Publication No. 92-e50

Waterbody No. WA-08-9350

RESULTS OF SEDIMENT SAMPLING IN THE J.H. BAXTER COVE, LAKE WASHINGTON- JUNE 1991

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May 20, 1992

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Water Body No. WA-08-9350
(Segment No. 04-08-101)

ABSTRACT

Priority pollutant polynuclear aromatic hydrocarbon (PAH), chlorophenol, and polychlorinated biphenyl (PCB) analyses were conducted on surface sediment samples from the cove at the southern end of the J.H. Baxter site and a reference station in Lake Washington. To assess sediment toxicity, *Hyalella azteca* and Microtox® bioassays were also conducted.

Total PAH concentrations, on a dry weight basis ranged from 43 - 33,000 mg/kg. Peak PAH concentrations in the J.H. Baxter Cove are the highest yet recorded in Lake Washington near either Quendall Terminals or the J.H. Baxter site. The highest PAH concentration measured in the Baxter Cove (3.3% total PAH) would be sufficient to designate these sediments as extremely hazardous waste under Washington State's Dangerous Waste Regulations.

The distribution of PAH and chlorophenols (especially pentachlorophenol) point to an abandoned stormwater retention pond outfall located in the J.H. Baxter Cove, as the most likely source of these compounds to sediments in the cove. PCBs were not detected at any of the locations sampled during the present survey.

INTRODUCTION

Contamination of Lake Washington sediments with organic chemicals, primarily PAHs from historical refining and wood preserving operations at Quendall Terminals and the J.H. Baxter site, has been documented in previous investigations by Ecology (Norton, 1991), and others

(Woodward-Clyde, 1989a; EPA, 1984). One of the recommendations listed in Ecology's 1991 study was to collect additional sediment samples from the cove at the southern end of the J.H. Baxter site for concurrent total organic carbon (TOC) and PAH analysis. TOC-normalized PAH levels in these sediments could then be compared to freshwater sediment guidelines established by the Ontario Ministry of the Environment (OMOE) for the protection of aquatic biological resources (Persaud *et al.*, 1991).

Ecology's Northwest Regional Office (NWRO) requested that the Toxics, Compliance, and Ground Water Investigations Section conduct sediment sampling in the J.H. Baxter Cove (Lake Washington) with the following objectives:

- Collect surface sediments (top 2 cm) from the cove at the southern end of the J.H. Baxter site and conduct concurrent TOC and PAH analyses.

- Evaluate the aquatic toxicity of cove sediments through the use of bioassays.

Results from this sampling, in conjunction with data from previous investigations at the site, will provide information on the extent of sediment contamination, and the need for remediation in Lake Washington adjacent to Quendall Terminals and the J.H. Baxter site.

METHODS

Sample Collection

To evaluate the spatial distribution of contaminants and toxicity of sediments in the J.H. Baxter Cove, surface sediment samples (top 2 cm) were collected from three stations in the cove and one off-site (reference) location on June 6, 1991. Station locations are shown in Figure 1. Station positions were located with the use of a Magellan® Model 11001 Nav 1000 Plus GPS receiver, in conjunction with depth readings. Detailed descriptions of each station are shown below in Table 1.

Table 1: Station descriptions for J.H. Baxter Cove sediment survey.

Station #	Latitude	Longitude	Description	Depth (ft)
B-1	47 32 08	122 11 97	Head of cove approx. 10 ft. from bank	2
B-2	47 32 08	122 11 99	Mid-channel in cove approx. 60 ft. from head	2
B-3	47 32 09	122 12 01	Mid-channel @ mouth of cove	2
QBR	47 32 17	122 12 27	Offshore of cove	40

Lat/Long = Degrees/Minutes
- = No reading

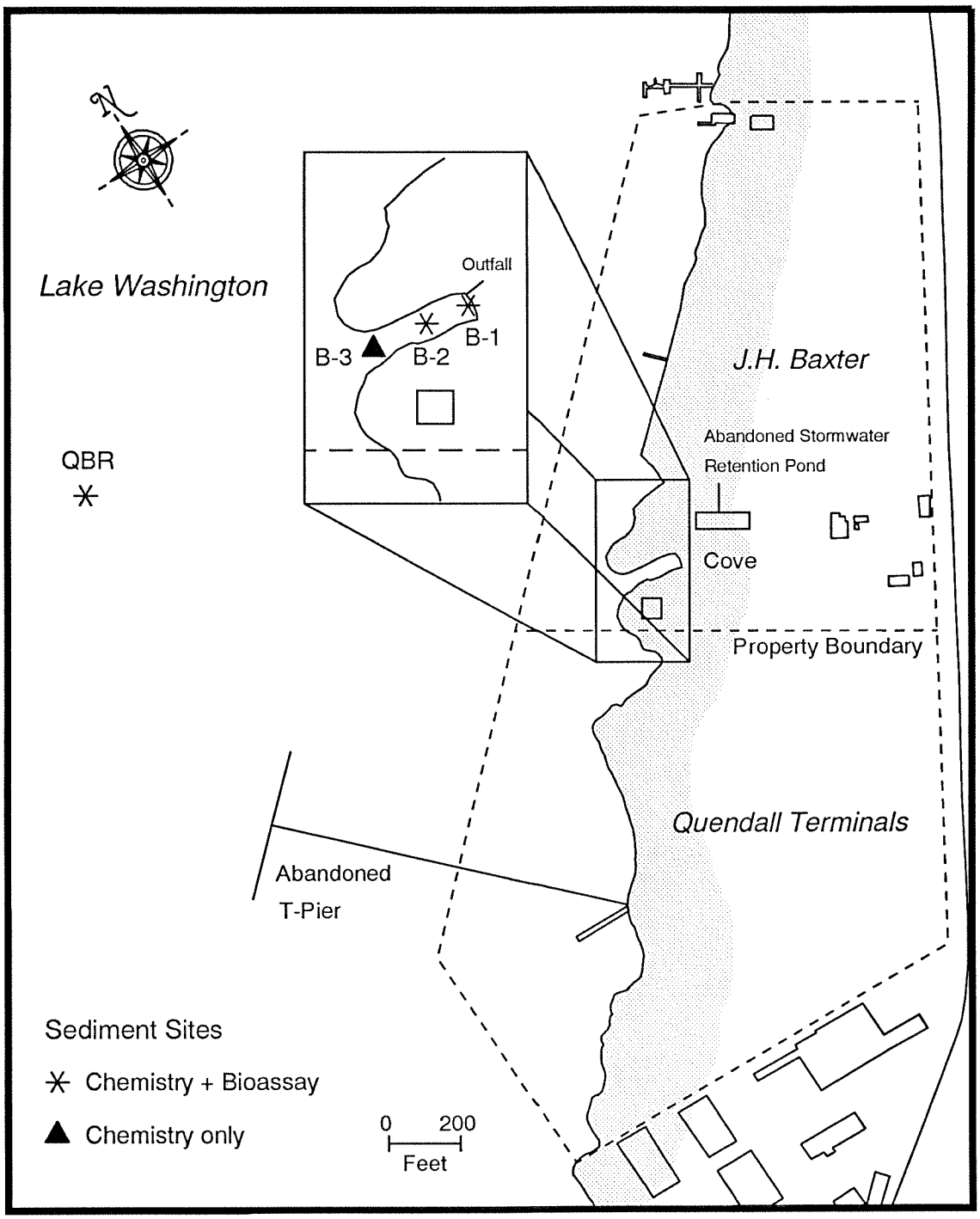

Figure 1: Station locations for sediment samples collected June 6, 1991 from the J.H. Baxter cove, Lake Washington.

Sampling was conducted in a manner consistent with methods and analytical techniques employed during Ecology's 1990 sediment investigation (Norton, 1991). Briefly, all samples were collected with the use of a 0.1 m^2 stainless steel van Veen grab. To minimize cross contamination between stations, sediments were collected in order of anticipated increasing contamination levels, based on previous sampling data and reconnaissance work. In addition, the grab was decontaminated between stations with on-site lake water, and only material not in contact with the sidewalls of the sampler was retained for analysis. Sample containers were priority-pollutant cleaned glass jars with teflon-lined lids, except for grain size aliquots which were placed in Whirlpac® bags. All samples were stored on ice for transport to the laboratory.

Sample Analysis

After reviewing data from previous site investigations, organics analysis for the present study focused on the following constituents: sixteen priority-pollutant PAHs, chlorophenols, and PCBs. The chemical analyses, analytical methods, and laboratories used in this investigation are listed in Table 2. Quality of the data set was assessed by analysis of method blanks, internal standards, surrogate spikes, duplicate matrix spikes, and blind field duplicates.

Estimates of overall precision (sampling + laboratory) calculated as relative percent difference (RPD) between detected values in blind field duplicates (range as a percent of mean) were as follows; total solids (7%), TOC (22%), grain size (20%), PAH (4%), and chlorophenols (60%). These data indicate that sample handling procedures and laboratory methods were not major contributors to data variability for most analytes. One exception being chlorophenols which had relatively low precision. Chlorophenol results are still acceptable, but could vary by a factor of two.

Quality assurance review of the PAH, chlorophenol, and PCB data was performed by Dickey Huntamer of the Ecology/EPA Manchester Laboratory. Based on quality assurance criteria specified in the analytical methods, no major problems were encountered in the analysis of these samples. Consequently, the data set is considered acceptable for use, with the accompanying qualifiers noted where appropriate. All organics results are reported in terms of mg/kg (*i.e.*, parts per million) dry weight basis unless otherwise specified.

Microtox® results were reviewed by Margaret Stinson of the Ecology/EPA Manchester Laboratory. Scott Noble, also with the Manchester Laboratory, reviewed the results of the *Hyalella azteca* toxicity test. These reviewers concluded that quality control data were appropriate for the test conditions in both bioassays.

RESULTS AND DISCUSSION

The results of conventionals analyses of Lake Washington sediments from the J.H. Baxter Cove and a reference site are shown in Table 3.

Table 2: Summary of analytical methods and laboratories for J.H. Baxter Cove sediment survey.

Analysis	Method	Reference	Laboratory
CONVENTIONALS			
Total Solids	Dry @ 104°C	Tetra Tech, 1986	AMTEST- Seattle, WA.
Total Organic Carbon	Combustion/CO2 measurement	"	AMTEST- Seattle, WA.
Grain Size	Seive and pipet	"	Soil Technology- Bainbridge Is., WA.
BIOLOGY			
Hyalella azteca	Solid phase- 14 day	ASTM, 1990	Ecology/EPA- Manchester, WA.
Microtox	Extraction/Light emission	Tetra Tech, 1986	" " "
ORGANICS			
PAH	GC/MS No. 3520/3630/8270	EPA, 1986	Ecology/EPA- Manchester, WA.
Chlorophenols	GC/ECD No. 8150 (modified)	"	" " "
PCB	GC/ECD No. 3520/8080	"	" " "

Table 3: Results of Conventionals analyses of sediment samples collected June 6, 1991, from the J.H. Baxter Cove in Lake Washington.

Station No.	B-1	B-2	B-3	QBR
Sample No. 23-	8043/44*	8042	8041	8040
Depth (ft)	2	2	2	40
Total Solids (%)	26	24	27	22
Total Organic Carbon (%)	8.3	10	9	5.7
Grain Size (%)				
Gravel (>m)	8	2	10	0
Sand (2mm-62μm)	38	12	75	24
Silt (62μm-4μm)	38	50	15	59
Clay (<4μm)	16	36	0	17

* = Reported as mean of duplicate analysis

TOC concentrations were fairly consistent in the Baxter Cove ranging from 8.3-10%. The lowest TOC value was measured at the reference site (5.7%). Grain size analysis indicates that Stations B-1, B-2, and QBR were composed primarily of silt (62 - 4μm) and clay (<4μm) size particles, while Station B-3 was primarily sand (m- 62μm).

Table 4 summarizes results of semivolatile organics analysis of sediments from the J.H. Baxter Cove and the reference site. PAH concentrations were extremely variable within the Baxter Cove with concentrations covering three orders of magnitude (total PAH= 43 - 33,000 mg/kg). The highest PAH levels were measured in the upper half of the Baxter Cove. Total PAH concentrations at the head and middle of the cove were 9,300 mg/kg, and 33,000 mg/kg, respectively. Total PAH concentrations at the mouth of the cove were 43 mg/kg. PAH concentrations at the mouth of the cove were in good agreement with concentrations obtained approximately 20 feet outside the cove during Ecology's 1990 sediment investigation (Norton, 1991). At the reference site, total PAH levels were an order of magnitude lower then those measured at the mouth of the J.H. Baxter Cove.

Two patterns were evident in the distribution of individual PAHs. In the upper half of the Baxter Cove, the sum of individual low molecular weight PAHs (LPAH) exceeded the sum of individual high molecular weight PAHs (HPAH). The opposite pattern was apparent in sediments from the mouth of the cove and at the reference site. This finding is consistent with the results of previous sediment investigations at Quendall Terminals and the J.H. Baxter site (Ecology, 1991, Woodward-Clyde, 1989a, and EPA, 1984). A total of 52 sediment samples have been collected since 1983 in Lake Washington adjacent to these sites which contain detectable levels of both LPAH and HPAH. Examination of these data indicate that the only location where LPAH to HPAH ratios exceeded one was in the upper half of the J.H. Baxter

Table 4. Summary of semivolatile organics analysis of sediment samples collected June 6, 1991 from the J.H. Baxter cove in Lake Washington (mg/kg, dry).

Station No.	B-1	B-2	B-3	QBR
Sample No. 23-	8043/44*	8042	8041	8040
Depth (ft)	2	2	2	40
Total Organic Carbon (%)	8.3	10	9	5.7
Acenaphthene	980	3900	1.1 j	1.5 u
Acenaphthylene	3.5 j	11 j	0.03 j	1.5 u
Naphthalene	600	2300	0.84 j	1.5 u
Fluorene	930	3200	1 j	1.5 u
Anthracene	680	890	0.7 j	0.057 j
Phenanthrene	2600	9500	4.4	0.19 j
Sum LPAH	5800 j	20000 j	8.1 j	0.25 j
Fluoranathene	1600	5200	7.2	0.41 j
Benzo(a)anthracene	270	890	2.7	0.35 j
Chrysene	300	950	4.2	0.51 j
Pyrene	1100	3900	6	0.41 j
Benzo(b)fluoranthene	130 j	420	5.4	0.53 j
Benzo(k)fluoranthene	39 j	140 j	1.2	0.15 j
Benzo(a)pyrene	62 j	250	3.7	0.28 j
Dibenzo(a,h)anthracene	310 u	710 j	1.1 u	3.9 u
Indeno(1,2,3-cd)pyrene	27 j	88 j	1.8	0.33 j
Benzo(g,h,i)perylene	20 j	310 j	1.9	0.32 j
Sum HPAH	3500 j	13000 j	34	3.3 j
Total PAH	9300 j	33000 j	43 j	3.6 j
Carbazole	430 j	480 j	0.32 j	7.9 u
Dibenzofuran	580	2200	0.61 j	1.5 u
Retene	130 u	360	690 j	35
1-Methylnaphthalene	460	1700	0.47 j	1.5 u
2-Methylnaphthalene	460	1600	0.31 j	1.5 u
2-Chloronaphthalene	130 u	360	1.1 u	1.5 u
Pentachlorophenol	24	0.39 j	0.19	0.025 u
2,4,5-Trichlorophenol	0.14 j	0.16 uj	0.17 u	0.12 u
2,4,6-Trichlorophenol	0.44	0.081 uj	0.085 u	0.062 u
2,3,4,5-Tetrachlorophenol	0.25	0.049 uj	0.051 u	0.037 u
2,3,4,6-Tetrachlorophenol	3.2	0.049 uj	0.051 u	0.037 u
Total PCB's	0.5 u	0.63 uj	0.11 u	-

*=Reported as mean of duplicate analysis
u=Not detected at detection limit shown
j=Estimated concentration
-=Not analyzed

Cove. Similar ratios were observed between samples from the head of the Baxter Cove collected by Woodward-Clyde in 1989 (Station No. 62= 1.7; No. 63= 1.3) and Ecology (Station B-1= 1.7; B-2= 1.5) during the present study. The apparent enrichment of LPAHs relative to HPAHs in sediments from the upper half of the Baxter Cove, suggests that an ongoing source of these compounds exists in this portion of the cove. It is well documented that weathering processes such as evaporation, photochemical oxidation, dissolution, and microbial degradation can preferentially remove PAHs with molecular weights lower than fluoranthene (Merill and Wade, 1985). The most likely source of PAHs to this area is discharge from an outfall located at the head of the cove. This outfall is connected to an abandoned stormwater retention pond which has been shown to contain high concentrations of PAHs in previous investigations (Woodward-Clyde, 1989b). The median LPAH to HPAH ratio for 19 sediment samples from the stormwater retention pond was 2.0, which is similar to the ratios observed in sediments at the head of the Baxter Cove.

Several additional compounds (carbazole, dibenzofuran, 1-methylnaphthalene, 2-methylnaphthalene, and 2-chloronaphthalene), most of which are closely related to the PAHs, were also detected in cove sediments. Peak concentrations for these compounds occurred in the middle of the cove. These compounds were not detected at the reference site. Retene, a naturally occurring resin acid-derived compound (Prahl and Carpenter, 1984), was detected in the majority of samples at concentrations ranging from 35 to 690 mg/kg. The highest concentrations were present at the mouth of the Baxter Cove, with the lowest occurring at the reference site. The apparent distribution of retene in sediments, is probably related to the presence of wood waste. This finding is consistent with field observations which noted a substantial amount of wood waste in samples from the mouth of the cove.

Three chlorophenols; tri-, tetra-, and pentachlorophenol (PCP) were noted at the head of the Baxter Cove. With the exception of PCP, which was present throughout the cove, this was the only location where chlorophenols were detected. PCP concentrations in the remainder of the cove were two orders of magnitude lower than those measured at the head. PCP was also detected at the head of the cove (Station No. 62= 2.5 mg/kg estimated) during Woodward-Clyde (1989a) sampling. For comparison, PCP concentrations (24 mg/kg) at this location during the present study were an order of magnitude higher.

The distribution of chlorophenols observed during the present study in the J.H. Baxter Cove suggests that a source of these compounds is located at the head of the cove. As with the PAHs, the most likely source of chlorophenols is discharge from the abandoned stormwater retention pond outfall. High concentrations of PCP [median(range)= 47(10-280) mg/kg] were documented in sediments from the stormwater retention pond by Woodward-Clyde (1989b). Chlorophenols were not detected at the reference site.

Technical PCP formulations used in wood treating often contain chlorinated dibenzo-*p*-dioxins and furans as impurities (Verschueren, 1983). Several dioxin and furan isomers were detected in sediments from the abandoned stormwater retention pond by Woodward-Clyde in (1989b). No testing has been performed for these compounds in the J.H. Baxter Cove. Given these facts,

it would be prudent to perform congener specific sediment analyses for dioxins and furans in that area of the Baxter Cove with the highest PCP concentrations.

PCBs were not detected at any location sampled during the present study. They were also not detected in Lake Washington sediments near Quendall Terminals or the J.H. Baxter site during Ecology's 1990 sediment investigation (Norton, 1991).

In addition to the target organics, 40 semivolatile organic compounds were tentatively identified (TI) in sediments (Table 5). TI compounds are found during mass spectral searches of sample extracts; they represent some of the most prevalent peaks in sample chromatograms that were not among the original target compounds (PSEP, 1988). The majority of TI organics were compounds closely related to PAHs. In general, a similar spatial pattern was noted for the TI organics to that of the target PAHs, with the highest concentrations being present in the upper half of the cove and substantially lower levels at the mouth.

To place PAH results from the current study into perspective, presented in Table 6 is a compilation of PAH levels in sediments from the J.H. Baxter Cove, adjoining areas of Lake Washington near Quendall Terminals and the J.H. Baxter site, and Gas Works Park in Lake Union. Median PAH concentrations from the current study are an order of magnitude higher then the median value measured in the Baxter Cove by Woodward-Clyde (1989a). Peak PAH levels were similar in these two investigations. In addition, peak concentrations from the current study are similar to peak concentrations measured by EPA (1985) near Gas Works Park (Lake Union), which is considered a heavily contaminated site. Compared to results from previous investigations in Lake Washington, sediments from the Baxter Cove contain the highest PAH concentrations yet recorded near either Quendall Terminals or the J.H. Baxter site. In fact, peak PAH concentrations (3.3% total PAH) from the present survey are high enough to designate (>1% total PAH) these sediments as an extremely hazardous waste (EHW) under Washington State's Dangerous Waste Regulations (Ecology, 1991).

Figure 2 compares total PAH in sediments from the Baxter Cove, on a TOC normalized basis, to Provincial Sediment Quality Guidelines developed by the OMOE for the protection of freshwater aquatic biological resources. These guidelines were included for comparison because they are the only biologically-based guidelines currently available to evaluate PAH levels in freshwater sediments (Bennett and Cubbage, 1991). Sediments at the head (110,000 mg PAH/kg OC) and middle (330,000 mg PAH/kg OC) of the Baxter Cove exceeded the sediment guideline for total PAH (11,000 mg PAH/kg OC) by an order of magnitude.

Caution should be used in applying these guidelines as cleanup standards because they were developed on a regional basis and have not been adopted as sediment standards or criteria by the OMOE. While Washington State is actively developing freshwater sediment standards, it will be approximately one to two years before they are available. When completed, Washington's standards may be more or less stringent than the OMOE guidelines. With these caveats in mind,

Table 5. Summary of tentatively identified semivolitile organics in sediments collected June 6, 1991 from the J.H. Baxter cove (mg/kg, dry).

Station No.	B-1	B-2	B-3	QBR
Sample No. 23-	8043/44*	8042	8041	8040
Depth (ft)	2	2	2	40
Substituted PAH's				
Naphthalenes	880	2900	21	-
Fluorenes	110	650	0.16	-
Anthracenes	-	780	1.6	-
Phenanthrenes	440	1300	11	0.55
Non-Substituted PAH's				-
Phenyl-naphthalene	120	440	0.84	-
Hexahydro-naphthalene	-	-	0.32	-
Decahydro-naphthalene	-	-	0.21	-
Benzo(a)fluorene	240	700	-	-
Benzo(b)fluorene	190	790	-	-
Benzo(g.h.i.)fluoranthene	-	360	-	-
Methanoazulene	-	-	0.29	-
Dihydroanthracene	53	220	-	-
Benzo(a)anthracene	-	120	-	-
Phenanthrene carboxaldehyde	-	-	0.87	-
Benzo(c)phenanthrene	-	220	-	-
Dihydro phenanthrene	-	71	-	-
Octahydro phenanthrene	-	-	520	-
Octahydro phenanthrenol	-	-	2.8	-
Cyclopenta(DEF)phenanthrene	370	1400	-	-
Benzo(e)pyrene	110	350	6.3	0.78
Methyl pyrene	-	140	-	-
Misc. Semivolatiles				
Substituted Benzenes	-	-	2.4	-
Substituted Biphenyls	360	690	-	-
Substituted Furans	88	670	0.23	-
Substituted Dibenzothiophene	26	-	-	-
Biphenyl	90	550	-	-
Biphenyl carboxaldehyde	170	330	-	-
3-Carene	-	-	2.1	-
Bicyclo hexane	-	-	0.72	-
Cyclohexenol	-	-	-	0.2
Cyclotetradecatetraene	-	-	11	-
Dioxabicyclooctene	-	-	0.45	-
Benzo(b)naphthofuran	78	250	-	-
Hexadecanoic Acid	-	-	-	0.98
Phenyl indene	-	170	-	-
Benzemethanol	-	-	0.32	-
Tetracosanoic acid	-	-	32	-
Terphenyl	-	110	-	-
Benzo(b)thiophene	22	76	-	-
Dibenzothiophene	170	640	0.32	-

-=Not detected at unspecified detection limit

*=Reported as mean of duplicate analysis

(All values are estimated concentrations only)

Table 6. Comparison of PAH concentrations in J.H. Baxter cove sediments with other data on sediments from Lake Washington and Gas Works Park (Lake Union).

Location	Sampling Interval	No. Samples	Median(Range) (mg/kg,dry) LPAH	HPAH	TPAH
J.H. Baxter Cove					
Present Study	Top 2cm	3	5800 (8.1–20000)	3500 (34–13000)	9300 (43–33000)
Woodward-Clyde (1989a)	Top 1ft	5*	250 (5–18000)	280 (160–10000)	530 (200–28000)
J.H. Baxter Nearshore					
Norton (1991)	Top 2cm	4	2.1 (0.23–7.2)	24 (2–7.1)	18 (2.2–30)
Woodward-Clyde (1989a)	Top 1ft	14	0.51 (ND–7.6)	1.1 (ND–15)	1.5 (ND–22)
Quendall Terminals Nearshore					
Norton (1991)	Top 2cm	4	23 (0.09–29)	210 (0.0–860)	230 (0.79–1000)
EPA (1984)	Top 1ft	2	490 (96–890)	760 (24–1500)	1300 (120–2400)
DNR Aquatic Lands near Quendall Terminals/J.H. Baxter					
Norton (1991)	Top 2cm	11	1.9 (0.36–3700)	6.7 (3.6–3600)	7.3 (4.7–7300)
EPA (1984)	Top 1ft	9	0.13 (0.02–3700)	0.69 (ND–12000)	1.9 (0.08–16000)
Gas Works Park, Lake Union					
Cubbage (1992)	Top 2cm	2	130 (2.1–260)	260 (14–510)	400 (16–780)
EPA (1985)	Top 10cm	33	34 (ND–5900)	180 (ND–25000)	420 (ND–31000)

ND= Not detected

*=Includes stations 61, 62, 63, 64, and 65.

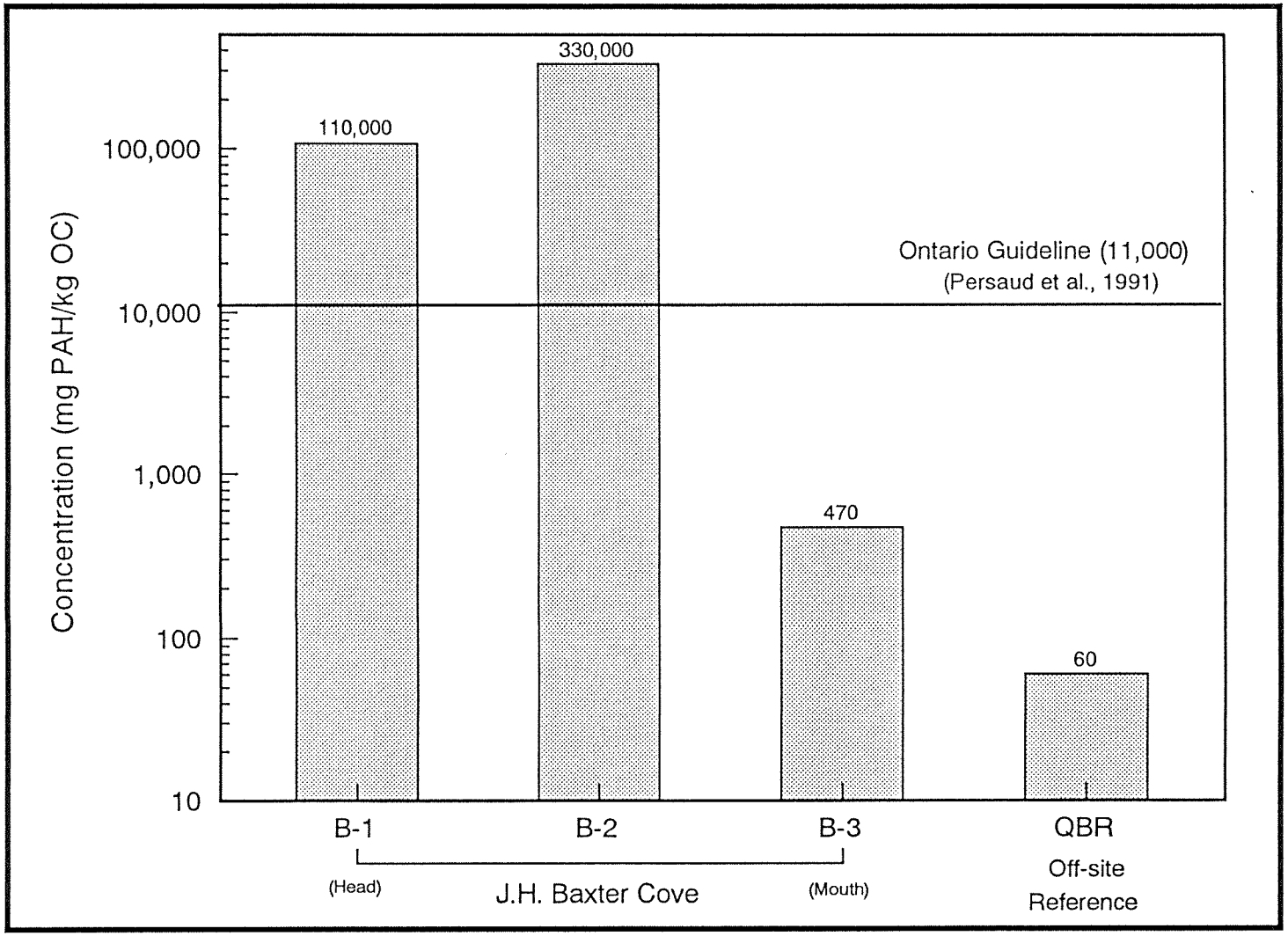

Figure 2: Comparison of TPAH concentrations in J.H. Baxter cove sediments to Provincial Sediment Quality Guidelines established by the Ontario Ministry of the Environment for the protection of aquatic resources.

the guideline shown for total PAH represents the "Severe Effects Level", which is the sediment concentration of a compound that would be detrimental to the majority of benthic species (Persaud *et al.*, 1991).

Toxicity of sediments from the J.H. Baxter Cove and the reference site were evaluated with the use of two bioassays (see Table 7 below). The bioassays were: *Hyalella azteca* (solid phase), which measures percent survival of the amphipod after a 14-day exposure to the test sediment; and Microtox® (extraction), which measures the reduction in luminescence by the bacterium *Photobacterium phosphoreum* in the presence of aqueous toxicants. Microtox® results are reported in terms of an EC_{50}, which is the concentration of test sediment (extract) required to elicit a fifty percent reduction in bioluminescence after 15 minutes of exposure.

Table 7. Results of *Hyallella azteca* and Microtox bioassays of sediments from the J. H. Baxter Cove.

Station Sample No. 23- Depth (ft)	Laboratory Control -	B-1 8043 2	B-2 8042 2	QBR 8040 40
Hyallella azteca	--	--	--	--
Survival (%)	92	0	0	50
Microtox	--	--	--	--
15 minute EC_{50} (%)	--	1.0	0.13	33

EC_{50} = 50 percent reduction in light output

Percent survival for *Hyalella azteca* ranged from 0-50%. Survival in all sediments was significantly different from that of the laboratory control, indicating that all sediments analyzed displayed some degree of toxicity to the test organism. The highest survival (50%) was measured at the reference site. No *Hyalella azteca* survived in sediments from the upper half of the Baxter Cove.

Similar results were obtained in the Microtox® bioassay, where all sediments exhibited some degree of toxicity. Microtox® results (EC_{50}) ranged from 0.13-33%. Again, the lowest toxicity was measured at the reference and the highest in sediments from the upper half of the Baxter Cove. Data from both bioassays indicate that sediments from the upper half of the J.H. Baxter Cove clearly exhibited a high degree of toxicity.

SUMMARY

The major findings of the present study can be summarized as follows:

- PAH concentrations measured during the present study are the highest yet recorded in Lake Washington near Quendall Terminals or the J.H. Baxter site. In fact, peak PAH concentration (3.3% total PAH) in the J.H. Baxter Cove are high enough to designate these sediments as an EHW under Washington State's Dangerous Waste Regulations. Total PAH concentrations in sediments from the cove were extremely variable (43-33,000 mg/kg, dry weight) covering three orders of magnitude.

- The apparent enrichment of LPAHs relative to HPAHs in sediments from the upper half of the Baxter Cove, suggests that an ongoing source of PAHs is present in this portion of the cove. The most likely source is the abandoned stormwater retention pond outfall located at the head of the cove.

- Total PAH concentrations in sediments from the upper half of the J.H. Baxter Cove are high enough to adversely affect benthic communities, based on comparisons with OMOE guidelines for the protection of aquatic biological resources. This finding is consistent with the results of *Hyalella azteca* and Microtox® bioassays, which showed these sediments to be highly toxic.

- The distribution of chlorophenols (especially PCP) in the J.H. Baxter Cove suggests that the abandoned stormwater retention pond outfall at the head of the cove is probably a major source of these compounds to sediments in the Baxter Cove.

RECOMMENDATIONS

- Control any ongoing sources of PAHs and chlorophenols (especially PCP) to the J.H. Baxter Cove prior to remediating contaminated sediments in this area.

- Remediate highly contaminated sediments in the J.H. Baxter Cove.

- Perform congener specific testing for chlorinated dibenzo-*p*-dioxins and furans on a limited number of samples from the head of the Baxter Cove. This corresponds to the area with the highest concentrations of PCP (24 mg/kg) during the present study.

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