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Segment No. 03-06-07

MEMORANDUM

September 10, 1986

To: John Glynn

From: Don Reif

Subject: Coupeville Wastewater Treatment Plant Class II Inspection, August 19-20, 1985

ABSTRACT

A Class II inspection and abbreviated receiving water survey were conducted at the town of Coupeville's wastewater treatment plant on August 19 and 20, 1985. The oxidation ditch activated sludge plant discharges an average of 80,000 gallons per day into Penn Cove. Treatment efficiency was found to be very good, with effluent quality far exceeding permit requirements. Laboratory procedures also were very good--two minor recommendations were made. Copper concentrations were high in the secondary sludge and may be the limiting factor in a land-disposal application. Penn Cove water quality near the plant outfall appeared to be improved and exceeded bacterial water quality standards

INTRODUCTION

Coupeville is a community located on the south shore of Penn Cove on Whidbey Island. The Coupeville wastewater treatment plant (WTP) consists of an oxidation ditch for secondary treatment, followed by secondary clarification and discharge of chlorinated effluent to Penn Cove. Sludge is aerobically digested prior to land disposal. The treatment plant is designed for an average flow of 0.25 MGD, and peak flows of 1 MGD. The current average flow is 80,000 gpd.

On August 19 and 20, 1985, a Class II inspection was conducted at the plant site by John Bernhardt, Washington Department of Ecology, Water Quality Investigations Section. The objectives were:

1. Evaluate treatment plant efficiency.
2. Review sampling and laboratory procedures.
3. Perform an abbreviated receiving water survey.
4. Analyze sludge for land-disposal suitability.

In conjunction with this survey comprehensive investigation of subtidal Eagle Harbor sediments was conducted at approximately the same time. This companion investigation was funded by Ecology's Hazardous Waste Cleanup Program and the Puget Sound Estuary Program. It focused on chemical and biological characterization of subtidal Eagle Harbor sediments and was conducted by Tetra Tech, Inc., Bellevue, Washington (in preparation).

Sample storage, extraction, and analytical problems at the Municipality of Metropolitan Seattle (METRO) laboratory resulted in the loss of many of the data for organic compounds in the ground-water and seepage samples. Implications of the remaining data and on-site observations are discussed, as are the relationships between PNA concentrations in seepage and contamination in clam tissues reported by previous investigators.

METHODS

STUDY AREA: SAMPLING SITES

The study area and sampling locations are shown in Figure 1. Station descriptions are summarized in Table 1.

Table 1. Sample location.

Sample/ Station Number	Station Name/Media	Latitude/longitude
WA-1	Old test well/groundwater	47°36'59"/122°29'57"
IW-1 IS-1	North of Milwaukee dock - intertidal seep/water /sediment	47°36'59"/122°29'56"
IW-2 IS-2	West shore - intertidal seep/water /sediment	47°37'03"/122°29'57"
IW-3 IS-3	East of shipping dock - intertidal seep/water /sediment	47°37'05"/122°30'01"
IW-4 IS-4	Southwest of shipping dock - intertidal seep/water /sediment	47°37'02"/122°30'2.5"

Samples of ground water were obtained from an old test well (WA-1) with a 12-inch (inside diameter) steel casing and 28.51 feet total depth (top of casing to bottom of water column). This well was apparently drilled by Harbinger, Inc. in July of 1972 (Allworth, 1972a). Tulley (personal communication) indicated that this well was drilled with a 36-inch rotary bucket. Because of the drilling method, a detailed well log is not available. Allworth (1972) states "During the drilling of this well, a large quantity of creosote was encountered in narrow strata, particularly at 24-27 feet where coarse sand, gravel, and cobbles were evident and permeability to liquid appeared high." More detailed information from soil borings taken on the same area during the 1972 investigations is available on request.

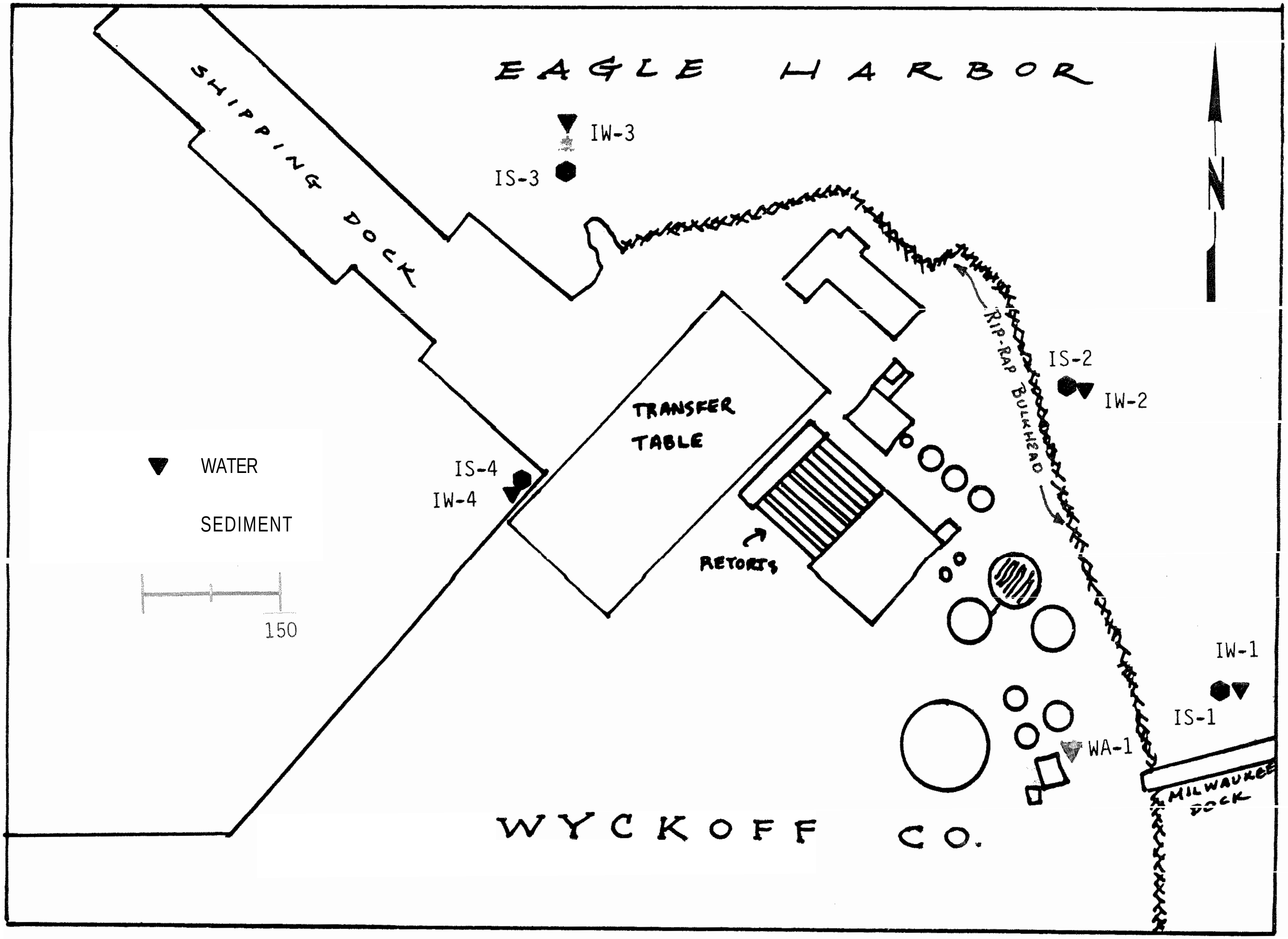


Figure 1. Study area.

Intertidal seepage (IN-1 to IN-4) and sediment samples (IS-1 to IS-4) were taken at four locations adjacent to the Wyckoff site, numbered sequentially from the southeast (near the Milwaukee dock) to the north and west (west of the shipping dock).

Site Visits; Sampling Events

The Nyckoff site was visited three times during the course of this investigation. An initial reconnaissance survey was conducted on May 23, 1985. Ecology was represented by Dave Bradley and Don Leske (HWCP) and Dale Norton and Bill Yake (WQIS). We were accompanied by Chuck Stoddard (Wyckoff Company). Layout and operations at the facility were reviewed and potential sampling sites were evaluated. Water samples were obtained from the old test well (WA-1) and the most visually contaminated seep (IN-I). These samples were analyzed for conventional parameters including oil and grease, phenolics, and specific conductivity. (As discussed later under Sampling Methods, it is important to note that the ground-water sample obtained during this inspection included a sustantial amount of floating product. The subsequent sample obtained on June 19 was obtained from below the water/product interface.)

The main sampling effort was conducted on June 19, 1985, by Dale Norton and Bill Yake (WQIS). Water and sediment samples were collected for analyses of selected conventional constituents, trace metals, and organic chemicals.

A final visit occurred on October 19, 1985, during which Dale Norton re-sampled IW-1. This re-analysis was required because a memorandum from Dave Mitchell (METRO laboratory) transmitting preliminary data noted that with regard to this sample, the laboratory "obtained extremely low surrogate recovery and therefore the uncertainty associated with these values is large" ((Mitchell, 1985).

All sampling efforts were centered around low tides. Times and heights of low tides on sampling days are summarized in Table 2.

Table 2. Lower low water tide heights on sampling days.[1]

May 23, 1985		June 19, 1985		October 9, 1985	
Time	Height	Time	Height	Time	Height
1357	-1.6	1218	-2.2	0723	1.0

[1] U.S. Dept. of Commerce (NOAA), 1984.

Sampling Methods

Ground Water: On May 23, a ground-water sample was obtained from the 12-inch diameter "old test well" using a teflon bailer.

The well was not purged prior to sampling on this or subsequent occasions for two reasons. First, there was no acceptable way to dispose of the large volume of contaminated water which would be generated by pumping. Second, Allworth (1972b) noted that, "The well produces a higher-than-expected volume of creosote-water mixture, with a lower-than-expected creosote content." This implies the possibility of a high-yield, relatively clean, ground-water aquifer (perhaps near the bottom of the well) which would dilute the contamination if the well were purged.

The ground-water sample obtained on June 19 was collected using a peristaltic pump (Geoteck 0700), with a 5-inch section of 3116-inch (OD) silicone tubing contacting the pump head, and 3116-inch (ID) teflon (FEP) tubing on both the suction and delivery sides of the silicone tubing. Prior to sampling, a pump blank was obtained by passing organic-free water (obtained from the METRO laboratory) through the peristaltic pump system. The first 10 to 20 milliliters passing through the system were discarded.

The ground-water sample was taken as follows:

1. To prevent product from entering the tubing, the pump was run in reverse as the teflon tubing was passed through the product floating on the ground water.

2. The pump was returned to the suction mode and the sample taken about one foot below the floating product. Several hundred milliliters of water were passed through the system prior to collecting the sample.

The teflon bailer and all pump tubing was washed with Liqui-Nox detergent, de-ionized water, 10 percent hydrochloric acid, nanograde methylene chloride, and nanograde acetone prior to sampling. Bailer ends and tubing ends were covered with aluminum foil cleaned in the same manner, This foil remained in place until immediately prior to sampling.

Intertidal Seeps (water): Intertidal seepage was collected using two-inch diameter stainless steel tubes six inches long. A small depression was made in the beach and the tube set at a slight incline in the "dam" at the downstream side of the depression. Sufficient time (5 to 10 minutes) was allowed for settling of suspended particles in seepage pooling in the depression. Sample bottles were filled by the discharge from the tube. The tube was placed so that the intake was not submerged in the pool, and floating product was obtained in the sample at those locations (IW-1, IW-2) where it was present in the seepage.

Tubes were cleaned and stored as previously noted for the ground-water sampling equipment.

Intertidal Sediment: Intertidal sediment was collected using a three-inch diameter stainless steel corer. The corer was inserted 2 cm into the sediment and a stainless steel plate inserted under the corer. The sediment was then removed and placed in a large stainless steel beaker. Fifteen cores were obtained at each site and composited. Sediment samples were homogenized in the beakers using large stainless steel spoons. Each composited sample was collected with a dedicated corer, beaker, and spoon.

Corers, beakers, and spoons were cleaned and stored as noted above for water and ground-water sampling equipment.

Analytical Methods

Samples collected during this survey were analyzed for the parameters shown in Table 3.

Table 3. Samples submitted for analyses.

Parameters	Ground Water 5/23	Ground Water 6/19	Intertidal Seeps (water) 5/23	Intertidal Seeps (water) 6/19	Intertidal Seeps (water) 10/9	Intertidal Seeps (sediment) 6/19
Conventionals						
specific conductivity	X	X	X	X	X	
pH	X	X	X	X	X	
turbidity	X		X			
color	X		X			
oil & grease	X	X	X	X	X	
recoverable phenolics	X	X	X	X		
nutrients	X	X	X	X	X	
suspended solids		X		X	X	
total organic carbon		X		X		X
percent solids						X
grain size						X
Trace Metals		X̲		X̲	X̲	X
Organics						
volatile organics		X̲		X̲		X
acid extractables		(X)		(X)	X̲	X
base neutral extractables		(X)		(X)	X̲	X
pesticides/PCBs		(X)		(X)	X	X

X = Sample collected and analyzed.
(X) = Sample collected; analytical data unusable due to laboratory problems.
X̲ = Sample collected; analytical data provided as estimates or with caveats due to laboratory problems.

These analyses were conducted at four laboratories summarized in Table 4.

Table 4. Laboratories performing analyses.

Analysis	Laboratory;Location
Conductivity, pH, tubidity, color, oil & grease, recoverable phenolics, nutrients, suspended solids	Ecology/EPA; Manchester, WA.
Metals, percent solids	Ecology/EPA; Manchester, WA.
Total organic carbon	Laucks Testing Labs.; Seattle, WA.
Grain size	Parametrix, Inc.; Bellevue, WA.
Priority pollutant organics	METRO; Seattle, WA.

Conventional Analyses: Methods used for the analysis of conventional and ancillary parameters are summarized as follows:

- Specific conductivity was determined with a Beckman model #RC20 conductivity bridge,
- pH was measured with a Corning pH/ion analyzer model #155.
- Turbidity was determined using a Hach 2100A turbidometer.
- Color was measured using a Beckman DU-2 spectrophotometer.
- Oil/grease concentrations were determined using Method 503A: Partition-gravimetric in Standard Methods for the Examination of Water and Wastewater (APHA, 1985).
- Recoverable phenolics analyses followed Method 510C - Direct photometric (APHA, 1985).
- Nutrients: Ammonia - Method 350.1 - Colorometric, automated phenate in Methods for Chemical Analysis of Water and Wastes (EPA, 1979).

  Nitrate, nitrite - Method 353.2 - Colorometric, automated, cadmium reduction (EPA, 1979).

Orthophosphate - Method 365.1 - Colorornetric, automated, ascorbic acid (EPA, 1979).

Total phosphate - Digestion following Method 424C - Preliminarv digestion steps for total phosphorus (APHA, 1985), followed by EPA Method 365.1, as above.

- Suspended solids and percent solids followed Method 160.2 - Gravimetric, dried at 103 - 105°C and Method 160.3 - Gravimetric, dried at 103 - 105°C (EPA, 1979), respectively.
- Total organic carbon was analyzed by Laucks Testing Laboratories by CO_2 generation on combustion (Laucks, 1985).
- Grain size was analyzed by Parametrix, Inc. using the methods of sieves and pipettes described by Buchanin and Kain (1971).

Metals Analyses: Sediment and water samples were analyzed for seven metals. Sediments were digested with redistilled nitric acid and hydrogen peroxide in accordance with Contract Laboratory Procedures (EPA, 1983). Because of contamination problems experienced in the digestion of the water samples, the water samples were analyzed by direct aspiration.

Digested sediment and undigested water samples were analyzed by atomic absorption spectrophotometry using the following EPA (1979) methods:

Table 5. Analytical methods for metals analysis (EPA, 1979).

Metal	Method	
	Water	Sediment
Arsenic	206.2	206.2
Cadmium	213.2	213.2
Chromium	218.1	218.1
Copper	220.2	220.1
Iron	236.1	
Nickel	249.1	249.1
Lead	239.2	239.2
Zinc	289.1	289.1

Organics Analysis: All organic priority pollutant analyses were conducted at the METRO laboratory. After WQIS received the initial (Round 1) results, questions were raised about the accuracy of the results. Because a set of subtidal Eagle Harbor sediment samples collected by Tetra Tech as part of a HWCS study were being analyzed by METRO at the same time, arrangements were made to have Tetra Tech conduct a review of the analytical methods used. Results of this review, including recommendations for data use and caveats, are located in the appendix of this report. Based on this review, three of the four intertidal sediments were re-analyzed (Round 2). In addition, METRO personnel noted a problem with the analysis of one of the water samples (IN-1) prior to the Tetra Tech review and recommended re-sampling. This site was re-sampled on October 9, 1985. Review of analytical techniques used on the first round of water analyses resulted in the rejection of most of these data. By the time this determination was made, holding times on the water samples had been substantially exceeded and re-analysis was not possible. Additional analytical problems resulted in the partial compromising of many of the data. Thus many of the data are reported with qualifiers. Users should keep these caveats in mind.

All volatile organics analyses (VOA) were run using gas chromatography/mass spectrophotometry (GC/MS) with isotope dilution. This method is described in METRO's methods manual (METRO, 1985). These analyses were acceptable during Round 1. VOA data were calculated and reported in the manner specified by EPA's Contract Laboratory Program. These data were somewhat compromised by the fact that sample bottles provided by the METRO laboratory were not septum-sealed. Data are therefore reported as estimates and may, most likely, be slight underestimates of actual concentrations.

The METRO extraction procedure used for the acid/base/neutral (A/B/N) fractions is shown in Figure 2. This extraction is followed by gel permeation chromatography (GPC), and finally normal-phase chromatography (NPC) (METRO, 1985). As noted in the Tetra Tech QA/QC review (see appendix) "Serious problems were encountered during extraction and cleanup [of June water samples] and all [these acid/base/neutral and pesticides] . . . data are rejected."

Extractions from each sample were analyzed for A/B/N compounds using GC/MS with isotope dilution; and for pesticides/PCBs using gas chromatograpy/electron capture detection (GC/ECD) (METRO, 1985).

Caveats related to the A/B/N and pesticide/PCB data include the following: the IW-1 seep sample was allowed to stand at room temperature for 14 days prior to extraction (these results are therefore reported as estimates and are probably somewhat low); actual detection limits for individual pesticides and PCBs are unknown.

Method I: A/N and base with back extraction,

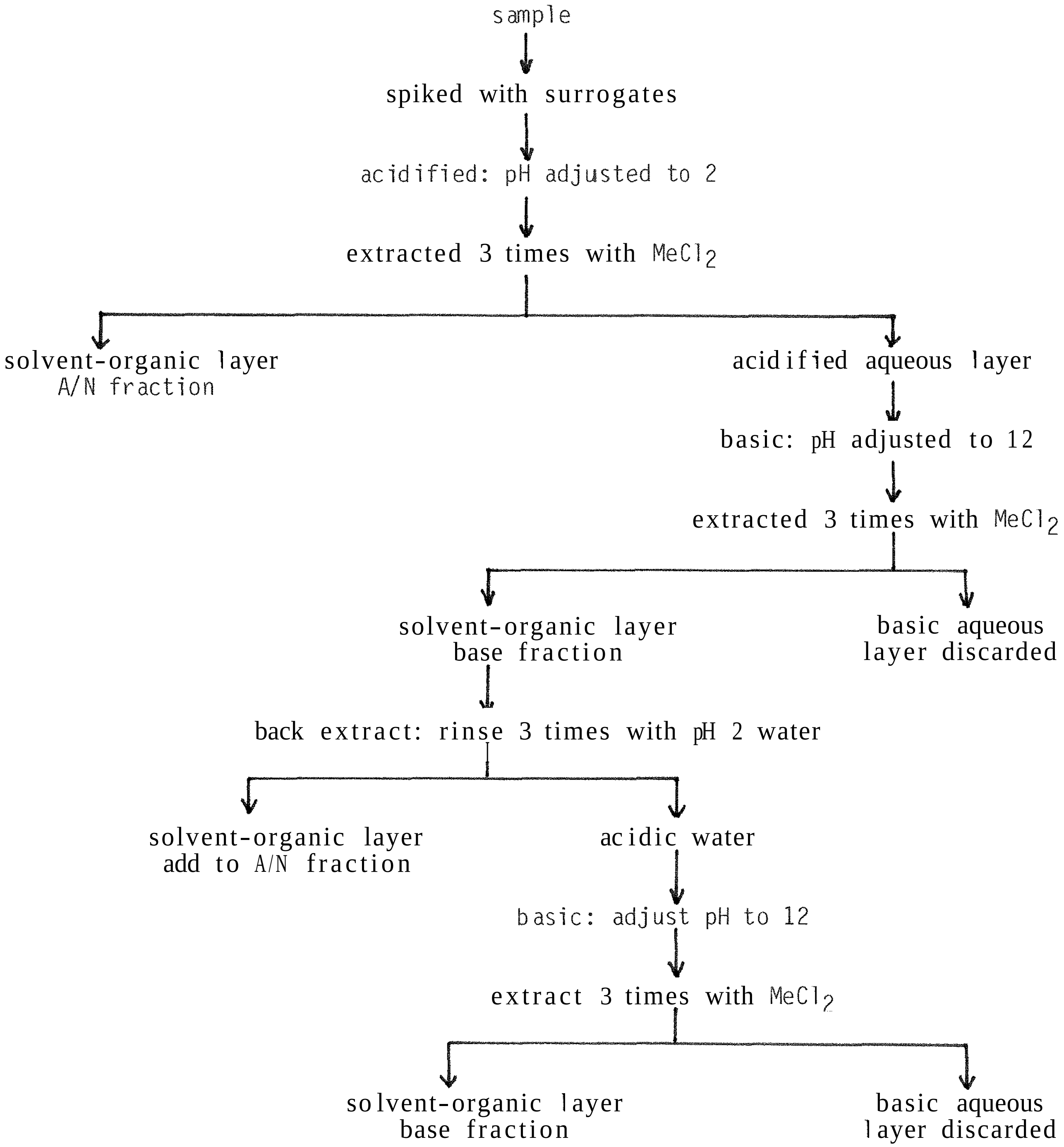


Figure 2. METRO extraction. Source: Dave Mitchell, METRO laboratory.

RESULTS AND DISCUSSION

Ground Water and Seep

The results of conventional pollutant and metals analyses on water samples are shown in Table 6. Results of organic priority pollutant analyses are summarized in Table 7.

Conventionals: Ground-water samples taken with a bailer (5/23/85) from the old test well (WA-1) showed a dark oily layer floating on slightly discolored ground water. The ground-water sample which contained this layer of product had a much higher oil and grease concentration (4,900 mg/L) than the subsequent sample obtained on 6/19/85 by peristaltic pump from the ground water below this product (3 mg/L).

The water seeping from the intertidal zone north of the Milwaukee dock (IN-1) was visually very similar to the contaminated ground water. This seep water had dark oily material in it which formed a surface sheen. Based on both water quality data and visual observations, it is apparent that contaminated ground water below the Wyckoff site is moving eastward offsite and entering Puget Sound intertidally along the east-facing shore.

Based on the limited data available, ground water is substantially diluted by marine water between the old test well site and the seeps. This is probably the result of saltwater penetration at higher tide stages. Conductivity in the seep water (24,000 to 44,000 umhos/cm) was much higher than that in the ground water (3,000 to 5,000 umhos/cm). The samples collected on June 19, 1985, showed concentrations of some contaminants (recoverable phenolics, oil and grease, and TOC) lower in the ground water than the seep. This is almost certainly an artifact of sampling (e.g., not including the highly contaminated surface fraction in the ground-water sample). Note that the three oil and grease samples collected from the IW-1 seep (120, 160, and 360 mg/L) are intermediate between the whole ground-water sample collected on May 23 (4,900 mg/L) and the ground water collected from below the surface on June 19 (3 mg/L).

Metals: Metals data (particularly from the June 19 sampling) are somewhat ambiguous and should be used with caution. The atomic absorption spectrophotometer at Manchester was experiencing some background correction problems during this time period (Twiss, personal communication) The disparate results from the two IW-1 seep samples are not readily explainable. Until both ground-water and seeps can be re-sampled and analyzed, it is probably unwise to draw any conclusions about potential metals problems at the site.

Organics: Organics results are summarized in Table 7. Complete data (including detection limits) is included in the appendix.

Table 6. Conventional and metals results, ground water and seep analyses - Wyckoff, 1985.

Sample Location	WA-1		IW-1			IW-2	IW-3	IW-4
Date	5/23	6/19	5/23	6/19	10/9	6/19	6/19	6/19
Time	1305	1030	1400	1200	0730	1300	1430	1345
Conventionals								
Specific Conduct. (umhos/cm)	3,270	4,580	24,400	36,900	42,200	44,200	42,200	41,100
pH (S.U.)	7.9	7.6	7.7	7.0	8.0	7.2	7.1	6.8
Turbidity (NTU)	160		98					
Color (S.U.)	57		36					
Oil & Grease (mg/L)	4,900	3	360	120	160	8	<1	<1
Recoverable Phenolics (mg/L)	0.484	0.10	0.297	0.24		0.19	0.14	0.045
NH_3-N (mg/L)	0.12	0.05	0.95	1.02	0.88	0.76	0.34	0.28
NO_2-N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NO_3-N (mg/L)	0.03	0.01	0.01	0.01	0.06	<0.01	<0.01	<0.01
O-PO_4-P (mg/L)	0.11	0.21	0.76	0.13	0.93	0.14	0.13	0.14
T-PO_4-P (mg/L)	0.17	0.23	0.92	0.30	0.96	0.20	0.27	0.17
TSS (mg/L)		21		99	50	150	59	68
TOC (mg/L)		27		[illegible]		21	[illegible]	6.2
Metals								
Arsenic (ug/L)		*		*		*	*	*
Cadmium (ug/L)		<0.2		0.4	0.2	0.3	0.3	1.0
Chromium (ug/L)		<1		99**	3	49**	24**	3
Copper (ug/L)		<1		79**	<1	49**	39**	<1
Nickel (ug/L)		<1		155**	<1	74**	22**	40**
Lead (ug/L)		<1		13**	<1	<1	<1	<1
Zinc (ug/L)		<1		204**	<1	108**	46**	<1

"Unusable data - QA/QC problems.
**Use data with caution, see text.

Table 7. Organic priority pollutant results, water and ground water analyses (units, ug/L) - Wyckoff, 1985.

Sample Type	Ground Water	Intertidal Seeps					Blanks				
Sample Location	WA-1	IN-1	IW-1	IW-2	IN-3	IW-4	Pump	Transport	Field	Transport	Field
Sample Number	248587	248588	418151	248589	248590	248591	248596	248598	248597	418156	418157
Date	6/19	6/19	10/9	6/19	6/19	6/19	6/19	6/19	6/19	10/9	10/9
Time	1045	1200	0740	1300	1430	1345	1040				
Volatile Organics											
Ethylbenzene	E28	E21		E11	E5u	E5u	E5u	E5u	E5u		
Methylene chloride	E72u	E66u		E60u	E5u	E5u	E8	E13	E35		
Acid Extractables	*	*		*	*	*	*	*	*		
Phenol			PE12							ND	ND
2,4-Dimethylphenol			E16							ND	ND
2,4,5-Trichlorophenol			E4.4							ND	ND
Pentachlorophenol			E14							ND	ND
Base/Neutrals	*	*		*	*	*	*	*	*		
Naphthalene			E5800							ND	ND
Acenaphthene			E2300							ND	ND
Acenaphthylene			E80							ND	ND
Fluorene			E1600							ND	ND
Anthracene			E1600							ND	ND
Phenanthrene			E2500							ND	(E3.0)
Fluoranthene			E1500							ND	(E1.4)
Chrysene			E390							ND	ND
Pyrene			E1420							ND	(E1.2)
Benzo(a)anthhracene			E430							ND	ND
Benzo(b)fluoranthene			E200							ND	ND
Benzo(k)fluoranehene			E170							ND	ND
Benzo(a)pyrene			E200							ND	ND
Dibenzo(a,h)anthracene			E30							ND	ND
Benzo(g,h,i)perylene			E70							ND	ND
Indeno(1,2,3-cd)pyrene			E60							ND	ND
Diethylphthalate			E240u							E6.9	(E2.4)
Di-n-butylphthalate			E20u							E15	(E18)
Bis(2-ethylhexyl)phthalate			E12u							E14	(E6.6)
Pesticides/PCBs††	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND

* = Data rejected due to laboratory problems.
P = Internal standard recovery <10 percent.
u = Undetected at detection level shown.
ND = Not detected, detection limits not verified.
___ = Detection of compounds in environmental samples.
E = Estimate (VOA's - bottle provided for collection not septum-sealed; B/N/A's - sample allowed to stand at room temperature for 14 of 47 days between delivery to METRO labroatory and extraction).
( ) = Blank sample run on NPLC immediately following highly contaminated sample, carryover contamination suspected.
†† = Actual detection limits unknown.

Relatively low concentrations of ethyl benzene (10 to 30 ug/L) were detected in the ground water as well as seeps 1W-1, which had low (less than 20 ug/L) concentrations of several acid extractable compounds including phenol and several chlorinated phenolics.

Of primary importance were results indicating heavy contamination of the IW-1 seep with 2- to 6-ring aromatic hydrocarbons. Figure 3 compares concentration of specific PNA's in the TW-1 seep to the concentration of the same PNA's quantified in ground water at another wood-treating facility in Puget Sound--McFarland/Cascade, Budd Inlet (Johnson, 1985). The PNA "fingerprints" are quite similar with the exception that 6-ring PNA compounds were comparatively more prevalent at the Wyckoff site.

Table 8 compares the concentrations of PNA's with current EPA criteria for the protection of saltwater aquatic life. Concentrations in each case exceed these criteria by 2 to 100 times. Although this study made no attempt to formally quantify the presence or abundance of marine life in the areas visually affected by the seeps, live organisms were not observed on or in sediments near contaminated seep areas. Criteria violations, coupled with the apparent lack of viable intertidal communities, suggest a measurable negative impact on marine organisms in the immediate vicinity of the contaminated seeps.

Table 8. Concentrations of several PNA's in seep (IW-1) water compared to EPA saltwater criteria (Federal Register, 1980) for the protection of saltwater aquatic life.

Pollutant	EPA Saltwater Criteria Acute (ug/L)	 Chronic (ug/L)	Seep (IN-1) Concentration (ug/L)	Dilution Required to Meet Criteria Acute	 Chronic
Naphthalene	2,350	*	E5,800	2.5	*
Acenaphthene	710	500	E2,300	3.2	4.6
Fluoranthene	40	16	E1,500	38	94
Polynuclear aromatic hydrocarbons	300	*	E10,000	33	*

* = No criteria yet developed.
E = Estimated concentration.

The contaminated seepage is also an apparent source of the elevated PNA concentrations found in clams collected south of the seeps (from Wyckoff property along Rockaway Beach to Point Blakely). PNA contamination of clam tissues has been documented by previous studies (Yake, et al., 1904; Kalman, 1984).

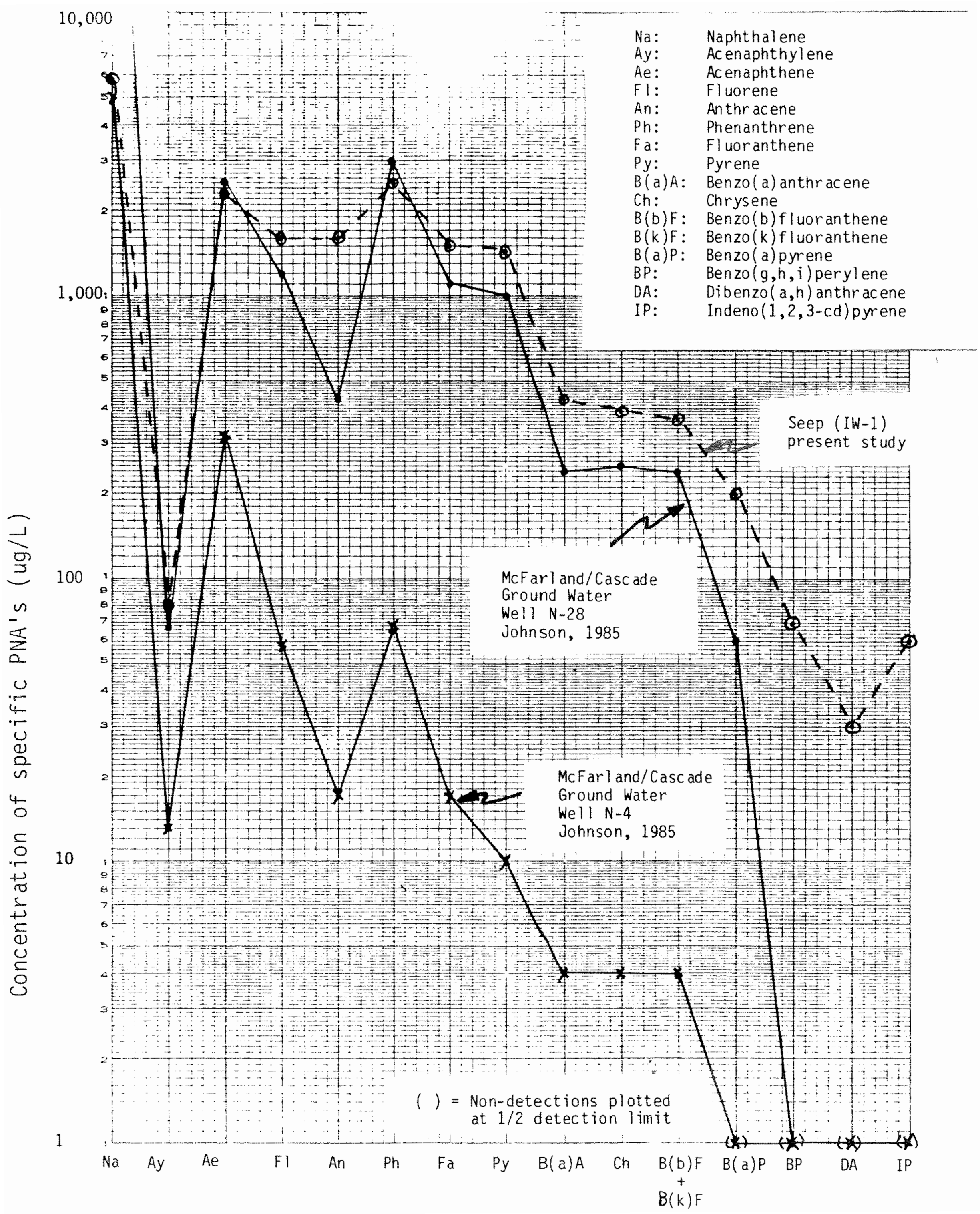


Figure 3. PNA concentration in ground water at a facility on Budd Inlet compared to seep contamination at Wyckoff.

Figure 4 plots concentrations of three PNA's in clam tissue against distance south of the IW-1 seep. The three PNA's are those reported at detectable concentration in both of the above-referenced studies. A consistent pattern with concentrations highest near the seep and decreasing concentrations to the south is apparent.

Another linkage between the seep contamination and elevated concentrations of PNA's in clams is summarized in Table 9 and shown in Figure 5. The figure plots concentrations of specific PNA's in seepage (IW-1) and clam tissues collected about 600 feet south of the seep and reported by Yake, et al. (1984). Despite the fact that the samples were collected 18 months apart and analyzed at different laboratories, the match is quite good, particularly for the higher weight PNA's (4- to 6-ring). Linear regression for the 4- to 6-ring PNA's (9 compounds) yields a very high r^2 of 0.974.

Table 9. PNA concentrations in seepage and clam tissue.

Compound	Molecular Weight	Concentration in Seepage IW-1 (ug/L)	Concentration in Clam Tissues Stn. 1, Yake, et al., 1984 ug/Kg wet weight
Naphthalene	128	E5800	26
Acenaphthylene	152	E80	4u*
Acenaphthene	154	E2300	130
Fluorene	165	E1600	180
Anthracene	178	E1600	130
Phenanthrene	178	E2500	740
Fluoranthene	201	E1500	970
Pyrene	201	E1420	920
Chrysene	228	E390	360
Benzo(a)anthracene	228	E430	210
Benzo(b)fluoranthene	252	E200	120
Benzo(k)fluoranthene	252	E170	
Benzo(a)pyrene	252	E200	58
Dibenzo(a,h)anthracene	276	E30	8.6
Benzo(g,h,i)perylene	276	E70	21
Indeno(1,2,3-cd)pyrene	276	E60	11

* = Not detected; calculation assumes 2 ug/Kg wet weight.
E = Estimated concentration.
u = Undetected at detection limit shown.

An alternative method of evaluating the relationship between PNA contamination in seepage and shellfish is shown in Figure 6. Here the ratios of the concentration of specific PNA's in clam tissue:seepage are plotted

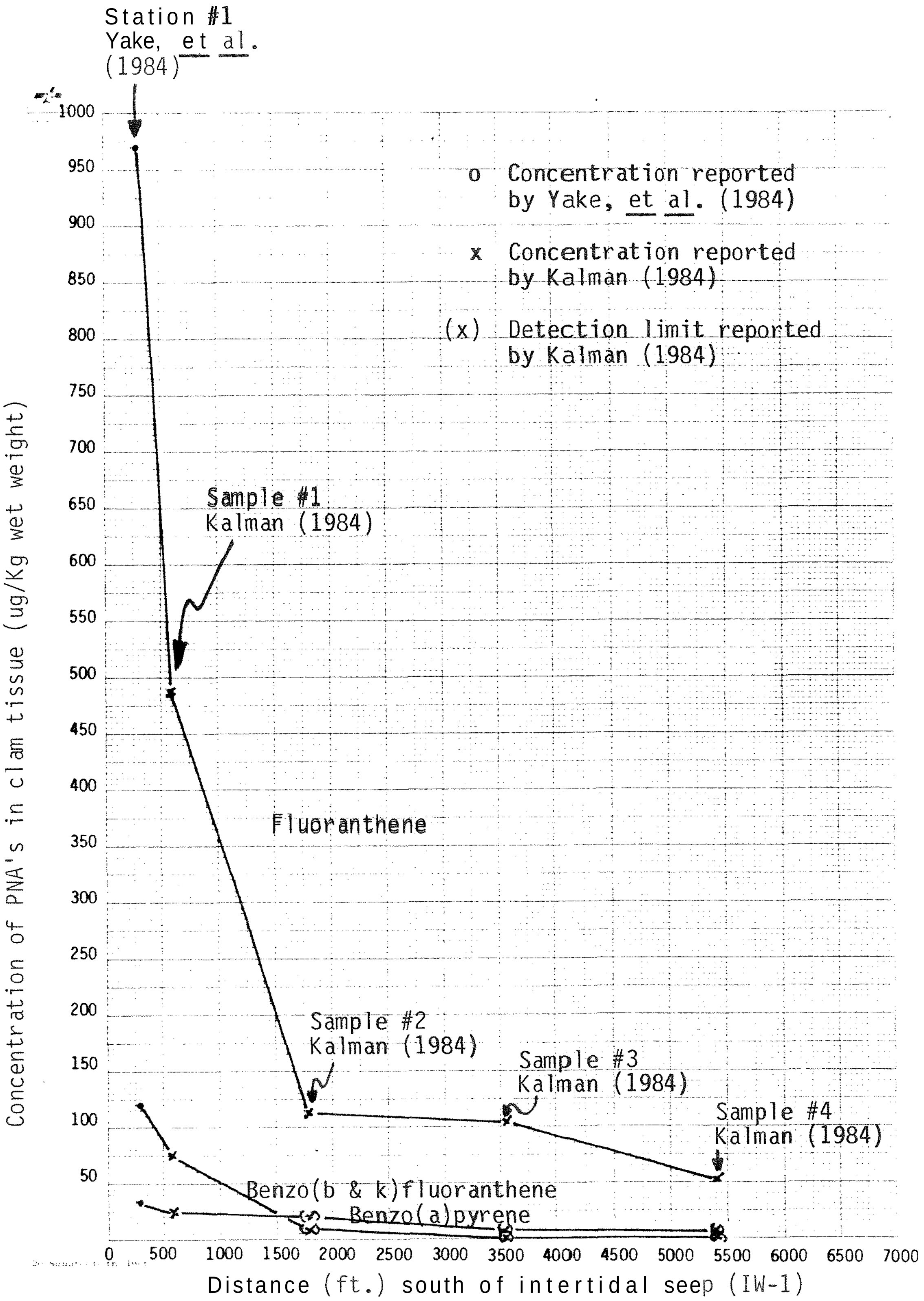


Figure 4. Concentration of specific PNA's in clam tissue as a function of distance south of contaminated seep (IW-1).

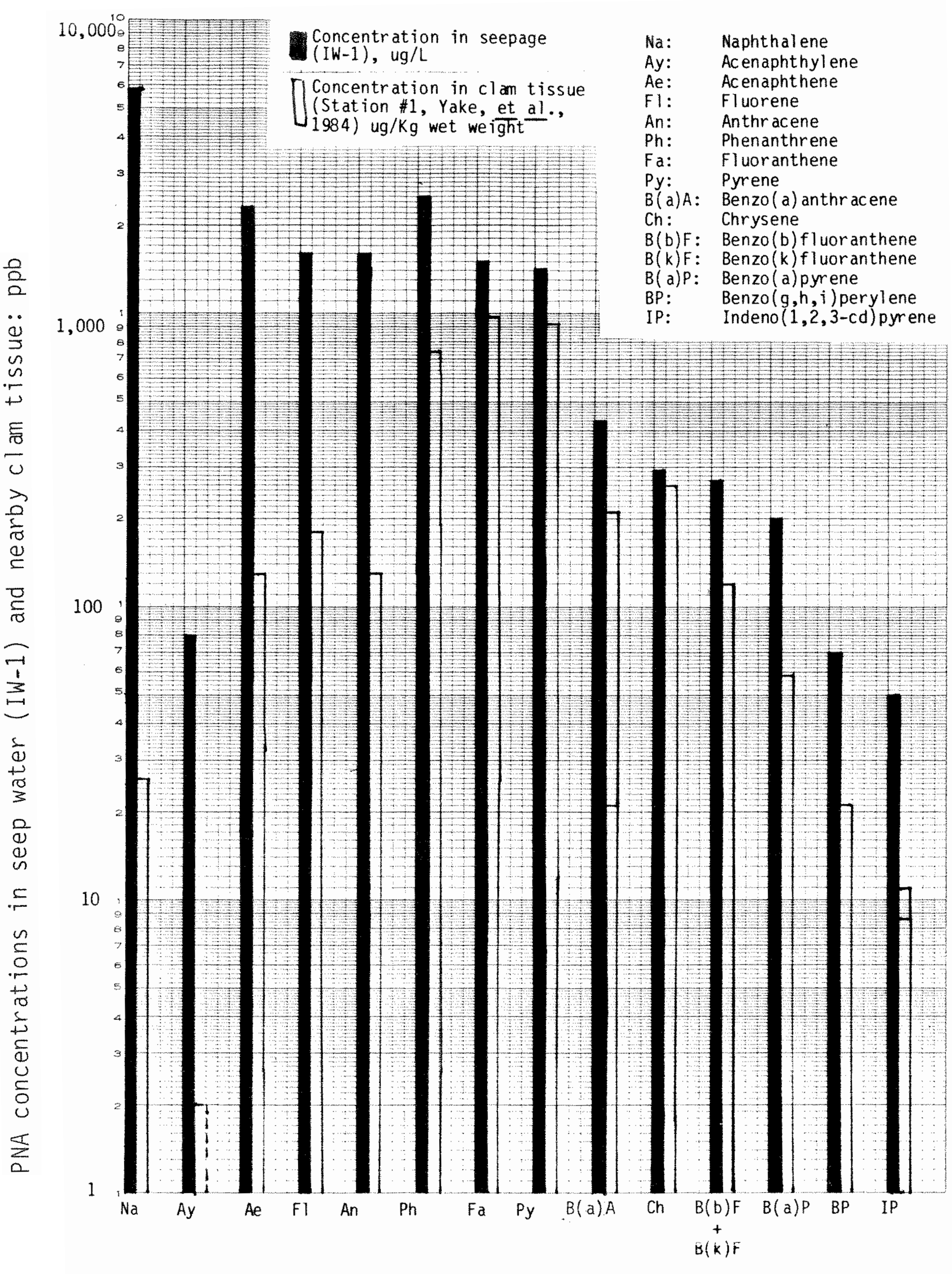
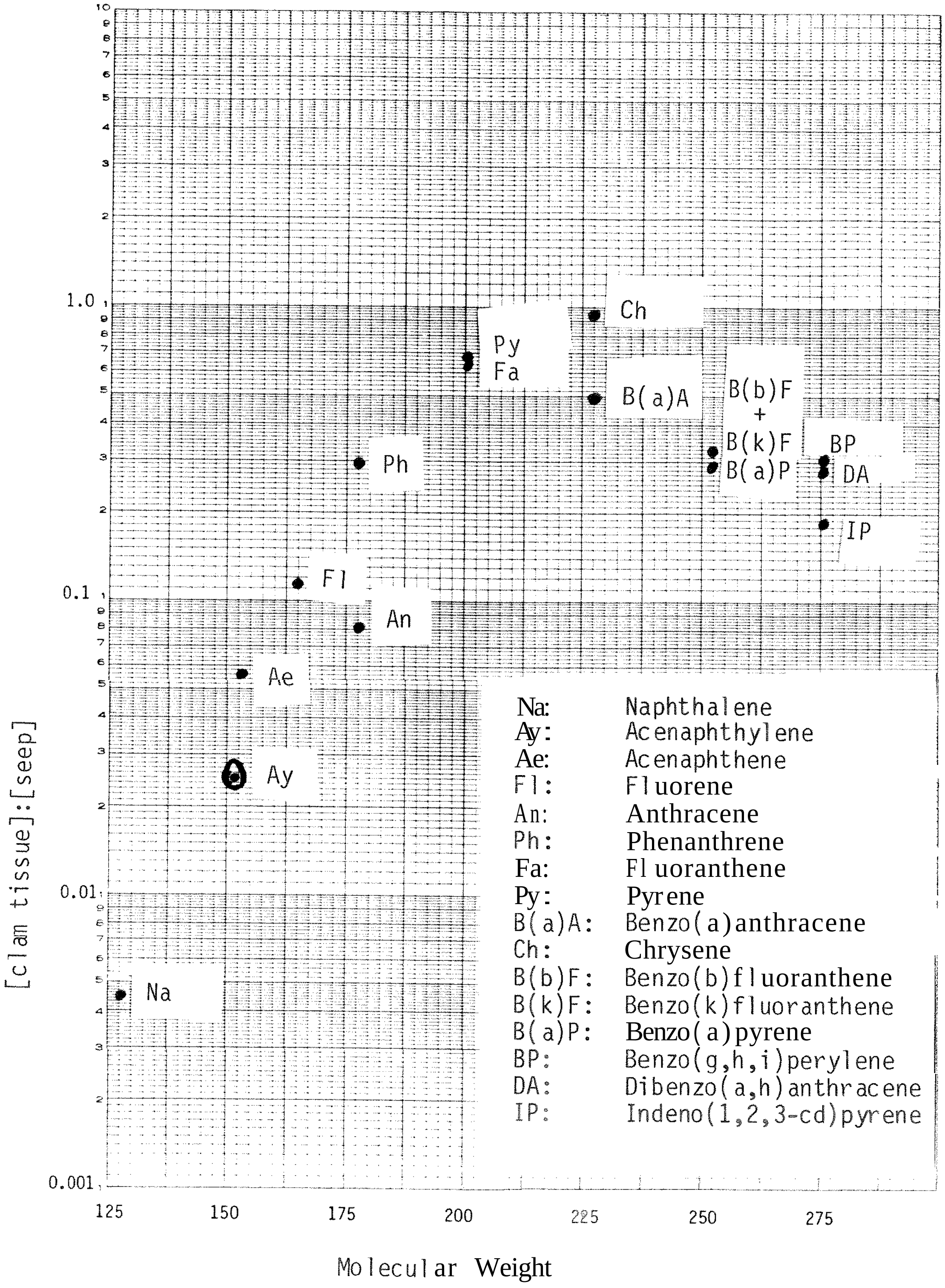


Figure 5. Concentrations of specific PNA's in seepage (IW-1) and nearby clam tissue (Station #1, Yake, et al., 1984).



⊙ = Not detected in seep.
Ratio based on 1/2 detection limit.

Figure 6. Ratio of specific PNA concentrations in clams (Station #1, Yake, et al., 1985):PNA concentration in seep water (IW-1) versus molecular weight.

against the molecular weight of the PNA. The ratio is low for the lighter PNA's and higher for the higher weight PNA's indicating a higher rate of uptake and/or retention of high weight PNA's by clams. The ratio plot shows a smooth curve with a peak in the range of the 4-ring PNA's and slight drop-off at higher molecular weights. Potential explanations for the shape of this curve include:

- Attenuation of compounds between the seep and the clams. This probably includes volatilization of the lighter weight PNA's. Other mechanisms may also be important.
- Differential rates of uptake by shellfish. For instance, because shellfish are filter feeders, there may be preferential uptake of PNA's adsorbed onto suspended particles.
- Differential rates ofmetabolism and excretion of the specific PNA's by shellfish.
- Difference in analytical sensitivity and accuracy between the laboratories conducting the analysis.

Further research would be necessary to explore the relative importance of these potential explanations. Interestingly, Obana, et al. (1983) in a seven-day exposure experiment using short-necked clams (Tapes japonica, a species not collected or analyzed in the Eagle Harbor area) and selected 3- to 6-ring PNA's showed a similar relationship with the peak in the 4- to 5-ring range. Their ratios were based on exposure water concentrations, suggesting that the shape of the curve (particularily in the 4- to 6-ring range) is mainly a function of uptake, metabolism and excretion in clams. Differential attenuation may be a major mechanism in the 2- to 3-ring range.

Taken together, the spatial pattern of clam contamination and the similarity in the "fingerprints" of seep and clam contamination provide a strong indication that contaminated seepage from Wyckoff is responsible for much of the clam contamination along Rockaway Beach.

As efforts toward the cleanup of contaminated ground water proceed at Wyckoff, there will be a need to set goals for this cleanup: the "How clean is clean?" question. There are two potential mechanisms for setting cleanup goals which follow from the discussion above: minimizing contamination of shellfish, and protecting marine organisms from acute and chronic toxic effects.

The first alternative is potentially more complex, in part because there are no FDA criteria for PNA contamination in shellfish, and developing a cleanup target would probably involve a human health risk assessment with the attendant assumptions. The Health Risk Guidance Manual (Tetra Tech, 1986a) prepared for the Puget Sound Estuary Program would provide some of the framework for this assessment, however issues such as consumption rate assumptions and acceptable risk levels are currently unresolved.

The second alternative is more straight-forward. Requiring that pollutant concentrations in seep waters meet EPA water quality criteria for the protection of marine organisms could result in decreasing present levels of contamination by 60 to 99 percent for compounds currently exceeding these criteria (see Table 8). This requirement would be consistent with protecting marine resources because organisms which live in and on the beach near the seeps would be regularly exposed to concentrations similar to those found in seep waters.

Seep contamination is also a source of nearby sediment contamination. For this reason the relationships between seepage and sediment contamination should be determined to assure that the target chosen for seep cleanup is adequate to prevent sediment contamination in excess of applicable sediment criteria.

Sediments

Results of conventional and metals analyses of intertidal sediments are summarized in Table 10; organic priority pollutants in Table 11. Full sediment organics data including detection limits are given in the appendix.

Conventionals: Total organic carbon (TOC) and grain-size results show the substantial difference in the character of sediments between the Milwaukee dock and the shipping dock (IS-1, 2, and 3), and the sediment west of the shipping dock (IS-4). Sediments on the east- and northeast-facing shore are sandy, with low fines (3.6 to 5.7 percent) and TOC (<0.1 to 0.3 percent) concentrations; while IS-4 is more representative of a depositional area with a higher fines content (16.2 percent) and TOC concentration (2.6 percent).

Table 10. Intertidal sediment results: conventionals and metals.

Sample	IS-1	IS-2	IS-3	IS-4
Sample Number	248592	248593	248594	248595
Date	6/19	6/19	6/19	6/19
Time	1210	1315	1430	1400
Conventionals				
Percent solids (Ecology/Laucks)	79/73.2	79/80.1	78/72.6	59/57.1
TOC (percent of dry weight)	0.3	<0.1	<0.1	2.6
Grain Size				
Percent Rock (2 mm)	5.63*	13.70	9.68	18.35
Percent Sand (0.063 - 2 mm)	88.66*	82.65	86.71	65.40
Percent Silt (4 u - 62 u)	3.24*	1.93	1.75	8.37
Percent Clay (0.24 u - 4 u)	2.48*	1.73	1.86	7.88
Metals (mg/Kg dry weight)				
Arsenic	1.2	1.2	1.5	3.7
Cadmium	0.21	0.20	0.24	0.61
Chromium	22.3	25.2	21.3	15.4
Copper	12.2	13.3	13.5	47.5
Nickel	25.2	26.5	24.7	25.4
Lead	6.0	4.1	3.0	18.2
Zinc	37.5	44.7	40.3	75.4

*Average of two replicate values.

Table 11. Intertidal sediment results: organic priority pollutants (units in ug/Kg dry weight)

Sample Location	IS-1	IS-2	IS-3	IS-4
Sample Number	248592	248593	248594	248595
Date	6/19	6/19	6/19	6/19
Time	1210	1315	1430	1400
Volatile Organics				
Ethyl benzene	E750	E50u	E50u	E50u
Acid Extractables				
Phenol	E39	E33	R	E1700
2,4-Dimethylphenol	E53	E60	R	E60
Pentachlorophenol	E100u	E>3800u	R	E180
Base/Neutrals				
1,2-dichlorobenzene	E93	E120	P11,000u	P50u
Naphthalene	PE36,000	PE18,000	11,000	PE1100
Acenaphthene	9600	100u	4700	4500
Acenaphthylene	500u	500u	400u	1600
Fluorene	6500	1600	3200	4600
Anthracene	6000	500u	3200	14,000
Phenanthrene	6800	1800	3200	20,000
Total low wt. PNA's	E65,000	E21,000	25,000	E46,000
Fluoranthene	5400	800	3600	110,000
Chrysene	1300	400u	1700	29,000
Pyrene	4200	450	3000	75,000
Benzo(a)anthhracene	1300	700u	1300	20,000
Benzo(b)fluoranthene	430	700u	830	22,000
Benzo(k)fluoranehene	560	400u	720	20,000
Benzo(a)pyrene	440	1200u	600	14,000
Dibenzo(a,h)anthracene	>1100u	P500u	100u	2000
Benzo(g,h,i)perylene	P37,000u	P1500u	900u	8300
Indeno(1,2,3-cd)pyrene	>1100u	P500u	100u	4000
Total high wt. PNA's	13,500	1250	12,000	300,000
Dimethylphthalate	P700u	>1300u	300u	250
Diethylphthalate	1100u	600u	92	440
Di-n-butyl phthalate	P210	190	400	1300
Bis(2-ethylhexyl)phthalate	P2100u	P500u	470	36,000
Butyl benzylphthalate	>1100u	>1300u	>1300u	130
Di-n-octylphthalate	P800u	P300u	100u	83
Pesticides/PCBs[††]				
Total PCBs	ND	20 to 80		

E = Estimated value.
P = Internal standard recovery <10% (high uncertainty regarding accuracy of reported value).
R = Data rejected.
u = Undetected at detetion limit shown.
>u = Minimum detection limit. No internal standard recovery.
ND = Not detected; actual detection limit unknown.
___ = Denotes detection of compounds.

Metals: Metals results were, in general, unremarkable. Concentrations in samples IS-1, -2, and -3 were similar to those commonly reported in control areas. Metals concentrations at IS-4 were somewhat elevated, but still below those generally associated with adverse biological effects.

Organics: Sediment samples were collected in seepage areas. In the case of samples IS-1, -2, and -3, water was seeping directly from the exposed sediments. The seepage at each of these sites had a visible sheen indicative of creosote or oil-like contamination. This sheen ranged from heavy and dark at IS-1 to light at IS-3. This pattern is reflected in the results for the lighter aromatic compounds (1- to 3-ring) with concentrations being generally highest at IS-1, lower at IS-3.

The seepage observed at IS-4 was leaking from the timber bulkhead west of the loading dock. Sediments collected near the base of the bulkhead were dark. Although there were visible sheens on the exposed sediment, this sheen was not noted on the seep water sample. Low molecular weight aromatic concentrations in the IS-4 sediment samples were intermediate between IS-1 and IS-3. High molecular weight PNA concentrations were 20 to 30 times higher (on a dry-weight basis) at the IS-4 site than at the other sites.

Other organics observed in sediments included phenol (highest concentration at IS-4); 2,4-dimethylphenol and pentachlorophenol (detected only at IS-4); dichlorobenzene at IS-1 and -2; an array of phthalates (primarily at IS-4); and relatively low levels of PCBs at IS-2.

Table 12 compares the maximum concentrations of various organics detected in sediments during this study with maxima reported in the extensive Commencement Bay Nearshore/Tideflats Superfund Study (Tetra Tech, 1985) and near another wood-treating facility--McFarland/Cascade, Budd Inlet (Johnson, 1985). Maximum PNA concentrations (all weights) detected during this study were higher than those reported in any of the Commencement Bay sediments. One Budd Inlet sediment sample was more contaminated with PNA's than the maximum concentrations reported in this study. Low molecular weight PNA's were generally highest in IS-1, high weight PNA's were highest in IS-4.

Criteria (presently referred to as "sediment contamination values") are currently being developed for Puget Sound sediments. The latest, most comprehensive development and compilation of these values is being generated by a cooperative effort of the Puget Sound Dredge Spoils Analysis (PSDSA, an Army Corps of Engineers effort) and the Puget Sound Estuarine Program (PSEP, a joint EPA/Ecology effort). These values are tabulated, explained, and discussed in a draft document (Tetra Tech, 1986). The concentrations of selected organic contaminants in Wyckoff intertidal sediments are compared to selected draft "criteria" in Table 13. Only sediment concentrations which exceed one or several of the draft "criteria" are included in Table 13.

Table 12. Maximum concentrations of selected organic priority pollutants in intertidal Eagle Harbor sediments compared to maxima from other Puget Sound studies (units in ug/Kg dry weight)

	Present Study		Commencement Bay (Tetra Tech, 1985)		Budd Inlet/McFarland Cascade (Johnson, 1985)	
Selected Organic Priority Pollutants	Maximum Concentration	Station(s)	Maximum Concentration	No. of Stations	Maximum Concentration	No, of Stations
Acid Extractables						
Phenol	E1,700	IS-4	2,100	158	400u	8
2,4-Dimethylphenol	E60	IS-2, IS-4	210	158	400u	8
Pentachlorophenol	E180	IS-4	860	158	400u	8
Base/Neutrals						
Naphthalene	PE36,000	IS-1	5,500	158	210,000	8
Acenaphthylene	1,600	IS-4	650	158	E100	8
Acenaphthene	9,600	IS-1	2,500	158	370,000	8
Fluorene	6,500	IS-1	3,100	158	200,000	8
Phenanthrene	20,000	IS-4	11,000	158	800,000	8
Anthracene	14,000	IS-4	1,600	158	150,000	8
Total low wt. PNA's	E65,000	IS-1			1,730,000	8
Fluoranthene	110,000	IS-4	8,100	158	530,000	8
Pyrene	75,000	IS-4	5,800	158	400,000	8
Benzo(a)anthhracene	20,000	IS-4	3,500	158	95,000	8
Chrysene	29,000	IS-4	6,100	156	120,000	8
Benzo(b)fluoranthene	22,000	IS-4	8,800	136	73,000	8
Benzo(k)fluoranehene	20,000	IS-4				
Benzo(a)pyrene	14,000	IS-4	6,100	154	40,000	8
Indeno(1,2,3-cd)pyrene	4,000	IS-4	2,700	157	E100	8
Dibenzo(a,h)anthracene	2,000	IS-4	1,500	157	ND	8
Benzo(g,h,i)perylene	8,300	IS-4	1,900	157	E100	8
Total high wt. PNA's	300,000	IS-4			1,260,000	8

E = Estimated concentration.
P = Internal standard recovery <10% (high uncertainty regarding accuracy of reported value).
u = Not detected at this quantification limit.
ND = Not detected.

13. Selected sediment organics compared to a suite of proposed (draft) criteria (normalized to dry weight, organic carbon, and percent fines)

	Intertidal Sediment Concentrations				Proposed (drart) Criteria (Tetta Tech, 1986)1/					
					Apparent Effects Thresholds				Toxic Endpoint	
	IS-1	IS-2	IS-3	IS-4	Amphipod	Oyster	Microtox	Benthic	80% Reduction	100% Reduction
Ethylbenzene										
ug/Kg - d.w.	E750				>50	37	33	37		
ug/Kg - TOC	E250,000				>3800	>3800	>3800	>3800		
ug/Kg - % fines	E13,000				>180	>180	180	>180		
Phenol										
ug/Kg - d.w.				E1700	560	420	1200	1200		
ug/Kg - TOC				E65,000	>39,000	>39,000	33,000	>39,000		
ug/Kg - % fines				E21,500	>3800	>3800	>14,000	>3800		
2,4-dimethylphenol										
ug/Kg - d.w.	E53	E60		E60	>50	29	29	29		
ug/Kg - TOC	E1800	>E60,000		E2300	>1300	>1300	630	>1300		
ug/Kg - % fines	E930	E1600		E760	>68	32	36	36		
1,2-dichlorobenzene										
ug/Kg - d.w.	E93	E120			>350	50	35	50		
ug/Kg - TOC	E31,000	>E120,000			>3200	2300	2300	2300		
ug/Kg - % fines	E1600	E3300			>480	62	13	130		
Naphthalene										
ug/Kg - d.w.	PE36,000	PE18,000	11,000	PE1100	2100	2100	2100	2100	550	860
ug/Kg - TOC	PE12,000,000	>PE18,000,000	>11,000,000	PE42,000	>200,000	99,000	>170,000	>330,000	33,000	37,000
ug/Kg - % fines	PE630,000	PE490,000	300,000	PE6800	4300	4300	>9500	>9500		
Total low wt. PNA's										
ug/Kg - d.w.	E65,000	E21,000	25,000	E46,000	5200	5200	5200	6100		
ug/Kg - TOC	E22,000,000	>E21,000,000	>25,000,000	E1,750,00	396,000	370,000	>530,000	>6,100,000		
ug/Kg - % fines	E1,100,000	E570,000	690,000	E580,000	16,000	16,000	29,000	>92,000		
Total high wt. PNA's										
ug/Kg - d.w.	13,500	1250	12,000	300,000	18,000	17,000	12,000	>51,000	4900	5800
ug/Kg - TOC	4,500,000	>1,250,000	>12,000,000	11,500,00	960,000	960,000	1,500,000	>51,000,000	200,000	230,000
ug/Kg - % fines	240,000	34,000	332,000	3,800,000	42,000	42,000	770,000	82,000		

E = Estimated concentration.
P = Internal standard recovery <10% (high uncertainty regarding accuracy of reported value).
\> = Greater than.
1/ = See text.

A detailed explanation of the derivation of the criteria values is beyond the scope of this report. However, a brief description follows:

- Equilibrium Partitioning: The liquid-solid phase partitioning of neutral organics can be derived mathematically. This approach assumes adverse biological effects of pollutants in sediment is due to liquid-phase concentrations. Limits for liquid-phase concentrations are derived using EPA water quality criteria or other appropriate values for the protection of marine organisms. Comparison of values obtained using this theoretical approach often yields much higher criteria than other, empirical approaches. In addition, values derived by this approach yield very wide confidence intervals and appear to perform poorly as a predictor of which sediments will display adverse bological effects. For this reason, these values are not used in Table 13.

- Apparent Effects Thresholds: This approach uses the results of chemical analyses and biological data (bioassays or infaunal analysis) from field-collected sediments to derive criteria. The highest concentration of a potential pollutant at which no significant adverse effect is detected is termed the "apparent effects threshold." Four values are given in Table 13. These are based on amphipod, oyster larvae, and microtox bioassay results, as well as analysis of benthic infaunal communities. The values given in Table 13 are based on the analyses of a fairly wide range of Puget Sound sediments.

- Toxic Endpoint: This also is an empirical approach which uses the presence/absence or significant depression of specific types of benthic organisms. Sediments are arranged in order of target contaminant concentration. The concentration at the station representing the 90th percentile of the total number of stations at which the species was found (or was or was not reduced by more than 80 percent of the density at reference stations) is determined (see 100 percent and 80 percent reduction columns in Table 13). This value (the "Species Probable No-Effects Level," SPNEL) is determined for a number of species. The concentration above which 95 percent of the SPNELs are found is termed the "Probable Mo-Effects Level" (PNEL). This is a promising approach, but is data-intensive and has been used to determine PNELs for only a few compounds or classes of compounds.

The "criteria" concentrations determined by these various approaches can be expressed in three different ways: dry-weight, organic-carbon-normalized, or a percent-fines-normalized basis.

Table 13 shows sediment concentrations for seven organic chemicals or groups of compounds which exceed one or more of the "criteria." The most serious excursions include low molecular weight PNA's (including naphthalene) in samples IS-1, -2, and -3. Because these samples were coarse and carbon-poor, the organic-carbon and fines-normalized concentrations are very high. For instance, the naphthalene concentration in IS-2 normalized to organic carbon is greater than 480 to 550 times the toxic endpoint sediment values.

High molecular weight PNA concentrations also indicate substantial problems in these sediments. IS-4 has the highest concentrations on both a dry-weight and fines-normalized basis, while IS-1 and -3 are particularly high on an organic-carbon-normalized basis.

The application of sediment criteria to the cleanup of contaminated sediment is a process which is still evolving. The most pressing need is to eliminate current sources. Control of seepage should go a long way toward improving conditions in sediments between the shipping dock and the Milwaukee dock. The high concentrations of high molecular weight PNA's in the surface sediment at IS-4 imply recent or current sources are contributing to sediments west of the shipping dock. The source of this contamination has not been documented.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of ground-water, seep, and intertidal sediment samples at the Wyckoff/Eagle Harbor site, the following conclusions may be drawn:

1. There is ongoing seepage of PNA-contaminated ground water from the intertidal zone east of the Wyckoff property. Concentrations of these contaminants in the IW-1 seep exceed the EPA acute and chronic receiving water criteria for the protection of marine aquatic life.

2. Based on visual observations and conventional analytical results, ground-water contamination consists of at least two phases: a floating oil-based phase and a contaminated-water phase. Partitioning of priority pollutant organics in these two phases has not yet been measured, A third phase of heavy components which sink to the impermeable boundry of the aquifer may also be present.

3. There is strong evidence that contaminated seepage is the major source of PNA contamination in shellfish collected south of the seeps along Rockaway Beach toward Point Blakely. This evidence includes trends in the spatial distribution of PNA's in shellfish and the marked similarity of seep and clam contamination "fingerprints," particularly for the high molecular weight PNA's. PNA contamination in clams collected south of these seeps is the highest reported in Puget Sound and has led to posting of advisories by the Kitsap-Bremerton Public Health Department.

4. The three sediments collected between the Milwaukee dock and the shipping dock (IS-1, -2, and -3) were low in organic carbon and fines concentrations, while the single sediment sample collected west of the shipping dock (IS-4) was more indicative of a depositional environment, having a higher organic carbon and fines content.

5. Aromatic hydrocarbon (1- to 3-ring) compounds predominated in the intertidal seep sediments between the docks, with the higher concentrations generally associated with IS-1, lower concentrations with IS-3. When compared with available sediment contamination values ("criteria"), these concentrations were very high, particularly when normalized on an organic carbon or fines basis.

6. Phenol and the high molecular weight PNA contamination was most severe at IS-4. High weight PNA concentrations were much higher than several applicable criteria when expressed either on a dry-weight or fines-normalized basis. When normalized to organic carbon, IS-1 and -3 also appear to have substantial high weight PNA contamination problems.

Recommendations

There are several areas where future investigations or research are likely to yield useful information in resolving the contamination problems at the Wyckoff site and in understanding similar contamination problems in Puget Sound. These include:

- Analyses of the oil-based and water-based phases of contaminated ground water for a range of organics including contaminants detected in seep waters and sediment. This information would be useful in determining the extent to which physical treatment (i.e., oil/water separation) would decrease contaminant flux to Puget Sound. An investigative inquiry into the possible existence of a heavy contaminant phase at the bottom boundry of the aquifer would also be useful.

- Full investigation of the extent, magnitude, and mechanics of ground-water contamination and subsequent discharge to the Sound leading to the effective containment and control of this source (i.e., "pump and treat" techniques to minimize contaminant migration to the Sound). The ongoing EPA RCRA investigation may provide much of this information. It may be useful to focus a portion of this investigation on selective collection and treatment of the surface layer (oil-based contamination) and/or a heavy contaminant phase (if it exists).

- Determine the source of recent contamination of surface sediments west of the shipping dock.

- Investigate the attenuation and selective uptake metabolism and excretion of specific PNA's by clams suggested by Figures 5 and 6.

2. It is important to proceed as quickly as possible with source control (that is, elimination or mitigation of contaminated ground-water seepage to Puget Sound). The use of EPA water quality criteria (acute and chronic for the protection of marine organisms) as a target for seep water quality is suggested as a relatively straight-forward means for determining a cleanup level. Prior to implementation, the implications of choosing this target cleanup level should be assessed in terms of predicted effects on nearby sediments and clam tissues. Acceptably low levels of clam tissue and sediment contamination should be assured.

BY:cp

Attachments

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APPENDIX

TETRA TECH, INC.
11820 NORTHUP WY, STE 100
BELLEVUE, WA 98005-1927
TELEPHONE (206) 822-9596

April 7, 1986

Mr. Mark Snyder
Black & Veatch Engineers-Architects
6240 South Sprague Avenue
Tacoma, WA 98409-6819

Dear Mark:

Per Bill Yake's request, I am transmitting revised QA memos and data summaries on the intertidal samples collected in Eagle Harbor. These supersede the memos previously submitted March 21, 1986.

These evaluations should reflect the data review approach agreed upon with Bill. You will be notified as presently unresolved issues (e.g., detection limits for pesticides and PCBs) are resolved. There were library searches processed for the sediment samples but they have not been evaluated.

Sincerely,

Julia Wilcox

Julia Wilcox
Environmental Chemist
Environmental Systems Engineering

JW/ct:TC-3025-03

Enclosures

cc: B. Yake, Ecology, w/enclosures
M. McCall, Ecology, w/enclosures
G. Stumpf, Ecology, w/enclosures
B. Barrick, Tetra Tech

MEMO TO: Bill Yake, Ecology

FROM: Julia Wilcox, Tetra Tech JW

DATE: April 4, 1986

SUBJECT: Quality Assurance Report - Organic Analyses of Eagle Harbor Seep Samples

This quality assurance memo supersedes the memo on the same subject of March 21, 1986.

VOLATILE COMPOUNDS

Metro performed all analyses. The samples were collectd in 1L glass jugs and stored in a cooler until analysis. All analyses were performed within five days of collection. The volume of sample purged ranged from 1 mL to 200 mL based on the estimated or tested level of contamination. Twenty-six internal recovery standards were used for quantitation by isotope dilution GC/MS. Erratic recoveries (i.e., very high, or low) for chloromethane and vinyl chloride were evident. There was no apparent explanation for this provided by the laboratory, but it was indicated that it was an ongoing problem.

The water samples were collected in containers provided by the laboratory that were not airtight and removals of alliquots for multiple analysis allowed headspace to exist. Because of these conditions, it is likely that volatile compounds were lost prior to analysis. It is not possible to assess the magnitude of any loss and the data for these compounds are qualified as estimates (E).

As we discussed, these data for volatile organic compounds would be evaluated in a manner similar to that used for data produced by contract laboratories for the U.S. EPA Superfund program (e.g., no positive results are reported unless the sample concentration is >5 times the blank concentration of methylene chloride or acetone). The summaries of the results are attached. The data are not blank corrected but are corrected for recovery of the internal standards.

SEMIVOLATILE COMPOUNDS

Metro performed all analyses. Fifty-four internal recovery standards were used for quantitation by isotope dilution GCIMS. Serious problems were encountered during extraction and cleanup and all the data for samples Ecology #248587-248591, 248596 and 248597 (June sampling) are rejected. Station IW-1 was resampled (Ecology #418151) and delivered to Metro October 9, 1985. This sample was allowed to stand at room temperature for 14 of the 47 days between sampling and extraction. The quantitation of acid compounds was performed on an extract of a one liter sample taken to a 1 mL final volume. The base/neutral fraction was run at 1:8 and 1:20 dilutions. The 1:20 dilution results in quantitation very near the lower limit of detection. Therefore only the 1:8 dilution will be considered appropriate for quantitation of all base and neutral compounds. Some calculation errors have been detected and corrected. Because of the improper stroage techniques and extended holding time, all values for semivolatile compounds should be considered estimates (E). The values are recovery corrected and expressed in ug/L.

No pesticides or PCBs were detected. Metro states that the detection limits for these compounds are the same as those listed in their Organics Analytical Support and Data Validity document (i.e., 0.002 to 0.01 ug/L). Sufficient data to verify these detection limits have not been provided.

SUMMARY

The data for volatile and semivolatile compounds are estimates only. The semivolatile data from Ecology #248587-248591, 248596 and 248597 are rejected. Resampled station IW-1 (Ecology #418151) data are usable with the corrections and qualifications noted on the data summary provided.

/jfw: TC 3025-03

MEMO TO: Bill Yake, Ecology

FROM: Julia Wilcox, Tetra Tech jw

DATE: April 4, 1986

SUBJECT: Quality Assurance Report - Organic Analyses of Eagle Harbor Intertidal Sediment samples

This quality assurance memo supersedes the memo on the same subject of March 21, 1986.

VOLATILE COMPOUNDS

Metro performed all analyses. All samples were kept in a cooler and analyzed with 22 days of sampling. Between 0.28 and 0.85 grams of sample were purged. All samples were brought to a volume of 200 mL with organic free water. Twenty-six internal recovery standards were used for quantitation by isotope dilution GCIMS.

As we discussed, these data for volatile organic componds have been evaluated in a manner similar to that used for data produced by contract laboratories for the U.S. EPA Superfund program (e.g., no positive results are reported unless the sample concentration is >5 times the blank concentration or >10 times blank concentration of methylene chloride or acetone). The summaries of the results are attached. The data are not blank corrected but are corrected for recovery of the internal standards. The values are reported as ug/kg dry-weight. (The data from the laboratory are reported as ug/kg wet-weight).

SEMIVOLATILE COMPOUNDS

Metro performed all analyses. Fifty-four internal recovery standards were used for quantitation by isotope dilution GC/MS. Analytical problems were encountered and three samples were extracted and analyzed a second time [i.e., IS-1, IS-2, IS-4 (Ecology #248592, 248593, 248595]. The samples were held in storage at 4° C. Recovery of acid compounds is improved in the second analyses Although it is suspected that there may have been sample degradation during storage there is no conclusive evidence to support this conclusion. The results have been accepted as estimates (E). Results for IS-3 acid compounds have been rejected (R).

While concentrations of high molecular weight PAH are similar for both the first and second analyses, the results of the second analysis indicate that there may have been some degration of low molecular weight PAH in IS-1 and IS-2 during storage. There is no basis for suspecting degradation of IS-4. The results of the first analyses of IS-1, IS-2, and IS-3 have been accepted with the qualifiers shown for base and neutral compounds. The results of the second analysis of IS-4 have been accepted with the qualifiers shown. Some calculation errors have been detected and corrected. The values and detection limits summarized are recovery and blank corrected and expressed in uglkg dry-weight.

The second extraction and preparation of the samples resulted in generally cleaner extracts for GC/ECD analysis. These results have been accepted with the qualifications noted. It is recommended that the results for PCBs be reported as total PCBs rather than individual Aroclors. Where the laboratory reported a < value, the charicteristic Aroclor peaks were present but interferences prevented proper quantification. The number reported is a maximum estimate for that Aroclor. Results for Aroclors have been added and the result is expressed as total PCBs. A total PCB value that contains a < sign indicates that at least one "maximum estimate" was included in the total (i.e., IS-2). No pesticides were detected in any sample. Metro states that the detecction limits for these compounds are the same as those listed in their Organics Analytical Support and Data Validity document. Sufficient data to verify these detection limits have not been provided.

SUMMARY

Volatile compound analyses have been evaluated using criteria similar to those used for U.S. EPA Superfund contract laboratory program. The acid results for the reanalyses of IS-1, IS-2, and IS-4 are estimates and IS-3 has been rejected. Base and neutral compounds results are accepted from the first analyses of IS-1, IS-2, IS-3 and the second analysis of IS-4. The pesticide and PCB results from the second analyses are accepted for IS-1, IS-2, IS-4 and the first analysis for IS-3.

/jfw: TC 3025-03

TETRA TECH, INC.
A HONEYWELL SUBSIDIARY
11820 NORTHUP WY, STE. 100
BELLEVUE, WA 98005-1927
TELEPHONE (206) 822-9596

May 16, 1986

Bill Yake
Department of Ecology
LU-11
7272 Cleanwater Lane
Olympia, WA 98504

Dear Bill:

Enclosed please find the summary sheets for your two Eagle Harbor samples (418155, 418156). These data were received by Tetra Tech May 15, 1986. As we discussed on the phone, the field blank concentrations are low relative to the IW-1 sample. Please call if you have any questions.

Sincerely,

Harry Beller for

Julia Wilcox
Environmental Chemist
Environmental Systems Engineering

JW/blm: TC-3025-03

Enclosure

cc: R. Barrick, Tt
G. Stumpf, Ecology
M. McCall, Ecology

ORGANICS ANALYSIS DATA REPORT

DOE Eagle Harbor

Metro Sample Number: 418155 Sample I.D. Number: Field Blank

PESTICIDE/PCB COMPOUNDS

		PPB Dry Weight	Standard Deviation	% Recovery
.	Alpha-BHC	ND		
.	Beta-BHC			
.	Delta-BHC			
.	Gamma-BHC (Lindane)			
.	Heptachlor			
.	Aldrin			
.	Heptachlor Epoxide			
.	Endosulfan 1			
.	Dieldrin			
0.	4,4-DDE			
1.	Endrin			
2.	Endosulfan 11			
3.	4,4-DDD			
4.	Endrin Aldehyde			
5.	Endosulfan Sulfate			
.	4,4-DDT	ND		
7.	Methoxychlor	NA		
3.	Endrin Ketone	NA		
.	Chlordane	ND		
.	Toxaphene			
.	Aroclor-1016			
.	Aroclor-1221			
.	Aroclor-1232			
.	Aroclor-1242			
.	Aroclor-1248			
.	Aroclor-1254			
.	Aroclor-1260	ND		

RECEIVED
MAY 15 1986
BELLEVUE, WASHINGTON

ORGANICS SAMPLE NARRATIVE

DOE Eagle Harbor

Metro Sample Number: 418155 Sample I.D. Number: Field Blank

Matrix: H_2O Date Received: 10-9-85 Date Extracted: 11-25-85

%Solids: NA Wet Weight Ext./Final Ext. Vol.: 1 liter/1 ml

Storage Method Prior to Ext.: 4°C* Storage Method After Ext.: 4°C

		Acids	Base	Neutrals
Spike I.D.: 240	Spike ug/sample ~~Ng Max.~~:	60	30	30

Instrumentation:	GPC	NPC	FID	ECD:	
Date:	12-23-85	12-24-85	12-31-85	1-11-86	
Volume Injected:	1 ml	1 ml	1 ul	1 ul	

GC-MS:	1	2	3	4
Fraction:	Neutral	Acid	Backflush	
Fraction Vol.:	1 ml	1 ml	1 ml	
Instrument:	Finn B	Finn B	Finn B	
Amount Inj.:				
Data File:	N0105B	A0104E	BF0115C	

Comments:

- This sample was run on the Normal Phase Liquid Chromatograph immediately following sample 248550 (EH-). This sample (248550) was highly contaminated and the possibility of sample carry over may explain the small amounts of florene, phenanthrene, etc found in the blank.
- No target compound peaks were found in the base fraction by FID and it was not analyzed by GC-MS.

*- This blank was allowed to sit at room temperature for 14 days during our lab move.

1-17-86

ORGANCCS ANALYSIS DATA SHEET

METRO SAMPLE NUMBER: 418155

DOE SAMPLE NUMBER: Field Blank

DRY WT. FACTOR: NA

MATRIX: H_2O

AMOUNT ANALYZED: 1 liter

Just B –

SPIKE ID: 240 (150ul)

IKE max	COMPOUND	DETECTION LIMIT ng	SPIKE ng	SAMPLE ng	PPB	S.D.	% REC
	1. N-Nitrosodimethylamine	—	—	NA	—		
	2. Phenol	3.0	4.8	ND	ND		8
	3. Aniline	—	—	NA	—		
	4. bis(-2-Chloroethyl)Ether	0.4	2.9		ND		19
	5. 2-Chlorophenol	1.7	~~26.5~~ 18		↕		30
	6. 1,3-Dichlorobenzene	0.2	2.5				17
	7. 1,4-Dichlorobenzene	0.3	~~31~~ 2.9		ND		~~21~~ 19
	8. Benzyl Alcohol	—	—	NA	—		
	9. 1,2-Dichlorobenzene	0.4	3.1		ND		21
	10. 2-Methylphenol	—	—	NA	—		
	11. bis(2-chloroisopropyl)Ether	2.1	3.9		ND		26
	12. 4-Methylphenol	—	—	NA	—		
	13. N-Nitroso-Di-n-Propylamine	—	—	NA	—		
	14. Hexachloroethane	0.2	2.2		ND		15
	15. Nitrobenzene	0.2	1.6		↕		10
	16. Isophorone	0.6	3.0				20
	17. 2-Nitrophenol	0.7	1.3				2
	18. 2,4-Dimethylphenol	1.0	~~38~~ 22.6				38
	19. Benzoic Acid	—	—	NA			
	20. bis(-2-Chloroethoxy)Methane	0.5	2.7				18
	21. 2,4-Dichlorophenol	0.4	4.8				8
	22. 1,2,4-Trichlorobenzene	0.2	4.2				28
	23. Naphthalene	1.7	4.7	0.5	ND		31
	24. 4-Chloroaniline	—	—	NA	—		
	25. Hexachlorobutadiene	0.2	3.3		ND		22
	26. 4-Chloro-3-Methylphenol	1.6	16.2	0.1	ND		21
	27. 2-Methylnaphthalene	—	—	NA	—		
	28. Hexachlorocyclopentadiene	0.8	ND		ND		0
	29. 2,4,6-Trichlorophenol	3.8	5.1		↕		8
	30. 2,4,5-Trichlorophenol	3.1	6.2				10
	31. 2-Chloronaphthalene	0.5	5.4		ND		36
	32. 2-Nitroaniline	—	—	NA	—		
	33. Dimethyl Phthalate	0.3	5.1		ND		34
	34. Acenaphthylene	0.4	5.6		ND		38
	35. 3-Nitroaniline	—	—	NA	—		
	36. Acenaphthene	0.4	5.9		ND		40
	37. 2,4-Dinitrophenol	1.7	2.2		ND		4
	38. 4-Nitrophenol	1.0	2.8		ND		5
	39. Dibenzofuran	—		NA	—		
	40. 2,4-Dinitrotoluene	0.4	1.5		ND		10
	41. 2,6-Dinitrotoluene	0.4	2.7		ND		18
	42. Diethylphthalate	0.9	5.2	1.2	2.4		35
	43. 4-Chlorophenyl-phenylether	0.2	7.0		ND		47
	44. Fluorene	0.5	7.4	0.4	ND		50
	45. 4-Nitroaniline	—	—	NA	—		
	46. 4,6-Dinitro-2-Methylphenol	0.6	7.1		ND		12
	47. N-Nitrosodiphenylamine(1)	1.1	4.5		ND		30
	48. 4-Bromophenyl-phenylether	—	—	NA	—		
	49. Hexachlorobenzene	0.1	7.8		ND		52
	50. Pentachlorophenol	0.5	15.6		ND		26
	51. Phenanthrene	0.3	7.7	1.5	3.0		51
	52. Anthracene	0.4	7.7	0.4	ND		51
	53. Di-n-Butylphthalate	1.0	4.7	9.0	18.0		31
	54. Fluoranthene	0.6	8.5	0.7	1.4		57
	55. Benzidine	2.3	ND		ND		0
	56. Pyrene	0.4	8.2	0.6	1.2		55
	57. Butylbenzylphthalate	0.2	2.0	0.5	1.0		13
	58. 3,3-Dichlorobenzidine	0.7	ND		ND		0
	59. Benzo(a)Anthracene	0.3	6.2	0.1	ND		41
	60. bis(2-Ethylhexyl)Phthalate	0.6	1.8	3.3	6.6		12
	61. Chrysene	0.3	7.5	0.1	ND		50
	62. Di-n-Octyl Phthalate	0.4	1.5		ND		10
	63. Benzo(b)Fluoranthene	1.3	6.1		↕		41
	64. Benzo(k)Fluoranthene	1.5	6.5				44
	65. Benzo(a)Pyrene	0.8	6.0				40
	66. Indeno(1,2,3-cd)Pyrene	0.9	NA				24
	67. Dibenz(a,h)Anthracene	1.4	3.6				24
	68. Benzo(g,h,i)Perylene	1.0	4.8		ND		32

RECEIVED
MAY 15 1986
BELLEVUE, WASHINGTON
DOE Eagle Harbor

ORGANICS SAMPLE NARRATIVE

Metro Sample Number: 418156 Sample I.D. Number: Transit Blank

Matrix: H_2O Date Received: 10-9-85 Date Extracted: 11-25-85

% Solids: NA Wet Weight Ext./Final Ext. Vol.: 1 liter / 1 ml

Storage Method Prior to Ext.: 4°C Storage Method After Ext.: 4°C

		Acids	Base	Neutrals
Spike I.D.: 240	Spike Ng Max.: 150 µL	60	30	30

Instrumentation:	GPC	NPC	FID	ECD	
Date:	12-23-85	12-25-85	1-8-86	1-11-86	
Volume Injected:	1 ml	1 ml	1µL	1µL	

GC-MS:	1	2	3	4
Fraction:	(1:2 DIL.) Neutural	Acid	Backflush	
Fraction Vol.:	1mL	1mL	1mL	
Instrument:	Finn A	Finn B	Finn B	
Amount Inj.:	1µL	1µL	1µL	
Data File:	N0109B	A0109C	BF0113E	

Comments:

- Low recovery of more volatile compounds appears to be a blow-down problem.
- This blank was allowed to sit at room temperature for 14 days prior to extraction

ORGANCCS ANALYSIS DATA SHEET

METRO SAMPLE NUMBER: 418156

DOE SAMPLE NUMBER: Eagle Harbor Transport Blank DRY WT. FACTOR: ——

MATRIX: H_2O AMOUNT ANALYZED: 1 liter SPIKE ID: 240 (150µl)

Ist B –

IKE max	COMPOUND	DETECTION LIMIT ng	SPIKE ng	SAMPLE ng	PPB	S.D.	REC
1.	N-Nitrosodimethylamine	—	—	NA			
2.	Phenol	3.0	2.0		ND		3
3.	Aniline	—	—	NA			
4.	bis(-2-Chloroethyl)Ether	0.4	ND		ND		0
5.	2-Chlorophenol	1.7	9.2		↕		15
6.	1,3-Dichlorobenzene	0.2	ND		↕		0
7.	1,4-Dichlorobenzene	0.3	ND		ND		0
8.	Benzyl Alcohol	—	—	NA			
9.	1,2-Dichlorobenzene	0.4	ND		ND		0
10.	2-Methylphenol	—	—	NA			
11.	bis(2-chloroisopropyl)Ether	2.1	ND		ND		0
12.	4-Methylphenol	—	—	NA			
13.	N-Nitroso-Di-n-Propylamine	—	—	NA			
14.	Hexachloroethane	0.2	ND		ND		0
15.	Nitrobenzene	0.2	ND		↕		0
16.	Isophorone	0.6	1.9		↕		12
17.	2-Nitrophenol	0.7	1.6		↕		3
18.	2,4-Dimethylphenol	1.0	11.4		ND		19
19.	Benzoic Acid	—	—	NA			
20.	bis(-2-Chloroethoxy)Methane	0.5	1.9		ND		13
21.	2,4-Dichlorophenol	0.4	5.4		↕		9
22.	1,2,4-Trichlorobenzene	0.2	ND		↕		0
23.	Naphthalene	1.7	ND		ND		0
24.	4-Chloroaniline	—	—	NA			
25.	Hexachlorobutadiene	0.2	ND		ND		0
26.	4-Chloro-3-Methylphenol	1.6	8.5		ND		14
27.	2-Methylnaphthalene	—	—	NA			
28.	Hexachlorocyclopentadiene	0.8	ND		ND		0
29.	2,4,6-Trichlorophenol	3.8	6.3		↕		10
30.	2,4,5-Trichlorophenol	3.1	7.0		↕		12
31.	2-Chloronaphthalene	0.5	1.0		ND		6
32.	2-Nitroaniline	—	—	NA			
33.	Dimethyl Phthalate	0.3	4.2		ND		28
34.	Acenaphthalene	0.4	1.6		ND		11
35.	3-Nitroaniline	—	—	NA			
36.	Acenaphthene	0.4	3.5		ND		23
37.	2,4-Dinitrophenol	1.7	ND		↕		0
38.	4-Nitrophenol	1.0	5.4		ND		9
39.	Dibenzofuran	—	—	NA			
40.	2,4-Dinitrotoluene	0.4	1.2		ND		8
41.	2,6-Dinitrotoluene	0.4	3.0		ND		20
42.	Diethylphthalate	0.9	4.4	6.9	14		30
43.	4-Chlorophenyl-phenylether	0.2	4.5		ND		30
44.	Fluorene	0.5	4.5		ND		30
45.	4-Nitroaniline	—	—	NA			
46.	4,6-Dinitro-2-Methylphenol	0.6	4.0		ND		7
47.	N-Nitrosodiphenylamine(1)	1.1	3.4		ND		23
48.	4-Bromophenyl-phenylether	—	—	NA			
49.	Hexachlorobenzene	0.1	6.4		ND		42
50.	Pentachlorophenol	0.5	14.3		↕		24
51.	Phenanthrene	0.3	5.0		↕		33
52.	Anthracene	0.4	5.3		ND		35
53.	Di-n-Butylphthalate	1.0	4.4	15.4	31		29
54.	Fluoranthene	0.6	5.8		ND		39
55.	Benzidine	2.3	0.6		↕		4
56.	Pyrene	0.4	6.0		↕		40
57.	Butylbenzylphthalate	0.2	3.9		↕		26
58.	3,3-Dichlorobenzidine	0.7	ND		↕		0
59.	Benzo(a)Anthracene	0.3	4.9		ND		33
60.	bis(2-Ethylhexyl)Phthalate	0.6	4.2	13.6	27		28
61.	Chrysene	0.3	5.3		ND		35
62.	Di-n-Octyl Phthalate	0.4	3.5		↕		24
63.	Benzo(b)Fluoranthene	1.3	5.4		↕		36
64.	Benzo(k)Fluoranthene	1.5	5.1		↕		34
65.	Benzo(a)Pyrene	0.8	4.4		↕		29
66.	Indeno(1,2,3-cd)Pyrene	0.9			↕		
67.	Dibenz(a,h)Anthracene	1.4	4.5		↕		30
68.	Benzo(g,h,i)Perylene	1.0	2.1		ND		14

ORGANICS ANALYSIS DATA REPORT

DOE Eagle Harbor

Sample Number: 418156   Sample I.D. Number: Transport Blank

PESTICIDE/PCB
COMPOUNDS

	PPB Dry Weight	Standard Deviation	% Recovery
Alpha-BHC	ND		
Beta-BHC			
Delta-BHC			
Gamma-BHC (Lindane)			
Heptachlor			
Aldrin			
Heptachlor Epoxide			
Endosulfan 1			
Dieldrin			
4,4-DDE			
Endrin			
Endosulfan 11			
4,4-DDD			
Endrin Aldehyde			
Endosulfan Sulfate			
4,4-DDT	ND		
Methoxychlor	NA		
Endrin Ketone	NA		
Chlordane	ND		
Toxaphene			
Aroclor-1016			
Aroclor-1.223			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260	ND		

EAGLE HARBOR INTERTIDAL SEEP SAMPLES
Volatile Organic Analysis Report ug/L

COMPOUND	IW-1	IW-2	IW-3	IW-4	WA-1	FB
Chloromethane	UE 10	UE 10	UE 10	UE 10	UE 10	UE 10
Bromomethane	UE 10	UE 10	UE 10	UE 10	UE 10	UE 10
Vinyl Chloride	UE 10	UE 10	UE 10	UE 10	UE 10	UE 10
Chloroethane	UE 10	UE 10	UE 10	UE 10	UE 10	UE 10
Methylene Chloride	UE 66	UE 60	UE 5	UE 5	UE 72	E 35
1,1-Dichloroethene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,1-Dichloroethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
trans-1,2-dichloroethene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
cis-1,2-dichloroethene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Chloroform	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,2-Dichloroethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,1,1-Trichloroethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Carbon Tetrachloride	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Bromodichloromethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,1,2,2-Tetrachloroethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,2-Dichloropropane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
trans-1,3-Dichloropropene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Trichloroethene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Dibromochloromethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
1,1,2-Trichloroethane	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Benzene	UE 11	UE 5	UE 5	UE 5	UE 5	UE 5
Bromoform	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Tetrachloroethene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Toluene	UE 68	UE 23	UE 5	UE 5	UE 53	UE 5
Chlorobenzene	UE 5	UE 5	UE 5	UE 5	UE 5	UE 5
Ethylbenzene	E 21	E 11	UE 5	UE 5	E 28	UE 5

U = undetected at detection limit shown.

E = estimated value. [illegible]

EAGLE HARBOR INTERTIDAL SEEP SAMPLES

Volatile Organic Analysis Report ug/L

COMPOUND	TB	PB
Chloromethane	UE 10	UE 10
Bromomethane	UE 10	UE 10
Vinyl Chloride	UE 10	UE 10
Chloroethane	UE 10	UE 10
Methylene Chloride	E 13	E 8
1,1-Dichloroethene	UE 5	UE 5
1,1-Dichloroethane	UE 5	UE 5
trans-1,2-dichloroethene	UE 5	UE 5
cis-1,2-dichloroethene	UE 5	UE 5
Chloroform	UE 5	UE 5
1,2-Dichloroethane	UE 5	UE 5
1,1,1-Trichloroethane	UE 5	UE 5
Carbon Tetrachloride	UE 5	UE 5
Bromodichloromethane	UE 5	UE 5
1,1,2,2-Tetrachloroethane	UE 5	UE 5
1,2-Dichloropropane	UE 5	UE 5
trans-1,3-Dichloropropene	UE 5	UE 5
Trichloroethene	UE 5	UE 5
Dibromochloromethane	UE 5	UE 5
1,1,2-Trichloroethane	UE 5	UE 5
Benzene	UE 5	UE 5
Bromoform	UE 5	UE 5
Tetrachloroethene	UE 5	UE 5
Toluene	UE 5	UE 5
Chlorobenzene	UE 5	UE 5
Ethylbenzene	UE 5	UE 5

U = undetected at the detection limit shown.
E = estimated value.

Eagle Harbor intertidal sediment samples

μg/kg dry weight

IKE max	COMPOUND	IS-1	IS-2	IS-3	IS-4	
*						
/2	1. N-Nitrosodimethylamine	NA →				
	2. Phenol	E39	E 33	R	E1700	A
	3. Aniline	NA →				
/2	4. bis(-2-Chloroethyl)Ether	>U 1100	>U 1300	PU 5000	U 300	
	5. 2-Chlorophenol	E >U 3200	E>U 3800	R	EU 400	A
0/2	6. 1,3-Dichlorobenzene	>U 1100	>U 1300	PU 9000	PU 300	
0/2	7. 1,4-Dichlorobenzene	>U 1100	>U 1300	PU 9000	PU 400	
	8. Benzyl Alcohol	NA →				
0/2	9. 1,2-Dichlorobenzene	E 93	E120	PU 11000	PU 500	
	10. 2-Methylphenol	NA →				A
0/2	11. bis(2-chloroisopropyl)Ether	>U 1100	>U 1300	PU 500	U 1000	
	12. 4-Methylphenol	NA →				A
	13. N-Nitroso-Di-n-Propylamine	NA →				
0/2	14. Hexachloroethane	>U 1100	>U 1300	>U 1300	PU 500	
0/2	15. Nitrobenzene	>U 1100	>U 1300	>U 1300	U 1400	
0/2	16. Isophorone	>U 1100	>U 1300	U 300	U 300	
	17. 2-Nitrophenol	E >U 3200	EUP 600	R	>U 3400	A
	18. 2,4-Dimethylphenol	E 53	E 60	R	E 60	A
	19. Benzoic Acid	NA →				
	20. bis(-2-Chloroethoxy)Methane	>U 1100	>U 1300	>U 1300	U 200	
0	21. 2,4-Dichlorophenol	EU 200	EUP 400	R	PEU 3000	A
0/2	22. 1,2,4-Trichlorobenzene	PU 1100	>U 1300	PU 400	PU 200	
2/2	23. Naphthalene	P E 36000	PE 18000	11000	PE 1100	
	24. 4-Chloroaniline	NA →				
0/2	25. Hexachlorobutadiene	>U 1100	>U 1300	PU 5000	PU 250	
0	26. 4-Chloro-3-Methylphenol	EU 200	EU 250	R	EU 250	A
	27. 2-Methylnaphthalene	NA →				
/2	28. Hexachlorocyclopentadiene	>U 1100	>U 1300	>U 1300	>U 1700	
	29. 2,4,6-Trichlorophenol	EU 400	EUP 2400	R	EU 1500	
0	30. 2,4,5-Trichlorophenol	EU 800	EUP 5000	R	EU 3000	
0/2	31. 2-Chloronaphthalene	PU 400	U 400	U 300	U 400	
	32. 2-Nitroaniline	NA				
0/2	33. Dimethyl Phthalate	PU 700	>U 1300	U 300	250	
0/2	34. Acenaphthylene	U 500	U 500	U 400	1600	
	35. 3-Nitroaniline	NA →				
0/2	36. Acenaphthene	9600	U 100	4700	4600	
0	37. 2,4-Dinitrophenol	P EU 1500	E>U 3800	R	E>U 3400	A
0	38. 4-Nitrophenol	P EU 500	E>U 3800	R	E>U 3400	A
	39. Dibenzofuran	NA →				
0/2	40. 2,4-Dinitrotoluene	>U 1100	U 50	>U 1300	>U 1700	
0/2	41. 2,6-Dinitrotoluene	>U 1100	U 1200	>U 1300	U 300	
0/2	42. Diethylphthalate	>U 1100	U 600	92	440	
0/2	43. 4-Chlorophenyl-phenylether	U 100	U 100	U 100	U 100	
0/2	44. Fluorene	6500	1600	3200	4500	
	45. 4-Nitroaniline	NA →				
0	46. 4,6-Dinitro-2-Methylphenol	P EU 250	E>U 3800	R	PEU 1500	A
0/2	47. N-Nitrosodiphenylamine(1)	U 1700	U 1700	U 800	U 500	
	48. 4-Bromophenyl-phenylether	NA →				
0/2	49. Hexachlorobenzene	U 200	U 100	PU 3000	U 100	
0	50. Pentachlorophenol	EU 100	E>U 3800	R	E 180	A
0/2	51. Phenanthrene	6800	1800	3200	20000	
0/2	52. Anthracene	6000	U 500	3200	14000	
0/2	53. Di-n-Butylphthalate	P 210	190	400	1300	
0/2	54. Fluoranthene	5400	800	3600	110000	
0/2	55. Benzidine	>U 1100	>U 1300	>U 1300	>U 1700	
0/2	56. Pyrene	4200	450	3000	75000	
	57. Butylbenzylphthalate	>U 1100	>U 1300	>U 1300	130	
0/2	58. 3,3-Dichlorobenzidine	>U 1100	>U 1300	>U 1300	>U 1700	
0/2	59. Benzo(a)Anthracene	1300	U 700	1300	20000	
0/2	60. bis(2-Ethylhexyl)Phthalate	PU 2100	PU 500	470	36000	
0/2	61. Chrysene	1300	U 400	1700	29000	
0/2	62. Di-n-Octyl Phthalate	PU 800	PU 300	U 100	83	
0/2	63. Benzo(b)Fluoranthene	430	U 700	830	22000	
0/2	64. Benzo(k)Fluoranthene	560	U 400	716	20000	
0/2	65. Benzo(a)Pyrene	440	U 1200	600	14000	
0/2	66. Indeno(1,2,3-cd)Pyrene	>U 1100	PU 500	U 100	4000	
0/2	67. Dibenz(a,h)Anthracene	>U 1100	PU 500	U 100	2000	
0/2	68. Benzo(g,h,i)Perylene	PU 37000	PU 1500	U 900	8300	

P = internal standard recovery <10%

>U = minimum detection limit. No internal standard recovery.

U = Undetected at detection limit shown

R = Data rejected.

E = Estimated value.

NA = NOT ANALYSED

EAGLE HARBOR INTERTIDAL SEDIMENT SAMPLES

Volatile Organic Analysis Report ug/kg dry-weight

COMPOUND	IS-1	IS-2	IS-3	IS-4
Chloromethane	UE 100	UE 100	UE 100	UE 100
Bromomethane	UE 100	UE 100	UE 100	UE 100
Vinyl Chloride	UE 100	UE 100	UE 100	UE 100
Chloroethane	UE 100	UE 100	UE 100	UE 100
Methylene Chloride	UE 50	UE 50	UE 50	UE 50
1,1-Dichloroethene	UE 50	UE 50	UE 50	UE 50
1,1-Dichloroethane	UE 50	UE 50	UE 50	UE 50
trans-1,2-dichloroethene	UE 50	UE 50	UE 50	UE 50
cis-1,2-dichloroethene	UE 50	UE 50	UE 50	UE 50
Chloroform	UE 50	UE 50	UE 50	UE 50
1,2-Dichloroethane	UE 50	UE 50	UE 50	UE 50
1,1,1-Trichloroethane	UE 50	UE 50	UE 50	UE 50
Carbon Tetrachloride	UE 50	UE 50	UE 50	UE 50
Bromodichloromethane	UE 50	UE 50	UE 50	UE 50
1,1,2,2-Tetrachloroethane	UE 50	UE 50	UE 50	UE 50
1,2-Dichloropropane	UE 50	UE 50	UE 50	UE 50
trans-1,3-Dichloropropene	UE 50	UE 50	UE 50	UE 50
Trichloroethene	UE 50	UE 50	UE 50	UE 50
Dibromochloromethane	UE 50	UE 50	UE 50	UE 50
1,1,2-Trichloroethane	UE 50	UE 50	UE 50	UE 50
Benzene	UE 50	UE 50	UE 50	UE 50
Bromoform	UE 50	UE 50	UE 50	UE 50
Tetrachloroethene	UE 50	UE 50	UE 50	UE 50
Toluene	UE 300	UE 50	UE 50	UE 50
Chlorobenzene	UE 50	UE 50	UE 50	UE 50
Ethylbenzene	E 750	UE 50	UE 50	UE 50

U = undetected at detection limit shown.
E = estimated value. all samples analysed after 14 d holding time

COMPOUND	DI IW-1			
*	ug/L			
1. N-Nitrosodimethylamine	NA			
2. Phenol P	E12			
3. Aniline	NA			
4. bis(-2-Chloroethyl)Ether E	U8			
5. 2-Chlorophenol E	U8			
6. 1,3-Dichlorobenzene E	U9			
7. 1,4-Dichlorobenzene E	U10			
8. Benzyl Alcohol	NA			
9. 1,2-Dichlorobenzene E	U15			
10. 2-Methylphenol	NA			
11. bis(2-chloroisopropyl)Ether	EU100			
12. 4-Methylphenol	NA			
13. N-Nitroso-Di-n-Propylamine	NA			
14. Hexachloroethane	EU13			
15. Nitrobenzene	EU7			
16. Isophorone	EU11			
17. 2-Nitrophenol	EU6			
18. 2,4-Dimethylphenol	E16			
19. Benzoic Acid	NA			
20. bis(-2-Chloroethoxy)Methane	EU240			
21. 2,4-Dichlorophenol	EU3			
22. 1,2,4-Trichlorobenzene	EU14			
23. Naphthalene	E5800			
24. 4-Chloroaniline	NA			
25. Hexachlorobutadiene	EU7			
26. 4-Chloro-3-Methylphenol	EU8			
27. 2-Methylnaphthalene	NA			
28. Hexachlorocyclopentadiene	EU240			
29. 2,4,6-Trichlorophenol	EU30			
30. 2,4,5-Trichlorophenol	E4.4			
31. 2-Chloronaphthalene	EU35			
32. 2-Nitroaniline	NA			
33. Dimethyl Phthalate	EU8			
34. Acenaphthylene	E80			
35. 3-Nitroaniline	NA			
36. Acenaphthene	E2300			
37. 2,4-Dinitrophenol	EU24			
38. 4-Nitrophenol	EU7			
39. Dibenzofuran	NA			
40. 2,4-Dinitrotoluene	EU240			
41. 2,6-Dinitrotoluene	EU15			
42. Diethylphthalate	EU240			
43. 4-Chlorophenyl-phenylether	EU5			
44. Fluorene	E1600			
45. 4-Nitroaniline	NA			
46. 4,6-Dinitro-2-Methylphenol	EU4			
47. N-Nitrosodiphenylamine(1)	EU30			
48. 4-Bromophenyl-phenylether	NA			
49. Hexachlorobenzene	EU3			
50. Pentachlorophenol	E14			
51. Phenanthrene	E2500			
52. Anthracene	E1600			
53. Di-n-Butylphthalate	EU20			
54. Fluoranthene	E1500			
55. Benzidine	EU240			
56. Pyrene	E1420			
57. Butylbenzylphthalate	EU4			
58. 3,3-Dichlorobenzidine	E23			
59. Benzo(a)Anthracene	E430			
60. bis(2-Ethylhexyl)Phthalate	EU12			
61. Chrysene	E390			
62. Di-n-Octyl Phthalate	EU7			
63. Benzo(b)Fluoranthene	E200			
64. Benzo(k)Fluoranthene	E170			
65. Benzo(a)Pyrene	E200			
66. Indeno(1,2,3-cd)Pyrene	E60			
67. Dibenz(a,h)Anthracene	E30			
68. Benzo(g,h,i)Perylene	E70			

ORGANICS ANALYSIS DATA REPORT

Metro Sample Number: 418151 sample I.D. Number: IW-1

PESTICIDE/PCB
COMPOUNDS

	PPB Dry Weight	Standard Deviation	% Recovery
Alpha-BHC	ND		
Beta-BHC			
Delta-BHC			
Gamma-BHC (Lindane)			
Heptachlor			
Aldrin			
Heptachlor Epoxide			
Endosulfan I			
Dieldrin			
4,4-DDE			
Endrin			
Endosulfan II			
4,4-DDD			
Endrin Aldehyde			
Endosulfan Sulfate			
4,4-DDT	ND		
Methoxychlor	NA		
Endrin Ketone	NA		
Chlordane	ND		
Toxaphene			
Aroclor-1016			
Aroclor-1221			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260	ND		

ORGANICS ANALYSIS DATA REPORT

tro Sample Number: 248592 Sample I.D. Number: ~~248592~~ IS-1

ESTICIDE/PCB
COMPOUNDS

	PPB Dry Weight	Standard Deviation	% Recovery
Alpha-BHC	ND		
Beta-BHC			
Delta-BHC			
Gamma-BHC (Lindane)			
Heptachlor			
Aldrin			
Heptachlor Epoxide			
Endosulfan 1			
Dieldrin			
4,4-DDE			
Endrin			
Endosulfan 11			
4,4-DDD			
Endrin Aldehyde			
Endosulfan Sulfate	↓		
4,4-DDT	ND		
Methoxychlor	NA		
Endrin Ketone	NA		
Chlordane	ND		
Toxaphene			
Aroclor-1016			
Aroclor-1221			
roclor-3.232			
roclor-1242			
roclor-1248			
roclor-1254	↓		
roclor-1260	ND		

DRM

2-8-86

ORGANICS ANALYSIS DATA REPORT

Metro Sample Number: 248593 Sample I.D. Number: IS-2

PESTICIDE/PCB COMPOUNDS

	PPB Dry Weight	Standard Deviation	% Recovery
Alpha-BHC	ND		
Beta-BHC			
Delta-BHC			
Gamma-BHC (Lindane)			
Heptachlor			
Aldrin			
Heptachlor Epoxide			
Endosulfan I			
Dieldrin			
4,4-DDE			
Endrin			
Endosulfan II			
4,4-DDD			
Endrin Aldehyde			
Endosulfan Sulfate			
4,4-DDT	↓		
Methoxychlor	NA		
Endrin Ketone	NA		
Chlordane	ND		
Toxaphene			
Aroclor-1016			
Aroclor-1221			
Aroclor-1232	↓		
Aroclor-1242	<30		
Aroclor-1248	<30		
Aroclor-1254	20	15	26
Aroclor-1260	ND		

total PCBs <80

total PCBs = sum of detected Aroclors
< = actual value less than value shown
80 is a maximum estimate

DRM
2-7-86

ORGANICS ANALYSIS DATA SHEET

METRO SAMPLE NUMBER: 248594

DOE SAMPLE NUMBER: IS-3

DRY WT. FACTOR: 0.8

MATRIX: Sediment

AMOUNT ANALYZED: 30 g

SPIKE ID: 237

COMPOUND	SAMPLE ng	PPB	S.D.	% RE
Alpha-BHC		ND		
Beta-BHC				
Delta-BHC				
Gamma-BHC (Lindane)				
Heptachlor				
Aldrin				
Heptachlor Epoxide				
Endosulfan I				
Dieldrin				
4,4-DDE				
Endrin				
Endosulfan II				
4,4-DDD				
Endrin Aldehyde				
Endosulfan Sulfate				
4,4-DDT				
Methoxychlor				
Endrin Ketone				
Chlordane				
Toxaphene				
Aroclor-1016				
Aroclor-1221				
Aroclor-1232				
Aroclor-1242				
Aroclor-1248				
Aroclor-1254				
Aroclor-1260		ND		

ORGANICS ANALYSIS DATA REPORT

Metro Sample Number: 248595   Sample I.D. Number: IS-4

PESTICIDE/PCB COMPOUNDS

	PPB Dry Weight	Standard Deviation	% Recovery
Alpha-BHC	ND		
Beta-BHC			
Delta-BHC			
Gamma-BHC (Lindane)			
Heptachlor			
Aldrin			
Heptachlor Epoxide			
Endosulfan I			
Dieldrin			
4,4-DDE			
Endrin			
Endosulfan II			
4,4-DDD			
Endrin Aldehyde			
Endosulfan Sulfate			
4,4-DDT	ND		
Methoxychlor	NA		
Endrin Ketone	NA		
Chlordane	ND		
Toxaphene			
Aroclor-1016			
Aroclor-1221			
Aroclor-1232			
Aroclor-1242			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260	ND		

DRM
2-7-86