24	10-6-85	W/B/RM-A	MAB766	AD572
L-14-0-2.5	0132	24-30	10-6-85	W/B/RM-A	MAB765	AD571
L-19-0-1	0143	0-12	10-6-85	W/B/RM-C	MAB782	AD588
L-19-0-2	0144	12-24	10-6-85	W/B/RM-C	MAB781	AD587
L-20-0-1	9978	0-12	9-16-85	W/B/RM-C	MAB793	AD599
L-20-0-2	9979	12-24	9-16-85	W/B	-	-
L-20-0-3	9980	24-36	9-16-85	W/B	-	-
L-23-0-1	9981	0-12	9-16-85	W/B/RM-Y	MAB756	AD562
L-23-0-2	9982	12-24	9-16-85	W/B/RM-Y	MAB755	AD561
L-23-0-3	9983	24-36	9-16-85	W/B/RM-Y	MAB754	AD560
L-25-1-1	9984	0-12	9-15-85	W/B/RM-C	MAB792	AD598
L-25-1-2	9985	12-24	9-15-85	W/B	-	-
L-25-1-3	9986	24-36	9-15-85	W/B	-	-
L-25-1-1	9987	0-12	9-15-85	W/B	-	-
L-25-2-2	9988	12-24	9-15-85	W/B	-	-
L-25-2-3	9989	24-36	9-15-85	W/B	-	-
L-27-0-1	9990	0-12	9-15-85	W/B/RM-Y	MAB753	AD559
L-27-0-2	9991	12-24	9-15-85	W/B/RM-Y	MAB752	AD558
L-27-0-3	9992	24-36	9-15-85	W/B/RM-Y	MAB751	AD557
M-5-0-1	0112	0-12	10-5-85	W/B/RM-A	MAB776	AD582
M-5-0-2	0113	12-24	10-5-85	W/B/RM-A	MAB775	AD581
M-5-0-3	0114	24-36	10-5-85	W/B/RM-A	MAB774	AD580
M-8-0-1	0146	0-12	10-5-85	W/B/RM-A	AMB761	AD567
M-8-0-2	0147	12-24	10-5-85	W/B/RM-A	MAB760	AD566
M-22-0-1	9993	0-12	9-16-85	W/B/RM-Y	MAB750	AD556
M-22-0-2	9994	12-24	9-16-85	W/B/RM-C	MAB791	AD597
M-22-0-3	9995	24-36	9-16-85	W/B	-	-
M-26-0-1	0103	0-12	9-15-85	W/B/RM-C	MAB790	AD596
M-26-0-2	0104	12-24	9-15-85	W/B	-	-
M-26-0-3	0105	24-36	9-15-85	W/B	-	-
.-6-0-1	0115	0-12	10-5-85	W/B/RM-C	MAB788	AD594

Grid No. ID **	Lab ID	Stratum (inches)	Date Sampled	C of C * History	Inorganic Sample No.	Organic Sample No.
N-6-0-2	0116	12-24	10-5-85	W/B	-	-
N-6-0-3	0117	24-36	10-5-85	W/B	-	-
N-7-1-1	0118	0-12	10-5-85	W/B/RM-C	MAB787	AD593
N-7-1-2	0119	12-24	10-5-85	W/B	-	-
N-7-1-2.4	0120	12-29	10-5-85	W/B	-	-
N-7-2-1	0148	0-12	10-5-85	W/B	-	-
N-7-2-2	0149	12-24	10-5-85	W/B	-	-
N-7-2- 2.4	0150	24-36	10-5-85	W/B	-	-
N-8-0-1	0106	0-12	10-5-85	W/B/RM-A	MAB779	AD585
N-8-0-2	0107	12-24	10-5-85	W/B/RM-A	MAB778	AD584
N-8-0-3	0108	24-36	10-5-85	W/B/RM-A	MAB777	AD583

* C of C = Chain-of-Custody

B = WQL in Barre, MA

W = Waltham, MA

RM = Rocky Mountain Analytical Lab in Arvada, CO

A = Aquatec in Burlington, VT

C = Cambridge Analytical in Boston, MA

Y = York Labs in Monroe, CT

"1"= change in custody

Example:

W/B/RM-A indicates samples were transferred from Waltham to Barre whereupon sample was split with portions being sent to Rocky Mountain Analytical and Aquatec.

** Grid ID No:

The letters J-N are the east-west ordinates of the arbitrary grid system. The numbers 5-26 immediately following the letters are the north-south ordinates of the arbitrary grid system. The second number (0,1, or 2) is the replicate number of the sample, i.e., 0 indicates a single sample only, 1 is the first replicate, etc. The final number is roughly the lowest depth of each one-foot segment; e.g., 3 would be the 2-3 foot segment (24-36 in).

Example: N-7-2-1 would be the second replicate from grid coordinates N-7 whose segment depth was 0-1 feet (0-12").

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our 35th year

C-34-1-6-292

January 16, 1986

Project Number 5725.05

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
60 Westview Street
Lexington, Massachusetts 02173

Subject: New Bedford Inorganic Data Validation, Soil Samples MA8750-MA8769, Case No. 5058, Rocky Mountain Analytical

Dear Mr. Taylor:

The inorganic analytical data for samples MA8750 through MA8769 have been reviewed to assure the validity of the data. A Level I data validation was completed considering the following parameters:

- holding times
- initial and continuing calibration verification
- blanks
- ICP interference checks
- laboratory control standards
- spike sample recovery
- duplicate sample analysis

The samples were analyzed within holding times required for metal analysis.

With the exception of tin, initial calibration verification and continuing calibration verification analytical procedures and results conform to contract requirements. All three continuing calibration verification results for tin were below the 90% contract requirement (86%, 84% and 83%). However, due to the close proximity of the calibration results to the 90% contract requirement, the satisfactory initial calibration verification result, and the nature of the tin levels in the data package, no action is taken.

ICP interference check sample and laboratory control sample procedures and analyses conform to contract requirements.

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
January 16, 1986 - Page Two

Furnace duplicates and spikes met the contract criteria. ICP duplicates for aluminum and copper were noted by the lab as being outside the control limits. The lab erroneously used the criteria for >5 times CRDL, when in fact the criteria for sample values <5 times the CRDL applies. The aluminum and copper duplicate results are therefore satisfactory. Al is OK EL

There were no field blanks or field duplicates taken with this set of soil samples.

ICP spike recovery met contract requirements for all elements except chromium and copper (both at 126%). Chromium and copper analytical results are therefore estimated (J).

ICP quality control serial dilution procedures and results met contract requirements with the exception of sodium. Sodium results are therefore flagged as estimated (J).

The review of the data associated with soil samples MA8750 through MA8769 from Case No. 5058 indicates that the data presented in Table A should be accepted for use.

Very truly yours,

Patrick K. Radigan

Approved for submission:

George J. Latulippe
Region I Manager of Projects

PKR/cts
Enclosures

cc: Nancy Piligian

I acknowledge receipt and approval of the NUS/REMPO Level I validation of the inorganic data for samples MA8750 through MA8769 from Case 5058 analyzed by Rocky Mountain Analytical Lab.

Deputy Project Officer - QA

Sample Numbers, DMS

Laboratory Name: Rocky Mountain Analytical	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA
Traffic Report No.:	MAB 750D	MAB 750	MAB 750D	MAB 751	MAB 752	MAB 753	MAB 754	MAB 755	MAB 756	MAB 757
Date Sample Received:		10/4/85		10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85
Date Extracted/Prepared:										
Date Analyzed:	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85
Conc/Dil Factor:	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500
CAS Number / Percent Moisture (Circle One)	~~MAB 750D MB/KG~~									
% Solids		23%		16%	16%	31%	83%	61%	28%	
Aluminum		3270		6770	6920	2790	2550	3010	4100	
Antimony										
Arsenic		[11]				[5.2]			[11]	
Barium		[36]							[26]	
Beryllium										
Cadmium										
Calcium		[3390]		[5210]	4660	[2290]	[394]	[509]	[3430]	[55]
Chromium		36 J		[18] J	[22] J	116 J	[46] J	8.1 J	199 J	6.2 J
Cobalt										
Copper		155 J		[35] J	[21] J	505 J	[3.2] J	30 J	482	[12] J
Iron		4010		5990	6230	3730	3096	4550	10400	
Lead		167		24	34	128	4.8	19	215	
Magnesium		[5360]		[9340]	[9620]	[3670]	[105]	[1070]	[4910]	[1]
Manganese		59		58	68	34	23	34	112	
Mercury		[0.43] CV			0.87 CV	0.48 CV			0.43	
Nickel						[26]		[19]	[28]	[4]
Potassium										
Selenium										
Silver										
Sodium		33000 J		50400 J	53100 J	19300 J	[1790] J	[3100] J	22500 J	[2230] J
Thallium										
Tin										
Vanadium		[48]		[41]	[34]	[28]	[6.6]	[12]	[35]	
Zinc		45		152	141	100	24	32	62	[93]
Other:									112	34
Comments:										

Sample Numbers, IHIS

Laboratory Name: Rocky Mountain Analytical

Traffic Report No.:	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA	RMA
	MAB 758	MAB 759	MAB 760	MAB 761	MAB 762	MAB 763	MAB 764	MAB 765	MAB 766	MAB 767
Date Sample Received:	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85	10/4/85
Date Extracted/Prepared:										
Date Analyzed:	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85	11/4/85
Conc/Dil Factor:	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500	1:500
CAS Number / Percent Moisture	~~mg/L or mg/Kg~~ N/A (Circle One)									
% Solids	15%	55%	37%	25%	80%	76%	72%	86%	84%	85%
Aluminum	1720	4850	2640	5900	3130	4250	1020	4800	4550	[illegible]
Antimony										
Arsenic	[2.5]	[5.1]				[5.8]		[2.8]	[3.6]	[2.5]
Barium		[19]						[13]	[13]	[16]
Beryllium										
Cadmium										
Calcium	[761]	[1620]	[1650]	[3110]	[399]	[548]	[867]	[319]	[300]	[385]
Chromium	9.2 J	63 J	[6.6] J	[14] J	7 J	11 J	23 J	[4.7] J	[5.3] J	7.5 J
Cobalt										
Copper	43 J	172 J	[15] J	76 J	[12] J	33 J	108 J	[12] J	[9.5] J	[11]
Iron	6260	10300	1470	3960	4860	7320	6930	6130	5330	[illegible]
Lead	27	165	7.6	72	6.9	16	40	13	10	[illegible]
Magnesium	[1140]	[2400]	[2620]	[5980]	[912]	[1320]	[1460]	[652]	[592]	[illegible]
Manganese	61	82	[16]	[30]	34	53	74	35	29	[illegible]
Mercury		0.27 CV					[0.085] CV			
Nickel	[9.2]	[17]			[59]	[7.1]	[8.6]			[4.9]
Potassium										
Selenium										
Silver										
Sodium	[3280] J	8240 J	14,100 J	33,000 J	3130 J	[2860] J		[550] J	[712] J	[608] J
Thallium										
Tin		[19]								
Vanadium	[16]	[34]	[5.2]	[17]	[83]	[14]	[18]	[10]	[8.3]	[12]
Zinc	53	136	49	102	46	56	57	28	32	27
Others:										
Comments:										

Sample Numbers, HHS

Laboratory Name: Rocky Mountain Analytical	KMA	RMA	KMA
Traffic Report No.:	MAB 768	MAB 767	MAB 799
Date Sample Received:	10/4/85	10/4/85	
Date Extracted/Prepared:	11500	11500	110
Date Analyzed:	11/4/85	11/4/85	11/4/85
Conc/Dil Factor:			
CAS Number Percent Moisture	~~µg/L or µg/Kg~~ (Circle One)		
% Solids	19%	24%	
Aluminum	13900	9780	
Antimony			
Arsenic		[8.3]	
Barium			
Beryllium			
Cadmium			
Calcium	[3950]	[2920]	
Chromium	40 J	39 J	
Cobalt			
Copper	79 J	94 J	
Iron	28100	23300	
Lead	145	134	
Magnesium	[9620]	[6910]	
Manganese	190	135	
Mercury		0.63 CV	
Nickel	[20]	[19]	
Potassium			
Selenium			
Silver			
Sodium	32100 J	25800 J	
Thallium			
Tin			
Vanadium	[55]	[39]	
Zinc	170	243	
Other:			
Comments:			

NUS CORPORATION

Parx West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

C-34-2-6-31

February 10, 1986

Project Number S725.1009

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
Region I
60 Westview Street
Lexington, Massachusetts 02173

Subject: Inorganic Data Validation, New Bedford Harbor
Case Number 5058; Samples MAB790 through MAB794
Analyzed by Rocky Mountain Analytical

Dear Mr. Taylor:

Inorganic data for five (5) medium-level soil samples from New Bedford Harbor analyzed by Rocky Mountain Analytical, have been reviewed by a Level I data validation. The data were evaluated with regard to the following parameters:

- sample holding times
- instrument calibration
- blanks
- ICP interference check samples
- duplicate sample analysis
- spiked sample analysis

All analyses were performemd within contract specified holding times.

All initial and continuing calibration criteria were met.

All blanks analyzed met contract specifications.

No abberations occurred in the analysis of ICP interference check samples.

Sample number MAB790 served as the duplicate sample. Only one (1) out of the twenty-four (24) parameters analyzed yielded duplicate results having an RPD outside of acceptable limits. Lead's RPD of 70% clearly exceeded the ~~20%~~ 35% acceptability range.

Sample MAB790 also served as the matrix spike sample for the set of analyses. Two analytes - lead and tin - did not meet matrix spike criteria. Tin yielded a percent recovery value of 71% which is just outside of the 75-125% acceptability range. The %R for lead was 172%.

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
February 10, 1986 - Page Two

Based upon duplicate analysis results, matrix spike recoveries and serial dilution results, all quantifications for lead have been flagged as estimated (J) due to the occurrence of matrix interference. Values reported for tin have also been flagged as estimated (J) as the results relevant to this sample's analysis indicate that the detection limits indicated for tin may be affected. However, it is not felt that the detectibility of tin has been grossly impacted. [redacted]

Overall review of the data for these samples from Case Number 5058 leads to the recommendation that the data be accepted as noted. The validated results discussed are presented in the attached Table I.

Very truly yours,

Debra A. Scheib
Chemist

Approved for submission:

George J. Laculiope
Region I Manager of Projects

DAS/cts
Enclosures

cc: Nancy Piligian

5058 RM AL

I hereby acknowledge receipt and approval of the NUS/REMPO Level I data validation for New Bedford Harbor, Case Number 5058, Samples MA8790 through MA8794, analyzed by Rocky Mountain Analytical.

Deputy Project Officer - QA

TABLE I

DATA SUMMARY

Case No. 5058

Laboratory ROCKY MOUNTAIN ANALYTICAL Matrix SOIL-MEDIUM Units mg/Kg dry weight

EPA ID #	MAB790	MAB791	MAB792	MAB793	MAB794									COMMENTS
Lab ID														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	2490	3390	4470	4110	2720									
Antimony	17 U	39 U	39 U	51 U	19 U									
Arsenic	[0.9] F	14 U	[16]	[7.5]	[0.1]									
Barium	9 U	18 U	[136]	27 U	7.6 U									
Beryllium	0.38 U	0.59 U	0.63 U	0.83 U	0.24 U									
Cadmium	2.8 U	5.4 U	6.3 U	6.3 U	2.4 U									
Calcium	[906]	[1230]	[4230]	[2890]	[453]									
Chromium	9	[8.3]	38	[16]	[5]									
Cobalt	3.5 U	6.8 U	7.8 U	10 U	2.9 U									
Copper	39	[37]	358	128	23									
Iron	2920	3070	10500	3640	5950									
Lead	J 6.7	J 43	J 316	J 154	J 16									
Magnesium	[1020]	[3800]	[1500]	[5000]	[457]									
Manganese	18	[19]	51	[21]	28									
Mercury	0.069 U	0.14 U	[0.23]	0.87	0.059 U									
Nickel	4.9 U	9.5 U	[33]	[18]	[6.4]									
Potassium	1510 U	2930 U	3370 U	4620 U	1210 U									
Selenium	1.4 U	2.7 U	7.8 U	4.1 U	1.2 U									
Silver	2.1 U	4.1 U	4.7 U	6.3 U	1.7 U									
Sodium	[2740]	21500	16500	28700	[640]									
Thallium	1.4 U	2.7 U	3.1 U	4.2 U	1.2 U									
Tin	J [13]	J 22 U	J 25 U	J 33 U	J 7.4 U									
Vanadium	[22]	[13]	90	[41]	[7.9]									
Zinc	71	46	79	199	29									
Cyanide	NR	NR	NR	NR	NR									
% Solids	72	37	32	24	85									

page one of one

NUS CORPORATION

Park West Two
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412-788-1080

C-34-2-6-30

February 10, 1986

Project Number S725.1009

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
Region I
60 Westview Street
Lexington, Massachusetts 02173

Subject: Inorganic Data Validation, New Bedford Harbor
Case Number 5058; Samples MAB770 through MAB789
Analyzed by Rocky Mountain Analytical

Dear Mr. Taylor:

Inorganic data for twenty (20) medium-level soil samples from New Bedford Harbor analyzed by Rocky Mountain Analytical, have been reviewed by a Level I data validation. The data were evaluated with regard to the following parameters:

- sample holding times
- instrument calibration
- blanks
- ICP interference check samples
- duplicate sample analysis
- spiked sample analysis

All analyses were performed within contract specified holding times.

All initial and continuing calibration criteria were met.

All blanks analyzed met contract specifications.

No abberations occurred in the analysis of ICP interference check samples.

Sample number MA8770 served as the duplicate sample analyzed for this set of twenty medium-level soils.

Six (6) out of the twenty-four (24) parameters analyzed yielded duplicate results having RPD's outside of acceptable limits. The analytes which did not meet contract specifications are aluminum, chromium, copper, iron, lead and zinc.

The RPD calculated for aluminum in the duplicate run was 21%. This value falls just outside of the ±20% acceptability range.

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Mr. Edward L. Taylor
U.S. Environmental Protection Agency
February 10, 1986 - Page Two

Iron yielded a calculated duplicate RPD of 35%. Due to the high concentration of iron in this sample, it is felt that the unacceptable RPD is attributable to non-homogeneous dispersion.

The remaining four unacceptable analytes - chromium, copper, lead and zinc yielded duplicate RPD values of 52%, 42%, 47% and 48% respectively. In lieu of the poor matrix spike recoveries also generated by these parameters, it is felt that the impression is attributable to a matrix effect.

Matrix spike criteria were not met for chromium, copper, lead, mercury, selenium and zinc.

Quantifications reported for mercury have been flagged as estimated (J). The %R for mercury was 146% and selenium yielded 66%R. It is felt, however, that these values primarily illustrate the impact upon statistical calculations made when such small quantities (0.5 mg/kg and 5 mg/kg respectively) are used for spiking.

None of the samples analyzed reported values for selenium, and it is felt that selenium's unacceptable spike sample recovery does not significantly impact this parameter's detection limit. UJ all nondetects - EG

Spiked sample recoveries for copper are exceedingly poor. Because of the poor results demonstrated in the analysis of this parameter, all values reported for copper have been flagged as rejected (R). I would report CU to J (pre-ww) EG

It is the opinion of this reviewer that the unacceptable spiked sample recoveries for lead, chromium and zinc are attributable to matrix interferences. Consequently, quantifications reported for these three parameters (lead, chromium and zinc) have been flagged as estimated (J).

Please see the attached sheet which depicts the spiked sample recovery results discussed.

Overall review of the data for these samples from Case Number 5058 leads to the recommendation that the data be accepted as noted. The validated results discussed are presented in the attached Table I.

Very truly yours,

Debra A. Scheib
Chemist

Approved for submission:

George J. Latulippe
Region I Manager of Projects

DAS/cts
Enclosure

cc: Nancy Piligian

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
February 10, 1986 - Page Three

I acknowledge receipt and approval of the NUS/REMPO Level I data validation for New Bedford Harbor, Case No. 5058, Samples MAB770 through MAB789, analyzed by Rocky Mountain Analytical.

Deputy Project Officer - QA

(1)

TABLE I
DATA SUMMARY

NEW BEDFORD

Case No. 5059

Laboratory ROCKY MOUNTAIN ANALYT. Matrix SOILS - MEP. Units mg/Kg dry weight

	LPA ID #	MAB 770	MAB 771	MAB 772	MAB 773	MAB 774	MAB 775	MAB 776	MAB 777	MAB 778	MAB 779	MAB 780	MAB 781	MAB 782	COMMENTS
	Lab I.D.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Aluminum	7200	4000	5000	3200	11100	7990	6510	11300	10000	15600	1760	1080	2120	
	Antimony														
	Arsenic	[7.5]	[0.6]					[4.1]		4.1	[13]	[3.3]	[1.4]		
	Barium	[69]			[41]			[42]		[27]	[31]	[8.8]			
	Beryllium														
	Cadmium	8.2													
	Calcium	[2099]	[2620]	[2720]	[2580]	[2410]	[2710]	[2000]	[3040]	[2700]	[3430]	[484]	[156]	[399]	
X	Chromium	227	31	[18]	53	28	[19]	41	34	49	117	111	[3.3]	[5.6]	
	Cobalt									[17]	[12]				
	Copper	557	[28]	[25]	287	[25]	[54]	306	70	343	333	185	[3.4]	[9.2]	
	Iron	12700	31400	7610	6560	37000	10600	9700	23600	28800	26100	5710	4810	4560	
X	Lead	435	14	16	162	17	55	228	167	440	277	95	5.8	33	
	Magnesium	[4090]	[7570]	[5830]	[5440]	[6140]	[5280]	[3960]	[6000]	[5730]	9740	[985]	[568]	[1300]	
	Manganese	84	147	46	64	115	79	94	145	172	352	54	24	26	
X	Mercury	0.83			1.14		[0.3]	1.56	0.57	1.44	0.62	[0.093]			
	Nickel	[27]	[23]		[40]	[18]		[17]	[22]	[32]	[33]	[12]		[4.7]	
	Potassium														
	Selenium														
	Silver														
	Sodium	14800	20700	32000	26000	20200	19400	10300	[9390]	[7210]	[5850]	[2370]		[816]	
	Thallium														
	Tin	[37]			[63]			64		[50]	[33]	22			
	Vanadium	[97]	[37]	[29]	[55]	[43]	[45]	[19]	[44]	[39]	[66]	[19]	[8.3]	[10]	
X	Zinc	508	63	52	395	118	74	109	237	2820	391	95	32	22	
	Cyanide														
	% Solids	36	22	18	21	20	20	32	21	27	26	91	86	82	

J = estimated

R = rejected

page one of two

72W RADFORD

TABLE I
DATA SUMMARY

Case No. [illegible]

Laboratory ROCKY MOUNTAIN ANALYT Matrix SOILS - MEDIUM Units mg / Kg dry weight

EPA TR #	MAB78[illegible]	MAB784	MAB785	[illegible]	[illegible]	[illegible]	MAB789							COMMENTS
Lab I.D.														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Aluminum	5080	5290	2480	6130	5900	6050	13 300							
Antimony														
Arsenic	[8.8]	[2.3]	[1.2]				18							
Barium	[26]			[63]			[44]							
Beryllium														
Cadmium														
Calcium	[1590]	[350]	[152]	[1800]	[2900]	[2530]	[2800]							
Chromium	J25	J15	J[4.9]	J59	J[19]	J[22]	J46							
Cobalt	[6.1]													
Copper	J84	J[14]	J[8.1]	J338	J[20]	J[119]	J167							
Iron	7560	14500	5660	12100	4920	11100	16100							
Lead	75	J14	J4.8	273	203	153	375							
Magnesium	[2720]	[771]	[571]	[4040]	[3530]	[4130]	[5220]							
Manganese	49	92	58	74	35	63	161							
Mercury	J0.24			J0.76			J1.57							
Nickel	[19]	[11]		[16]			[20]							
Potassium														
Selenium														
Silver														
Sodium	9690	[1770]		15200	[4550]	18000	[27[illegible]							
Thallium														
Tin				[41]	[39]									
Vanadium	[34]	[11]	[11]	[28]	[23]	[32]	[45]							
Zinc	J70	J124	J16	J596	J117	J79	J1290							
Cyanide														
% Solids	49	87	92	33	22	19	30							

page two of two

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Park West Two
Cliff Mine Road
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412-788-1080

C-34-4-6-474

April 28, 1986

Project Number S725.05

Dr. Thomas M. Spittler
U.S. Environmental Protection Agency
Region I
60 Westview Street
Lexington, Massachusetts 02173

Subject: New Bedford Organic Data Validation
Case Number 5058
York Laboratories

Dear Dr. Spittler:

Data for ten (10) soil sample analyses (SMO Numbers AD556 through AD565) Case Number 5058 - New Bedford; have been reviewed by a Level I data validation. The data, produced by York Laboratories, were evaluated with regard to the following parameters:

- holding times
- data completeness
- spectral performance
- instrument calibration
- laboratory blank analysis
- laboratory duplicate
- surrogate spikes
- matrix spikes
- pesticide standards check

Although the ten (10) soil samples presented in this data package were shipped as medium-level samples, all analyses were conducted using low-level analytical techniques.

Several problems in communications and shipment occurred in the receipt and processing of these samples. A copy of York Laboratories' case narrative (which documents these problems) has been appended. The problems that occurred are also described briefly below:

a. U.S. Army Corps of Engineers' chain-of-custody sheets accompanied the ten soil samples when delivered for analysis. No SMO traffic reports were submitted at that time. SMO traffic reports arrived at the laboratory three days later (on October 18, 1985).

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b. Upon receipt, the SMO traffic reports indicated that only the analyses of extractable compounds was required. However, because of prior communications with Leslie Braun, full HSL organics analyses had already been initiated. Subsequent communication with Leslie Braun resulted in the continuation of full HSL organic analyses.

c. The samples received were not iced.

d. The chain-of-custody seal on the samples' shipping container was not intact.

e. Various jars of sample submitted were not sealed tightly.

The data package, forwarded in two installments, was complete in content except for the omission of volatile matrix spike data. (Volatile MSD data was present.)

York Laboratories performed all analyses promptly upon receipt of the samples and so, no analytical holding times were exceeded. However users of this data should bear in mind that approximately one month lapsed between the date of sampling and shipment for analysis. Also, conditions of the samples' storage are unknown and the samples were not iced for shipment nor were chain-of-custody seals intact. Furthermore, several individual sample containers were not sealed tightly. It is difficult to judge what impact these occurrences had upon the integrity of each analytical fraction.

Spectral performance for each fraction was satisfactory and no abberations occurred in the initial and continuing instrument calibration.

Each fraction is discussed separately; the following problems were detected:

<u>Volatile Fraction</u>

Blanks analyzed for this fraction contained several contaminants. Four parameters, methylene chloride, acetone, chloroform and 2-butanone are of major concern. An average of 4 ug/kg methylene chloride and 22 ug/kg acetone was found in the blanks. Values reported for these two parameters up to ten times their average occurrence (i.e., up to 40 ug/kg methylene chloride and 220 ug/kg acetone) have been rejected (R).

The average amount of chloroform contamination found in these blanks was 2 ug/kgk. An average of 6 ug/kg 2-butanone was also found. Reported values less than five times the average amount of contaminant have been rejected (R).

All of the forty-five (45) compounds spiked as surrogates fell within the accepted limits.

All five of the matrix spiked parameters yielded recoveries within the accepted range. Matrix spike duplicate recoveries were also acceptable.

It is recommended that the volatile fraction be accepted as noted.

Semivolatile Fraction

The semivolatile method blank run for this fraction contained the following:

36 ug/kg	phenanthrene
61 ug/kg	fluoranthene
39 ug/kg	pyrene
150 ug/kg	bis(2-ethylhexyl)phthalate
11 ug/kg	di-n-octylphthalate
18 ug/kg	benzo(b)fluoranthene
160 ug/kg	benzo(a)fluoranthene

All contaminants were well below the criteria for an acceptable method blank.

Only one of the seventy-eight surrogate compounds spiked fell outside of acceptable limits (2-fluorbiphenyl sample AD564).

All eleven of the base neutral/acid extractable matrix spike compounds yielded recoveries with the accepted ranges. All matrix spike duplicate recovery criteria were also met.

It is recommended that the data for this fraction be accepted as submitted.

Pesticide/PCB Fraction

The blank generated for this fraction was acceptable.

The beta BHC value reported for sample AD561 has been flagged as estimated (J) due to a % difference in calibration which exceeded the 15% acceptable limit. Copies of the continuing calibration worksheets have been appended.

Two out of thirteen surrogate compounds spiked for this fraction yielded recoveries outside of acceptpable limits. (The unacceptable recoveries occurred in samples AD559 and AD563.)

Dr. Thomas M. Spittler
U.S. Environmental Protection Agency
April 28, 1986 - Page Four

No matrix spike data could be generated for this fraction due to substantial PCB interference.

Data for this fraction should be accepted as noted.

The validation results discussed are presented in the attached Table I.

Sincerely yours,

Debra A. Scheib
Chemist

Approved for submission:

George J. Latulippe
Region I Manager of Projects

DAS/cts
Enclosures

cc: Nancy Piligian

I hereby acknowledge receipt and approval of the NUS/REMPO Level I data validation for New Bedford, Case No. 5058, SMO Numbers AD556 through AD565, analyzed by York Laboratories.

Deputy Project Officer - QA

bcc: J. Yeasted
R. Smith
P. Byrne
E. Denner

Case No:	Sample Number (MUS):								
5058	Traffic Report Number:	AD556	AD557	AD558	AD559	AD560	AD561	AD562	AD563
	Date Sampled:	9-16-85	9-15-85	9-15-85	9-15-85	9-16-85	9-16-85	9-16-85	9-16-85
	Date Sample Received:	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85
Site Name:	Date Extracted/Prepared:	10-24-85	10-24-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85
	Date Analyzed:	10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-24-85	10-25-85
	Conc/Dil Factor:	1	1	1	1	1	1	20	1
	Percent Moisture:	79.15	81.35	84.51	78.41	17.22	19.46	75.56	14.49
	Units: ug/l or ug/kg Notes:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg

CAS Number	Chemical(CRDL)														
		BHDL				BHDL				BHDL					
	Pesticides/PCBs														
319-84-6	alpha-BHC (0.05/8.0)										☑	3.5			
319-85-7	beta-BHC (0.05/8.0)														
319-86-8	delta-BHC (0.05/8.0)														
58-89-9	gamma-BHC (0.05/8.0)														
76-44-8	heptachlor (0.05/8.0)														
1024-57-3	heptachlor epoxide (0.05/8.0)														
50-29-3	4,4'-DDT (0.10/16.0)														
74-54-8	4,4'-DDD (0.10/16.0)														
72-55-9	4,4'-DDE (0.10/16.0)														
72-20-8	endrin (0.10/16.0)														
53494-70-5	endrin ketone (0.10/16.0)														
7421-93-4	endrin aldehyde (0.10/16.0)														
959-98-8	endosulfan I (0.05/8.0)														
33213-65-9	endosulfan II (0.10/16.0)														
1031-07-8	endosulfan sulfate (0.10/16.0)														
309-99-2	aldrin (0.05/8.0)														
60-57-1	dieldrin (0.10/16.0)														
57-74-9	chlordane (0.5/80.0)														
72-43-5	methoxychlor (0.5/80.0)														
8001-35-2	toxaphene (1.0/80.0)														
12674-11-2	Arochlor 1016 (0.5/80.0)														
11104-28-2	Arochlor 1221 (0.5/80.0)														
11141-16-5	Arochlor 1232 (0.5/80.0)														
53469-21-9	Arochlor 1242 (0.5/80.0)														
12672-29-6	Arochlor 1248 (0.5/80.0)						5800C						1800C		
11097-69-1	Arochlor 1254 (1.0/160.0)			390			24000C						49000C		74
11096-82-5	Arochlor 1260 (1.0/160.0)														

SMO Case No. 9285F

SITE Alternaseep

Sample Numbers, NUS		21.2 %M	24.5 %M									
Laboratory Name /No.	York Laboratories											
Traffic Report No.:		AD524	AD585									
Date Sample Received:		10/15/85	10/17/85									
Date Extracted/Prepared:		10/24/85	10/23/85									
Date Analyzed:		10/25/85	10/26/85									
Conc/Dil Factor:		1										
CAS Number	Percent Moisture	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg
319-84-6	Alpha-BHC (102P)											
319-85-7	Beta-BHC (103P)											
319-86-8	Delta-BHC (104P)											
58-89-9	Gamma-BHC (Lindane) (105P)											
76-44-8	Heptachlor (100P)											
309-99-2	Aldrin (89P)											
1024-57-3	Heptachlor Epoxide (101P)											
959-98-8	Endosulfan I (95P)											
60-57-1	Dieldrin (90P)											
72-55-9	4,4'-DDE (93P)											
72-20-8	Endrin (98P)											
33213-65-9	Endosulfan II (96P)											
74-54-8	4,4'-DDD (94P)											
7421-93-4	Endrin Aldehyde (99P)											
1031-07-8	Endosulfan Sulfate (97P)											
50-29-3	4,4'-DDT (92P)											
72-43-5	Methoxychlor											
53494-70-5	Endrin Ketone											
57-74-9	Chlordane (91P)											
8001-35-2	Toxaphene (113P)											
12674-11-2	Arochlor-1016 (112P)											
11104-28-2	Aroclor-1221 (108P)											
11141-16-5	Aroclor-1232 (109P)											
53469-21-9	Arochlor-1242 (106P)											
12672-29-6	Arochlor-1248 (110P)	280	1600 C									
11097-69-1	Aroclor-1254 (107P)	640	4200 C									
11096-82-5	Aroclor-1260 (111P)											

DAS

NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

C-34-4-6-94

April 7, 1986

Project Number 5725.1009

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
60 Westview Street
Lexington, Massachusetts 02173

Subject: New Bedford Data Validation
Case Number 5058
Aquatec Environmental Services

Dear Mr. Taylor:

Data for twenty (20) soil sample analyses (SMO Numbers AD576 through AD585) Case Number 5058 - New Bedford; have been review by a Level I data validation. The data, produced by Aquatec Environmental Services, were evaluated with regard to the following parameters:

- holding times
- data completeness
- spectral performance
- instrument calibration
- laboratory blank analysis
- laboratory duplicates
- surrogate spikes
- matrix spikes
- pesticide standards check

Originally shipped and denoted as medium-level samples, these twenty samples were screened and found to be low in concentrations. Consequently, all twenty samples were analyzed as low-level samples.

An erroneous cover letter accompanied this set of samples. Laboratory assignment numbers mentioned in the cover letter did not agree with the laboratory assignment numbers reported on the analytical report forms. The laboratory assignment numbers as they appear throughout the data package are consistent. No action is recommended. The data package was complete as received.

A Halliburton Company

Discrepancies occurred also in the recording of sample receipt dates. This problem is addressed and documented in the case narrative. The holding times for sample analyses have not been exceeded as an extension was granted by the Project Officer. This problem is also addressed and documented in the case narrative.

Spectral performance for each fraction was satisfactory and no problems occurred during the initial or continuing instrument calibrations.

Each fraction of the twenty full organics analyses is discussed separately. The following problems were detected:

Volatile Fraction

An average of 7 ug/kg methylene chloride and 14 ug/kg acetone was found in the volatile method blanks. Consequently, all values <70 ug/kg methylene chloride and 140 ug/kg acetone have been rejected (R). The rejection limit is ten times the average amount of contaminant found.

None of the ninety-three (0 out of 93) surrogate compounds spiked were beyond acceptance limits. All ten of the matrix spike recoveries were also within acceptable limits. The volatile fraction should be accepted as noted.

Semivolatile Fraction

Quantities of N-nitrosodiphenylamine, di-n-butylphthalate and bis(2-ethylhexyl)phthalate were found in the method blanks analyzed with this set of samples. All values <1460 ug/kg N-nitrosodiphenylamine, ≤435 ug/kgk di-n-butylphthalate and ≤8450 ug/kg bis(2-ethylhexyl)phthalate have been flagged as rejected (R).

All of the 150 surrogate compound spike recoveries are acceptable. Three of the twenty-two matrix compounds spiked for this fraction yielded recoveries outside of acceptable limits.

The semivolatile fraction should be accepted as noted.

Pesticide/PCB Fraction

Sample number AD577 was reanalyzed due to previous clean-up problems which interfered with the original analysis of this sample.

Mr. Edward L. Taylor
U.S. Environmental Protection Agency
April 7, 1986 - Page Three

300 ug/kg Aroclor 1254 was found in method blank B102385-1 analyzed on 11-12-85. Results reported for samples with values up to 3000 ug/kg Aroclor 1254 analyzed on November 12th have been rejected (R).

All surrogate spike recovery criteria for this fraction were met. Three of the twelve matrix spike compound recoveries, however, fell outside of the accepted range.

Pesticide and Aroclor 1254 data should be accepted as noted.

The validated results discussed are presented in the attached Table I.

Very truly yours,

for Debra A. Schelb / C.A. Kiely

Debra A. Schelb
Chemist

Approved for submission:

George J. Latulippe
Region I Manager of Projects

DAS/cts

cc: Nancy Piligian

bcc: Joe Yeasted
Art Olszewski
Earl Denner

I hereby acknowledge receipt and approval of the NUS/REMPO Level I data validation for New Bedford, Case Number 5058, samples AD576 through AD585, analyzed by Aquatec Environmental Services.

_____
Deputy Project Officer - QA

SMO Case No. _____

SITE _____

Sample numbers, NUS			✓									
Laboratory Name /No.					✓	✓	✓			✓	✓	
Traffic Report No.:		AD566	AD567	AD568	AD569	AD570	AD571	AD572	AD573	AD574	AD575	
Date Sample Received:		10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	
Date Extracted/Prepared:		10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-25-85	10-23-85	10-23-85	
Date Analyzed:		11-19-85	11-19-85	11-19-85	11-19-85	11-19-85	11-14-85	11-14-85	11-14-85	11-14-85	11-14-85	
Conc/Dil Factor:		0.0386 C	0.0085 C	0.1220 C	0.1213 C	0.0048 C	0.1201 C	.1230 C	.1205 C	0.0170 C	0.0051	
CAS Number	Percent Moisture	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/K
319-84-6	Alpha-BHC (102P)											
319-85-7	Beta-BHC (103P)											
319-86-8	Delta-BHC (104P)											
58-89-9	Gamma-BHC (Lindane) (105P)											
76-44-8	Heptachlor (100P)											
309-99-2	Aldrin (89P)											
1024-57-3	Heptachlor Epoxide (101P)											
959-98-8	Endosulfan I (95P)											
60-57-1	Dieldrin (90P)											
72-55-9	4,4'-DDE (93P)											
72-20-8	Endrin (98P)											
33213-65-9	Endosulfan II (96P)											
74-54-8	4,4'-DDD (94P)											
7421-93-4	Endrin Aldehyde (99P)											
1031-07-8	Endosulfan Sulfate (97P)											
50-29-3	4,4'-DDT (92P)											
72-43-5	Methoxychlor											
53494-70-5	Endrin Ketone											
57-74-9	Chlordane (91P)											
8001-35-2	Toxaphene (113P)											
12674-11-2	Arochlor-1016 (112P)											
11104-28-2	Aroclor-1221 (108P)											
11141-16-5	Aroclor-1232 (109P)											
53469-21-9	Arochlor-1242 (106P)									4800 C	12,000 C	
12672-29-6	Arochlor-1248 (110P)											
11097-69-1	Aroclor-1254 (107P)	[1,100]	16,000 C	1300 C	[370]	39000 C	[180]			4200 BC	8900 BC	
11096-82-5	Aroclor-1260 (111P)											
		LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	

SMO Case No.

SITE

Sample Numbers, MUS			95									
Laboratory Name /No.												
Traffic Report No.:		A0576	A0577	A0578	A0579	A0580	A0581	A0582	A0583	A0584	A0585	
Date Sample Received:		10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	10-15-85	
Date Extracted/Prepared:		10-23-85	10-15-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85	10-23-85	
Date Analyzed:		11-14-85	11-20-85	11-14-85	11-13-85	11-13-85	11-12-85	11-13-85	11-12-85	11-12-85	11-12-85	
Conc/Dil Factor:		0.0001	0.0217	0.0072	0.0013	0.0134	0.0191	0.0005	0.0030	0.0016	0.0004	
CAS Number	Percent Moisture	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/
319-84-6	Alpha-BHC (102P)											
319-85-7	Beta-BHC (103P)											
319-86-8	Delta-BHC (104P)											
58-89-9	Gamma-BHC (Lindane) (105P)											
76-44-8	Heptachlor (100P)											
309-99-2	Aldrin (89P)											
1024-57-3	Heptachlor Epoxide (101P)											
959-98-8	Endosulfan I (95P)											
60-57-1	Dieldrin (90P)											
72-55-9	4,4'-DDE (93P)											
72-20-8	Endrin (98P)											
33213-65-9	Endosulfan II (96P)											
72-54-8	4,4'-DDD (94P)											
7421-93-4	Endrin Aldehyde (99P)											
1031-07-8	Endosulfan Sulfate (97P)											
50-29-3	4,4'-DDT (92P)											
72-43-5	Methoxychlor											
53494-70-5	Endrin Ketone											
57-74-9	Chlordane (91P)											
8001-35-2	Toxaphene (113P)											
12674-11-2	Aroclor-1016 (112P)											
11104-28-2	Aroclor-1221 (108P)											
11141-16-5	Aroclor-1232 (109P)											
53469-21-9	Aroclor-1242 (106P)	700,000				[600]		[140,000]	28,000	[44,000]	[230,000]	
12672-29-6	Aroclor-1248 (110P)											
11097-69-1	Aroclor-1254 (107P)	1200,000	[840]	[1700]	[460]	[510]	[300]	[500]	17,000	[40,000]	[200,000]	
11096-82-5	Aroclor-1260 (111P)											
		LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW		

SMO Case No. _____

SITE _____

Sample Numbers, NUS		AD 586	AD 587	AD 588	AD 589	AD 590	AD 591	AD 592	AD 593	AD 594	AD 595
Laboratory Name /No.											
Traffic Report No.:											
Date Sample Received:											
Date Extracted/Prepared:		11-04-85	11-04-85	11-04-85	11-04-85	11-04-85	11-04-85	11-04-85	11-04-85	11-04-85	11-04-85
Date Analyzed:		11-13-85	11-13-85	11-13-85	11-13-85	11-13-85	11-13-85	11-14-85	11-14-85	11-14-85	11-04-85
Conc/Dil Factor:		500	5	5	5	5	5	100	5	5	500
CAS Number	Percent Moisture	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg
319-84-6	Alpha-BHC (102P)										
319-85-7	Beta-BHC (103P)										
319-86-8	Delta-BHC (104P)										
58-89-9	Gamma-BHC (Lindane) (105P)										
76-44-8	Heptachlor (100P)										
309-99-2	Aldrin (89P)										
1024-57-3	Heptachlor Epoxide (101P)										
959-98-8	Endosulfan I (95P)										
60-57-1	Dieldrin (90P)										
72-55-9	4,4'-DDE (93P)										
72-20-8	Endrin (98P)										
33213-65-9	Endosulfan II (96P)										
74-54-8	4,4'-DDD (94P)										
7421-93-4	Endrin Aldehyde (99P)										
1031-07-8	Endosulfan Sulfate (97P)										
50-29-3	4,4'-DDT (92P)										
72-43-5	Methoxychlor		~~80~~	~~80~~	~~80~~	~~80~~	~~80~~		~~80~~	~~80~~	
53494-70-5	Endrin Ketone										
57-74-9	Chlordane (91P)										
8001-35-2	Toxaphene (113P)										
12674-11-2	Arochlor-1016 (112P)										
11104-28-2	Aroclor-1221 (108P)										
11141-16-5	Aroclor-1232 (109P)										
53469-21-9	Arochlor-1242 (106P)*										380 000
12672-29-6	Arochlor-1248 (110P)*	30 000						31 000	470	810	
11097-69-1	Aroclor-1254 (107P)*	30 000			690	150		130 000	2 100	6 000	170 000
11096-82-5	Aroclor-1260 (111P)										
	Total	60 000			690	150		161 000	2570	6810	550 000

* There is no evidence in the data that Methoxychlor was identified in the samples. It appears that the CAA contractor lab [illegible] on their data sheets.

SMO Case No. _____

SITE _____

Sample Numbers, MUS		AD 596	AD 597	AD 598	AD 599	AD 600						
Laboratory Name /No.												
Traffic Report No.:												
Date Sample Received:												
Date Extracted/Prepared:		11-14-85	11-14-85	11-14-85	11-14-85	11-14-85						
Date Analyzed:		11-14-85	11-14-85	11-14-85	11-14-85	11-14-85						
Conc/Dil Factor:		5	5	5	50	5						
CAS Number	Percent Moisture _____	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg	µg/L or µg/Kg
319-84-6	Alpha-BHC (102P)											
319-85-7	Beta-BHC (103P)											
319-86-8	Delta-BHC (104P)											
58-89-9	Gamma-BHC (Lindane) (105P)											
76-44-8	Heptachlor (100P)											
309-99-2	Aldrin (89P)											
1024-57-3	Heptachlor Epoxide (101P)											
959-98-8	Endosulfan I (95P)											
60-57-1	Dieldrin (90P)											
72-55-9	4,4'-DDE (93P)			21								
72-20-8	Endrin (98P)											
33213-65-9	Endosulfan II (96P)											
74-54-8	4,4'-DDD (94P)											
7421-93-4	Endrin Aldehyde (99P)											
1031-07-8	Endosulfan Sulfate (97P)											
50-29-3	4,4'-DDT (92P)											
72-43-5	Methoxychlor	~~80~~	~~80~~	~~80~~		~~80~~	~~5~~					
53494-70-5	Endrin Ketone											
57-74-9	Chlordane (91P)											
8001-35-2	Toxaphene (113P)											
12674-11-2	Arochlor-1016 (112P)											
11104-28-2	Aroclor-1221 (108P)											
11141-16-5	Aroclor-1232 (109P)											
53469-21-9	Arochlor-1242 (106P)											
12672-29-6	Arochlor-1248 (110P) *				8400	230						
11097-69-1	Aroclor-1254 (107P) *	240		1500	41000	1300						
11096-82-5	Aroclor-1260 (111P)											
	TOTAL	240		1500	49400	1530						
			*	See	Previous		Pest	report	Sheet			

APPENDIX D

COMMON AND SCIENTIFIC NAMES OF PLANT AND ANIMAL SPECIES OBSERVED DURING THE WETLAND SURVEYS

ACUSHNET RIVER ESTUARY PLANT SPECIES LIST

MACROALGAE

Scientific Name	Common Name
Ascophyllum nodosum	Wrack
Codium fragile[1]	Green Fleece
Enteromorpha sp	Hollow Green Weed
Fucus vesiculosus	Rockweed
Gracilaria sp	Red Weed
Ulva lactuca	Sea Lettuce

EMERGENT AND TERRESTRIAL PLANTS

Scientific Name	Common Name
Acer rubrum	Red Maple
Achillea millefolium	Yarrow
Agalinus martima*	Seaside Gerardia
Agrostis sp	Bentgrass
Ammophila breviligulata	Beach Grass
Andropogon scoparius	Little Blue Stem
Aster spp	Aster
Aster tenuifolius*	Slender-leaved Aster
Atriplex patula*	Sea Orach
Baptisia tinctoria	Wild Indigo
Cakile edentula	Sea Rocket
Celastrus scandens	Climbing Bittersweet
Cichorium intybus	Chicory
Daucus carota	Queen Anne's Lace
Distichlis spicata*	Spike Grass
Fagus grandifolia	American Beach
Iva frutescens*	Marsh Elder
Juncus sp	Rush
Juncus gerardi*	Black Grass
Juniperus virginiana	Red Cedar
Lespedeza capitata	Round-headed bush clover
Limonium carolinianum*	Sea Lavender
Lonicera japonica	Japanese Honeysuckle
Myrica pensylvanica	Bayberry
Nyssa sylvatica	Tupelo
Panicum virgatum	Switchgrass
Phragmites australis	Common Reed
Pinus rigida	Pitch Pine
Polygonum glaucum	Seabeach Knotweed
Polytrichum sp	Polytrichum Moss
Prunus maritima	Beach Plum
Prunus serotina	Black Cherry
Pteridium aquilinum	Bracken Fern
Pyrus malus	Apple

Plant Species List (continued)

EMERGENT AND TERRESTRIAL PLANTS

Scientific Name	Common Name
Quercus coccinea	Scarlet Oak
Quercus ilicifolia	Scrub Oak
Quercus robur	English Oak
Rhus copallina	Winged Sumac
Rosa multiflora	Multiflora Rose
Rosa rugosa	Rugosa Rose
Rosa virginianus	Carolina Rose
Rubus sp	Bramble
Rumex crispus	Curly Dock
Salicornia europaea agg*	Annual Glasswort
Sarcocornia perennis=(Salicornia virginica)*	Perennial Glasswort
Scirpus pungens=(Scirpus americanus)*	Chair-maker's Rush
Scirpus robustus*	Salt Marsh Bulrush
Smilax rotundifolia	Horse-Brier
Solidago sempervirens*	Sea-side Goldenrod
Solidago spp	Goldenrod
Spartina alterniflora*	Salt Marsh Cordgrass
Spartina patens*	Salt Meadow Cordgrass
Spartina pectinata*	Fresh Water Cordgrass
Spergularia marina*	Sand-Spurrey
Suaeda linearis*	Sea-Blite
Suaeda maritima*	Sea-Blite
Toxicodendron radicans=(Rhus radicans)	Poison Ivy
Triglochin maritima[1]*	Arrow-Grass
Verbascum thapsus	Mullein
Viburnum dentatum	Arrow-wood
Vitis sp	Grape

[1] Found only at the reference marsh on Buzzards Bay.
* Salt marsh species.

The total number of salt marsh plant species observed growing in the Acushnet River wetlands was 18.

ACUSHNET RIVER WETLAND ANIMAL SPECIES LIST

MACROBENTHOS
(for a more complete list see SES 1987, the Acushnet River estuary benthic sampling report)

EPIFAUNA

Mollusks

Scientific Name	Common Name	Feeding Guild
Cepea hortensis		
Crepidula fornicata	Slipper Limpet	suspension feeder
Crassostrea virginica	Common Oyster	suspension feeder
Discus sp.		
Geukensia demissa	Ribbed Mussel	suspension feeder
Hydrobia tottenti	Minute Hydrobid	detritivore
Ilyanassa obsoleta	Mudsnail	detritivore
Littorina littorea	Common Periwinkle	herbivore
Melampus bidentatus	Coffee Bean Snail	detritivore

Arthropods

Amphipoda	Scuds	burrowers/deposit feeders
Balanus sp.	Barnacle	filter feeder
Carcinus maenus	Green Crab	scavenger
Isopoda	Isopods	deposit feeder
Uca pugnax	Mud Fiddler Crab	deposit feeder

INFAUNA

Polychaeta

Scientific Name	Common Name	Feeding Guild
Nereis succinea	Nereid Polychaete	burrowing omnivore
Pectinaria gouldii	Trumpet Worm	deposit feeder

Molluscs

Macoma balthica	Macoma Clam	deposit feeder
Mercenaria mercenaria	Hard-shelled Clam	suspension feeder
Mya arenaria	Soft-shelled Clam	suspension feeder

SALT MARSH INSECTS

Scientific Name	Common Name	Feeding Guild
Coleophora sp.	Casebearers	herbivore
Gryllidae	Cricket	herbivore
Miridae	Mirids	herbivore
Tenodera aridifolia	Chinese Mantid	predaceous
Tettigoniidae	Katydid	herbivore

FISH

Alosa pseudoharengus	Alewife	planktivore
Fundulus heteroclitus	Mummichog	omnivore

MAMMALS

Scientific Name	Common Name	Feeding Guild
Fur and Game Mammals:		
Didelphis virginiana[1]	Opossum	omnivore
Mephitis mephitis	Skunk	omnivore
Sylvilagus floridanus	Eastern Cottontail	herbivore
Small Mammals:		
Felius catus	Domestic Cat	carnivore
Microtus pensylvanicus	Meadow Vole	herbivore
Peromyscus sp.	White-footed Mouse	omnivore
Rattus norvegicus	Norway Rat	omnivore
Sciurus catolinensis	Gray Squirrel	herbivore
Tamias striatus[1]	Eastern Chipmunk	herbivore

[1] Animals observed only at the Buzzards Bay reference marsh.

SCIENTIFIC NAMES OF BIRD SPECIES RECORDED DURING WINTER, SPRING, AND LATE SUMMER SURVEYS (BIRD SPECIES GROUPED BY ORDER)

COMMON NAME	SCIENTIFIC NAME
Waterfowl	
Common Loon	Gavia immer
Double-crested Cormorant	Phalacrocorax auritus
Marsh and Wading Birds	
Snowy Egret	Egretta thula
Great Blue Heron	Ardea herodias
Green-backed heron	Butorides striatus
Great Egret	Casmerodius albus
Waterfowl	
Mute Swan	Cygnus olor
Canada Goose	Branta canadensis
American Black Duck	Anas rubripes
Mallard	A. platyrhynchos
American Wigeon	A. americana
Canvasback	Aythya valisineria
Greater Scaup	A. marila
Scaup sp.	A. sp.
Common Goldeneye	Bucephala clangula
Bufflehead	B. albeola
White-winged Scoter	Melanitta fusca
Birds of Prey	
Osprey	Pandion haliaetus
American Kestrel	Falco sparverius
Peregrine Falcon	F. peregrinus
Merlin	F. columbarius
Northern Harrier	Circus cyaneus
Marsh and Shorebirds	
Black-bellied Plover	Pluvialis squatarola
Killdeer	Charadrius vociferus
Greater Yellowlegs	Tringa melanoleuca
Lesser Yellowlegs	T. flavipes
Spotted Sandpiper	Actitis macularia
Water Birds	
Laughing Gull	Larus atricilla
Common Black-headed Gull	L. ridibundus
Ring-billed Gull	L. delawarensis
Herring Gull	L. argentatus
Iceland Gull	L. glaucoides
Great Black-backed Gull	L. marinus
Forster's Tern	Sterna forsteri
Least Tern	S. antillarum

COMMON NAME	SCIENTIFIC NAME
Upland Gamebirds	
Rock Dove	Colomba livia
Mourning Dove	Zenaida macroura
Belted Kingfisher	Megaceryle alcyon
Downy Woodpecker	Picoides pubescens
Hairy Woodpecker	P. villosus
Northern Flicker	Colaptes auratus
Songbirds	
Tree Swallow	Iridoprocne bicolor
Blue Jay	Cyanocitta cristata
American Crow	Corvus brachyrhynchos
Black-capped Chickadee	Parus atricapillus
Tufted Titmouse	P. bicolor
House Wren	Trogoldytes aedon
Carolina Wren	Thryothorus ludovicianus
American Robin	Turdus migratorius
Gray Catbird	Dumetella carolinensis
Northern Mockingbird	Mimus polyglottos
European Starling	Sturnus vulgaris
Yellow-rumped Warbler	Dendroica coronata
Rose-breasted Grosbeak	Pheucticus ludovicianus
Northern Cardinal	Cardinalis cardinalis
American Tree Sparrow	Spizella arborea
Field Sparrow	S. pusilla
Savannah Sparrow	Passerculus sandwichensis
Song Sparrow	Melospiza melodia
Swamp Sparrow	M. georgiana
White-throated Sparrow	Zonotrichia albicollis
Red-winged Blackbird	Agelaius pheoniceus
Eastern Meadowlark	Sturnella magna
Common Grackle	Quiscalus quiscula
Brown-headed Cowbird	Molothrus ater
House Finch	Carpodacus mexicanus
American Goldfinch	Carduelis tristis
House Sparrow	Passer domesticus
Red-eyed Vireo	Vireo olivaceus
White-eyed Vireo	V. griseus
Solitary Vireo	V. solitarius
Tennessee Warbler	Vermivora peregrina
Bay-breasted Warbler	Dendroica castanea
Blackpoll Warbler	D. striata
Connecticut Warbler	Oporornis agilis
Common Yellowthroat	Geothylpis trichas
American Redstart	Setophaga ruticilla

APPENDIX E

ANALYTICAL METHODS AND PROCEDURES FOR THE BIOACCUMULATION/ BICONCENTRATION STUDY ACUSHNET RIVER ESTUARY

Sample Preparation:

Since homogenous samples were desired from varying types of samples, the procedure for generating these representative ssmples differed for differing sample types as follows:

Mice: The mice were frozen in liquid nitrogen and placed into a high speed blender which contained dry ice. They were macerated at differing speeds until completely powdered. The resulting sample composites were mixed thoroughly and subsampled.

Seagull Muscle Tissue: The muscle tissue was ground using a mortar and pestle and the resulting homogenate subsampled.

Seagull Fat Tissue: These tissues were placed in a tissuemiser and homogenized. The resulting composites were subsampled.

Fresh Water Mussels: These samples were mixed thoroughly and directly subsampled.

Insects: These were ground with a mortar and pestle and the entire portion was analyzed for PCB's.

Grass: The grass was placed in a high speed blender, chopped finely and subsampled.

Acorns: These were ground with a mortar and pestle and subsampled.

Fruits: These were subsampled whole.

STANDARD OPERATING PROCEDURE

Procedure By/Date JEM / 4-14-86	TITLE: Metals Degestions 4: Tissues	Page 1 of 2
Approved By/Date		Procedure No. 3050
Effective Date:		Reference: SW846

Comments: The procedure is carried out exactly according to the procedure with an additional pretreatement with Fuming Nitric acid and the following Exceptions, Protocols and Quality Control.

Approximately 1.00 g of tissue is added to a 12 mL glass/teflon screw-cap vial (acid-rinsed) and approximately 5 mL Fuming Nitric acid is added. (Do NOT pipet). Shake vial GENTLY periodically until all or most of the tissue undergoes dissolution. The sample is then transferred as quantitatively as possible to a 100 mL beaker with Type II water and evaporated to near dryness.

The sample is then digested exactly according to the method 3050 except that Nitric Acid is used as the final reflux acid for all samples as is specified for analysis by graphite furnace.

Quality control is maintained through the analysis of blanks, duplicates and spikes according to the following schedule, whenever practical, given amounts of available sample.

1. For every set of samples one blank consisting of Type II water is to be digested concurrently and analyzed for all metals included in that set of digestions.
2. For every 10 samples digested one will be digested in duplicate.
3. For every sample duplicated, one additional replicate will be spiked.

4. Unless very high metal concentrations are expected or recovery is to be determined at very low levels, the following guidelines are to be adhered to.

Metal(s)	Spike Protocol[1]	Concentration In Tissue[4]	Concentration in Final Dilution[5]
As, Se	(A) 1.00 ml of Std.[2] to 100.0 mL Blank[3]. 0.5 mL Sol'n (A) to sample	5.0 ug/g	0.5 mg/L
Ag, Ba, Ca, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Tl	0.50 mL Std.[2] to sample.	500 ug/g	50 mg/L
Sn	1 mL Std.[2] to sample.	1000 ug/g	100 mg/L
Be, Cd, Mg, Zn	(A) 1.00 mL Std.[2] to 10.0 mL Blank[3]. 0.50mL Sol'n (A) to sample.	50 ug/g	5 mg/L

[1] Dilution protocol: read as "Dilute x mL to a final volume of y mL with Blank."
[2] 1000 ug/ml commercial AA standard
[3] 0.1 % HNO_3 in Type II water
[4] assuming a 1. mL sample
[5] Assuming 10 mL final dilution. Dilute when necessary prior to AA analysis!

Recoverable PCB's In Plant And Animal Tissue

Summary:

Approximately five grams of sample was placed in a 40 mL glass centrifuge tube with a teflon lined screw cap. To the sample 10 mL of 50% Aqueous potassium hydroxide and 10 mL of pesticide grade methanol was added. The tubes were sealed, mixed thoroughly by shaking, and then digested in an oven at 90°C for one hour. The cooled digestates were extracted with three 15 mL portions of petroleum ether. The extracts from samples 6467-14 through 6467-23 were back extracted with water to remove water soluble residues. The extracts were reduced to 1 mL in a K-D apparatus. The concentrates were cleaned up using florisil/alumina chromatography and re-concentrated to 1 mL. The samples were then analyzed by GC/ECD and GC/MS.

References:

Warner et al., 1976.

EPA SW846/8080, Second Edition.

APPENDIX F

QUALITY ASSURANCE DATA

1. PCB Precision and Accuracy Data
2. Metals Precision and Accuracy Data

I. Quality Control Data for PCB's

1.) Precision

Laboratory Number: 6467-2
Field Identification: Ring-billed Gulls No. 2 Muscles

Rep. 1		Rep. 2		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
<0.04	1.0	<0.04	0.97	-	3

Laboratory Number: 6467-7
Field Identification: Ring-billed Gulls No. 7 Muscles

Rep. 1		Rep. 2 (S)		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
<0.04	25	<0.04	25	-	-

Laboratory Number: 6467-8
Field Identification: Ring-billed Gulls No. 8 Muscles

Rep. 1		Rep. 2		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
<0.04	28	<0.04	26	-	7.4

Laboratory Number: 6467-15
Field Identification: Mussel Meat Geukensia Station 1-M Rep. 2

Rep. 1		Rep. 2 (S)		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
20	10	19	11	5.1	9.5

Laboratory Number: 6467-16
Field Identification: Mussel Meat Geukensia Station 2-M Rep. 1

Rep. 1		Rep. 2		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
22	10	20	10	9.5	-

Laboratory Number: 6467-21
Field Identification: Mussel Meat Geukensia Station 4-M Rep. 2

Rep. 1		Rep. 2 (S)		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
26	9.5	21	7.2	21.3	27.5

Laboratory Number: 6467-26
Field Identification: White Footed Mice Station 3-WFM Composite of 4

Rep. 1		Rep. 2		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
<0.04	11	<0.04	11	-	-

Laboratory Number: 6467-30
Field Identification: Mouse Food Acorns Station No. 2

Rep. 1		Rep. 2		% Relative Range	
PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)	PCB 1242 (ug/g)	PCB 1254 (ug/g)
<0.04	<0.04	<0.04	<0.04	-	-

2.) Accuracy

Four samples were spiked at the 0.5 ug/g level with PCB 1254. The concentrations of PCB's in the original samples were twenty to fifty times this value preventing the calculation of meaningful recovery data. The spike samples are included as replicates and are designated with (S).

QUALITY ASSURANCE/QUALITY CONTROL

PCB'S

1. Blank Data

Blank Number	Blank Value (ug/g)
B-M130	<0.02
B-M131	<0.02
B-M132	<0.02

2. Accuracy

Sample Number	Original Conc. AR 1254 (ug/g)	Spike Level AR 1254 (ug/g)	Total AR 1254 Conc. Found (ug/g)	AR 1254 Spike % Recovery*
S-M113 (mussel)	17	1.0	26	+900
S-M114 (ulva)	8.8	1.0	4.1	-470
S-M115 (duck)	100	1.0	124	+2400

3. Precision

Sample Number	Target Compound	Conc. Rep. 1 (ug/g)	Conc. Rep. 2 (ug/g)	Average	% Rel. Range
10,853-10 (mussel)	AR 1242	47	42	45	11
	AR 1254	17	21	19	21
10,853-19 (ulva)	AR 1242	40	27	34	38
	AR 1254	8.8	5.1	7.0	53
10,853-20 (duck)	AR 1242	0.58	0.35	0.47	49
	AR 1254	100	86	93	15

* The reported % recovery values are exaggerated due to the inappropriate spike level and to the effect of dilution. Non-homogeneous sample tissue may also have affected this parameter.

II. QUALITY CONTROL DATA FOR METALS ANALYSIS

Sample Type Tissue Lab ID 6467-11 Client ID Ring-billed gull Composite no. 15 fat

PARAMETER	PREP. DATE	ANALYSIS DATE	CONC. UNITS	REP. 1	REP. 2	AVERAGE CONC.	% RELATIVE RANGE	SPIKE CONC. ADDED	SPIKE CONC. RECOVERED	% RECOVERY
Chromium	4/7-4/10	4/18	ug/g	2.9	5.3	4.1	58.5	794	603	75.4
Copper	4/7-4/10	4/16	ug/g	3.0	3.9	3.4	26.5	794	784	98.2
Lead	4/7-4/10	4/16	ug/g	2.9	3.5	3.2	18.8	794	803	101
Zinc	4/7-4/10	4/18	ug/g	126	67	96	61.5	794	967	110

QUALITY ASSURANCE/QUALITY CONTROL

CHROMIUM

1. Blank Data

Blank Number	Blank Value (ug/g)
MB 406	0.01
MB 407	0.01

2. Accuracy

Lab Number	Sample Conc. (ug/g)	Conc. Added (ug/g)	Conc. Found (ug/g)	Recovery (%)
10,853-9 (mussel)	0.27	0.97	1.12	88
10,853-11 (ulva)	3.61	0.96	4.55	98
10,853-20 (duck)	0.21	0.94	1.02	86

3. Precision

Lab Number	Conc. Rep. 1 (ug/g)	Conc. Rep. 2 (ug/g)	Average	Relative Range (%)
10,853-9 (mussel)	0.27	0.27	0.27	NC
10,853-11 (ulva)	3.72	3.49	3.61	6.4
10,853-20 (duck)	0.22	0.19	0.21	14.3

NC = Not calculable due to result below detection limit.

QUALITY ASSURANCE/QUALITY CONTROL

COPPER

1. Blank Data

Blank Number	Blank Value (ug/g)
MB 406	0.02
MB 407	0.02

2. Accuracy

Lab Number	Sample Conc. (ug/g)	Conc. Added (ug/g)	Conc. Found (ug/g)	Recovery (%)
10,853-9 (mussel)	3.1	48.5	42.2	81
10,853-11 (ulva)	24.3	48.0	69.4	94
10,853-20 (duck)	5.7	47.0	44.0	82

3. Precision

Lab Number	Conc. Rep. 1 (ug/g)	Conc. Rep. 2 (ug/g)	Average	Relative Range (%)
10,853-9 (mussel)	2.9	3.2	3.1	9.6
10,853-11 (ulva)	25.8	22.8	24.3	12.3
10,853-20 (duck)	5.5	5.8	5.7	5.3

QUALITY ASSURANCE/QUALITY CONTROL

LEAD

1. Blank Data

Blank Number	Blank Value (ug/g)
MB 406	0.1
MB 407	0.1

2. Precision

Lab Number	Conc. Rep. 1 (ug/g)	Conc. Rep. 2 (ug/g)	Average	Relative Range (%)
10,853-9 (mussel)	<0.9	<0.9	<0.9	NC
10,853-11 (ulva)	17.9	17.8	17.9	0.56
10,853-20 (duck)	<0.9	<0.9	<0.9	NC

NC = Not calculable due to result below detection limit.

QUALITY ASSURANCE/QUALITY CONTROL

ZINC

1. Blank Data

Blank Number	Blank Value (ug/g)
MB 406	0.02
MB 407	0.02

2. Accuracy

Lab Number	Sample Conc. (ug/g)	Conc. Added (ug/g)	Conc. Found (ug/g)	Recovery (%)
10,853-9 (mussel)	11	485	523	106
10,853-11 (ulva)	87	480	604	108
10,853-20 (duck)	9.8	472	500	104

3. Precision

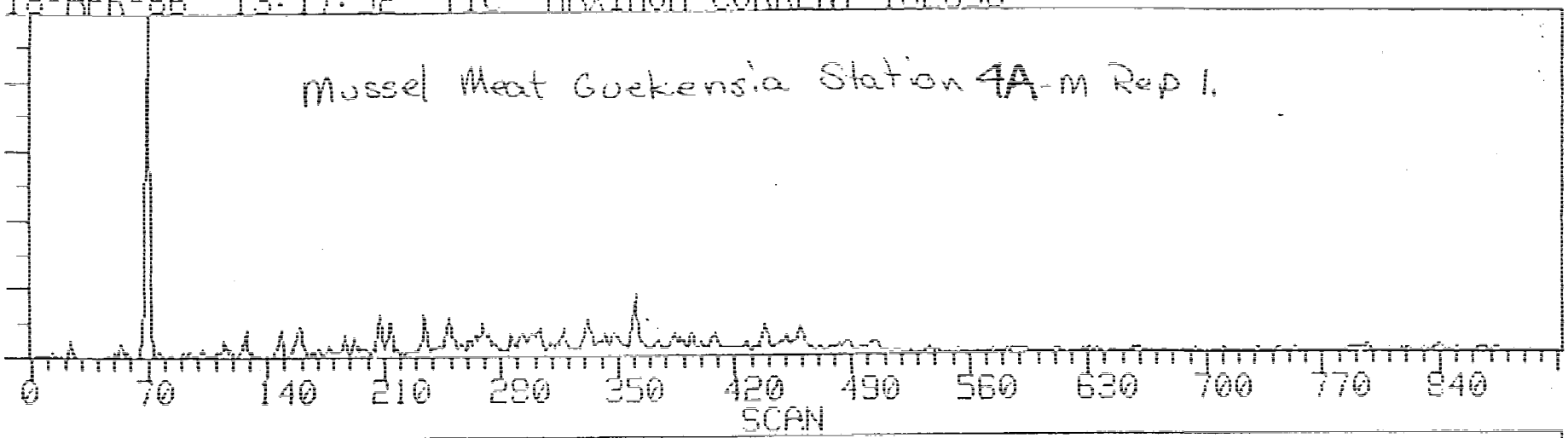
Lab Number	Conc. Rep. 1 (ug/g)	Conc. Rep. 2 (ug/g)	Average	Relative Range (%)
10,853-9 (mussel)	11	11	11	0
10,853-11 (ulva)	76	97	87	24
10,853-20 (duck)	9.9	9.7	9.8	2

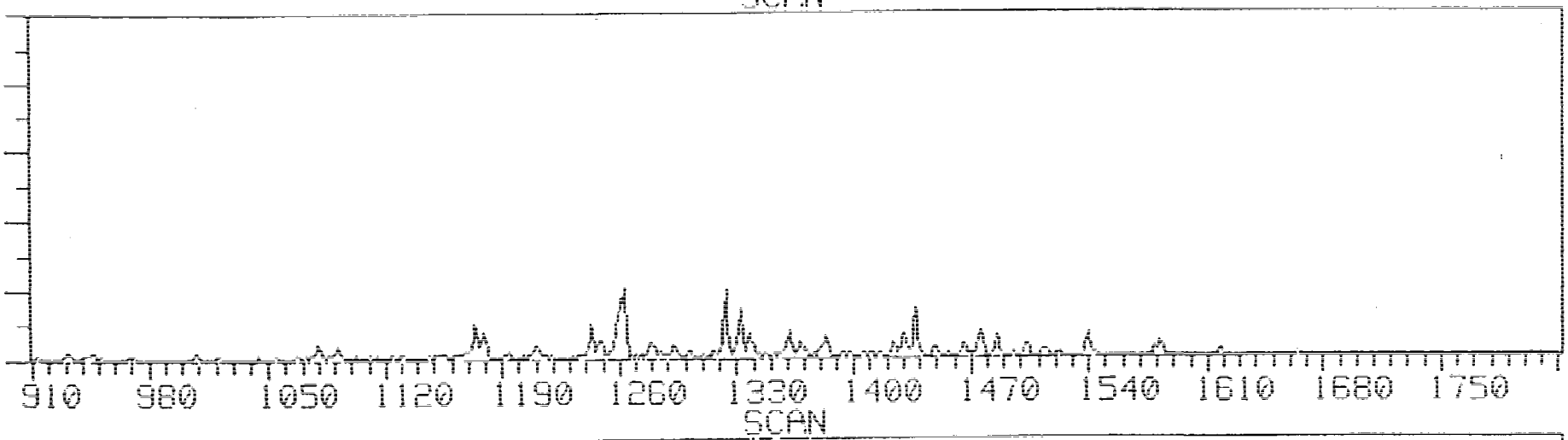
APPENDIX G

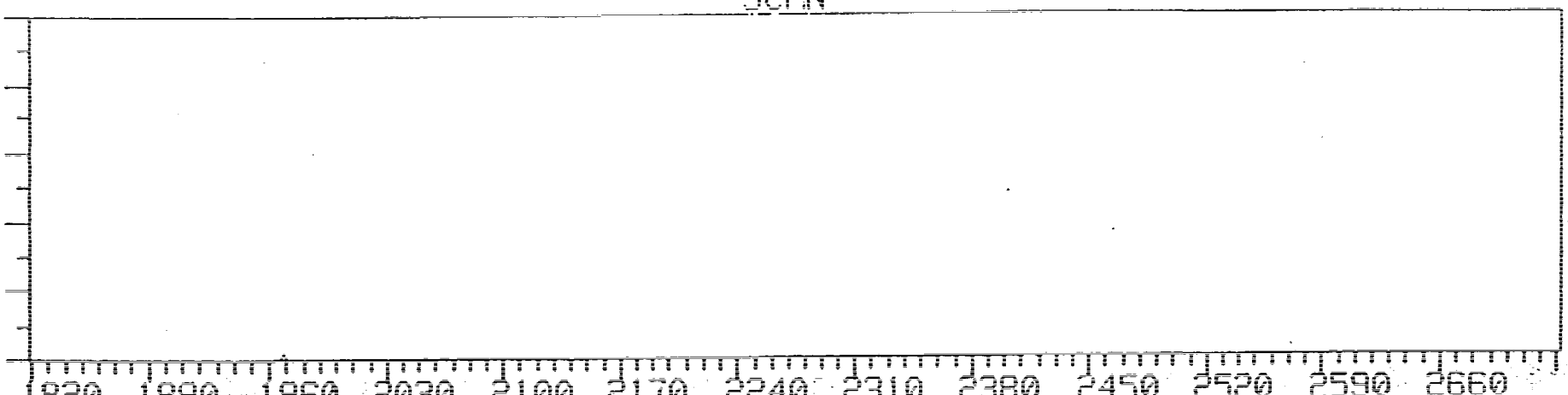
GAS CHROMATOGRAPH/MASS SPECTROPHOTOMETER

CONFIRMATION OF PCB DATA

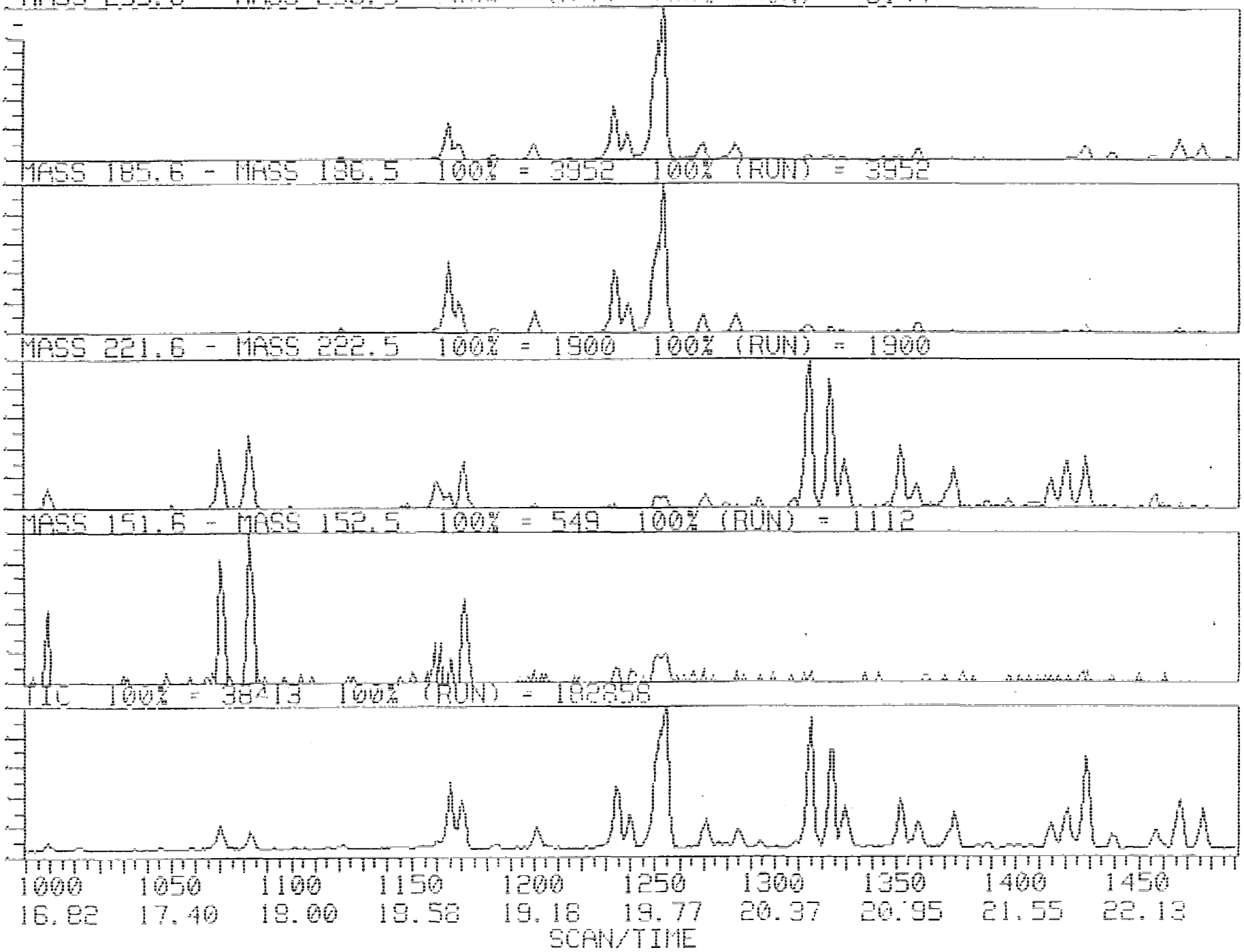
646722
18-APR-86 13:17:52 TIC MAXIMUM CURRENT=182858



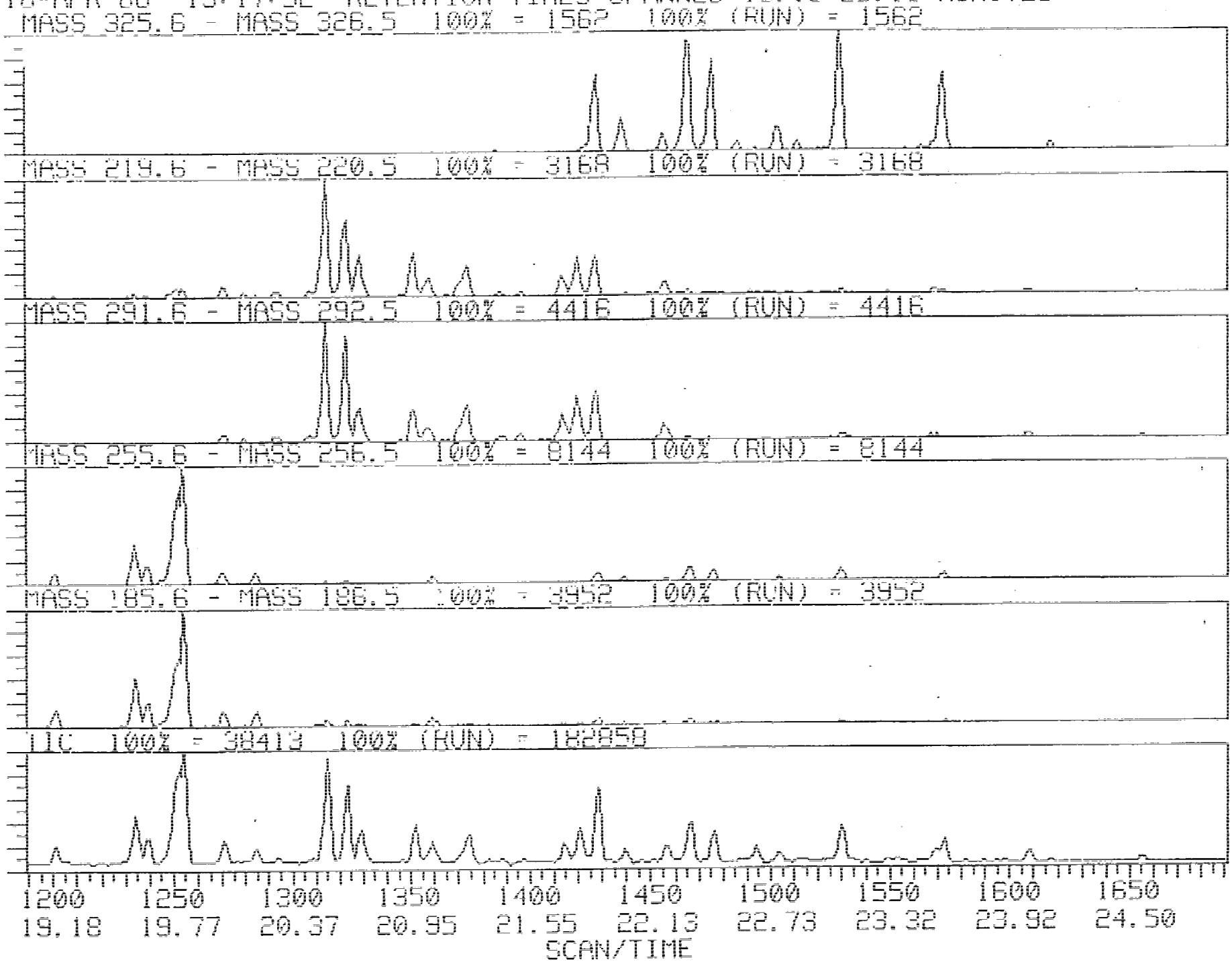




646722
19-APR-86 13:17:52 RETENTION TIMES SPANNED 16.82-22.73 MINUTES

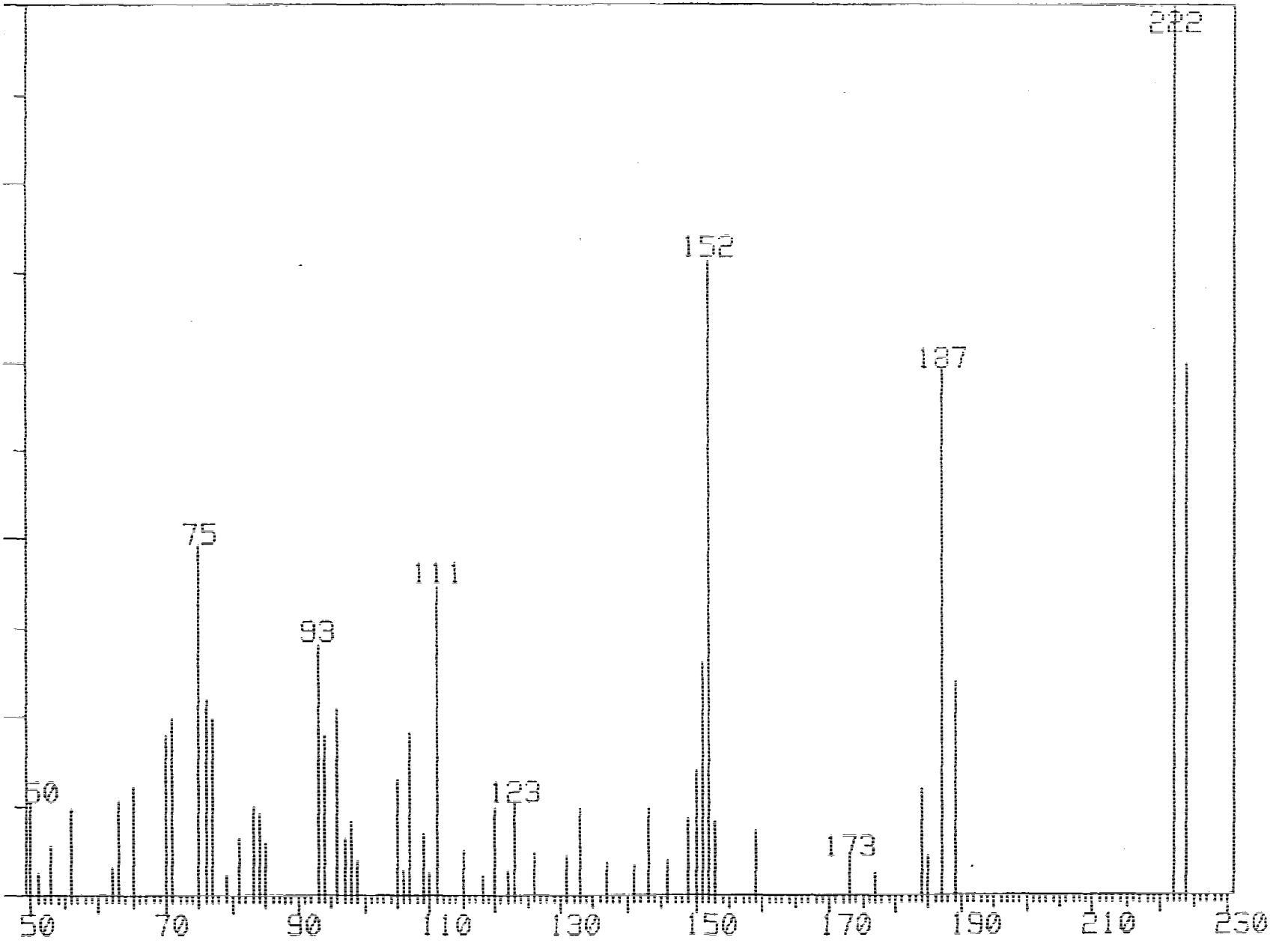


646722
18-APR-86 13:17:52 RETENTION TIMES SPANNED 19.18-25.08 MINUTES



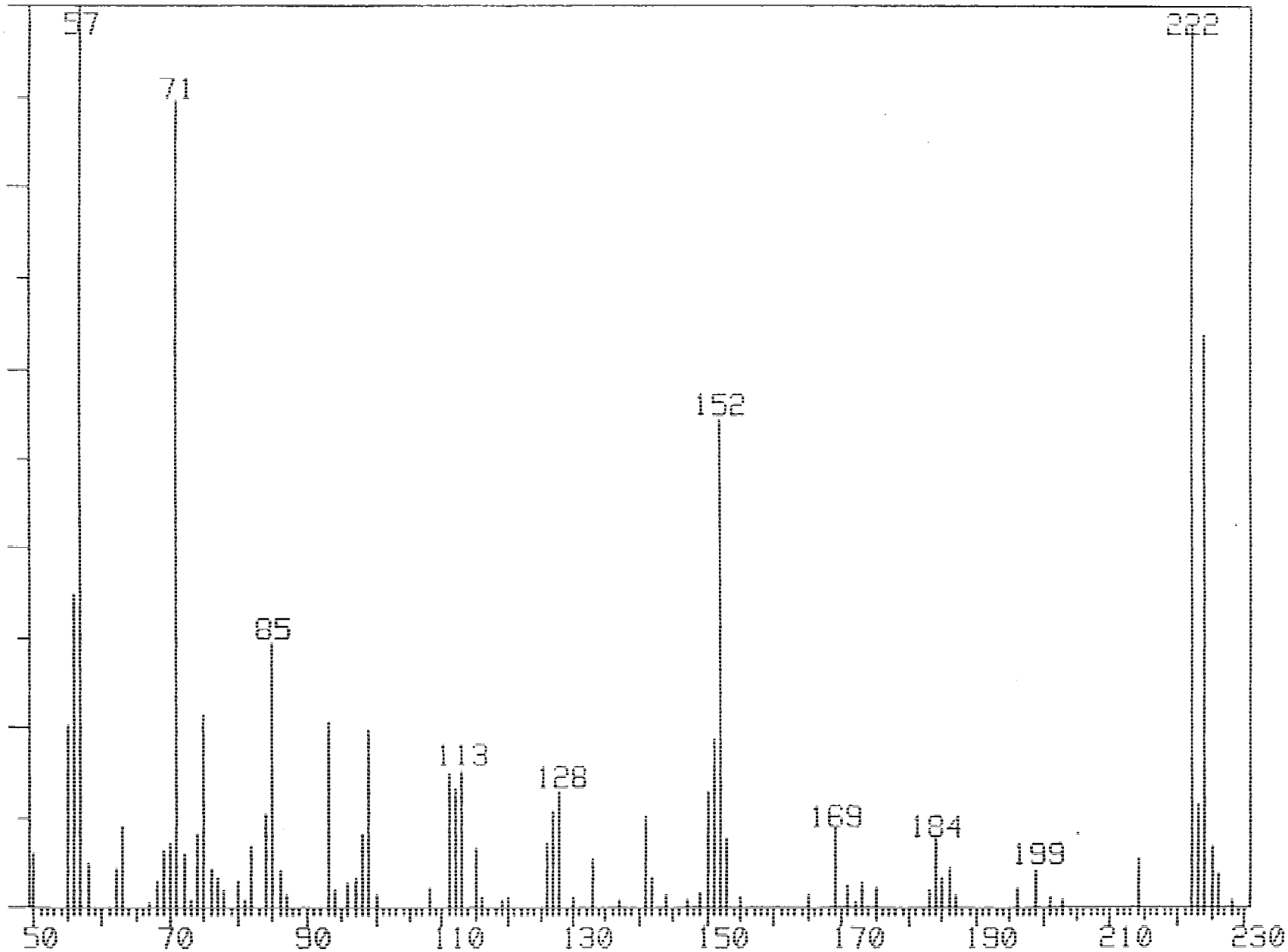
64B722
18-APR-86 13:17:52 SCANS AVERAGED 1008-1011 TIME 16.93 MIN.
BCKG SCANS * 1.00 1005 1013 100 % = 168

TOTAL SCALE
1412 1*



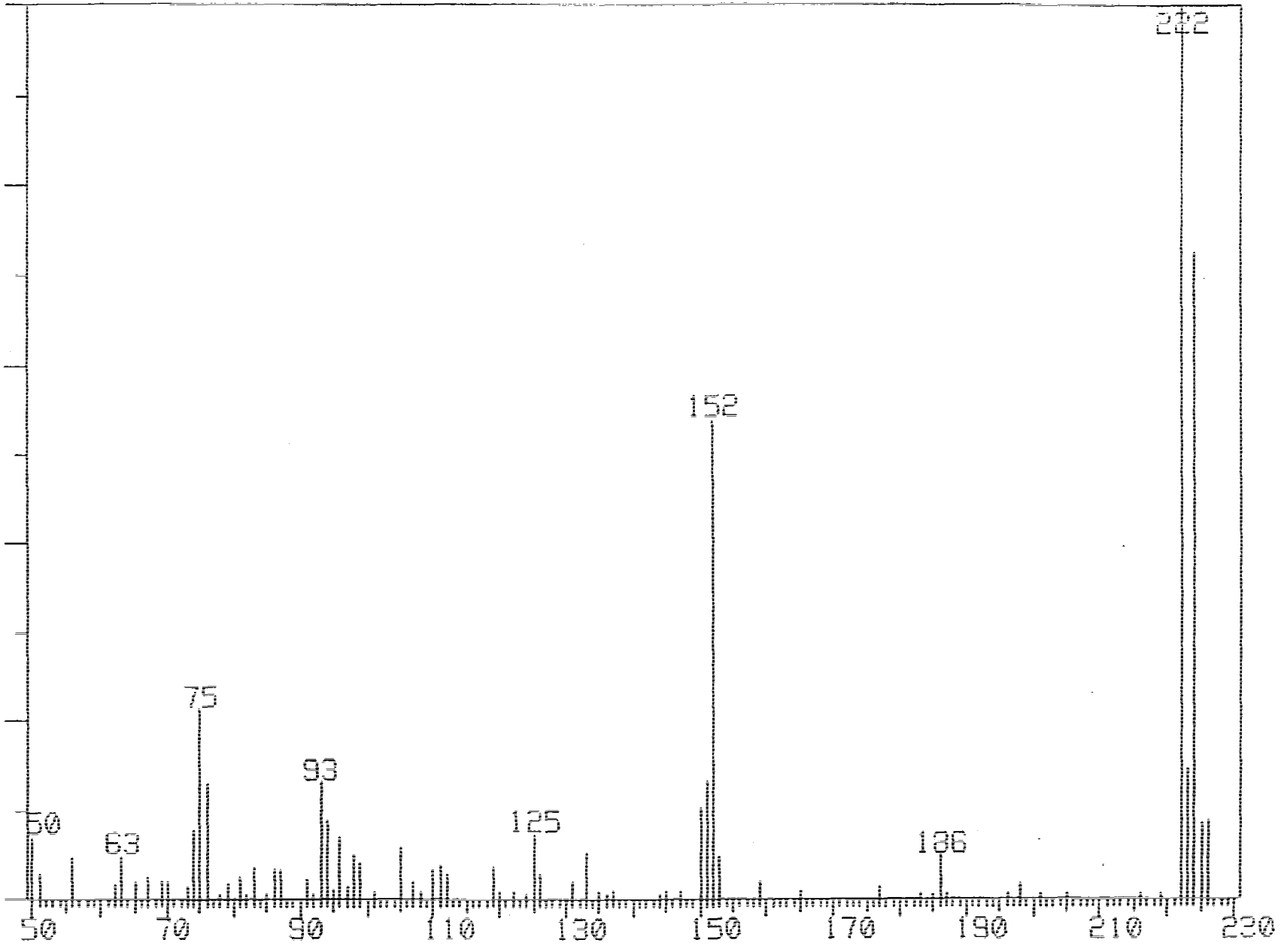
646722
18-APR-86 13:17:52 SCANS AVERAGED 1078-1083 TIME 17.77 MIN.
BCKG SCANS * 1.00 1075 1087 100 % = 366

TOTAL SCALE
3265 1*

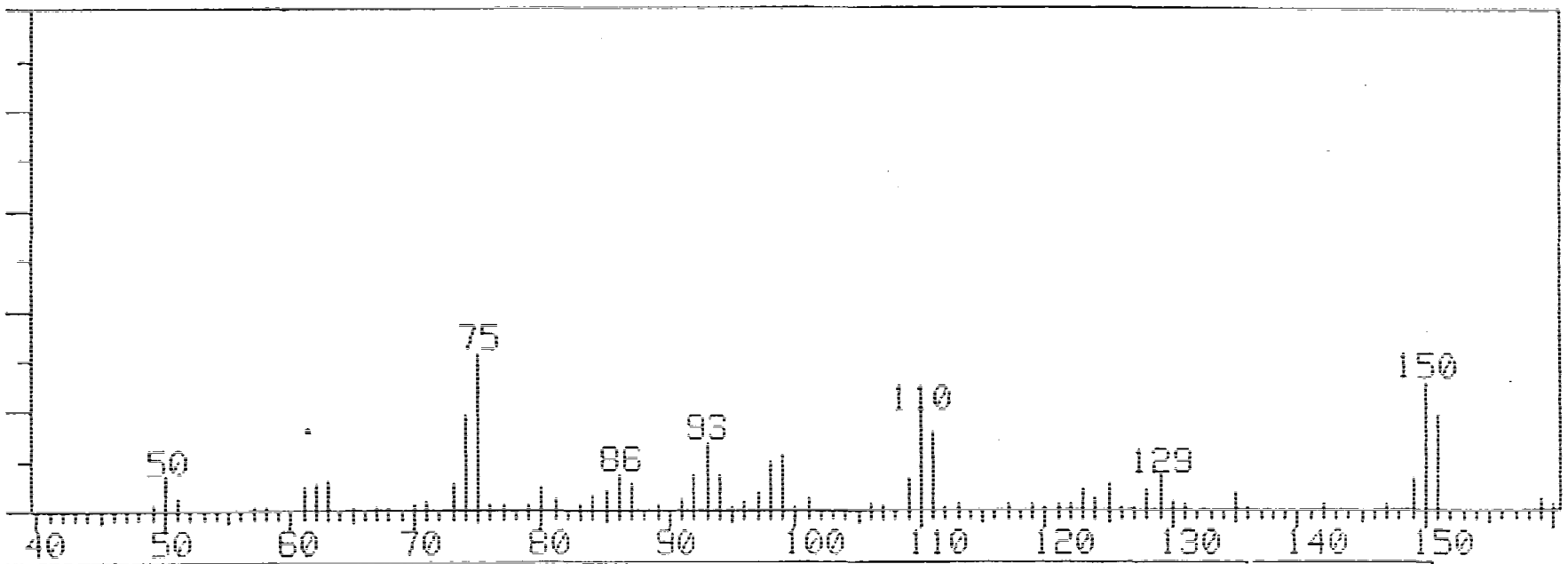


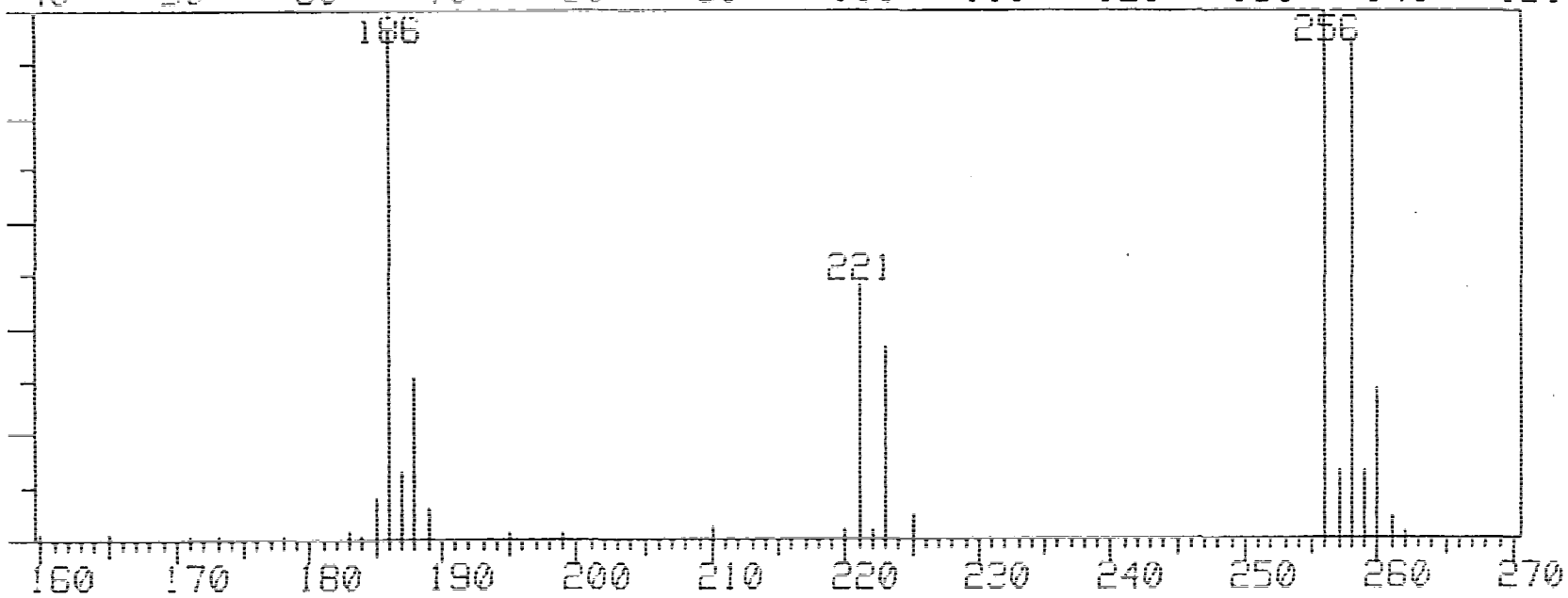
B46722
18-APR-86 13:17:52 SCANS AVERAGED 1090-1095 TIME 17.91 MIN.
BCKG SCANS * 1.00 1088 1098 100 % = 499

TOTAL SCALE
2419 1*



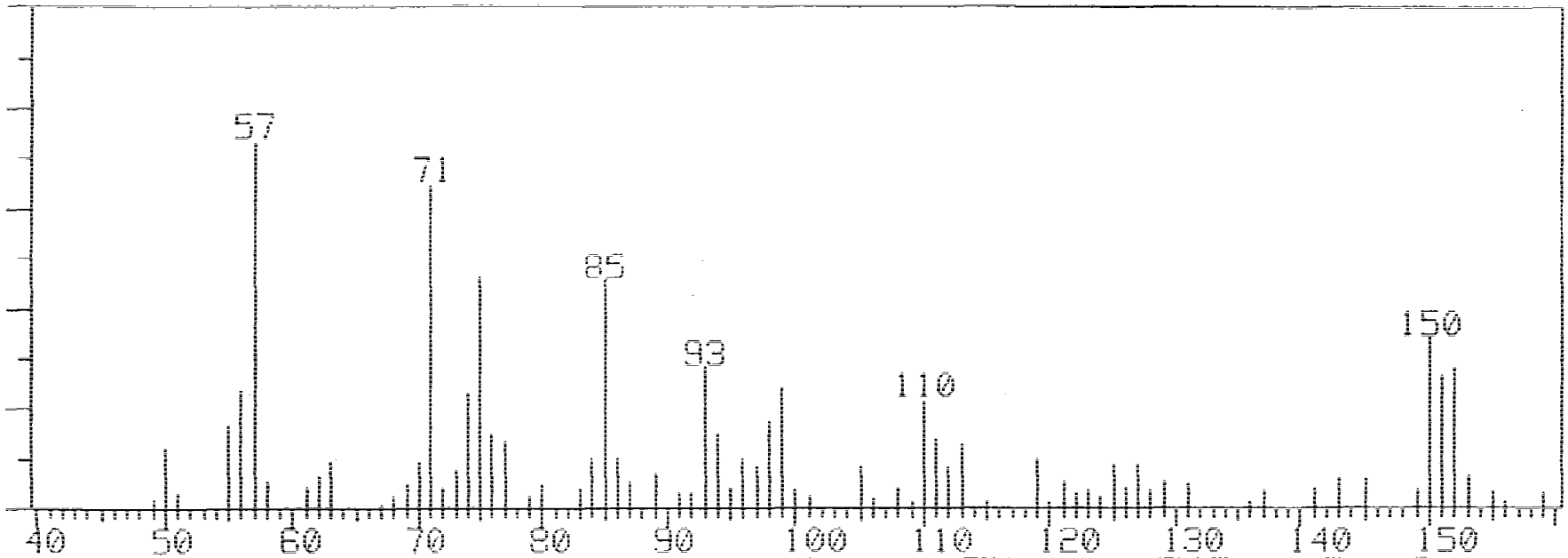
646722
18-APR-86 13:17:52 SCANS AVERAGED 1173-1177 TIME 18.88 MIN. TOTAL SCALE 9435 1*
BCKG SCANS * 1.00 1171 1186 100 % = 1130

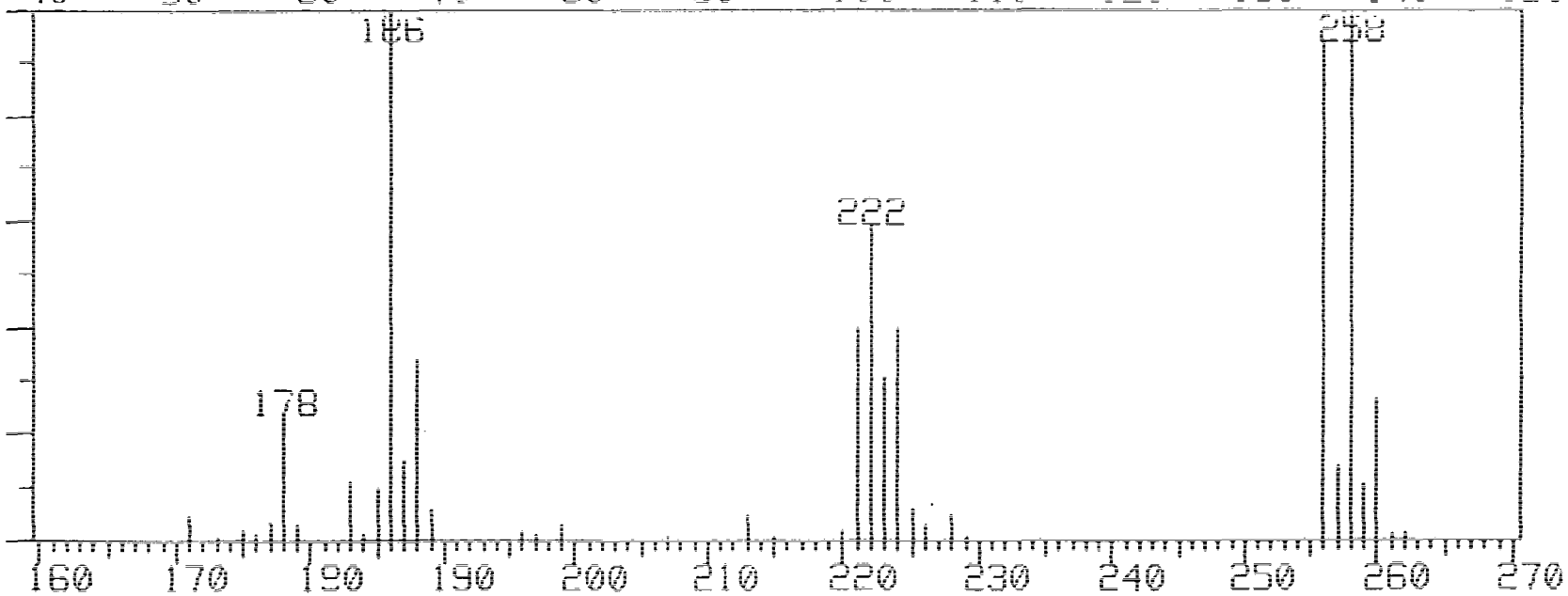




646722
18-APR-86 13:17:52 SCANS AVERAGED 1178-1182 TIME 18.94 MIN.
BCKG SCANS * 1.00 1188 100 % = 522

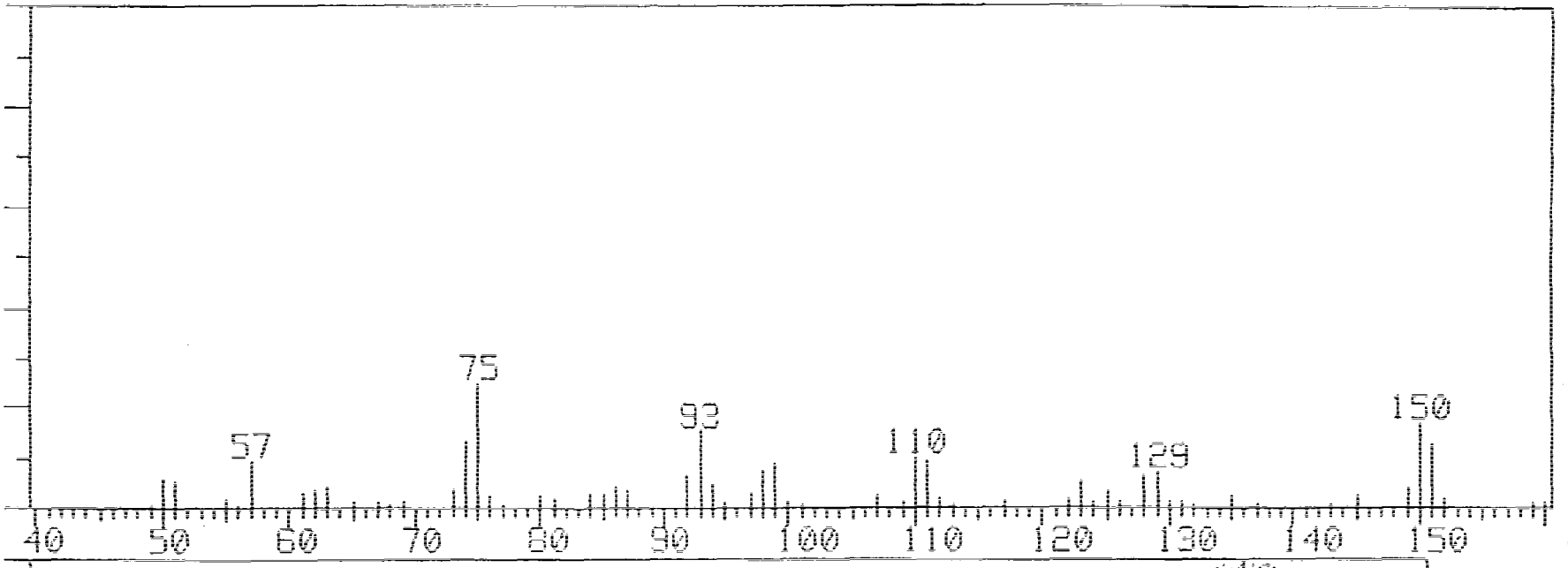
TOTAL SCALE
7680 1*

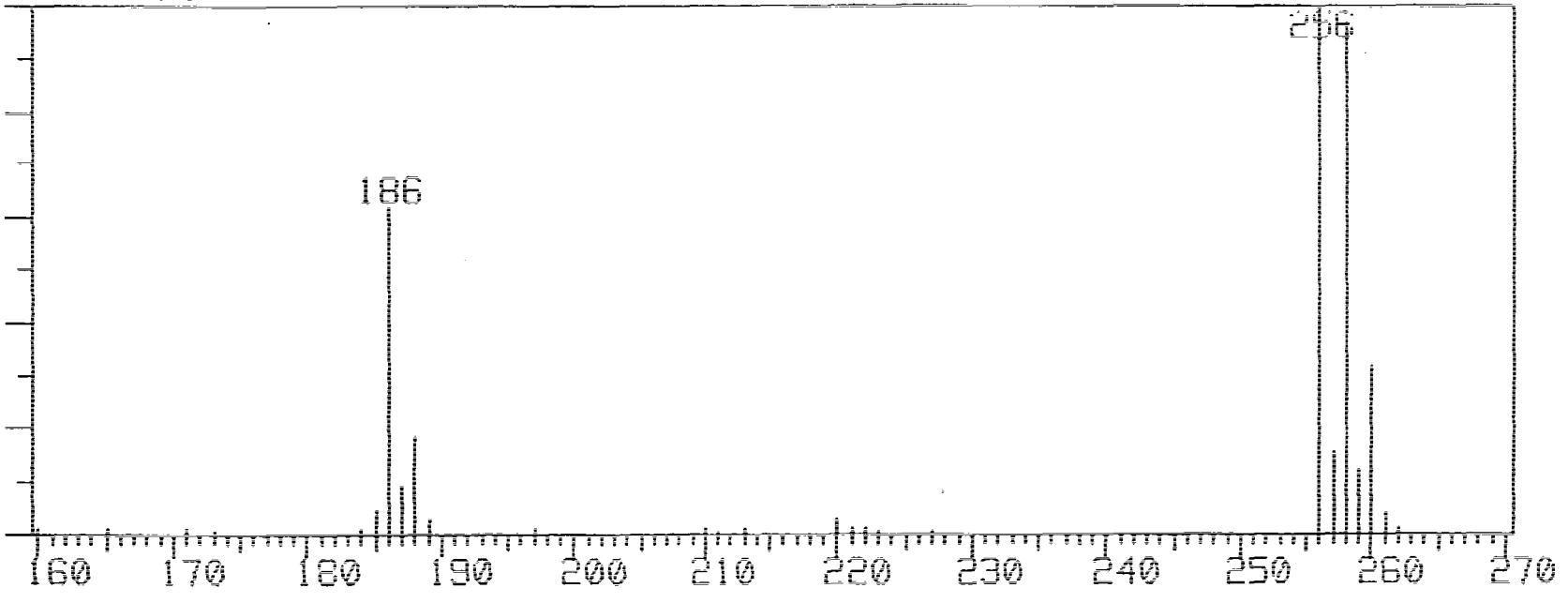




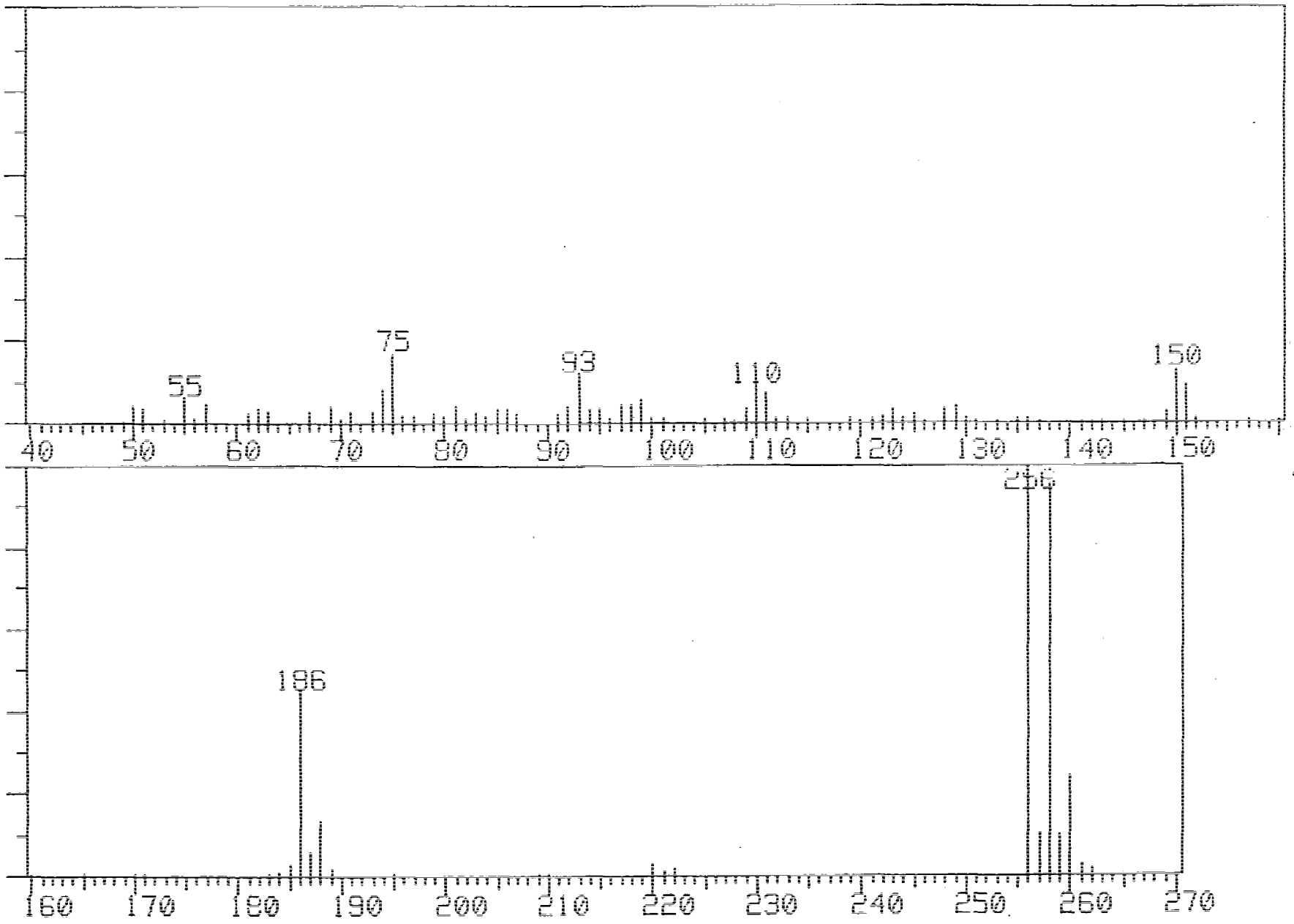
646722
18-APR-86 13:17:52 SCANS AVERAGED 1242-1246 TIME 19.70 MIN.
BCKG SCANS * 1.00 1238 100 % = 1564

TOTAL SCALE
9862 1*

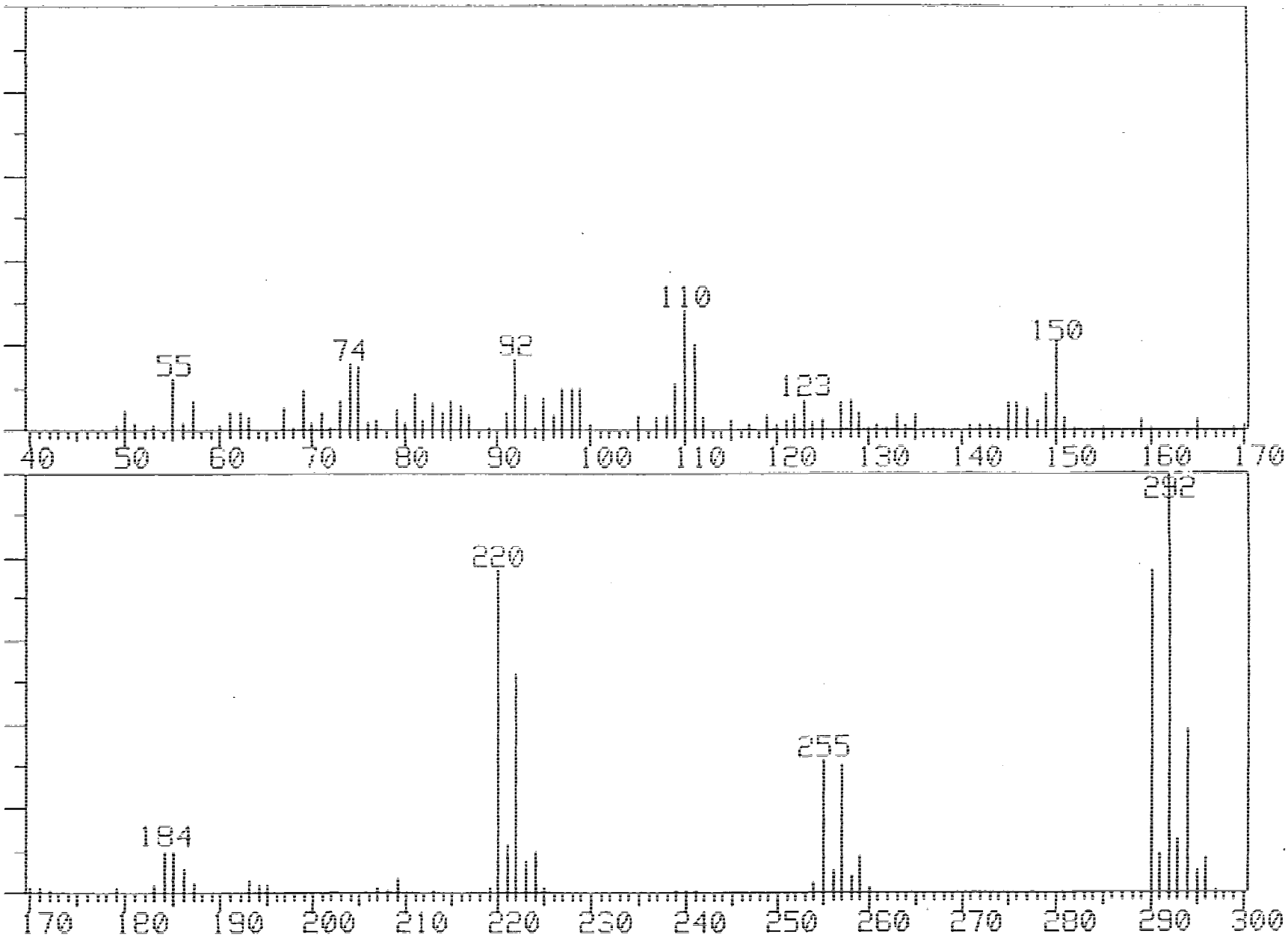




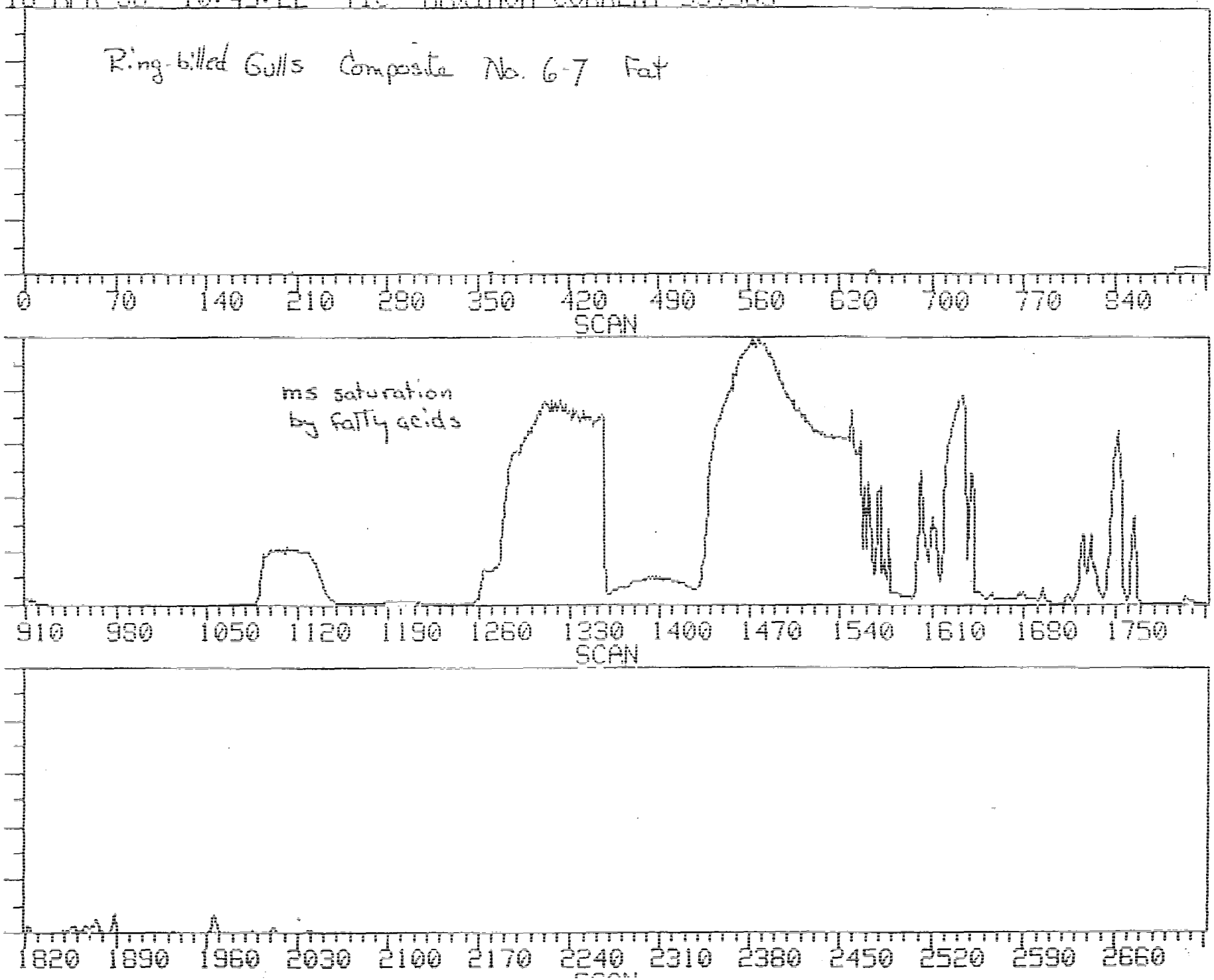
646722 TOTAL SCALE
19-APR-86 13:17:52 SCANS AVERAGED 1257-1266 TIME 19.91 MIN. 23131 1*
100 % = 4130



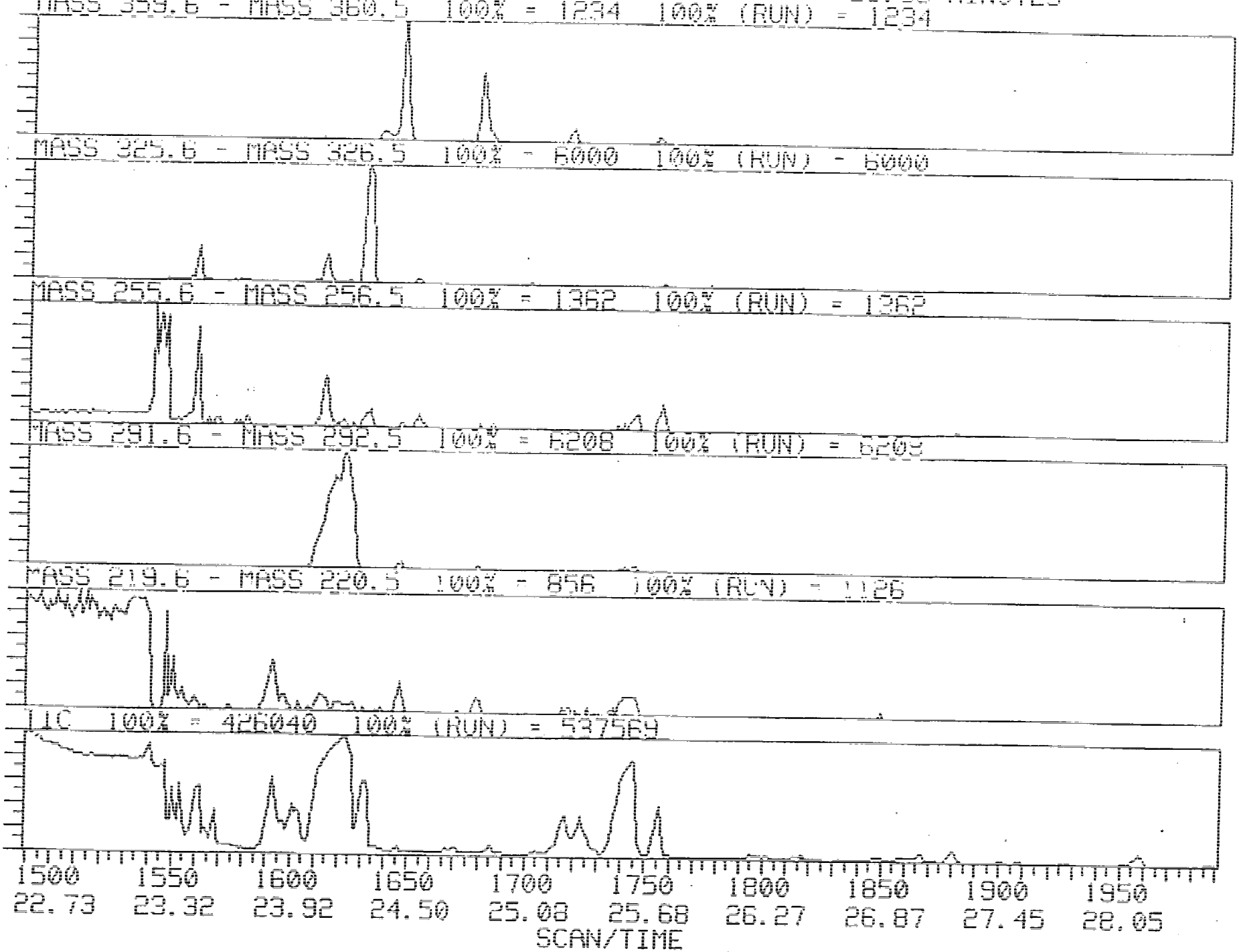
646722
18-APR-86 13:17:52 SCANS AVERAGED 1321-1327 TIME 20.65 MIN. TOTAL SCALE 16750 1*
100 % = 1730



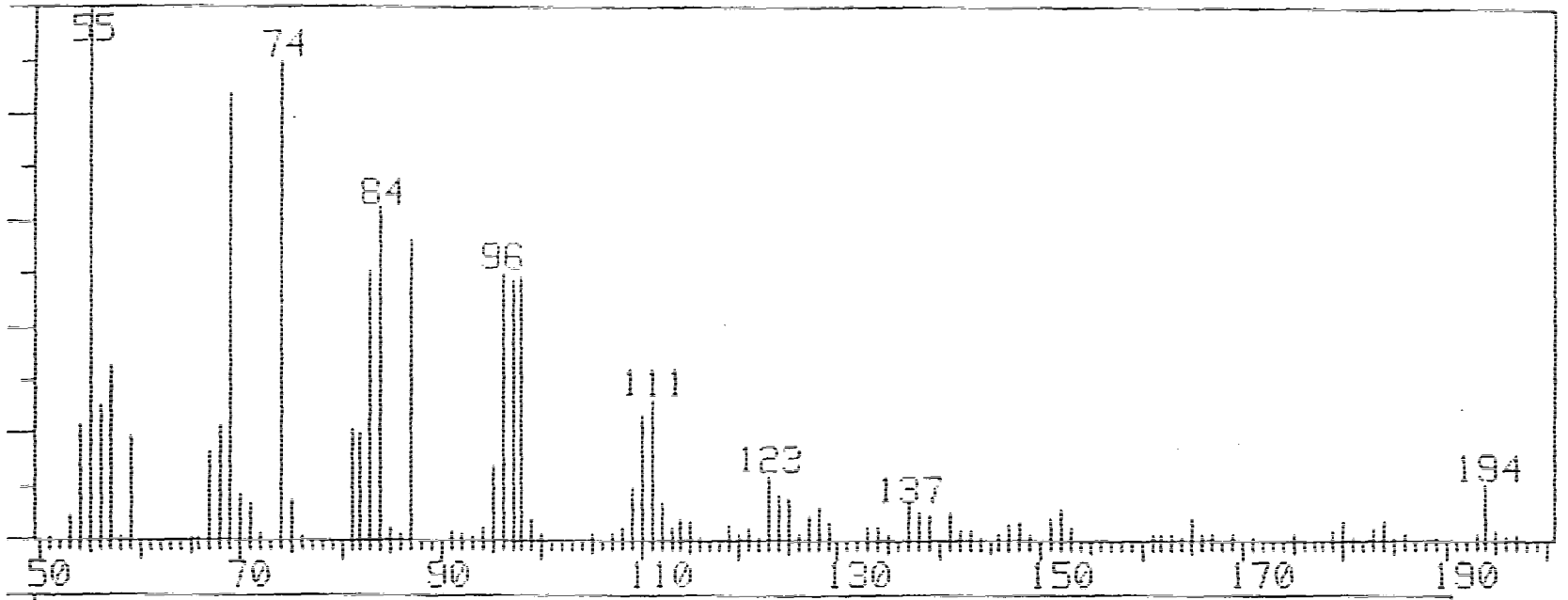
G-0716
18-APR-96 10:45:22 TIC MAXIMUM CURRENT=537569

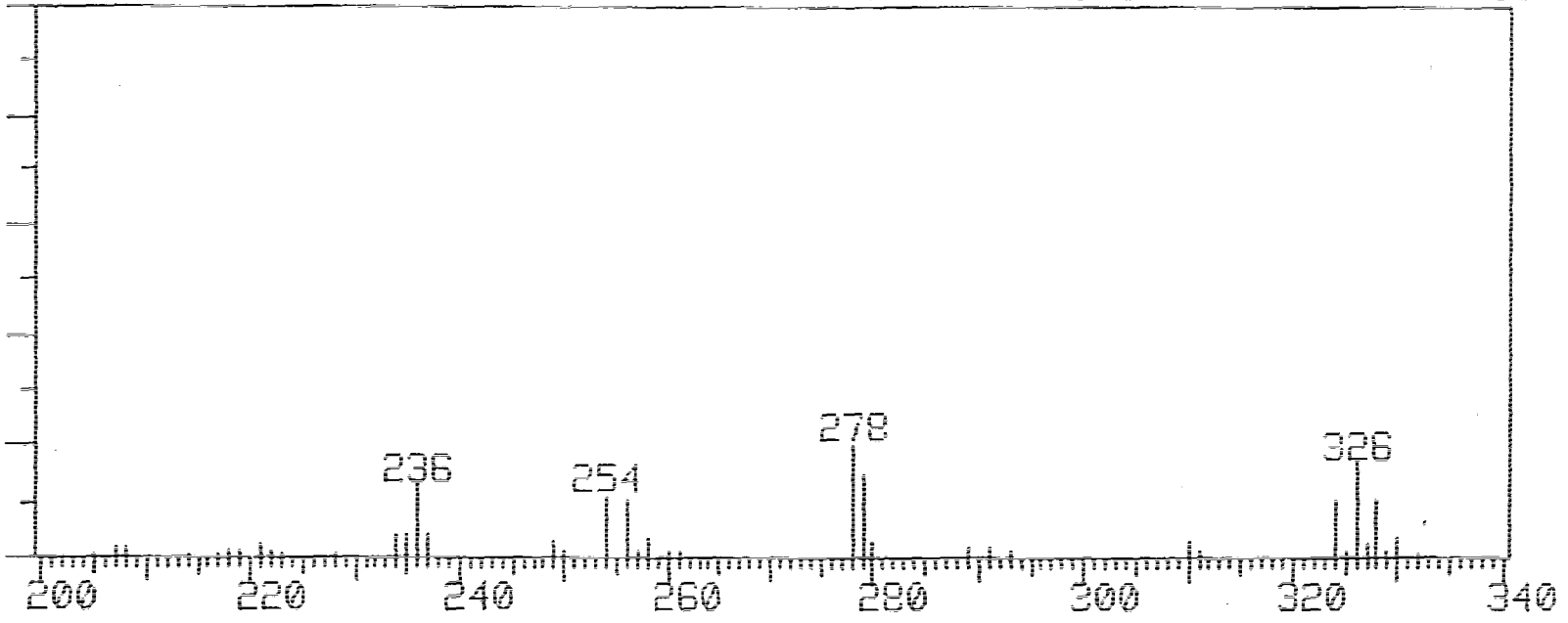


646712
18-APR-86 10:45:22 RETENTION TIMES SPANNED 22.73-28.63 MINUTES

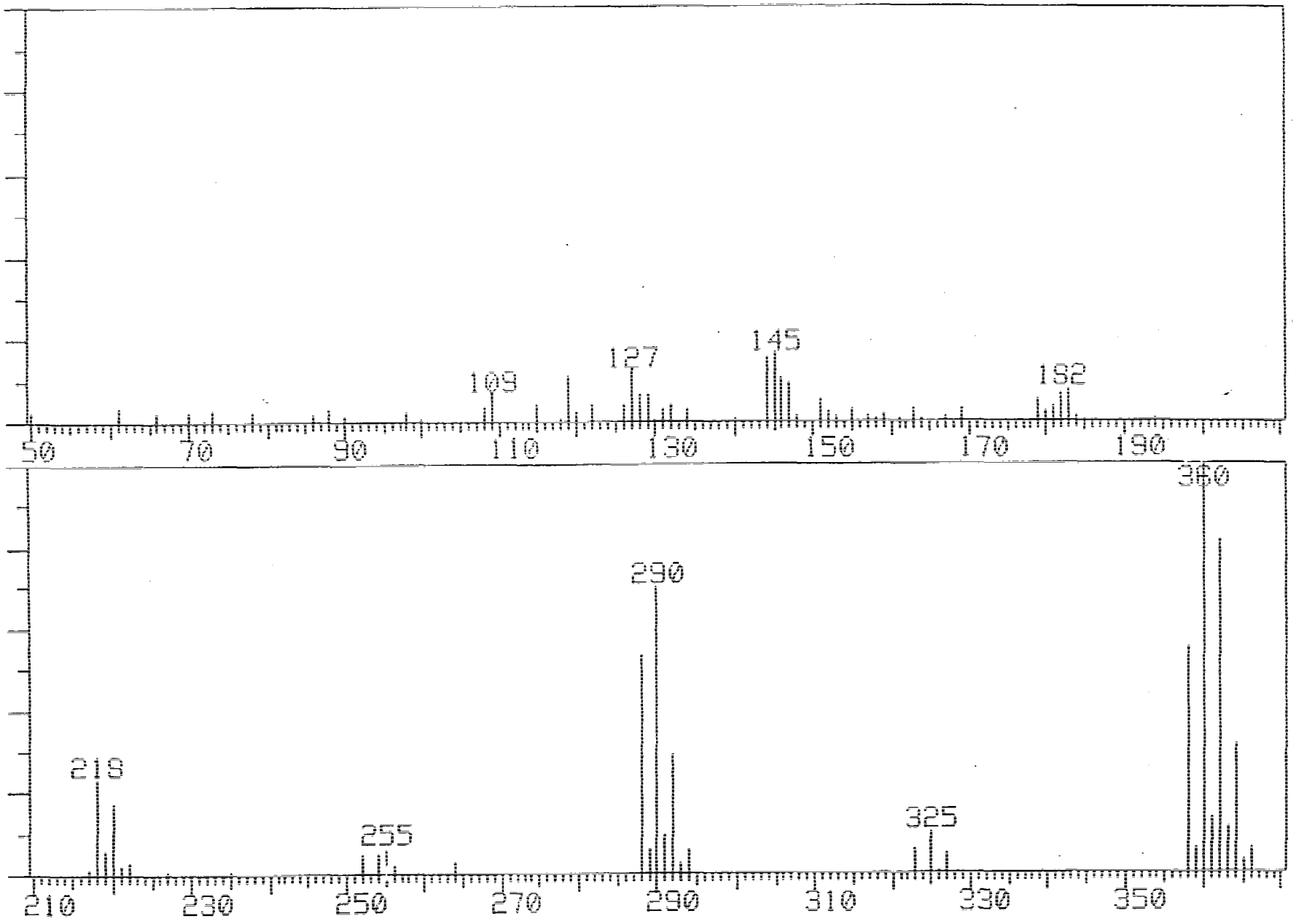


6-40712
18-APR-86 10:45:22 SCANS AVERAGED 1569-1570 TIME 23.54 MIN. TOTAL SCALE 74544 1*
BCKG SCANS * 1.00 1565 1575 100 % = 5987





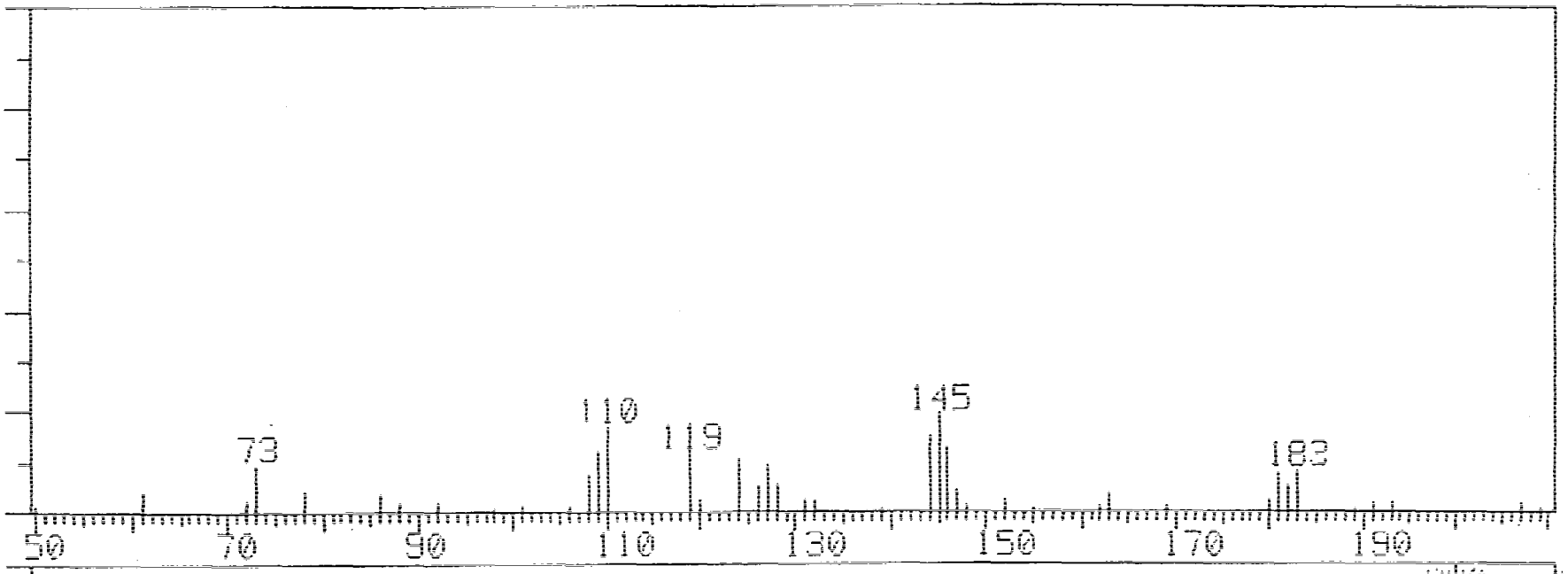
6.0712 TOTAL SCALE
19-APR-86 10:45:22 SCANS AVERAGED 1654-1657 TIME 24.57 MIN. 6263 1*
BCKG SCANS * 1.00 1650 100 % = 799

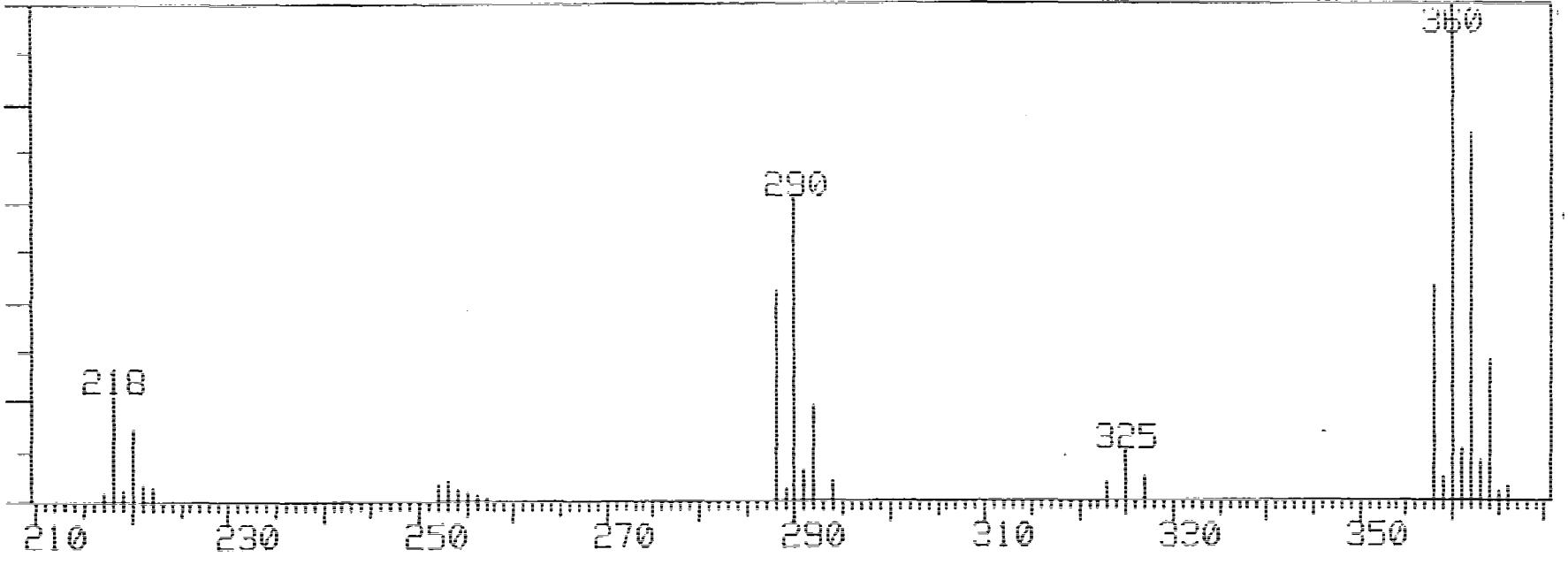


6.-712

18-APR-96 10:45:22 SCANS AVERAGED 1686-1691 TIME 24.96 MIN. TOTAL SCALE 2601 1*

BCKG SCANS * 1.00 1683 1703 1669 100 % = 373





APPENDIX H

CHAIN OF CUSTODY DOCUMENTATION

Record No: 1
Date: 15 April 1985

CHAIN OF CUSTODY RECORD

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
#1 Lt/muse	PCB, M.L.L. (Dan)	Ring-billed Gull. Whole animal	Clean paper and ice	15 Apr.'85		William S. Brewster
#2 " "						
#3 " "						
#4 " "						
#5 " "						
#6 " "						
#7 " "						
#8 " "						
#9 " "						
#10 " "						

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
[illegible]	[illegible]	15 Apr 0740 to 1985 0930	Fresh shot
Relinquished by: (Signature) [illegible]	Received by: (Signature) [illegible]	Date/Time 3/12/86	Sample Conditions: Frozen (Fat + Muscle only)
Relinquished by: (Signature) [illegible]	Received by: (Signature) [illegible]	Date/Time [illegible]	Sample Conditions:

FIRST NO. STATION / SAMPLE NO.

CHAIN OF CUSTODY RECORD

Record No: #2
Date: 21, 22 April '85

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
2/1-3	PCB	Peromyscus	ICE	21 April	12:26	Neis Barrett
3/1-3	PCB	"	ICE	21 April	12:56	Neis Barrett Charlotte Cogswell
4/2-7	PCB	"	ICE	"	1:17	Neis Barrett Charlotte Cogswell
5/1	PCB	"	ICE	"	1:46	Neis Barrett
3/4	PCB	"	ICE	22 April	2:30	Charlotte Cogswell

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
X Charlotte Cogswell	Kenneth J. Thomson	3/14/86 1:27 pm	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
Kenneth Thomson	David M. Pease	3/14/86 1655	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:

Record No: 21
Date: 20 April 1985

CHAIN OF CUSTODY RECORD

STATION No. — M = MUSSELS A = AMPHIPODS — SAMPLE No.

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
1-M/1-2	PCBs	MUSSELS	ICE	20 APRIL 85	10:41	CHARLOTTE COGSWELL
1-A	PCBs	AMPHIPODS	"	"	10:44	"
2-M/1-2	PCBs	MUSSELS	"	"	11:57	"
2-A	"	AMPHIPODS	"	"	12:20	"
3-M/1-2	"	MUSSELS	"	"	1:14	"
3-A	"	AMPHIPODS	"	"	1:27	"
4-M/1-2	"	MUSSELS	"	"	2:29	"
4-A	"	AMPHIPODS	"	"	2:42	MARK HARRIGAN
5-M/1-2	"	MUSSELS	"	"	3:11	CHARLOTTE COGSWELL
5-A	"	AMPHIPODS	"	"	4:09	"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
Charlotte Cogswell	Kenneth A. Thomson	3/14/86 1:37 PM	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
Kenneth A. Thomson	David M. Pease	3/14/8 1655	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:

Purpose of Inspection:

WHITE FLOTED MOUSE FOOD

Record No: 4
Date: 24 APRIL 85

CHAIN OF CUSTODY RECORD

Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
2/ SMILAX	PCM		ON ICE	29 APRIL 85	STATION 2 11:20 -	CHARLOTTE COGSWELL
2/ ACORNS	"		"		1:25	"
2/ ISOPODS	"		"			"
2/ MILLIPEDES	"		"			"
2/ ARAMERICES	"		"			"
	"					"
2/ RED MAPLE FRUIT	"		"			"
INSECTA { 2/ WEEVIL HEMIPTERAN 4/ GRASSHOPPER	"		"		STATION 4 1:57 -	"
4/ ISOPODS	"		"		3:20	"
4/ MELAMPUS	"		"			"
4/ ARAMERICES	"		"			"
4/ ROSE HIPS	"		"			"
4/ Juncus gerardii	"		"			"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
X Charlotte Cogswell	Kenneth J Thomson	3/14/86 1:27 PM	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
Kenneth Thomson	David M Pease	3/14/86 1655	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:

CHAIN OF CUSTODY RECORD

Date: 23 March 1987

1803	Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
1	Sta.1A	PCB's	Mussels / Cr, Cu, Pb, Zn	Ice	23 MAR 1987	1000	J. L. Atwood
2	Sta.1B	PCB's	Mussels / Cr, Cu, Pb, Zn	Ice	"	"	"
3	Sta.2A	PCB's	" "	"	"	"	"
4	Sta.2B	PCB's	" "	"	"	"	"
5	Sta.3A	PCB's	" "	"	"	"	"
6	Sta.3B	PCB's	" "	"	"	"	"
7	Sta.4A	PCB's	" "	"	"	"	"
8	Sta.4B	PCB's	" "	"	"	"	"
9	Sta.5A	PCB's	" "	"	"	"	"
10	Sta.5B	PCB's	" "	"	"	"	"
11	Sta.1-1	PCB's	Ulva "	"	"	"	"
12	Sta. 1-2	PCB's	" "	"	"	"	"
13	Sta.1-3	PCB's	" "	"	"	"	"
14	Sta.2-1	PCB's	" "	"	"	"	"

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
Jonath J Atwood	Frances K Rallin	9/3/87 0945	
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
Frances K Rallin	[illegible]	9/3/87 11 AM	Iced Down
Relinquished by: (Signature)	Received by: (Signature)	Date/Time	Sample Conditions:
[illegible]	Donna Stanek	9387 1630	BOTTLE

Method of Shipment:

CHAIN OF CUSTODY RECORD

Date: 23 March 1987

	Sample Designation	Analysis Required	Type of Sample Grab 1 Comp.	Preservative	Date Collected	Time Collected	Collectors Name
15	Sta.2-2	PCB's / Cr, Cu, Pb, Zn	Ulva	Ice	23 Mar 1987	1000	J. L. Atwood
16	Sta. 3-1	PCB's / Cr, Cu, Pb, Zn	"	"	"	"	"
17	Sta. 4-1	PCB's / Cr, Cu, Pb, Zn	"	"	"	"	"
18	Sta.4A-1	PCB's / Cr, Cu, Pb, Zn	"	"	"	"	"
19	Sta.5-1	PCB's / Cr, Cu, Pb, Zn	"	"	"	"	"
20	Black Duck A	PCB's / Cr, Cu, Pb, Zn	Anas rubripes (breast muscle)	"	20 Mar 1987	0830	J. L. Atwood
21	Black Duck A	(Vial provided) PCB's / Cr, Cu, Pb, Zn	Anas rubripes (subcutaneous fat)	"	"	"	"
22	Black Duck A	PCB's / Cr, Cu, Pb, Zn	Anas rubripes (liver)	"	"	"	"
23	STA. 4-2	"	ULVA				
24	STA 3-2	"	ULVA				

Relinquished by: (signature)	Received by: (signature)	Date/Time	Sample Conditions:
Jonathan J. Atwood	Frances K. Rattier	9/3/87 0945	
Relinquished by: (Signature) Frances K. Rattier	Received by: (Signature)	Date/Time 9/4/87 11 am	Sample Conditions: Iced down
Relinquished by: (Signature) Gary Kadis	Received by: (Signature) Donna Stanek	Date/Time 9/3/87 1630	Sample Conditions: BOTTLES DO NOT MATCH CHAIN OF CUSTODY

Method of Shipment: