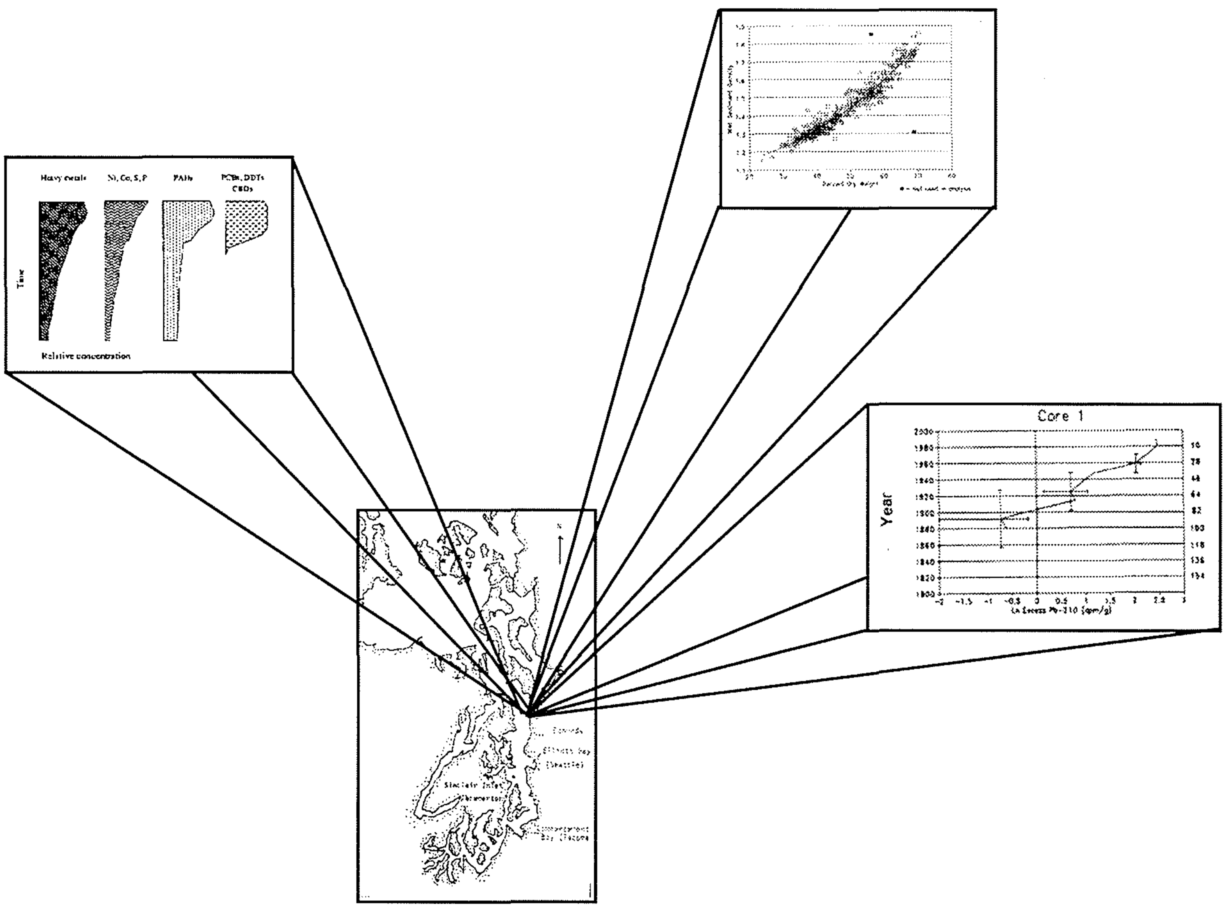
NOAA Technical Memorandum NOS ORCA 111

National Status and Trends Program
for Marine Environmental Quality

Historical Trends in the Accumulation of Chemicals in Puget Sound



Silver Spring, Maryland
December 1997

US Department of Commerce

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Coastal Monitoring and Bioeffects Assessment Division
Office of Ocean Resources Conservation and Assessment
National Ocean Service

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Notice

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The National Oceanic and Atmospheric Administration
National Status and Trends Program
Core Project Report Series

Foreword
by Nathalie Valette-Silver

Historical trends in contamination of estuarine and coastal sediments:

The composition of surface waters in rivers, lakes, and coastal areas has changed over time. In particular, changes due to the Industrial Revolution, dating from the middle of the last century, are very well known. These changes are expressed by increased levels of natural components, such as trace metals and nutrients, but also by the increase of anthropogenic compounds, such as polychlorinated biphenyls (PCBs) and pesticides.

Since the early 1960's, regulatory measures have been taken to decrease the amount of pollutants entering our waterways, but the bulk of these environmental measures were not enacted until the 1970's. Because of the scarcity of accurate data, due to the lack of sensitive techniques or of regular data collection in the past, the extent of the past pollution and the effect of the recent legislative limitations is often difficult to assess.

The analysis of sediment cores presents a way out of this dilemma. Most pollutants have an affinity for and adsorb easily onto sediments and fine particles. Therefore, by analyzing cores of undisturbed sediments it is possible to assess the historic pollution of a given system. Sediment cores reflect not only the history of pollutant concentrations but also register the changes in the ecology of a water body. For example, changes in estuarine eutrophication are reflected in the concentration of organic matter, nitrogen, and phosphorous, while lake acidification is translated into changes in diatom assemblages.

The use of cored sediments to reconstruct the chronology of coastal and estuarine contamination is not, however, devoid of problems and caution must be exercised. Sediment mixing by physical or biological processes can obscure the results obtained by such studies, and sophisticated methods must be used in these cases to tease out the desired information.

The NS&T Core Project

Between 1989 and 1996, the National Status and Trends Program sponsored research that gathered information on long term trends in contamination of US coastal and estuarine sediments. In this project, ten areas have been targeted. They include:

1) On the East coast:
   - Hudson/ Raritan estuary
   - Long Island Sound marshes
   - Chesapeake Bay
   - Savannah Estuary
2) On the Gulf coast:
   - Tampa Bay
   - Mississippi River Delta
   - Galveston Bay
3) On the West coast:
   - Southern California Bight
   - San Francisco Bay
   - Puget Sound

Presently, all the studies are completed and reports are, or will soon be, directly available from the cooperators. One of the most important results of the NS&T studies and of other similar studies reported in the literature, is the observed decline in recent years of many organic and inorganic contaminants in the sediments. It is very encouraging to know that mitigating measures taken in the 1970's have been effective. This has shed a hopeful light on the potential success of future efforts to curb even more coastal and estuarine pollution.

In an effort to widely disseminate the results of these studies, the NS&T Prgram, in collaboration with the authors, is publishing some of the reports as NOAA Technical Memoranda. This study of the Puget Sound area is the second one to be published in this series.

Historical Trends in the Accumulation of Chemicals in Puget Sound

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EXECUTIVE SUMMARY

Human activity in and around Puget Sound is reflected in the discharge of concentrated organic and inorganic contaminants into the sound's sediments. As industrial-age human activity increased, so did the contaminant levels in the sediment. Age-dated sediment cores collected in 1982 showed that the input of chemicals to the Sound, including lead (Pb), mercury (Hg), silver (Ag), copper (Cu), and hydrocarbons, began to increase above background in the late 1800s. The maximum concentration of these chemicals appears to have been discharged into sediments between 1945 and 1965. Synthetic organic compounds, such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichlorethane (DDT), and chlorinated butadienes, first appeared in sediments deposited in the 1930s and reached a maximum in the 1960s. The presence of the subsurface maximum concentrations in fine-grained, deep-water sediments suggests that pollution-control strategies have improved the sediment quality of central Puget Sound.

The purpose of this study is to: 1) continue monitoring historical trends in the concentration of contaminants in Puget Sound sediments, and 2) quantify recent trends in the recovery of contaminated sediments. Results from this study can be compared with those obtained in the 1982 study to determine whether sediment quality is still improving and to estimate the rate of recovery. A statistically significant reduction in sediment contamination over the past 20 years would provide empirical evidence that environmental regulation has had a positive impact on the water quality in Puget Sound.

Chemical trends were evaluated from six age-dated sediment cores collected from the main basin of Puget Sound. Chemical analyses included metals, polynuclear aromatic hydrocarbons (PAHs), PCBs and chlorinated pesticides, nutrients (total nitrogen [N], and phosphorus [P]), butyltins, and total organic carbon (TOC). Sedimentation (cm/yr) and deposition rates (g/cm2/yr) were estimated using a steady-state 210Pb dating technique (Lavelle et al. 1985, 1986; Nevissi et al. 1989).

The results of this study were in agreement with the earlier study by Bloom and Crecelius (1987). Trace metal contamination including Ag, arsenic (As), Cu, Hg, Pb, antimony (Sb), tin (Sn), and zinc (Zn) began in the late 1800s, reached a maximum in the mid-1900s, and began to decline in

the mid-1970s. Statistically significant average recovery rates estimated from the slope between the maximum and surface concentrations were observed for Cu, Hg, Pb, Sb, and Sn. Recovery rates for Ag, As, and Zn showed only a trend toward recovery. Concentrations of Cu, Pb, Sb, and Zn declined at a statistically significant rate in the last 20 years (which is generally after the maximum concentration was observed), lending support to our hypothesis that the strengthening of environmental regulation since 1970 has influenced the water quality of Puget Sound.

Trends in organic chemicals in the sediments over time also show a subsurface maximum. Hydrocarbon contamination appears to parallel that of heavy metals. Only DDT, however, showed a statistically significant average recovery rate. PAH concentrations, although decreased over four-fold from maximum concentrations, appear to be relatively constant over the past several decades. Significant decreases in sediment concentrations of synthetic organic contaminants were also observed with two- to four-fold decreases in surficial sediment concentrations. Concentrations of PCBs and DDT appear to be continuing to decrease.

Nutrients (P and N), linear alkyl benzenes (LABs), and biomarkers (hopane and total terpanes) were the only contaminants not showing a clear decrease in concentration. The nutrients show an extremely slight, but statistically significant, increase. Since the concentrations of LABs and biomarkers fluctuate in the near surface sediments, a plateau cannot be substantiated. Nutrients and LABs are associated with municipal sewage. Hopane and total terpanes are associated with petroleum products. Both sources of contaminants are expected to increase with an increasing population. However, despite the population growth of over one million people in the Seattle/Tacoma region in the past several decades, there has not been a substantial increase in these contaminants. Thus, the effect of strengthening environmental regulations on water quality cannot be negated.

CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

Human activity in and around Puget Sound is reflected in the discharge of concentrated organic and inorganic contaminants into the Sound's sediments. As industrial-age human activity increased, so did the contaminant levels in the sediment. Age-dated sediment cores collected in 1982 (Bloom and Crecelius 1987) showed that the input of chemicals to the Sound, including lead (Pb), mercury (Hg), silver (Ag), copper (Cu), and hydrocarbons, began to increase above background in the late 1800s. The maximum concentration of these chemicals appears to have been discharged into sediments between 1945 and 1965. Synthetic organic compounds, such as polychlorinated biphenyls (PCBs), dichlorophenyltrichlorethane (DDT), and chlorinated butadienes, first appeared in sediments deposited in the 1930s and reached a maximum in the 1960s. The presence of the subsurface maximum concentrations in fine-grained, deep-water sediments suggests that pollution-control strategies have improved the sediment quality of central Puget Sound.

The purpose of this study is to: 1) continue monitoring historical trends in the concentration of contaminants in Puget Sound sediments, and 2) quantify recent trends in the recovery of contaminated sediments. It is hypothesized that changes recorded in the cores reflect changes in the sediment contaminant loading and are a result of changes in industrial practices and in laws restricting disposal of contaminants. In the mid-1980s, two federal laws, the Safe Drinking Water Act (enacted 1974) and the Clean Water Act (enacted 1972), were amended by the Water Quality Act (1987) to provide greater enforcement and stricter regulatory standards to reduce chemical discharges from industrial waste into fresh surface waters, underground aquifers, and marine waters. Before 1980, regulations in Puget Sound were established for only 23 contaminants or groups of contaminants (Arbuckle et al. 1993). The relatively recent monitoring activities of the Puget Sound Water Quality Authority, established in 1985 by the Washington State legislature, puts greater political pressure on point-source polluters to further reduce chemical concentrations from their waste discharge. Results from this study can be compared with those obtained approximately 10 years ago by Bloom and Crecelius (1987) to determine whether sediment quality is still improving and if so, to estimate the rate of recovery. A statistically significant reduction in sediment contamination over the past 20 years would provide empirical evidence that regulation has had a positive impact on the water quality in Puget Sound.

2.0 METHODS

2.1 FIELD SAMPLING

Sediment cores were collected from six locations in the main basin of Puget Sound during September, 1991 (Figure 2.1) by scientists from the Battelle/Marine Sciences Laboratory (MSL). These sites were chosen because an earlier study (Bloom and Crecelius 1987) showed that little natural or anthropogenic disturbance occurred in these areas. The mixing of sediments from bioturbation takes place mainly within the top 2 cm but can occur down to 200 cm in depth from activity of crustaceans (e.g., *Axiopsis spinacauda*), bivalves (e.g., *Panope generosa*), sea urchins (e.g., *Brissaster latifrons*), sea cucumbers (e.g., *Molpadia intermedia*), and echiuroid worms (MacGinitie and MacGinitie 1949). These species are all known to occur at the sampling depth of 200 m (Wennekens 1959). Coring locations were determined using a Global Positioning System and a Loran C radio navigation system (Appendix A).

Samples were collected from the *RV Kittiwake* using a stainless steel, open-barrel gravity corer (Kasten corer), 2.5 m long, with a square cross section of 15 x 15 cm (Zangger and McCave 1990). Both a Kasten corer and a 7.6-cm-diameter open-barrel gravity corer, 1.5 m long, with a clear plastic liner, were used in the 1982 study (Bloom and Crecelius 1987). The Kasten corer, however, tended to provide more intact cores with less core shortening (Nevissi et al. 1989). Core shortening, an artifact of the coring process, is when the cored material is not pushed upwards within the core barrel.

Sediment cores were processed on board the research vessel. The core barrel was opened by removing screws along the entire length. Sediment smeared during the coring was removed by scraping the exposed surface with a clean stainless steel spatula. An acceptable core was approximately 1.5 m in length and had no visible disturbance of surface sediments. Color photographs were taken, and visible changes in color, structure, and texture were recorded. The core was then sectioned into 2-cm intervals with a clean, stainless steel spatula. Sectioned samples were stored in precleaned jars, either glass or polystyrene, depending on the corresponding analysis. The coring equipment was rinsed with ambient seawater between stations and scrubbed and acetone rinsed after each cruise

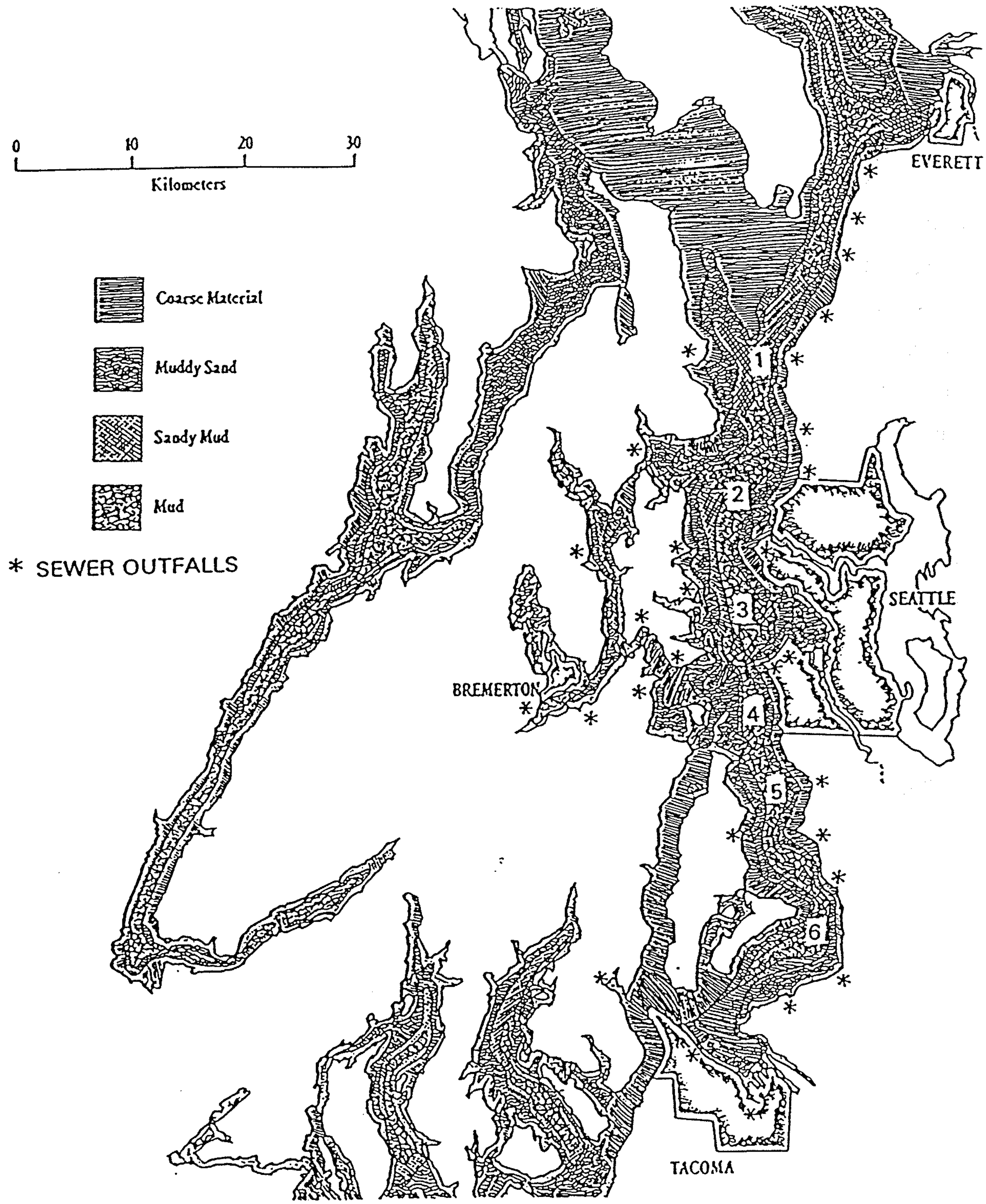


FIGURE 2.1. Sediment Coring Stations (1 - 6) Collected with Kasten Cores in the Summer 1991 and Sewer Outfalls that Could Affect Sediment Contamination Loadings

day to remove possible contamination. The 300-kg-weight corer stand was wrapped in a polyethylene film to further reduce possible contamination.

At the time of collection, a chain-of-custody form was initiated and then maintained with each sample through the life of the sample (i.e., through storage, analytical analysis, and disposal). Samples were stored on ice in a cooler for no more than 2 days while in transit to the MSL, where they were logged into the laboratory database system (FOXBASE). Samples were then stored approximately 1 month either frozen (-22°C ± 2°C) or cold (4°C ± 2°C) until analysis.

2.2 ANALYTICAL METHODS

Approximately 25 2-cm sections were analyzed from each core. Sediment concentrations of metals and the radionuclide lead-210 (^{210}Pb) were analyzed from equally spaced intervals from all six cores. Cesium-137 (^{137}Cs) was analyzed from equally spaced intervals from Cores 2 through 6. For Cores 3, 5, and 6, sediments from the adjoining 2-cm sections were analyzed for polynuclear aromatic hydrocarbons (PAHs), PCBs, chlorinated pesticides, nutrients (phosphorous [P] and nitrogen [N]), and butyltins. In addition, adjoining sections from Cores 3, 5, and 6 were analyzed for grain size and total organic carbon (TOC). All samples were analyzed for percentage of moisture. Specific compounds analyzed are presented in Table 2.1.

Analyses for most of the chemicals measured followed methods used for the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends Program (Lauenstein and Cantillo 1993). Measurements of analytical precision were based on the variance from individually processed standard reference materials.

2.2.1 Metals

A total of 16 metals were analyzed at the MSL in Sequim, Washington. They were: silver (Ag), aluminum (Al), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), manganese (Mn), nickel (Ni), lead (Pb), antimony (Sb), selenium (Se), silica (Si), tin (Sn) and zinc (Zn). Three metals (Ag, Cd, Se) were analyzed by graphite furnace atomic absorption (GFAA) spectrometry using Zeeman background correction following the method of Bloom (1983). Two metals, Sb and Sn, were analyzed by inductively coupled plasma mass spectrometry (ICP/MS). Mercury was analyzed using

TABLE 2.1. Organic Compounds, Elements, and Physical Properties Quantified in Sediment Cores

Polynuclear Aromatic Hydrocarbons
Naphthalene[a]
2-Methylnaphthalene[a]
1-Methylnaphthalene
Biphenyl
2,6-Dimethylnaphthalene
Acenaphthylene[a]
Acenaphthene[a]
2,3,5-Trimethylnaphthalene
Fluorene[a]
Phenanthrene[a]
Anthracene[a]
1-Methylphenanthrene
Fluoranthene[a,b]
Pyrene[a,b]
Benz(a)anthracene[a,b]
Chrysene[a,b]
Benzo(b)fluoranthene[a,b]
Benzo(k)fluoranthene[a,b]
Benzo(e)pyrene
Benzo(a)pyrene[a,b]
Perylene
Indeno(1,2,3-c,d)pyrene[a,b]
Dibenz(a,h)anthracene[a,b]
Benzo(g,h,i)perylene[a,b]

Elements
Aluminum (Al)
Silver (Ag)
Arsenic (As)
Cadmium (Cd)
Chromium (Cr)
Copper (Cu)
Iron (Fe)
Mercury (Hg)
Manganese (Mn)
Nickel (Ni)
Lead (Pb)
Antimony (Sb)
Selenium (Se)
Silicon (Si)
Tin (Sn)
Zinc (Zn)

Polychlorinated Biphenyls [c]
2,4'-Cl2(8)
2,2',5-Cl3(18)
2,4,4'-Cl3(28)
2,2'3,5'Cl4(44)
2,2'5,5'-Cl4(52)
2,3',4,4'-Cl4(66)
3,3',4,4'-Cl4(77)
2,2',4,5,5'-Cl5(101)
2,3,3',4,4'-C15(105)
2,3',4,4',5-Cl5(118)
3,3',4,4',5-Cl5(126)
2,2'3,3',4,4'-Cl6(128)
2,2',3,4,4'5'-C16(138)
2,2'4,4'5,5'-C16(153)
2,2'3,3',4,4',5-C17(170)
2,2'3,4,4',5,5'-C17(180)
2,2',3,4',5,5',6-C17(187)
2,2',3,3',4,4',5,6-C18(195)
2,2',3,3',4,4',5,5',6-C19(206)
decachlorobiphenyl-Cl10(209)

Pesticides
Hexachlorobenzene
Lindane
Heptachlor
Aldrin
Heptachlorepoxide
alpha-Chlordane
trans-Nonachlor
Dieldrin
Endrin
Mirex
o,p'-DDD
p,p'-DDD
o,p'-DDE
p,p'-DDE
o,p'-DDT
p,p'-DDT

Nutrients
Nitrogen (N)
Phosphorus (P)

Butyltins
Tributyltin
Dibutyltin
Monobutyltin

Radionuclides
^{210}Pb
^{137}Cs

Physical Properties
Dry weight
Grain size
Total Organic Carbon (TOC)

Biomarkers
Hopane
Total Terpanes

Linear Alkyl Benzenes (LAB)
Phenyl Decanes
Phenyl Undecanes
Phenyl Dodecanes
Phenyl Tridecanes
Phenyl Tetradecanes

(a) Summed to create the variable Total PAH.
(b) Summed to create the variable Combustable PAH.
(c) Isomer numbers are indicated in parentheses.

cold-vapor atomic absorption (CVAA) spectroscopy (Bloom and Crecelius 1983). The remaining 10 metals were analyzed using energy-diffusive x-ray fluorescence (XRF). All metal concentrations are presented in μg/g dry weight.

To prepare sediments for analysis, samples were freeze-dried and blended in a ceramic Spex mixer-mill. Approximately 5 g of mixed sample was ground in the ceramic ball mill. The XRF analysis was performed on a 0.5-g aliquot of dried, ground material pressed into a pellet with a diameter of 2 cm. For ICP/MS, GFAA, and CVAA analyses, 0.2-g aliquots of dried homogenous sample were totally digested using a 4:1 nitric:perchloric acid solution and concentrated hydrofluoric acid in a Teflon pressure vessel placed in a 130°C oven for a period of 16 h.

2.2.2 Radionuclide Analysis ^{210}Pb and ^{137}Cs

The activity of ^{210}Pb in sediment was determined at the MSL by counting the alpha particles from the granddaughter polonium-210 (^{210}Po), similar to the method of Koide et al. (1973). Sediment samples were spiked with ^{208}Po and digested with nitric acid. The Po isotopes were plated on a silver disk and then counted using silicon barrier diode detectors. The excess ^{210}Pb was determined by subtracting supported ^{210}Pb from the measured ^{210}Pb activity. Activity of ^{210}Pb is reported in disintegrations per minute per gram (dpm/g) on a dry weight basis.

The activity of ^{137}Cs was determined at the MSL by gamma counting sediment on a lithium drifted germanium diode [Ge (Li)] detector; it is reported in dpm/g on a dry weight basis. The diode was calibrated with certified reference soil in the same geometry.

2.2.3 Polynuclear Aromatic Hydrocarbons (PAH)

Polynuclear aromatic hydrocarbons analyses were performed at the Battelle Ocean Sciences (BOS) Laboratory in Duxbury, Massachusetts, following the method of NOAA Status and Trends Program (Lauenstein and Cantillo 1993). Samples were solvent extracted with dichloromethane (CH_2Cl_2) using Soxhlet extraction. Extracts were cleaned using a combination of Al/Si column chromatography, followed by additional cleanup using high-performance liquid chromatography (HPLC). Extracts were then analyzed using gas chromatography/mass spectrometry (GC/MS) operated in the selective ion mode (SIM). A total of 20 specific PAH compounds and a number of alklylated PAH compounds were reported. In addition, linear alkylbenzenes, hopanes, and terpanes were also analyzed. Results are reported in μg/kg dry weight.

2.2.4 Polychlorinated Biphenyl (PCB) and Chlorinated Pesticides

PCB and chlorinated pesticide analyses were performed at BOS. Samples were extracted simultaneously with the PAHs, as described above, and analyzed by gas chromatography/electron capture detection. Eighteen individual PCB congeners and 16 chlorinated pesticides were reported without second column confirmation in μg/kg dry weight.

2.2.5 Total Nitrogen and Phosphorus

Nitrogen was analyzed by Huffman Laboratories, Inc. of Golden, Colorado. Analysis was performed using a Carlo-Erba 1106 combustion instrument using The American Society for Testing and Materials (ASTM) D5291 (ASTM 1992 guide). Phosphorus was analyzed at Battelle/Pacific Northwest Laboratories in Richland, Washington, using wavelength-dispersive XRF. Both nutrients are presented as a percentage of the total dry weight.

2.2.6 Butyltins

Butyltin compounds were analyzed at the MSL using gas chromatography/flame photometric detection (GC/FPD) following the methods of Unger et al. (1986). Samples were extracted with methylene chloride and tropolone. Propyltin was added before extraction as a surrogate compound to assess extraction efficiency. The mono-, di- and tributyltin compounds extracted from the sediment were derivatized to a less volatile, more thermally stable form (nonionic n-pentyl derivatives). Extracts were passed through a Florisil liquid chromatography column for cleanup, and butyltins were quantified by GC/FPD. Butyltin results are presented in μg/kg dry weight.

2.2.7 Grain Size

Sediment grain size was determined at the MSL using a combination of sieve and pipette. The grain-size intervals measured were gravel (<2 mm), sand (2 mm to 0.063 mm), silt (0.063 mm to 0.004 mm), and clay (<0.004 mm). Results are presented in percentage by weight.

2.2.8 Total Organic Carbon (TOC)

Total organic carbon was analyzed at Global Geochemistry in Canoga Park, California. Dried, ground samples were sent to the lab, where the inorganic carbon was driven off and the remaining sample was analyzed for organic carbon using a combustion method, with a Leco WR-12 induction furnace. Results are presented as a percentage of the total dry weight.

2.2.9 Sediment Dry Weight

The dry weight of each sediment section was determined by freeze-drying known amounts of sediment for a minimum of 96 h. Results are reported in percentage by weight.

2.3 DATA ANALYSIS

2.3.1 Sedimentation and Deposition Rates

Sedimentation (cm/yr) and deposition rates ($g/cm^2/yr$) were estimated using a steady-state ^{210}Pb dating technique (Lavelle et al. 1985, 1986; Nevissi et al. 1989). This method assumes: 1) sedimentation rate is constant, 2) loss of ^{210}Pb from sediment layers occurs only by radioactive decay, 3) mixing is confined to the surface mixed layer, and 4) intervals of sediment used for analysis have well defined depositional times that are short compared to the overall dating period.

Wet sediment density (ρ_w) was calculated from the measured percentage dry weight (d) using the nonlinear relationship

$$\rho_w = \alpha\left(\beta + e^{\gamma d}\right) \qquad (1)$$

where the parameters (with 95% confidence limits in parentheses) α = 0.1737 (0.1087 to 0.2889), β = 5.0245 (2.4646 to 8.9962), and γ = 0.0238 (0.0187 to 0.0290) were estimated from 381 observations of wet sediment density and percentage of dry weight sampled from Puget Sound in 1981 (Figure 2.2 and Appendix B). It is preferable to measure wet sediment density concurrent with each measurement of ^{210}Pb (Carpenter et al. 1984, 1985). However, this practice is difficult and not often done. Often, a constant

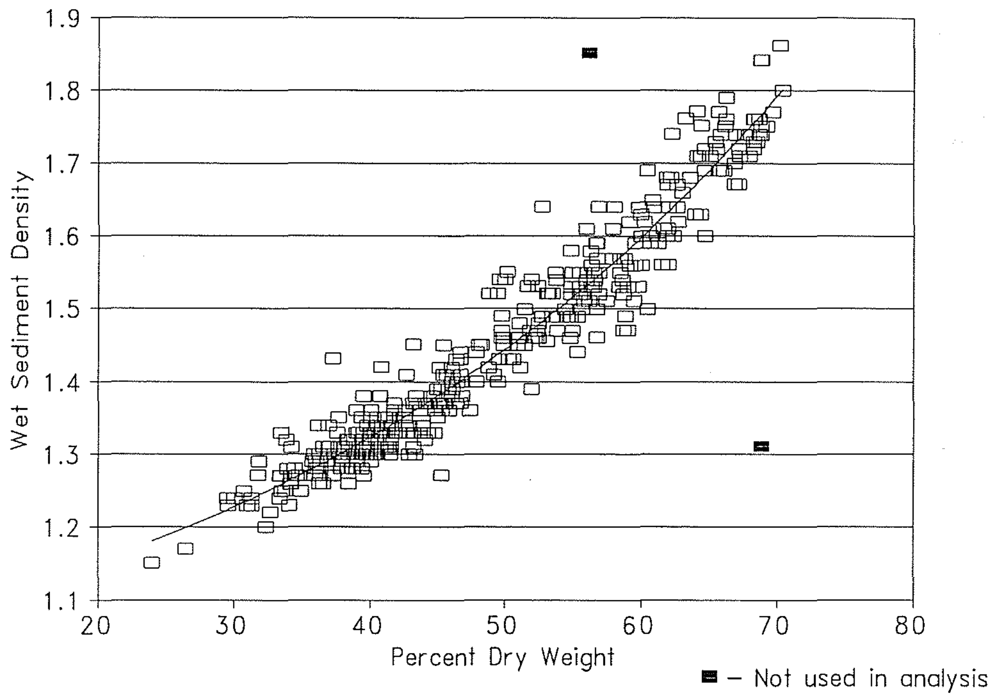


FIGURE 2.2. Nonlinear, Best Fit Model of the Form $y = 0.1737\ (5.0245 + e^{0.0238\,x})$ for y, Wet Sediment Density (g/cm^3), and x, the Associated Percent Dry Weight, for 383 Sediment Samples Collected from Puget Sound During Summer 1981

wet density measured from a few samples is assumed for each depth and across all cores. If the deposition rate (which is a function of sediment density) and porosity cannot be accurately assessed, then a simpler model with constant density often provides less error in the core dating than would additional model structure and inaccurate density information.

Only data from below the surface mixed layer was used to calculate the sedimentation rate. Mixing can be a result of human activities and/or can occur naturally from bioturbation and currents. The thickness of the surface mixed layer is elucidated (albeit subjectively) by a plot of the natural log ^{210}Pb activity (dpm/g) of dry sediment versus sediment depth (cm). The depth at which the natural log ^{210}Pb activity indicates steady-state decay behavior and no longer fluctuates erratically marks the end of the mixed layer. The mixed layer within Puget Sound has been observed to vary in thickness from depths of 2 cm to 30 cm (Carpenter et al. 1984,1985).

Excess ^{210}Pb was determined by subtracting supported ^{210}Pb, which is generally assumed to be the average concentration of ^{210}Pb measured in the lower section of the cores displaying a constant ^{210}Pb activity. However, if a core was not long enough to reach background, a value for supported ^{210}Pb associated with cores taken in close proximity from earlier studies (Bloom and Crecelius 1987; Lavelle et al. 1985) was used. Previous studies in Puget Sound sediment have reported excess ^{210}Pb activities in the surface sediment of approximately 10 dpm/g and supported ^{210}Pb ranging from 0.5 to 1 dpm/g (Bloom and Crecelius 1987; Carpenter et al. 1985; Lavelle et al. 1985, 1986).

If cores did not reach background ^{210}Pb activity, a second evaluation on the supported ^{210}Pb activity was conducted. Using the current value of supported ^{210}Pb activity (i.e., from neighboring cores that did reach background), the resulting stable Pb time series was evaluated, since this time series is well documented for Puget Sound (Romberg et al. 1984). Romberg et al. (1984) determined that the background levels (prior to 1890) of stable Pb range from approximately 4 μg/g in sandy sediment to 7μg/g in mud. By 1890 ($\pm$5 yr) stable Pb concentrations equaled two times the background concentration. This was most likely due to the Tacoma smelter, which began operating as a Pb smelter in 1890. If the resulting stable Pb time series showed increases of Pb beyond approximately

10 μg/g before 1900, then the supported ^{210}Pb was decreased in a step-wise fashion until the resulting elemental Pb time series matched historical knowledge.

The activity of excess ^{210}Pb per unit weight of dry sediment (dpm/g) at depth x (cm), C_x (dpm/g), is given by

$$C_x = \frac{P\, e^{\frac{-kx}{S}}}{\rho S} \tag{2}$$

where P is the unknown deposition rate of unsupported ^{210}Pb (dpm/cm^2/yr), $k = 0.0311$ is the radioactive decay constant of ^{210}Pb per year, S is the unknown constant sedimentation rate (cm/yr), and ρ is the *in situ* density of dry sediment (g/cm^3) (Nevissi et al. 1989). The natural logarithm of the activity of excess ^{210}Pb is then given by

$$\ln C_x = \ln \frac{P}{\rho\, S} - \frac{k}{S}\, x \tag{3}$$

which facilitates a least squares solution for the slope, k/S. The constant sedimentation rate, S (cm/yr), in each of the six cores collected was then estimated by dividing the radioactive decay constant, 0.0311, by the slope of the functional response in equation (3) using data from below the mixed layer and above the layer indicating background levels of ^{210}Pb activity. If sediment density is ignored or not known, the age of each sediment interval can be determined by the mean depth divided by the sedimentation rate. Confidence limits about the mean year for each sediment interval was based on the error about the least squares slope estimate.

The constant sedimentation rate, S, can be related to the deposition rate (r), or mass accumulation rate, of unsupported ^{210}Pb per unit area and unit time (g/cm^2/yr) by the equation:

$$r = S(1 - \phi)\rho_s \tag{4}$$

where ρ_s is the dry density of sediment (g/cm^3)

$$\rho_s = \frac{\rho_w \text{ (Fraction Dry Weight)}}{1 - \rho_w \text{ (Fraction Wet Weight)}} \tag{5}$$

and ϕ is defined as the porosity

$$\phi = \frac{\rho_s \text{ (1 - Fraction Dry Weight)}}{\left(\rho_s \text{ [1 - Fraction Dry Weight]} + \rho \text{ [Fraction Dry Weight - Salinity Fraction]} \right)} \tag{6}$$

with ρ equal to the density of seawater (Lavelle et al. 1985). For purposes of comparison, the deposition rate was calculated assuming a seawater density of 1.0229 g/cm^3 and a salinity of 30‰ (Lavelle et al. 1985). Sediment age corrected for variable sediment density was calculated by dividing the total accumulated solids corrected for salt (A_x) in (g/cm^2) to each interval depth (x) by the deposition rate ($g/cm^2/yr$), where A_x is calculated as

$$A_x = \sum_{j \le x} j \left(\rho_{w(j)} \left[\text{Fraction Dry Weight}_j \right] - \text{Salinity Fraction} \left[\text{Fraction Wet Weight}_j \right] \right) \tag{7}$$

for the j^{th} wet density and j^{th} fraction dry weight allocated to only the centimeters of sediment between the i-1 and the i^{th} sample of sediment. Sediment age, ignoring sediment density (from Equation 3), however, was used in all plots evaluating contaminant trends, because fewer model assumptions are required.

2.3.2 Trend Analysis

A trend analysis, following Bloom and Crecelius (1987), was conducted on metal, PCBs, and DDT concentrations, which displayed a potential decline after obtaining a maximum value. In order to determine the correlation between the strengthening of environmental laws with sediment contaminant loadings, the linear correlation coefficient (r) was used to evaluate the significance of the relationship between the concentrations of Ag, As, Cu, Hg, Pb, Sb, Zn, total PCBs, and DDT against year from 1970 to 1991 individually for Cores 3, 5, and 6. A least squares analysis would be inappropriate since neither axis can be assumed to be known without error. A significant negative correlation (i.e., a decrease in concentration of these contaminants with increasing year) provides empirical evidence that the strengthening of environmental legislation in the past 20 years has had an influence on the water quality in Puget Sound.

2.3.3 Sediment Recovery Rates

Sediment recovery rates are defined as the rate at which contaminant loadings in the sediment are reduced. Ideally, one would be interested in the year that sediment contaminant loadings return to background conditions. However, this estimation problem requires an unrealistic assumption that recovery rates remain constant beyond the bounds of the observed data.

Recovery rates were estimated by calculating the slope between the subsurface maximum and the surface concentration for contaminants indicating a decrease (e.g., Ag, As, Cu, Hg, Pb, Sb, Zn, total PCBs, and DDT). The slope was calculated using only these two observations per contaminant to provide greater weight to the current recovery pattern. Alternatively, the least squares solution, using all of the data between the maximum and surface concentrations, could be used to estimate recovery rates. However, observations with the steepest gradient (generally deeper in the core) would have much greater influence on the slope estimate than would the data near the surface, which generally show a slowing of recovery.

An average recovery rate for the region based on the combined rates estimated from Cores 3, 5, and 6, and with 95% confidence limits were calculated. Even though contaminant loadings and deposition rates are different for each site, it might be expected that the rate of recovery within the region might be consistent for any given contaminant.

3.0 RESULTS AND DISCUSSION

Summary tables of results for all analyses are presented in appendices attached to this report. Appendix A contains the site-specific data for each core sampling station. Radionuclide results and the data used to estimate wet sediment density are presented in Appendices B and C, respectively. Results for all physical and chemical analyses are presented in Appendices D through K. All results reported in the text include the 95% confidence limits in parentheses.

3.1 SEDIMENTATION RATES

In this study, the mixed layers ranged from 10 cm to 40 cm in depth based on observed fluctuations in the concentrations of ^{210}Pb (Figure 3.1). Core 5, taken northeast of Vashon Island, showed the deepest mixed zone of approximately 39 cm, and Cores 1 and 6, the northern- and southernmost cores, had the smallest, at approximately 10 cm. Table 3.1 presents the location, supported ^{210}Pb, mixing depth, sedimentation rates, porosity, and deposition rates for all six cores, assuming a seawater density of 1.0229 g/cm^3 and a salinity of 30‰ (Lavelle et al. 1985). The time-corrected ^{210}Pb and excess ^{210}Pb concentrations and percentage of dry weight for each core section is listed in Appendix B.

Initially it appeared that background was reached in Core 6, based upon a leveling of the ^{210}Pb activity, which decreased to an average 0.78 ($\pm$0.07) dpm/g. However, the resulting time series for stable Pb (Figure 3.2) was not consistent with established background concentrations (Romberg et al. 1984). A supported level of 0.4 ^{210}Pb dpm/g, however, did approximate the expected stable Pb time series and was used in the final calculations. A supported ^{210}Pb concentration of 1 dpm/g was sufficient for Cores 3 and 5 and a supported ^{210}Pb concentration of 0.3 dpm/g was needed for Cores 2 and 4. Activities of excess ^{210}Pb ranged from approximately 0.6 dpm/g to 12 dpm/g (Figure 3.3 and Appendix B).

Our results indicate a sedimentation rate of approximately 1 to 2 cm/yr in the deep region of central Puget Sound, which agrees with the results found in an earlier study by Lavelle et al. (1985, 1986). The mean porosity ranged from 0.72 to 0.82, which is

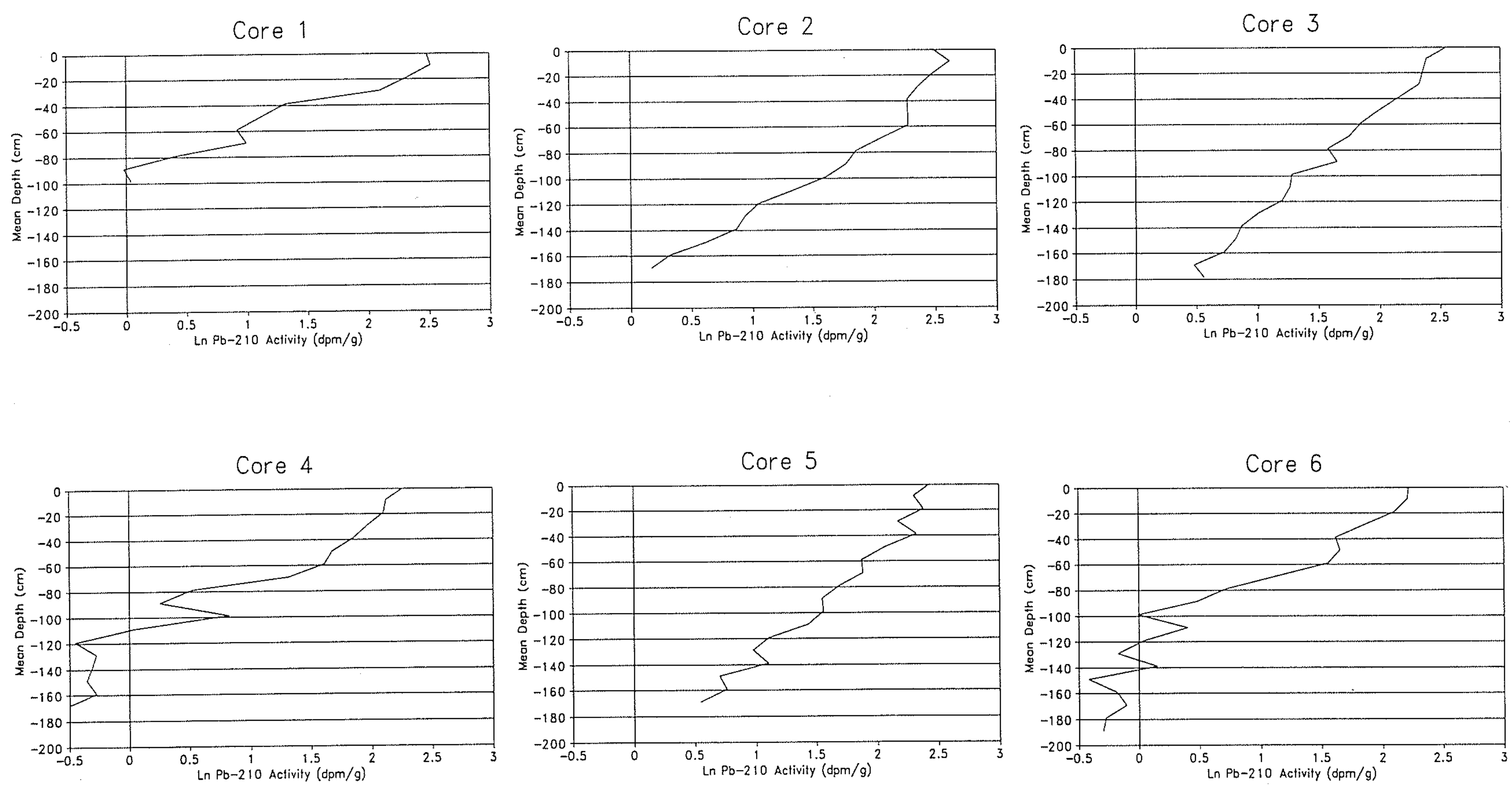


FIGURE 3.1. Natural Logarithm of ^{210}Pb Activity ($\pm$ 0.17 dpm/g) for Cores Collected from Puget Sound During Summer 1991

TABLE 3.1. Station Data and Best-Fit Model Results

Core No.	Latitude (N)/ Longitude (W)	Water Depth (m)	Core Depth) (cm)	Supported ^{210}Pb Activity (dpm/g)	Number of Samples[a]	Mixing Depth (cm)	Sedimen-tation Rate[b] (cm/yr)	Mean Porosity	Average Deposition Rate[c] ($g/cm^2/yr$)
1	47°47.59' N 122°25.97' W	189	100	0.5	7	9	0.90 ± 0.37	0.725 ± 0.020	0.65 ± 0.05
2	47°42.09' N 122°26.58' W	203	170	0.3	15	19	1.70 ± 0.20	0.774 ± 0.008	1.00 ± 0.04
3	47°36.90' N 122°26.80' W	201	188	1.0	14	19	1.88 ± 0.14	0.803 ± 0.006	0.94 ± 0.04
4	47°33.41' N 122°26.26' W	238	170	0.3	9	19	1.11 ± 0.49	0.794 ± 0.010	0.58 ± 0.03
5	47°28.68' N 122°24.28' W	194	170	1.0	10	39	2.01 ± 0.47	0.819 ± 0.009	0.90 ± 0.06
6	47°21.00' N 122°24.59' W	178	190	0.4	9	9	1.05 ± 0.31	0.816 ± 0.006	0.48 ± 0.02

(a) Below the mixed layer and above background.
(b) Confidence limits are at the 95% level.
(c) The deposition rate is calculated using Equation 4 assuming a seawater density of 1.0229 g/cm^3, and a salinity of 30‰ (Lavelle et al. 1985).

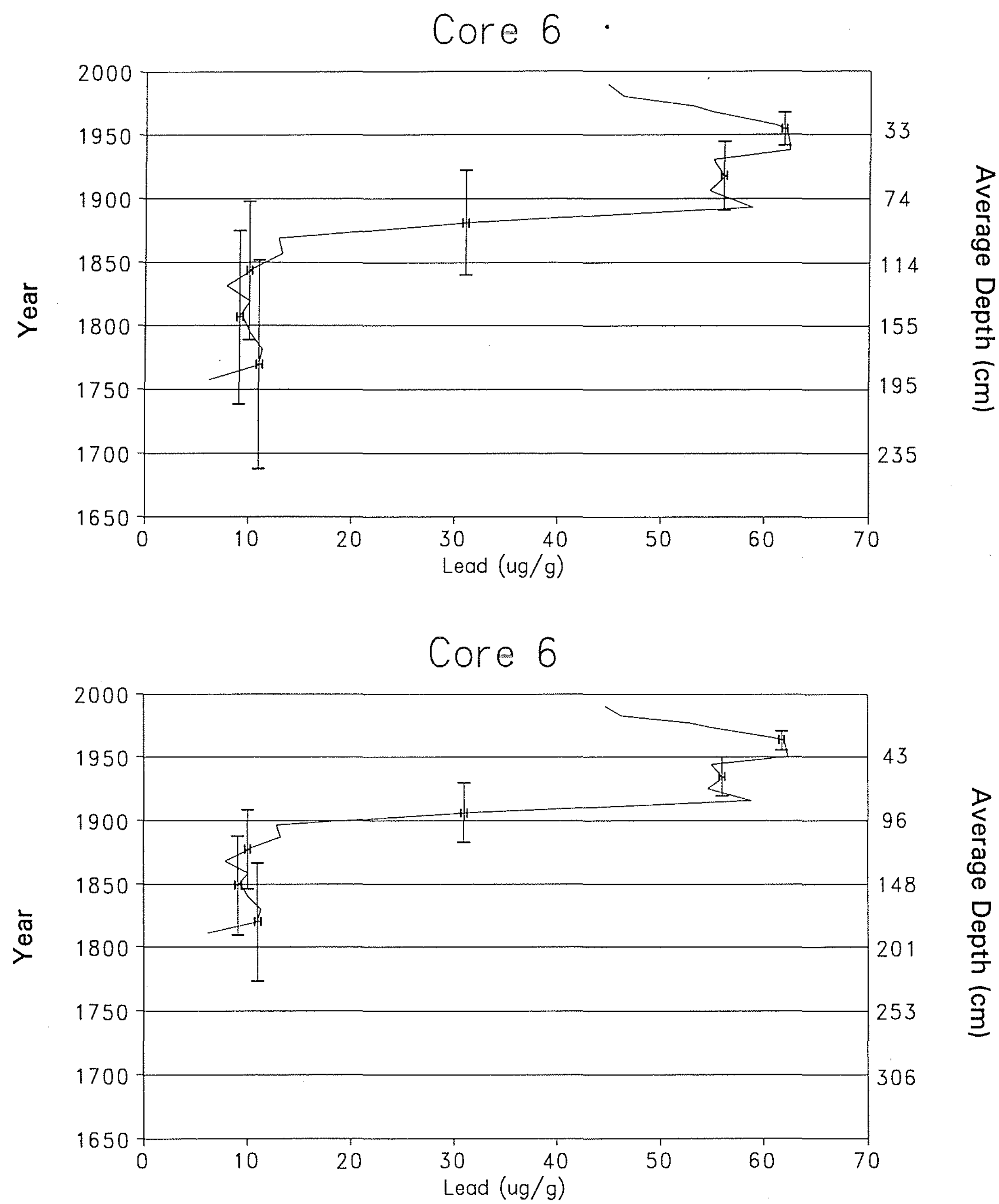


FIGURE 3.2. Stable Lead Profiles (μg/g dry weight) for Core 6 Calculated Using Background ^{210}Pb Activities of 0.78 dpm/g (Top) and 0.4 dpm/g (Bottom)(error bars encompass the 95% confidence interval about the mean year and concentration)

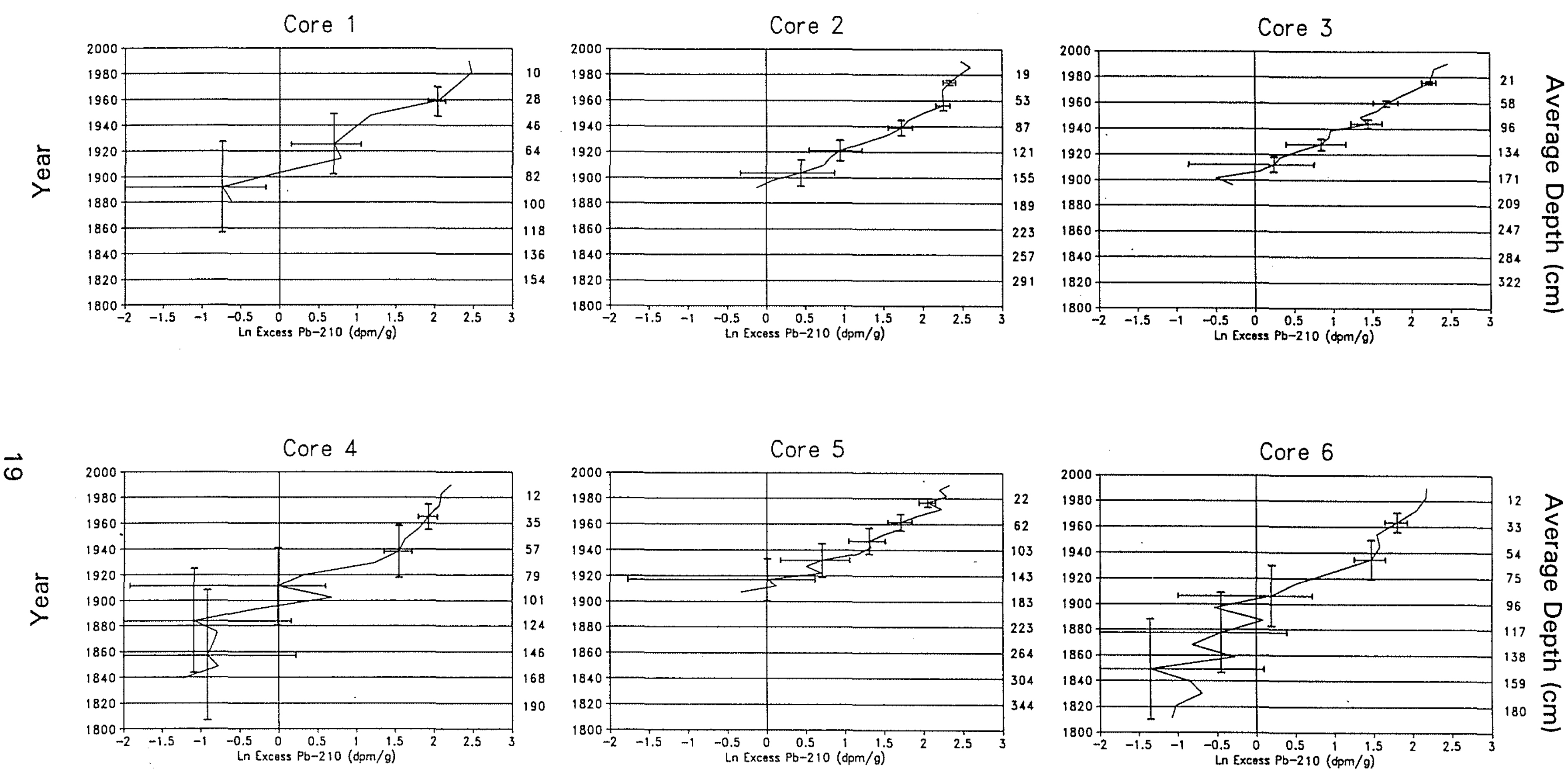


FIGURE 3.3. Natural Logarithm of Excess ^{210}Pb Activity ($\pm$ 0.84 dpm/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year)

consistent with the mean porosities calculated by Lavelle et al. (1985, 1986), which ranged from 0.66 to 0.83. Deposition rates ranged from 480 to 1000 mg/cm^2/yr, with the lowest accumulation found in Core 6, which was located just north of Tacoma. These rates agree well with data from past studies within the same region and water depth of Puget Sound, where mass accumulation rates ranged from 98 to 790 mg/cm^2/yr (Carpenter et al. 1985), 340 to 1400 mg/cm^2/yr (Bloom and Crecelius 1987), and 260 to 1200 mg/cm^2/yr (Lavelle et al. 1985, 1986).

Sediment ages calculated by: 1) correcting for sediment density, and 2) ignoring sediment density were in excellent agreement (Table 3.2). The 95% confidence limits for the latter, which are based on the error in the regression from Equation 3, encompassed the sediment age incorporating sediment density information. Confidence limits for sediment age corrected for density incorporate the error from the nonlinear model in Equation 1. This added model structure may or may not reflect the appropriate error in the core dating resolution. Thus, the simpler model, which ignores the density information, was chosen for the evaluation of contaminant trends.

3.1.1 Cesium-137 Dating

Activity of ^{137}Cs (dpm/g) in the sediment was measured to provide a second means of determining the age of a sediment layer. During the last 30 years, ^{137}Cs has been entering the oceans from the atmospheric testing of nuclear weapons. The major input occurred between 1957 and 1965, producing a maximum of ^{137}Cs activity in the ocean surface water in approximately 1965. Since then, the ^{137}Cs level in surface water has decreased slowly due to mixing with the deep ocean and radioactive decay (Livingston and Bowen 1979). Marine sediments in contact with seawater exchange stable Cs and ^{137}Cs; thus, the levels of ^{137}Cs in the seawater and the sediments are related. Once these sediments are removed from interaction with seawater through burial, the ^{137}Cs activity could change. The presence of a subsurface maximum would suggest that both mixing and migration have not been intense enough to distort this feature (Romberg et al. 1984).

Figure 3.4 presents the ^{137}Cs profile for Cores 2 through 6 against depth. A distinct subsurface maximum is evident in the 1960s for Cores 2, 3, and 6. Cores 4 and 5 reached a maximum in the early 1970s.

TABLE 3.2. Sediment Ages Calculated by Correcting for Sediment Density and by Ignoring Sediment Density for Cores Collected from Puget Sound During Summer 1991

Core	Mean Depth	Year Density Corrected	Mean Year Ignoring Density	95% Confidence Limits Ignoring Density Lower	Upper
1	1	1989	1990	1989	1990
	9	1980	1981	1977	1985
	19	1970	1970	1962	1977
	29	1960	1959	1947	1970
	39	1949	1948	1932	1963
	49	1936	1936	1917	1956
	59	1928	1925	1902	1949
	69	1911	1914	1887	1942
	79	1900	1903	1872	1934
	89	1905	1892	1857	1927
	99	1875	1881	1842	1920
2	1	1990	1990	1990	1990
	9	1985	1986	1985	1986
	19	1979	1980	1979	1981
	29	1973	1974	1972	1976
	39	1968	1968	1965	1971
	49	1963	1962	1959	1966
	59	1955	1956	1952	1960
	69	1950	1950	1946	1955
	79	1944	1945	1939	1950
	89	1938	1939	1933	1945
	99	1933	1933	1926	1940
	109	1927	1927	1920	1934
	119	1920	1921	1913	1929
	129	1921	1915	1907	1924
	139	1912	1909	1900	1919
	149	1907	1903	1893	1914
	159	1903	1898	1887	1908
	169	1899	1892	1880	1903
3	1	1990	1990	1990	1991
	9	1986	1986	1986	1987
	19	1981	1981	1980	1982
	29	1975	1976	1974	1977
	39	1969	1970	1969	1972
	49	1966	1965	1963	1967
	59	1960	1960	1957	1962
	69	1956	1954	1952	1957
	79	1951	1949	1946	1952

TABLE 3.2. (contd)

Core	Mean Depth	Year Density Corrected	Mean Year Ignoring Density	95% Confidence Limits Ignoring Density	
				Lower	Upper
3	89	1944	1944	1940	1947
	99	1940	1938	1935	1942
	109	1936	1933	1929	1937
	119	1926	1928	1923	1932
	129	1922	1923	1917	1928
	139	1913	1917	1912	1923
	149	1916	1912	1906	1918
	159	1913	1907	1900	1913
	169	1910	1901	1895	1908
	179	1899	1896	1889	1903
4	1	1989	1990	1990	1990
	9	1982	1983	1980	1986
	19	1974	1974	1967	1980
	29	1967	1965	1955	1975
	39	1957	1956	1943	1969
	49	1950	1947	1930	1964
	59	1938	1938	1918	1958
	69	1928	1929	1906	1952
	79	1924	1920	1893	1947
	89	1918	1911	1881	1941
	99	1888	1902	1868	1936
	109	1903	1893	1856	1930
	119	1878	1884	1844	1925
	129	1879	1875	1831	1919
	139	1862	1866	1819	1913
	149	1863	1857	1806	1908
	159	1854	1848	1794	1902
	169	1856	1839	1782	1897
5	1	1990	1991	1990	1991
	9	1986	1987	1986	1988
	19	1981	1982	1979	1984
	29	1976	1977	1973	1980
	39	1970	1972	1967	1976
	49	1967	1967	1961	1972
	59	1964	1962	1955	1968
	69	1957	1957	1949	1964
	79	1957	1952	1943	1960
	89	1950	1947	1937	1957
	99	1946	1942	1931	1953

TABLE 3.2. (contd)

Core	Mean Depth	Year Density Corrected	Mean Year Ignoring Density	95% Confidence Limits Ignoring Density Lower	Upper
5	109	1940	1937	1925	1949
	119	1934	1932	1919	1945
	129	1934	1927	1913	1941
	139	1925	1922	1907	1937
	149	1923	1917	1901	1933
	159	1921	1912	1895	1929
	169	1915	1907	1888	1926
6	1	1989	1990	1990	1990
	9	1981	1982	1980	1985
	19	1972	1973	1968	1978
	29	1963	1963	1956	1971
	39	1956	1954	1944	1964
	49	1943	1944	1931	1957
	59	1936	1935	1919	1950
	69	1930	1925	1907	1943
	79	1919	1916	1895	1936
	89	1914	1906	1883	1930
	99	1903	1897	1871	1923
	109	1887	1887	1859	1916
	119	1875	1878	1846	1909
	129	1870	1868	1834	1902
	139	1864	1859	1822	1895
	149	1856	1849	1810	1888
	159	1841	1840	1798	1881
	169	1824	1830	1786	1874
	179	1830	1820	1774	1867
	189	1823	1811	1761	1861

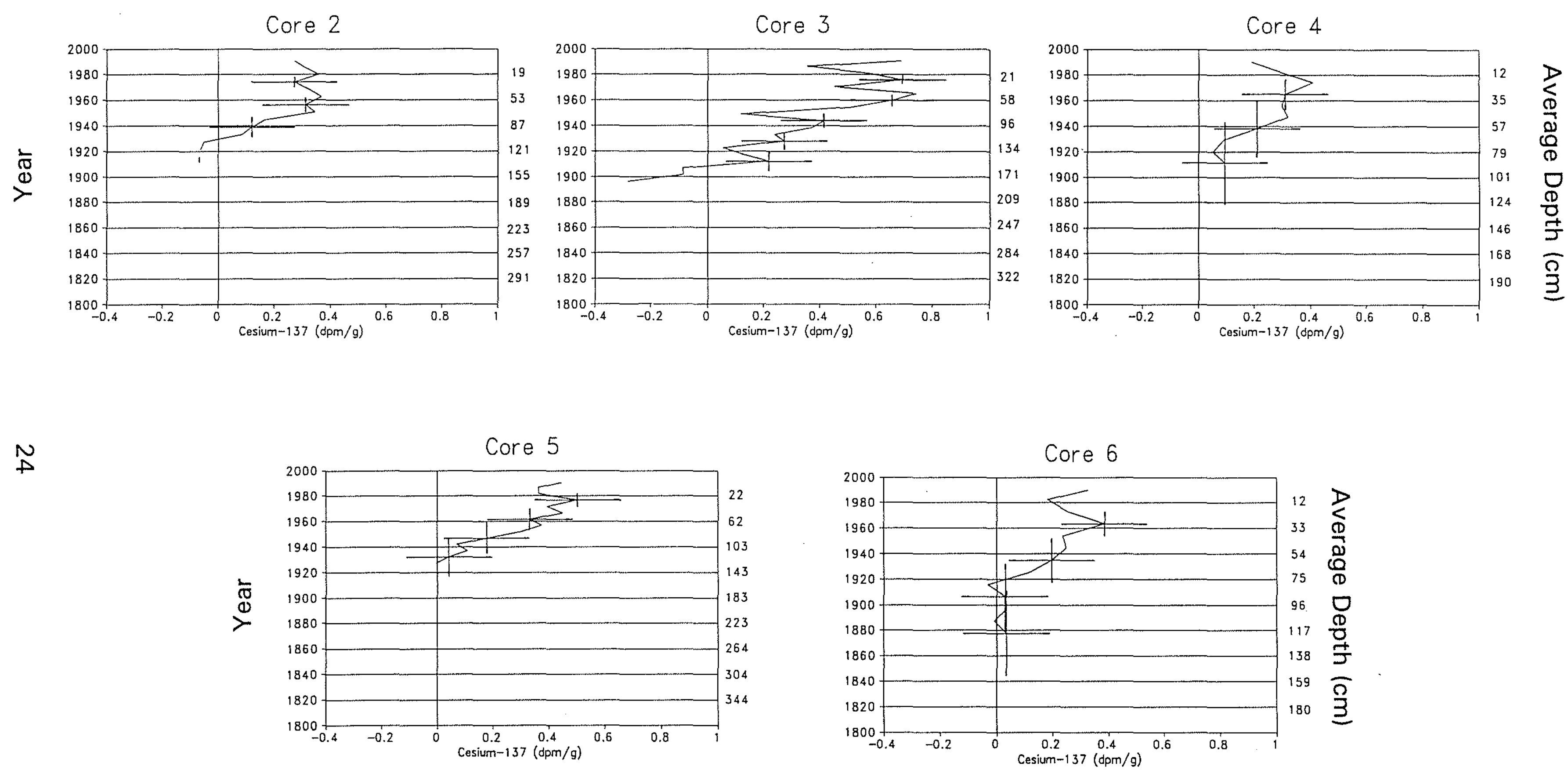


FIGURE 3.4. ^{137}Cs Activity (dpm/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

Assuming that the ^{137}Cs maximum was introduced in roughly 1965, the ^{137}Cs profile compares well to the sedimentation rate determined from the ^{210}Pb data.

3.2 ANCILLARY ANALYSIS

Grain size was analyzed in approximately 20 samples from Cores 3, 5 and 6 (Appendix D). Greater than 95% of the particles from Core 3 were <0.0625 mm in diameter, with approximately 51% silt (0.0625 mm to 0.004 mm) and 45% clay (<0.004mm). Core 5 was approximately 5% sand, 46% silt, and 49% clay. Sediment from Core 6, however, contained slightly higher percentages of sand, ranging from 4% to 18%, especially in the upper half of the core. The average percentages of silt and clay for Core 6, the southernmost station, were 42% and 49%, respectively. Overall, the ranges of sand, silt, and clay content did not vary greatly with depth. This supports the assumption of a constant sedimentation rate in the ^{210}Pb-dating model.

Total solids were measured in all intervals from all cores. Percentage total solids ranged from approximately 30% to 45% and increased slightly with depth in all cores. Total organic carbon was measured from equally spaced intervals from Cores 3, 5, and 6; it ranged from 1.37% to 2.26%, reported as a percentage of TOC on a dry weight basis. In general, a decrease in TOC can be correlated with an increase in percent sand; thus, TOC was measured to confirm changes in sediment type. The range of TOC for these cores suggests that no natural or other disturbances that would affect sediment type occurred within the 200-year time frame encompassed by the cores.

3.3 NUTRIENTS

Nutrients (percentage of P and percentage of total N) were measured from equally spaced 2-cm intervals from Cores 3, 5, and 6 (Appendix G). There was a general increase in concentration of nutrients over time. The concentration of P ranged from 0.09% at the surface to 0.06% in the deepest sections of the cores and increased an average of 0.0002% ($\pm 7 \times 10^{-5}$) per year, whereas that of N ranged from 0.26% at the surface to 0.16% at the bottom of Core 6, and increased an average of 0.0005% (±.0001) per year. The increases in both nutrients are statistically significant (α = 0.05). The slight increase in total N is probably a result of increased sewage entering the system. In closed systems, peaks in a core profile indicate over-nutrification, which can often be associated with a point-source, such as a sewage outfall. However, in the nutrient rich waters of the Pacific Ocean and Puget Sound, these measurements may be too coarse to determine anthropogenic influences. Specific nitrogen compounds (e.g., nitrites) might provide more information associated with anthropogenic sources of contamination.

3.4 METALS CONCENTRATIONS AND TRENDS

Ten metals were analyzed by XRF in all cores (Appendix H). An additional six metals, for a total of 16, were analyzed at equally spaced intervals from Cores 3, 5, and 6. The level of many of these metals has decreased steadily since the study by Bloom and Crecelius (1987).

The profile of Pb concentration versus year (Figure 3.5) is similar for all cores. In general, each profile depicts a steep rise in Pb concentration to a series of peaks spanning from 1920 to 1960 and then declining from 1960 to the present. The maximum value of Pb was 69.4 ($\pm$0.276) μg/g obtained in approximately 1922 from Core 6. Cores 3, 5, and 6 produced an average 38% drop from the maximum to the surface concentration (Table 3.3). The concentration of Pb in the central basin of Puget Sound was determined to be significantly (α = 0.05) decreasing by 0.57 ($\pm$0.31) μg/g per year. Significant (α = 0.05) negative correlations between year and concentration for sediments deposited after 1970 lends support for the effectiveness of current environmental regulation.

Concentrations of the crustal elements, Al, Fe, and Si, were at background levels in all cores and showed little or no change in concentration with depth (Figures 3.6 through 3.8). These profiles are consistent with the assumption that sediment mineralogy (a mixture of feldspars, quartz, and clay minerals) in the deep basin of Puget Sound has not changed in the recent past as a result of either natural or human causes. The profiles of Mn (Figure 3.9) show a slight to a nearly twofold increase in concentration in the upper intervals of the core. We suggest that this is due to reducing conditions at depth and post-depositional migration (Riley and Chester 1976) rather than to anthropogenic influences. The extent to which elements are mobilized prior to migration is dependent on the redox potential, pH, and organic content of the sediment. Iron has been predicted to be

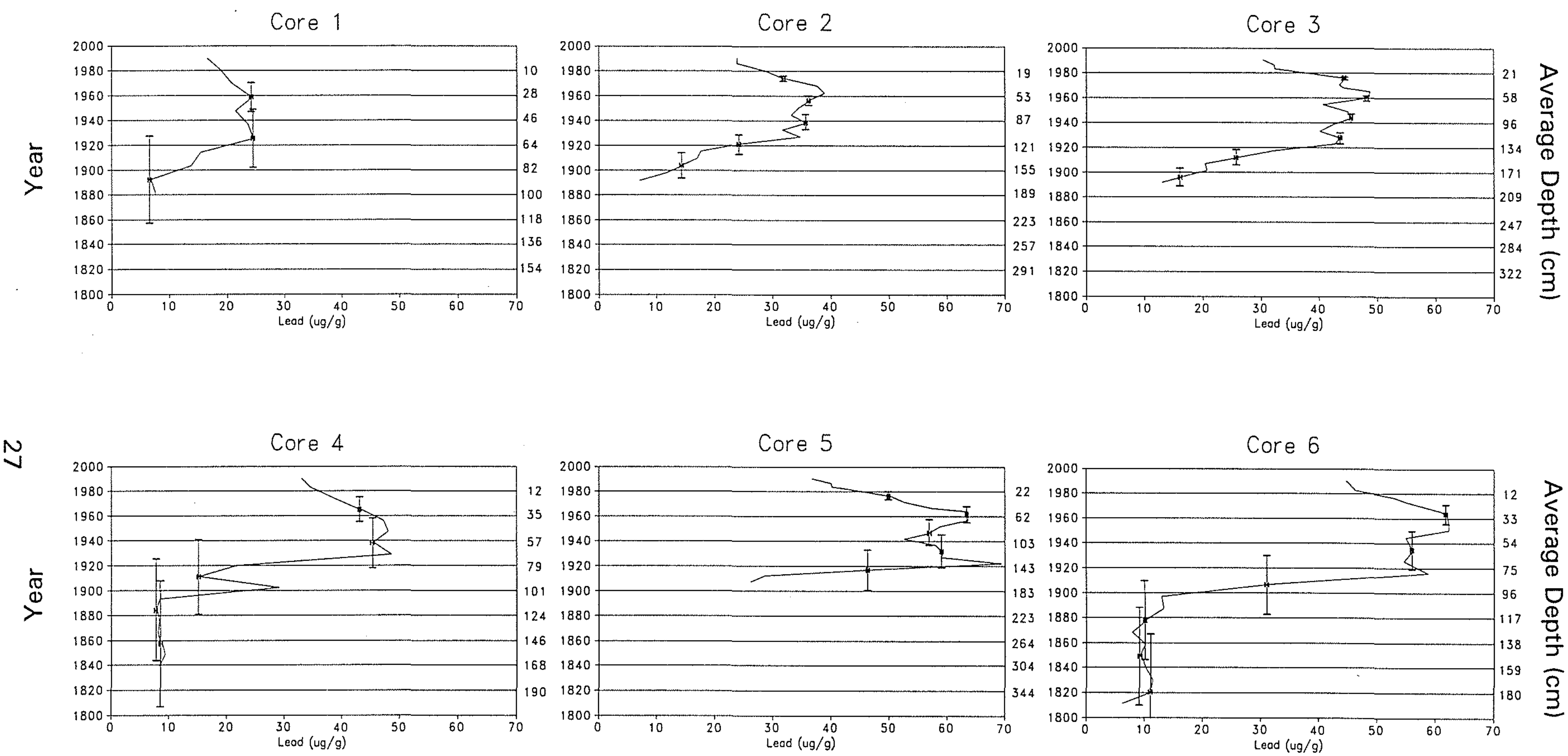


FIGURE 3.5. Lead (Pb) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

TABLE 3.3. Maximum and Surface Concentrations (μg/g) of Selected Metals for Three Cores Collected from Puget Sound During Summer 1991

	Ag	As	Cu	Hg	Pb	Sb	Sn	Zn
Core 3:								
Max Year	1965	1965	1960	1949	1965	1960	1965	1965
Max	0.91	19.5	54.6	0.479	48.9	2.05	4.9	134.6
Surface	0.68	12.5	42.7	0.179	30.3	1.28	3.94	114.7
%change	25.3%	35.9%	21.8%	62.6%	38.0%	37.6%	19.6%	14.8%
Recovery Rate	0.009	0.280	0.397	0.007	0.744	0.026	0.038	0.796
Core 5:								
Max Year	1982	1964	1947	1947	1922	1952	1962	1962
Max	0.84	28.3	70	0.505	69.4	3.9	4.85	167.7
Surface	0.69	13.1	49.3	0.213	36.7	1.6	3.96	119.2
%change	17.9%	53.7%	29.6%	57.8%	47.1%	59.0%	18.4%	28.9%
Recovery Rate	0.017	0.563	0.470	0.007	0.474	0.059	0.031	1.672
Core 6:								
Max Year	1965	1950	1963	1950	1954	1963	1963	1954
Max	0.65	23.5	64.7	0.403	62.3	2.43	4.25	128.8
Surface	0.59	17.3	52.7	0.277	44.7	1.52	2.78	115.5
%change	9.2%	26.4%	18.5%	31.3%	28.3%	37.4%	34.6%	10.3%
Recovery Rate	0.002	0.155	0.444	0.003	0.489	0.034	0.054	0.369
Average Recovery Rate	0.009	0.333	0.437	0.006	0.569	0.039	0.041	0.946
95% CL ±	0.014	0.424	0.076	0.005	0.308	0.035	0.025	1.348

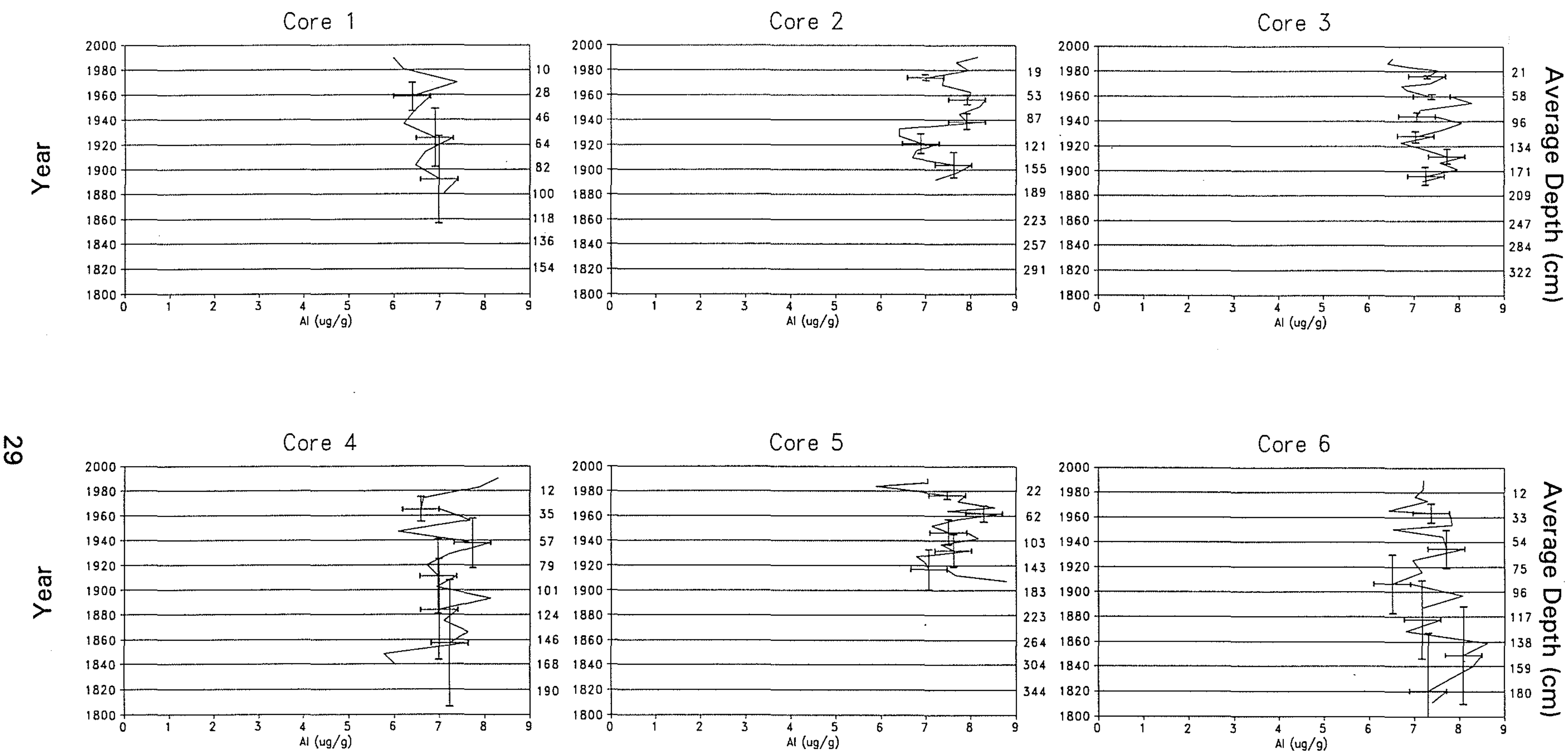


FIGURE 3.6. Aluminum (Al) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

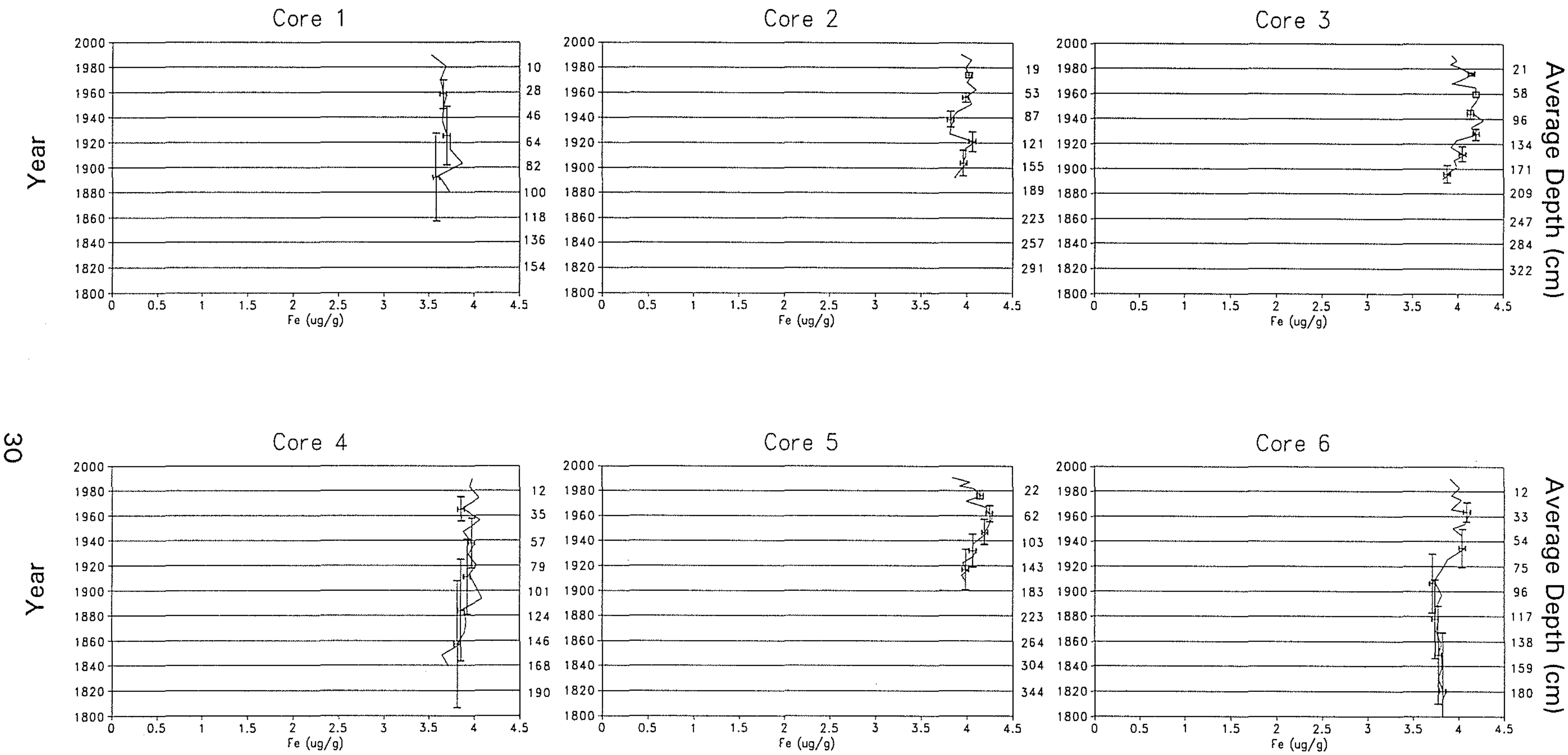


FIGURE 3.7. Iron (Fe) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

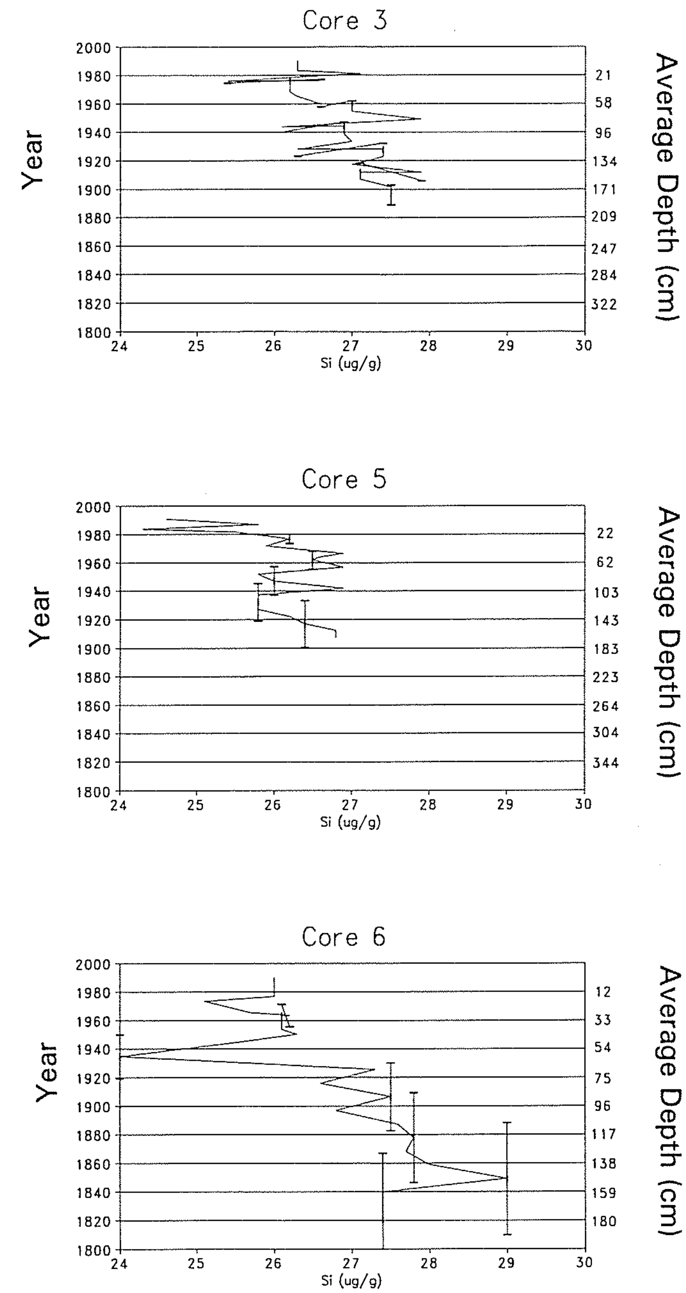


FIGURE 3.8. Silica (Si) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

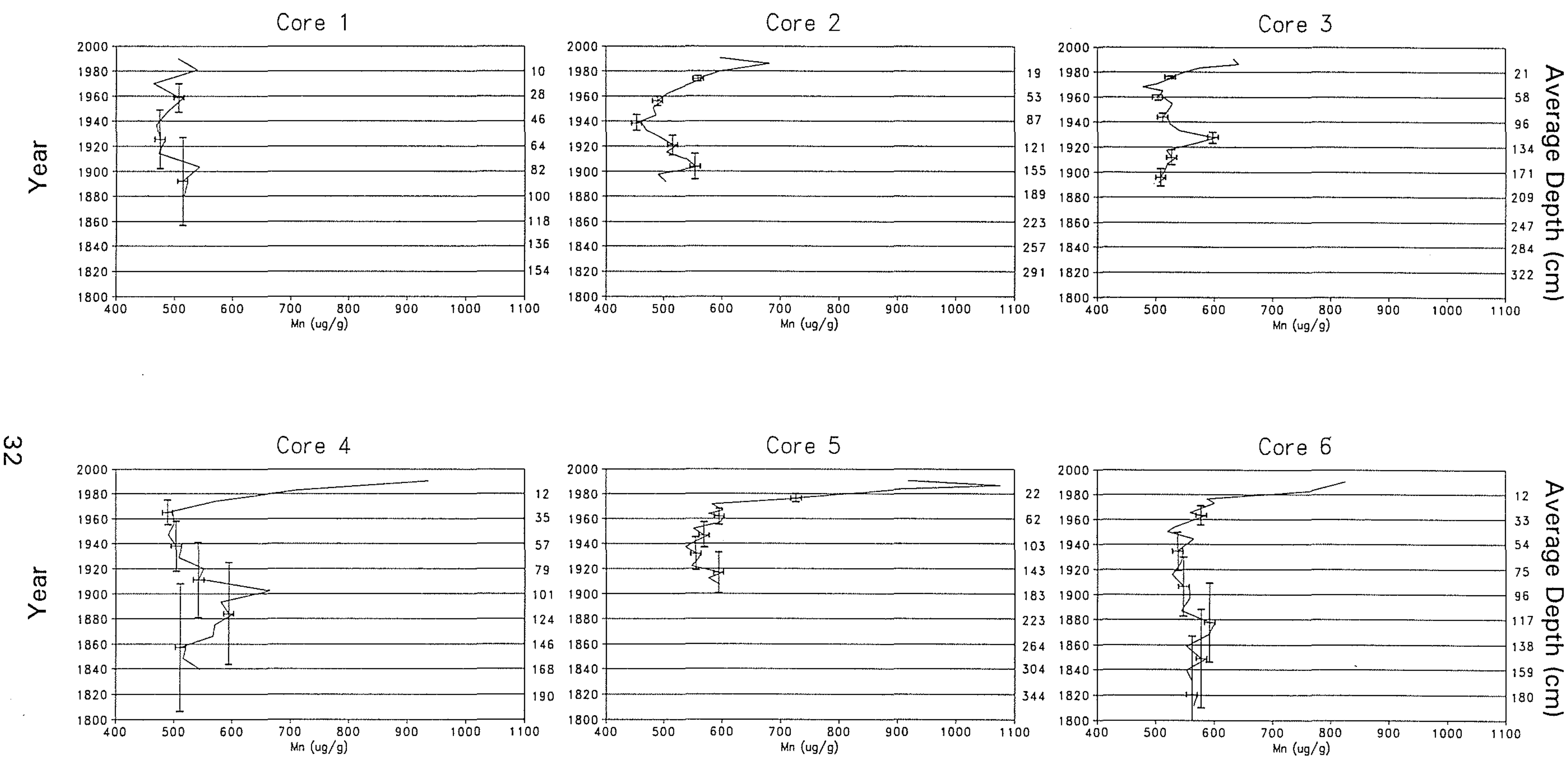


FIGURE 3.9. Manganese (Mn) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

slightly more stable than Mn (Riley and Chester 1976). With one possible exception (Core 6), the profile for Fe does not indicate that post-depositional migration is occurring, even though the profiles for TOC for Cores 3, 5 and 6 are nearly identical. This result is consistent with the findings of other studies (Carpenter 1985; Romberg et al. 1984).

Concentrations of a number of other metals analyzed (Ni, Cd, Cr, and Se) did not show any consistent changes in concentrations with depth; instead, they showed erratic fluctuations throughout the core. Concentrations in the top five surficial sediment intervals of Cr, Ni, and Se were not significantly different from the sediment concentrations found in the five deepest sections of the cores, based on a t-test with $\alpha = 0.05$. Cadmium was found to be significantly different ($\alpha = 0.05$). However, in Core 3, Cd increased with time, and in Cores 5 and 6 a general decrease was observed. In all three cores, Cd fluctuated continuously; therefore, any observed relationship is probably spurious.

Temporal trends for some metals showed a reproducible pattern of increasing concentrations to a maximum, then of decreasing concentrations through the present. This trend has been detailed in a number of other studies from sediment cores taken from Puget Sound (Bloom and Crecelius 1987; Romberg et al. 1984). Metals showing this trend are Pb, Ag, As, Cu, Hg, Sb, Sn and Zn. Figures 3.5 and 3.10 through 3.16 present concentrations of these metals by year for each of the cores analyzed. Bloom and Crecelius (1987) tested the apparent trend of decreasing metal concentrations of Pb, Ag, Cu, and Hg in Puget Sound sediment deposited between 1955 and 1982 for a significant negative correlation. The trends established in 1987 indicated mean concentrations of Pb, Ag, and Hg decreased significantly ($\alpha = 0.05$), approximately 7% to 17% since the 1960s. No statistically significant decreases in Cu concentrations were observed (Bloom and Crecelius 1987).

Arsenic concentrations reached a maximum concentration of 28 ($\pm$0.68) μg/g between the early 1950s and 1960s (Figure 3.11). The highest levels of As were found in Cores 5 and 6, the southernmost cores and closest to the ASARCO smelter, which operated in Tacoma from approximately 1889 to the 1980s. Crecelius et al. (1975) suggest that the ASARCO smelter was a major source of As to Puget Sound sediments. Antimony

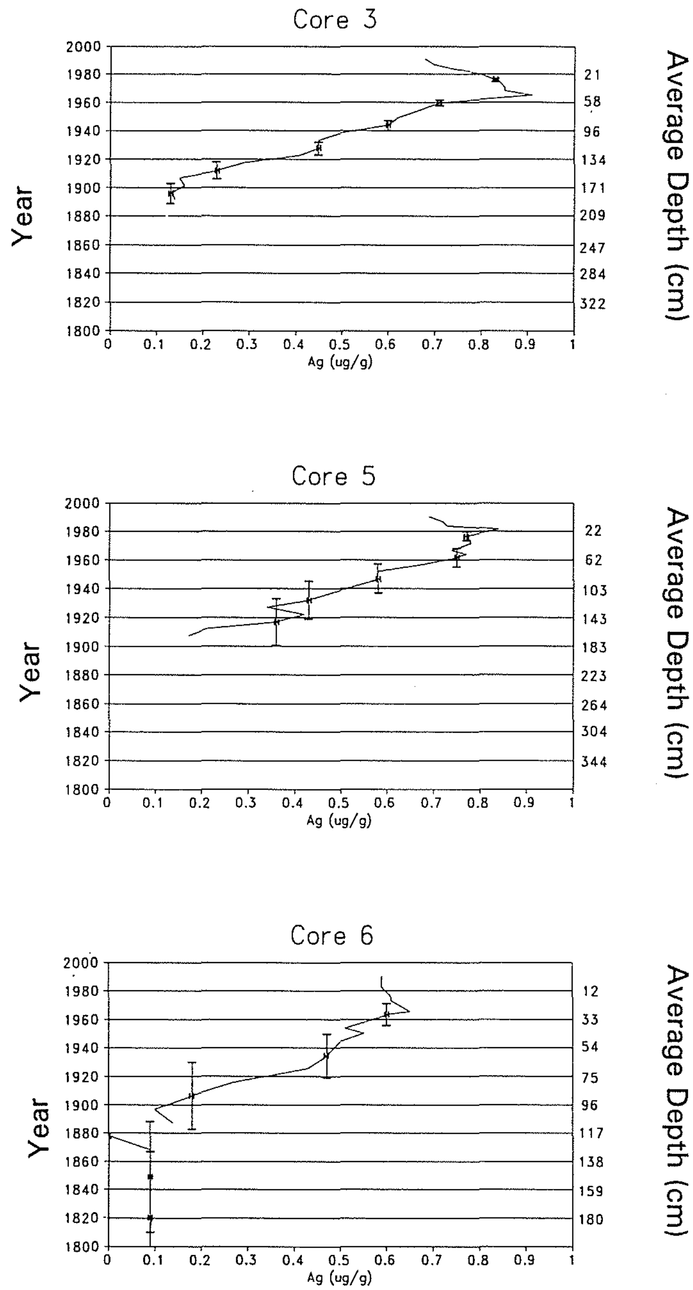


FIGURE 3.10. Silver (Ag) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

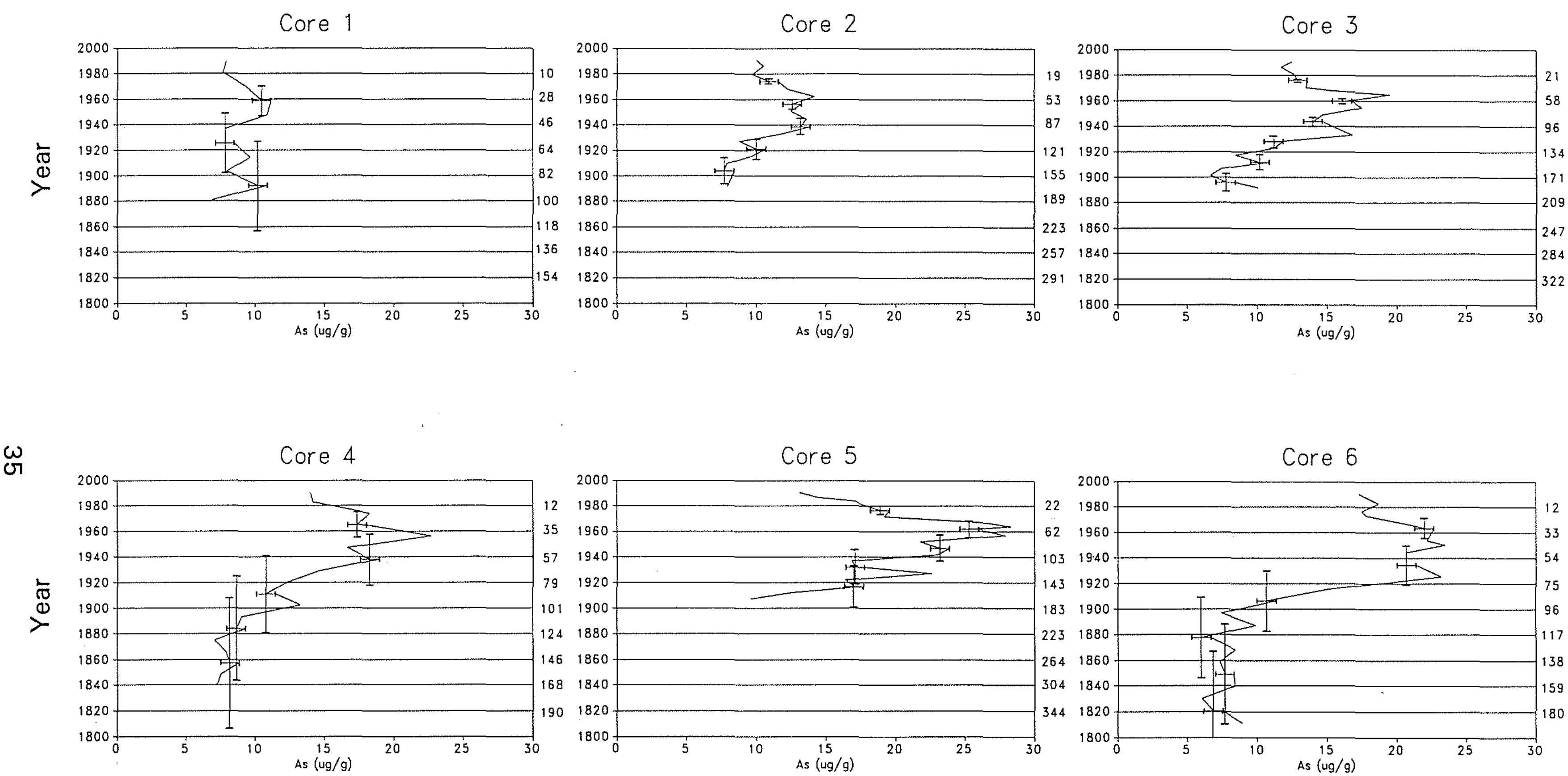


FIGURE 3.11. Arsenic (As) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

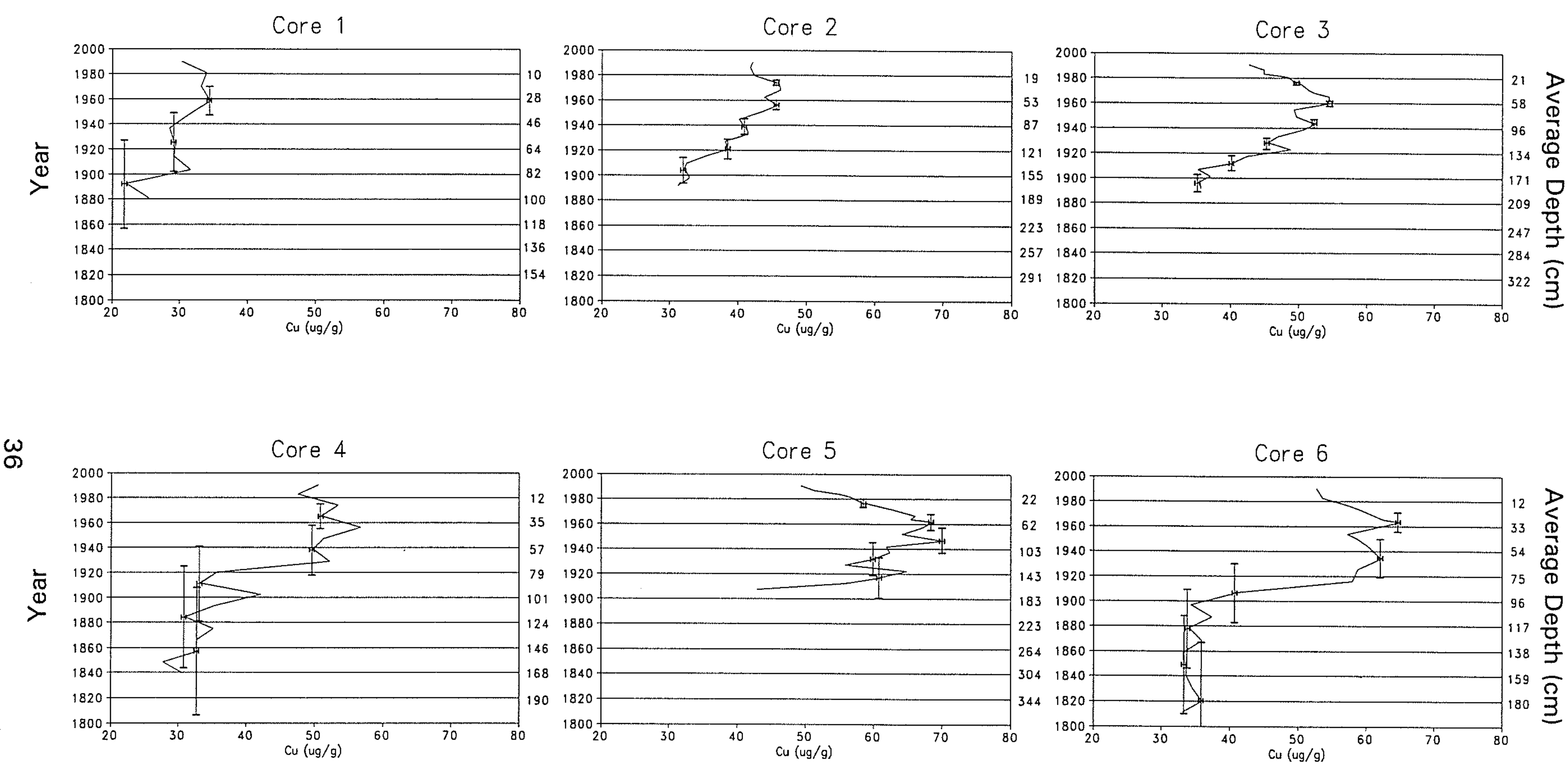


FIGURE 3.12. Copper (Cu) Profiles ($\mu g/g$) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

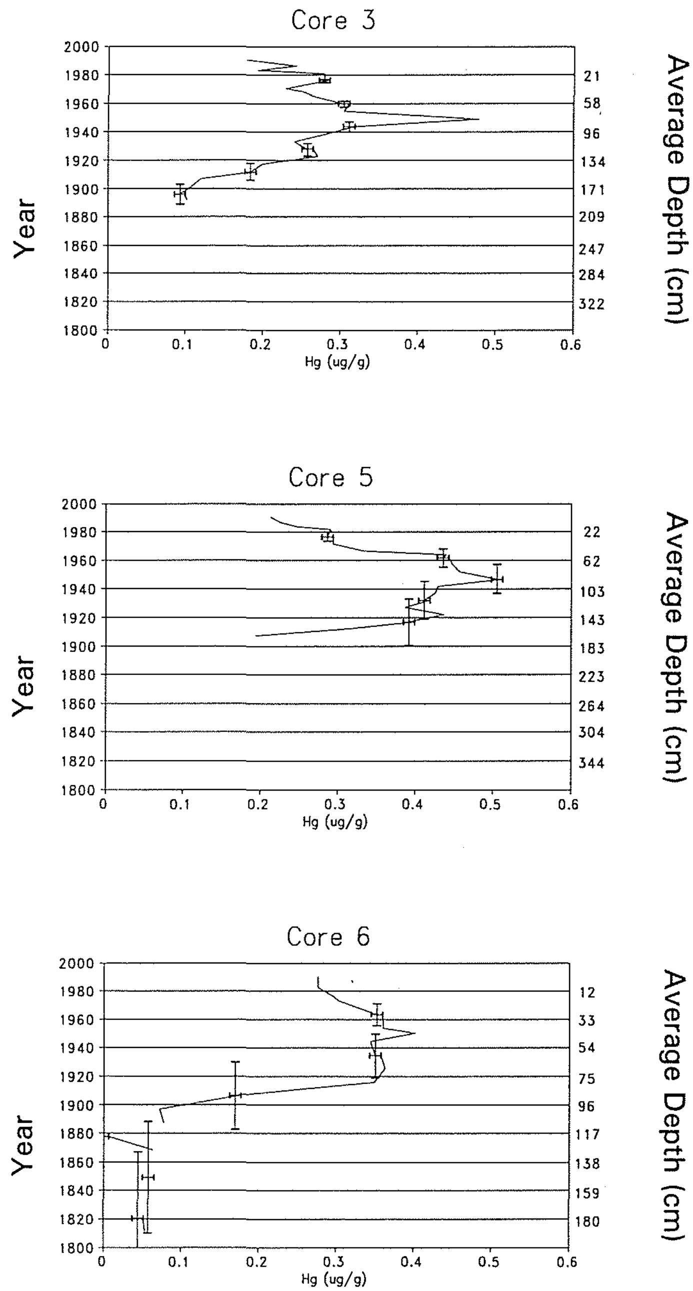


FIGURE 3.13. Mercury (Hg) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

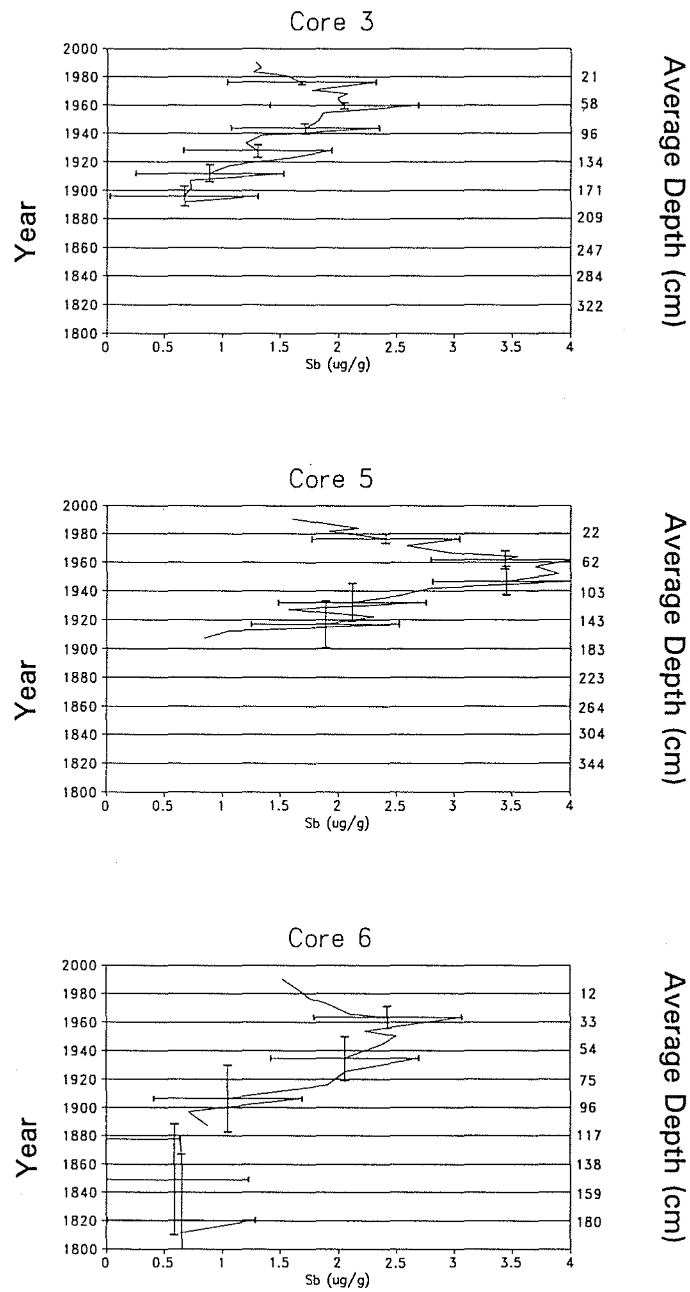


FIGURE 3.14. Antimony (Sb) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

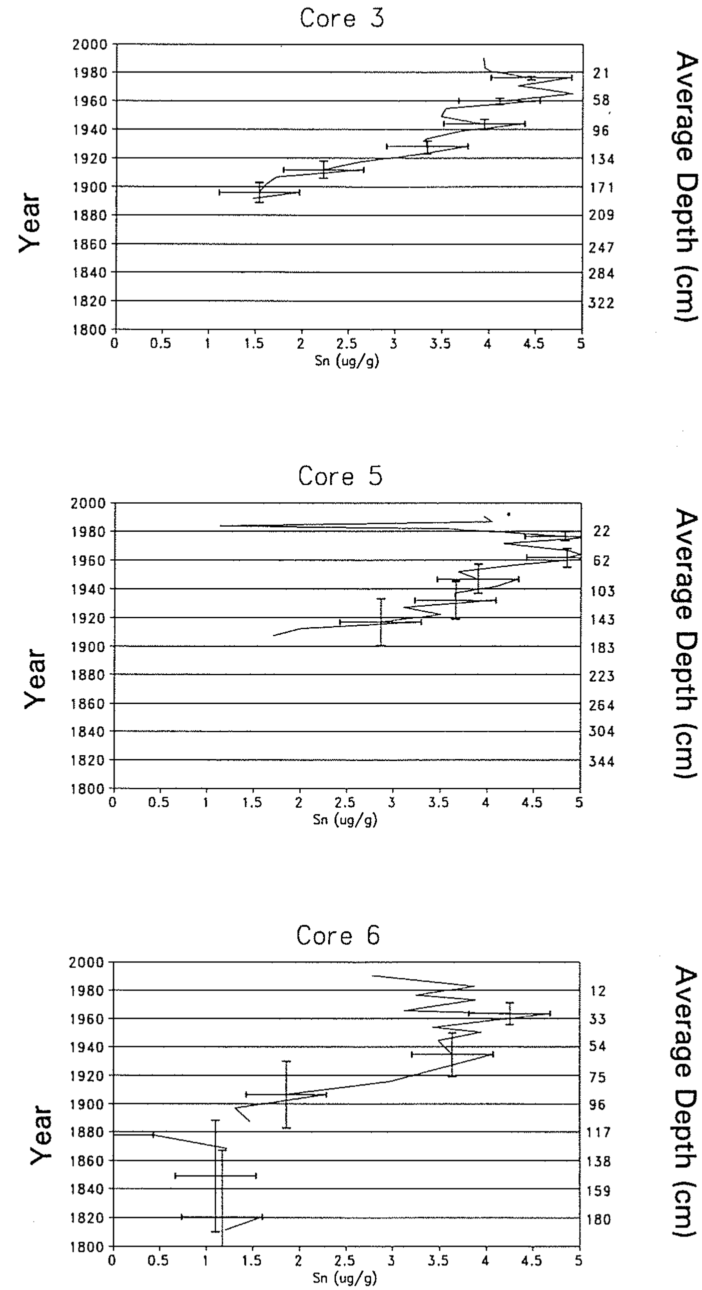


FIGURE 3.15. Tin (Sn) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

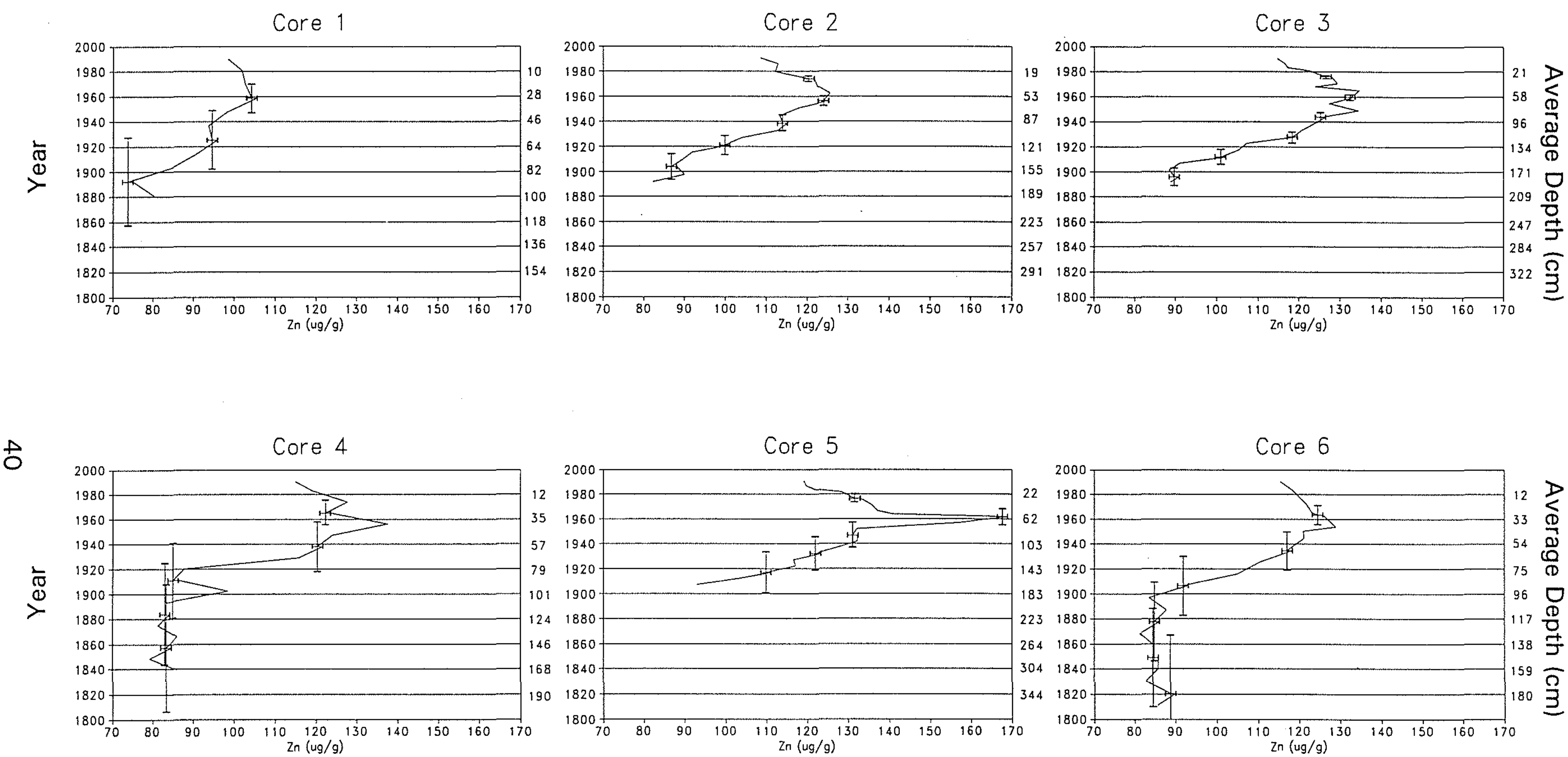


FIGURE 3.16. Zinc (Zn) Profiles (μg/g) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

concentrations, a byproduct of smelter operations at ASARCO, followed a similar pattern, reaching a maximum concentration of between 2 and 4 μg/g between the 1950s and 1960s (Figure 3.14). Both metals have shown a greater than 25% decrease from the maximum to the surface concentration in all cores (Table 3.3). Only Sb, however, had a significant (α = 0.05) recovery rate of 0.039 ($\pm$0.035) μg/g per year. Antimony also produced a consistent significant (α = 0.05) negative correlation between year and concentration in sediments deposited after 1970. In contrast, concentrations of As in deposited sediments have remained fairly constant over this time period.

Mercury (Figure 3.13) reached a maximum concentration of 0.5 ($\pm$0.01) μg/g in the late 1940s. An average 50% drop from the maximum to the surface concentration was observed in Cores 3, 5, and 6 (Table 3.3) with a significant (α = 0.05) average sediment recovery of 0.006 ($\pm$0.005) μg/g per year. However, the concentrations of Hg over the last 20 years remained fairly constant and did not produce a statistically significant negative correlation.

Silver (Figure 3.10), Cu (Figure 3.12), and Zn (Figure 3.16) all appear to have reached maximum concentrations in the early 1960s followed by decreasing concentrations in the late 1960s. Silver reached a maximum of 0.91 ($\pm$0.004) μg/g in mid-1960; however, it displayed an average drop of only 17% from the maximum to the surface concentration (Table 3.3). Except in Core 3, there was no statistically significant negative correlation between year and concentration for Ag in sediments deposited after 1970. Copper and Zn, however, had maximum values of 70 ($\pm$0.34) and 167.7 ($\pm$1.26) μg/g respectively, dropped an average of 23% and 18%, and had significant (α = 0.05) negative correlations between year and concentration. Only Cu produced a significant (α = 0.05) sediment recovery rate of 0.437 ($\pm$0.076) μg/g per year.

Tin (Figure 3.15) may have reached a maximum concentration in the 1960s; however, concentrations have not steadily declined since wide fluctuations in concentration are still evident in surficial sediments. Despite the wide fluctuations, all three cores displayed an average 24.2% drop from the subsurface maximum to the surface concentration and produced a significant (α = 0.05) regional recovery rate of 0.041 ($\pm$0.025) μg/g per year (Table 3.3).

Except for Ag and Hg reductions in Core 3, the largest percentage of reductions was observed in Core 5, which is located near several sewage treatment plant outfalls (Figure 2.1). Secondary treatment of sewage discharged into the Sound did not begin until the late 1950s. Therefore, the initiation of primary treatment and changes to industrial practices must account for the decrease in metals observed at the site.

3.5 ORGANIC CONCENTRATIONS AND TRENDS

Organic compounds were analyzed in equally spaced intervals from Cores 3, 5 and 6 (Appendix C). Analytes of interest were PAHs, PCB congeners, and chlorinated pesticides. Consistent with the Puget Sound Protocols (Tetra Tech, Inc. 1986), total PAHs consist of the sum of 16 anthropogenically derived PAH compounds (Table 2.1). The PAHs that are primarily derived from combustion processes, such as the burning of automobile fuels, coal, and wood, are defined as combustible PAHs; they have four, five, and six rings. In addition, linear alkylbenzenes (LABs), indicators of municipal waste, and biomarkers hopane and total terpanes, hydrocarbons associated with petroleum products, were analyzed.

3.5.1 PAHs

Total PAH concentrations ranged from approximately 100 ($\pm$21.6) μg/kg in the deepest sections of the cores to a maximum of up to 6788 μg/kg in the early 1940s, and then declined to an average of 1300 μg/kg in the surface sediments. An average 59% decrease in concentration of total PAHs was observed between the maximum and surface concentrations (Table 3.4); however, a statistically significant negative correlation between year and concentration was not obtained for sediments deposited after 1970 for any of the cores. The sediment recovery for total PAHs was estimated as 56.5 ($\pm$106) μg/kg per year, which was not significant. Figure 3.17 shows the PAH profiles for Cores 3, 5, and 6. The sedimentary history of these hydrocarbons appears to parallel the initial urbanization of the Seattle/Tacoma area, which coincides with an increased use of fossil fuels. Sources of PAHs to the Puget Sound are postulated to be primarily sewage and atmospheric dustfall (Barrick 1982).

TABLE 3.4. Maximum and Surface Concentrations (μg/kg) of Selected Organic Compounds for Three Cores Collected from Puget Sound During Summer 1991

	PCB	DDT	Total PAH	Combustible PAH	LABS	Terpanes	Hopane
Core 3:							
Max Year	1960	1960	1943	1943	1983	1943	1953
Max	34.5	4.71	6788	5917	101	2260	235
Surface	9.00	1.19	1434	1162	80.7	1570	158
% Change	73.9%	74.8%	78.9%	80.4%	19.8%	30.5%	32.8%
Recovery Rate	0.851	0.117	114	101	2.85	14.7	2.09
Core 5:							
Max Year	1966	1984	1942	1942	1986	1990	1962
Max	25.8	5.76	3430	2898	184	2360	227
Surface	5.33	4.77	1303	1050	29.3	2360	224
% Change	79.3%	17.2%	62.0%	63.8%	84.0%	0.0%	1.1%
Recovery Rate	0.819	0.142	43.412	37.706	30.878	0.000	0.087
Core 6:							
Max Year	1961	1961	1935	1935	1977	1923	1965
Max	15.5	4.25	1883	1516	69.4	2290	203
Surface	7.39	2.80	1212	977	63.9	1860	183
% Change	52.2%	34.2%	35.6%	35.5%	7.9%	18.8%	9.5%
Recovery Rate	0.278	0.050	12.198	9.793	0.421	6.418	0.768
Average Recovery Rate	0.649	0.103	56.5	49.6	11.4	7.03	0.980
95% CL ±	0.653	0.096	106	95	34.3	14.9	2.061

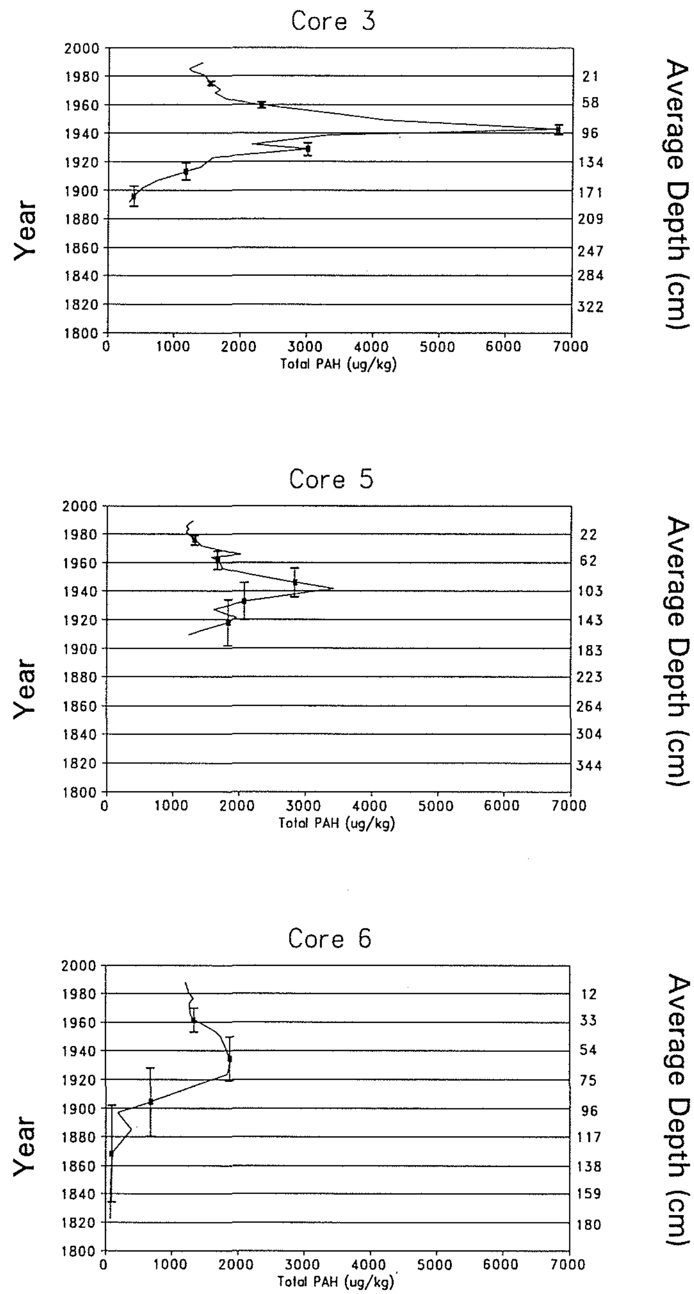


FIGURE 3.17. Total PAH Profiles (μg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

3.5.2 Combustible PAHs

Combustible PAHs are the higher molecular weight PAH compounds, consisting of the four-, five-, and six-benzene-ring compounds. These compounds are produced by the combustion of fossil fuels and other organic-rich materials, such as wood. The concentrations of combustible PAHs generally parallel the total PAH concentrations in the sediment cores (Figure 3.18). An average 60% reduction in concentration between the maximum and surface concentrations was observed; however, sediments deposited after 1970 did not produce a significant negative correlation between year and concentration. Average sediment recovery estimated at 49.6 ($\pm$ 95) μg/kg per year was not significant.

Prior to 1900, the relative contribution of combustible PAHs to total PAHs averaged about 50% (Figure 3.19). As the use of fossil fuels increased, this ratio also increased to a maximum of approximately 85% in the 1940s, which corresponds to the increased number of households in the Seattle/Tacoma area using coal as their heat source. Since the 1920s, this ratio has remained approximately 80%. The near-surface proportions of combustible PAHs does not appear to be decreasing in Cores 5 and 6, and shows only a slight decrease in Core 3.

The maximum concentrations of both total and combustible PAHs occurred in sediments deposited between 1930 and 1950. These patterns were observed in cores collected in 1981, as part of a study on the distribution of toxicants in Puget Sound (Romberg et al. 1984). Comparison of PAH levels measured from cores in the same vicinity as the 1981 study reveal similar concentrations in both surface and subsurface sediments. This would be expected, based on the assumption that the source of these elements to Puget Sound during the last century has been consistent over the entire region.

3.5.3 Linear Alkyl Benzenes

LABs are used in the production of linear alkyl sulfonates (LAS), which are widely used anionic surfactants in detergents. These products became commercially available in the early 1960s and their use rapidly became widespread. The source of LABs to the

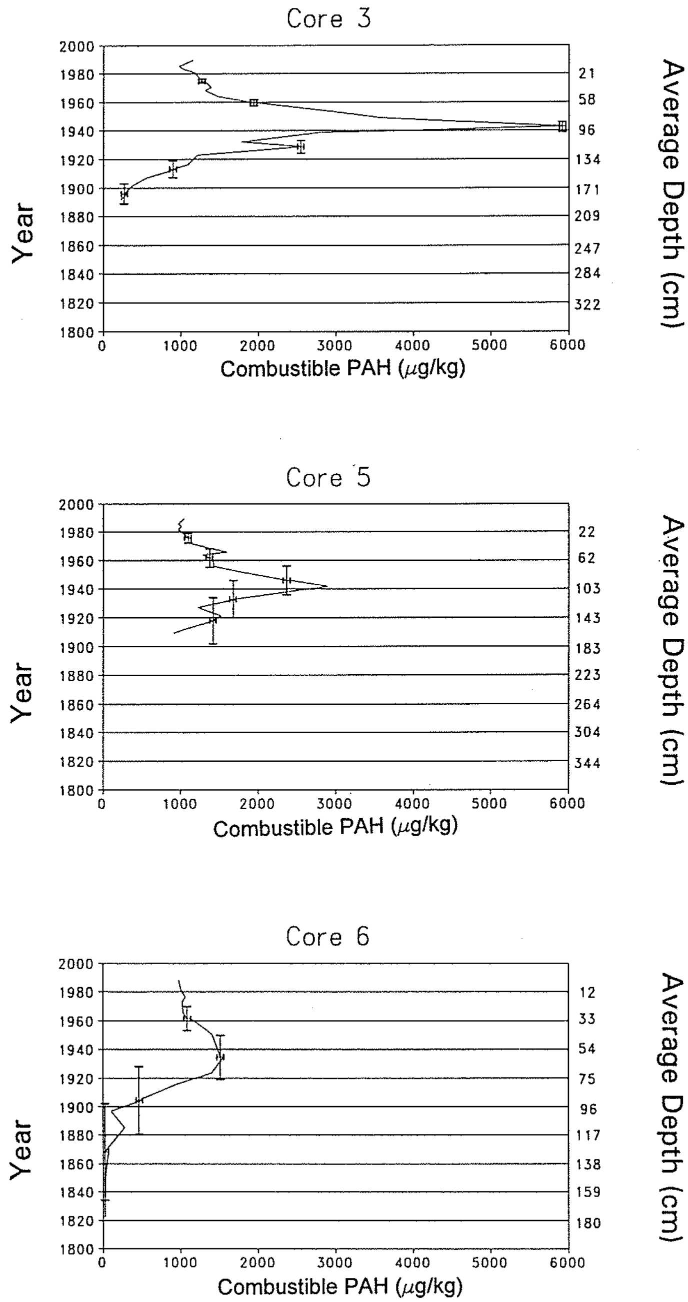


FIGURE 3.18. Combustible PAH Profiles (μg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

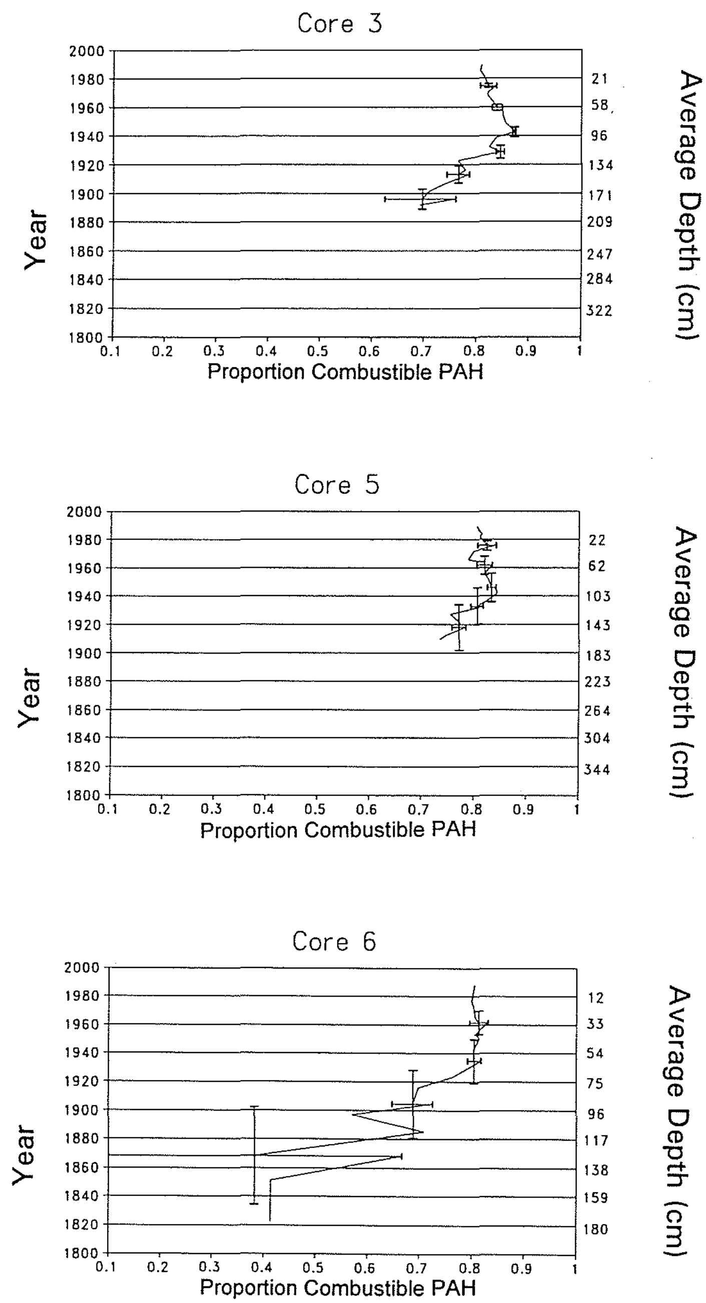


FIGURE 3.19. Ratio of Combustible to Total PAH Profiles for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

environment is exclusively anthropogenic, primarily from municipal sewage. Figure 3.20 shows the concentrations of total LABs with depth in three cores. A dramatic increase in concentrations occurred in the early 1980s in all cores to a maximum of 184 μg/kg, which corresponds to the rapid increase in population in the Seattle/Tacoma region. The actual concentrations vary among the different coring locations and may be due to differences in the volumes of effluent discharged near each site. In general, concentrations do not appear to be decreasing in surficial sediments, and there is no negative correlation between year and concentration for sediments deposited after 1970. The average sediment recovery rate for LABs was 11.4 ($\pm$34.3) μg/kg per year and was not statistically significant.

Core 5 showed an 84% decrease in LABs between the maximum and surficial concentrations. Although this result may be spurious, this core also had the greatest decreases in metals, which we hypothesize to be due to changes in sewage treatment. Regionally, however, a decreasing trend in LAB concentrations is not evident, which suggests that sources of these compounds are still being actively discharged.

3.5.4 Biomarkers: Hopane and Total Terpanes

Biomarkers such as hopane and total terpanes are biomolecules that are naturally derived from organic compounds and are found in petroleum materials, such as oils and coals. These compounds are resistant to both physical and biological degradation, and can be used to characterize petroleum contamination. The distribution of these biomarkers within oil deposits (i.e., oil fields and oiled sediments) can be used to distinguish among possible sources of oil or to evaluate weathering (or degradation) of the deposit.

In Cores 5 and 6, the concentrations of both hopane and the total terpanes show little variation with depth after 1920, averaging approximately 200 and 2000 μg/kg, respectively (Figures 3.21 and 3.22). Core 3, in contrast, displayed a 30% reduction between the maximum and surficial concentrations of both biomarkers (Table 3.4), and there were significant ($\alpha = 0.05$) negative correlations between year and concentration for sediments deposited after 1970. Neither biomarker, however, produced a statistically significant average recovery rate.

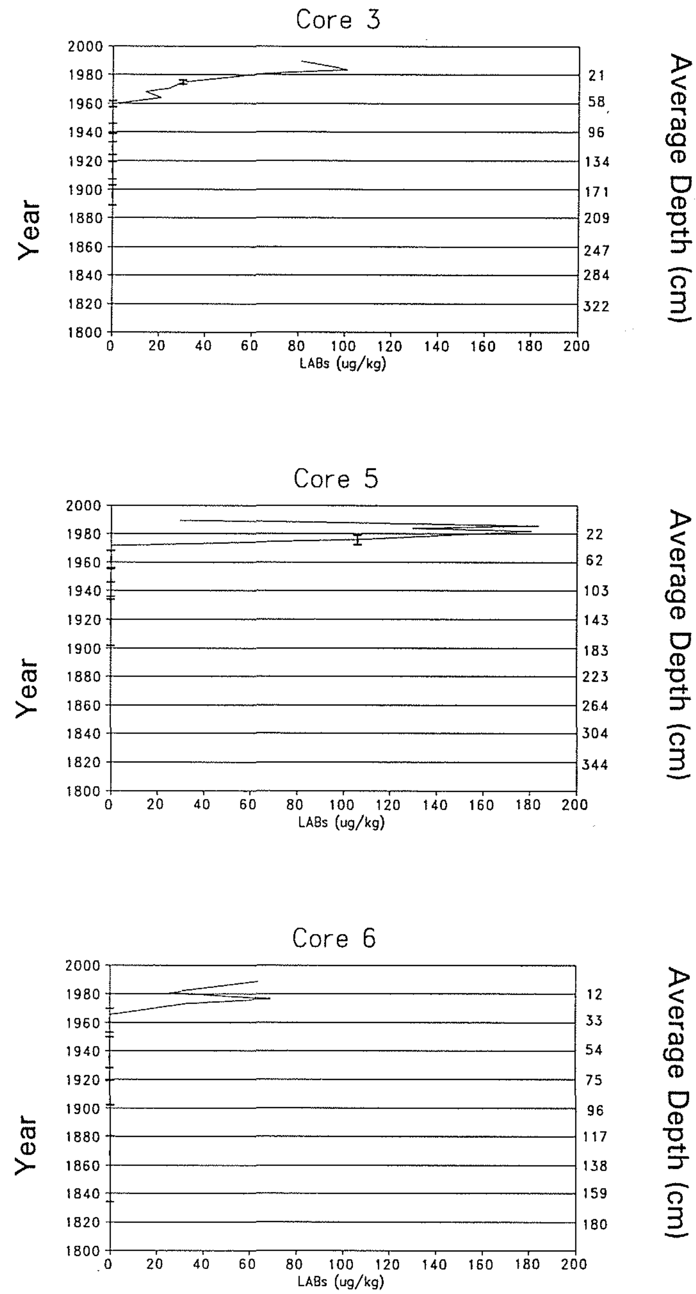


FIGURE 3.20. Linear Alkyl Benzenes (LABs) Profiles (µg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

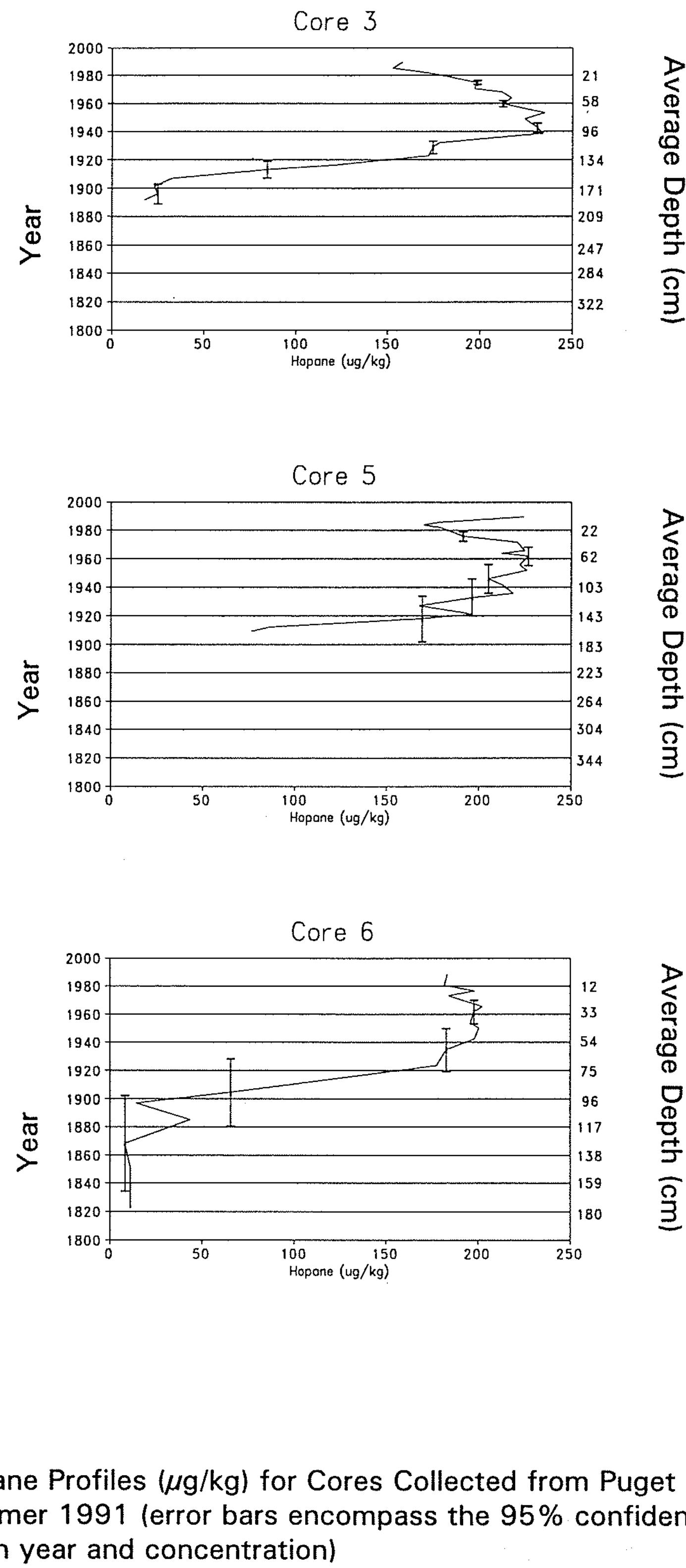
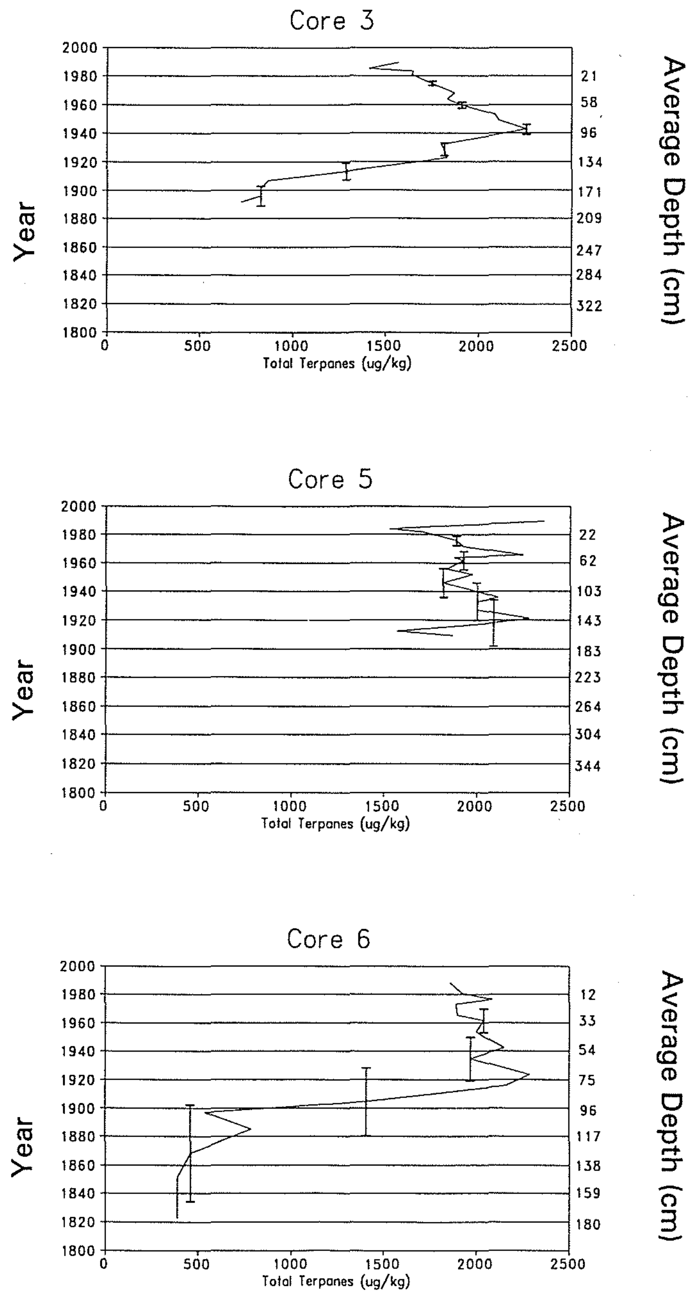


FIGURE 3.21. Hopane Profiles (μg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

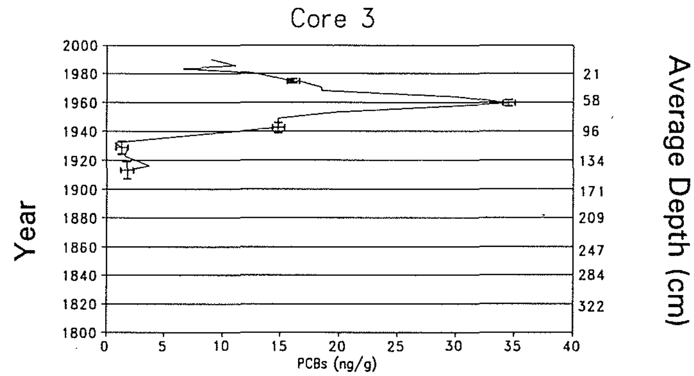


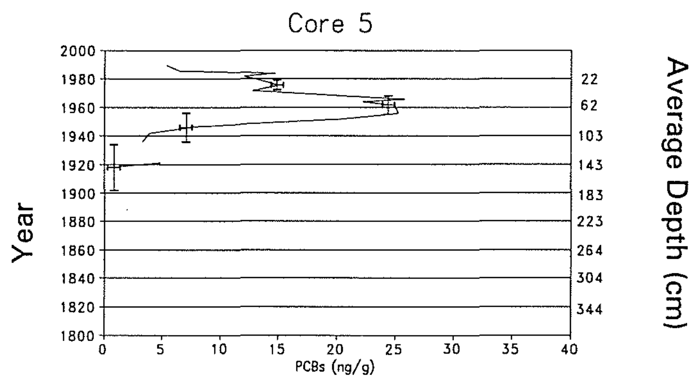
<u>FIGURE 3.22</u>. Total Terpane Profiles (μg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

3.5.5 <u>Polychlorinated Biphenyls (PCB) and Dichlorodiphenyltrichloroethane (DDT)</u>

Temporal trends in the contamination of central Puget Sound with synthetic organic chemicals, such as PCB and DDT, are similar to those of metals and hydrocarbons, except these chemicals did not appear until about the 1930s. Figure 3.23 presents PCB concentrations from three cores over time. Since these compounds are anthropogenic in origin, no background levels occurred in sediments prior to their introduction in the mid-1930s (values less than 5 μg/kg should be regarded as analytical noise). A rapid increase in concentrations occurred until the mid-1970s when environmental regulations, such as the Toxic Substance Control Act (enacted 1976), limited their use and greatly reduced the amount of PCBs getting into the environment. Maximum concentrations observed in the sediments during this period reached over 35 ($\pm$0.523) μg/kg. Concentrations found in the surface sediments of the cores average about 8 μg/kg. Even though an average 68% reduction between the maximum and surface concentrations of PCBs was observed (Table 3.4), only Core 3 had a significant (α = 0.05) negative correlation between years and concentration for sediments deposited after 1970. The average sediment recovery rate estimated as 0.649 ($\pm$0.653) μg/kg per year was not statistically significant.

DDT concentrations for Cores 3 and 6 showed a depositional pattern similar to that of PCBs, increasing in the 1930s and producing a maximum in the 1960s (Figure 3.24). Core 5, however, reached its maximum concentration in the 1980s. Over all, concentrations of DDT are low and do not vary dramatically in relation to the analytical error. Maximum levels of DDT reached 5.7 ($\pm$1.0) μg/kg compared to undetected at 1 μg/kg in the early 1920s. Regulations have resulted in decreasing use of this pesticide and current surficial sediment concentrations vary, ranging from 1 to 2.8 μg/kg. Despite a 42% reduction between the maximum and surface concentrations of DDT (Table 3.4), only in Core 3 was there a potentially significant (α = 0.05) negative correlation between year and concentration for sediments deposited after 1970. DDT, however, did show a potentially significant (α = 0.05) average recovery rate of 0.103 ($\pm$0.096) μg/kg per year. The words "potentially significant" were used in association with the DDT results because the analytical error was large in relation to the observed concentrations. These data should be used only to suggest a possible trend.





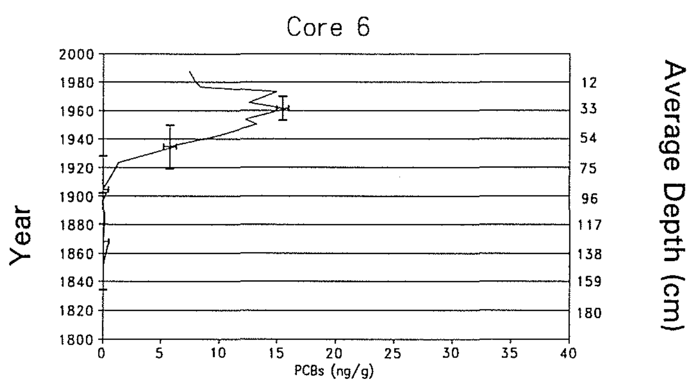


FIGURE 3.23. PCB Profiles (μg/kg) for Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

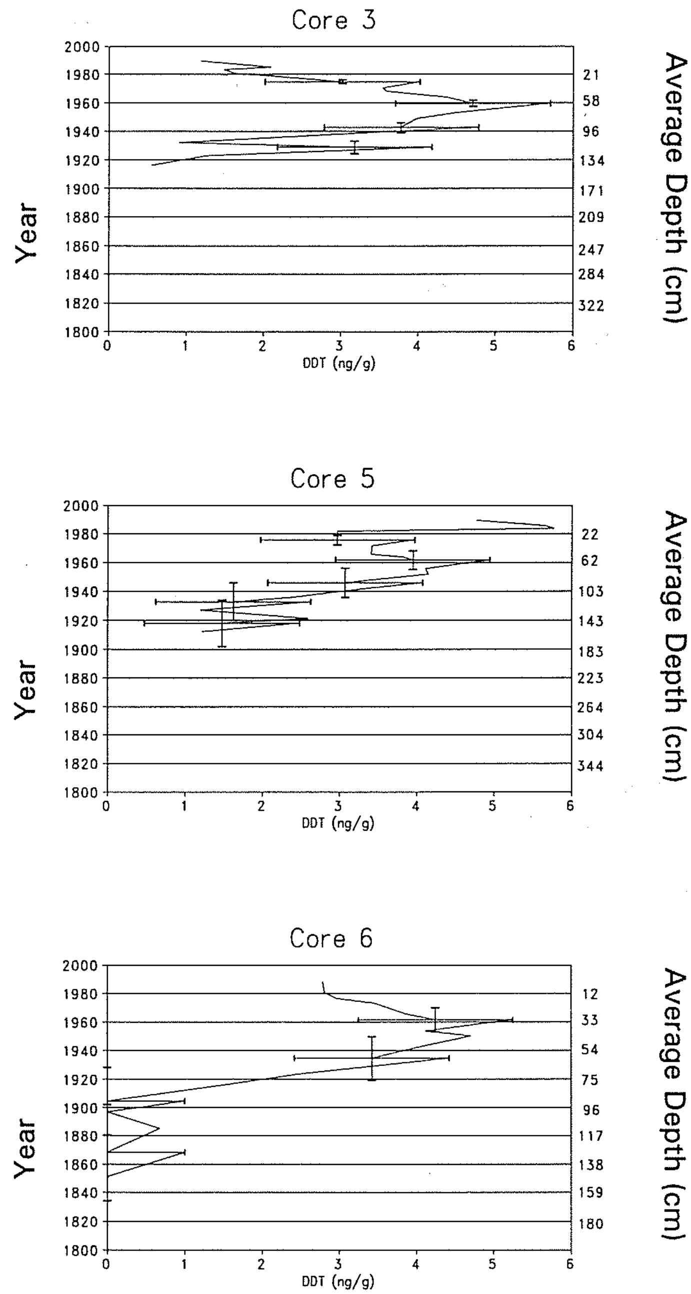


FIGURE 3.24. DDT Profiles (μg/kg) For Cores Collected from Puget Sound During Summer 1991 (error bars encompass the 95% confidence interval about the mean year and concentration)

3.5.6 Trends in Organic Contaminants

Overall trends show subsurface maxima and a steady decrease in concentrations to the present for all organic constituents except LABs, hopane, and total terpanes. Unlike the metals, which showed the greatest decreases in contaminant concentrations in Core 5, organic contaminants showed the greatest declines in Core 3, taken west of Elliott Bay. Surface total PAH concentrations of approximately 1400 μg/kg represent a two-fold decrease over the maximum concentrations observed earlier this century. Decreases in total PAH ranged from 36% to 79% for the three cores, but concentrations from sediments deposited after 1970 did not suggest that the strengthening of environmental laws in the past 20 years had much of an influence on this decline. Decreases in other organic contaminants, such as PCBs and DDT, also decreased significantly, but not within the last 20 years. Total PCB concentrations decreased on the average of 68% from the early 1960s to present. DDT concentrations decreased an average of 42%.

3.6 BUTYLTINS

Four sediment core samples (two from the upper 10 cm top, one from the middle of the core, and one from near the bottom of the core), from Cores 3, 5, and 6 were analyzed for butyltins. All observations were less than detection (1 μg/kg) and were not considered productive for a profile analysis. Thus, no further analyses were conducted.

4.0 CONCLUSIONS

The temporal trends in central Puget Sound described in this report were based on the chemical composition of age-dated sediment cores. The sedimentation rates used to estimate the dates of the various sediment fractions ranged from 1 to 2 cm/yr. This range is consistent with sedimentation rates obtained from similar locations in other studies (Bloom and Crecelius 1987; Carpenter et al. 1985; Lavelle et al. 1985, 1986).

Trace metal contamination (Ag, As, Cu, Hg, Pb, Sb, Sn, and Zn) began in the late 1800s, reached a maximum in the mid-1900s, and began to decrease in the last two decades. Average recovery rates, estimated from the slope between the maximum and surface concentrations, were observed for Cu, Hg, Pb, Sb, and Sn. Recovery rates for Ag, As, and Zn were too variable to be declared significantly different from zero. However, all three showed a trend toward recovery. Concentrations of Cu, Pb, Sb, and Zn declined at a significant rate in the last 20 years, lending support to our hypothesis that the strengthening of environmental regulation since 1970 has influenced the water quality of Puget Sound.

Trends in organic chemicals in the sediments over time also show a subsurface maximum. Hydrocarbon contamination appears to parallel that of heavy metals. Only DDT, however, showed a statistically significant average recovery rate. The recovery rates for PCB, total PAH, and combustable PAH were too variable to be called significant, but these contaminants did show a trend toward recovery. PAH concentrations, although decreased over four-fold from maximum concentrations, appear to be relatively constant over the past several decades. Synthetic organic contaminants appear in sediments deposited more recently, in the mid-1930s and 1940s, and reached a maximum in the mid-1960s. Statistically significant decreases in sediment concentrations of these contaminants were also observed with two- to four-fold decreases in surficial sediment concentrations. Concentrations of compounds such as PCBs and DDT appear to be continuing to decrease.

Nutrients (P and N), LABs, and biomarkers (hopane and total terpanes) were the only contaminants not showing a clear decrease in concentration. The nutrients show an extremely slight, but statistically significant, increase. The concentrations of LABs and biomarkers fluctuate in the near-surface sediments so that a plateau cannot be substantiated. Nutrients and LABs are associated with municipal sewage. Hopane and total terpanes are associated with petroleum products. Both sources of contaminants are expected to increase with an increasing population. However, despite the population growth of over one million people in the Seattle/Tacoma region in the past several decades, there has not been a substantial increase in these contaminants. Thus, the effect of strengthening environmental regulations on water quality cannot be negated.

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APPENDIX A

SEDIMENT CORE STATION LOCATIONS

PUGET SOUND HISTORICAL TRENDS SEDIMENT CORE STATION LOCATIONS

Station Number	Date	Latitude °N/ Longitude °W	Jitter[a]	Loran Time Delays	Time	Depth
1	9/11/91	47° 47.59′ N 122° 25.97′ W	0.05 nm	28107.5 42307.0	1716	189 m
2 (Rep 1)	9/11/91	47° 42.09′ N 122° 26.58′ W	0.05 nm	28064.5 42294.7	1001	203 m
2 (Rep 2)	9/11/91	47° 42.11′ N 122° 26.56′ W	0.05 nm	28064.6 42294.9	1029	202 m
3	9/10/91	47° 36.90′ N 122° 26.80′ W	0.05 nm	28024.0 42284.6	1051	200 m
4	9/11/91	47° 33.41′ N 122° 26.26′ W	0.06 nm	27996.4 42278.9	1421	237 m
5	9/10/91	47° 28.68′ N 122° 24.28′ W	0.04 nm	27950.7 42277.3	1820	194 m
6	9/10/91	47° 21.00′ N 122° 24.59′ W	0.05 nm	27895.8 42263.7	1457	178 m

[a] Jitter, the error in the satellite determined positioning, assumes that "selective availability" (SA) is turned on. Actually SA is intermittant. Accuracy with SA is 100 m and without SA is greater than 15 m.

APPENDIX B

TIME CORRECTED ^{210}Pb AND ^{137}Cs

PUGET SOUND HISTORICAL TRENDS
TIME CORRECTED Pb-210 AND CS-137

Sample No.			Segment Depth (cm)	Percent Dry Weight	Time Corrected Pb-210 (dpm/g)	Excess Pb-210 (dpm/g)	Cs-137 (dpm/g)	Cs-137 Detection Limit
CORE #1								
372PSHT-	448		0-2	38.45	12.00	11.50	NA	-
372PSHT-	452		8-10	48.50	12.39	11.89	NA	-
372PSHT-	457	Rep 1	18-20	50.17	10.03	9.53	NA	-
372PSHT-	457	Rep 2	18-20	NA	10.14	9.64	NA	-
372PSHT-	462		28-30	53.34	8.14	7.64	NA	-
372PSHT-	467		38-40	53.43	3.72	3.22	NA	-
372PSHT-	472		48-50	52.20	3.04	2.54	NA	-
372PSHT-	477		58-60	53.74	2.50	2.00	NA	-
372PSHT-	482		68-70	50.99	2.70	2.20	NA	-
372PSHT-	487		78-80	51.24	1.52	1.02	NA	-
372PSHT-	492		88-90	57.70	0.98	0.48	NA	-
372PSHT-	497		98-100	51.07	1.04	0.54	NA	-
CORE #2A								
372PSHT-	275		0-2	35.78	12.22	11.92	0.279	0.002
372PSHT-	279	Rep 1	8-10	43.61	14.06	13.76	0.339	0.006
372PSHT-	279	Rep 2	8-10	NA	13.80	13.50	NA	-
372PSHT-	284		18-20	43.57	11.88	11.58	0.335	0.004
372PSHT-	289		28-30	42.55	10.64	10.34	0.298	0.004
372PSHT-	294		38-40	43.56	9.73	9.43	0.312	0.003
372PSHT-	299		48-50	45.62	9.74	9.44	0.377	0.003
CORE #2								
372PSHT-	304		58-60	43.66	9.81	9.51	0.282	0.005
372PSHT-	309		68-70	43.86	7.78	7.48	0.323	0.004
372PSHT-	314		78-80	43.96	6.38	6.08	0.180	0.004
372PSHT-	319		88-90	43.84	5.89	5.59	0.094	0.005
372PSHT-	324		98-100	44.81	4.98	4.68	0.129	0.006
372PSHT-	329		108-110	44.43	3.81	3.51	-0.035	0.004
372PSHT-	334		118-120	44.07	2.86	2.56	-0.073	0.002
372PSHT-	339		128-130	47.32	2.55	2.25	NA	-
372PSHT-	344		138-140	45.95	2.37	2.07	NA	-
372PSHT-	349		148-150	46.46	1.86	1.56	NA	-
372PSHT-	354		158-160	47.00	1.38	1.08	NA	-
372PSHT-	359		168-170	47.88	1.18	0.88	NA	-

PUGET SOUND HISTORICAL TRENDS
TIME CORRECTED Pb-210 AND CS-137

Sample No.			Segment Depth (cm)	Percent Dry Weight	Time Corrected Pb-210 (dpm/g)	Excess Pb-210 (dpm/g)	Cs-137 (dpm/g)	Cs-137 Detection Limit
CORE #3								
372PSHT-	1		0-2	33.69	12.78	11.78	0.690	0.097
372PSHT-	5	Rep 1	8-10	36.53	10.87	9.87	0.312	0.100
372PSHT-	5	Rep 2	8-10	NA	10.90	9.90	0.400	0.045
372PSHT-	10		18-20	38.13	10.58	9.58	0.572	0.086
372PSHT-	15		28-30	38.19	10.27	9.27	0.693	0.093
372PSHT-	20		38-40	37.14	8.71	7.71	0.454	0.084
372PSHT-	25	Rep 1	48-50	39.94	7.36	6.36	0.936	0.096
372PSHT-	25	Rep 2	48-50	NA	NA	NA	0.550	0.044
372PSHT-	30		58-60	39.28	6.36	5.36	0.657	0.093
372PSHT-	35		68-70	40.58	5.79	4.79	0.507	0.097
372PSHT-	40	Rep 1	78-80	41.10	4.85	3.85	-0.011	0.094
372PSHT-	40	Rep 2	78-80	NA	NA	NA	0.249	0.041
372PSHT-	45		88-90	39.88	5.23	4.23	0.414	0.084
372PSHT-	50		98-100	41.05	3.60	2.60	0.373	0.078
372PSHT-	55		108-110	41.74	3.54	2.54	0.238	0.078
372PSHT-	60		118-120	39.14	3.32	2.32	0.273	0.080
372PSHT-	65		128-130	39.67	2.73	1.73	0.055	0.086
372PSHT-	70		138-140	38.32	2.37	1.37	0.127	0.090
372PSHT-	75		148-150	41.48	2.27	1.27	0.219	0.071
372PSHT-	80	Rep 1	158-160	42.43	2.06	1.06	-0.321	0.094
372PSHT-	80	Rep 2	158-160	NA	NA	NA	0.143	0.062
372PSHT-	85	Rep 1	168-170	43.56	1.61	0.61	-0.170	0.081
372PSHT-	85	Rep 2	168-170	NA	NA	NA	-0.003	0.039
372PSHT-	90		178-180	41.54	1.75	0.75	-0.284	0.100
CORE #4								
372PSHT-	360		0-2	30.21	9.49	9.19	0.203	0.004
372PSHT-	364		8-10	36.19	8.35	8.05	0.264	0.004
372PSHT-	369		18-20	38.11	8.15	7.85	0.391	0.004
372PSHT-	374		28-30	41.93	7.15	6.85	0.297	0.003
372PSHT-	379		38-40	41.51	6.36	6.06	0.314	0.004
372PSHT-	384		48-50	43.14	5.33	5.03	0.295	0.005
372PSHT-	389		58-60	41.33	4.99	4.69	0.176	0.006
372PSHT-	394		68-70	40.54	3.71	3.41	0.079	0.003
372PSHT-	399		78-80	43.25	1.67	1.37	0.014	0.006
372PSHT-	404		88-90	44.71	1.29	0.99	0.052	0.006
372PSHT-	409		98-100	37.52	2.29	1.99	NA	-
372PSHT-	414		108-110	45.11	1.03	0.73	NA	-

PUGET SOUND HISTORICAL TRENDS
TIME CORRECTED Pb-210 AND CS-137

Sample No.			Segment Depth (cm)	Percent Dry Weight	Time Corrected Pb-210 (dpm/g)	Excess Pb-210 (dpm/g)	Cs-137 (dpm/g)	Cs-137 Detection Limit
CORE #4 contd								
372PSHT-	419		118-120	40.27	0.64	0.34	NA	-
372PSHT-	424		128-130	43.10	0.76	0.46	NA	-
372PSHT-	429		138-140	40.96	0.73	0.43	NA	-
372PSHT-	434		148-150	43.48	0.70	0.40	NA	-
372PSHT-	439		158-160	43.39	0.76	0.46	NA	-
372PSHT-	444		168-170	45.93	0.59	0.29	NA	-
CORE #5								
372PSHT-	190	Rep 1	0-2	27.58	12.23	11.23	0.393	0.008
372PSHT-	190	Rep 2	0-2	NA	10.26	9.26	NA	-
372PSHT-	194		8-10	32.78	10.00	9.00	0.346	0.004
372PSHT-	199		18-20	34.46	10.83	9.83	0.351	0.004
372PSHT-	204		28-30	33.77	8.78	7.78	0.445	0.008
372PSHT-	209		38-40	32.53	10.22	9.22	0.383	0.003
372PSHT-	214		48-50	34.40	7.85	6.85	0.427	0.005
372PSHT-	219		58-60	37.58	6.51	5.51	0.302	0.006
372PSHT-	224		68-70	35.76	6.56	5.56	0.397	0.004
372PSHT-	229		78-80	39.76	5.43	4.43	0.318	0.004
372PSHT-	234		88-90	38.12	4.69	3.69	0.166	0.003
372PSHT-	239		98-100	38.87	4.76	3.76	0.034	0.007
372PSHT-	244		108-110	38.22	4.18	3.18	0.107	0.001
372PSHT-	249		118-120	37.74	3.03	2.03	0.006	0.006
372PSHT-	254		128-130	40.63	2.65	1.65	-0.012	0.003
372PSHT-	259		138-140	38.33	3.01	2.01	NA	-
372PSHT-	264		148-150	39.86	2.01	1.01	NA	-
372PSHT-	269		158-160	41.37	2.13	1.13	NA	-
372PSHT-	274		168-170	40.99	1.72	0.72	NA	-
CORE #6								
372PSHT-	95	Rep 1	0-2	31.03	9.20	8.80	0.177	0.126
372PSHT-	95	Rep 2	0-2	NA	NA	NA	0.475	0.057
372PSHT-	99	Rep 1	8-10	33.62	9.10	8.70	-0.069	0.125
372PSHT-	99	Rep 2	8-10	NA	NA	NA	0.431	0.055
372PSHT-	104		18-20	34.29	8.17	7.77	0.253	0.041
372PSHT-	109	Rep 1	28-30	35.56	6.44	6.04	0.518	0.088
372PSHT-	109	Rep 2	28-30	NA	NA	NA	0.259	0.002
372PSHT-	114		38-40	37.52	5.04	4.64	0.219	0.004

PUGET SOUND HISTORICAL TRENDS
TIME CORRECTED Pb-210 AND CS-137

Sample No.		Segment Depth (cm)	Percent Dry Weight	Time Corrected Pb-210 (dpm/g)	Excess Pb-210 (dpm/g)	Cs-137 (dpm/g)	Cs-137 Detection Limit
CORE #6 contd							
372PSHT-	119	48-50	35.26	5.22	4.82	0.227	0.004
372PSHT-	124	58-60	37.03	4.73	4.33	0.169	0.005
372PSHT-	129	68-70	38.96	3.09	2.69	0.100	0.002
372PSHT-	134	78-80	38.33	2.06	1.66	-0.008	0.005
372PSHT-	139	88-90	39.99	1.61	1.21	0.035	0.002
372PSHT-	144	98-100	39.65	0.99	0.59	0.057	0.005
372PSHT-	149	108-110	37.82	1.49	1.09	0.000	0.003
372PSHT-	154	118-120	37.21	1.04	0.64	0.035	0.001
372PSHT-	159	128-130	38.34	0.84	0.44	NA	-
372PSHT-	164	138-140	39.17	1.16	0.76	NA	-
372PSHT-	169	148-150	39.62	0.66	0.26	NA	-
372PSHT-	174	158-160	38.38	0.83	0.43	NA	-
372PSHT-	179	168-170	37.13	0.90	0.50	NA	-
372PSHT-	184	178-180	39.89	0.76	0.36	NA	-
372PSHT-	189	188-190	40.33	0.74	0.34	NA	-
Blank, Rep 1		-		ND		-	-
Blank, Rep 2		-		ND		-	-

NA Not analyzed.
ND Not detected.

APPENDIX C

ASSOCIATED WET DENSITY AND ESTIMATED WET DENSITY

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
36.2	1.34	1.28
40.8	1.38	1.33
43.9	1.34	1.37
45.1	1.37	1.38
43.7	1.36	1.36
45.6	1.37	1.39
46.9	1.38	1.40
45.0	1.39	1.38
42.6	1.35	1.35
43.9	1.33	1.37
43.2	1.37	1.36
44.9	1.36	1.38
44.8	1.38	1.38
45.9	1.36	1.39
45.3	1.39	1.38
46.5	1.40	1.40
47.9	1.40	1.42
44.2	1.37	1.37
46.7	1.37	1.40
62.3	1.74	1.64
67.7	1.74	1.74
68.7	1.74	1.76
70.4	1.80	1.80
68.7	1.76	1.76
68.8	1.74	1.77
67.9	1.74	1.75
68.4	1.76	1.76
64.5	1.75	1.68
66.3	1.76	1.71
66.3	1.79	1.71
65.5	1.73	1.70
66.2	1.75	1.71
53.7	1.55	1.50
56.5	1.55	1.54
52.8	1.64	1.48
60.9	1.65	1.61
64.7	1.72	1.68
64.4	1.63	1.68
60.7	1.60	1.61
59.2	1.56	1.58
57.9	1.57	1.56
55.0	1.55	1.52

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
57.9	1.61	1.56
68.0	1.71	1.75
61.9	1.60	1.63
59.6	1.56	1.59
56.9	1.55	1.55
58.7	1.52	1.58
56.7	1.59	1.54
55.7	1.52	1.53
55.7	1.50	1.53
54.8	1.46	1.51
53.5	1.49	1.49
53.8	1.54	1.50
58.4	1.53	1.57
56.8	1.50	1.54
58.9	1.49	1.58
59.0	1.53	1.58
62.1	1.56	1.63
61.6	1.56	1.63
60.0	1.56	1.60
54.9	1.52	1.51
53.8	1.49	1.50
55.8	1.51	1.53
54.6	1.49	1.51
56.8	1.46	1.54
58.5	1.55	1.57
61.9	1.68	1.63
56.4	1.53	1.54
54.8	1.49	1.51
52.7	1.49	1.48
54.7	1.49	1.51
46.1	1.42	1.39
45.9	1.39	1.39
52.4	1.47	1.48
52.0	1.39	1.47
46.7	1.44	1.40
45.7	1.41	1.39
46.2	1.41	1.39
46.9	1.40	1.40
46.4	1.43	1.40
51.2	1.42	1.46
45.5	1.41	1.39
50.6	1.43	1.45

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
50.3	1.43	1.45
51.1	1.46	1.46
49.2	1.41	1.43
48.8	1.42	1.43
51.0	1.46	1.46
53.9	1.47	1.50
49.8	1.46	1.44
49.6	1.43	1.44
50.9	1.45	1.46
56.5	1.53	1.54
55.5	1.52	1.52
51.1	1.48	1.46
51.5	1.45	1.46
50.1	1.54	1.45
52.5	1.53	1.48
53.3	1.52	1.49
54.8	1.49	1.51
58.7	1.47	1.58
51.7	1.53	1.47
60.7	1.59	1.61
56.0	1.61	1.53
60.0	1.60	1.60
60.0	1.63	1.60
62.7	1.64	1.65
62.8	1.62	1.65
62.7	1.67	1.65
38.5	1.31	1.31
40.1	1.29	1.32
39.6	1.31	1.32
41.3	1.34	1.34
41.4	1.31	1.34
41.6	1.32	1.34
41.3	1.33	1.34
45.0	1.35	1.38
42.9	1.34	1.35
44.3	1.33	1.37
40.7	1.32	1.33
43.2	1.33	1.36
40.0	1.31	1.32
45.5	1.37	1.39
45.3	1.36	1.38
44.1	1.32	1.37

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
47.4	1.36	1.41
45.3	1.27	1.38
46.7	1.41	1.40
54.9	1.53	1.51
62.1	1.64	1.63
64.7	1.69	1.68
65.1	1.71	1.69
64.2	1.77	1.67
67.2	1.72	1.73
68.5	1.73	1.76
68.3	1.76	1.76
69.2	1.75	1.77
68.8	1.75	1.77
65.9	1.69	1.71
62.2	1.68	1.64
67.3	1.71	1.73
66.9	1.70	1.73
65.6	1.72	1.70
68.3	1.73	1.76
68.9	1.84	1.77
38.3	1.32	1.30
41.0	1.33	1.33
37.6	1.33	1.30
36.4	1.29	1.29
42.7	1.34	1.35
40.5	1.32	1.33
39.5	1.30	1.32
38.5	1.26	1.31
43.0	1.33	1.36
24.0	1.15	1.18
26.5	1.17	1.20
34.2	1.26	1.26
52.3	1.46	1.48
49.9	1.46	1.44
55.4	1.49	1.52
66.1	1.69	1.71
67.0	1.74	1.73
56.2	1.51	1.53
61.7	1.61	1.63
51.9	1.47	1.47
29.5	1.24	1.22
36.0	1.27	1.28

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
36.2	1.28	1.28
36.6	1.26	1.29
37.4	1.27	1.30
36.1	1.28	1.28
38.4	1.28	1.31
39.8	1.30	1.32
40.8	1.33	1.33
36.6	1.31	1.29
38.2	1.31	1.30
68.9	1.31	1.77
40.0	1.32	1.32
41.6	1.31	1.34
40.0	1.32	1.32
39.4	1.30	1.32
39.6	1.31	1.32
40.6	1.30	1.33
40.0	1.31	1.32
39.8	1.31	1.32
39.0	1.36	1.31
44.6	1.38	1.37
45.2	1.42	1.38
46.4	1.37	1.40
46.1	1.38	1.39
45.2	1.37	1.38
46.1	1.40	1.39
49.5	1.40	1.44
48.1	1.45	1.42
47.9	1.44	1.42
53.6	1.52	1.49
55.5	1.53	1.52
57.5	1.51	1.56
54.9	1.58	1.51
53.2	1.52	1.49
56.6	1.54	1.54
52.5	1.48	1.48
52.0	1.54	1.47
55.0	1.47	1.52
48.3	1.45	1.42
30.1	1.24	1.23
32.7	1.22	1.25
34.1	1.23	1.26
33.6	1.25	1.26

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
33.8	1.25	1.26
31.3	1.24	1.24
31.3	1.23	1.24
33.4	1.24	1.26
36.2	1.28	1.28
36.3	1.26	1.28
35.9	1.30	1.28
36.4	1.27	1.29
37.3	1.27	1.29
36.9	1.29	1.29
40.9	1.33	1.33
38.8	1.28	1.31
38.7	1.28	1.31
40.5	1.30	1.33
39.4	1.28	1.32
40.3	1.30	1.33
68.8	1.84	1.77
69.7	1.77	1.79
70.2	1.86	1.80
31.0	1.23	1.24
34.3	1.26	1.27
33.4	1.27	1.26
34.3	1.26	1.27
34.2	1.26	1.26
34.8	1.27	1.27
37.9	1.31	1.30
39.1	1.29	1.31
40.0	1.33	1.32
39.0	1.30	1.31
40.0	1.30	1.32
37.0	1.31	1.29
38.5	1.30	1.31
37.1	1.31	1.29
38.0	1.29	1.30
41.4	1.34	1.34
49.8	1.47	1.44
60.3	1.62	1.60
39.5	1.31	1.32
41.2	1.31	1.34
37.3	1.43	1.29
43.2	1.45	1.36
49.8	1.49	1.44

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
49.7	1.54	1.44
56.2	1.85	1.53
49.9	1.45	1.44
59.8	1.53	1.59
61.3	1.59	1.62
64.0	1.63	1.67
52.8	1.49	1.48
56.0	1.54	1.53
59.0	1.47	1.58
59.2	1.62	1.58
64.5	1.75	1.68
64.7	1.60	1.68
62.0	1.61	1.63
56.8	1.59	1.54
62.0	1.67	1.63
67.2	1.67	1.73
63.1	1.66	1.65
30.8	1.25	1.23
35.8	1.29	1.28
31.9	1.29	1.24
36.3	1.30	1.28
39.6	1.27	1.32
40.1	1.32	1.32
40.4	1.33	1.33
41.6	1.31	1.34
44.8	1.33	1.38
45.2	1.37	1.38
42.7	1.36	1.35
46.2	1.39	1.39
58.8	1.57	1.58
56.8	1.57	1.54
60.5	1.50	1.61
51.5	1.50	1.46
53.1	1.46	1.49
40.1	1.36	1.32
63.3	1.76	1.66
58.6	1.54	1.57
50.2	1.55	1.45
60.5	1.69	1.61
58.5	1.57	1.57
58.1	1.64	1.57
56.9	1.64	1.55

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
59.6	1.59	1.59
59.9	1.64	1.60
62.4	1.60	1.64
61.0	1.64	1.61
63.6	1.68	1.66
64.2	1.71	1.67
65.9	1.74	1.71
68.3	1.72	1.76
64.4	1.71	1.68
66.9	1.67	1.73
68.3	1.73	1.76
65.7	1.69	1.70
65.7	1.77	1.70
29.6	1.23	1.22
31.8	1.27	1.24
34.3	1.27	1.27
34.7	1.27	1.27
33.5	1.27	1.26
34.0	1.28	1.26
34.5	1.28	1.27
38.5	1.32	1.31
34.3	1.31	1.27
40.7	1.32	1.33
37.8	1.30	1.30
37.8	1.30	1.30
42.9	1.30	1.35
39.7	1.30	1.32
33.9	1.32	1.26
38.9	1.32	1.31
41.6	1.34	1.34
41.6	1.31	1.34
41.4	1.35	1.34
39.6	1.33	1.32
35.0	1.25	1.27
33.5	1.33	1.26
36.1	1.29	1.28
40.6	1.34	1.33
39.6	1.38	1.32
39.8	1.34	1.32
41.4	1.31	1.34
39.8	1.31	1.32
41.5	1.30	1.34

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
39.2	1.33	1.31
39.4	1.35	1.32
44.2	1.37	1.37
42.2	1.33	1.35
42.8	1.33	1.35
41.8	1.33	1.34
43.4	1.30	1.36
43.2	1.31	1.36
40.1	1.35	1.32
41.8	1.35	1.34
36.4	1.29	1.29
32.4	1.20	1.25
38.4	1.32	1.31
40.9	1.42	1.33
37.7	1.35	1.30
36.4	1.28	1.29
38.1	1.30	1.30
37.9	1.29	1.30
37.0	1.30	1.29
37.9	1.28	1.30
39.0	1.33	1.31
41.1	1.35	1.33
40.5	1.34	1.33
41.8	1.37	1.34
39.6	1.33	1.32
40.7	1.32	1.33
41.8	1.36	1.34
40.8	1.31	1.33
40.5	1.32	1.33
37.0	1.34	1.29
42.8	1.41	1.35
49.5	1.52	1.44
48.9	1.52	1.43
43.5	1.38	1.36
43.5	1.37	1.36
44.4	1.37	1.37
45.5	1.45	1.39
46.7	1.43	1.40
52.5	1.46	1.48
52.2	1.46	1.47
54.4	1.50	1.51
55.4	1.44	1.52

PUGET SOUND SEDIMENT PERCENT DRY WEIGHT, ASSOCIATED WET DENSITY, AND ESTIMATED WET DENSITY

Collected in 1981 by scientists at Battelle Marine Sciences Laboratory

Percent Dry Weight (g)	Sediment Wet Density (g/cm3)	Estimated Sediment Wet Density (g/cm3)
59.5	1.51	1.59
56.9	1.52	1.55
56.4	1.56	1.54
55.5	1.55	1.52
56.3	1.58	1.54

APPENDIX D

GRAIN-SIZE ANALYSIS

PUGET SOUND HISTORICAL TRENDS
GRAIN SIZE ANALYSIS

Sample No.	Segment Depth (cm)	% Total Solids	PERCENT OF TOTAL MASS > 2.0 mm	0.063-2.0 mm	3.9 63 um	< 3.9 um	TOTAL FINES (%)
CORE #3							
372-2	2-4	34.40	0.11	5.11	52.53	42.25	94.78
372-6	10-12	37.93	0.77	4.57	51.85	42.81	94.66
372-8	14-16	38.27	0.00	3.76	52.33	43.90	96.23
372-10	18-20	36.94	0.00	2.92	53.77	43.31	97.08
372-16	30-32	38.92	0.03	3.48	51.81	44.68	96.49
372-20	38-40	38.86	0.20	2.94	51.36	45.50	96.86
372-22	42-44	37.87	0.00	2.29	53.53	44.17	97.70
372-26	50-52	39.95	0.00	2.93	54.33	42.75	97.08
372-30	58-60	39.08	0.00	3.32	51.30	45.38	96.68
372-36	70-72	39.70	0.00	5.47	49.62	44.91	94.53
372-40	78-80	41.27	0.00	2.50	50.47	47.03	97.50
372-46	90-92	41.64	0.00	3.51	49.00	47.49	96.49
372-50	98-100	42.02	0.00	3.58	51.62	44.80	96.42
372-56	110-112	40.49	0.00	3.20	50.82	45.98	96.80
372-59	116-118	38.40	0.05	3.68	51.32	44.95	96.27
372-65	128-130	41.69	0.00	2.77	50.37	46.86	97.23
372-71	140-142	39.87	6.26	4.40	46.47	42.86	89.33
372-74	146-148	42.52	0.00	3.67	50.91	45.42	96.33
372-80	158-160	44.02	0.00	3.15	52.66	44.19	96.85
372-85	168-170	41.50	0.00	3.78	51.14	45.08	96.22
372-90	178-180	42.91	0.00	3.34	51.51	45.15	96.66
372-94	186-188	41.77	0.00	2.59	50.99	46.42	97.41
CORE #5							
372-191	2-4	28.62	0.06	6.99	45.77	47.18	92.95
372-195	10-12	32.49	0.00	5.37	44.36	50.28	94.64
372-197	14-16	33.06	0.00	4.97	45.71	49.32	95.03
372-199	18-20	34.57	0.07	5.40	45.97	48.56	94.53
372-205	30-32	35.80	0.03	5.74	44.63	49.60	94.23
372-209	38-40	33.00	0.00	3.97	44.61	51.42	96.03
372-215	50-52	32.88	0.00	4.09	43.97	51.94	95.91
372-217	54-56	34.54	0.00	3.71	45.60	50.69	96.29
372-219	58-60	35.70	0.00	4.58	45.23	50.19	95.42
372-225	70-72	34.38	0.00	3.38	46.69	49.93	96.62

PUGET SOUND HISTORICAL TRENDS
GRAIN SIZE ANALYSIS

			PERCENT OF TOTAL MASS				
Sample No.	Segment Depth (cm)	% Total Solids	> 2.0 mm	0.063- 2.0 mm	3.9 63 um	< 3.9 um	TOTAL FINES (%)
CORE #5 (contd)							
372-229	78-80	43.93	0.04	18.09	42.70	39.18	81.88
372-235	90-92	38.68	0.00	3.96	46.79	49.26	96.05
372-239	98-110	38.65	0.00	2.49	48.87	48.64	97.51
372-245	110-112	37.79	0.00	3.98	49.06	46.96	96.02
372-248	116-118	37.64	0.13	3.96	46.06	49.85	95.91
372-254	128-130	39.71	0.00	2.45	47.62	49.93	97.55
372-260	140-142	40.19	1.25	3.14	45.66	49.95	95.61
372-263	146-148	39.20	0.30	3.23	44.14	52.34	96.48
372-269	158-160	39.82	0.00	4.18	46.06	49.75	95.81
372-272	164-166	41.02	0.11	3.65	45.58	50.66	96.24
CORE #6							
372-96	2-4	27.91	0.00	9.42	42.75	47.83	90.58
372-100	10-12	35.32	0.00	12.31	39.66	48.03	87.69
372-102	14-16	32.92	0.07	17.82	39.40	42.71	82.11
372-104	18-20	32.27	0.16	13.83	40.24	45.77	86.01
372-108	26-28	34.18	0.00	14.34	38.69	46.97	85.66
372-110	30-32	36.99	0.00	9.33	41.03	49.64	90.67
372-114	38-40	36.67	0.02	10.49	40.61	48.88	89.49
372-116	42-44	36.57	0.28	10.49	41.77	47.45	89.22
372-120	50-52	36.59	0.00	10.15	41.83	48.02	89.85
372-124	58-60	38.56	0.61	10.05	41.33	48.02	89.35
372-130	70-72	39.47	0.00	9.77	43.30	46.93	90.23
372-134	78-80	40.07	0.07	6.29	42.54	51.11	93.65
372-140	90-92	39.46	0.00	5.39	45.04	49.57	94.61
372-144	98-100	38.02	0.09	4.02	43.92	51.98	95.90
372-150	110-112	33.73	0.04	4.71	43.85	51.40	95.25
372-159	128-130	37.38	0.06	3.76	42.59	53.59	96.18
372-168	146-148	40.07	0.00	3.64	42.02	54.34	96.36
372-183	176-178	39.50	0.00	5.13	43.34	51.54	94.88

APPENDIX E

TOTAL ORGANIC CARBON (TOC) ANALYSIS

PUGET SOUND HISTORICAL TRENDS
TOTAL ORGANIC CARBON (TOC) ANALYSIS

Sample No.	Segment Depth (cm)	TOC (% of Dry Wt)
CORE #3		
372-2	2-4	2.14
372-6	10-12	2.13
372-8	14-16	2.10
372-10	18-20	2.10
372-16	30-32	2.07
372-20	38-40	2.09
372-22	42-44	2.05
372-26	50-52	2.12
372-30	58-60	1.96
372-36	70-72	2.04
372-40	78-80	2.00
372-46	90-92	1.97
372-50	98-100	2.02
372-56	110-112	1.85
372-59	116-118	1.82
372-65	128-130	1.76
372-71	140-142	1.73
372-74	146-148	1.67
372-80	158-160	1.61
372-85	168-170	1.74
372-90	178-180	1.66
372-94	186-188	1.51
CORE #5		
372-191	2-4	2.20
372-195	10-12	2.26
372-197	14-16	2.19
372-199	18-20	2.16
372-205	30-32	2.13
372-209	38-40	2.16
372-215	50-52	2.17
372-217	54-56	2.17
372-219	58-60	1.99
372-225	70-72	2.11
372-229	78-80	2.06
372-235	90-92	2.04

PUGET SOUND HISTORICAL TRENDS
TOTAL ORGANIC CARBON (TOC) ANALYSIS

Sample No.	Segment Depth (cm)	TOC (% of Dry Wt)
CORE #5 (contd)		
372-239	98-110	2.07
372-245	110-112	2.03
372-248	116-118	2.08
372-254	128-130	1.95
372-260	140-142	2.00
372-263	146-148	1.90
372-269	158-160	1.83
372-272	164-166	1.84
CORE #6		
372-96	2-4	2.17
372-100	10-12	2.18
372-102	14-16	2.18
372-104	18-20	2.11
372-108	26-28	2.14
372-110	30-32	2.12
372-114	38-40	2.16
372-116	42-44	2.14
372-120	50-52	2.10
372-124	58-60	1.98
372-130	70-72	1.98
372-134	78-80	1.94
372-140	90-92	1.72
372-144	98-100	1.51
372-150	110-112	1.57
372-159	128-130	1.45
372-168	146-148	1.40
372-183	176-178	1.37
BLANK-1		0.002
BLANK-2		0.001
BLANK-3		0.002
BLANK-4		0.003
BLANK-5		0.005
BLANK-6		0.003

PUGET SOUND HISTORICAL TRENDS
TOTAL ORGANIC CARBON (TOC) ANALYSIS

Sample No.	Segment Depth (cm)	TOC (% of Dry Wt)
STANDARD REFERENCE MATERIAL		
MESS-1 REP 1		2.24
MESS-1 REP 2		2.21
MESS-1 REP 3		2.17

APPENDIX F

PERCENTAGE OF DRY WEIGHT IN SEDIMENT SAMPLES

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

CORE #1

Sample No.		Segment Depth (cm)	% Dry Weight
372PSHT-	448	0-2	38.45
372PSHT-	449	2-4	41.45
372PSHT-	450	4-6	44.06
372PSHT-	451	6-8	45.09
372PSHT-	452	8-10	48.50
372PSHT-	453	10-12	48.59
372PSHT-	454	12-14	48.54
372PSHT-	455	14-16	51.35
372PSHT-	456	16-18	52.25
372PSHT-	457	18-20	50.17
372PSHT-	458	20-22	50.37
372PSHT-	459	22-24	52.36
372PSHT-	460	24-26	52.89
372PSHT-	461	26-28	51.53
372PSHT-	462	28-30	53.34
372PSHT-	463	30-32	52.78
372PSHT-	464	32-34	53.30
372PSHT-	465	34-36	50.85
372PSHT-	466	36-38	52.32
372PSHT-	467	38-40	53.43
372PSHT-	468	40-42	54.58
372PSHT-	469	42-44	52.08
372PSHT-	470	44-46	53.54
372PSHT-	471	46-48	53.24
372PSHT-	472	48-50	52.20
372PSHT-	473	50-52	51.88
372PSHT-	474	52-54	50.72
372PSHT-	475	54-56	52.69
372PSHT-	476	56-58	52.08
372PSHT-	477	58-60	53.74
372PSHT-	478	60-62	52.56
372PSHT-	479	62-64	52.13
372PSHT-	480	64-66	50.98
372PSHT-	481	66-68	49.93
372PSHT-	482	68-70	50.99
372PSHT-	483	70-72	51.75
372PSHT-	484	72-74	50.66
372PSHT-	485	74-76	51.44

CORE #2A

Sample No.		Segment Depth (cm)	% Dry Weight
372PSHT-	275	0-2	35.78
372PSHT-	276	2-4	38.77
372PSHT-	277	4-6	40.04
372PSHT-	278	6-8	41.28
372PSHT-	279	8-10	43.61
372PSHT-	280	10-12	43.43
372PSHT-	281	12-14	42.33
372PSHT-	282	14-16	44.20
372PSHT-	283	16-18	44.15
372PSHT-	284	18-20	43.57
372PSHT-	285	20-22	41.74
372PSHT-	286	22-24	43.24
372PSHT-	287	24-26	43.37
372PSHT-	288	26-28	43.18
372PSHT-	289	28-30	42.55
372PSHT-	290	30-32	45.04
372PSHT-	291	32-34	45.28
372PSHT-	292	34-36	44.91
372PSHT-	293	36-38	44.13
372PSHT-	294	38-40	43.56
372PSHT-	295	40-42	43.43
372PSHT-	296	42-44	44.54
372PSHT-	297	44-46	43.06
372PSHT-	298	46-48	44.16
372PSHT-	299	48-50	45.62
372PSHT-	300	50-52	45.98
372PSHT-	301	52-53	46.49
372PSHT-	302	53-56	45.77
372PSHT-	303	56-58	43.51

CORE #2

Sample No.		Segment Depth (cm)	% Dry Weight
372PSHT-	304	58-60	43.66
372PSHT-	305	60-62	44.54
372PSHT-	306	62-64	44.87
372PSHT-	307	64-66	45.05
372PSHT-	308	66-68	44.38
372PSHT-	309	68-70	43.86

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

CORE #1 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 486	76-78	52.69
372PSHT- 487	78-80	51.24
372PSHT- 488	80-82	52.26
372PSHT- 489	82-84	51.34
372PSHT- 490	84-86	50.76
372PSHT- 491	86-88	50.47
372PSHT- 492	88-90	57.70
372PSHT- 493	90-92	54.81
372PSHT- 494	92-94	53.42
372PSHT- 495	94-96	54.33
372PSHT- 496	96-98	51.65
372PSHT- 497	98-100	51.07
372PSHT- 498	100-102	50.89
372PSHT- 499	102-104	51.78

CORE #3

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 1	0-2	33.69
372PSHT- 2	2-4	35.48
372PSHT- 3	4-6	35.85
372PSHT- 4	6-8	36.60
372PSHT- 5	8-10	36.53
372PSHT- 6	10-12	37.24
372PSHT- 7	12-14	37.52
372PSHT- 8	14-16	37.11
372PSHT- 9	16-18	37.23
372PSHT- 10	18-20	38.13
372PSHT- 11	20-22	37.14
372PSHT- 12	22-24	38.70
372PSHT- 13	24-26	39.73
372PSHT- 14	26-28	38.32
372PSHT- 15	28-30	38.19
372PSHT- 16	30-32	39.27
372PSHT- 17	32-34	39.49
372PSHT- 18	34-36	38.61
372PSHT- 19	36-38	39.04
372PSHT- 20	38-40	37.14
372PSHT- 21	40-42	36.40

CORE #2 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 310	70-72	44.81
372PSHT- 311	72-74	43.92
372PSHT- 312	74-76	41.16
372PSHT- 313	76-78	43.53
372PSHT- 314	78-80	43.96
372PSHT- 315	80-82	42.73
372PSHT- 316	82-84	41.51
372PSHT- 317	84-86	45.31
372PSHT- 318	86-88	44.44
372PSHT- 319	88-90	43.84
372PSHT- 320	90-92	43.42
372PSHT- 321	92-94	44.87
372PSHT- 322	94-96	44.68
372PSHT- 323	96-98	43.23
372PSHT- 324	98-100	44.81
372PSHT- 325	100-102	43.17
372PSHT- 326	102-104	45.83
372PSHT- 327	104-106	45.17
372PSHT- 328	106-108	43.51
372PSHT- 329	108-110	44.43
372PSHT- 330	110-112	43.12
372PSHT- 331	112-114	44.24
372PSHT- 332	114-116	49.82
372PSHT- 333	116-118	42.88
372PSHT- 334	11 8-120	44.07
372PSHT- 335	120-122	44.35
372PSHT- 336	122-124	46.09
372PSHT- 337	124-126	46.37
372PSHT- 338	126-128	46.93
372PSHT- 339	128-130	47.32
372PSHT- 340	130-132	44.20
372PSHT- 341	132-134	47.49
372PSHT- 342	134-136	46.83
372PSHT- 343	136-138	47.04
372PSHT- 344	138-140	45.95
372PSHT- 345	140-142	46.46
372PSHT- 346	142-144	45.48
372PSHT- 347	144-146	47.37

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

CORE #3 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 22	42-44	37.56
372PSHT- 23	44-46	37.51
372PSHT- 24	46-48	39.08
372PSHT- 25	48-50	39.94
372PSHT- 26	50-52	38.98
372PSHT- 27	52-54	40.50
372PSHT- 28	54-56	39.70
372PSHT- 29	56-58	39.67
372PSHT- 30	58-60	39.28
372PSHT- 31	60-62	41.05
372PSHT- 32	62-64	40.19
372PSHT- 33	64-66	40.09
372PSHT- 34	66-68	40.24
372PSHT- 35	68-70	40.58
372PSHT- 36	70-72	40.87
372PSHT- 37	72-74	39.43
372PSHT- 38	74-76	40.36
372PSHT- 39	76-78	40.85
372PSHT- 40	78-80	41.10
372PSHT- 41	80-82	39.08
372PSHT- 42	82-84	39.65
372PSHT- 43	84-86	41.08
372PSHT- 44	86-88	40.61
372PSHT- 45	88-90	39.88
372PSHT- 46	90-92	42.34
372PSHT- 47	92-94	40.50
372PSHT- 48	94-96	42.55
372PSHT- 49	96-98	40.70
372PSHT- 50	98-100	41.05
372PSHT- 51	100-102	39.22
372PSHT- 52	102-104	38.59
372PSHT- 53	104-106	40.78
372PSHT- 54	106-108	41.01
372PSHT- 55	108-110	41.74
372PSHT- 56	110-112	42.92
372PSHT- 57	112-114	42.13
372PSHT- 58	114-116	40.68
372PSHT- 59	116-118	41.61

CORE #2 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 348	146-148	45.70
372PSHT- 349	148-150	46.46
372PSHT- 350	150-152	46.66
372PSHT- 351	152-154	47.97
372PSHT- 352	154-156	49.07
372PSHT- 353	156-158	46.85
372PSHT- 354	158-160	47.00
372PSHT- 355	160-162	46.65
372PSHT- 356	162-164	46.48
372PSHT- 357	164-166	46.30
372PSHT- 358	166-168	45.80
372PSHT- 359	168-170	47.88

CORE #4

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 360	0-2	30.21
372PSHT- 361	2-4	34.33
372PSHT- 362	4-6	34.77
372PSHT- 363	6-8	36.05
372PSHT- 364	8-10	36.19
372PSHT- 365	10-12	37.59
372PSHT- 366	12-14	38.90
372PSHT- 367	14-16	38.51
372PSHT- 368	16-18	38.80
372PSHT- 369	18-20	38.11
372PSHT- 370	20-22	38.75
372PSHT- 371	22-24	40.86
372PSHT- 372	24-26	42.09
372PSHT- 373	26-28	42.44
372PSHT- 374	28-30	41.93
372PSHT- 375	30-32	42.65
372PSHT- 376	32-34	41.91
372PSHT- 377	34-36	41.38
372PSHT- 378	36-38	41.82
372PSHT- 379	38-40	41.51
372PSHT- 380	40-42	42.11
372PSHT- 381	42-44	41.73
372PSHT- 382	44-46	41.95

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #3 (contd)			
372PSHT-	60	11 8-120	39.14
372PSHT-	61	120-122	39.96
372PSHT-	62	122-124	41.86
372PSHT-	63	124-126	41.17
372PSHT-	64	126-128	42.01
372PSHT-	65	128-130	39.67
372PSHT-	66	130-132	40.39
372PSHT-	67	132-134	38.89
372PSHT-	68	134-136	38.50
372PSHT-	69	136-138	38.62
372PSHT-	70	138-140	38.32
372PSHT-	71	140-142	39.43
372PSHT-	72	142-144	40.61
372PSHT-	73	144-146	41.13
372PSHT-	74	146-148	41.91
372PSHT-	75	148-150	41.48
372PSHT-	76	150-152	42.56
372PSHT-	77	152-154	42.68
372PSHT-	78	154-156	43.31
372PSHT-	79	156-158	42.49
372PSHT-	80	158-160	42.43
372PSHT-	81	160-162	43.24
372PSHT-	82	162-164	42.33
372PSHT-	83	164-166	42.58
372PSHT-	84	166-168	41.27
372PSHT-	85	168-170	43.56
372PSHT-	86	170-172	43.25
372PSHT-	87	172-174	44.79
372PSHT-	88	174-176	42.13
372PSHT-	89	176-178	42.58
372PSHT-	90	178-180	41.54
372PSHT-	91	180-182	43.31
372PSHT-	92	182-184	43.59
372PSHT-	93	184-186	42.54
372PSHT-	94	186-188	42.77

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #4 (contd)			
372PSHT-	383	46-48	43.04
372PSHT-	384	48-50	43.14
372PSHT-	385	50-52	42.77
372PSHT-	386	52-54	42.12
372PSHT-	387	54-56	42.82
372PSHT-	388	56-58	41.23
372PSHT-	389	58-60	41.33
372PSHT-	390	60-62	44.07
372PSHT-	391	62-64	41.80
372PSHT-	392	64-66	42.07
372PSHT-	393	66-68	43.44
372PSHT-	394	68-70	40.54
372PSHT-	395	70-72	41.94
372PSHT-	396	72-74	41.91
372PSHT-	397	74-76	42.08
372PSHT-	398	76-78	42.10
372PSHT-	399	78-80	43.25
372PSHT-	400	80-82	43.94
372PSHT-	401	82-84	43.16
372PSHT-	402	84-86	45.88
372PSHT-	403	86-88	46.13
372PSHT-	404	88-90	44.71
372PSHT-	405	90-92	45.26
372PSHT-	406	92-94	45.01
372PSHT-	407	94-96	43.45
372PSHT-	408	96-98	40.94
372PSHT-	409	98-100	37.52
372PSHT-	410	100-102	44.92
372PSHT-	411	102-104	46.73
372PSHT-	412	104-106	44.75
372PSHT-	413	106-108	45.41
372PSHT-	414	108-110	45.11
372PSHT-	415	110-112	44.73
372PSHT-	416	112-114	44.68
372PSHT-	417	114-116	43.02
372PSHT-	418	116-118	42.23
372PSHT-	419	11 8-120	40.27
372PSHT-	420	120-122	40.80

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #5			
372PSHT-	190	0-2	27.58
372PSHT-	191	2-4	29.88
372PSHT-	192	4-6	29.56
372PSHT-	193	6-8	31.65
372PSHT-	194	8-10	32.78
372PSHT-	195	10-12	34.29
372PSHT-	196	12-14	33.99
372PSHT-	197	14-16	34.08
372PSHT-	198	16-18	33.71
372PSHT-	199	18-20	34.46
372PSHT-	200	20-22	33.74
372PSHT-	201	22-24	35.07
372PSHT-	202	24-26	35.11
372PSHT-	203	26-28	35.49
372PSHT-	204	28-30	33.77
372PSHT-	205	30-32	34.01
372PSHT-	206	32-34	32.89
372PSHT-	207	34-36	34.19
372PSHT-	208	36-38	33.71
372PSHT-	209	38-40	32.53
372PSHT-	210	40-42	33.34
372PSHT-	211	42-44	33.50
372PSHT-	212	44-46	33.51
372PSHT-	213	46-48	34.43
372PSHT-	214	48-50	34.40
372PSHT-	215	50-52	34.47
372PSHT-	216	52-54	35.24
372PSHT-	217	54-56	36.74
372PSHT-	218	56-58	35.92
372PSHT-	219	58-60	37.58
372PSHT-	220	60-62	35.31
372PSHT-	221	62-64	37.05
372PSHT-	222	64-66	37.14
372PSHT-	223	66-68	37.81
372PSHT-	224	68-70	35.76
372PSHT-	225	70-72	36.52
372PSHT-	226	72-74	34.85
372PSHT-	227	74-76	38.00

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #4 (contd)			
372PSHT-	421	122-124	41.76
372PSHT-	422	124-126	42.91
372PSHT-	423	126-128	43.15
372PSHT-	424	128-130	43.10
372PSHT-	425	130-132	43.08
372PSHT-	426	132-134	43.82
372PSHT-	427	134-136	43.96
372PSHT-	428	136-138	42.79
372PSHT-	429	138-140	40.96
372PSHT-	430	140-142	41.76
372PSHT-	431	142-144	42.53
372PSHT-	432	144-146	43.19
372PSHT-	433	146-148	42.70
372PSHT-	434	148-150	43.48
372PSHT-	435	150-152	41.06
372PSHT-	436	152-154	41.41
372PSHT-	437	154-156	42.94
372PSHT-	438	156-158	43.24
372PSHT-	439	158-160	43.39
372PSHT-	440	160-162	40.96
372PSHT-	441	162-164	41.33
372PSHT-	442	164-166	44.38
372PSHT-	443	166-168	46.03
372PSHT-	444	168-170	45.93
372PSHT-	445	170-172	44.00
372PSHT-	446	172-174	44.41
372PSHT-	447	174-176	43.82
CORE #6			
372PSHT-	95	0-2	31.03
372PSHT-	96	2-4	30.99
372PSHT-	97	4-6	29.80
372PSHT-	98	6-8	32.73
372PSHT-	99	8-10	33.62
372PSHT-	100	10-12	34.43
372PSHT-	101	12-14	34.07
372PSHT-	102	14-16	33.66

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

CORE #5 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 228	76-78	36.77
372PSHT- 229	78-80	39.76
372PSHT- 230	80-82	37.77
372PSHT- 231	82-84	37.71
372PSHT- 232	84-86	37.78
372PSHT- 233	86-88	38.38
372PSHT- 234	88-90	38.12
372PSHT- 235	90-92	39.48
372PSHT- 236	92-94	37.80
372PSHT- 237	94-96	37.50
372PSHT- 238	96-98	37.93
372PSHT- 239	98-100	38.87
372PSHT- 240	100-102	38.12
372PSHT- 241	102-104	38.29
372PSHT- 242	104-106	38.85
372PSHT- 243	106-108	37.90
372PSHT- 244	108-110	38.22
372PSHT- 245	110-112	37.39
372PSHT- 246	112-114	38.25
372PSHT- 247	114-116	38.39
372PSHT- 248	116-118	38.94
372PSHT- 249	11 8-120	37.74
372PSHT- 250	120-122	38.96
372PSHT- 251	122-124	40.47
372PSHT- 252	124-126	39.43
372PSHT- 253	126-128	39.13
372PSHT- 254	128-130	40.63
372PSHT- 255	130-132	39.23
372PSHT- 256	132-134	39.26
372PSHT- 257	134-136	38.44
372PSHT- 258	136-138	37.55
372PSHT- 259	138-140	38.33
372PSHT- 260	140-142	37.38
372PSHT- 261	142-144	39.97
372PSHT- 262	144-146	39.47
372PSHT- 263	146-148	39.53
372PSHT- 264	148-150	39.86
372PSHT- 265	150-152	40.77

CORE #6 (contd)

Sample No.	Segment Depth (cm)	% Dry Weight
372PSHT- 103	16-18	35.75
372PSHT- 104	18-20	34.29
372PSHT- 105	20-22	34.65
372PSHT- 106	22-24	37.10
372PSHT- 107	24-26	34.53
372PSHT- 108	26-28	34.54
372PSHT- 109	28-30	35.56
372PSHT- 110	30-32	36.99
372PSHT- 111	32-34	37.53
372PSHT- 112	34-36	36.82
372PSHT- 113	36-38	35.47
372PSHT- 114	38-40	37.52
372PSHT- 115	40-42	36.25
372PSHT- 116	42-44	35.25
372PSHT- 117	44-46	35.69
372PSHT- 118	46-48	34.12
372PSHT- 119	48-50	35.26
372PSHT- 120	50-52	35.77
372PSHT- 121	52-54	35.48
372PSHT- 122	54-56	37.39
372PSHT- 123	56-58	35.47
372PSHT- 124	58-60	37.03
372PSHT- 125	60-62	37.44
372PSHT- 126	62-64	38.11
372PSHT- 127	64-66	38.65
372PSHT- 128	66-68	39.33
372PSHT- 129	68-70	38.96
372PSHT- 130	70-72	39.36
372PSHT- 131	72-74	38.78
372PSHT- 132	74-76	39.06
372PSHT- 133	76-78	38.33
372PSHT- 134	78-80	38.33
372PSHT- 135	80-82	39.15
372PSHT- 136	82-84	40.63
372PSHT- 137	84-86	40.15
372PSHT- 138	86-88	39.59
372PSHT- 139	88-90	39.99
372PSHT- 140	90-92	40.06

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #5 (contd)			
372PSHT-	266	152-154	42.29
372PSHT-	267	154-156	39.91
372PSHT-	268	156-158	40.35
372PSHT-	269	158-160	41.37
372PSHT-	270	160-162	40.80
372PSHT-	271	162-164	40.90
372PSHT-	272	164-166	39.92
372PSHT-	273	166-168	40.56
372PSHT-	274	168-170	40.99

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #6 (contd)			
372PSHT-	141	92-94	39.46
372PSHT-	142	94-96	39.68
372PSHT-	143	96-98	38.91
372PSHT-	144	98-100	39.65
372PSHT-	145	100-102	39.05
372PSHT-	146	102-104	37.50
372PSHT-	147	104-106	37.73
372PSHT-	148	106-108	35.98
372PSHT-	149	108-110	37.82
372PSHT-	150	110-112	36.44
372PSHT-	151	112-114	35.91
372PSHT-	152	114-116	38.39
372PSHT-	153	116-118	36.57
372PSHT-	154	118-120	37.21
372PSHT-	155	120-122	37.41
372PSHT-	156	122-124	37.06
372PSHT-	157	124-126	37.58
372PSHT-	158	126-128	38.50
372PSHT-	159	128-130	38.34
372PSHT-	160	130-132	36.61
372PSHT-	161	132-134	37.09
372PSHT-	162	134-136	38.58
372PSHT-	163	136-138	38.12
372PSHT-	164	138-140	39.17
372PSHT-	165	140-142	37.85
372PSHT-	166	142-144	39.31
372PSHT-	167	144-146	37.67
372PSHT-	168	146-148	40.34
372PSHT-	169	148-150	39.62
372PSHT-	170	150-152	39.73
372PSHT-	171	152-154	37.84
372PSHT-	172	154-156	38.52
372PSHT-	173	156-158	40.42
372PSHT-	174	158-160	38.38
372PSHT-	175	160-162	39.02
372PSHT-	176	162-164	37.88
372PSHT-	177	164-166	38.95
372PSHT-	178	166-168	36.42

PUGET SOUND HISTORICAL TRENDS
% DRY WEIGHT IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	% Dry Weight
CORE #6 (contd)			
372PSHT-	179	168-170	37.13
372PSHT-	180	170-172	39.74
372PSHT-	181	172-174	39.02
372PSHT-	182	174-176	40.85
372PSHT-	183	176-178	40.03
372PSHT-	184	178-180	39.89
372PSHT-	185	180-182	40.01
372PSHT-	186	182-184	40.98
372PSHT-	187	184-186	39.57
372PSHT-	188	186-188	40.06
372PSHT-	189	188-190	40.33

APPENDIX G

NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
CORE #3					
372PSHT-	1	0-2	0.0910	NA	25.9
372PSHT-	2	2-4	NA	0.26	NA
372PSHT-	5	8-10	0.0867	NA	25.7
372PSHT-	6	10-12	NA	0.26	NA
372PSHT-	8	14-16	0.0769	0.26	25.5
372PSHT-	10	18-20	0.0808	0.25	26.6
372PSHT-	15	28-30	0.0759	NA	26.3
372PSHT-	16	30-32	NA	0.24	NA
372PSHT-	20	38-40	0.0740	0.23	27.1
372PSHT-	22	42-44	0.0721	0.24	25.4
372PSHT-	25	48-50	0.0736	NA	26.6
372PSHT-	26	50-52	NA	0.23	NA
372PSHT-	30	58-60	0.0692	0.23	26.2
372PSHT-	35	68-70	0.0679	NA	26.3
372PSHT-	36	70-72	NA	0.23	NA
372PSHT-	40	78-80	0.0697	0.22	26.6
372PSHT-	45	88-90	0.0700	NA	27.0
372PSHT-	46	90-92	NA	0.22	NA
372PSHT-	50	98-100	0.0714	0.23	27.9
372PSHT-	55	108-110	0.0719	NA	26.1
372PSHT-	56	110-112	NA	0.23	NA
372PSHT-	59	116-118	NA	0.23	NA
372PSHT-	60	118-120	0.0631	NA	26.9
372PSHT-	65	128-130	0.0623	0.22	27.0
372PSHT-	70	138-140	0.0636	NA	26.3
372PSHT-	71	140-142	NA	0.22	NA
372PSHT-	74	146-148	NA	0.22	NA
372PSHT-	75	148-150	0.0627	NA	27.4
372PSHT-	80	158-160	0.0649	0.22	27.0
372PSHT-	85	168-170	0.0662	0.22	27.9
372PSHT-	90	178-180	0.0665	0.22	27.1
372PSHT-	94	186-188	0.0605	0.22	27.5

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.			Segment Depth (cm)	Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
CORE #5						
372PSHT-	190		0-2	0.0893	NA	24.6
372PSHT-	190	REP	0-2	0.0918	NA	NA
372PSHT-	191		2-4	NA	0.26	NA
372PSHT-	194		8-10	0.0953	NA	25.8
372PSHT-	194	REP	8-10	0.0997	NA	NA
372PSHT-	195		10-12	NA	0.30	NA
372PSHT-	197		14-16	0.0887	0.30	24.3
372PSHT-	199		18-20	0.0732	0.28	25.5
372PSHT-	204		28-30	0.0774	NA	26.2
372PSHT-	205		30-32	NA	0.27	NA
372PSHT-	209		38-40	0.0819	0.28	25.9
372PSHT-	214		48-50	0.0679	NA	26.9
372PSHT-	215		50-52	NA	0.26	NA
372PSHT-	217		54-56	0.1039	0.25	26.6
372PSHT-	217	REP	54-56	0.0747	NA	NA
372PSHT-	219		58-60	0.0701	0.25	26.5
372PSHT-	224		68-70	0.0675	NA	26.9
372PSHT-	225		70-72	NA	0.24	NA
372PSHT-	229		78-80	0.0719	0.25	25.8
372PSHT-	234		88-90	0.0686	NA	26.0
372PSHT-	235		90-92	NA	0.24	NA
372PSHT-	239		98-100	0.0684	0.25	26.9
372PSHT-	244		108-110	0.0757	NA	25.8
372PSHT-	244	REP	108-110	0.0724	NA	NA
372PSHT-	245		110-112	NA	0.24	NA
372PSHT-	248		116-118	NA	0.25	NA
372PSHT-	249		118-120	NA	NA	25.8
372PSHT-	254		128-130	0.0683	0.24	25.8
372PSHT-	259		138-140	0.0698	NA	26.2
372PSHT-	260		140-142	NA	0.24	NA
372PSHT-	263		146-148	NA	0.25	NA
372PSHT-	264		148-150	0.0646	NA	26.4
372PSHT-	269		158-160	0.0717	0.23	26.8
372PSHT-	272		164-166	NA	0.22	NA
372PSHT-	274		168-170	0.0565	NA	26.8

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.			Segment Depth (cm)	Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
CORE #6						
372PSHT-	95		0-2	0.0839	NA	24.6
372PSHT	96		2-4	NA	0.26	NA
372PSHT-	99		8-10	0.0816	NA	24.6
372PSHT-	100		10-12	NA	0.26	NA
372PSHT-	102		14-16	0.0768	0.26	25.6
372PSHT-	104		18-20	0.0719	0.24	26.1
372PSHT-	104	REP	18-20	0.0763	NA	NA
372PSHT-	108		26-28	0.0724	0.23	24.9
372PSHT-	108	REP	26-28	0.0676	NA	NA
372PSHT-	109		28-30	0.0642	NA	26.0
372PSHT-	109	REP	28-30	0.0684	NA	NA
372PSHT-	110		30-32	NA	0.22	NA
372PSHT-	114		38-40	0.0681	0.20	25.1
372PSHT-	116		42-44	0.0631	0.20	25.7
372PSHT-	119		48-50	0.0687	NA	26.2
372PSHT-	120		50-52	NA	0.20	NA
372PSHT-	124		58-60	0.0693	0.20	26.1
372PSHT-	124	REP	58-60	0.0705	NA	NA
372PSHT-	129		68-70	0.0654	NA	26.3
372PSHT-	129	REP	68-70	0.0693	NA	NA
372PSHT-	130		70-72	NA	0.18	NA
372PSHT-	134		78-80	0.0627	0.20	25.5
372PSHT-	139		88-90	0.0628	NA	24.0
372PSHT-	140		90-92	NA	0.19	NA
372PSHT-	144		98-100	0.0584	0.26	27.3
372PSHT-	149		108-110	0.0580	NA	26.6
372PSHT-	150		110-112	NA	0.19	NA
372PSHT-	154		118-120	NA	NA	27.5
372PSHT-	159		128-130	0.0572	0.21	26.8
372PSHT-	159	REP	128-130	0.0585	NA	NA
372PSHT-	164		138-140	NA	NA	27.6
372PSHT-	168		146-148	NA	0.16	NA
372PSHT-	169		148-150	0.0540	NA	27.8
372PSHT-	174		158-160	NA	NA	27.7
372PSHT-	179		168-170	NA	NA	28.0
372PSHT-	183		176-178	NA	0.16	NA

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.		Segment Depth (cm)	Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
CORE #6 (contd)					
372PSHT- 184		178-180	0.0587	NA	29.0
372PSHT- 184	REP	178-180	0.0597	NA	NA
372PSHT- 189		188-190	NA	NA	27.4
STANDARD REFERENCE MATERIAL					
1646- 1			0.0582	NA	28.4
1646- 2			0.0554	NA	28.8
1646- 3			0.0423	NA	29.3
1646- 4			0.0565	NA	29.7
1646- 5			0.0497	NA	27.7
1646- 6			0.0571	NA	29.0
1646- 7			0.0577	NA	29.2
1646- 8			0.0591	NA	NA
1646- 9			0.0594	NA	NA
1646- 10			0.0587	NA	NA
1646- 11			0.0589	NA	NA
1646- 12			0.0577	NA	NA
1646- 13			0.0547	NA	NA
		certified	0.0540	NA	NC
		value	±0.005	NA	NC

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.	Segment Depth (cm)	Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
STANDARD REFERENCE MATERIAL				
2704- 1		0.0998	NA	NA
2704- 2		0.0998	NA	NA
2704- 3		0.0998	NA	NA
2704- 4		0.0998	NA	NA
2704- 5		0.0091	NA	NA
2704- 6		0.1006	NA	NA
2704- 7		0.1031	NA	NA
2704- 8		0.0967	NA	NA
2704- 9		0.1009	NA	NA
2704- 10		0.0987	NA	NA
2704- 11		0.0994	NA	NA
2704- 12		0.1002	NA	NA
2704- 13		0.0991	NA	NA
2704- 14		0.1005	NA	NA
	certified	0.0998	NA	NA
	value	±0.007	NA	NA
PACS-1 1		0.1003	NA	NA
PACS-1 2		0.1006	NA	NA
PACS-1 3		0.0897	NA	NA
PACS-1 4		0.0896	NA	NA
PACS-1 5		0.0908	NA	NA
PACS-1 6		0.0993	NA	NA
PACS-1 7		0.1039	NA	NA
	certified	0.1000	NA	NA
	value	±0.009	NA	NA
MESS-1 1		0.0705	NA	NA
MESS-1 2		0.0713	NA	NA
	certified	0.0640	NA	NA
	value	±0.006	NA	NA
BCSS-1 1		0.0684	NA	NA
BCSS-1 2		0.0710	NA	NA
	certified	0.0670	NA	NA
	value	±0.007	NA	NA

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.			Segment Depth (cm)		Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
REPLICATE ANALYSIS							
372PSHT-	104		18-20		0.0719	NA	NA
372PSHT-	104	REP	18-20		0.0763	NA	NA
				RPD %	**6%**	NA	NA
372PSHT-	108		26-28		0.0724	NA	NA
372PSHT-	108	REP	26-28		0.0676	NA	NA
				RPD %	**7%**	NA	NA
372PSHT-	109		28-30		0.0642	NA	NA
372PSHT-	109	REP	28-30		0.0684	NA	NA
				RPD %	**6%**	NA	NA
372PSHT-	124		58-60		0.0693	NA	NA
372PSHT-	124	REP	58-60		0.0705	NA	NA
				RPD %	**2%**	NA	NA
372PSHT-	129		68-70		0.0654	NA	NA
372PSHT-	129	REP	68-70		0.0693	NA	NA
				RPD %	**6%**	NA	NA
372PSHT-	159		128-130		0.0572	NA	NA
372PSHT-	159	REP	128-130		0.0585	NA	NA
				RPD %	**2%**	NA	NA
372PSHT-	184		178-180		0.0587	NA	NA
372PSHT-	184	REP	178-180		0.0597	NA	NA
				RPD %	**2%**	NA	NA
372PSHT-	190		0-2		0.0893	NA	NA
372PSHT-	190	REP	0-2		0.0918	NA	NA
				RPD %	**3%**	NA	NA

PUGET SOUND HISTORICAL TRENDS
NUTRIENTS AND SILICON IN SEDIMENT SAMPLES

Sample No.			Segment Depth (cm)		Phosphorus (% of Dry Wt)	Nitrogen (% of Dry Wt)	Silicon (% of Dry Wt)
REPLICATE ANALYSIS							
372PSHT-	194		8-10		0.0953	NA	NA
372PSHT-	194	REP	8-10		0.0997	NA	NA
				RPD %	5%	NA	NA
372PSHT-	217		54-56		0.1039	NA	NA
372PSHT-	217	REP	54-56		0.0747	NA	NA
				RPD %	33%	NA	NA
372PSHT-	244		108-110		0.0757	NA	NA
372PSHT-	244	REP	108-110		0.0724	NA	NA
				RPD %	4%	NA	NA

NA = Not applicable/analyzed.
RPD % = Relative Percent Difference.

APPENDIX H

METALS IN SEDIMENT SAMPLES

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.		Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
CORE #1																	
372PSHT-	448	0-2	NA	5.98	7.9	NA	92	30.3	3.53	NA	506	46.3	16.6	NA	NA	NA	98.5
372PSHT-	452	8-10	NA	6.20	7.7	NA	79	34.0	3.69	NA	540	47.0	18.8	NA	NA	NA	101.9
372PSHT-	457	18-20	NA	7.39	9.3	NA	89	33.2	3.63	NA	464	50.8	20.8	NA	NA	NA	102.7
372PSHT-	462	28-30	NA	6.40	10.5	NA	77	34.4	3.66	NA	508	46.6	24.2	NA	NA	NA	104.3
372PSHT-	467	38-40	NA	6.47	10.9	NA	92	31.4	3.66	NA	489	46.2	21.5	NA	NA	NA	98.2
372PSHT-	472	48-50	NA	6.22	7.8	NA	109	28.5	3.65	NA	469	44.7	23.6	NA	NA	NA	93.7
372PSHT-	477	58-60	NA	6.90	7.8	NA	99	29.1	3.70	NA	475	50.8	24.5	NA	NA	NA	94.6
372PSHT-	482	68-70	NA	6.69	9.7	NA	96	29.1	3.74	NA	473	47.8	15.4	NA	NA	NA	90.7
372PSHT-	487	78-80	NA	6.47	8.0	NA	75	31.6	3.87	NA	543	51.3	13.7	NA	NA	NA	84.8
372PSHT-	492	88-90	NA	6.99	10.2	NA	92	21.8	3.58	NA	514	40.9	6.6	NA	NA	NA	73.7
372PSHT-	497	98-100	NA	7.11	6.9	NA	84	25.4	3.72	NA	517	45.6	7.6	NA	NA	NA	80.3
CORE #2A																	
372PSHT-	275	0-2	NA	8.18	10.0	NA	80	42.2	3.93	NA	597	54.2	23.9	NA	NA	NA	108.5
372PSHT-	279	8-10	NA	7.69	10.5	NA	106	41.8	4.05	NA	681	50.1	24.0	NA	NA	NA	112.9
372PSHT-	284	18-20	NA	7.96	9.7	NA	106	42.3	3.98	NA	597	48.5	29.0	NA	NA	NA	112.3
372PSHT-	289	28-30	NA	7.01	10.9	NA	91	45.6	4.02	NA	560	51.0	31.9	NA	NA	NA	120.4
372PSHT-	294	38-40	NA	7.38	12.2	NA	75	46.2	4.00	NA	537	51.2	37.6	NA	NA	NA	122.5
372PSHT-	299	48-50	NA	8.01	14.2	NA	105	43.9	4.10	NA	507	51.2	39.0	NA	NA	NA	125.5
CORE #2																	
372PSHT-	304	58-60	NA	7.93	12.6	NA	104	45.6	3.98	NA	490	51.1	36.2	NA	NA	NA	124.0
372PSHT-	309	68-70	NA	8.21	12.5	NA	100	43.5	4.05	NA	482	54.0	34.6	NA	NA	NA	118.0
372PSHT-	314	78-80	NA	7.76	13.6	NA	86	40.2	3.89	NA	487	45.7	33.2	NA	NA	NA	113.3
372PSHT-	319	88-90	NA	7.92	13.2	NA	101	40.9	3.82	NA	454	50.2	35.7	NA	NA	NA	114.0
372PSHT-	324	98-100	NA	6.41	11.7	NA	83	41.5	3.82	NA	471	47.6	31.7	NA	NA	NA	112.7
372PSHT-	329	108-110	NA	6.40	8.8	NA	92	38.1	3.81	NA	494	48.2	34.7	NA	NA	NA	104.0
372PSHT-	334	118-120	NA	6.89	10.0	NA	74	38.5	4.06	NA	515	51.2	24.2	NA	NA	NA	99.8
372PSHT-	339	128-130	NA	6.79	9.6	NA	82	35.3	3.98	NA	505	48.6	17.6	NA	NA	NA	91.8
372PSHT-	344	138-140	NA	6.70	7.8	NA	83	32.5	3.98	NA	540	49.7	17.0	NA	NA	NA	89.5
372PSHT-	349	148-150	NA	7.62	7.7	NA	87	32.0	3.96	NA	554	51.1	14.3	NA	NA	NA	86.8
372PSHT-	354	158-160	NA	7.69	8.2	NA	80	32.9	3.92	NA	490	50.1	11.5	NA	NA	NA	90.0
372PSHT-	359	168-170	NA	7.21	7.9	NA	89	31.2	3.86	NA	504	45.2	7.1	NA	NA	NA	82.3

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.		Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
CORE #3																	
372PSHT-	1	0-2	0.68	6.55	12.5	0.37	84	42.7	3.93	0.179	633	46.9	30.3	1.28	0.76	3.94	114.7
372PSHT-	5	8-10	0.70	6.43	11.7	0.38	85	44.9	3.99	0.244	642	47.7	32.3	1.33	1.00	3.95	116.7
372PSHT-	8	14-16	0.74	6.91	12.2	0.37	85	44.8	3.92	0.193	575	53.9	32.4	1.26	0.75	3.95	117.3
372PSHT-	10	18-20	0.79	7.54	12.6	0.37	102	48.4	4.02	0.279	555	45.9	36.5	1.54	0.91	4.01	122.6
372PSHT-	15	28-30	0.83	7.30	12.9	0.35	94	49.7	4.15	0.279	525	48.1	44.4	1.68	0.84	4.45	126.6
372PSHT-	20	38-40	0.85	7.36	13.5	0.36	104	51.5	4.02	0.229	501	50.6	43.5	1.77	0.84	4.31	129.3
372PSHT-	22	42-44	0.85	6.74	15.3	0.35	85	52.2	3.94	0.253	478	52.3	44.2	2.08	1.14	4.57	124.1
372PSHT-	25	48-50	0.91	6.85	19.5	0.37	99	54.5	4.20	0.266	512	50.7	48.9	1.99	0.99	4.90	134.6
372PSHT-	30	58-60	0.71	7.40	16.1	0.36	102	54.6	4.20	0.305	503	47.2	48.2	2.05	0.83	4.11	132.4
372PSHT-	35	68-70	0.67	8.30	17.5	0.35	102	49.3	4.21	0.305	529	50.3	40.7	1.87	0.84	3.54	127.4
372PSHT-	40	78-80	0.62	7.14	14.7	0.35	92	49.7	4.15	0.306	521	49.2	44.9	1.83	0.68	3.49	134.4
372PSHT-	45	88-90	0.60	7.07	14.0	0.35	96	52.3	4.14	0.312	512	47.5	45.5	1.71	0.99	3.95	125.3
372PSHT-	50	98-100	0.50	8.07	15.7	0.35	100	50.7	4.28	0.283	524	47.4	42.4	1.33	0.84	3.69	123.7
372PSHT-	55	108-110	0.45	7.63	16.8	0.36	93	47.0	4.15	0.241	541	46.7	40.2	1.20	0.83	3.32	120.6
372PSHT-	60	118-120	0.45	7.04	11.2	0.33	89	45.3	4.20	0.258	597	46.7	43.6	1.30	0.92	3.34	118.4
372PSHT-	65	128-130	0.41	6.71	11.2	0.34	84	48.8	3.99	0.271	566	44.2	42.6	1.58	1.38	3.28	107.2
372PSHT-	70	138-140	0.29	7.25	8.5	0.32	78	42.4	3.92	0.200	518	44.1	32.2	1.06	0.75	2.63	105.3
372PSHT-	75	148-150	0.23	7.73	10.2	0.31	102	40.1	4.05	0.184	527	44.3	25.7	0.89	0.99	2.23	100.9
372PSHT-	80	158-160	0.15	7.57	7.5	0.30	93	35.2	3.96	0.121	519	42.3	20.4	0.72	0.84	1.73	91.0
372PSHT-	85	168-170	0.16	7.96	6.7	0.28	80	37.0	3.99	0.108	515	44.5	20.7	0.73	0.76	1.61	88.4
372PSHT-	90	178-180	0.13	7.26	7.8	0.75	77	35.1	3.88	0.093	508	45.2	16.1	0.67	0.92	1.54	89.6
372PSHT-	94	186-188	0.14	7.18	10.1	0.38	92	35.6	3.82	0.102	505	53.3	13.0	0.67	0.90	1.47	88.7
CORE #4																	
372PSHT-	360	0-2	NA	8.30	14.0	NA	68	50.6	3.98	NA	938	45.2	33.0	NA	NA	NA	114.9
372PSHT-	364	8-10	NA	7.86	14.2	NA	81	47.6	3.95	NA	711	45.1	34.6	NA	NA	NA	119.1
372PSHT-	369	18-20	NA	6.65	18.3	NA	94	53.5	4.05	NA	572	47.1	38.7	NA	NA	NA	127.7
372PSHT-	374	28-30	NA	6.60	17.4	NA	86	50.9	3.85	NA	489	48.3	43.1	NA	NA	NA	122.3
372PSHT-	379	38-40	NA	7.68	22.7	NA	92	56.8	4.06	NA	500	51.5	47.2	NA	NA	NA	137.6
372PSHT-	384	48-50	NA	6.09	16.7	NA	75	51.3	3.88	NA	490	50.8	48.0	NA	NA	NA	124.0
372PSHT-	389	58-60	NA	7.73	18.3	NA	81	49.6	3.97	NA	504	50.2	45.3	NA	NA	NA	120.4
372PSHT-	394	68-70	NA	7.22	14.6	NA	91	52.2	3.93	NA	507	51.0	48.6	NA	NA	NA	115.7
372PSHT-	399	78-80	NA	6.72	12.3	NA	76	35.7	4.02	NA	550	50.3	21.8	NA	NA	NA	87.6
372PSHT-	404	88-90	NA	6.97	10.8	NA	89	33.1	3.92	NA	542	52.2	15.1	NA	NA	NA	85.0

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.		Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
CORE #4 (contd)																	
372PSHT-	409	98-100	NA	6.93	13.3	NA	82	42.1	4.02	NA	665	51.8	29.1	NA	NA	NA	98.5
372PSHT-	414	108-110	NA	8.13	9.0	NA	87	35.3	4.08	NA	580	52.5	8.5	NA	NA	NA	83.4
372PSHT-	419	118-120	NA	6.99	8.6	NA	85	30.8	3.85	NA	594	46.8	7.8	NA	NA	NA	83.0
372PSHT-	424	128-130	NA	7.09	7.1	NA	89	35.2	3.91	NA	570	49.3	8.4	NA	NA	NA	81.3
372PSHT-	429	138-140	NA	7.62	7.9	NA	86	32.7	3.89	NA	567	48.0	8.1	NA	NA	NA	85.9
372PSHT-	434	148-150	NA	7.22	8.2	NA	71	32.7	3.81	NA	511	49.1	8.6	NA	NA	NA	83.3
372PSHT-	439	158-160	NA	5.78	7.5	NA	92	27.7	3.64	NA	516	47.7	9.3	NA	NA	NA	79.3
372PSHT-	444	168-170	NA	6.04	7.2	NA	92	30.6	3.71	NA	545	50.5	8.4	NA	NA	NA	86.0
CORE #5																	
372PSHT-	190	0-2	0.69	7.03	13.1	0.40	59	49.3	3.84	0.213	918	49.0	36.7	1.60	0.99	3.96	119.2
372PSHT-	194	8-10	0.72	7.05	14.4	0.33	74	51.3	4.03	0.226	1076	48.5	40.0	1.92	0.99	4.05	119.8
372PSHT-	197	14-16	0.73	5.90	17.1	0.32	80	55.0	3.92	0.247	907	54.0	40.2	2.17	1.07	1.13	121.9
372PSHT-	199	18-20	0.84	6.38	17.5	0.35	77	56.5	4.07	0.291	859	49.1	43.2	1.92	0.85	3.59	128.4
372PSHT-	204	28-30	0.77	7.49	18.9	0.34	82	58.5	4.14	0.287	727	51.7	49.9	2.41	0.97	4.83	131.6
372PSHT-	209	38-40	0.78	7.72	19.2	0.33	82	62.8	3.99	0.294	583	51.0	52.6	2.59	0.96	4.17	135.6
372PSHT-	214	48-50	0.74	8.54	26.8	0.40	87	66.1	4.21	0.334	603	53.4	57.4	2.98	0.85	4.87	137.1
372PSHT-	217	54-56	0.77	7.49	28.3	0.40	81	65.4	4.21	0.440	578	56.1	63.6	3.55	0.79	5.00	140.7
372PSHT-	219	58-60	0.75	8.30	25.3	0.38	98	68.4	4.24	0.436	596	53.4	63.4	3.44	1.03	4.85	167.7
372PSHT-	224	68-70	0.68	7.68	27.9	0.43	84	67.0	4.26	0.448	598	55.4	63.6	3.70	0.97	4.34	157.0
372PSHT-	229	78-80	0.58	7.13	21.8	0.42	86	64.2	4.23	0.458	552	53.1	58.8	3.90	0.84	3.69	132.0
372PSHT-	234	88-90	0.58	7.51	23.2	0.43	93	70.0	4.19	0.462	570	54.0	56.9	3.45	1.03	3.90	131.1
372PSHT-	239	98-100	0.53	8.17	23.0	0.39	86	61.9	4.14	0.430	555	49.7	52.6	2.78	1.04	4.10	132.0
372PSHT-	244	108-110	0.48	7.34	16.9	0.40	73	62.3	4.06	0.426	538	51.7	57.9	2.54	0.84	3.65	127.4
372PSHT-	249	118-120	0.43	7.62	17.1	0.40	92	59.9	4.06	0.412	555	53.7	59.0	2.12	0.73	3.66	122.0
372PSHT-	254	128-130	0.34	6.79	22.6	0.42	90	55.8	4.06	0.387	558	52.0	58.9	1.57	0.90	3.11	116.7
372PSHT-	259	138-140	0.42	6.99	16.4	0.46	75	64.8	3.95	0.437	548	55.4	69.4	2.31	0.89	3.51	117.1
372PSHT-	264	148-150	0.36	7.07	17.0	0.45	66	60.8	3.98	0.392	594	51.7	46.3	1.89	0.96	2.86	109.9
372PSHT-	269	158-160	0.21	7.65	12.6	0.42	91	55.8	3.94	0.315	577	51.1	28.6	1.06	0.79	2.00	103.4
372PSHT-	274	168-170	0.17	8.80	9.6	0.40	64	42.9	3.98	0.194	596	52.8	26.2	0.85	0.79	1.71	92.9

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.		Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA		Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
CORE #6																		
372PSHT-	95	0-2	0.59	7.20	17.3	0.35	83	52.7	3.91	0.277		826	42.8	44.7	1.52	0.73	2.78	115.5
372PSHT-	99	8-10	0.59	7.19	18.7	0.31	60	53.6	4.01	0.277		764	46.4	46.3	1.66	0.67	3.88	118.7
372PSHT-	102	14-16	0.61	7.02	17.5	0.31	72	57.5	3.92	0.296		588	49.5	53.0	1.76	0.72	3.25	120.4
372PSHT-	104	18-20	0.61	7.30	17.8	0.32	68	59.2	4.03	0.304		601	43.0	55.0	1.90	0.79	3.89	121.5
372PSHT-	108	26-28	0.65	6.45	21.3	0.35	84	62.5	3.92	0.343		560	51.9	61.0	2.11	0.90	3.13	123.1
372PSHT-	109	28-30	0.60	7.38	22.0	0.32	90	64.7	4.09	0.353		578	46.0	61.8	2.43	0.78	4.25	124.5
372PSHT-	114	38-40	0.51	7.84	22.2	0.33	77	57.2	4.07	0.362		532	45.6	62.3	2.23	0.91	3.43	128.8
372PSHT-	116	42-44	0.55	6.54	23.5	0.34	114	58.6	3.94	0.356		521	51.4	62.3	2.50	0.66	3.95	121.0
372PSHT-	119	48-50	0.50	7.63	20.7	0.34	73	60.2	4.04	0.345		566	41.5	55.0	2.38	0.85	3.49	121.1
372PSHT-	124	58-60	0.47	7.71	20.7	0.31	77	62.1	4.04	0.351		538	43.1	56.0	2.06	0.78	3.64	117.1
372PSHT-	129	68-70	0.43	6.96	23.2	0.31	59	58.8	3.88	0.364		543	47.6	54.6	2.07	0.84	3.54	110.4
372PSHT-	134	78-80	0.27	7.17	15.2	0.39	64	58.0	3.80	0.350		528	48.1	58.8	1.91	0.92	2.98	104.9
372PSHT-	139	88-90	0.18	6.51	10.7	0.35	54	40.7	3.71	0.170		548	46.2	31.0	1.05	0.97	1.86	91.8
372PSHT-	144	98-100	0.10	8.07	7.5	0.41	71	34.3	3.81	0.073		558	42.6	13.0	0.71	0.85	1.31	83.5
372PSHT-	149	108-110	0.14	7.17	9.9	0.43	72	37.4	3.75	0.078		544	45.8	13.3	0.88	0.79	1.47	87.6
372PSHT-	154	118-120	NA	7.17	6.0	NA	76	33.8	3.74	NA		592	44.0	10.1	NA	NA	NA	84.8
372PSHT-	159	128-130	0.09	6.80	8.4	0.43	57	35.9	3.75	0.064		591	43.3	8.0	0.65	0.91	1.23	81.2
372PSHT-	164	138-140	NA	8.62	7.3	NA	81	33.2	3.80	NA		553	46.8	10.2	NA	NA	NA	84.7
372PSHT-	169	148-150	0.09	8.09	7.7	0.37	65	33.3	3.77	0.058		578	47.0	9.2	0.59	0.97	1.10	84.5
372PSHT-	174	158-160	NA	8.29	8.4	NA	75	33.6	3.81	NA		553	45.9	10.2	NA	NA	NA	85.7
372PSHT-	179	168-170	NA	7.79	6.1	NA	67	34.6	3.77	NA		563	47.0	11.4	NA	NA	NA	82.7
372PSHT-	184	178-180	0.09	7.30	6.9	0.47	59	35.8	3.82	0.045		562	46.3	11.1	0.65	0.90	1.17	88.7
372PSHT-	189	188-190	0.09	7.39	8.9	0.47	75	33.1	3.81	0.054		565	45.7	6.2	0.64	0.80	1.20	85.6
Blank, Rep 1			0.01	NA	NA	0.01	NA	NA	NA	3E-04	U	NA	NA	NA	0.005	< 0.13	0.04	NA
Blank, Rep 2			0.01	NA	NA	0.02	NA	NA	NA	3E-04	U	NA	NA	NA	0.008	< 0.13	0.04	NA
Blank, Rep 3			0.02	NA	NA	0.01	NA	NA	NA	0.004		NA	NA	NA	0.006	< 0.18	0.03	NA

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.	Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
STANDARD REFERENCE MATERIAL																
1646, Rep 1		0.13	7.75	9.0	0.37	76	19.0	3.28	0.065	344	32.8	28.9	0.55	0.54	3.43	126.6
1646, Rep 2		0.13	6.68	11.1	0.37	60	17.6	3.34	0.076	358	36.1	28.9	0.45	0.76	2.59	128.4
1646, Rep 3		0.13	7.44	10.7	0.43	66	17.6	3.43	0.080	352	32.6	28.0	1.67	0.73	3.33	131.7
1646, Rep 4		0.14	7.07	11.4	0.42	79	17.8	3.40	NA	357	33.5	28.9	NA	0.60	NA	128.7
1646, Rep 5		NA	6.21	11.8	NA	69	17.9	3.31	NA	326	33.5	28.9	NA	NA	NA	130.0
1646, Rep 6		NA	7.72	11.7	NA	76	17.7	3.33	NA	332	30.9	29.3	NA	NA	NA	127.2
1646, Rep 7		NA	6.75	11.2	NA	76	17.9	3.33	NA	336	35.9	28.9	NA	NA	NA	127.2
	certified	NC	6.25	11.6	0.36	76	18.0	3.35	0.063	375	32.0	28.2	NC	NC	NC	138.0
	value	NC	±0.20	±1.3	±0.07	±3	±3	±0.10	±0.012	±20	±3	±1.8	NC	NC	NC	±6
MESS-1, Rep 1		0.14	NA	NA	0.56	NA	NA	NA	0.174	NA	NA	NA	0.84	0.26	4.03	NA
MESS-1, Rep 2		0.13	NA	NA	0.74	NA	NA	NA	0.175	NA	NA	NA	0.87	0.26	4.11	NA
	certified	NC	NA	NA	0.59	NA	NA	NA	0.171	NA	NA	NA	0.73	0.34	3.98	NA
	value	NC	NA	NA	±0.1	NA	NA	NA	±0.014	NA	NA	NA	±0.08	±0.06	±0.44	NA
MATRIX SPIKE RESULTS																
Amount Spiked		1.00	NS	NS	1.00	NS	NS	NS	0.500	NS	NS	NS	2.00	2.00	10.00	NS
372-10		0.79	NS	NS	0.37	NS	NS	NS	0.279	NS	NS	NS	1.54	0.91	4.01	NS
371-10 + Spike		1.67	NS	NS	1.27	NS	NS	NS	0.692	NS	NS	NS	3.71	2.79	14.00	NS
Amount Recovered		0.88	NS	NS	0.90	NS	NS	NS	0.413	NS	NS	NS	2.17	1.88	9.99	NS
Percent Recovery		88%	NS	NS	90%	NS	NS	NS	83%	NS	NS	NS	109%	94%	100%	NS

PUGET SOUND HISTORICAL TRENDS
METAL CONCENTRATIONS IN SEDIMENT SAMPLES

(concentrations in ug/g dry wt)

Sample No.	Segment Depth (cm)	Ag AA	Al (%) XRF	As XRF	Cd AA	Cr XRF	Cu XRF	Fe (%) XRF	Hg CVAA	Mn XRF	Ni XRF	Pb XRF	Sb ICP/MS	Se AA	Sn ICP/MS	Zn XRF
MATRIX SPIKE RESULTS																
Amount Spiked		1.00	NS	NS	1.00	NS	NS	NS	0.496	NS	NS	NS	2.00	2.00	10.00	NS
372-104		0.61	NS	NS	0.32	NS	NS	NS	0.304	NS	NS	NS	1.90	0.79	3.89	NS
372-104 + Spike		1.56	NS	NS	1.35	NS	NS	NS	0.764	NS	NS	NS	4.05	2.74	14.10	NS
Amount Recovered		0.95	NS	NS	1.03	NS	NS	NS	0.460	NS	NS	NS	2.15	1.95	10.21	NS
Percent Recovery		95%	NS	NS	103%	NS	NS	NS	93%	NS	NS	NS	108%	98%	102%	NS
Amount Spiked		1.00	NS	NS	1.00	NS	NS	NS	0.498	NS	NS	NS	2.00	2.00	10.00	NS
372-199		0.84	NS	NS	0.35	NS	NS	NS	0.291	NS	NS	NS	1.92	0.85	3.59	NS
372-199 + Spike		1.67	NS	NS	1.21	NS	NS	NS	0.722	NS	NS	NS	4.24	2.75	14.10	NS
Amount Recovered		0.83	NS	NS	0.86	NS	NS	NS	0.431	NS	NS	NS	2.32	1.90	10.51	NS
Percent Recovery		83%	NS	NS	86%	NS	NS	NS	87%	NS	NS	NS	116%	95%	105%	NS

NA Not applicable/analyzed.
NC Not certified.
NS Not spiked.
U Indicates below detection limits.

APPENDIX I

PAH IN SEDIMENT CORES

PUGET SOUND HISTORICAL TRENDS
PAH IN SEDIMENT CORES

CORE #3

(concentrations in ug/kg dry wt.)

Sample No.	372-2	372-6	372-8	372-10	372-16	372-20	372-22	372-26
Segment Depth (cm)	2-4	10-12	14-16	18-20	30-32	38-40	42-44	50-52
naphthalene	34.26	24.99	25.79	32.87	33.7	35.75	35.49	33.76
2-methylnaphthalene	40.09	35.75	35.65	37.25	37.94	38.33	39.5	36.69
1-methylnaphthalene	29.65	26.83	27.25	28.69	28.42	28.86	29.83	27.18
C1-naphthalenes	71.86	63.84	63.69	67.28	67.51	68.69	67.63	65.03
2,6-dimethylnaphthalene	46.68	43.58	42.72	43.76	43.31	43.94	45.78	42.42
C2-naphthalenes	174.96	161.31	156.87	163.97	164.18	171.52	174.53	163.25
1,6,7-trimethylnaphthalene	21.12	23.67	22.19	22.31	22.67	24.16	26.23	24.95
C3-naphthalenes	138.05	142.44	128.89	144.86	144.58	145.05	147.97	148.26
C4-naphthalenes	90.92	82.68	77.26	90.98	80.32	95.21	86.3	83.27
biphenyl	12.41	10.95	10.88	11.5	11.57	12.14	12.33	11.57
acenaphthylene	19.79	16.03	15.44	17.14	19.39	22.49	20.41	22.85
acenaphthene	7.3	5.79	5.08	5.27	6.37	6.31	5.85	6.28
fluorene	17.01	16.76	16.68	17.66	17.91	18.32	17.78	17.88
C1-fluorenes	42.31	42.66	38.96	41.74	41.23	42.46	44.38	45.25
C2-fluorenes	118.69	114.96	113.72	116.69	120.46	111.14	115.66	125.96
C3-fluorenes	109.45	104.89	97.38	119.46	124.77	105.81	102.52	129.19
phenanthrene	119.89	105.79	110.45	122.91	123.37	140.73	129.59	141.18
anthracene	33.33	29.15	30.47	32.84	35.36	39.3	37.67	43.49
1-methylphenanthrene	32.09	29.85	31.21	30.84	34.38	37.87	34.48	36.55
C1-phenanthrenes/anthracenes	164.17	150.61	158.53	172.17	172.51	193.15	171.36	192.38
C2-phenanthrenes/anthracenes	189.76	172.87	176.3	189.21	190.58	222.88	205	216.87
C3-phenanthrenes/anthracenes	166.36	142.19	147.77	148.59	164.18	165.54	143.8	171.35
C4-phenanthrenes/anthracenes	123.35	178.27	187.38	121.17	143.53	141.79	160.27	149.05
dibenzothiophene	12.27	10.68	11.05	12.07	12.43	13.99	12.98	13.62
C1-dibenzothiophenes	22.15	19.65	20.36	21.94	21.48	25.76	23.1	24.62
C2-dibenzothiophenes	30.71	28.65	25.64	29.34	28.52	32.39	33.22	34.02
C3-dibenzothiophenes	34.09	30.69	28.62	32.33	30.49	35.58	31.88	31.31
fluoranthene	184.52	160.15	167.66	185.86	194.94	216.36	194.18	215.15
pyrene	227.08	195.61	203.16	235.58	260.31	293.36	266.92	308.56
C1-fluoranthenes/pyrenes	142.13	124.03	127.69	141.35	151.86	170.36	152.6	173.21
benz[a]anthracene	91.12	73.21	78.28	92.11	98.08	111.83	104.19	108.93
chrysene	122.99	93.82	100.74	112.29	119.18	129.09	125.54	137.26
C1-chrysenes	92.66	68.37	69.43	92.51	83.14	104.49	105.43	90.18
C2-chrysenes	175.2	152.79	153.87	181.98	182.7	190.02	205.8	213.6
C3-chrysenes	114.12	97.39	101.61	116.74	120.77	123.55	136.11	136.53
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND
benzo[b]fluoranthene	140.58	109.1	123.05	130.49	141.06	158.94	178.77	162.27
benzo[k]fluoranthene	76.35	73.49	70.74	89.9	103.82	86.55	79.23	122.19
benzo[e]pyrene	102.52	84.74	88.51	104.02	110.09	123	124.6	131.36
benzo[a]pyrene	109.07	94.07	99.21	108.08	123	137.08	123.52	149.9
perylene	103.73	95.84	99.98	105.17	107.77	101.55	102.68	102.7
indeno[1,2,3-c,d]pyrene	96.32	84.23	88.77	101.9	107.14	117.82	113.69	131.19
dibenz[a,h]anthracene	12.93	11.43	12.14	14.31	14.46	16.31	15.4	17.24
benzo[g,h,i]perylene	100.92	84.99	84.25	105.2	109.37	125	118.44	135.16
TOTAL PAH	1433.55	1214.36	1267.56	1441.66	1545.4	1693.57	1606.17	1789.98
COMBUSTABLE PAH	1161.88	980.1	1028	1175.72	1271.36	1392.34	1319.88	1487.85
Surrogate Recoveries (%)								
acenaphthane-d10	70.01	63.62	68.49	64.55	63.16	65.57	66.95	65.45
phenanthrene-d10	71.14	69.99	69.23	66.75	66.64	65.74	69.45	67.44
benzo[a]pyrene-d12	69.34	73.41	72.25	66.28	68.59	65.84	63.83	69.09

ND Not detected.

CORE #3 (contd)
(concentrations in ug/kg dry wt.)

Sample No.	372-30	372-36	372-40	372-46	372-50	372-56	372-59	372-65	372-71
Segment Depth (cm)	58-60	70-72	78-80	90-92	98-100	110-112	116-118	128-130	140-142
naphthalene	42.76	48.6	58.27	84.35	65.05	41.36	53.75	43.81	33.25
2-methylnaphthalene	38.36	42.85	44.95	55.17	50.33	45.36	59.39	53.41	46.83
1-methylnaphthalene	29.06	32.03	33.74	39.12	36.42	33.49	41.27	38.88	34.51
C1-naphthalenes	68.65	76.17	79.87	95.69	88.24	79.83	101.94	93.36	82.53
2,6-dimethylnaphthalene	44.43	51.32	52.24	58.71	55.53	55.06	69.2	67.3	60.54
C2-naphthalenes	170.03	200.06	207.23	235.09	215.7	218.1	266.29	253.77	228.43
1,6,7-trimethylnaphthalene	25.67	35.35	33.36	34.44	31.58	35.32	41.36	40.96	40.1
C3-naphthalenes	156.96	191.73	200.6	219.23	189.47	213.64	249.9	237.05	222.18
C4-naphthalenes	103.44	128.57	126.87	149.97	114.93	153.36	172.84	157.89	158.52
biphenyl	12.49	15.09	15.89	20.85	16.09	14.19	18.6	16.31	14.92
acenaphthylene	30.47	45.24	53.72	84.62	46.09	35.89	38.7	27.87	24.06
acenaphthene	6.82	9.87	9.04	11.02	10.55	8.8	10.24	8.54	8.61
fluorene	21.27	30.13	30.65	41.03	34.21	26.92	34.5	29.07	24.98
C1-fluorenes	49.05	64.47	71.72	87.07	69.37	61.21	69.78	63.58	56.6
C2-fluorenes	124.49	161.92	167.19	214.13	177.49	175.75	189.15	174.36	162.9
C3-fluorenes	112.36	153.21	148.31	210.75	153.76	157.62	184.6	155.59	150.94
phenanthrene	178.32	268.07	321.48	447.95	244.72	159.96	193.44	148.39	116.95
anthracene	52.42	74.05	89.25	146.85	86.9	61.51	74.94	58.74	56.47
1-methylphenanthrene	43.57	58.14	63.7	91.21	71.9	63.94	77.76	60.5	57.38
C1-phenanthrenes/anthracenes	227.1	306.53	364.71	502.24	355.98	283.24	346.54	259.96	246.58
C2-phenanthrenes/anthracenes	249.33	330.5	345.68	461.41	400.81	357.88	422.34	373.45	350.24
C3-phenanthrenes/anthracenes	197.34	228.5	240.73	302.76	302.62	308.74	356.04	363.16	325.59
C4-phenanthrenes/anthracenes	176.09	230.87	288.93	524.26	261.33	230.36	254.6	225.44	181.92
dibenzothiophene	17.43	28.03	33.28	40.78	20.69	14.04	19.59	15.4	11.99
C1-dibenzothiophenes	30.25	42.54	47.25	59.91	44.55	35.85	42.89	36.19	31.08
C2-dibenzothiophenes	38.15	50.4	56.81	76.31	61.48	48.17	55.11	40.77	38.17
C3-dibenzothiophenes	35.89	45.81	48.63	58.3	56.46	43.4	48.78	41.24	36.13
fluoranthene	282.1	432.15	516.43	855.21	365.68	248.97	270.2	179.05	152.57
pyrene	415.91	651.8	783.8	1371.1	605.16	391.99	479.1	265.64	240.96
C1-fluoranthenes/pyrenes	217.04	313.15	363.49	564.51	394.3	290.49	368.19	208.87	218.64
benz[a]anthracene	148.45	236.08	278.55	453.88	225.28	165.16	265.02	102.92	105.32
chrysene	180.05	269.07	320.89	538.89	300.22	174.94	288.82	103.89	104.64
C1-chrysenes	122.46	173.08	193.49	254.71	222.61	167.89	269.06	148.94	143.97
C2-chrysenes	231.4	300.17	307.67	387.97	393.28	339.51	512.32	319.94	274.21
C3-chrysenes	155.94	181.68	189.34	214.1	239.98	205.35	268.85	208.39	168.53
C4-chrysenes	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzo[b]fluoranthene	186.27	280.95	316.24	516.56	228.81	173.09	247.89	124.69	99.18
benzo[k]fluoranthene	154.15	200.11	249.56	388.07	225.33	126.69	244.79	81.34	85.89
benzo[e]pyrene	161.35	244.14	290.02	455.99	222.06	140.26	221.23	96.13	81.1
benzo[a]pyrene	201.35	316.46	395.5	670.13	299.28	183.49	234.59	113.34	104.45
perylene	113.78	144.11	153.01	219.14	136.16	115.05	151.39	131.22	180.72
indeno[1,2,3-c,d]pyrene	169.24	274.07	337.19	526.65	240.81	145.51	239.69	107.87	89.02
dibenz[a,h]anthracene	21.13	33.49	41.52	60.39	31.58	20.32	32.92	14.09	13.01
benzo[g,h,i]perylene	175.91	281.23	352.78	536.36	255.96	152.36	243.59	118.73	94.35
TOTAL PAH	2304.98	3494.22	4199.82	6788.23	3315.96	2162.32	3011.57	1581.39	1400.54
COMBUSTABLE PAH	1934.56	2975.41	3592.46	5917.24	2778.11	1782.52	2546.61	1211.56	1089.39
Surrogate Recoveries (%)									
acenaphthane-d10	62.88	64.69	66.71	71.23	70.73	66.87	67.21	69.55	66.14
phenanthrene-d10	63.72	68.87	69.91	72.33	69.91	70.10	67.63	71.16	70.32
benzo[a]pyrene-d12	64.80	67.79	70.29	74.47	70.03	68.22	48.24	72.08	71.65

ND Not detected.

PUGET SOUND HISTORICAL TRENDS
PAH IN SEDIMENT CORES

	CORE #3 (contd) (concentrations in ug/kg dry wt.)					CORE #5			
Sample No.	372-74	372-80	372-85	372-90	372-94	372-191	372-195	372-197	372-199
Segment Depth (cm)	146-148	158-160	168-170	178-180	186-188	2-4	10-12	14-16	18-20
naphthalene	33.14	23.44	17.84	11.69	8.6	34.82	29.86	33.11	28.44
2-methylnaphthalene	44.68	34.32	29.55	24.45	20.21	45.28	38.28	39.47	35.09
1-methylnaphthalene	33.78	28.22	24.88	20.91	17.43	34.36	28.85	29.81	27.05
C1-naphthalenes	79.4	63.25	55.53	46.77	37.19	81.98	68.68	70.73	63.54
2,6-dimethylnaphthalene	57.15	45.15	40	34.73	30.39	54.64	46.42	46.46	45.16
C2-naphthalenes	218.88	175.43	157.4	140.93	121.32	209.57	176.14	179.63	173.32
1,6,7-trimethylnaphthalene	39.87	29.75	28.97	24.34	21.87	31.05	27.47	27.15	26.9
C3-naphthalenes	213.42	169.45	156.95	142.51	117.07	180.85	157.64	162.22	162.69
C4-naphthalenes	138.88	119.08	118.55	103.23	83.87	126.68	106.67	98.04	100.4
biphenyl	14.19	11.06	9.53	8.23	7.18	13.56	11.64	12.3	11.42
acenaphthylene	16.61	8.79	6.28	3.71	2.87	13.63	10.77	11.76	12.58
acenaphthene	8.15	5.65	4.52	3.69	3.27	6.02	6.35	6.45	6.1
fluorene	25.98	20.7	16.21	13.86	11.47	18.19	16.57	17.85	17.32
C1-fluorenes	53.25	41.96	37.75	33.48	29.93	46.81	41.49	42.79	43.41
C2-fluorenes	158.43	121.42	116.12	98.13	83.85	153.36	121.13	136.31	131.43
C3-fluorenes	153.66	112.73	100.68	80.52	73.25	140.78	125.3	142.34	114.03
phenanthrene	106.01	77.25	63.76	51.78	46.33	107.2	97.85	95.6	100.07
anthracene	41.63	22.61	14.11	8.99	7.4	27.98	25.98	24.96	26.74
1-methylphenanthrene	51.9	40.61	37.11	30.66	25.48	39.65	34.5	47.97	36.47
C1-phenanthrenes/anthracenes	224.77	169.09	143.43	121.09	108	177.82	165.85	176.74	167.19
C2-phenanthrenes/anthracenes	328.24	242.32	208.84	171.82	140.08	231.62	222.5	223.01	214.36
C3-phenanthrenes/anthracenes	320.68	230.77	214.29	176.85	133.58	210.48	184.65	195.21	211.81
C4-phenanthrenes/anthracenes	173.26	112.73	98.52	82.21	55.87	145.56	126.84	128.18	143.68
dibenzothiophene	10.82	7.07	5.33	4.4	4.72	11.53	10.51	10.53	10.5
C1-dibenzothiophenes	27.87	21.2	17.49	13.82	14.56	23.32	22.39	21.1	21.79
C2-dibenzothiophenes	33.58	19.9	15.42	13.15	15.35	34.39	28.58	30.23	28.57
C3-dibenzothiophenes	30.22	14.27	12	9.46	12.39	35.18	30.1	31.38	31.24
fluoranthene	156.97	121.63	79.37	55.98	46.12	164.6	158.95	157.14	157.61
pyrene	182.56	104.31	68.74	47.63	42.62	182.84	176.18	172.14	181.43
C1-fluoranthenes/pyrenes	164.77	88.94	67.16	53.48	47.25	131.42	122.01	122.62	122.63
benz[a]anthracene	82.2	48.32	30.81	22.94	18.98	83.82	76.35	82.74	76.46
chrysene	81.72	47.27	32.08	25.82	22.73	111.2	105.83	114.15	97.95
C1-chrysenes	107.22	56	40.79	34.88	29.59	102.9	75.39	86	78.61
C2-chrysenes	243.48	158.08	126.14	121.5	93.5	253.14	185.85	209.78	189.52
C3-chrysenes	149.81	95.36	78.02	67.19	40.39	137.28	99.61	101.25	105.3
C4-chrysenes	68.24	0	0	0	ND	ND	54.9	62.72	60.47
benzo[b]fluoranthene	85.61	51.78	40.89	30.33	23.43	143.9	127.93	143.84	119.42
benzo[k]fluoranthene	68.9	44.3	28.22	18.91	16.12	81.4	70.53	71.41	77.24
benzo[e]pyrene	64.02	38.22	26.06	20.99	16.97	99.22	89.13	96.79	89.56
benzo[a]pyrene	76.3	40.17	26.17	19.1	15.69	90.73	85.52	85.9	86.44
perylene	221.29	273.08	411.87	419.92	371.59	113.18	98.74	102.75	103.34
indeno[1,2,3-c,d]pyrene	74.02	43	29.71	21.83	16.71	86.16	76.91	86.31	78.51
dibenz[a,h]anthracene	9.91	5.12	3.73	3.04	2.25	11.56	10.68	11.97	11.33
benzo[g,h,i]perylene	78.75	44.43	33.01	25.21	19.55	93.9	84.36	91.51	86.44
TOTAL PAH	1173.14	743.09	525	388.96	324.35	1303.23	1198.9	1246.31	1199.17
COMBUSTABLE PAH	896.94	550.33	372.73	270.79	224.2	1050.11	973.24	1017.11	972.83
Surrogate Recoveries (%)									
acenaphthane-d10	62.50	69.36	63.22	67.50	62.12	70.49	74.78	67.21	73.87
phenanthrene-d10	63.99	70.48	66.63	71.00	63.33	74.11	76.65	71.87	77.54
benzo[a]pyrene-d12	63.68	66.51	65.35	65.60	59.46	67.03	71.65	60.61	73.73

ND Not detected.

CORE #5 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-205	372-209	372-215	372-217	372-219	372-225	372-229	372-235	372-239
Segment Depth (cm)	30-32	38-40	50-52	54-56	58-60	70-72	78-80	90-92	98-110
naphthalene	34.17	42.48	39.37	33.39	36.98	36.56	43.3	55.4	64.24
2-methylnaphthalene	36.97	41.02	46.27	39.89	42.21	42.22	45.63	51.77	56.18
1-methylnaphthalene	28.27	32.1	36.94	30.66	32.81	32.26	36.39	39.72	42.64
C1-naphthalenes	66.22	74.75	85.12	72.39	76.8	76.52	83.58	93.15	100.32
2,6-dimethylnaphthalene	45.73	52.85	60.95	51.29	53.62	53.58	61.02	64.86	68.51
C2-naphthalenes	174.23	204.76	237.41	202.87	212.82	211.62	243.18	257.35	277.24
1,6,7-trimethylnaphthalene	26.48	34.6	36.73	37.89	35.3	39.98	44.02	48.54	52
C3-naphthalenes	152.58	196.44	210.95	203.62	198.61	198.65	247.2	267.65	288.56
C4-naphthalenes	96.38	135.55	137.86	150.49	133.54	143.19	179.84	188.63	209.24
biphenyl	11.78	14.23	15.28	11.92	12.66	13.38	14.63	16.34	18.11
acenaphthylene	12.75	18.51	29.65	18.15	19.76	21.34	27.42	35.97	42.36
acenaphthene	6.01	7.68	7.79	6.29	6.23	7.42	8.5	8.91	10.7
fluorene	16.97	21.14	32	21.23	21.84	22.18	25.46	29.01	33.37
C1-fluorenes	38.73	50.63	64.86	52.34	53.78	57.54	65.15	70	76.54
C2-fluorenes	120.26	168.61	185.52	172.32	162.49	177.08	209.98	212.96	236.42
C3-fluorenes	139.64	165.77	167.39	168.22	172.49	171.89	185.24	186.58	211.76
phenanthrene	100.47	124.83	212.03	131.55	136.45	145.43	172.56	229.5	257.13
anthracene	24.79	33.52	61.53	34.78	37.24	40.81	47.12	61.51	68.76
1-methylphenanthrene	47.21	57.89	63.46	52.11	52.14	53.86	65.62	76.88	82.62
C1-phenanthrenes/anthracenes	170.36	215.46	283.66	227.27	224.24	242.91	267.73	333.17	344.93
C2-phenanthrenes/anthracenes	223.72	275.89	325.8	309.27	284.67	323.9	372.61	454.74	469.77
C3-phenanthrenes/anthracenes	202	262.68	280.83	304.1	302.28	322.54	365.84	428.14	436.53
C4-phenanthrenes/anthracenes	130.04	183.6	194.34	180.05	203.95	218.02	210.32	282.56	317.5
dibenzothiophene	10.38	12.04	21.13	13.57	13.79	14.94	17.47	23.08	23.83
C1-dibenzothiophenes	21.45	26.71	36.01	29.18	29.61	31.12	34.25	44.37	45.02
C2-dibenzothiophenes	29.35	35.31	41.96	39.33	37.7	40.98	45.36	55.89	54.96
C3-dibenzothiophenes	30.61	36.96	40.97	38.27	38.82	40.42	42.32	50.35	47.61
fluoranthene	153.78	175.61	234.61	186.89	194.92	202.74	250.72	352.03	417.95
pyrene	180.45	212.73	324.5	262.25	272.96	289.57	360.67	521.75	607.9
C1-fluoranthenes/pyrenes	124.8	149.79	208.66	170.9	176.34	185.09	220.69	285.8	309.4
benz[a]anthracene	91.21	93.2	132.15	103.28	110.52	115.64	146.31	189.52	232.72
chrysene	122.4	118.56	161.98	121.82	129.29	135.15	165.96	215.86	265.72
C1-chrysenes	91.72	92.84	124.01	122.44	127.68	121.38	138.26	162.02	180.83
C2-chrysenes	218.97	234.17	276.07	274.15	277.1	299.72	347.97	364.83	401.73
C3-chrysenes	128.37	137.93	157.11	176.55	174.95	174.94	213.46	204.4	220.01
C4-chrysenes	68.68	77.65	ND	ND	ND	ND	ND	ND	ND
benzo[b]fluoranthene	146.88	146.62	181.96	156.36	171.2	167.53	192.08	208	284.53
benzo[k]fluoranthene	96.27	90.65	130.46	99.37	99.27	105.65	128.71	171.16	204.52
benzo[e]pyrene	107.83	105.78	142.93	125.27	133.62	134.8	160.52	202.46	245.72
benzo[a]pyrene	90.2	103.49	151.41	115.07	129.13	140.1	177.01	247.33	303.95
perylene	104.94	108.5	112.24	101.2	101.15	106.96	115.68	126.93	141.4
indeno[1,2,3-c,d]pyrene	96.59	94.15	128.21	111.74	120.17	127.38	159.45	206.85	262.3
dibenz[a,h]anthracene	13.46	13.23	17.21	15.31	15.98	17.1	19.38	26.22	32.04
benzo[g,h,i]perylene	103.76	101.75	136.7	119.2	131.51	137.42	173.48	226.33	286.07
TOTAL PAH	1327.13	1439.17	2027.83	1576.57	1675.66	1754.24	2143.76	2837.12	3430.44
COMBUSTABLE PAH	1095	1149.99	1599.19	1291.29	1374.95	1438.28	1773.77	2365.05	2897.7
Surrogate Recoveries (%)									
acenaphthane-d10	73.78	61.57	56.89	50.21	54.73	56.09	51.01	55.83	54.06
phenanthrene-d10	77.06	67.27	63.66	57.34	60.84	62.76	59.50	59.84	61.13
benzo[a]pyrene-d12	61.70	65.10	63.13	56.74	59.90	62.26	57.67	61.31	60.16

ND Not detected.

PUGET SOUND HISTORICAL TRENDS
PAH IN SEDIMENT CORES

	CORE #5 (contd) (concentrations in ug/kg dry wt.)							CORE #6	
Sample No.	372-245	372-248	372-254	372-260	372-263	372-269	372-272	372-96	372-100
Segment Depth (cm)	110-112	116-118	128-130	140-142	146-148	158-160	164-166	2-4	10-12
naphthalene	57.43	48.08	45.95	54.11	50.44	40.67	35.32	28.46	34.55
2-methylnaphthalene	62.53	54.85	67.1	71.65	68.99	68.81	65.48	40.31	42.71
1-methylnaphthalene	47.8	44.09	52.75	55.68	53.85	55.44	54.02	31.43	33.18
C1-naphthalenes	112.55	100.59	121.42	128.95	124.21	125.03	122.73	72.82	77.24
2,6-dimethylnaphthalene	79.75	76.22	97.97	101.26	97.91	98.34	93.21	54.17	54.35
C2-naphthalenes	321.14	309.27	390.08	402.25	388.97	388.78	381.22	210.46	211.36
1,6,7-trimethylnaphthalene	60.82	64.71	79.42	80.53	83.52	88.53	78.09	37.33	38.39
C3-naphthalenes	334.92	340.6	430.13	444.17	411.88	433.4	415.11	208.76	198.52
C4-naphthalenes	228.46	260.29	336.98	359.53	332.05	340.5	327.59	138.31	147.65
biphenyl	17.94	16.05	16.96	19.36	18.78	18.89	19	11.43	11.93
acenaphthylene	34.64	30.39	27.8	31.98	29.21	18.85	12.53	13.56	14.24
acenaphthene	10.81	10.22	11.57	12.46	10.85	10.94	9.71	6.44	6.48
fluorene	32.85	31.94	36.23	38.69	38.47	37.54	36.8	18.21	18.96
C1-fluorenes	79.76	81.16	98.78	102.45	95.59	97.15	94.18	48.25	47.55
C2-fluorenes	258.69	269.19	337.91	338.2	335.09	324.11	313.32	151.32	150.03
C3-fluorenes	232.11	244.2	307.71	304.73	284.08	285.21	270.15	143.71	141.21
phenanthrene	200.62	176.16	157.59	181.78	172.7	145.33	133.5	98.46	103.71
anthracene	57.38	50.84	51.18	53.64	49.96	41.42	35.64	29.53	30.75
1-methylphenanthrene	90.15	93.25	114.66	114.11	115.21	112.79	107.76	48.16	47.94
C1-phenanthrenes/anthracenes	368.48	353.99	413.43	407.62	415.59	397.51	394.01	197.81	193.89
C2-phenanthrenes/anthracenes	549.03	554.69	713.69	690.78	705.39	696.16	686.88	291.86	273.84
C3-phenanthrenes/anthracenes	540.68	564.84	722.46	709.11	754.74	771.63	741.68	287.8	296.93
C4-phenanthrenes/anthracenes	305.89	278.38	352.74	368.88	356.19	348.02	365.95	160.53	168.71
dibenzothiophene	19.55	16.86	16.32	18.07	17.06	15.49	15.33	10.76	11.12
C1-dibenzothiophenes	49.74	45.27	52.36	54.62	51.81	52.13	52.22	26.7	28.08
C2-dibenzothiophenes	60.56	53.14	61.51	62.55	59.15	53.75	51.33	33.63	35.24
C3-dibenzothiophenes	56.94	46.62	58.83	58.51	58.38	46.84	40.42	31.58	34.17
fluoranthene	296.72	249.49	214.3	242.44	240.8	211.09	184.76	152.86	157.92
pyrene	437.95	342.13	253.45	310.38	289.59	208.38	174.15	179.71	186.54
C1-fluoranthenes/pyrenes	289.01	244.12	247.05	253.48	247.97	210.47	187.83	131.04	132.47
benz[a]anthracene	173.15	147.99	115.41	138.68	127.77	98.2	84.67	78.9	82.13
chrysene	202.1	161.64	118.49	141.17	131.39	100.93	87.94	107.03	103.48
C1-chrysenes	177.5	169.93	163.99	193.95	188.75	139.13	125.3	85.6	89.1
C2-chrysenes	444.05	462.41	509.64	535.47	564.03	528.03	508.24	236.48	235.52
C3-chrysenes	258.34	254.9	294.43	332.12	331.89	267.29	270.67	126.24	140.29
C4-chrysenes	ND	ND	142.22	ND	0	122.45	118.52	ND	ND
benzo[b]fluoranthene	230.12	174.18	116	153.64	135.24	103.72	88.82	119.56	137.32
benzo[k]fluoranthene	139.7	122.08	94.88	116.84	109.04	83.82	71.68	77.69	68.36
benzo[e]pyrene	181.99	140.12	94.64	130.5	116.34	79.45	66.24	88.85	93.62
benzo[a]pyrene	212.53	159.14	105.87	133.17	125.16	85.98	69.2	87.6	89.05
perylene	121.22	111.75	107.3	136.21	126.45	154.98	175.4	88.48	96.1
indeno[1,2,3-c,d]pyrene	186.33	140.75	93.77	127.26	117.39	82.28	70.05	80.35	86.32
dibenz[a,h]anthracene	23.56	18.08	12.34	15.88	14.56	10.58	8.35	11.63	12.46
benzo[g,h,i]perylene	205.82	160.88	102.72	141.9	128.22	88.75	75.16	82.01	89.72
TOTAL PAH	2564.24	2078.84	1624.65	1965.67	1839.78	1437.29	1243.76	1212.31	1264.7
COMBUSTABLE PAH	2107.98	1676.36	1227.23	1521.36	1419.16	1073.73	914.78	977.34	1013.3
Surrogate Recoveries (%)									
acenaphthane-d10	52.08	58.58	51.43	50.30	56.05	52.74	53.56	67.48	71.06
phenanthrene-d10	57.71	66.45	61.25	60.95	63.09	59.79	59.37	73.66	74.96
benzo[a]pyrene-d12	56.38	62.11	61.97	55.64	61.83	60.03	58.62	68.46	67.26

ND Not detected.

CORE #6 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-102	372-104	372-108	372-110	372-114	372-116	372-120	372-124	372-130
Segment Depth (cm)	14-16	18-20	26-28	30-32	38-40	42-44	50-52	58-60	70-72
naphthalene	38.85	33.75	33.95	28.53	35.79	36.16	46.15	45.83	58.89
2-methylnaphthalene	46.15	39.79	40.69	40.97	48.72	48.86	59.7	56.25	75.39
1-methylnaphthalene	35.9	31.39	32.74	32.83	38.93	39.59	45.16	44.11	59.12
C1-naphthalenes	82.81	72.73	74.62	74.56	88.62	89.8	105.8	101.75	136.17
2,6-dimethylnaphthalene	58.28	51.92	54.21	56.28	68.01	66.54	75.82	74.23	102.1
C2-naphthalenes	223.81	206.18	214.71	221.93	273.23	272.39	302.77	296.1	410.03
1,6,7-trimethylnaphthalene	37.28	37.06	38.26	43.83	54.05	51.89	56.03	56.08	82.46
C3-naphthalenes	203.43	205.36	217.3	235.7	289.51	280.73	307.76	310.29	430.46
C4-naphthalenes	151.98	148.01	148.1	168.08	216.94	206.47	222.83	210.92	322.4
biphenyl	12.96	11.38	11.86	11.27	13.73	14.25	15.38	15.65	17.84
acenaphthylene	14.03	14.16	14.19	14.84	19.42	19.32	19.3	22.3	23.99
acenaphthene	6.67	6.89	6.5	5.76	8.09	8.09	7.87	7.53	11.05
fluorene	19.09	17.8	18.33	19.12	24.05	23.56	24.79	26.04	32.45
C1-fluorenes	48.26	45.24	47.59	49.8	61.2	58.45	61.85	63.47	81.66
C2-fluorenes	158.62	146.15	153.41	164.9	204.09	196.45	204.5	209.66	286.53
C3-fluorenes	129.17	125.7	141.3	178.23	172.69	176.8	236.08	203.71	247.64
phenanthrene	107.98	105.44	104.83	106.43	137.94	142.75	159.68	162.82	176.66
anthracene	31.89	31.98	30.02	33.58	44.28	44.77	41.28	46.48	55.39
1-methylphenanthrene	50.76	50.73	52.8	55.55	71.51	69.87	84.14	79.71	115.81
C1-phenanthrenes/anthracenes	209.19	202.62	208.91	211.49	279.33	274.35	306.49	310.61	409.39
C2-phenanthrenes/anthracenes	307.58	299.47	315.03	329.01	419.12	408.23	463.8	469.07	705.46
C3-phenanthrenes/anthracenes	310.43	299.22	317.42	331.36	433.73	411.3	502.98	460.42	712.02
C4-phenanthrenes/anthracenes	177.05	165.17	185.38	209.48	249.27	231.4	234.41	272.34	412.18
dibenzothiophene	11.57	11.51	12	12.33	15.14	15.82	16.76	16.65	17.82
C1-dibenzothiophenes	28.23	27.6	28.74	28.83	38.78	38.51	43.41	40.91	55.34
C2-dibenzothiophenes	37.35	32.95	35.8	36.59	44.78	43.53	46.9	46.75	59.43
C3-dibenzothiophenes	35.81	33.66	34.63	37.15	41.68	43.8	42.46	41.19	52.7
fluoranthene	166.24	157.08	146.71	145.69	187.93	193.44	224.83	223.36	222.67
pyrene	195.12	190.49	195.32	198.17	262.03	270.3	283.73	305.99	296.3
C1-fluoranthenes/pyrenes	139.73	132.38	134.61	140.45	177.32	180.01	190.6	197.24	237
benz[a]anthracene	87.66	86.11	88.33	88.3	112.02	122.47	124.51	129.03	122.34
chrysene	110.26	109.59	106.18	101.07	133.23	140.37	145.59	139.93	127.96
C1-chrysenes	96.4	92.74	99.77	114.77	124.09	135.86	151.35	149.36	171.78
C2-chrysenes	269.82	252.86	277.55	285.29	354.99	447.92	375.3	363.29	466.84
C3-chrysenes	150.23	143.12	157.29	181.64	193.98	220.22	221.39	224.26	307.47
C4-chrysenes	76.42	71.46	84.61	ND	101.1	125.7	ND	ND	ND
benzo[b]fluoranthene	139.3	134	131.23	128.56	149.5	143.7	158.41	161.57	134.74
benzo[k]fluoranthene	80.58	72.3	79.2	127.41	105.79	120.58	106.49	105.68	104.91
benzo[e]pyrene	100.28	96.1	99.77	98.71	119.09	130.6	130.83	132.16	116.42
benzo[a]pyrene	93.09	89.23	92.16	92.72	124.26	138.29	134.16	145.22	129.76
perylene	102.29	90.51	91.94	82.96	97.54	102.31	94.76	99.09	95.93
indeno[1,2,3-c,d]pyrene	86.9	81.18	88.34	92.86	119.76	129.07	128.47	137.83	121.83
dibenz[a,h]anthracene	12.43	11.74	11.95	13.16	16.57	17.34	16.79	17.68	15.89
benzo[g,h,i]perylene	91.49	88.96	95.64	100.22	131.02	140.95	139.52	149.65	133.11
TOTAL PAH	1327.73	1270.49	1283.57	1337.39	1660.4	1740.02	1821.27	1883.19	1843.33
COMBUSTABLE PAH	1063.07	1020.68	1035.06	1088.16	1342.11	1416.51	1462.5	1515.94	1409.51
Surrogate Recoveries (%)									
acenaphthane-d10	66.62	70.05	56.91	70.66	66.64	69.22	75.22	73.74	74.82
phenanthrene-d10	67.92	72.10	60.39	75.25	71.46	72.63	68.63	76.09	74.77
benzo[a]pyrene-d12	59.87	61.86	50.40	65.88	63.77	60.90	67.95	70.34	72.82

ND Not detected.

PUGET SOUND HISTORICAL TRENDS
PAH IN SEDIMENT CORES

CORE #6 (contd)
(concentrations in ug/kg dry wt.)

Sample No.	372-134	372-140	372-144	372-150	372-159	372-168	372-183
Segment Depth (cm)	78-80	90-92	98-100	110-112	128-130	146-148	176-178
naphthalene	49.39	26.35	12.8	14.6	5.55	5.39	4.83
2-methylnaphthalene	93.35	47.76	18.83	25.59	17.44	15.86	15.32
1-methylnaphthalene	76	41.58	17.58	22.58	16.15	15.1	15.13
C1-naphthalenes	169.86	90.2	37.91	49.13	32.8	30.67	29.77
2,6-dimethylnaphthalene	127.9	68.27	25.08	33.54	23.9	22.72	21.26
C2-naphthalenes	511.82	287.76	106.68	139.99	100.08	94.49	90.21
1,6,7-trimethylnaphthalene	104.3	60.03	17.57	21.76	13.65	13.99	13.83
C3-naphthalenes	544.1	327.11	102.63	131.54	79.61	77.4	78.33
C4-naphthalenes	418.14	261.07	70.47	79.94	45.72	46.84	45.4
biphenyl	19.73	11.69	5.63	7.41	5.15	4.65	4.82
acenaphthylene	19.7	8.54	6.33	3.96	0.16	0	0.21
acenaphthene	11.3	5.56	1.31	2.71	0.91	0.91	0.78
fluorene	35.47	19.24	7.27	9.85	5.81	5.33	5.38
C1-fluorenes	99.22	61.23	22.21	29.79	20.53	18.62	18.73
C2-fluorenes	373.74	208.73	66.61	91	61.04	64.86	59.32
C3-fluorenes	354.82	171	59.86	74.23	56.85	46.19	47.38
phenanthrene	160.56	87.58	34.78	51.93	28.36	26.86	25.31
anthracene	41.88	18.08	2.88	8.14	0.63	1.13	0.93
1-methylphenanthrene	138.88	80.49	19.35	28.21	14.1	13.72	12.43
C1-phenanthrenes/anthracenes	477.72	280.77	85.18	114.45	68.26	65.59	63.82
C2-phenanthrenes/anthracenes	840.69	492.57	107.23	155.31	67.45	69.41	67.8
C3-phenanthrenes/anthracenes	885.41	607.76	103.55	141.3	47.72	51.84	43.98
C4-phenanthrenes/anthracenes	438.7	220.06	48.75	65.35	28.2	29.58	20.98
dibenzothiophene	17.32	9.23	3.22	5.06	2.75	2.75	2.67
C1-dibenzothiophenes	62.11	39.28	10.01	13.29	6.43	6.75	6.57
C2-dibenzothiophenes	65.1	32.88	9.01	14.17	6.15	6.52	5.73
C3-dibenzothiophenes	51.36	23.86	6.3	11.4	4.3	4.54	2.87
fluoranthene	161.12	78.05	16.61	39.27	4.1	4.3	3.22
pyrene	193.74	98.96	24.95	57.07	7.11	7.58	5.77
C1-fluoranthenes/pyrenes	207.19	113.76	32.29	55.55	0	22.56	20.46
benz[a]anthracene	90.45	43.57	9.27	25.85	2.92	3.31	2.81
chrysene	92.33	49.11	13.86	35.16	8.79	8.73	7.93
C1-chrysenes	170.74	77.77	22.03	41.52	17	18.11	16.82
C2-chrysenes	589.95	332.15	75.84	123.24	49.24	52.22	46.26
C3-chrysenes	361.33	171.24	38.5	55.66	25.31	29.71	23.91
C4-chrysenes	ND	76.62	ND	33.33	ND	ND	ND
benzo[b]fluoranthene	92.7	47.93	14.26	31.54	5.26	5.91	4.84
benzo[k]fluoranthene	71.47	33.36	6.29	20.86	1.17	1.38	0.75
benzo[e]pyrene	73.51	36.67	9.62	26.77	4.24	4.37	4.07
benzo[a]pyrene	78.49	37.53	7.43	23.35	1.68	1.82	1.42
perylene	88.09	89.47	66.78	77.63	65	62	67.93
indeno[1,2,3-c,d]pyrene	79.15	35.97	7.48	21.02	1.17	1.64	1.03
dibenz[a,h]anthracene	10.63	5.05	1.33	3.37	0.7	0.69	0.55
benzo[g,h,i]perylene	83.33	42	11.09	26.37	3.63	3.74	3.28
TOTAL PAH	1365.06	684.64	196.77	400.64	95.39	94.58	84.36
COMBUSTABLE PAH	953.41	471.53	112.57	283.86	36.53	39.1	31.6
Surrogate Recoveries (%)							
acenaphthane-d10	72.24	71.13	74.21	71.16	72.58	72.39	70.81
phenanthrene-d10	76.94	75.96	75.11	73.18	75.82	75.29	75.61
benzo[a]pyrene-d12	72.63	72.00	67.16	59.73	64.90	63.92	63.18

ND Not detected.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Batch	BATCH 1	BATCH 1	
Sample No.	JW57MS	372-10	% Rec
Dry Weight (g)	18.648	18.761	
		(Background)	
naphthalene	48.9	32.87	59.46
2-methylnaphthalene	60.95	37.25	89.79
1-methylnaphthalene	52.04	28.69	85.37
2,6-dimethylnaphthalene	71.83	43.76	104.43
1,6,7-trimethylnaphthalene	46.59	22.31	101.58
biphenyl	34.55	11.5	86.31
acenaphthylene	35.59	17.14	71.72
acenaphthene	30.54	5.27	91.48
fluorene	44.38	17.66	101.02
phenanthrene	139.09	122.91	58.06
anthracene	47.58	32.84	72.17
1-methylphenanthrene	56.96	30.84	98.44
fluoranthene	208.51	185.86	81.21
pyrene	249.99	235.58	48.83 &
benz[a]anthracene	121	92.11	124.02
chrysene	155.23	112.29	158.96 &
benzo[b]fluoranthene	163.04	130.49	119.83
benzo[k]fluoranthene	110.1	89.9	74.16
benzo[e]pyrene	135.98	104.02	117.67
benzo[a]pyrene	131.74	108.08	95.97
perylene	120.81	105.17	74.91
indeno[1,2,3-c,d]pyrene	135.53	101.9	140.07
dibenz[a,h]anthracene	35.42	14.31	104.75
benzo[g,h,i]perylene	128.53	105.2	96.28
Suroogate Recoveries (%):			
acenaphthene-d10			68.08
phenanthrene-d10			71.67
1-phenyl nonane			68.67
benzo[a]pyrene-d12			65.88
c30b,b-hopane			93.34

& Outside range (50% - 150%).
* Outside range (RPD >30%).
RPD Relative Percent Difference.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Batch	BATCH 2	BATCH 2	
Sample No.	JW74MS	372-104	% Rec
Dry Weight (g)	15.545	15.534	
		(Background)	
naphthalene	58.78	33.75	78.44
2-methylnaphthalene	71.58	39.79	101.46
1-methylnaphthalene	62.75	31.39	96.36
2,6-dimethylnaphthalene	88.04	51.92	113.20
1,6,7-trimethylnaphthalene	66.71	37.06	104.08
biphenyl	38.82	11.38	85.94
acenaphthylene	40.43	14.16	85.64
acenaphthene	34.6	6.89	83.74
fluorene	48.46	17.8	97.06
phenanthrene	143.09	105.44	118.29
anthracene	55.35	31.98	96.78
1-methylphenanthrene	83.9	50.73	105.08
fluoranthene	197.2	157.08	126.53
pyrene	232.64	190.49	132.59
benz[a]anthracene	114.18	86.11	102.65
chrysene	133.31	109.59	74.62
benzo[b]fluoranthene	162.32	134	89.37
benzo[k]fluoranthene	108.19	72.3	113.04
benzo[e]pyrene	129.85	96.1	105.88
benzo[a]pyrene	123.04	89.23	117.80
perylene	119.33	90.51	120.21
indeno[1,2,3-c,d]pyrene	127.2	81.18	162.97 &
dibenz[a,h]anthracene	38.36	11.74	110.60
benzo[g,h,i]perylene	125.88	88.96	130.81
Suroogate Recoveries (%):			
acenaphthene-d10			72.56
phenanthrene-d10			72.97
1-phenyl nonane			75.85
benzo[a]pyrene-d12			71.46
c30b,b-hopane			97.49

& Outside range (50% - 150%).
* Outside range (RPD >30%).
RPD Relative Percent Difference.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Batch	BATCH 3	BATCH 3	
Sample No.	JW83MS	372-199	% Rec
Dry Weight (g)	19.04	18.36	
		(Background)	
naphthalene	46.69	28.44	73.88
2-methylnaphthalene	58.67	35.09	96.99
1-methylnaphthalene	50.31	27.05	91.11
2,6-dimethylnaphthalene	72.07	45.16	109.38
1,6,7-trimethylnaphthalene	49.95	26.9	103.14
biphenyl	33.75	11.42	87.20
acenaphthylene	32.32	12.58	80.59
acenaphthene	28.99	6.1	85.51
fluorene	40.93	17.32	93.91
phenanthrene	116.02	100.07	74.98
anthracene	39.75	26.74	70.76
1-methylphenanthrene	60.68	36.47	98.88
fluoranthene	167.39	157.61	59.36
pyrene	185.32	181.43	39.83 &
benz[a]anthracene	98.1	76.46	108.92
chrysene	119.64	97.95	96.74
benzo[b]fluoranthene	146.59	119.42	121.10
benzo[k]fluoranthene	98.7	77.24	93.30
benzo[e]pyrene	113.05	89.56	102.35
benzo[a]pyrene	105.8	86.44	95.61
perylene	117.26	103.34	89.77
indeno[1,2,3-c,d]pyrene	103.58	78.51	120.76
dibenz[a,h]anthracene	30.53	11.33	99.74
benzo[g,h,i]perylene	100.96	86.44	76.28
Suroogate Recoveries (%):			
acenaphthene-d10			77.06
phenanthrene-d10			79.52
1-phenyl nonane			78.41
benzo[a]pyrene-d12			71.30
c30b,b-hopane			113.90

& Outside range (50% - 150%).
* Outside range (RPD >30%).
RPD Relative Percent Difference.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Batch	BATCH 4	BATCH 3		
Sample No.	JW86MS	372-199	% Rec	RPD
Dry Weight (g)	18.128	18.36		
		(Background)		
naphthalene	50.29	28.44	78.45	11
2-methylnaphthalene	62.64	35.09	100.78	5
1-methylnaphthalene	53.08	27.05	91.97	4
2,6-dimethylnaphthalene	79.19	45.16	122.14	6
1,6,7-trimethylnaphthalene	66.61	26.9	161.00 &	21
biphenyl	35.71	11.42	88.15	1
acenaphthylene	37.22	12.58	93.03	9
acenaphthene	30.96	6.1	87.32	3
fluorene	47.79	17.32	111.62	7
phenanthrene	136.94	100.07	130.14	31 *
anthracene	51.88	26.74	119.64	22
1-methylphenanthrene	54.05	36.47	63.15	18
fluoranthene	195.92	157.61	133.11	31 *
pyrene	214.97	181.43	114.15	48 *
benz[a]anthracene	113.1	76.46	151.75 &	16
chrysene	141.29	97.95	153.90 &	30
benzo[b]fluoranthene	155.77	119.42	127.72	13
benzo[k]fluoranthene	96.36	77.24	66.50	21
benzo[e]pyrene	128.17	89.56	136.79	12
benzo[a]pyrene	112.91	86.44	102.86	9
perylene	131.8	103.34	131.71	22
indeno[1,2,3-c,d]pyrene	111.97	78.51	133.87	11
dibenz[a,h]anthracene	32.04	11.33	99.61	4
benzo[g,h,i]perylene	114.3	86.44	110.35	19
Suroogate Recoveries (%):				
acenaphthene-d10			53.15	
phenanthrene-d10			62.51	
1-phenyl nonane			57.45	
benzo[a]pyrene-d12			60.91	
c30b,b-hopane			94.46	

& Outside range (50% - 150%).
* Outside range (RPD >30%).
RPD Relative Percent Difference.

PUGET SOUND HISTORICAL TRENDS
PROCEDURAL BLANKS
units: ug/kg dry wt.

Batch Sample No.	BATCH 1 P. Blank-1	BATCH 2 P. Blank-2	BATCH 3 P. Blank-3	BATCH 4 P. Blank-4
naphthalene	11.91	12.58	8.43	12.67
2-methylnaphthalene	6.09	6.1	ND	6.5
1-methylnaphthalene	4.73	4.84	ND	7.83
C1-naphthalenes	12.22	16.76	ND	21.07
2,6-dimethylnaphthalene	ND	ND	ND	ND
C2-naphthalenes	ND	ND	ND	ND
1,6,7-trimethylnaphthalene	ND	ND	ND	ND
C3-naphthalenes	ND	ND	ND	ND
C4-naphthalenes	ND	ND	ND	ND
biphenyl	7.01	ND	4.69	ND
acenaphthylene	ND	ND	ND	ND
acenaphthene	ND	ND	ND	ND
fluorene	ND	ND	ND	ND
C1-fluorenes	ND	ND	ND	ND
C2-fluorenes	ND	ND	ND	ND
C3-fluorenes	ND	ND	ND	ND
phenanthrene	6.64	6.01	5.96	5.9
anthracene	ND	ND	ND	ND
1-methylphenanthrene	ND	ND	ND	ND
C1-phenanthrenes/anthracenes	ND	ND	ND	ND
C2-phenanthrenes/anthracenes	ND	ND	ND	ND
C3-phenanthrenes/anthracenes	ND	ND	ND	ND
C4-phenanthrenes/anthracenes	ND	ND	ND	ND
dibenzothiophene	ND	ND	ND	ND
C1-dibenzothiophenes	ND	ND	ND	ND
C2-dibenzothiophenes	ND	ND	ND	ND
C3-dibenzothiophenes	ND	ND	ND	ND
fluoranthene	3.03	8.49	8.55	4.98
pyrene	6.72	20.49	19.48	7.62
C1-fluoranthenes/pyrenes	ND	ND	ND	ND
benz[a]anthracene	ND	9.5	7.08	ND
chrysene	ND	7.44	4.46	ND
C1-chrysenes	ND	ND	ND	ND
C2-chrysenes	ND	ND	ND	ND
C3-chrysenes	ND	ND	ND	ND
C4-chrysenes	ND	ND	ND	ND
benzo[b]fluoranthene	ND	7.77	4.84	ND
benzo[k]fluoranthene	ND	6.42	2.83	ND
benzo[e]pyrene	ND	6.62	5.35	ND
benzo[a]pyrene	ND	10.46	ND	ND
perylene	ND	7.13	4.15	ND
indeno[1,2,3-c,d]pyrene	ND	7.38	ND	ND
dibenz[a,h]anthracene	ND	ND	ND	ND
benzo[g,h,i]perylene	8.33	80.89	18.97	23.69
Surrogate Recoveries (%)				
acenaphthene-d10	65.59	67.77	77.91	62.88
phenanthrene-d10	64.33	63.28	79.46	64.63
benzo[a]pyrene-d12	58.54	56.29	56.42	44.37

ND Not detected.

PUGET SOUND HISTORICAL TRENDS
STANDARD REFERENCE MATERIAL
units: ug/kg dry wt.

Batch Sample No.	BATCH 1 SRM 1941-1	BATCH 2 SRM 1941-2	BATCH 3 SRM 1941-3	BATCH 4 SRM 1941-4	% RSD	Certified Value	Range
naphthalene	699.70	655.00	689.82	694.19	3%	NC	NC
2-methylnaphthalene	314.27	299.27	322.64	348.30	6%	NC	NC
1-methylnaphthalene	170.39	161.22	173.21	191.59	7%	NC	NC
C1-naphthalenes	484.45	463.02	496.21	544.77	7%	NC	NC
2,6-dimethylnaphthalene	171.02	170.22	181.97	205.54	9%	NC	NC
C2-naphthalenes	624.48	623.92	656.70	775.94	11%	NC	NC
1,6,7-trimethylnaphthalene	50.30	58.90	55.47	73.97	17%	NC	NC
C3-naphthalenes	414.16	436.50	472.58	587.28	16%	NC	NC
C4-naphthalenes	296.68	312.46	249.66	404.79	21%	NC	NC
biphenyl	73.14	72.72	77.55	85.24	8%	NC	NC
acenaphthylene	82.42	80.57	74.05	98.66	12%	NC	NC
acenaphthene	33.77	36.12	37.16	42.89	10%	NC	NC
fluorene	73.28	78.28	79.89	99.60	14%	NC	NC
C1-fluorenes	139.73	176.42	163.80	234.96	23%	NC	NC
C2-fluorenes	499.17	542.81	548.70	924.39	32%	NC	NC
C3-fluorenes	573.26	772.34	730.51	1095.66	28%	NC	NC
phenanthrene	491.23	513.07	498.72	603.51	10%	577	±59
anthracene	168.09	184.89	165.75	191.26	7%	202	±42
1-methylphenanthrene	102.40	108.03	103.67	130.78	12%	NC	NC
C1-phenanthrenes/anthracenes	563.80	637.12	602.29	744.87	12%	NC	NC
C2-phenanthrenes/anthracenes	695.08	772.86	710.20	918.94	13%	NC	NC
C3-phenanthrenes/anthracenes	712.43	751.12	703.35	875.56	10%	NC	NC
C4-phenanthrenes/anthracenes	1006.06	1109.87	934.73	1047.34	7%	NC	NC
dibenzothiophene	67.34	73.57	68.79	83.09	10%	NC	NC
C1-dibenzothiophenes	130.66	134.33	126.17	159.74	11%	NC	NC
C2-dibenzothiophenes	294.14	310.39	284.29	344.72	9%	NC	NC
C3-dibenzothiophenes	415.24	438.40	423.94	511.43	10%	NC	NC
fluoranthene	1147.68	1182.75	1123.91	1346.64	8%	1220	±240
pyrene	1068.40	1109.07	1044.54	1232.18	7%	1080	±200
C1-fluoranthenes/pyrenes	725.86	763.26	703.64	893.50	11%	NC	NC
benz[a]anthracene	725.60	608.59	644.06	750.58	10%	550	±79
chrysene	939.53	759.57	828.73	958.99	11%	NC	NC
C1-chrysenes	655.02	575.94	588.94	799.08	16%	NC	NC
C2-chrysenes	1228.63	1057.78	1042.53	1392.89	14%	NC	NC
C3-chrysenes	762.23	716.70	625.36	848.38	13%	NC	NC
C4-chrysenes	ND	ND	ND	ND	ND	NC	NC
benzo[b]fluoranthene	1247.29	1020.07	1069.01	1335.23	13%	780	±190
benzo[k]fluoranthene	941.63	768.08	782.23	858.69	10%	444	±49
benzo[e]pyrene	890.93	722.82	746.55	907.62	12%	NC	NC
benzo[a]pyrene	686.07	656.18	645.94	682.69	3%	670	±130
perylene	459.32	442.15	434.71	463.53	3%	422	±33
indeno[1,2,3-c,d]pyrene	778.84	661.04	653.41	725.81	8%	569	±83
dibenz[a,h]anthracene	150.50	123.45	121.53	136.54	10%	NC	NC
benzo[g,h,i]perylene	669.88	568.58	571.96	644.43	8%	516	±40
Surrogate Recoveries (%)							
acenaphthane-d10	73.58	69.76	79.35	48.17 #	20%	NA	NA
phenanthrene-d10	71.85	68.64	81.24	54.89	16%	NA	NA
benzo[a]pyrene-d12	51.96	63.53	65.03	45.43 #	17%	NA	NA

NC Not certified.
ND Not detected.
NA Not applicable.
\# Surrogate outside acceptability range (50-150%).

APPENDIX J

PCB/PESTICIDES IN SEDIMENT CORES

PUGET SOUND HISTORICAL TRENDS
PCB/PESTICIDES IN SEDIMENT CORES

CORE #3

(concentrations in ug/kg dry wt.)

Batch	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1
Sample No.	372-2	372-6	372-8	372-10	372-16	372-20	372-22	372-26
Segment Depth (cm)	2-4	10-12	14-16	18-20	30-32	38-40	42-44	50-52
Dry Weight (g)	19.367	19.694	19.151	18.761	20.411	20.098	19.679	20.707
TCMX	4.794	4.322	4.760	4.884	4.452	4.660	3.884	3.411
CL2(08)	ND	ND	ND	12.743 *	ND	ND	ND	ND
HCB	ND	ND	ND	ND	0.482	0.693	0.620	0.470
LINDANE	ND	ND	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND	ND	ND	0.780	1.119
ALDRIN	ND	ND	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	ND	ND	ND	ND	0.507	0.862
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND	ND
CL4(66)	ND	3.064	ND	0.744	1.645	2.343	ND	2.344
2,4-DDE	ND	ND	ND	ND	ND	ND	ND	ND
CL5(101)	1.521	1.457	1.461	2.008	2.356	2.802	2.767	3.976
CHLORDANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	ND	0.153	ND	ND	0.349	0.323	0.336	0.381
4,4-DDE	1.187	1.187	1.484	1.619	1.454	1.617	1.619	1.908
CL4(77)	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	ND	0.406	ND	ND	0.695	0.814	0.921	0.962
ENDRIN	ND	ND	ND	ND	ND	ND	ND	ND
CL5(118)	1.101	0.643	0.991	1.486	1.874	2.198	2.480	3.304
4,4-DDD	ND	0.509	ND	ND	0.872	1.116	1.052	1.505
2,4-DDT	ND	ND	ND	ND	ND	ND	ND	ND
CL6(153)	1.991	1.798	1.782	2.830	3.843	4.187	4.771	5.685
CL5(105)	0.281	0.338	0.376	0.507	0.676	0.778	0.783	1.113
4,4-DDT	ND	ND	ND	ND	ND	ND	ND	ND
CL6(138)	1.515	1.418	1.610	2.154	2.612	2.931	3.226	4.246
CL5(126)	ND	ND	ND	ND	ND	ND	ND	ND
CL7(187)	0.373	0.413	0.340	0.524	0.974	1.353	1.085	1.578
CL6(128)	1.758	1.517	ND	2.032	ND	ND	ND	2.926
CL7(180)	0.458	0.374	ND	ND	1.338	1.277	1.522	2.035
MIREX	ND	ND	ND	ND	ND	ND	ND	ND
CL7(170)	ND	0.107	ND	ND	0.716	0.621	0.603	0.809
CL8(195)	ND	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	9.00	11.13	6.56	12.29	16.03	18.49	18.53	30.00
TOTAL DDT (1)	1.19	2.10	1.48	1.62	3.02	3.55	3.59	4.38
Surrogate Recovery (%)								
DBOFB	80.78	88.11	82.27	81.85	82.53	80.08	98.11	106.18
CL5(112)	96.93	106.62	96.11	84.38	88.06	87.15	92.10	96.11

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

PUGET SOUND HISTORICAL TRENDS
PCB/PESTICIDES IN SEDIMENT CORES

CORE #3 (contd)

(concentrations in ug/kg dry wt.)

Batch	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 1	BATCH 2
Sample No.	372-30	372-36	372-40	372-46	372-50	372-56	372-59	372-65
Segment Depth (cm)	58-60	70-72	78-80	90-92	98-100	110-112	116-118	128-130
Dry Weight (g)	21.37	20.558	20.881	21.196	20.378	20.788	20.792	19.543
TCMX	4.170	4.017	4.009	4.079	4.147	4.030	4.268	5.695
CL2(08)	ND	ND	ND	ND	ND	ND	ND	ND
HCB	0.557	0.442	ND	1.686	1.636	ND	ND	9.196 B
LINDANE	ND	ND	ND	ND	ND	ND	ND	0.925
CL3(18)	ND	ND	ND	ND	ND	ND	ND	ND
CL3(28)	1.171	ND	ND	ND	ND	ND	ND	1.663
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND	ND
CL4(52)	1.833	ND	ND	ND	ND	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND	ND	ND
CL4(44)	1.071	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND	ND
CL4(66)	2.278	2.271	ND	ND	ND	ND	ND	ND
2,4-DDE	ND	ND	ND	ND	ND	ND	ND	ND
CL5(101)	4.220	2.588	2.073	1.875	1.783	0.739	1.376	ND
CHLORDANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	0.443	0.401	0.320	0.344	0.465	0.280	0.473	0.220
4,4-DDE	1.926	1.784	1.782	1.467	1.641	0.900	1.674	0.654
CL4(77)	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	1.070	1.081	0.977	1.465	1.541	ND	1.505	0.618
ENDRIN	ND	ND	ND	ND	ND	ND	ND	ND
CL5(118)	3.309	1.392	0.863	0.411	0.374	ND	ND	ND
4,4-DDD	1.713	1.653	1.233	0.853	ND	ND	ND	ND
2,4-DDT	ND	ND	ND	ND	ND	ND	ND	ND
CL6(153)	6.695	3.170	2.200	1.240	1.216	ND	ND	ND
CL5(105)	0.874	0.646	0.318	0.105	0.083	ND	ND	ND
4,4-DDT	ND	ND	ND	ND	ND	ND	ND	ND
CL6(138)	4.501	2.277	1.683	0.764	0.748	ND	ND	ND
CL5(126)	ND	ND	ND	ND	ND	ND	ND	ND
CL7(187)	1.646	0.802	0.694	0.498	0.444	ND	ND	ND
CL6(128)	3.893	4.780	5.959	9.903	4.576	ND	ND	ND
CL7(180)	2.178	1.473	0.770	ND	ND	ND	ND	ND
MIREX	ND	ND	ND	ND	ND	ND	ND	ND
CL7(170)	0.853	0.473	0.217	ND	ND	ND	ND	ND
CL8(195)	ND	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	34.52	19.87	14.78	14.80	9.22	0.74	1.38	1.66
TOTAL DDT (1)	4.71	4.52	3.99	3.79	3.18	0.90	3.18	1.27
Surrogate Recovery (%)								
DBOFB	84.16	90.81	89.59	86.74	88.74	89.53	84.52	67.38
CL5(112)	90.34	96.54	101.13	92.13	92.81	97.16	69.17	85.48

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

CORE #3 (contd)

(concentrations in ug/kg dry wt.)

Batch	BATCH 2	BATCH 2	BATCH 2	BATCH 2	BATCH 2	BATCH 2
Sample No.	372-71	372-74	372-80	372-85	372-90	372-94
Segment Depth (cm)	140-142	146-148	158-160	168-170	178-180	
Dry Weight (g)	19.133	18.764	21.324	22.544	18.652	20.663
TCMX	4.938	5.622	3.973	4.353	4.084	5.097
CL2(08)	ND	ND	ND	ND	ND	ND
HCB	17.337 B	20.059 B	ND	ND	1.160 B	0.414 B
LINDANE	0.822	0.353	0.285	1.014	1.084	1.072
CL3(18)	ND	ND	ND	ND	ND	ND
CL3(28)	1.590	1.791	ND	0.506	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND
CL4(66)	ND	ND	ND	ND	ND	ND
2,4-DDE	ND	ND	ND	ND	ND	ND
CL5(101)	ND	ND	ND	ND	ND	ND
CHLORDANE	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND
DIELDRIN	ND	ND	ND	ND	ND	ND
4,4-DDE	0.557	ND	ND	ND	ND	ND
CL4(77)	ND	ND	ND	ND	ND	ND
2,4-DDD	ND	ND	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND	ND	ND
CL5(118)	ND	ND	ND	ND	ND	ND
4,4-DDD	ND	ND	ND	ND	ND	ND
2,4-DDT	ND	ND	ND	ND	ND	ND
CL6(153)	ND	ND	ND	ND	ND	ND
CL5(105)	ND	ND	ND	ND	ND	ND
4,4-DDT	ND	ND	ND	ND	ND	ND
CL6(138)	ND	ND	ND	ND	ND	ND
CL5(126)	ND	ND	ND	ND	ND	ND
CL7(187)	ND	ND	ND	ND	ND	ND
CL6(128)	2.186	ND	ND	ND	ND	ND
CL7(180)	ND	ND	ND	ND	ND	ND
MIREX	ND	ND	ND	ND	ND	ND
CL7(170)	ND	ND	ND	ND	ND	ND
CL8(195)	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND
TOTAL PCB	3.78	1.79	ND	0.51	ND	ND
TOTAL DDT (1)	0.56	ND	ND	ND	ND	ND
Surrogate Recovery (%)						
DBOFB	79.37	71.08	88.52	76.42	98.44	71.20
CL5(112)	91.44	85.42	98.10	99.28	87.91	81.64

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

PUGET SOUND HISTORICAL TRENDS
PCB/PESTICIDES IN SEDIMENT CORES

CORE #5

(concentrations in ug/kg dry wt.)

Batch	BATCH 3	BATCH 3	BATCH 3	BATCH 3	BATCH 3	BATCH 4	BATCH 4
Sample No.	372-191	372-195	372-197	372-199	372-205	372-209	372-215
Segment Depth (cm)	2-4	ND	14-16	18-20	30-32	38-40	50-52
Dry Weight (g)	11.561	17.425	17.748	18.360	17.964	17.689	18.237
TCMX	6.826	4.737	4.652	4.264	4.438	4.429	4.778
CL2(08)	ND	ND	ND	ND	ND	ND	ND
HCB	2.442	1.785	5.758	3.752	ND	0.597 B	0.710 B
LINDANE	ND	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND	1.431
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND	ND	ND	1.348
ALDRIN	ND	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	0.865	ND	ND	ND	1.058
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND
CL4(66)	ND	ND	2.279	2.847	2.488	ND	3.968
2,4-DDE	ND	ND	ND	ND	ND	ND	ND
CL5(101)	1.320	1.414	1.421	1.417	1.938	2.106	2.846
CHLORDANE	ND	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	ND	0.104	0.262	0.177	ND	ND	0.402
4,4-DDE	1.571	1.650	2.082	1.450	1.999	2.041	1.865
CL4(77)	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	ND	0.171	0.930	0.730	ND	0.749	0.671
ENDRIN	ND	ND	ND	ND	ND	ND	ND
CL5(118)	0.229	0.785	1.524	1.029	1.595	1.431	2.084
4,4-DDD	1.128	0.972	1.025	0.788	0.974	0.628	0.877
2,4-DDT	ND	1.990	ND	ND	ND	ND	ND
CL6(153)	1.652	1.729	2.567	2.157	3.281	2.682	3.957
CL5(105)	0.169	0.244	0.304	0.407	0.634	0.703	0.911
4,4-DDT	2.072	0.884	1.727	ND	ND	ND	ND
CL6(138)	1.536	1.488	2.014	1.847	2.535	2.008	2.757
CL5(126)	ND	ND	ND	ND	ND	ND	ND
CL7(187)	0.178	0.271	0.861	0.708	0.949	0.987	0.991
CL6(128)	ND	ND	1.950	1.383	ND	1.537	2.283
CL7(180)	0.250	0.363	0.649	ND	0.982	0.913	1.561
MIREX	ND	ND	ND	ND	ND	ND	ND
CL7(170)	ND	0.161	0.242	0.267	0.446	0.406	0.619
CL8(195)	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	5.33	6.45	14.68	12.06	14.85	12.77	25.81
TOTAL DDT (1)	4.77	5.67	5.76	2.97	2.97	3.42	3.41
Surrogate Recovery (%)							
DBOFB	94.96	90.80	90.76	97.86	94.00	95.71	86.06
CL5(112)	123.03	113.83	83.48	106.06	87.29	109.14	104.82

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

CORE #5 (contd)

(concentrations in ug/kg dry wt.)

Batch	BATCH 4	BATCH 4	BATCH 4	BATCH 4	BATCH 4	BATCH 4	BATCH 4
Sample No.	372-217	372-219	372-225	372-229	372-235	372-239	372-245
Segment Depth (cm)	54-56	58-60	70-72	78-80	90-92	98-100	110-112
Dry Weight (g)	19/076	19.053	18.226	19.359	19.760	19.526	17.945
TCMX	4.883	4.700	4.826	4.681	4.601	4.424	4.694
CL2(08)	ND	ND	ND	ND	ND	ND	ND
HCB	0.758 B	0.890 B	0.702 B	0.639 B	0.526 B	0.325 B	0.340 B
LINDANE	ND	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND
CL4(52)	ND	1.469	1.456	1.431	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND	ND
CL4(44)	ND	0.689	0.525	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND
CL4(66)	3.935	3.494	4.058	3.154	ND	ND	ND
2,4-DDE	ND	ND	ND	ND	ND	ND	ND
CL5(101)	3.179	3.428	3.460	2.777	1.931	1.569	1.598
CHLORDANE	ND	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	0.356	ND	0.363	ND	0.375	ND	ND
4,4-DDE	1.921	1.944	2.009	1.874	1.417	1.451	1.202
CL4(77)	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	0.696	0.656	0.758	0.884	0.698	0.818	0.676
ENDRIN	ND	ND	ND	ND	ND	ND	ND
CL5(118)	2.266	2.319	2.196	1.545	0.774	ND	0.230
4,4-DDD	1.196	1.350	1.345	1.396	0.958	1.023	0.515
2,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(153)	4.235	3.976	4.177	3.068	1.562	0.743	0.432
CL5(105)	0.967	1.023	1.037	0.825	0.406	0.165	0.189
4,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(138)	2.914	2.935	2.981	2.252	1.132	0.589	0.350
CL5(126)	ND	ND	ND	ND	ND	ND	ND
CL7(187)	1.144	1.231	0.987	0.953	0.341	0.189	0.081
CL6(128)	2.046	2.072	2.131	2.772	ND	ND	ND
CL7(180)	1.524	1.273	1.549	1.422	0.797	0.585	0.426
MIREX	ND	ND	ND	ND	ND	ND	ND
CL7(170)	ND	0.484	0.715	0.456	0.107	0.063	0.024
CL8(195)	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	22.21	24.39	25.27	20.66	7.05	3.90	3.33
TOTAL DDT (1)	3.81	3.95	4.11	4.15	3.07	3.29	2.39
Surrogate Recovery (%)							
DBOFB	80.50	83.73	85.25	82.74	82.47	86.80	89.02
CL5(112)	98.58	105.30	109.78	104.48	106.99	106.07	108.38

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

CORE #5 (contd)

(concentrations in ug/kg dry wt.)

Batch	BATCH 4	BATCH 4	BATCH 4	BATCH 4	BATCH 4	BATCH 4
Sample No.	372-248	372-254	372-260	372-263	372-269	372-272
Segment Depth (cm)	116-118	128-130	140-142	146-148	158-160	164-166
Dry Weight (g)	19.035	19.816	18.217	19.804	22.702	11.59
TCMX	4.234	4.405	4.779	3.921	3.769	7.083
CL2(08)	ND	ND	ND	ND	ND	ND
HCB	0.207 B	0.175 B	ND	ND	ND	0.263 B
LINDANE	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND
CL4(66)	ND	ND	ND	ND	ND	ND
2,4-DDE	ND	ND	ND	ND	ND	ND
CL5(101)	ND	ND	1.732	0.855	ND	ND
CHLORDANE	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND
DIELDRIN	ND	0.265	ND	ND	ND	ND
4,4-DDE	0.884	0.670	1.282	0.869	0.548	ND
CL4(77)	ND	ND	ND	ND	ND	ND
2,4-DDD	0.744	0.530	0.733	0.610	0.358	ND
ENDRIN	ND	ND	ND	ND	ND	ND
CL5(118)	ND	ND	0.485	ND	ND	ND
4,4-DDD	ND	ND	0.587	ND	ND	ND
2,4-DDT	ND	ND	ND	ND	ND	ND
CL6(153)	ND	ND	0.905	ND	ND	ND
CL5(105)	ND	ND	0.274	ND	ND	ND
4,4-DDT	ND	ND	ND	ND	0.319	ND
CL6(138)	ND	ND	0.840	ND	ND	ND
CL5(126)	ND	ND	ND	ND	ND	ND
CL7(187)	ND	ND	0.111	ND	ND	ND
CL6(128)	ND	ND	ND	ND	ND	ND
CL7(180)	ND	ND	0.393	ND	ND	ND
MIREX	ND	ND	ND	ND	ND	ND
CL7(170)	ND	ND	0.133	ND	ND	ND
CL8(195)	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND
TOTAL PCB	ND	ND	4.87	0.85	ND	ND
TOTAL DDT (1)	1.63	1.20	2.60	1.48	1.22	ND
Surrogate Recovery (%)						
DBOFB	93.03	85.89	86.12	96.57	87.63	91.34
CL5(112)	115.00	115.64	108.31	113.30	123.84	95.39

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

PUGET SOUND HISTORICAL TRENDS
PCB/PESTICIDES IN SEDIMENT CORES

CORE #6

(concentrations in ug/kg dry wt.)

Batch	BATCH 2	BATCH 2	BATCH 2	BATCH 2	BATCH 2	BATCH 2	BATCH 2
Sample No.	372-96	372-100	372-102	372-104	372-108	372-110	372-114
Segment Depth (cm)	2-4	10-12	14-16	18-20	26-28	30-32	38-40
Dry Weight (g)	17.281	18.122	16.469	15.354	17.994	17.929	18.683
TCMX	10.612	5.408	6.062	6.166	6.899	5.119	5.049
CL2(08)	ND	ND	ND	10.183	ND	ND	ND
HCB	0.059 B	1.644 B	ND	2.626 B	4.631 B	4.801 B	0.104 B
LINDANE	ND	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	0.345	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	ND	0.843	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND
CL4(66)	ND	ND	ND	2.505	ND	ND	ND
2,4-DDE	ND	0.066	ND	ND	0.082	0.125	ND
CL5(101)	1.895	2.407	1.980	2.264	2.676	3.425	3.886
CHLORDANE	0.286	0.196	0.185	0.142	0.256	0.301	0.301
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	0.352	0.339	0.435	0.495	0.495	0.545	0.477
4,4-DDE	1.595	1.429	1.537	1.576	1.633	1.594	1.445
CL4(77)	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	0.594	0.670	0.710	0.947	1.047	0.978	1.012
ENDRIN	ND	ND	ND	ND	ND	ND	ND
CL5(118)	0.737	0.914	1.102	1.363	1.949	2.121	1.477
4,4-DDD	0.608	0.650	0.719	0.943	1.115	1.554	1.667
2,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(153)	1.771	1.807	2.112	2.526	2.992	3.662	2.727
CL5(105)	0.423	0.367	0.192	0.465	0.623	0.762	0.512
4,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(138)	1.567	1.360	1.705	1.823	2.221	2.962	1.975
CL5(126)	ND	ND	ND	ND	ND	ND	ND
CL7(187)	0.458	0.449	0.558	0.669	0.922	0.963	0.699
CL6(128)	ND	ND	ND	1.359	ND	ND	ND
CL7(180)	0.390	0.500	0.582	0.588	0.870	1.077	0.772
MIREX	ND	ND	ND	ND	ND	ND	ND
CL7(170)	0.151	0.121	0.134	0.216	0.298	0.490	0.217
CL8(195)	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	7.39	7.92	8.36	14.97	12.55	15.46	12.26
TOTAL DDT (1)	2.80	2.81	2.97	3.47	3.88	4.25	4.12
Surrogate Recovery (%)							
DBOFB	41.80	76.51	75.11	79.21	61.08	81.71	79.50
CL5(112)	55.61	110.69	91.56	94.38	77.64	96.27	115.56

ND Not detected.
Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

CORE #6 (contd)

(concentrations in ug/kg dry wt.)

Batch	BATCH 2	BATCH 3	BATCH 3	BATCH 3	BATCH 3	BATCH 3	BATCH 3
Sample No.	372-116	372-120	372-124	372-130	372-134	372-140	372-144
Segment Depth (cm)	42-44	50-52	58-60	70-72	78-80	90-92	98-100
Dry Weight (g)	17.500	16.628	18.549	19.830	19.518	18.500	20.259
TCMX	5.287	5.448	4.942	4.141	3.932	4.283	3.998
CL2(08)	ND	ND	ND	ND	ND	ND	ND
HCB	2.887 B	3.092 B	1.352 B	ND	0.826	0.818	0.574
LINDANE	ND	ND	ND	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND	ND	ND	ND
ALDRIN	ND	ND	ND	ND	ND	ND	ND
CL4(44)	ND	ND	ND	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND	ND	ND	ND
CL4(66)	ND	ND	ND	ND	ND	ND	ND
2,4-DDE	ND	ND	ND	ND	ND	ND	ND
CL5(101)	3.703	2.574	1.760	1.101	0.857	ND	ND
CHLORDANE	0.426	ND	ND	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND	ND	ND	ND
DIELDRIN	0.472	0.259	0.237	0.221	0.220	ND	ND
4,4-DDE	1.698	1.957	1.515	0.925	0.805	ND	ND
CL4(77)	ND	ND	ND	ND	ND	ND	ND
2,4-DDD	1.130	0.923	0.882	0.986	0.695	ND	ND
ENDRIN	ND	ND	ND	ND	ND	ND	ND
CL5(118)	1.532	0.779	0.536	ND	ND	ND	ND
4,4-DDD	1.882	1.151	1.029	0.567	ND	ND	ND
2,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(153)	3.198	1.718	1.388	0.096	ND	ND	ND
CL5(105)	0.522	0.356	0.253	ND	ND	ND	ND
4,4-DDT	ND	ND	ND	ND	ND	ND	ND
CL6(138)	2.239	1.377	0.961	0.165	ND	ND	ND
CL5(126)	ND	ND	ND	ND	ND	ND	ND
CL7(187)	0.786	0.335	0.188	0.027	ND	ND	ND
CL6(128)	ND	2.062	ND	ND	ND	ND	ND
CL7(180)	1.002	0.606	0.578	ND	ND	ND	ND
MIREX	ND	ND	ND	ND	ND	ND	ND
CL7(170)	0.265	0.210	0.119	ND	ND	ND	ND
CL8(195)	ND	ND	ND	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND	ND	ND	ND
TOTAL PCB	13.25	10.02	5.78	1.39	0.86	0.00	0.00
TOTAL DDT (1)	4.71	4.03	3.43	2.48	1.50	0.00	0.00
Surrogate Recovery (%)							
DBOFB	81.06	82.72	81.75	91.25	97.65	94.58	92.51
CL5(112)	98.39	115.66	101.85	118.81	119.84	121.62	105.89

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

CORE #6 (contd)
(concentrations in ug/kg dry wt.)

Batch	BATCH 3	BATCH 3	BATCH 3	BATCH 3
Sample No.	372-150	372-159	372-168	372-183
Segment Depth (cm)	110-112	128-130	146-148	176-178
Dry Weight (g)	19.043	19.135	19.883	120.438
TCMX	4.091	3.994	3.918	3.792
CL2(08)	ND	ND	ND	ND
HCB	0.483	0.307	0.222	0.437
LINDANE	ND	ND	ND	ND
CL3(18)	ND	ND	ND	ND
CL3(28)	ND	ND	ND	ND
HEPTACHLOR	ND	ND	ND	ND
CL4(52)	ND	ND	ND	ND
ALDRIN	ND	ND	ND	ND
CL4(44)	ND	ND	ND	ND
HEPTACHLOREPOXIDE	ND	ND	ND	ND
CL4(66)	ND	ND	ND	ND
2,4-DDE	ND	ND	ND	ND
CL5(101)	0.173	ND	ND	ND
CHLORDANE	ND	ND	ND	ND
TRANSNONACHLOR	ND	ND	ND	ND
CL5(112)	ND	ND	ND	ND
DIELDRIN	ND	ND	ND	ND
4,4-DDE	0.683	ND	ND	ND
CL4(77)	ND	ND	ND	ND
2,4-DDD	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND
CL5(118)	ND	ND	ND	ND
4,4-DDD	ND	ND	ND	ND
2,4-DDT	ND	ND	ND	ND
CL6(153)	ND	ND	ND	ND
CL5(105)	ND	ND	ND	ND
4,4-DDT	ND	ND	ND	ND
CL6(138)	ND	ND	ND	ND
CL5(126)	ND	ND	ND	ND
CL7(187)	ND	ND	ND	ND
CL6(128)	ND	ND	ND	ND
CL7(180)	ND	ND	ND	ND
MIREX	ND	ND	ND	ND
CL7(170)	ND	ND	ND	ND
CL8(195)	ND	ND	ND	ND
CL9(206)	ND	ND	ND	ND
CL10(209)	ND	ND	ND	ND
TOTAL PCB	0.17	0.00	0.00	0.00
TOTAL DDT (1)	0.68	0.00	0.00	0.00
Surrogate Recovery (%)				
DBOFB	96.19	98.06	96.19	96.70
CL5(112)	91.19	106.22	120.62	102.93

ND Not detected.
* Matrix interference.
B Blank Contamination.
(1) Total DDE, DDD & DDT.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Sample No.	Amount Spiked	372-10 (1)	372-10 + spike	Amount Recovered	% Recovery	Amount Spiked	372-104 (1)	372-10 + spike	Amount Recovered	% Recovery
CL2(08)	30	239.07	294.28 *	55.22	184% **	30	156.36	123.43 *	-32.93	-110% **
HCB	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LINDANE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL3(18)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL3(28)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
HEPTACHLOR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(52)	NS	NS	NS	NS	NS	30	5.30	35.40	30.10	100%
ALDRIN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(44)	NS	NS	NS	NS	NS	30	12.94	41.98	29.04	97%
HEPTACHLOREPOXIDE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(66)	30	13.96	85.08 *	71.11	237% **	30	38.47	59.36	20.89	70%
2,4-DDE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(101)	30	37.68	64.80	27.13	90%	30	34.76	65.00	30.24	101%
CHLORDANE	NS	NS	NS	NS	NS	30	2.18	31.15	28.97	98%
TRANSNONACHLOR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(112)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DIELDRIN	NS	NS	NS	NS	NS	30	7.60	24.55	16.95	57%
4,4-DDE	30	30.38	50.44	20.06	67%	30	24.30	47.95	23.64	79%
CL4(77)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,4-DDD	NS	NS	NS	NS	NS	30	14.54	36.37	21.84	74%
ENDRIN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(118)	30	27.88	51.95	24.07	80%	30	20.92	46.77	25.84	86%
4,4-DDD	NS	NS	NS	NS	NS	30	14.49	30.79	16.30	55%
2,4-DDT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL6(153)	30	53.09	66.75	13.66	46% **	30	38.78	58.03	19.25	64%
CL5(105)	30	9.51	29.31	19.79	66%	30	7.14	29.08	21.95	73%
4,4-DDT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL6(138)	30	40.42	57.77	17.36	58%	30	28.00	49.78	21.78	73%
CL5(126)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL7(187)	30	9.83	36.59	26.76	89%	30	10.27	31.66	21.39	71%
CL6(128)	30	38.12	53.23	15.11	50%	30	20.87	43.76	22.90	76%
CL7(180)	NS	NS	NS	NS	NS	30	9.03	31.22	22.19	74%
MIREX	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL7(170)	NS	NS	NS	NS	NS	30	3.32	25.25	21.93	73%
CL8(195)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL9(206)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL10(209)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS Not spiked.
(1) Sample concentration in ng/g multiplied by total mass analyzed.
* Matrix interference
** Outside QC criteria for recovery.

PUGET SOUND HISTORICAL TRENDS
MATRIX SPIKE SAMPLES
units: ug/kg dry wt.

Sample No.	Amount Spiked	372-199 (1)	372-199 + spike	Amount Recovered	% Recovery	Amount Spiked	372-199 (1)	372-199 + spike	Amount Recovered	% Recovery
CL2(08)	30	120.45	154.00 *	33.55	112%	30	120.45	138.16	17.71	59%
HCB	30	68.88	63.63 *	-5.25	-18% **	30	68.88	37.69 *	-31.19	-106% **
LINDANE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL3(18)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL3(28)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
HEPTACHLOR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(52)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
ALDRIN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(44)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
HEPTACHLOREPOXIDE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL4(66)	30	52.28	82.70	30.42	101%	30	52.28	83.62	31.34	104%
2,4-DDE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(101)	30	26.01	57.12	31.11	104%	30	26.01	47.86	21.85	73%
CHLORDANE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TRANSNONACHLOR	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(112)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DIELDRIN	30	3.25	19.56	16.31	55%	30	3.25	23.64	20.40	69%
4,4-DDE	30	26.62	43.27	16.64	55%	30	26.62	44.56	17.94	60%
CL4(77)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2,4-DDD	30	13.40	37.65	24.25	82%	30	13.40	28.81	15.41	52%
ENDRIN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL5(118)	30	18.89	38.56	19.67	66%	30	18.89	38.13	19.23	64%
4,4-DDD	30	14.64	28.66	14.02	47% **	30	14.64	25.76	11.12	38% **
2,4-DDT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL6(153)	30	39.60	53.37	13.77	46% **	30	39.60	52.99	13.39	45% **
CL5(105)	30	7.48	26.63	19.16	64%	30	7.48	26.97	19.50	65%
4,4-DDT	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL6(138)	30	33.09	45.05	11.96	40% **	30	33.09	40.74	7.65	26% **
CL5(126)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL7(187)	30	12.99	30.49	17.50	58%	30	12.99	29.92	16.93	56%
CL6(128)	30	25.38	41.55	16.16	54%	30	25.38	40.11	14.72	49% **
CL7(180)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MIREX	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL7(170)	30	4.90	24.32	19.42	65%	30	4.90	23.36	18.46	62%
CL8(195)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL9(206)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CL10(209)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS Not spiked.
(1) Sample concentration in ng/g multiplied by total mass analyzed.
* Matrix interference
** Outside QC criteria for recovery.

PUGET SOUND HISTORICAL TRENDS
PROCEDURAL BLANKS
units: ug/kg dry wt.

Batch Sample No.	BATCH 1 P. Blank-1	BATCH 2 P. Blank-2	BATCH 3 P. Blank-3	BATCH 4 P. Blank-4
Hexachlorobenzene	NA	1.36	NA	13.21
Surrogate Recovery (%)				
DBOFB	69.69	72.06	73.83	67.89
CL5(112)	80.48	85.65	91.54	84.39

NA Not applicable/analyzed.

PUGET SOUND HISTORICAL TRENDS
STANDARD REFERENCE MATERIAL
units: ug/kg dry wt.

Batch Sample No.	BATCH 1 SRM 1941-1	BATCH 2 SRM 1941-2	BATCH 3 SRM 1941-3	BATCH 4 SRM 1941-4	% RSD	Certified Value	Range
CL2(08)	NA	NA	NA	NA	NA	NC	NC
HCB	24.99	27.92	25.53	30.32	9%	NC	NC
LINDANE	NA	NA	NA	NA	NA	NC	NC
CL3(18)	4.31	5.41	5.15	7.21	22%	NC	NC
CL3(28)	10.44	8.64	9.92	10.88	10%	NC	NC
HEPTACHLOR	NA	NA	NA	NA	NA	NC	NC
CL4(52)	14.84	14.44	14.15	17.18	9%	NC	NC
ALDRIN	NA	NA	NA	NA	NA	NC	NC
CL4(44)	13.96	9.63	13.52	12.13	16%	NC	NC
HEPTACHLOREPOXIDE	0.97	1.80	1.39	2.30	35%	0.23	±0.02
CL4(66)	12.60	13.59	15.59	19.42	20%	NC	NC
2,4-DDE	NA	NA	NA	NA	NA	NC	NC
CL5(101)	25.68	28.21	23.55	30.34	11%	NC	NC
CHLORDANE	1.43	2.37	1.18	2.75	39%	2.06	±0.05
TRANSNONACHLOR	0.00	0.43	0.00	0.39	115%	0.97	±0.03
CL5(112)	4.38	5.43	3.72	3.74	19%	NC	NC
DIELDRIN	10.44	9.29	8.15	9.73	10%	0.63	±0.03
4,4-DDE	NA	NA	NA	NA	NA	9.71	±0.17
CL4(77)	NA	6.57	5.29	4.89	16%	NC	NC
2,4-DDD	NA	NA	NA	NA	NA	NC	NC
ENDRIN	16.22	13.82	14.00	15.55	8%	NC	NC
CL5(118)	6.95	7.30	5.96	6.49	9%	NC	NC
4,4-DDD	NA	NA	NA	NA	NA	10.3	±0.1
2,4-DDT	29.97	28.06	26.77	28.90	5%	NC	NC
CL6(153)	4.56	3.88	4.61	5.33	13%	NC	NC
CL5(105)	NA	NA	NA	NA	NA	NC	NC
4,4-DDT	18.64	16.36	17.48	17.06	6%	1.11	±0.05
CL6(138)	NA	NA	NA	NA	NA	NC	NC
CL5(126)	14.97	13.96	13.56	14.37	4%	NC	NC
CL7(187)	6.60	6.26	5.29	5.35	11%	NC	NC
CL6(128)	16.51	15.85	16.13	16.63	2%	NC	NC
CL7(180)	NA	NA	NA	NA	NA	NC	NC
MIREX	2.12	2.57	2.40	1.13	31%	NC	NC
CL7(170)	2.45	3.35	2.61	3.18	15%	NC	NC
CL8(195)	3.99	4.43	3.83	3.94	6%	NC	NC
CL9(206)	7.50	8.19	8.65	7.19	8%	NC	NC
CL10(209)	NA	NA	NA	NA	NA	NC	NC
Surrogate Recovery (%)							
DBOFB	83.30	73.57	86.89	63.24	14%	NA	NA
CL5(112)	81.26	80.69	89.79	75.17	7%	NA	NA

NA Not applicable/analyzed.
NC Not certified.

APPENDIX K

LINEAR ALKYL BENZENES AND BIOMARKERS IN SEDIMENT CORES

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #3

(concentrations in ug/kg dry wt.)

Sample No.	372-2	372-6	372-8	372-10	372-16	372-20	372-22
Depth (cm)	2	10	14	18	30	38	42
Total Terpanes	1570	1410	1650	1640	1750	1830	1870
HOPANE (C30 a,b)	157.84	152.59	164.11	176.2	198.37	196.89	212.04
LAB:							
PHENYL DECANES	ND	15.75	11.37	ND	ND	ND	ND
PHENYL UNDECANES	32.99	41.58	47.12	28.18	ND	ND	ND
PHENYL DODECANES	28.58	29.17	28.38	24.28	19.61	17.08	14.16
PHENYL TRIDECANES	19.15	9.41	13.81	13.03	10.46	7.44	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	80.72	95.91	100.68	65.49	30.07	24.52	14.16
Surrogate Recoveries (%):							
acenaphthene-d10	70.01	63.62	68.49	64.55	63.16	65.57	66.95
phenanthrene-d10	71.14	69.99	69.23	66.75	66.64	65.74	69.45
1-phenyl nonane	72.77	68.83	69.09	66.35	67.51	68.54	70.47
benzo[a]pyrene-d12	69.34	73.41	72.25	66.28	68.59	65.84	63.83
c30b,b-hopane	97.71	100.67	101.23	95.06	106.63	99.31	101.44

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #3 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-26	372-30	372-36	372-40	372-46	372-50	372-56
Depth (cm)	50	58	70	78	90	98	110
Total Terpanes	1830	1910	2090	2110	2260	2090	1800
HOPANE (C30 a,b)	217.29	212.51	235.03	224.21	231.13	234.21	177.85
LAB:							
PHENYL DECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	11.56	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	9.5	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	21.06	0	0	0	0	0	0
Surrogate Recoveries (%):							
acenaphthene-d10	65.45	62.88	64.69	66.71	71.23	70.73	66.87
phenanthrene-d10	67.44	63.72	68.87	69.91	72.33	69.91	70.10
1-phenyl nonane	66.33	64.15	67.47	70.47	75.12	71.86	69.91
benzo[a]pyrene-d12	69.09	64.80	67.79	70.29	74.47	70.03	68.22
c30b,b-hopane	107.26	102.05	117.33	113.89	110.19	114.96	107.76

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #3 (contd)
(concentrations in ug/kg dry wt.)

Sample No.	372-59	372-65	372-71	372-74	372-80	372-85	372-90
Depth (cm)	116	128	140	146	158	168	178
Total Terpanes	1820	1830	1460	1290	870	830	830
HOPANE (C30 a,b)	174.4	172.04	119.85	84.5	32.74	23.37	25.07
LAB:							
PHENYL DECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	0	0	0	0	0	0
Surrogate Recoveries (%):							
acenaphthene-d10	67.21	69.55	66.14	62.50	69.36	63.22	67.50
phenanthrene-d10	67.63	71.16	70.32	63.99	70.48	66.63	71.00
1-phenyl nonane	67.95	68.26	63.28	60.03	68.01	61.94	66.51
benzo[a]pyrene-d12	48.24	72.08	71.65	63.68	66.51	65.35	65.60
c30b,b-hopane	98.49	96.65	94.09	81.78	89.89	88.23	83.91

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

	CORE #3 (contd)	CORE #5				
	(concentrations in ug/kg dry wt.)					
Sample No.	372-94	372-191	372-195	372-197	372-199	372-205
Depth (cm)	186	2	10	14	18	30
Total Terpanes	720	2360	1750	1530	1710	1890
HOPANE (C30 a,b)	17.95	224.23	177.81	170.02	179.79	191.42
LAB:						
PHENYL DECANES	ND	ND	17.26	14.24	15.82	15.09
PHENYL UNDECANES	ND	ND	40.97	40.5	32.26	25.92
PHENYL DODECANES	ND	29.29	51.27	54.03	55.97	41.11
PHENYL TRIDECANES	ND	ND	33.79	20.83	29.04	23.69
PHENYL TETRADECANES	ND	ND	40.4	ND	47.42	ND
TOTAL LAB	0	29.29	183.69	129.6	180.51	105.81
Surrogate Recoveries (%):						
acenaphthene-d10	62.12	70.49	74.78	67.21	73.87	73.78
phenanthrene-d10	63.33	74.11	76.65	71.87	77.54	77.06
1-phenyl nonane	60.23	69.73	72.24	68.47	73.68	71.25
benzo[a]pyrene-d12	59.46	67.03	71.65	60.61	73.73	61.70
c30b,b-hopane	76.25	93.76	103.23	94.35	113.39	110.75

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #5 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-209	372-215	372-217	372-219	372-225	372-229	372-235
Depth (cm)	38	50	54	58	70	78	90
Total Terpanes	1930	2250	1880	1930	1840	1980	1820
HOPANE (C30 a,b)	220.94	224.86	212.33	226.76	222.27	226.27	205.35
LAB:							
PHENYL DECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	0	0	0	0	0	0
Surrogate Recoveries (%):							
acenaphthene-d10	61.57	56.89	50.21	54.73	56.09	51.01	55.83
phenanthrene-d10	67.27	63.66	57.34	60.84	62.76	59.50	59.84
1-phenyl nonane	64.04	61.26	53.11	55.09	57.98	53.28	55.49
benzo[a]pyrene-d12	65.10	63.13	56.74	59.90	62.26	57.67	61.31
c30b,b-hopane	108.31	107.26	94.03	95.72	107.48	100.77	101.45

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #5 (contd)
(concentrations in ug/kg dry wt.)

Sample No.	372-239	372-245	372-248	372-254	372-260	372-263	372-269
Depth (cm)	98	110	116	128	140	146	158
Total Terpanes	1950	2110	2000	2000	2280	2090	1570
HOPANE (C30 a,b)	213.04	218.73	196.44	167.7	196.61	169.23	86.68
LAB:							
PHENYL DECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	0	0	0	0	0	0
Surrogate Recoveries (%):							
acenaphthene-d10	54.06	52.08	58.58	51.43	50.30	56.05	52.74
phenanthrene-d10	61.13	57.71	66.45	61.25	60.95	63.09	59.79
1-phenyl nonane	56.45	54.38	61.81	58.40	55.73	60.54	61.21
benzo[a]pyrene-d12	60.16	56.38	62.11	61.97	55.64	61.83	60.03
c30b,b-hopane	100.15	95.11	104.89	99.24	90.56	96.68	94.17

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

	CORE #5 (contd)	CORE #6				
	(concentrations in ug/kg dry wt.)					
Sample No.	372-272	372-96	372-100	372-102	372-104	372-108
Depth (cm)	164	2	10	14	18	26
Total Terpanes	1870	1860	1930	2090	1890	1900
HOPANE (C30 a,b)	76.84	183.32	181.92	198.15	184.14	202.52
LAB:						
PHENYL DECANES	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	26.42	ND	25.74	ND	ND
PHENYL DODECANES	ND	37.46	25.75	43.63	32.54	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	63.88	25.75	69.37	32.54	0
Surrogate Recoveries (%):						
acenaphthene-d10	53.56	67.48	71.06	66.62	70.05	56.91
phenanthrene-d10	59.37	73.66	74.96	67.92	72.10	60.39
1-phenyl nonane	55.29	70.08	70.59	65.74	68.02	57.42
benzo[a]pyrene-d12	58.62	68.46	67.26	59.87	61.86	50.40
c30b,b-hopane	76.88	106.81	109.25	96.87	94.15	77.73

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #6 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-110	372-114	372-116	372-120	372-124	372-130	372-134
Depth (cm)	30	38	42	50	58	70	78
Total Terpanes	2040	2000	2040	2150	1970	2290	2160
HOPANE (C30 a,b)	197.84	195.9	200.62	198.14	182.82	177.7	132.53
LAB:							
PHENYL DECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	0	0	0	0	0	0
Surrogate Recoveries (%):							
acenaphthene-d10	70.66	66.64	69.22	75.22	73.74	74.82	72.24
phenanthrene-d10	75.25	71.46	72.63	78.63	76.09	74.77	76.94
1-phenyl nonane	72.77	68.98	71.28	76.74	73.21	78.18	78.30
benzo[a]pyrene-d12	65.88	63.77	60.90	67.95	70.34	72.82	72.63
c30b,b-hopane	107.78	108.18	107.37	109.02	108.75	109.00	104.05

PUGET SOUND HISTORICAL TRENDS
LINEAR ALKYL BENZENES AND
BIOMARKERS IN SEDIMENT CORES

CORE #6 (contd)

(concentrations in ug/kg dry wt.)

Sample No.	372-140	372-144	372-150	372-159	372-168	372-183
Depth (cm)	90	98	110	128	146	176
Total Terpanes	1410	540	790	460	390	440
HOPANE (C30 a,b)	65.57	14.74	43.37	8.53	11.19	8.08
LAB:						
PHENYL DECANES	ND	ND	ND	ND	ND	ND
PHENYL UNDECANES	ND	ND	ND	ND	ND	ND
PHENYL DODECANES	ND	ND	ND	ND	ND	ND
PHENYL TRIDECANES	ND	ND	ND	ND	ND	ND
PHENYL TETRADECANES	ND	ND	ND	ND	ND	ND
TOTAL LAB	0	0	0	0	0	0
Surrogate Recoveries (%):						
acenaphthene-d10	71.13	74.21	71.16	72.58	72.39	70.81
phenanthrene-d10	75.96	75.11	73.18	75.82	75.29	75.61
1-phenyl nonane	75.17	69.97	69.33	72.05	68.00	69.66
benzo[a]pyrene-d12	72.00	67.16	59.73	64.90	63.92	63.18
c30b,b-hopane	95.55	83.81	83.93	85.88	81.79	82.98