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APPLICATION OF EQUILIBRIUM PARTITIONING SEDIMENT QUALITY CRITERIA TO PUGET SOUND

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INTRODUCTION

The following data report summarizes an application of sediment quality values generated by the Sediment-Water Equilibrium Partitioning (EP) approach to predict adverse biological effects in Puget Sound. Data for generating EP sediment quality values were provided by the U.S. Environmental Protection Agency (EPA) (Zarba C., March 1989, personal communication). A comparison of predictions by these values and other sediment quality values generated by the Apparent Effects Threshold (AET) approach is also provided. These analyses were requested by the EPA Science Advisory Board (SAB) as part of an ongoing technical review of different methods to establish sediment quality values (EPA 1988a,b). The study was coordinated by the Washington Department of Ecology (Ecology), Sediment Management Unit, and EPA Region 10, Office of Puget Sound.

OBJECTIVES

The purpose of this report is to document the predictions of EP and other sediment quality values using a regional database of matched chemical and biological tests for Puget Sound sediments. In addition to EP and AET values, Ecology requested analysis of modified sediment quality values that are under consideration for sediment management in Puget Sound. These modified values are described in the Methods section. Ecology and EPA requested the following summaries of data and analyses:

- A listing of EP and AET sediment quality values
- A map showing the location of predicted adverse biological effects based on EP sediment quality values for all biological stations in the Puget Sound database (to enable comparison to previous maps generated for AET predictions)
- A tabulation of observed biological effects and EP and AET predictions at each biological station in the Puget Sound database
- A calculation of the reliability of chemical predictions by the various sediment quality values compared with results of biological tests on field sediments in Puget Sound.

This data report is intended for information purposes only. Interpretation of the results or conclusions for sediment management were not requested by the sponsoring agencies. Data are summarized in a Results section and accompanying appendices.

BACKGROUND

To meet the needs of most sediment quality management programs, an ideal sediment criteria approach would perform well on both of the following measures of reliability, which are evaluated with actual field data:

- **Sensitivity** in detecting environmental problems (i.e., are <u>all</u> biologically impacted sediments identified by the predictions of the chemical sediment criteria?)
- **Efficiency** in screening environmental problems (i.e., are <u>only</u> biologically impacted sediments identified by the predictions of the chemical sediment criteria?).

For the purpose of this data report, a biologically impacted station is defined as one at which a statistically significant ($P \leq 0.05$) biological response occurs relative to appropriate reference conditions (see EPA 1988b; Barrick et al. 1988). As a measure of reliability, sensitivity is defined as the proportion of all stations exhibiting a particular adverse biological effect that are correctly

predicted using sediment quality values for that biological indicator. Efficiency is defined as the proportion of all stations predicted to have a particular adverse biological effect that actually are impacted. The concepts of sensitivity and efficiency are illustrated in Figure 1.

Sensitivity and efficiency are independent measures of reliability. For example, a sediment criteria approach that sets values for a wide range of chemicals near their analytical detection limits will probably be sensitive but inefficient. That is, it will predict a large percentage of sediments with biological effects but will also predict many biologically nonimpacted sediments with only slightly elevated chemical concentrations. Such an approach may be environmentally protective but also may result in overregulation that would not be cost effective.

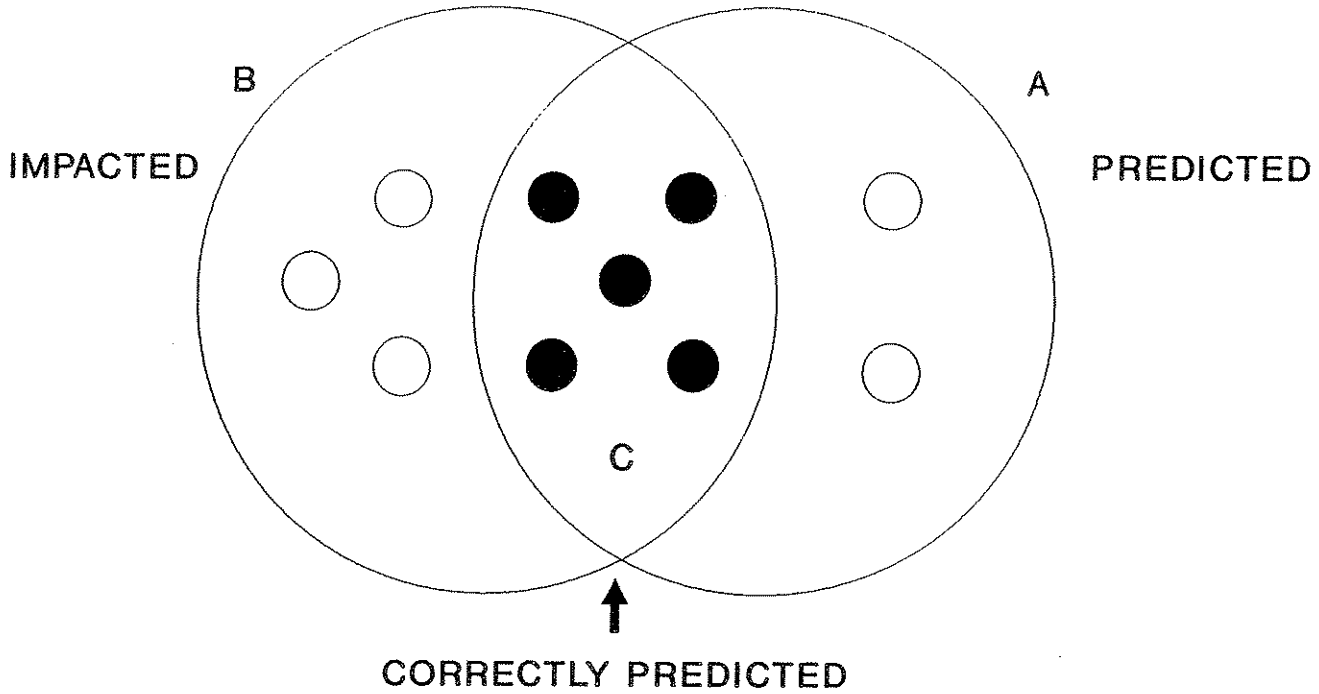
Conversely, a sediment criteria approach that sets values at the upper end of the range of environmental concentrations may be efficient but insensitive. That is, a high percentage of the stations with predicted impacts may indeed be biologically impacted, but the approach may fail to predict other biologically impacted stations with moderate to high chemical concentrations. Such an approach may be cost-effective and defensible in pursuing high priority remedial actions (i.e., would not overregulate) but would not be environmentally protective.

The overall reliability of any sediment criteria approach addresses both sensitivity and efficiency. Overall reliability is defined as the proportion of all stations for which correct predictions were made for either the presence or absence of adverse biological effects:

$$\textbf{Overall Reliability} = \frac{\left[\begin{array}{c}\text{All stations correctly predicted as impacted} \\ + \\ \text{All stations correctly predicted as nonimpacted}\end{array}\right]}{\text{Total number of stations evaluated}}$$

High reliability results from correct prediction of a large percentage of the impacted stations (i.e., high sensitivity; few false negatives) and correct prediction of a large percentage of the nonimpacted stations (i.e., high efficiency; few false positives).

Reliability analyses were conducted using a menu-driven program (SEDQUAL) initially developed for the Puget Sound sediment quality values database. A detailed description of the database and menu-driven features is given in the SEDQUAL users manual (Nielsen 1988). Biological analyses and statistical procedures used to determine adverse biological effects for sediment samples in this database have been summarized by Beller et al. (1986). Recent refinements to these procedures are discussed by Barrick et al. (1988). The sediment biological tests include *in-situ* measurements of the abundances of benthic macroinvertebrates in 201 samples and three acute bioassays: amphipod mortality (Swartz et al. 1985) in 287 samples; oyster larvae abnormality (Chapman and Morgan 1983) in 56 samples; and changes in bacterial luminescence using the Microtox test (Williams et al. 1986) in 50 samples. These samples were collected from thirteen embayments in Puget Sound exhibiting a wide range of grain size, total organic carbon (TOC), and chemical conditions.



SENSITIVITY = C/B x 100 = 5/8 x 100 = 63%

EFFICIENCY = C/A x 100 = 5/7 x 100 = 71%

FOR A GIVEN BIOLOGICAL INDICATOR:

A ALL STATIONS PREDICTED TO BE IMPACTED
B ALL STATIONS KNOWN TO BE IMPACTED
C ALL STATIONS CORRECTLY PREDICTED TO BE IMPACTED

Figure 1. Measures of reliability (sensitivity and efficiency)

METHODS

Results of predictions for the following four kinds of sediment quality values are summarized in this data report:

- An expected (mean) EP value and a lower and upper 95 percent confidence interval (C.I.) value have been determined for 34 nonionic organic chemicals (Zarba, March 1989, personal communication). Information used to calculate these values for each chemical is provided in Table 1. Of these chemicals, the 12 listed in Table 2 were detected at least once in Puget Sound sediments that have been tested for adverse biological effects.

- An AET value for over 60 chemicals detected in Puget Sound is available (Barrick et al. 1988) for each of the four biological indicators discussed in the Introduction. TOC- and dry-weight normalized AET for each biological indicator are summarized in Tables 2 and 3.

- In addition to indicator-specific AET, the lowest AET (LAET) and the highest AET (HAET) of the four biological indicators for each chemical is available as a predictor of sediment quality. For example, the TOC-normalized LAET for phenanthrene in Table 2 is 120 mg/kg TOC (oyster larvae bioassay AET) and the HAET for phenanthrene is 690 mg/kg TOC (amphipod bioassay). The dry-weight normalized LAET for phenanthrene in Table 3 is 1,500 ug/kg dry weight (based on both oyster larvae and Microtox bioassay AET normalized to sediment dry weight).

- Ecology requested analysis of an additional modified sediment quality values, termed the acute-to-chronic Ratio (ACR) AET. Discussion of ACR applied to sediments is provided in Becker et al. (1989). The ACR values are calculated as one-tenth the highest value among the acute bioassays but no lower than the 95th percentile of Puget Sound reference areas or higher than the benthic effects AET. The ACR provides a general estimate of the relationship between acute and chronic effects. Although ACR can vary over a wide range, a factor of 10 is used based on EPA guidance for complex chemical mixtures in effluents in the absence of specific information (U.S. EPA 1985). Both dry-weight and TOC-normalized ACR are reported in Tables 2 and 3.

EP values are determined from effects-based water quality criteria and theoretical sediment-interstitial water relationships. Puget Sound AET values are based on the highest concentration among nonimpacted stations in the Puget Sound sediment quality value database. AET values can be generated from the same group of nonimpacted stations used for predictions, or from a completely independent group of stations than that used for predictions. The reliability of both kinds of AET values was evaluated for this report.

Ecology requested that reliability tests for both EP and AET values be conducted by considering the biological information in the following two ways:

- Series A -- Predictions of sediment quality values were checked after subdividing the chemical database into groups of stations that were tested for the same biological effects indicator.

- Series B -- Predictions of sediment quality values were checked after pooling all biological stations in the chemical database, regardless of the particular biological indicator(s) tested at each station.

The methods for each series of tests applied to specific sediment quality values are further described in the following sections.

TABLE 1. SUMMARY OF AVAILABLE MARINE CHRONIC WATER QUALITY CRITERIA, MARINE FINAL RESIDUE VALUES, MARINE WATER ADVISORIES, EQUILIBRIUM PARTITIONING COEFFICIENTS, AND UNCERTAINTY ESTIMATES FOR SELECTED ORGANIC CONTAMINANTS

Chemical	Marine Chronic Water Quality Criteria (μg/L)	Marine Final Residue Value (μg/L)	Marine Water Advisory (μg/L)	Log K_{ow}	95 Percent Confidence Interval	Log K_{oc}	95 Percent Confidence Interval
Acenaphthene				4.18	4.02 - 4.34	4.11	3.5 - 4.73
Acetaldehyde[a]			37	0.51		0.5	
Acrylamide			239	-0.67	-0.82 - 0.52	-0.66	-1.42 - 0.10
Aniline[b,c]	27			0.98	0.91 - 1.05	0.96	0.37 - 1.56
Carbofuran			0.025	1.85	1.60 - 2.10	1.82	1.03 - 2.60
Carbon tetrachloride[c]			37	2.71	2.45 - 2.96	2.66	1.87 - 3.45
Chlordane[c]	0.0064	0.004		3.32	2.74 - 3.90	3.26	2.32 - 4.21
Chloroform[c]			102.2	3.94	1.69 - 2.19	1.9	1.12 - 2.69
Chlorphyrifos	0.0056			4.98	4.95 - 5.01	4.9	4.31 - 5.49
DDT[c]		0.001		6.02	5.73 - 6.31	5.92	5.26 - 6.58
Dieldrin[c]	0.084	0.0019		4.92	3.96 - 5.88	4.84	3.71 - 5.97
Diethylhexylphthalate[a,b]	360			5.78			
Dioxane (1,4)			10,100	-0.35	-0.48 - 0.21	-0.34	-1.10 - 0.42
Endosulfan[c]	0.0087			3.83	3.19 - 4.47	3.77	2.79 - 4.74
Endrin[c]	0.0093	0.0023		4.44	3.74 - 5.14	4.36	3.45 - 5.29
Ethylbenzene[c]			14	3.14	2.74 - 3.54	3.09	2.24 - 3.93
Formaldehyde[c]			2.5	0.35	0.09 - 0.61	0.34	-0.45 - 1.13
Furfural			33	0.38	0.24 - 0.51	0.37	-0.39 - 1.13
Guthion			0.01	2.72	2.35 - 3.09	2.67	1.85 - 3.50
Heptachlor[c]		0.0036		4.54	3.90 - 5.18	4.46	3.59 - 5.34
Lindane				3.35	2.32 - 3.47	3.29	2.69 - 3.90
Malathion			0.1	2.79	2.55 - 3.03	2.74	1.96 - 3.52
Methoxychlor[c]			0.03	4.34	4.11 - 4.57	4.27	3.49 - 5.04
Methylene chloride[c]			770	1.25	0.89 - 1.61	1.23	0.40 - 2.06
Methyl-parathion	0.076			2.66	2.45 - 2.87	2.61	1.84 - 3.34
Mirex			0.001	5.28	4.49 - 6.08	5.19	4.11 - 6.27
PCB (1254)[c]		0.03		6.25	6.63 - 6.14	6.14	5.44 - 6.85

TABLE 1. (Continued)

Chemical	Marine Chronic Water Quality Criteria (μg/L)	Marine Final Residue Value (μg/L)	Marine Water Advisory (μg/L)	Log K_{ow}	95 Percent Confidence Interval	Log K_{oc}	95 Percent Confidence Interval
Pentachloroethane			19	3.05	2.50 - 3.60	3	2.07 - 3.92
Pentachlorobenzene			0.023	5.12	4.85 - 5.40	5.03	4.24 - 5.83
Phenanthrene[c]	4.6			4.42	4.19 - 4.65	4.35	3.71 - 4.98
Pyridine			116	0.64	0.53 -.75	0.63	0.12 - 1.39
Styrene			12	3.06	2.66 - 3.45	3	2.16 - 3.84
Tetrachloroethylene[c]			36	3.04	2.65 - 3.43	2.99	2.15 - 3.84
Toluene[c]			330	2.6	2.43 - 2.77	2.56	1.79 - 3.32
Toxaphene	0.21	0.0002	0.002	3.27	2.69 - 3.85	3.21	2.27 - 4.15
Xylene[c]			21	3.11	2.90 - 3.32	3.05	2.28 - 3.83

[a] K_{ow} estimated from solubility. Ninety-five percent confidence interval not defined at this time.

[b] Draft criteria.

[c] Chemical compounds found in Puget Sound.

TABLE 2. SEDIMENT QUALITY VALUES FOR SELECTED CHEMICALS
(normalized to total organic carbon or dry weight, as appropriate)

Chemical	Low EP[a]	Mean EP[a]	High EP[a]	Amphipod AET[b]	Oyster AET[c]	Benthic AET[d]	Microtox AET[e]	ACR[f]	LAET[g]	HAET[h]
Nonionic Organic Compounds (mg/kg organic carbon; ppm)										
Low molecular weight PAH	--[i]	--	--	2,200	370	780	>530[j]	--	370	2,200
Naphthalene	--	--	--	220	99	170	>170	22	99	220
Acenaphthylene	--	--	--	66	>27	66	>27	6.6	66	66
Acenaphthene	--	--	--	200	16	57	>57	20	16	200
Fluorene	--	--	--	360	23	79	>71	36	23	360
Phenanthrene	24	100	440	690	120	480	>160	69	120	690
Anthracene	--	--	--	1,200	>79	220	>79	120	220	1,200
2-Methylnaphthalene	--	--	--	>120	--	64	--	4.8	64	>120
High molecular weight PAH	--	--	--	5,300	960	7,600	>1,500	--	960	7,600
Fluoranthene	--	--	--	3,000	160	1,200	>190	300	160	3,000
Pyrene	--	--	--	1,000	>120	1,400	>210	100	1,000	1,400
Benz(a)anthracene	--	--	--	270	110	650	>160	27	110	650
Chrysene	--	--	--	460	110	850	>200	46	110	850
Benzofluoranthenes	--	--	--	450	230	1,500	>430	45	230	1,500
Benzo(a)pyrene	--	--	--	210	99	>1,300	>140	21	99	>1,300
Indeno(1,2,3-c,d)pyrene	--	--	--	88	33	900	>87	8.8	88	900
Dibenzo(a,h)anthracene	--	--	--	47	120	89	33	4.7	33	120
Benzo(g,h,i)perylene	--	--	--	78	31	>1,200	>67	7.8	31	>1,200
Chlorinated benzenes	--	--	--	9	--	--	--	--	9	9
1,3-Dichlorobenzene	--	--	--	>15	>15	>15	>15	15	--	--
1,4-Dichlorobenzene	--	--	--	9	3.1	16	>16	5.1	3.1	>16
1,2-Dichlorobenzene	--	--	--	>5.8	2.3	2.3	2.3	4.2	2.3	>5.8
1,2,4-Trichlorobenzene	--	--	--	1.8	2.7	--	0.81	3	0.81	2.7
Hexachlorobenzene (HCB)	--	--	--	4.5	9.6	0.38	2.3	11.8	0.38	9.6
Total PCB	8.3	41	210	190	>46	65	12	--	12	190

TABLE 2. (Continued)

Chemical	Low EP[a]	Mean EP[a]	High EP[a]	Amphipod AET[b]	Oyster AET[c]	Benthic AET[d]	Microtox AET[e]	ACR[f]	LAET[g]	HAET[h]
Phthalates										
Dimethyl phthalate	--	--	--	53	>22	53	>19	19.9	53	53
Diethyl phthalate	--	--	--	>110	>5.3	61	>5.3	61	61	>110
Di-n-butyl phthalate	--	--	--	260	260	1,700	220	135.5	220	1,700
Butyl benzyl phthalate	--	--	--	42	>9.2	64	4.9	10.3	4.9	64
Bis(2-ethylhexyl)phthalate	--	--	--	78	60	60	47	172.9	47	78
Di-n-octyl phthalate	--	--	--	58	>57	4,500	--	10.3	58	4,500
Miscellaneous Extractable Compounds										
Aniline	0.06	0.26	0.98	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	>170	15	58	>58	3.8	15	>170
Hexachlorobutadiene	--	--	--	6.2	11	6.9	3.9	12.8	3.9	6.9
N-Nitrosodiphenylamine	--	--	--	>11	>11	11	>11	11	11	>11
Volatile Organic Compounds										
Chloroform	13	8	500	--	--	--	--	3.8	--	--
Tetrachloroethene	5.1	35	250	>22	>22	>22	>22	22	--	>22
Ethylbenzene	2.4	17	120	>3.8	>3.8	>3.8	>3.8	3.8	--	>3.8
Toluene	20	120	470	--	--	--	--	--	--	--
Total xylenes	--	--	--	>12	>12	>12	>12	12	--	>12
Pesticides										
Chlordane	0.001	0.01	0.1	--	--	--	--	--	--	--
Dieldrin	0.43	5.8	78	--	--	--	--	12.1	--	--
p,p'-DDE	--	--	--	0.81	--	0.31	--	.1	0.31	0.81
p,p'-DDD	--	--	--	2.2	--	1.0	--	.2	1.0	2.2
p,p'-DDT	0.18	0.83	3.8	>16	--	3.7	--	3.7	3.7	>16
Endrin	0.026	0.21	1.8	--	--	--	--	.9	--	--
Heptachlor	0.014	0.10	0.79	--	--	--	--	13	--	--
Ionizable Organic Compounds (ug/kg dry weight; ppb)										
Phenols and Miscellaneous Extractable Compounds										
Phenol	--	--	--	1,200	420	1,200	1,200	182	420	1,200
2-Methylphenol	--	--	--	63	63	72	>72	50	63	>72
4-Methylphenol	--	--	--	3,600	670	1,800	670	360	670	3,600
2,4-Dimethylphenol	--	--	--	72	29	210	29	12.4	29	210

TABLE 2. (Continued)

Chemical	Low EP[a]	Mean EP[a]	High EP[a]	Amphipod AET[b]	Oyster AET[c]	Benthic AET[d]	Microtox AET[e]	ACR[f]	LAET[g]	HAET[h]
Pentachlorophenol	--	--	--	360	>140	690	>140	36	360	690
Benzyl alcohol	--	--	--	870	73	870	57	87	57	870
Benzoic acid	--	--	--	760	650	650	650	76	650	760
Metals (mg/kg dry weight; ppm)										
Antimony	--	--	--	200	--	150	--	--	150	200
Arsenic	--	--	--	93	700	57	700	57	57	700
Cadmium	--	--	--	6.7	9.6	5.1	9.6	1.4	6.1	9.6
Chromium, total	--	--	--	270	--	260	--	--	260	270
Copper	--	--	--	1,300	390	530	390	130	390	1,300
Lead	--	--	--	660	660	450	530	66	450	660
Mercury	--	--	--	2.1	0.59	2.1	0.41	.2	0.41	2.1
Nickel	--	--	--	>140	--	>140	--	--	--	>140
Silver	--	--	--	6.1	>0.56	>6.1	>0.56	.6	6.1	>6.1
Zinc	--	--	--	960	1,600	410	1,600	160	410	1,600

[a] Mean EP values calculated using the formula:

$$C_{s/cr} = 10^{\log K_{oc}} * C_{w/cr}$$

where:

$C_{s/cr}$ = organic-carbon normalized sediment quality value based on equilibrium partitioning approach

$\log K_{oc}$ = partitioning coefficient between organic carbon and water

$C_{w/cr}$ = water quality value established as the marine chronic water quality criterion; or if not available, as the marine final residue value; or if not available, as the marine water advisory.

Low and high EP values are the lower and upper 95 percent confidence interval based on the estimated uncertainty in $\log K_{oc}$ values (see Table 1).

[b] Based on concentration data for 181 samples not exhibiting significant amphipod mortality from a total 287 Puget Sound samples.

[c] Based on concentration data for 39 samples not exhibiting significant oyster larvae abnormality from a total 56 Puget Sound samples.

[d] Based on concentration data for 93 samples not exhibiting significant depressions in benthic infauna abundance from a total 201 Puget Sound samples.

[e] Based on concentration data for 21 samples not exhibiting a significant decrease in bacterial luminescence from a total 50 Puget Sound samples.

[f] Acute to chronic ratio (ACR) values were calculated as one-tenth the highest value among amphipod, oyster, and Mictrox AET. These values were further bounded to be no greater than the benthic AET nor less than the 90th percentile concentration among reference areas (normalized to dry weight or organic carbon, as appropriate). (Reference areas include Carr Inlet, Case Inlet, Dabob Bay, Point Williams, Port Susan, Sequim Bay, and Samish Bay.)

TABLE 2. (Continued)

[g] Lowest AET for the range of the four biological indicators (i.e., amphipod mortality, benthic abundance, Microtox luminescence, and oyster larvae abnormality).

[h] Highest AET for the range of the four biological indicators.

[i] "--" indicates data not available to calculate the sediment quality value.

[j] ">" indicates that a defined AET could not be established because there were no "biological effects" stations with chemical concentrations above the highest concentration among "no effects" stations.

TABLE 3. SEDIMENT QUALITY VALUES FOR SELECTED CHEMICALS
(normalized to dry weight)

Chemical	Amphipod AET[a]	Oyster AET[b]	Benthic AET[c]	Microtox AET[d]	ACR[e]	LAET[f]	HAET[g]
Nonionic Organic Compounds (ug/kg dry weight; ppb)							
Low molecular weight PAH	24,000	5,200	13,000	5,200	6,900	5,200	24,000
Naphthalene	2,400	2,100	2,700	2,100	240	2,100	2,700
Acenaphthylene	1,300	>560[h]	1,300	>560	130	1,300	1,300
Acenaphthene	2,000	500	730	500	200	500	2,000
Fluorene	3,600	540	1,000	540	360	540	3,600
Phenanthrene	6,900	1,500	5,400	1,500	690	1,500	6,900
Anthracene	13,000	960	4,400	960	1,300	960	13,000
2-Methylnaphthalene	1,900	670	1,400	670	190	670	1,900
High molecular weight PAH	69,000	17,000	69,000	12,000	2,400	12,000	69,000
Fluoranthene	30,000	2,500	24,000	1,700	3,000	1,700	30,000
Pyrene	16,000	3,300	16,000	2,600	1,600	2,600	16,000
Benz(a)anthracene	5,100	1,600	5,100	1,300	510	1,300	5,100
Chrysene	9,200	2,800	9,200	1,400	920	1,400	9,200
Benzofluoranthenes	7,800	3,600	9,900	3,200	780	3,200	9,900
Benzo(a)pyrene	3,000	1,600	3,600	1,600	300	1,600	3,600
Indeno(1,2,3-c,d)pyrene	1,800	690	2,600	600	180	600	2,600
Dibenzo(a,h)anthracene	540	230	970	230	54	230	970
Benzo(g,h,i)perylene	1,400	720	2,600	670	140	670	2,600
Chlorinated benzenes	90	--[i]	--	--	--	90	90
1,3-Dichlorobenzene	>170	>170	>170	>170	--	--	>170
1,4-Dichlorobenzene	120	120	110	110	40	110	120
1,2-Dichlorobenzene	>110	50	50	35	40	35	>110
1,2,4-Trichlorobenzene	51	64	--	31	10	31	64
Hexachlorobenzene (HCB)	130	230	22	70	31.6	22	230
Total PCB	3,100	1,100	1,000	130	310	130	3,100

TABLE 3. (Continued)

Chemical	Amphipod AET[a]	Oyster AET[b]	Benthic AET[c]	Microtox AET[d]	ACR[e]	LAET[f]	HAET[g]
Phthalates							3,300
Dimethyl phthalate	>1,400	160	>1,400	71	50	71	1,400
Diethyl phthalate	>1,200	>73	200	>48	200	200	>1,200
Di-n-butyl phthalate	1,400	1,400	>5,100	1,400	201.6	1,400	>5,100
Butyl benzyl phthalate	900	>470	900	63	90	63	900
Bis(2-ethylhexyl)phthalate	>3,100	1,900	1,300	1,900	1,228	1,300	>3,100
Di-n-octyl phthalate	>2,100	>420	6,200	--	52.8	6,200	6,200
Miscellaneous Extracts							
Aniline	--	--	--	--	--	--	--
Dibenzofuran	1,700	540	700	540	170	540	1,700
Hexachlorobutadiene	180	270	11	120	29.5	11	270
N-Nitrosodiphenylamine	48	130	28	40	13	28	130
Volatile Organics							
Chloroform	--	--	--	--	--	--	--
Tetrachloroethene	>210	140	57	140	14	57	>210
Ethylbenzene	>50	37	10	33	14	10	>50
Toluene	--	--	--	--	--	--	--
Total xylenes	>160	120	40	100	12	40	>160
Pesticides							
Chlordane	--	--	--	--	--	--	--
Dieldrin	--	--	--	--	--	--	--
p,p'-DDE	15	--	9	--	25	9	15
p,p'-DDD	43	--	16	--	25	16	43
p,p'-DDT	>270	>6	34	--	34	34	>270
Endrin	--	--	--	--	--	--	--
Heptachlor	--	--	--	--	--	--	--
Ionizable Organic Compounds (µg/kg dry weight; ppb)							
Phenols and miscellaneous extractable compounds							
Phenol	1,200	420	1,200	1,200	182	420	1,200
2-Methylphenol	63	63	72	>72	50	63	>72
2,4-Dimethyl phenol	72	29	210	29	12.4	29	210
Pentachlorophenol	360	>140	690	>140	36	360	690
Benzyl alcohol	870	73	870	57	87	57	870
Benzoic acid	760	650	650	650	76	650	760

TABLE 3. (Continued)

Chemical	Amphipod AET[a]	Oyster AET[b]	Benthic AET[c]	Microtox AET[d]	ACR[e]	LAET[f]	HAET[g]
Metals (mg/kg dry weight; ppm)							
Antimony	200	--	150	--	--	--	--
Arsenic	93	700	57	700	57	57	700
Cadmium	6.7	9.6	5.1	9.6	1.4	5.1	9.6
Chromium	270	--	260	--	--	--	--
Copper	1,300	390	530	390	130	390	1,300
Lead	660	660	450	530	66	450	660
Mercury	2.1	0.59	2.1	0.41	0.21	0.41	2.1
Nickel	>140[i]	--	>140	--	--	--	>140
Silver	6.1	>0.56	>6.1	>0.56	0.61	6.1	>6.1
Zinc	960	1,600	410	1,600	160	410	1,600

[a] Based on concentration data for 181 samples not exhibiting significant amphipod mortality from a total 287 Puget Sound samples.

[b] Based on concentration data for 39 samples not exhibiting significant oyster larvae abnormality from a total 56 Puget Sound samples.

[c] Based on concentration data for 93 samples not exhibiting significant depressions in benthic infauna abundance from a total 201 Puget Sound samples.

[d] Based on concentration data for 21 samples not exhibiting a significant decrease in bacterial luminescence from a total 50 Puget Sound samples.

[e] Acute to chronic ratio (ACR) values were calculated as one-tenth the highest value among amphipod, oyster, and Mictrox AET. These values were further bounded to be no greater than the benthic AET not less than the 90th percentile concentration among Puget Sound reference areas. (Reference areas include Carr Inlet, Case Inlet, Dabob Bay, Point Williams, Port Susan, Sequim Bay, and Samish Bay.)

[f] Lowest AET for the range of the four biological indicators (i.e., amphipod mortality, benthic abundance, Microtox luminescence, and oyster larvae abnormality).

[g] Highest AET for the range of the four biological indicators.

[h] ">" indicates that a defined AET could not be established because there were no "biological effects" stations with chemical concentrations above the highest concentration among "no effects" stations.

[i] "--" indicates AET data not available to calculate the sediment quality value.

Series A -- Segregated Biological Indicators

For Series A, tests of reliability were carried out after subdividing the chemical database into groups of stations that were tested for the same biological effects indicators. For example, all chemistry stations with associated biological amphipod bioassay data were grouped together. Four station groupings were established according to available station-specific biological data (i.e., benthic infauna abundance, amphipod bioassay, oyster larvae bioassay, and Microtox bioassay groups). The following comparisons were made for different sediment quality values in Series A:

- Results for EP values are based on comparisons for the 12 chemicals listed in Table 2 at groups of stations for each of the four biological indicators.
- Results for each indicator-specific AET are based on predictions for all detected chemicals at stations for that biological indicator only.Results for LAET, HAET, and ACR values are based on comparisons at groups of stations for each of the four biological indicators, identical to the procedure for EP values.

All Series A reliability analyses of sediment quality values were conducted according to the following steps:

1. Chemical concentration data for each sediment sample were normalized to either sediment dry weight or TOC. For EP comparisons, sediment data for all chemicals were TOC-normalized as required by the EP approach. For AET, LAET, HAET, and ACR comparisons, sediment data for nonionic organic chemicals were TOC-normalized and data for other chemicals were dry-weight normalized.
2. The resulting concentration data for each chemical and sediment sample were then compared to each series of sediment quality values. Indicator-specific AET were tested only at stations for which biological data were available for the particular indicator. All EP, LAET, HAET, and ACR values were tested at all stations for which biological data were available for one or more indicators.
3. A sediment sample exhibiting a particular adverse biological effect was considered to be correctly predicted by a series of sediment quality values if at least one chemical concentration exceeded the corresponding sediment quality value for that chemical. For example:
   - Benthic infauna stations predicted to have biological effects using the series of mean EP values were identified as those stations with one or more chemical concentrations exceeding mean EP values.
   - Benthic infauna stations predicted to have biological effects using the series of benthic infauna AET were identified as those stations with one or more chemical concentrations exceeding benthic infauna AET.
   - Benthic infauna stations predicted to have biological effects using the series of LAET were identified as those stations with one or more chemical concentrations exceeding LAET values.
4. A sediment sample not exhibiting a particular adverse biological effect was considered to be correctly predicted by a series of sediment quality values if none of the chemical concentrations (or detection limits for undetected chemicals) exceeded any of the corresponding sediment quality values. High detection limits for undetected chemicals that exceeded sediment quality values were automatically excluded from the reliability analysis.
5. Reliability results were summarized across all samples for a particular biological indicator in the database. Therefore, a range of reliability is reported for comparisons based on the four different biological indicators.

Reliability results are reported for EP and AET comparisons that included two different sets of chemicals. A comparison was first made for all chemicals detected in Puget Sound and available for either of the two approaches (i.e., 12 chemicals for the EP approach and over 60 chemicals for the AET approach). A second comparison was made only for the two chemicals that were widely detected in Puget Sound and common to both approaches (i.e., total PCBs and phenanthrene). These comparisons serve two distinctly different objectives:

- Management assessment of the overall predictive ability of currently available sediment quality values to correctly identify adverse biological effects in Puget Sound (recognizing that different chemicals and a different total number of sediment quality values are available for the EP and AET approaches)
- Comparative assessment of the performance of only those chemical-specific values common to both approaches (recognizing that the ability to identify all adverse biological effects may be limited because this assessment necessarily excludes many chemicals that occur in high concentration at impacted stations).

Series B -- Pooled Biological Indicators

The same tests described above for Series A were repeated after pooling biological results at each station. This series of tests was requested by Ecology to support their assessment of the ability of different sediment quality values to predict any of the adverse biological effects that have been measured in Puget Sound. For this series of tests, biological results were pooled at each station as follows (not all biological indicators were available at each station):

- A biologically impacted station was defined as one at which <u>one or more</u> biological indicators tested at the station resulted in a significant adverse biological response.
- A biologically nonimpacted station was defined as one at which <u>none</u> of the biological indicators tested at the station resulted in a significant response.

For example, in Series B, the reliability of predictions of all EP and AET values were summarized across all 314 stations for which chemical concentration data, TOC data, and data for at least one biological indicator were available. With this exception on how biological stations were pooled, all other steps outlined for Series A reliability analyses were followed. The reliability results for each series of tests are summarized separately.

RESULTS

Results of this data report are summarized in the following three appendices:

- Maps showing the location of biological stations and the results of chemical predictions by the EP approach are presented in Appendix A.
- Summary matrices listing all observed and predicted adverse biological effects at each station in the Puget Sound database are presented in Appendix B.
- Tables of reliability analyses for the various sediment quality values are presented in Appendix C.

In Appendix A maps, all predictions are based on mean EP values only. Figures A-1 through A-14 show predicted adverse biological effects and observed adverse effects at amphipod bioassay stations in different regions of Puget Sound. Figures A-15 through A-22 show predicted adverse biological effects and observed adverse effects at benthic infauna stations. These maps can be compared with maps documenting predictions for the AET approach in Appendix D of Barrick et al. (1988).

In Appendix B matrices, predicted adverse effects are listed for a range of sediment quality values, including three different EP values (lower 95 percent C.I. value, mean value, and higher 95 percent C.I. value), four different AET values (benthic infauna AET, amphipod bioassay AET, oyster larvae bioassay AET, and Microtox bioassay AET), and three modified sediment quality values (ACR, LAET, and HAET). Results were generated for the following normalizations of chemical concentrations and combinations of chemicals:

- Figure B-1 is based on predictions of all chemicals detected in Puget Sound and normalized to TOC (nonionic organic compounds) or sediment dry weight (ionizable organic compounds and metals).
- Figure B-2 is based on all chemicals detected in Puget Sound and normalized only to sediment dry weight (i.e., excluding EP values, which are based only on TOC normalization).
- Figure B-3 is based only on predictions of PCB and phenanthrene sediment quality values normalized to TOC.
- Figure B-4 is based on analogous results for PCB and phenanthrene sediment quality values normalized to sediment dry weight (i.e., excluding EP values, which are based only on TOC normalization).

In Appendix C, reliability analyses are tabulated based on the results at individual stations listed in Appendix B. These reliability analyses are reported for the following two series described in the Methods section:

- Series A (Tables C-1 through C-3) is based on groups of stations that were segregated by biological indicator tested (for example, the reliability of predictions for mean EP values at benthic infauna stations is calculated separately from the reliability of predictions for mean EP values at amphipod bioassay stations).
- Series B (Tables C-4 and C-5) is based on pooled biological results. For example, the reliability of predictions for mean EP values is calculated after pooling all biological stations in the database, regardless of the specific biological indicator(s) tested at each station.

Reliability results are tabulated for all chemicals detected in Puget Sound in Table C-1 (Series A) and Table C-4 (Series B). Reliability results are tabulated only for PCB and phen-

anthrene predictions in Tables C-2 and C-3 (Series A) and Table C-5 (Series B). Both TOC and dry weight normalizations of chemical concentrations are considered in these tables. A summary of reliability results is presented in the following sections.

COMPARISON OF THE MAGNITUDE OF EP AND AET VALUES

Prior to conducting reliability analyses, a comparison of the magnitude of EP and AET values was made for five chemicals for which both EP and AET values have been developed (Table 2). Of these five chemicals, only total PCB and phenanthrene are commonly detected in Puget Sound. The range of EP values based on the 95 percent confidence interval for K_{oc} encompasses the range of available AET values for different biological indicators for three of the five chemicals in common to the two approaches (total PCB, tetrachloroethene, and ethylbenzene). The range of EP values for phenanthrene (24-440 mg/kg TOC) is similar to the range of AET values for phenanthrene (120-690 mg/kg TOC). The range of EP values for DDT (0.18-3.8 mg/kg TOC) encompasses the established benthic AET for DDT (3.7 mg/kg TOC) but is lower than the estimated AET for the amphipod bioassay (see Table 2, footnote j). Because EP values are intended for use only when normalized to sediment organic carbon, no comparison of these values was made with AET or ACR values normalized to dry weight.

SERIES A RELIABILITY TESTS

The reliability of sediment quality values at biological stations segregated according to biological test type (see Methods) is summarized in this section.

Reliability Tests Based on All Chemicals

Reliability results for the EP and AET approaches are summarized in Table C-1 based on all available chemicals that are detected in samples represented in the Puget Sound sediment quality database.

EP Values—The sensitivity of the various EP values in identifying adverse biological effects ranged from 3-70 percent, depending on the biological indicator. The lower 95 percent C.I. EP values exhibited the highest sensitivity (38-70 percent) and the upper 95 percent C.I. EP values were the least sensitive (3-13 percent). In contrast, the upper 95 percent C.I. EP values were more efficient (73-100 percent) in identifying only adverse biological effects than were the lower 95 percent C.I. EP values (32-61 percent).

Overall, EP values were 44-73 percent reliable in their ability to correctly predict both nonimpacted and impacted stations based on results for four different biological indicators in Puget Sound.

AET Values—The sensitivity of indicator-specific AET values in identifying adverse biological effects ranged from 55 to 93 percent, depending on the biological indicator. Reliability results are similar for AET values normalized to sediment dry weight or to TOC (see EPA 1988b for further discussion).

AET for the amphipod mortality bioassay and benthic infauna abundance measurements are based on both the largest number of data points and geographically diverse data points. The range of sensitivity of amphipod AET was lower (55-58 percent) than that for benthic AET (75-77 percent). The efficiency of amphipod bioassay (67 percent) and benthic AET (72 percent) in identifying only adverse biological effects was similar when comparing AET values that were generated independently from the database used for testing predictions (see Table C-1, footnote e).

Overall, the amphipod and benthic AET values were 71-88 percent reliable in their ability to correctly predict both nonimpacted and impacted stations based on results for the four different biological indicators in Puget Sound. The oyster larvae and Microtox AET values, generated from a smaller data set of one urban and one nonurban bay, were overall 50-96 percent reliable.

ACR Values—Sensitivities of ACR values were consistently high (94-100 percent). Efficiency values were between 30-58 percent, depending on the biological indicator. Overall reliability values for ACR ranged between 30-60 percent. ACR values had the highest overall reliability (58-60 percent) in predicting adverse effects at benthic infauna and Microtox stations.

Reliability Tests Based on PCB and Phenanthrene Only (TOC-Normalized)

For tests in this section, PCB and phenanthrene sediment quality values normalized to TOC were compared to TOC-normalized concentration data. Reliability results based only on the combined performance of these two chemical values are summarized in Table C-2 for the EP and AET approaches. For this test, the LAET and HAET for PCB and phenanthrene were used to provide a consistent comparison of predictions for the various biological indicators to the predictions of the range of EP values.

EP Values—The reliability of EP values for total PCB and phenanthrene (Table C-2) is nearly identical to the reliability of EP values for all chemicals (Table C-1). The sensitivity of the various EP values in identifying adverse biological effects ranged between 3-69 percent, depending on the biological indicator. The lower 95 percent C.I. EP values exhibited the highest sensitivity (29-69 percent), and the upper 95 percent C.I. EP values were the least sensitive (3-11 percent). In contrast, the upper 95 percent C.I. EP values were more efficient (75-100 percent) in identifying only adverse biological effects than were the lower 95 percent C.I. EP values (26-63 percent).

Overall, EP values for total PCB and phenanthrene were 44-73 percent reliable in their ability to correctly predict both nonimpacted and impacted stations based on results of four different biological indicators in Puget Sound.

AET Values—The sensitivity of the various TOC-normalized AET values (including LAET and HAET) for total PCB and phenanthrene ranged between 0-51 percent, depending on the biological indicator. LAET for total PCB and phenanthrene were the most sensitive of the AET values, predicting 45-51 percent of the adverse effects at amphipod bioassay and benthic infauna stations. The sensitivity of all other AET values was <30 percent, which was much lower than the sensitivity when all chemicals were considered (Table C-1). The overall reliability of total PCB and phenanthrene AET values ranged between 42-71 percent for the four biological indicators in Puget Sound.

ACR Values—The sensitivity of TOC-normalized ACR values for total PCB and phenanthrene ranged between 21-52 percent (Table C-2), compared with 95-100 percent sensitivity when all ACR values were considered (Table C-1). The efficiency of ACR values for total PCB and phenanthrene (48-75 percent) and overall reliability (50-73 percent) were both higher than the efficiency (30-58 percent) and overall reliability (30-60 percent) of all ACR values.

Reliability Tests Based on PCB and Phenanthrene Only (DW-Normalized)

For tests in this section, sediment quality values and chemical concentration data for PCB and phenanthrene were normalized to dry weight of sediment. Only AET values and ACR values modified from dry weight-normalized AET are considered in these tests (Table C-3).

AET Values (DW)—Total PCB and phenanthrene AET values normalized to DW were more sensitive than total PCB and phenanthrene values normalized to TOC. LAET values were the most sensitive, ranging between 31-64 percent. Sensitivities of indicator-specific AET values ranged between 11-31 percent. The sensitivity of HAET values was the lowest of all AET values (3-11 percent).

The overall reliability of DW-normalized AET was comparable to that of TOC-normalized AET. Values ranged between 44-77 percent, depending on the biological indicator.

ACR Values—The sensitivity of DW-normalized ACR values for total PCB and phenanthrene ranged between 38-63 percent, and was consistently higher than that for TOC-normalized ACR values (21-52 percent). The efficiency of these predictions (44-74 percent) was similar to that for TOC-normalized ACR for PCB and phenanthrene (48-75 percent). Overall reliability ranged between 52-68 percent for DW-normalized ACR values, comparable to that for TOC-normalized values (50-73 percent).

Summary of Comparative Performance for PCB and Phenanthrene Values

For predictions with PCB and phenanthrene only, a similar but higher range of sensitivity was found for the lower 95 percent C.I. EP values (29-69 percent) compared with LAET values (14-51 percent). The sensitivity of mean EP values (14-29 percent) was higher than that of AET values for different biological indicators (3-14 percent). The sensitivity of upper 95 percent C.I. EP values (3-11 percent) was also somewhat higher than that of HAET values (0-6 percent).

The sensitivity of phenanthrene and total PCB values for the AET approach is substantially lower than that for all AET chemicals in Table C-1. This lower sensitivity may reflect the fact that there are a number of problem areas in Puget Sound for which other nonionic organic chemicals, metals, or alkylated phenols are found in high concentration. The reliability results for the EP approach are similar in Tables C-1 and C-2 because EP values for phenanthrene and total PCB provided nearly all of the predictions of adverse biological effects by the EP approach in Puget Sound.

The two methods were generally comparable in efficiency in this test, ranging from 26-100 percent for the EP approach and 47-100 percent for the AET approach. The overall reliability of the two approaches was similar, ranging from 44-73 percent for the various EP values and 42-71 percent for the various AET values (Table C-2).

SERIES B RELIABILITY RESULTS

The reliability of predictions by different sediment quality values after pooling all biological stations in the Puget Sound database (see Methods) is summarized in this section.

Reliability Tests Based on All Chemicals

Results in this section are based on predictions for all chemicals for which there were detected concentrations in Puget Sound sediments and a corresponding chemical-specific sediment quality value. Reliability results for pooled biological effects predicted by sediment quality values for all chemicals are shown in Table C-4.

EP Values—The 95 percent C.I. of EP values for all chemicals was 8-61 percent sensitive in identifying an adverse biological effect when all 300+ biological stations in Puget Sound were pooled in one test. The efficiency of these predictions ranged between 57-88 percent. EP values were somewhat lower in overall reliability (48-54 percent) in comparison with AET or ACR values (Table C-4). This lower reliability may be attributed to the lower number of detected chemicals for which EP values were available relative to either AET or ACR values (see Reliability Tests Based on PCB and Phenanthrene Only).

AET Values—The sensitivity of AET predictions ranged between 32-88 percent when all 300+ biological stations in Puget Sound were pooled. Microtox AET were the most sensitive (>80 percent for all normalizations) of the indicator-specific AET values in predicting adverse biological effects at all Puget Sound stations. LAET were slightly more sensitive and HAET were much less sensitive (approximately 30 percent). The efficiency of these predictions ranged between 61-100 percent (because all biological stations were pooled, the efficiency of indicator-specific AET is no longer constrained to be 100 percent). All AET values exhibited overall reliability within a relatively narrow range (63-70 percent).

ACR Values—ACR values were the most sensitive of any of the sediment quality values tested (94 percent for DW-normalized values and 97 percent for mixed DW/TOC-normalized values). Efficiency of ACR values (58 percent) was lower than for the various AET values or the upper 95 percent C.I. EP values and comparable to that for the lower 95 percent C.I. or mean EP values. The overall reliability of ACR values for all chemicals was higher (60 percent) than that for EP values and lower than that for AET values.

Reliability Tests Based on PCB and Phenanthrene Only

Reliability results for pooled biological effects for sediment quality values for PCB and phenanthrene only are shown in Table C-5.

EP Values—The 95 percent C.I. of EP values for total PCB and phenanthrene was 7-78 percent sensitive in predicting adverse effects at all of the 300+ biological stations in Puget Sound. The efficiency of these predictions ranged between 57-93 percent. EP values exhibited an overall reliability ranging between 47-55 percent.

AET Values—The sensitivity of the various AET values for total PCB and phenanthrene ranged from 5-56 percent when all Puget Sound biological stations were pooled. For these chemicals, the sensitivity of predictions exceeded 50 percent only for the Microtox AET (56 percent) and LAET (56 percent). The efficiency of these AET ranged from 59-100 percent. For this test, the HAET for PCB and phenanthrene was 100 percent efficient by definition because all Puget Sound stations were included in the calculation of the indicator-specific AET that comprise the HAET. PCB and phenanthrene values for all AET indicators exhibited moderate overall reliability (46-62 percent).

ACR Values—The sensitivity of ACR values for total PCB and phenanthrene in predicting effects in the pooled database (42-55 percent, depending on the normalization) was substantially lower than the corresponding sensitivity when all chemicals were considered (Table C-4). The efficiency of these predictions was somewhat higher (59-68 percent compared with 58 percent when all chemicals were considered). The overall reliability of ACR values was approximately the same when comparing DW-normalized results for all chemicals vs. total PCB and phenanthrene. Because of an increase in sensitivity, the overall reliability of ACR values for all chemicals normalized to mixed DW/TOC was higher than the overall reliability of TOC-normalized ACR for total PCB and phenanthrene alone.

REFERENCES

Barrick, R.C., D.S. Becker, L. Brown, H.R. Beller and R.A. Pastorok. 1988. Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET. Volume 1. Prepared for Tetra Tech, Inc. and U.S. Environmental Protection Agency Region 10, Office of Puget Sound by PTI Environmental Services, Bellevue, WA. 74 pp. plus appendices.

Becker D.S., R.A. Pastorok, R.C. Barrick, P.N. Booth, and L.J. Jacobs. 1989. Contaminated sediments criteria report. Final Report. Prepared for Washington Department of Ecology, Sediment Management Unit by PTI Environmental Services, Bellevue, WA. 97 pp. plus appendices.

Beller, H.R., R.C. Barrick, and D.S. Becker. 1986. Development of sediment quality values for Puget Sound. Prepared for Resource Planning Associates/Puget Sound Dredged Disposal Analysis, and Puget Sound Estuary Program, Seattle, WA. by Tetra Tech, Inc., Bellevue, WA. 129 pp. plus appendices.

Chapman, P. and J. Morgan. 1983. Sediment bioassays with oyster larvae. Bull. Environ. Contam. Toxicol., 31:438-444.

Nielsen, D. 1988. SEDQUAL Users Manual. Prepared for Tetra Tech/U.S. Environmental Protection Agency, Region 10, Office of Puget Sound by PTI Environmental Services, Bellevue, WA. 114 pp. plus appendices.

Swartz, R.C., W.A. DeBen, J.K. Phillips, J.O. Lamberson, and F.A. Cole. 1985. Phoxocephalid amphipod bioassay for marine sediment toxicity. Aquatic Toxicology and Hazard Assessment: Seventh Symposium. R. D. Cardwell, R. Purdy, and R. Bahner (eds), American Society for Testing and Materials, Philadelphia, PA, ASTM STP 854. pp. 284-307.

U.S. EPA. 1985. Technical support document for water quality-based toxics control. EPA 440/4-85-032. U.S. Environmental Protection Agency, Office of Water, Washington, DC. 75 pp. plus appendices.

U.S. EPA. 1988a. Draft briefing report on the Equilibrium Partitioning approach to generating sediment quality criteria. Submitted to the EPA Science Advisory Board by U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, DC.

U.S. EPA. 1988b. Briefing report on the Apparent Effects Threshold approach. Submitted to the EPA Science Advisory Board by U.S. Environmental Protection Agency, Region 10, Office of Puget Sound. Prepared by PTI Environmental Services, Bellevue, WA. 57 pp.

Williams, L. G., Chapman, P. M. and Ginn, T. C. 1986. A comparative evaluation of sediment toxicity using bacterial luminescence, oyster embryo, and amphipod sediment bioassays. Mar. Environ. Res. 19:225-249.

Zarba, C. 1989. Personal communication (summary of available marine chronic water quality criteria, marine final residue values, marine water advisories, equilibrium partitioning coefficients, and uncertainty estimates for selected organic contaminants). March 1989, 1 pp.

APPENDIX A

Location by Region of Stations with Predicted Biological Effects Using Mean EP Values

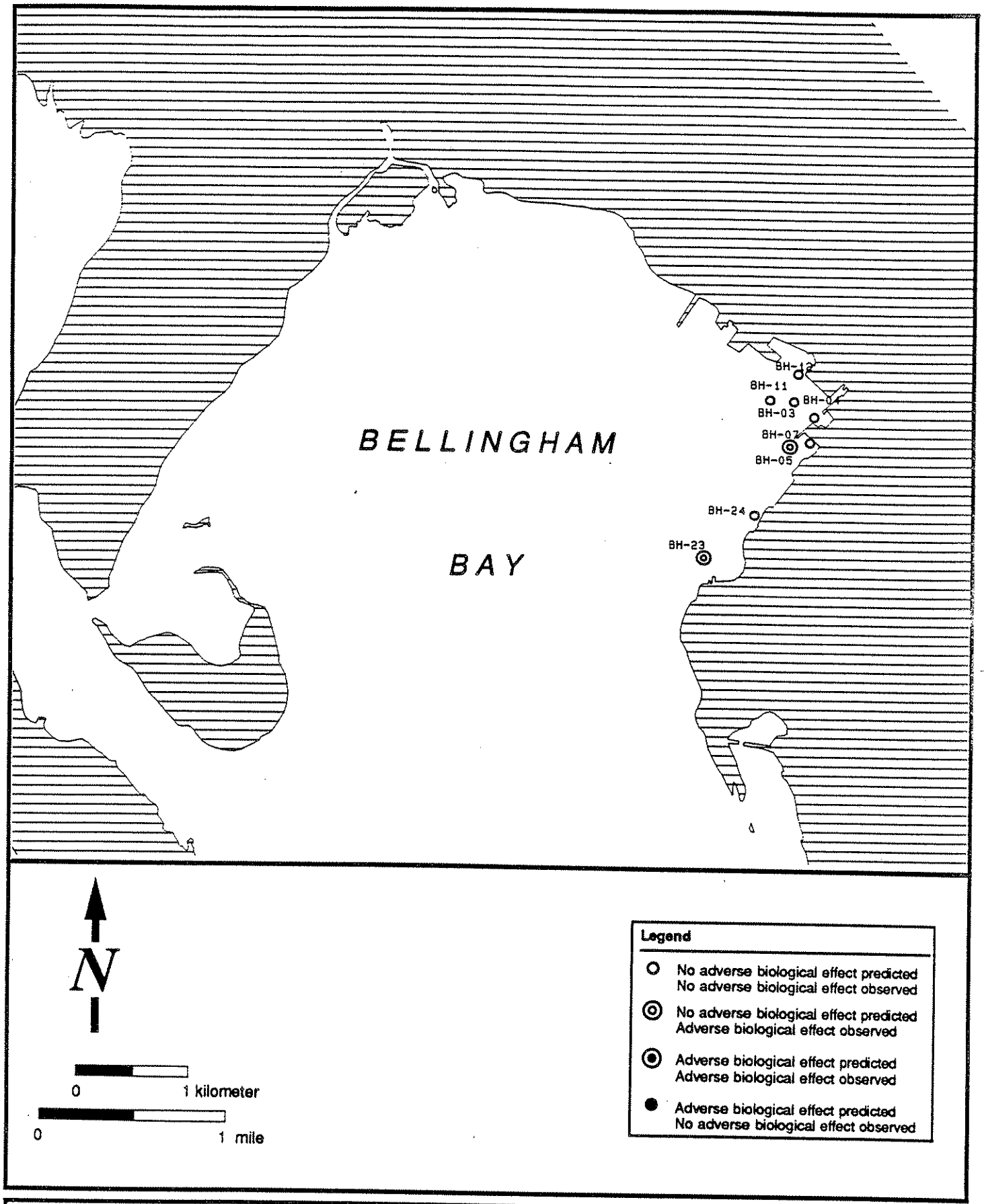


Figure A-1. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Bellingham Bay

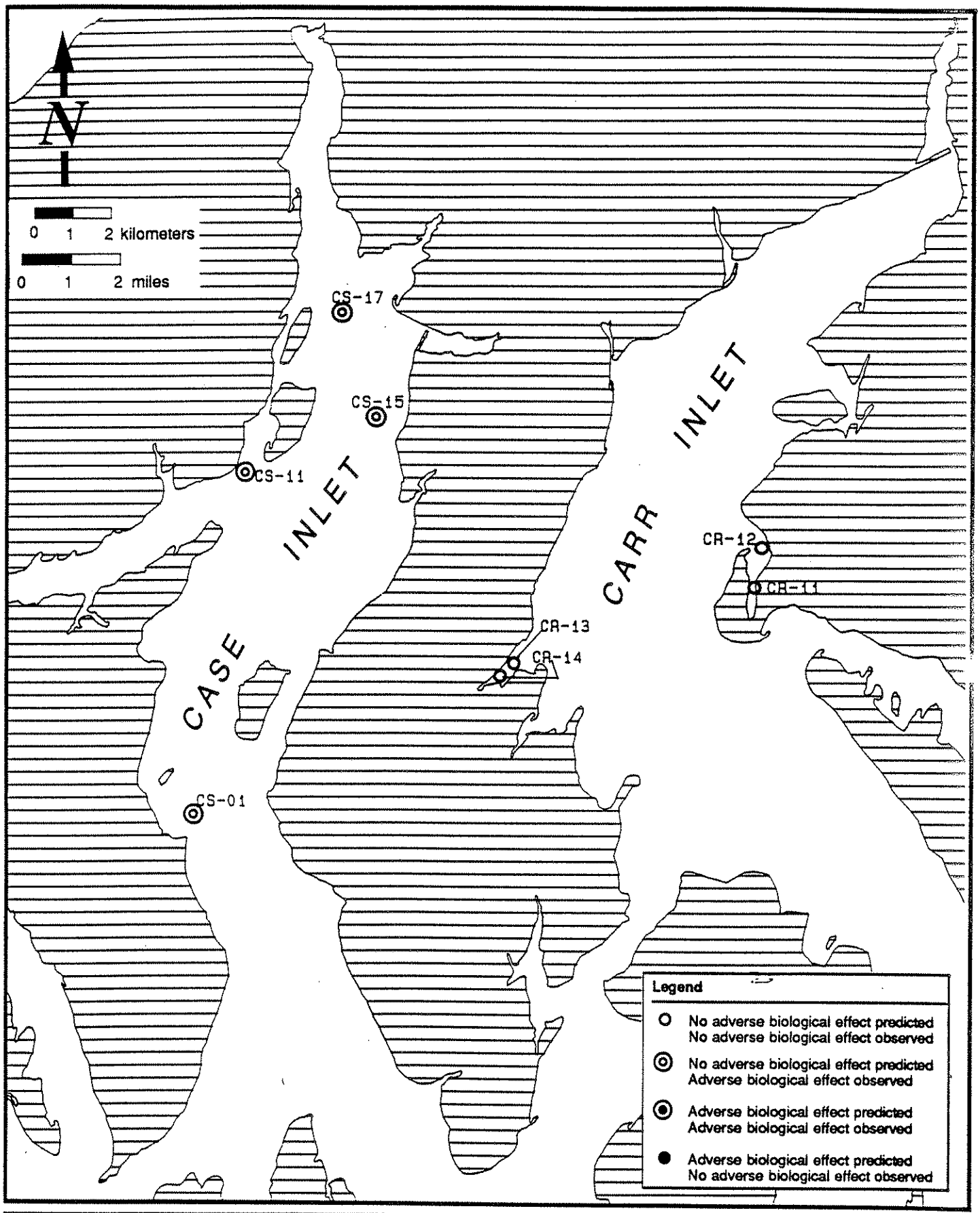


Figure A-2. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Case and Carr Inlets

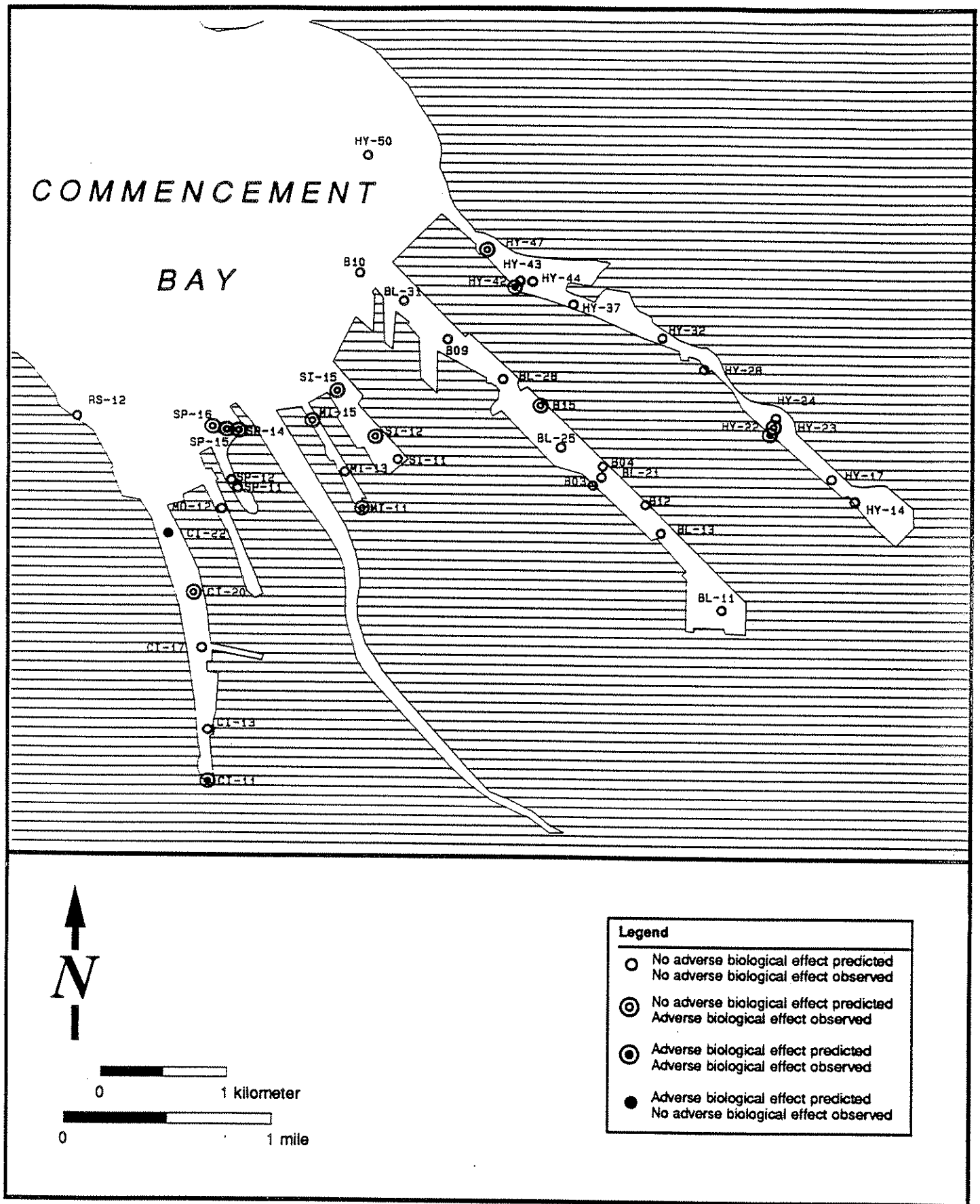


Figure A-3. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Commencement Bay Waterways

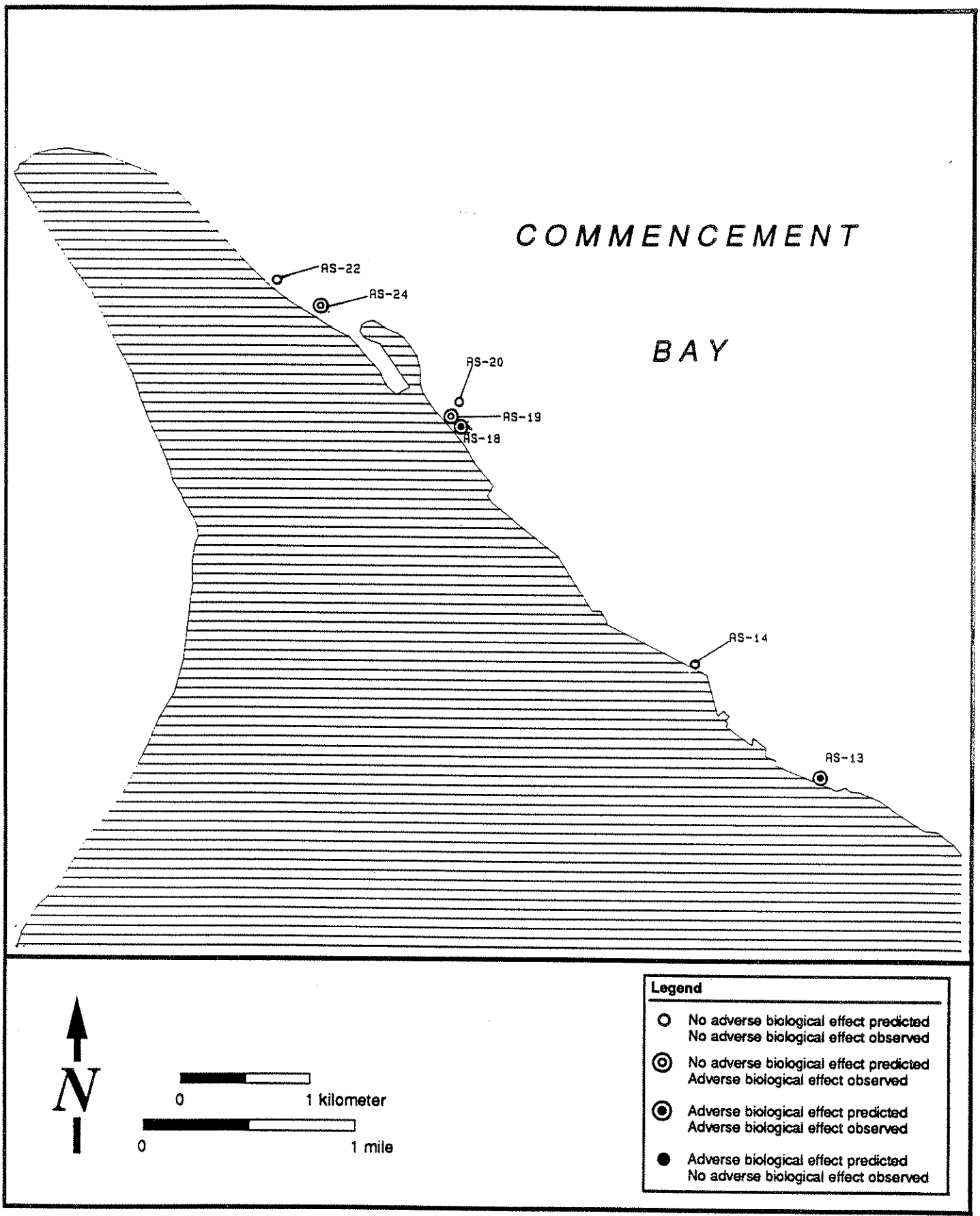


Figure A-4. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations near Commencement Bay Ruston-Point Defiance

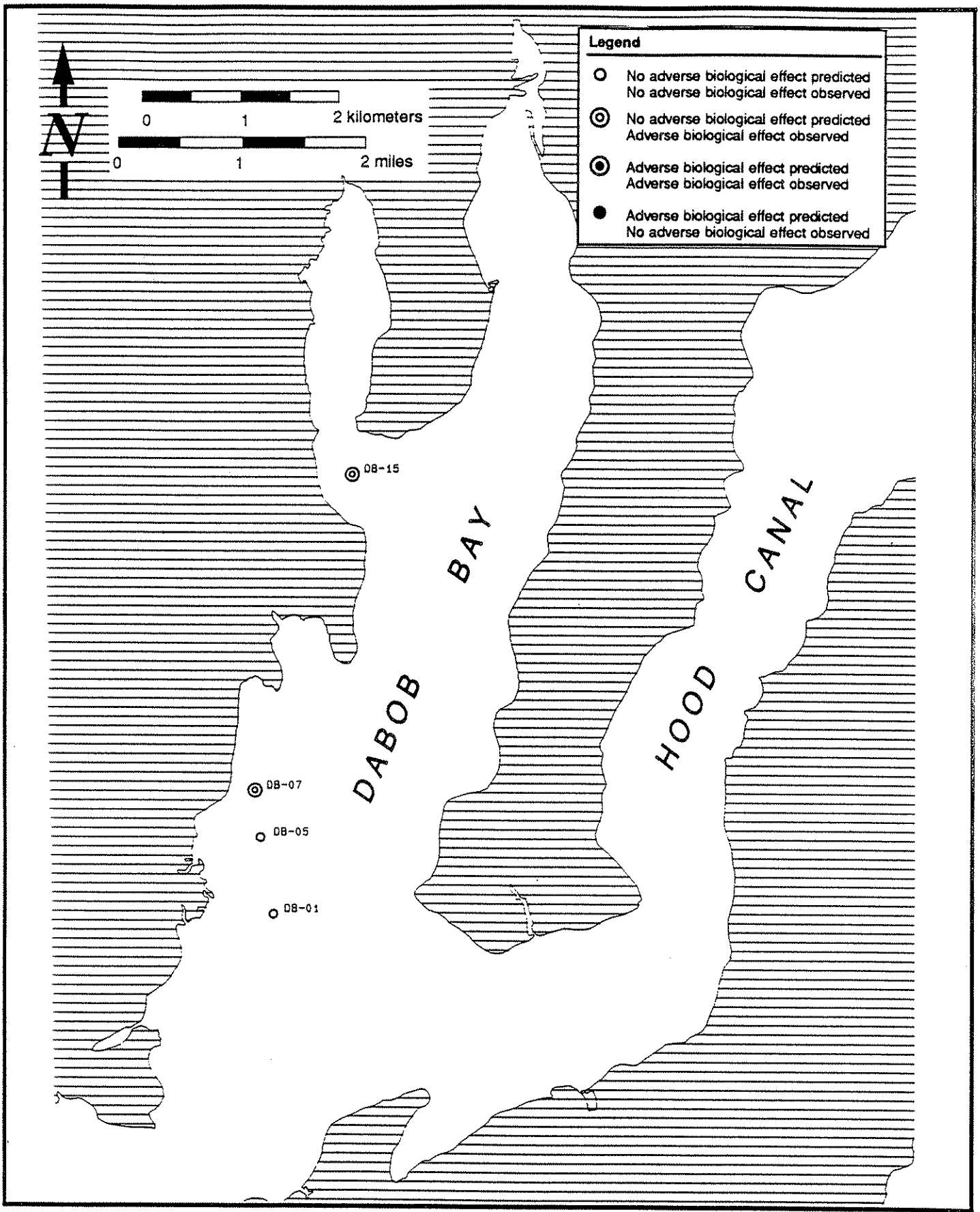
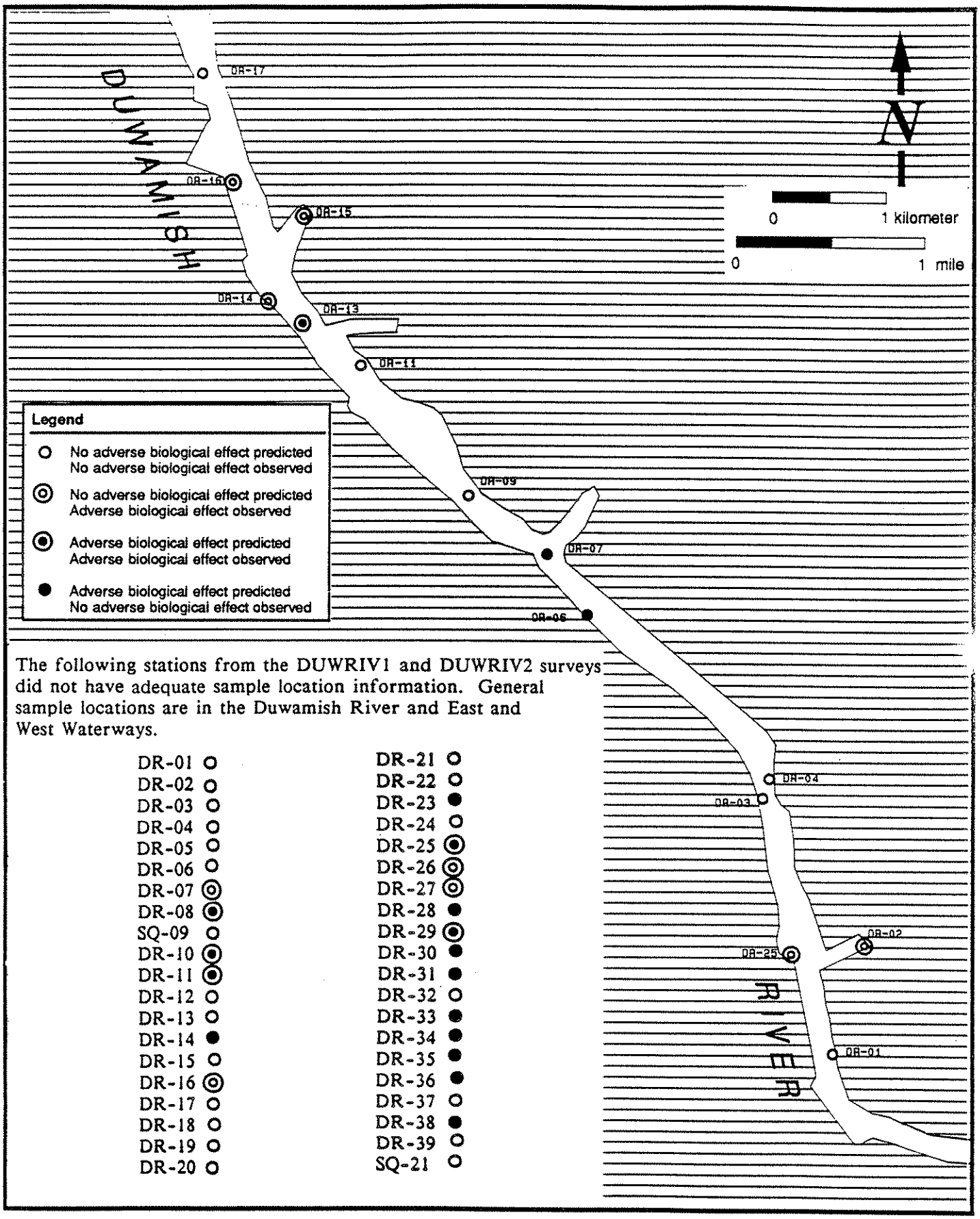


Figure A-5. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Dabob Bay



The following stations from the DUWRIV1 and DUWRIV2 surveys did not have adequate sample location information. General sample locations are in the Duwamish River and East and West Waterways.

DR-01 ○	DR-21 ○
DR-02 ○	DR-22 ○
DR-03 ○	DR-23 ●
DR-04 ○	DR-24 ○
DR-05 ○	DR-25 ◉
DR-06 ○	DR-26 ◎
DR-07 ◎	DR-27 ◎
DR-08 ◉	DR-28 ●
SQ-09 ○	DR-29 ◉
DR-10 ◉	DR-30 ●
DR-11 ◉	DR-31 ●
DR-12 ○	DR-32 ○
DR-13 ○	DR-33 ●
DR-14 ●	DR-34 ●
DR-15 ○	DR-35 ●
DR-16 ◎	DR-36 ●
DR-17 ○	DR-37 ○
DR-18 ○	DR-38 ●
DR-19 ○	DR-39 ○
DR-20 ○	SQ-21 ○

Figure A-6. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in the Duwamish River

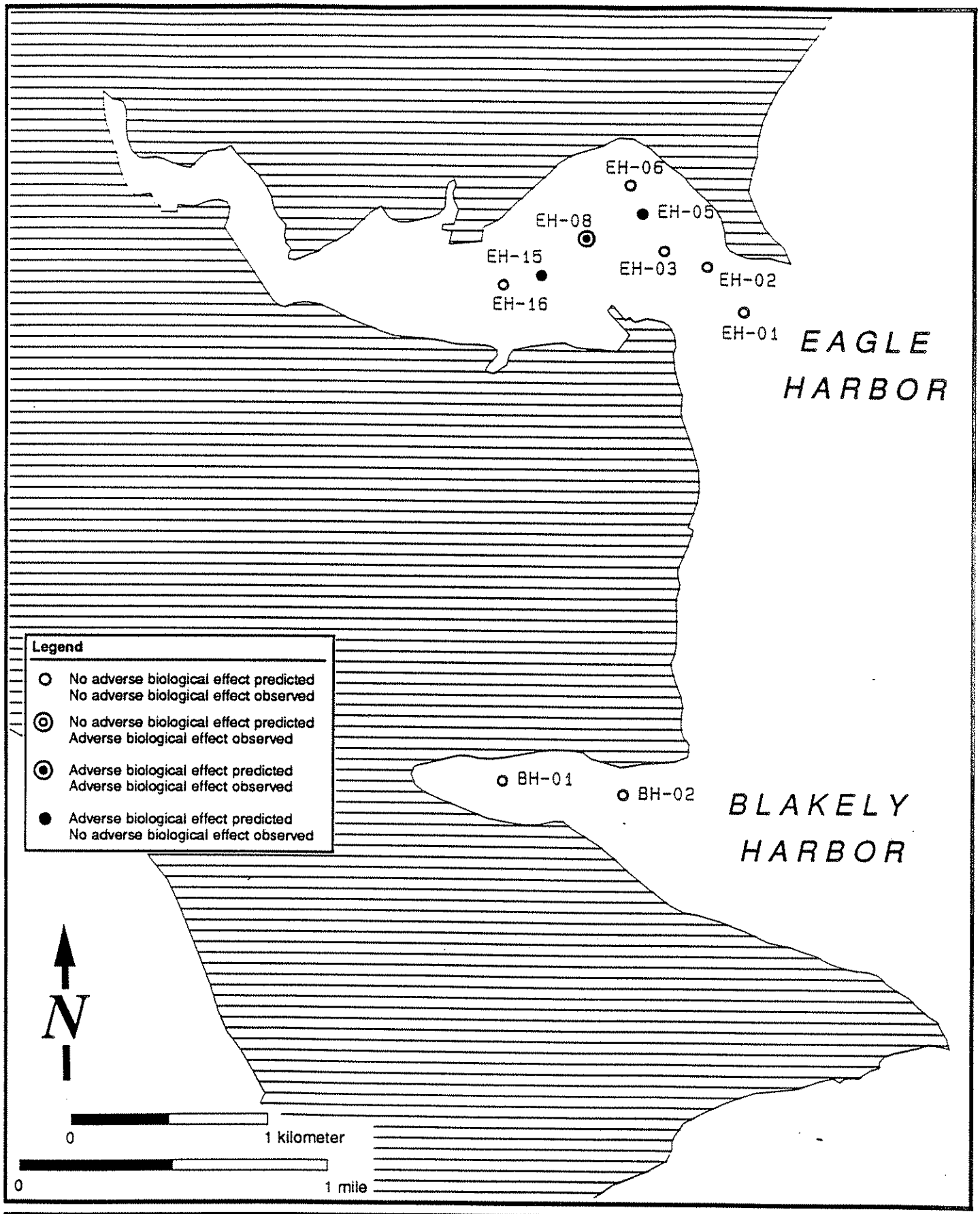


Figure A-7. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Eagle and Blakley Harbors

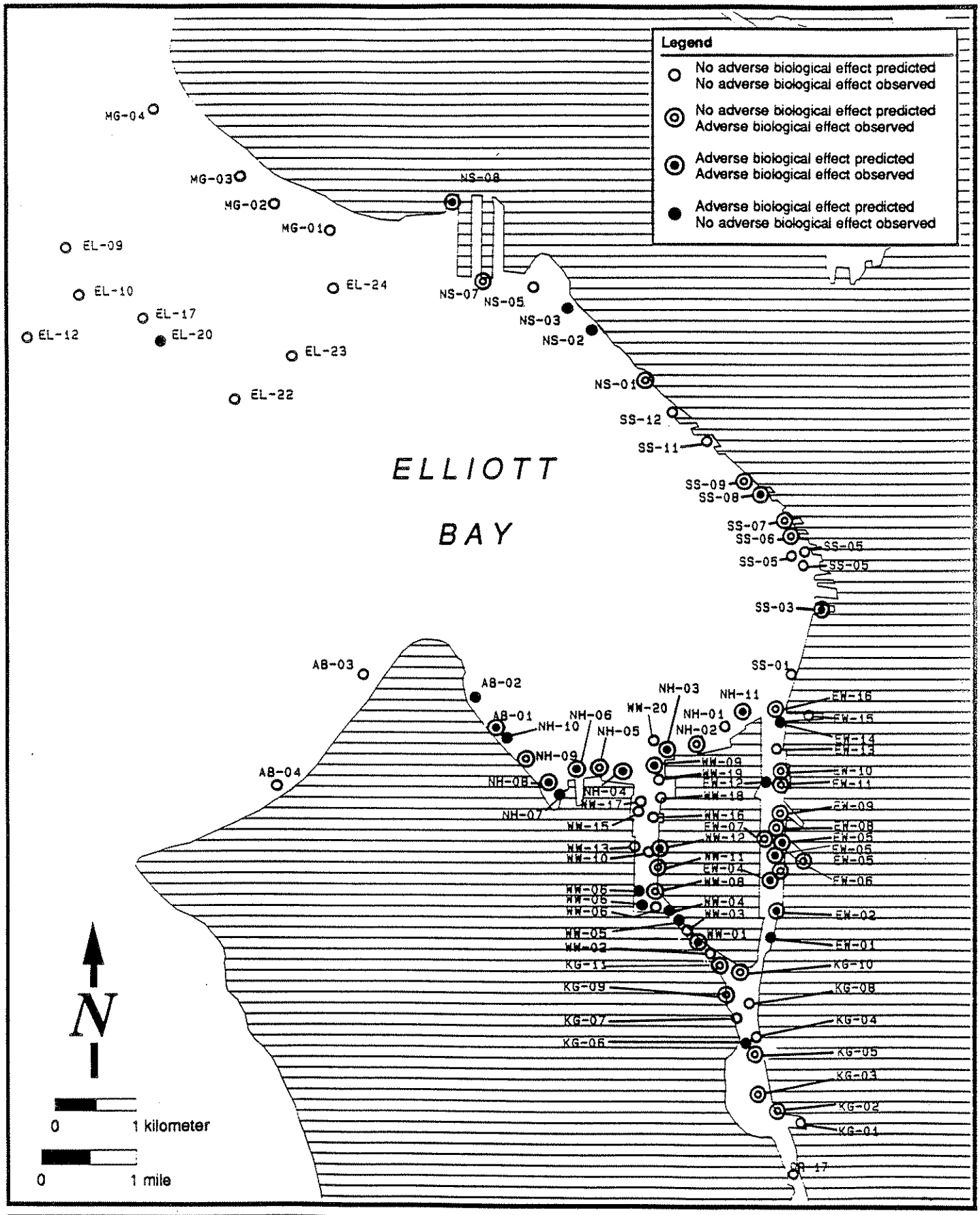


Figure A-8. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Elliott Bay

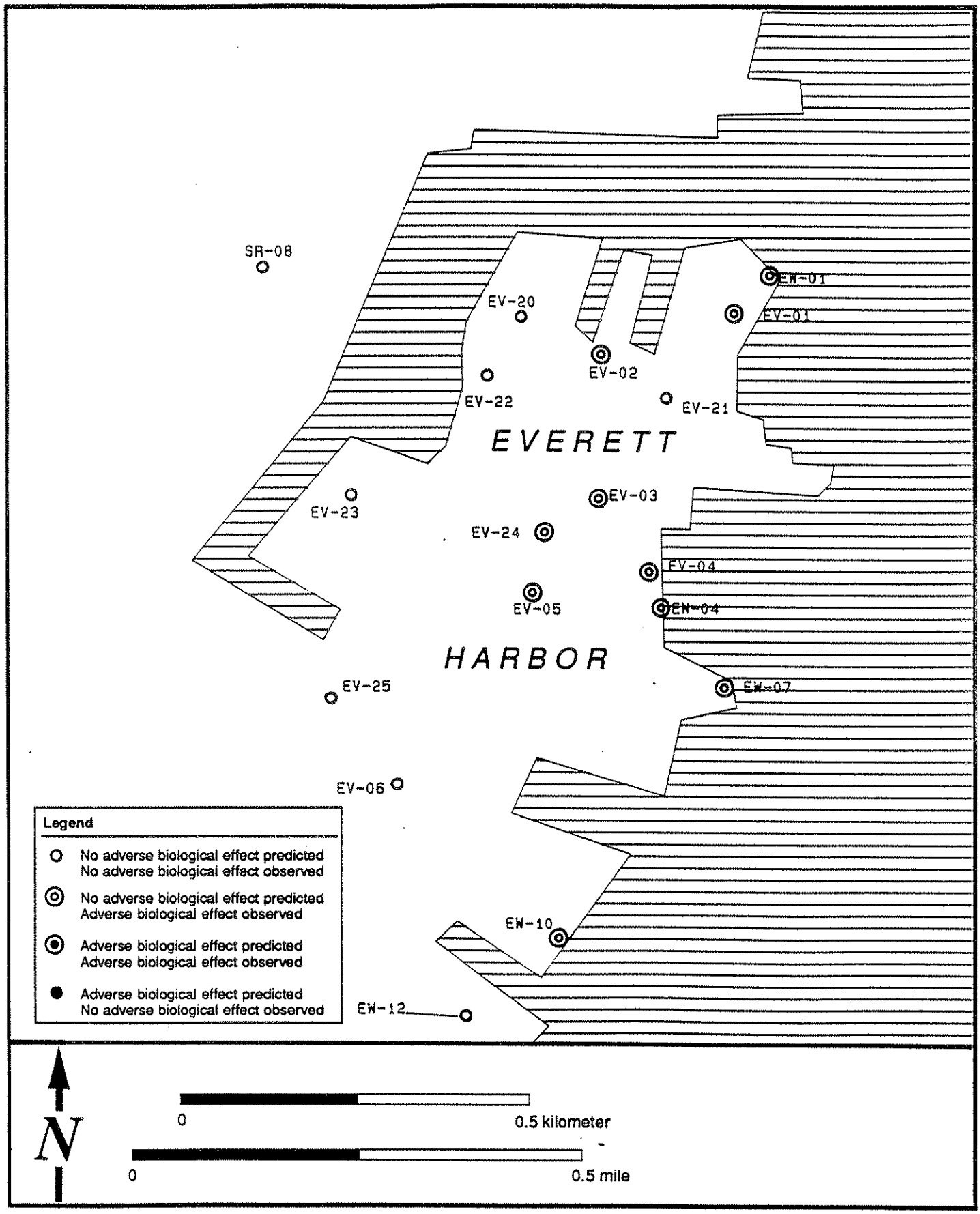


Figure A-9. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Everett Harbor

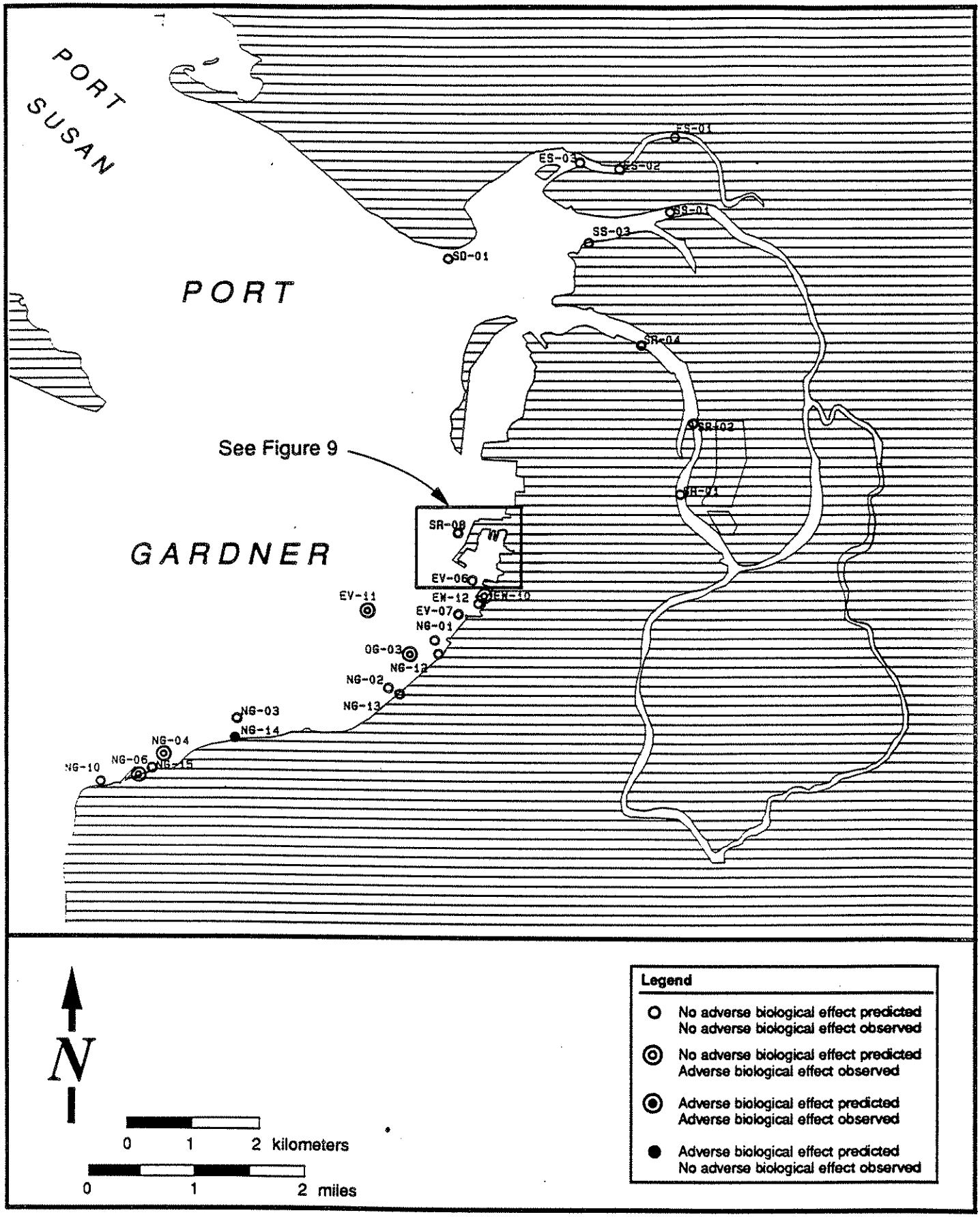


Figure A-10. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Port Gardner

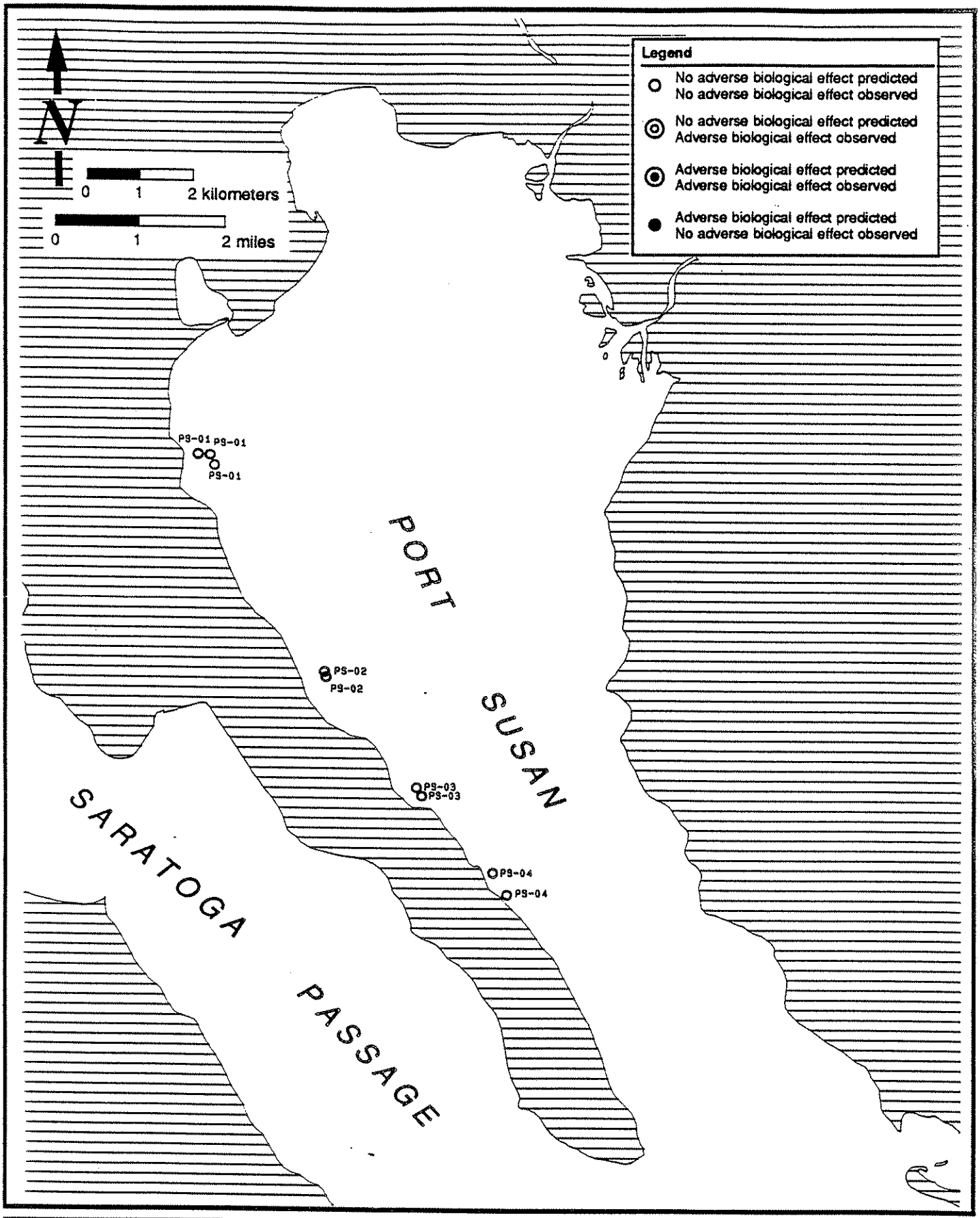


Figure A-11. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Port Susan

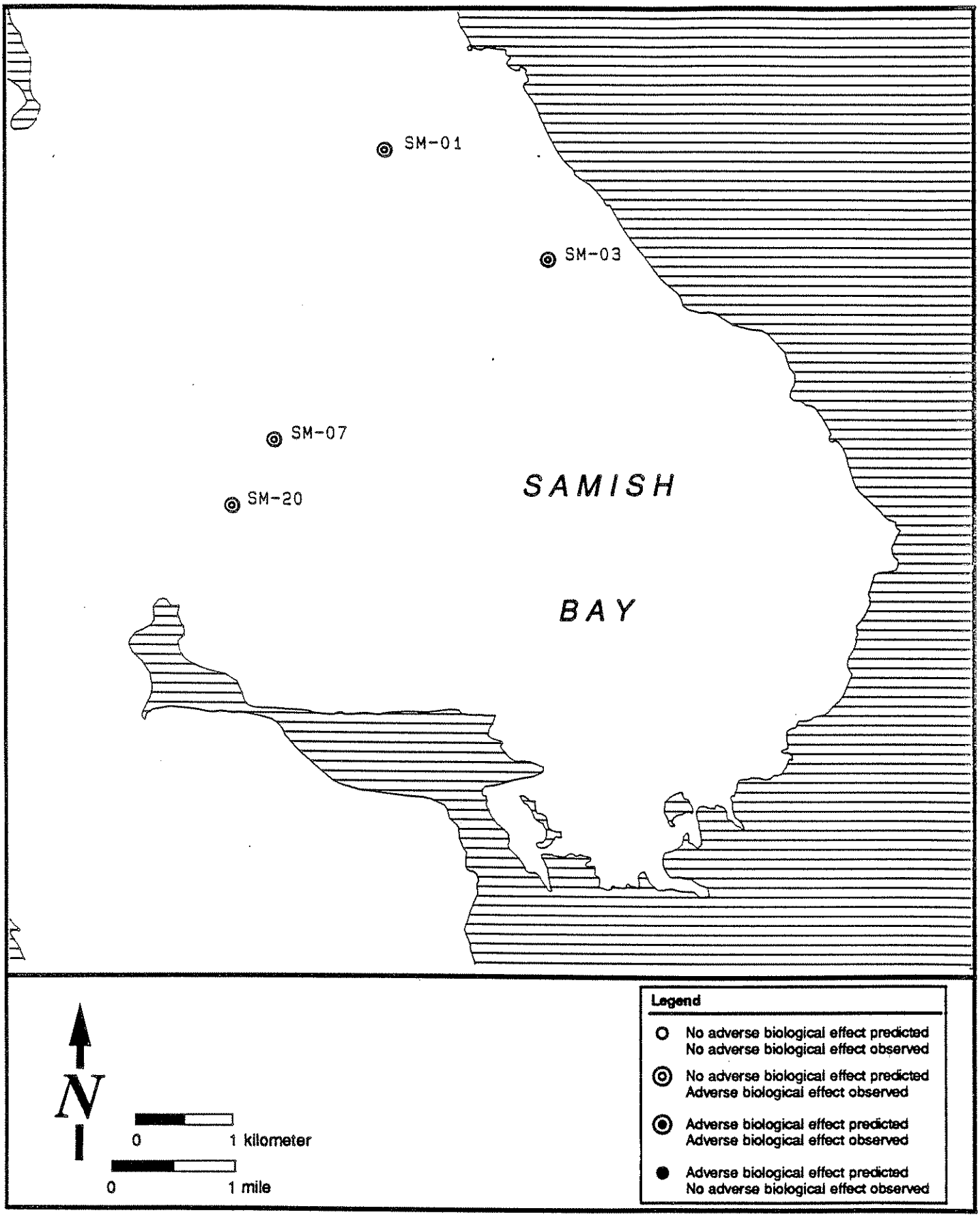


Figure A-12. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Samish Bay

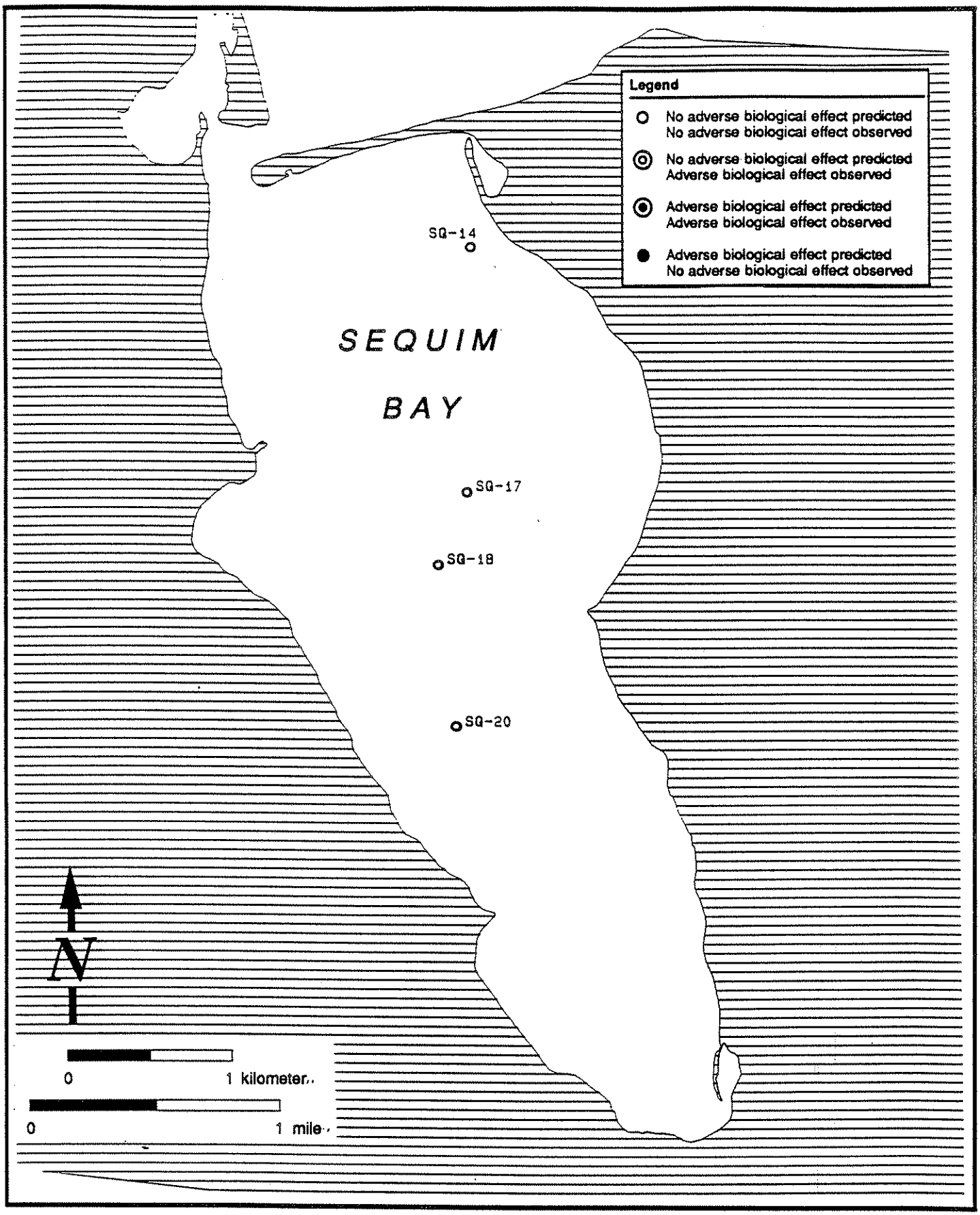


Figure A-13. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for amphipod bioassay stations in Sequim Bay

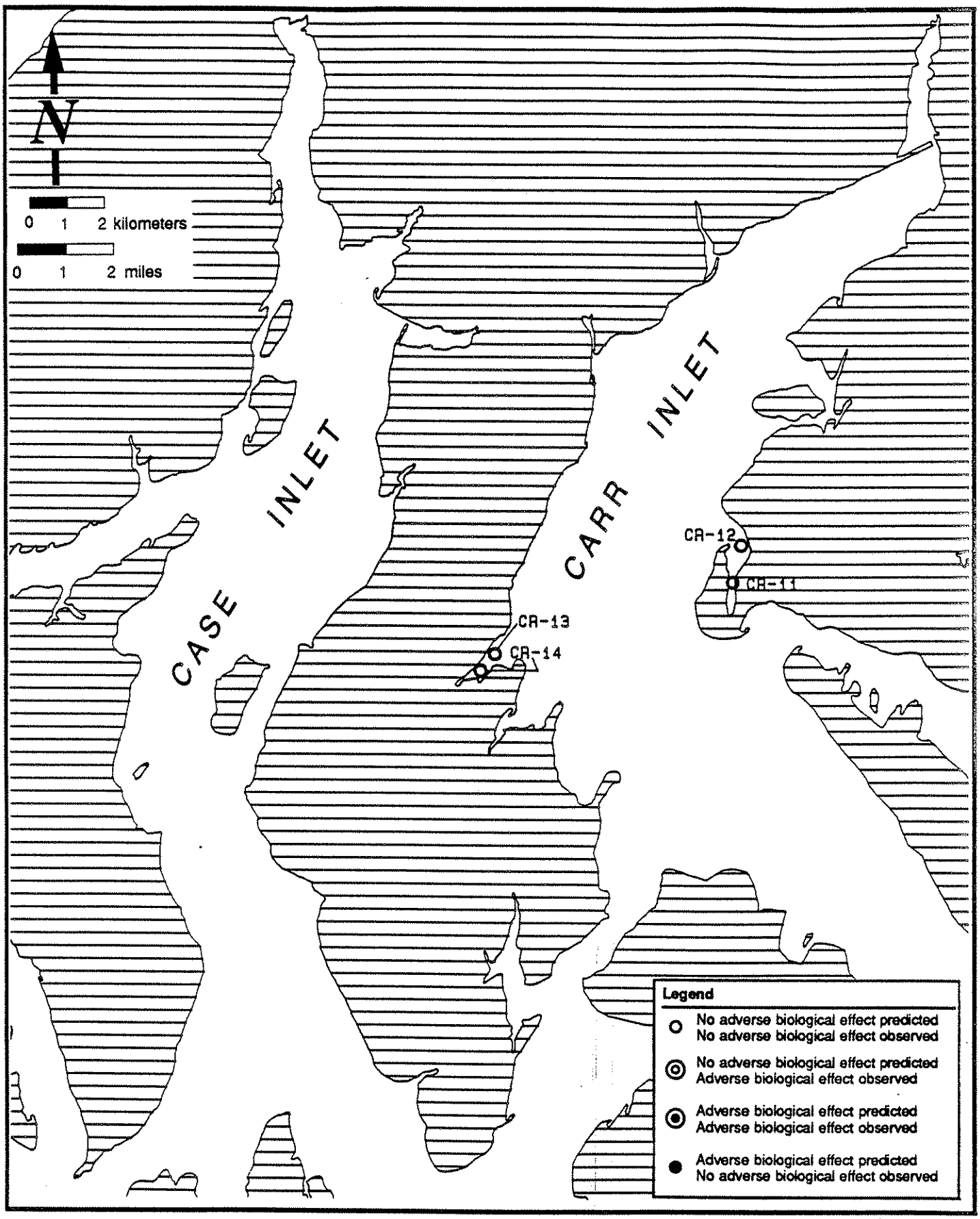


Figure A-15. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Case and Carr Inlets

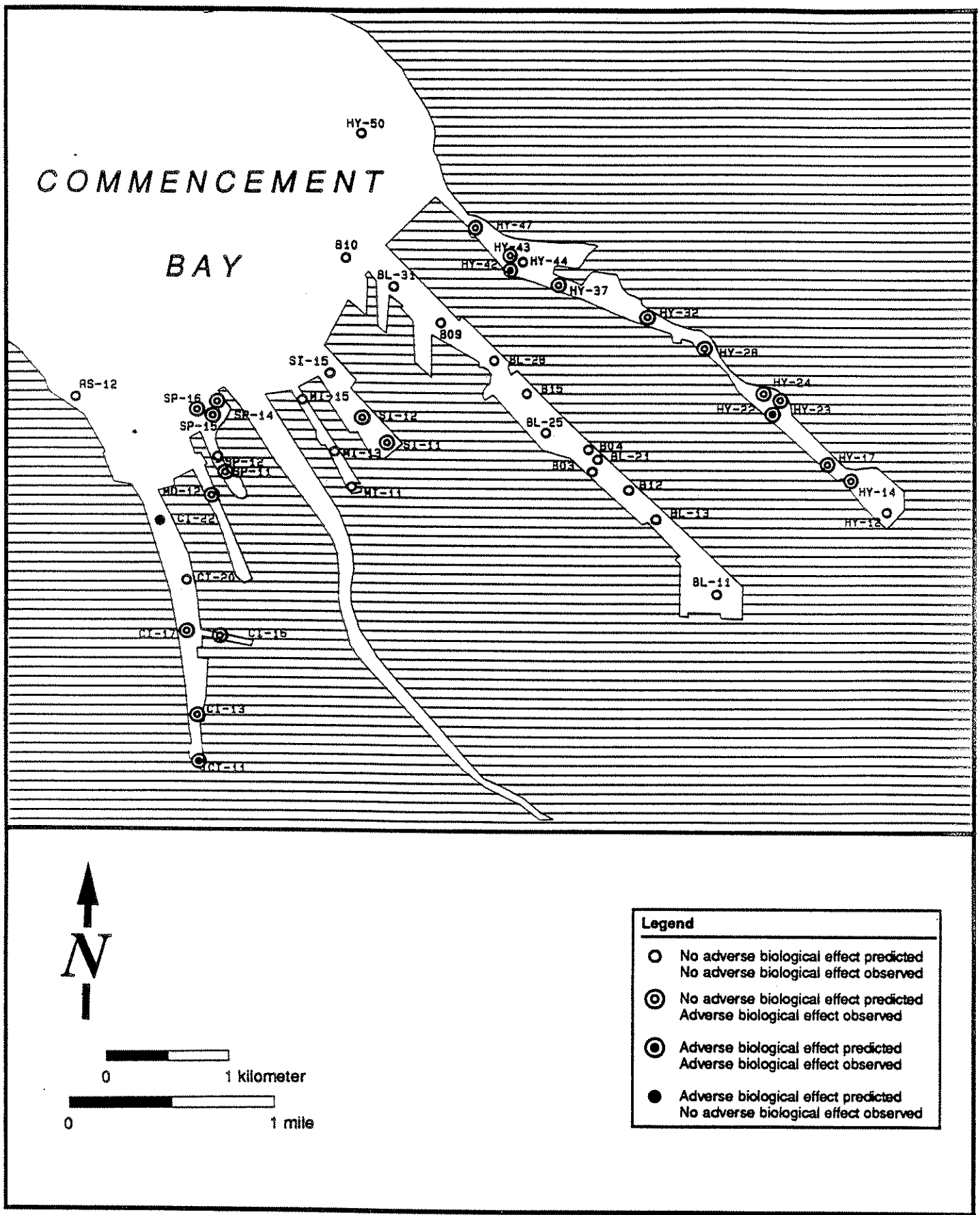


Figure A-16. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Commencement Bay Waterways

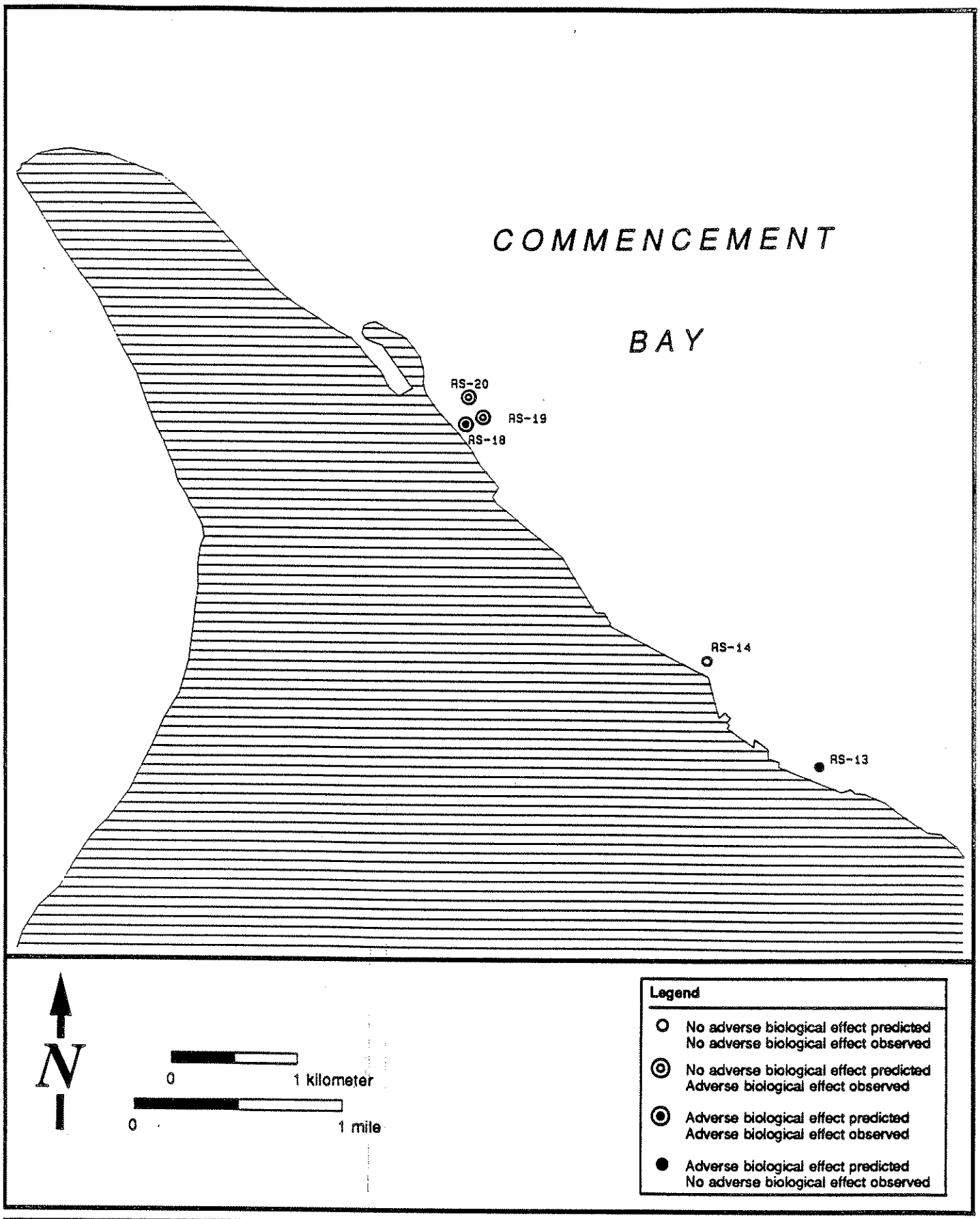


Figure A-17. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations near Commencement Bay Ruston-Point Defiance

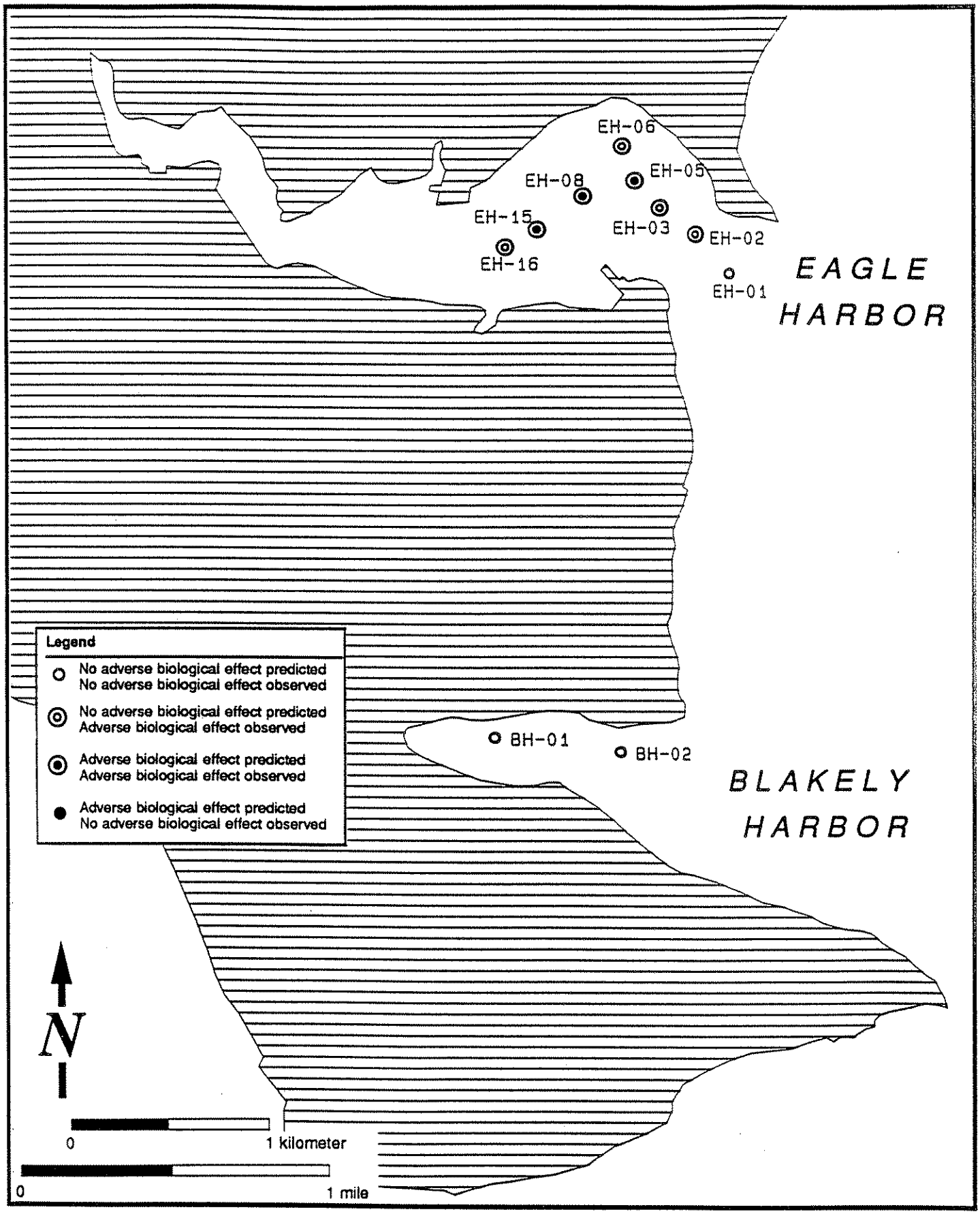


Figure A-18. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Eagle and Blakley Harbors

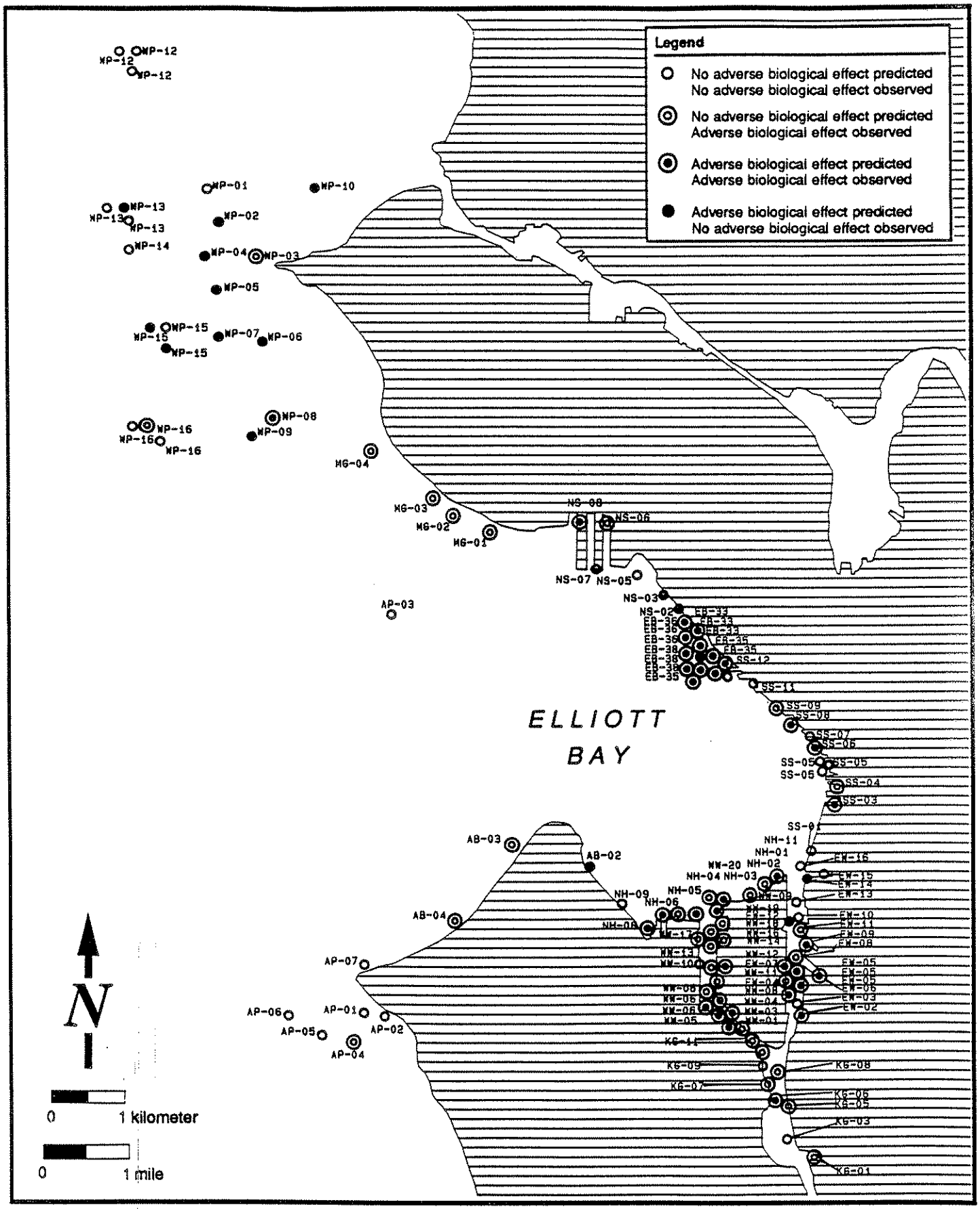


Figure A-19. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Elliott Bay

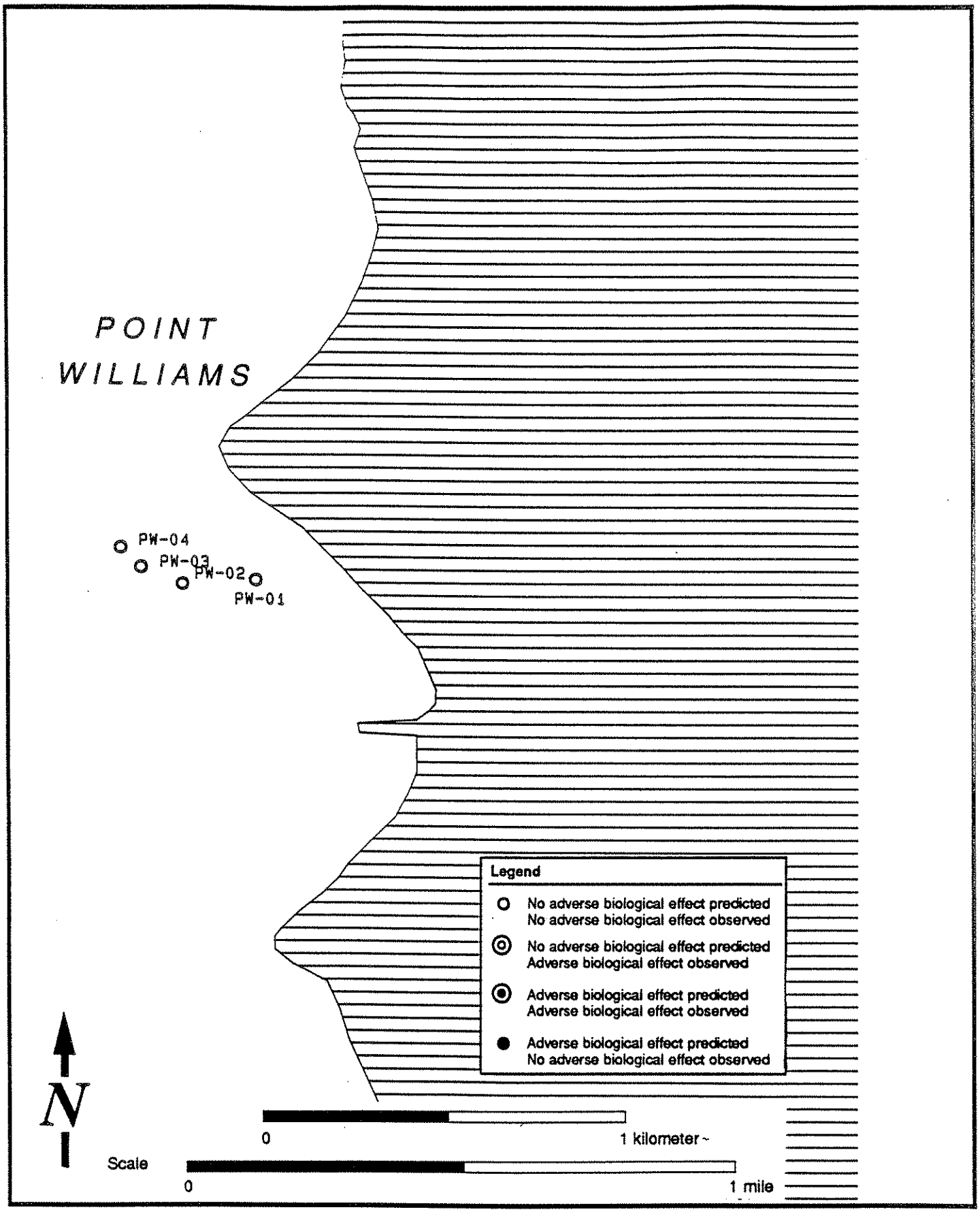


Figure A-20. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations near Point Williams

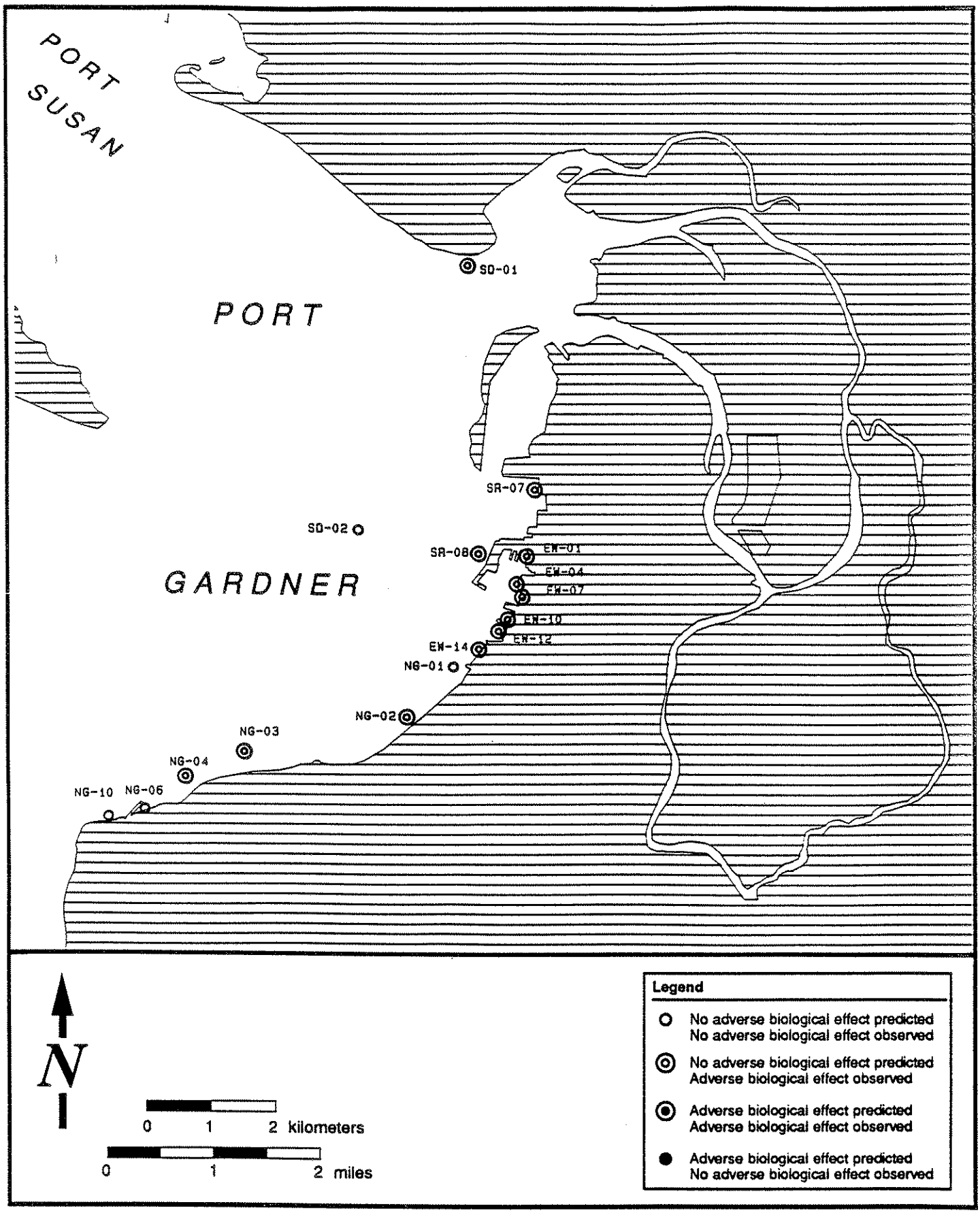


Figure A-21. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Port Gardner

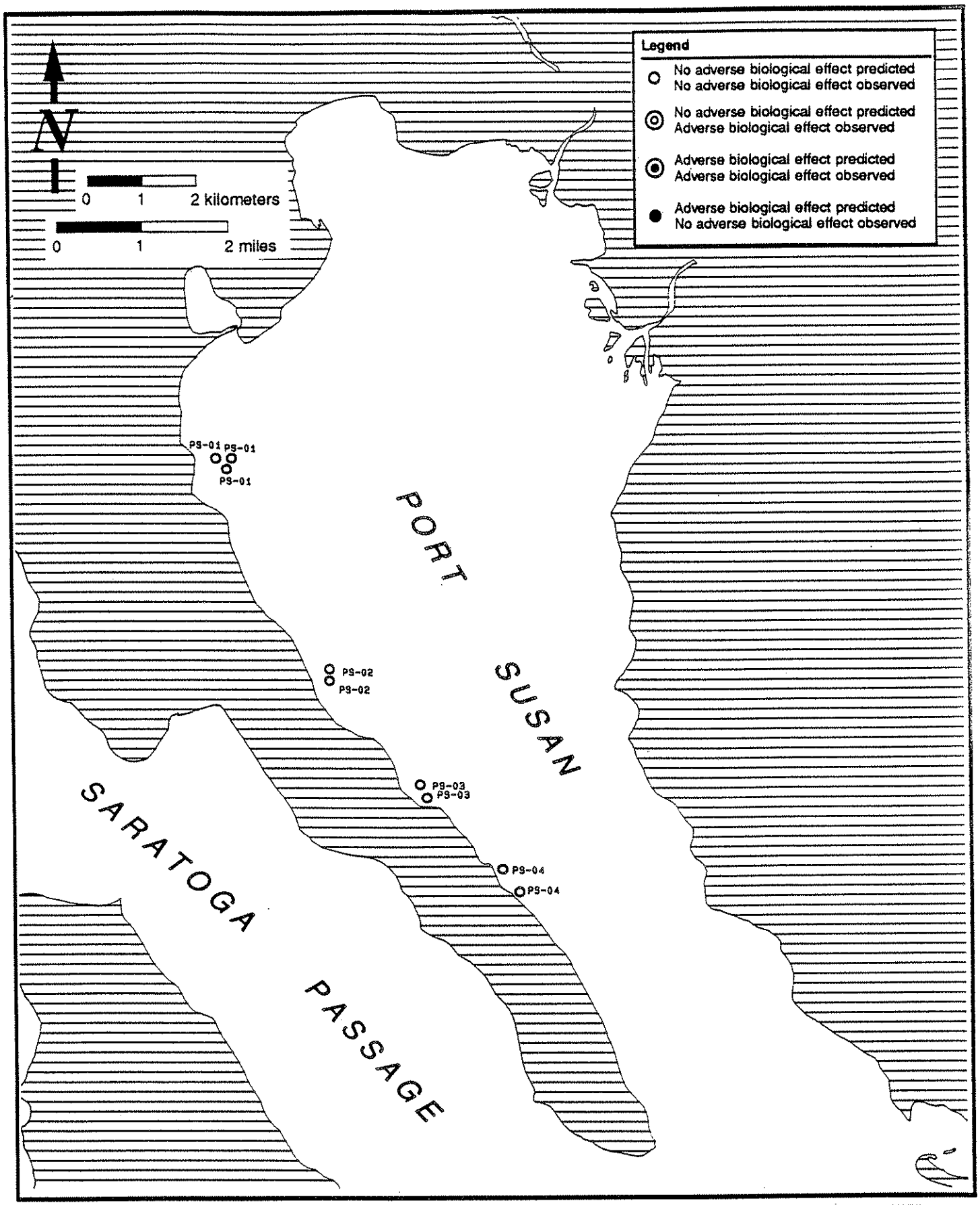


Figure A-22. Predicted mean equilibrium partitioning (EP) results and observed adverse biological effects for benthic abundance stations in Port Susan

TABLE A-1. LOCATIONS FOR PUGET SOUND BIOLOGICAL EFFECTS STATIONS USED IN THE EVALUATION OF SEDIMENT QUALITY VALUES

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates East	State Plane Coordinates South North
ALKI	AP-01	05/25/84	AP-01	47	34	22	122	25	5	--	--
ALKI	AP-02	05/25/84	AP-02	47	34	20	122	24	53	--	--
ALKI	AP-03	05/25/84	AP-03	47	37	15	122	24	53	--	--
ALKI	AP-04	05/25/84	AP-04	47	34	9	122	25	12	--	--
ALKI	AP-05	05/25/84	AP-05	47	34	12	122	25	31	--	--
ALKI	AP-06	05/25/84	AP-06	47	34	20	122	25	52	--	--
ALKI	AP-07	05/25/84	AP-07	47	34	43	122	25	5	--	--
ALKI	PW-01	05/26/84	PW-01	47	31	38	122	23	57	--	--
ALKI	PW-02	05/26/84	PW-02	47	31	38	122	24	8	--	--
ALKI	PW-03	05/26/84	PW-03	47	31	39	122	24	13	--	--
ALKI	PW-04	05/26/84	PW-04	47	31	41	122	24	16	--	--
CBBLAIR	B03	06/01/84	B03	--	--	--	--	--	--	1530370	710020
CBBLAIR	B04	06/01/84	B04	--	--	--	--	--	--	1530580	710540
CBBLAIR	B09	06/01/84	B09	--	--	--	--	--	--	1526600	713860
CBBLAIR	B10	06/01/84	B10	--	--	--	--	--	--	1524340	715560
CBBLAIR	B12	06/01/84	B12	--	--	--	--	--	--	1531670	709510
CBBLAIR	B15	06/01/84	B15	--	--	--	--	--	--	1528975	712150
CBMSQS	BL-11	01/01/84	BL-11	--	--	--	--	--	--	1533820	706730
CBMSQS	BL-13	01/01/84	BL-13	--	--	--	--	--	--	1532055	708770
CBMSQS	BL-21	01/01/84	BL-21	--	--	--	--	--	--	1530550	710225
CBMSQS	BL-25	01/01/84	BL-25	--	--	--	--	--	--	1529495	711030
CBMSQS	BL-28	01/01/84	BL-28	--	--	--	--	--	--	1528015	712810
CBMSQS	BL-31	01/01/84	BL-31	--	--	--	--	--	--	1525455	714850
CBMSQS	CI-11	01/01/84	CI-11	--	--	--	--	--	--	1520505	702125
CBMSQS	CI-13	01/01/84	CI-13	--	--	--	--	--	--	1520435	703435
CBMSQS	CI-16	01/01/84	CI-16	--	--	--	--	--	--	1520955	705470
CBMSQS	CI-17	01/01/84	CI-17	--	--	--	--	--	--	1520305	705560
CBMSQS	CI-20	01/01/84	CI-20	--	--	--	--	--	--	1520075	707100
CBMSQS	CI-22	01/01/84	CI-22	--	--	--	--	--	--	1519435	708655
CBMSQS	CR-11	01/01/84	CR-11	--	--	--	--	--	--	1458050	721700
CBMSQS	CR-12	01/01/84	CR-12	--	--	--	--	--	--	1458500	724750
CBMSQS	CR-13	01/01/84	CR-13	--	--	--	--	--	--	1439750	715750
CBMSQS	CR-14	01/01/84	CR-14	--	--	--	--	--	--	1438800	714750
CBMSQS	HY-12	01/01/84	HY-12	--	--	--	--	--	--	1538160	709035
CBMSQS	HY-14	01/01/84	HY-14	--	--	--	--	--	--	1537190	709630
CBMSQS	HY-17	01/01/84	HY-17	--	--	--	--	--	--	1536550	710220
CBMSQS	HY-22	01/01/84	HY-22	--	--	--	--	--	--	1534985	711485
CBMSQS	HY-23	01/01/84	HY-23	--	--	--	--	--	--	1535140	711635
CBMSQS	HY-24	01/01/84	HY-24	--	--	--	--	--	--	1535170	711850
CBMSQS	HY-28	01/01/84	HY-28	--	--	--	--	--	--	1533280	713110
CBMSQS	HY-32	01/01/84	HY-32	--	--	--	--	--	--	1532070	713975
CBMSQS	HY-37	01/01/84	HY-37	--	--	--	--	--	--	1529710	714835
CBMSQS	HY-42	01/01/84	HY-42	--	--	--	--	--	--	1528295	715315
CBMSQS	HY-43	01/01/84	HY-43	--	--	--	--	--	--	1528340	715405
CBMSQS	HY-44	01/01/84	HY-44	--	--	--	--	--	--	1528650	715415
CBMSQS	HY-47	01/01/84	HY-47	--	--	--	--	--	--	1527585	716250
CBMSQS	HY-50	01/01/84	HY-50	--	--	--	--	--	--	1524500	718750
CBMSQS	MD-12	01/01/84	MD-12	--	--	--	--	--	--	1520765	709285

TABLE A-1. (Continued)

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates - South East	State Plane Coordinates - South North
CBMSQS	MI-11	01/01/84	MI-11	--	--	--	--	--	--	1524495	709365
CBMSQS	MI-13	01/01/84	MI-13	--	--	--	--	--	--	1523925	710295
CBMSQS	MI-15	01/01/84	MI-15	--	--	--	--	--	--	1523035	711720
CBMSQS	RS-12	01/01/84	RS-12	--	--	--	--	--	--	1517000	711750
CBMSQS	RS-13	01/01/84	RS-13	--	--	--	--	--	--	1512250	714900
CBMSQS	RS-14*	01/01/84	RS-14	--	--	--	--	--	--	1508950	717400
CBMSQS	RS-18	01/01/84	RS-18	--	--	--	--	--	--	1502950	723900
CBMSQS	RS-19	01/01/84	RS-19	--	--	--	--	--	--	1503150	724000
CBMSQS	RS-20	01/01/84	RS-20	--	--	--	--	--	--	1503600	724300
CBMSQS	RS-21	01/01/84	RS-21	--	--	--	--	--	--	1502760	724150
CBMSQS	RS-22	01/01/84	RS-22	--	--	--	--	--	--	1498750	727500
CBMSQS	RS-24	01/01/84	RS-24	--	--	--	--	--	--	1499950	726850
CBMSQS	SI-11	01/01/84	SI-11	--	--	--	--	--	--	1525295	710650
CBMSQS	SI-12	01/01/84	SI-12	--	--	--	--	--	--	1524680	711295
CBMSQS	SI-15	01/01/84	SI-15	--	--	--	--	--	--	1523750	712510
CBMSQS	SP-11	01/01/84	SP-11	--	--	--	--	--	--	1521190	709820
CBMSQS	SP-12	01/01/84	SP-12	--	--	--	--	--	--	1521065	710090
CBMSQS	SP-14	01/01/84	SP-14	--	--	--	--	--	--	1521240	711425
CBMSQS	SP-15	01/01/84	SP-15	--	--	--	--	--	--	1520910	711475
CBMSQS	SP-16	01/01/84	SP-16	--	--	--	--	--	--	1520515	711535
DUWRIV1**	DR-01	04/15/85	DR-01	--	--	--	--	--	--	--	--
DUWRIV1	DR-02	04/15/85	DR-02	--	--	--	--	--	--	--	--
DUWRIV1	DR-03	04/15/85	DR-03	--	--	--	--	--	--	--	--
DUWRIV1	DR-04	04/15/85	DR-04	--	--	--	--	--	--	--	--
DUWRIV1	DR-05	04/15/85	DR-05	--	--	--	--	--	--	--	--
DUWRIV1	DR-06	04/15/85	DR-06	--	--	--	--	--	--	--	--
DUWRIV1	DR-07	04/15/85	DR-07	--	--	--	--	--	--	--	--
DUWRIV1	DR-08	04/15/85	DR-08	--	--	--	--	--	--	--	--
DUWRIV1	SQ-09	04/19/85	SQ-09	--	--	--	--	--	--	--	--
DUWRIV2**	DR-10	07/01/85	CA1	--	--	--	--	--	--	--	--
DUWRIV2	DR-11	07/01/85	CA2	--	--	--	--	--	--	--	--
DUWRIV2	DR-12	07/01/85	CA3	--	--	--	--	--	--	--	--
DUWRIV2	DR-13	07/01/85	CB1	--	--	--	--	--	--	--	--
DUWRIV2	DR-14	07/01/85	CB2	--	--	--	--	--	--	--	--
DUWRIV2	DR-15	07/01/85	CB3	--	--	--	--	--	--	--	--
DUWRIV2	DR-16	07/01/85	CB4	--	--	--	--	--	--	--	--
DUWRIV2	DR-17	07/01/85	CB5	--	--	--	--	--	--	--	--
DUWRIV2	DR-18	07/01/85	CC1	--	--	--	--	--	--	--	--
DUWRIV2	DR-19	07/01/85	CC2	--	--	--	--	--	--	--	--
DUWRIV2	DR-20	07/01/85	CC3	--	--	--	--	--	--	--	--
DUWRIV2	DR-21	07/01/85	CC4	--	--	--	--	--	--	--	--
DUWRIV2	DR-22	07/01/85	CC5	--	--	--	--	--	--	--	--
DUWRIV2	DR-23	07/01/85	CD1	--	--	--	--	--	--	--	--
DUWRIV2	DR-24	07/01/85	CD2	--	--	--	--	--	--	--	--
DUWRIV2	DR-25	07/01/85	CE1	--	--	--	--	--	--	--	--
DUWRIV2	DR-26	07/01/85	CE2	--	--	--	--	--	--	--	--
DUWRIV2	DR-27	07/01/85	CE3	--	--	--	--	--	--	--	--
DUWRIV2	DR-28	07/01/85	CF1	--	--	--	--	--	--	--	--

TABLE A-1. (Continued)

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates - South East	State Plane Coordinates - South North
EBCHEM	KG-03	09/25/85	KG-03	--	--	--	--	--	--	1626920	207515
EBCHEM	KG-04*	10/09/85	KG-04	--	--	--	--	--	--	1627015	209165
EBCHEM	KG-05	09/30/85	KG-05	--	--	--	--	--	--	1626950	209095
EBCHEM	KG-06	09/30/85	KG-06	--	--	--	--	--	--	1626450	209230
EBCHEM	KG-07	09/30/85	KG-07	--	--	--	--	--	--	1626160	209930
EBCHEM	KG-08	10/01/85	KG-08	--	--	--	--	--	--	1626585	210445
EBCHEM	KG-09	10/01/85	KG-09	--	--	--	--	--	--	1625945	210690
EBCHEM	KG-10	10/08/85	KG-10	--	--	--	--	--	--	1626385	211360
EBCHEM	KG-11	10/01/85	KG-11	--	--	--	--	--	--	1625415	211810
EBCHEM	MG-01	09/26/85	MG-01	--	--	--	--	--	--	1614150	233850
EBCHEM	MG-02	09/26/85	MG-02	--	--	--	--	--	--	1612525	234542
EBCHEM	MG-03	09/26/85	MG-03	--	--	--	--	--	--	1611550	235342
EBCHEM	MG-04	09/26/85	MG-04	--	--	--	--	--	--	1608975	237267
EBCHEM	NH-01*	10/15/85	NH-01	--	--	--	--	--	--	1625910	218580
EBCHEM	NH-02	10/15/85	NH-02	--	--	--	--	--	--	1625305	218055
EBCHEM	NH-03	10/16/85	NH-03	--	--	--	--	--	--	1624175	218035
EBCHEM	NH-04	10/15/85	NH-04	--	--	--	--	--	--	1622905	217355
EBCHEM	NH-05	10/15/85	NH-05	--	--	--	--	--	--	1622180	217365
EBCHEM	NH-06	10/16/85	NH-06	--	--	--	--	--	--	1621500	217335
EBCHEM	NH-07*	10/09/85	NH-07	--	--	--	--	--	--	1621275	216795
EBCHEM	NH-08	10/16/85	NH-08	--	--	--	--	--	--	1620958	216775
EBCHEM	NH-09	10/16/85	NH-09	--	--	--	--	--	--	1619808	217683
EBCHEM	NH-10	10/08/85	NH-10	--	--	--	--	--	--	1619225	218125
EBCHEM	NH-11	10/15/85	NH-11	--	--	--	--	--	--	1626325	219030
EBCHEM	NS-01*	10/08/85	NS-01	--	--	--	--	--	--	1623658	229392
EBCHEM	NS-02	09/27/85	NS-02	--	--	--	--	--	--	1622142	230717
EBCHEM	NS-03	10/04/85	NS-03	--	--	--	--	--	--	1621458	231317
EBCHEM	NS-05	10/04/85	NS-05	--	--	--	--	--	--	1620333	232058
EBCHEM	NS-06	09/27/85	NS-06	--	--	--	--	--	--	1619200	234492
EBCHEM	NS-07*	10/04/85	NS-07	--	--	--	--	--	--	1618783	232341
EBCHEM	NS-08*	09/26/85	NS-08	--	--	--	--	--	--	1618058	234617
EBCHEM	PS-01	10/12/85	PS-01	--	--	--	--	--	--	1601400	432100
EBCHEM	PS-01	10/12/85	PS-01	--	--	--	--	--	--	1601400	432100
EBCHEM	PS-02	10/12/85	PS-02	--	--	--	--	--	--	1608400	418700
EBCHEM	PS-03	10/12/85	PS-03	--	--	--	--	--	--	1613900	411600
EBCHEM	PS-04	10/12/85	PS-04	--	--	--	--	--	--	1618600	406300
EBCHEM	SS-01*	10/16/85	SS-01	--	--	--	--	--	--	1628000	220117
EBCHEM	SS-03	10/04/85	SS-03	--	--	--	--	--	--	1629142	222317
EBCHEM	SS-04	10/04/85	SS-04	--	--	--	--	--	--	1629158	222908
EBCHEM	SS-05	10/03/85	SS-05	--	--	--	--	--	--	1628600	223867
EBCHEM	SS-05	10/03/85	SS-05	--	--	--	--	--	--	1628600	223867
EBCHEM	SS-06	10/03/85	SS-06	--	--	--	--	--	--	1628350	224658
EBCHEM	SS-07	10/03/85	SS-07	--	--	--	--	--	--	1628092	224975
EBCHEM	SS-08	09/27/85	SS-08	--	--	--	--	--	--	1627242	225908
EBCHEM	SS-09*	09/27/85	SS-09	--	--	--	--	--	--	1626842	226292
EBCHEM	SS-11	09/27/85	SS-11	--	--	--	--	--	--	1625442	227400
EBCHEM	SS-12	09/27/85	SS-12	--	--	--	--	--	--	1624367	228317
EBCHEM	WW-01	10/01/85	WW-01	--	--	--	--	--	--	1624935	212415
EBCHEM	WW-02*	10/09/85	WW-02	--	--	--	--	--	--	1624615	212370
EBCHEM	WW-03	10/01/85	WW-03	--	--	--	--	--	--	1624525	212740

TABLE A-1. (Continued)

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates - South East	State Plane Coordinates - South North
EBCHEM	WW-04	10/01/85	WW-04	--	--	--	--	--	--	1624360	213175
EBCHEM	WW-05*	10/01/85	WW-05	--	--	--	--	--	--	1624045	213030
EBCHEM	WW-06	10/01/85	WW-06	--	--	--	--	--	--	1623365	213145
EBCHEM	WW-06	10/01/85	WW-06	--	--	--	--	--	--	1623365	213145
EBCHEM	WW-08	10/01/85	WW-08	--	--	--	--	--	--	1623680	213500
EBCHEM	WW-09	10/02/85	WW-09	--	--	--	--	--	--	1623890	217405
EBCHEM	WW-10	10/02/85	WW-10	--	--	--	--	--	--	1623625	215015
EBCHEM	WW-11	10/02/85	WW-11	--	--	--	--	--	--	1623885	214530
EBCHEM	WW-12	10/02/85	WW-12	--	--	--	--	--	--	1623915	215190
EBCHEM	WW-13*	10/02/85	WW-13	--	--	--	--	--	--	1623175	215095
EBCHEM	WW-14	10/02/85	WW-14	--	--	--	--	--	--	1623960	215945
EBCHEM	WW-15	10/08/85	WW-15	--	--	--	--	--	--	1623045	216110
EBCHEM	WW-16	10/02/85	WW-16	--	--	--	--	--	--	1623675	216020
EBCHEM	WW-17	10/03/85	WW-17	--	--	--	--	--	--	1623170	216390
EBCHEM	WW-18	10/03/85	WW-18	--	--	--	--	--	--	1623940	216520
EBCHEM	WW-19	10/03/85	WW-19	--	--	--	--	--	--	1624060	217095
EBCHEM	WW-20	10/03/85	WW-20	--	--	--	--	--	--	1623640	217925
EHCHEM	BH-01	06/01/85	B1	--	--	--	--	--	--	1586400	221843
EHCHEM	BH-02	06/01/85	B1	--	--	--	--	--	--	1588462	221601
EHCHEM	EH-01	06/01/85	B1	--	--	--	--	--	--	1590554	230004
EHCHEM	EH-02	06/01/85	B1	--	--	--	--	--	--	1589796	230636
EHCHEM	EH-03	06/01/85	V6	--	--	--	--	--	--	1589366	230960
EHCHEM	EH-05	06/01/85	V1	--	--	--	--	--	--	1588795	231512
EHCHEM	EH-06	06/01/85	V6	--	--	--	--	--	--	1588656	231958
EHCHEM	EH-08	06/01/85	V1	--	--	--	--	--	--	1587960	231225
EHCHEM	EH-15	06/01/85	V1	--	--	--	--	--	--	1587095	230645
EHCHEM	EH-16	06/01/85	V1	--	--	--	--	--	--	1586653	230426
EIGHTBAY	BH-03	04/23/84	BH-03	48	44	52.6	122	29	46	--	--
EIGHTBAY	BH-04	04/23/84	BH-04	48	44	49.7	122	29	32	--	--
EIGHTBAY	BH-05	04/23/84	BH-05	48	44	35.2	122	29	49	--	--
EIGHTBAY	BH-07	04/23/84	BH-07	48	44	37.5	122	29	34.1	--	--
EIGHTBAY	BH-11	04/30/84	BH-11	48	44	58	122	30	2.1	--	--
EIGHTBAY	BH-12	04/30/84	BH-12	48	45	12.5	122	29	40	--	--
EIGHTBAY	BH-23	04/30/84	BH-23	48	43	35.3	122	30	53.1	--	--
EIGHTBAY	BH-24	04/30/84	BH-24	48	43	56	122	30	12.5	--	--
EIGHTBAY	CS-01	05/29/84	CS-01	47	14	27.6	122	51	8.4	--	--
EIGHTBAY	CS-11	05/29/84	CS-11	47	18	47.4	122	50	18	--	--
EIGHTBAY	CS-15	05/29/84	CS-15	47	19	30	122	47	52.2	--	--
EIGHTBAY	CS-17	05/29/84	CS-17	47	20	49.2	122	48	39.6	--	--
EIGHTBAY	DB-01	05/22/84	DB-01	47	41	15.9	122	52	18.7	--	--
EIGHTBAY	DB-05	05/22/84	DB-05	47	42	8.4	122	52	31.9	--	--
EIGHTBAY	DB-07	05/22/84	DB-07	47	42	40.5	122	52	40.4	--	--
EIGHTBAY	DB-15	05/22/84	DB-15	47	46	21	122	51	12.6	--	--
EIGHTBAY	EL-09	05/08/84	EL-09	47	37	41	122	25	45	--	--
EIGHTBAY	EL-10	05/08/84	EL-10	47	37	27.4	122	25	39.7	--	--
EIGHTBAY	EL-12	05/08/84	EL-12	47	37	14	122	26	3.9	--	--
EIGHTBAY	EL-17	05/08/84	EL-17	47	37	21	122	25	12.1	--	--
EIGHTBAY	EL-20	05/15/84	EL-20	47	37	14.9	122	25	4.9	--	--

TABLE A-1. (Continued)

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates - South East	State Plane Coordinates - South North
EIGHTBAY	EL-22	05/15/84	EL-22	47	36	57.4	122	24	31	--	--
EIGHTBAY	EL-23	05/15/84	EL-23	47	37	10.8	122	24	8.9	--	--
EIGHTBAY	EL-24	05/15/84	EL-24	47	37	31	122	23	52	--	--
EIGHTBAY	EV-01	05/01/84	EV-01	47	59	17.5	122	13	2.5	--	--
EIGHTBAY	EV-02	05/01/84	EV-02	47	59	15.5	122	13	11.6	--	--
EIGHTBAY	EV-03	05/01/84	EV-03	47	59	8.3	122	13	11.5	--	--
EIGHTBAY	EV-04	05/01/84	EV-04	47	59	4.6	122	13	7.8	--	--
EIGHTBAY	EV-05	05/07/84	EV-05	47	59	3.4	122	13	16.5	--	--
EIGHTBAY	EV-06	05/07/84	EV-06	47	58	53.5	122	13	26	--	--
EIGHTBAY	EV-07	05/07/84	EV-07	47	58	36	122	13	35.1	--	--
EIGHTBAY	EV-11	05/07/84	EV-11	47	58	38.8	122	14	46.9	--	--
EIGHTBAY	SC-06	05/16/84	SC-06	47	32	54.9	122	39	56.9	--	--
EIGHTBAY	SC-07	05/16/84	SC-07	47	33	5	122	39	33	--	--
EIGHTBAY	SC-08	05/16/84	SC-08	47	33	4.8	122	39	7.6	--	--
EIGHTBAY	SC-14	05/16/84	SC-14	47	33	16.9	122	38	41.6	--	--
EIGHTBAY	SC-17	05/21/84	SC-17	47	33	27.1	122	38	3.2	--	--
EIGHTBAY	SC-18	05/21/84	SC-18	47	33	25.5	122	37	50.4	--	--
EIGHTBAY	SC-19	05/21/84	SC-19	47	33	34.6	122	37	47.9	--	--
EIGHTBAY	SC-20	05/21/84	SC-20	47	33	33.8	122	37	30.9	--	--
EIGHTBAY	SM-01	04/24/84	SM-01	48	38	38	122	31	5	--	--
EIGHTBAY	SM-03	04/24/84	SM-03	48	37	52	122	29	22	--	--
EIGHTBAY	SM-07	04/24/84	SM-07	48	36	31	122	32	12	--	--
EIGHTBAY	SM-20	04/24/84	SM-20	48	36	2	122	32	39	--	--
EIGHTBAY	SQ-14	05/29/84	SQ-14	48	4	34	123	1	25	--	--
EIGHTBAY	SQ-17	05/29/84	SQ-17	48	3	41	123	1	20	--	--
EIGHTBAY	SQ-18	05/29/84	SQ-18	48	3	25	123	1	28	--	--
EIGHTBAY	SQ-20	05/29/84	SQ-20	48	2	50	123	1	21	--	--
EVCHEM	ES-01	10/06/86	ES-01G	48	2	51.19	122	10	58.58	--	--
EVCHEM	ES-02	10/06/86	ES-02G	48	2	33.05	122	11	39.18	--	--
EVCHEM	ES-03	10/06/86	ES-03G	48	2	36.02	122	12	11.05	--	--
EVCHEM	EW-01	10/07/86	EW-01G	47	59	19.64	122	12	59	--	--
EVCHEM	EW-04	09/30/86	EW-04G	47	59	2.64	122	13	6.7	--	--
EVCHEM	EW-07	09/30/86	EW-07G	47	58	58.75	122	13	1.89	--	--
EVCHEM	EW-10	10/01/86	EW-10G	47	58	45.87	122	13	14.04	--	--
EVCHEM	EW-12	10/01/86	EW-12G	47	58	41.75	122	13	20.54	--	--
EVCHEM	EW-14	10/01/86	EW-14G	47	58	31.98	122	13	36.3	--	--
EVCHEM	NG-01	10/02/86	NG-01G	47	58	21.99	122	13	53.82	--	--
EVCHEM	NG-02	10/02/86	NG-02G	47	57	56.16	122	14	27.54	--	--
EVCHEM	NG-03	10/02/86	NG-03G	47	57	37.21	122	16	23.09	--	--
EVCHEM	NG-04	10/02/86	NG-04G	47	57	16.77	122	17	18.06	--	--
EVCHEM	NG-06	10/08/86	NG-06G	47	57	6.47	122	17	36.29	--	--
EVCHEM	NG-10	10/03/86	NG-10G	47	57	2.74	122	18	5.86	--	--
EVCHEM	NG-12	10/15/86	NG-12G	47	58	14.63	122	13	50.68	--	--
EVCHEM	NG-13	10/15/86	NG-13G	47	57	52.54	122	14	21.24	--	--
EVCHEM	NG-14	10/15/86	NG-14G	47	57	27.04	122	16	22.81	--	--
EVCHEM	NG-15	10/15/86	NG-15G	47	57	4.82	122	17	33.89	--	--
EVCHEM	OG-03	10/09/86	OG-03G	47	58	15.33	122	14	14.07	--	--
EVCHEM	PS-02	10/13/86	PS-02G	48	8	8.72	122	26	13.18	--	--
EVCHEM	PS-03	10/13/86	PS-03G	48	6	57.77	122	24	46.36	--	--

TABLE A-1. (Continued)

Survey	Station	Date	Sample	Lattitude Degrees	Lattitude Minutes	Lattitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	State Plane Coordinates East	State Plane Coordinates South North
EVCHEM	PS-04	10/10/86	PS-04G	48	5	59.54	122	23	25.88	--	--
EVCHEM	SD-01	10/09/86	SD-01G	48	1	43.32	122	13	48.97	--	--
EVCHEM	SD-02	10/07/86	SD-02G	47	59	29.95	122	15	4.48	--	--
EVCHEM	SR-01	10/06/86	SR-01G	47	59	42.21	122	10	47.03	--	--
EVCHEM	SR-02	10/06/86	SR-02G	48	--	19.25	122	10	36.52	--	--
EVCHEM	SR-04	10/06/86	SR-04G	48	1	0.68	122	11	20.71	--	--
EVCHEM	SR-07	10/03/86	SR-07G	47	59	52.42	122	12	56.12	--	--
EVCHEM	SR-08	10/03/86	SR-08G	47	59	19.45	122	13	36.85	--	--
EVCHEM	SS-01	10/06/86	SS-01G	48	2	11.51	122	10	59.31	--	--
EVCHEM	SS-03	10/06/86	SS-03G	48	1	53.6	122	12	1.24	--	--
EVERETT1	EV-20	01/01/85	EV-20	--	--	--	--	--	--	--	--
EVERETT1	EV-21	01/01/85	EV-21	--	--	--	--	--	--	--	--
EVERETT1	EV-22	01/01/85	EV-22	--	--	--	--	--	--	--	--
EVERETT1	EV-23	01/01/85	EV-23	--	--	--	--	--	--	--	--
EVERETT1	EV-24	01/01/85	EV-24	--	--	--	--	--	--	--	--
EVERETT1	EV-25	01/01/85	EV-25	--	--	--	--	--	--	--	--
TPPS3AB	EB-33	03/15/82	1779	47	37	6	122	21	41	--	--
TPPS3AB	EB-33	07/15/82	2080	47	37	6	122	21	41	--	--
TPPS3AB	EB-35	03/15/82	1775	47	37	4	122	21	34	--	--
TPPS3AB	EB-35	07/15/82	2079	47	37	4	122	21	34	--	--
TPPS3AB	EB-36	03/15/82	1776	47	37	3	122	21	41	--	--
TPPS3AB	EB-36	07/15/82	2072	47	37	3	122	21	41	--	--
TPPS3AB	EB-38	03/15/82	1778	47	37	--	122	21	37	--	--
TPPS3AB	EB-38	07/15/82	2074	47	37	--	122	21	37	--	--
TPPS3AB	WP-01	07/15/82	2088	47	40	16	122	26	52	--	--
TPPS3AB	WP-02	07/15/82	2089	47	40	3	122	26	45	--	--
TPPS3AB	WP-03	07/15/82	2090	47	39	46	122	26	20	--	--
TPPS3AB	WP-04	07/15/82	2091	47	39	47	122	26	52	--	--
TPPS3AB	WP-05	07/15/82	2092	47	39	32	122	26	44	--	--
TPPS3AB	WP-06	07/15/82	2084	47	39	11	122	26	17	--	--
TPPS3AB	WP-07	07/15/82	2093	47	39	12	122	26	43	--	--
TPPS3AB	WP-08	07/15/82	2083	47	38	37	122	26	7	--	--
TPPS3AB	WP-09	07/15/82	2082	47	38	30	122	26	22	--	--
TPPS3AB	WP-10	07/15/82	2076	47	40	17	122	25	46	--	--
TPPS3AB	WP-12	03/15/82	1786	47	41	13	122	27	36	--	--
TPPS3AB	WP-12	07/15/82	2069	47	41	13	122	27	36	--	--
TPPS3AB	WP-13	03/15/82	1784	47	40	6	122	27	41	--	--
TPPS3AB	WP-13	07/15/82	2070	47	40	6	122	27	41	--	--
TPPS3AB	WP-14	03/15/82	1785	47	39	49	122	27	38	--	--
TPPS3AB	WP-15	03/15/82	1817	47	39	14	122	27	14	--	--
TPPS3AB	WP-15	07/15/82	2094	47	39	14	122	27	14	--	--
TPPS3AB	WP-16	03/15/82	1816	47	38	30	122	27	22	--	--
TPPS3AB	WP-16	07/15/82	2086	47	38	30	122	27	22	--	--

* Station locations were approximated.

** Available information was inadequate to determine station locations.

APPENDIX B

Tabular Summary by Station of Observed Biological Effects, and Predicted Biological Effects Using Various EP, AET, and Other Modified Sediment Quality Values

				BIOLOGICAL EFFECT				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
ALKI	AP-01	05/25/84	AP-01		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-02	05/25/84	AP-02		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-03	05/25/84	AP-03		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-04	05/25/84	AP-04		●			–	–	–	–	–	–	–	–	–	–
ALKI	AP-05	05/25/84	AP-05		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-06	05/25/84	AP-06		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-07	05/25/84	AP-07		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-01	05/26/84	PW-01		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-02	05/26/84	PW-02		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-03	05/26/84	PW-03		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-04	05/26/84	PW-04		◇			–	–	–	–	–	–	–	–	–	–
CBBLAIR	B03	06/01/84	B03	◇	◇		◇							●	●	●	
CBBLAIR	B04	06/01/84	B04	◇	◇		◇							●	●	●	
CBBLAIR	B09	06/01/84	B09	◇	◇		◇							●	●	●	
CBBLAIR	B10	06/01/84	B10	◇	◇		●								●		
CBBLAIR	B12	06/01/84	B12	◇	◇		◇							●	●	●	
CBBLAIR	B15	06/01/84	B15	●	◇		◇					●		●	●	●	
CBMSQS	BL-11	01/01/84	BL-11	◇	◇	◇	◇								●		
CBMSQS	BL-13	01/01/84	BL-13	◇	◇	●	◇							●	●	●	
CBMSQS	BL-21	01/01/84	BL-21	◇	◇	◇	◇								●		
CBMSQS	BL-25	01/01/84	BL-25	●	◇	◇	◇								●		
CBMSQS	BL-28	01/01/84	BL-28	◇	◇	◇	◇	●							●		
CBMSQS	BL-31	01/01/84	BL-31	◇	◇	●	◇	●							●		
CBMSQS	CI-11	01/01/84	CI-11	●	●	●	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	CI-13	01/01/84	CI-13	◇	●	●	●				●		●	●	●	●	
CBMSQS	CI-16	01/01/84	CI-16		●	●	●				●	●	●	●	●	●	●
CBMSQS	CI-17	01/01/84	CI-17	◇	●	●	◇				●			●	●	●	
CBMSQS	CI-20	01/01/84	CI-20	●	◇	◇	●					●	●		●	●	
CBMSQS	CI-22	01/01/84	CI-22	◇	◇	◇	◇	●	●						●		
CBMSQS	CR-11	01/01/84	CR-11	◇	◇	◇	◇								●		
CBMSQS	CR-12	01/01/84	CR-12	◇	◇	◇	◇								●		
CBMSQS	CR-13	01/01/84	CR-13	◇	◇	◇	◇								●		
CBMSQS	CR-14	01/01/84	CR-14	◇	◇	◇	◇								●		
CBMSQS	HY-12	01/01/84	HY-12		◇	●	●						●	●	●	●	
CBMSQS	HY-14	01/01/84	HY-14	◇	●	●	◇								●		
CBMSQS	HY-17	01/01/84	HY-17	◇	●	●	●				●		●	●	●	●	
CBMSQS	HY-22	01/01/84	HY-22	●	●	●	●	●	●		●	●	●	●	●	●	●
CBMSQS	HY-23	01/01/84	HY-23	●	●	●	●	●			●			●	●	●	
CBMSQS	HY-24	01/01/84	HY-24	◇	●	●	◇				●			●	●	●	
CBMSQS	HY-28	01/01/84	HY-28	◇	●	◇	◇				●				●	●	
CBMSQS	HY-32	01/01/84	HY-32	◇	●	◇	◇				●				●	●	
CBMSQS	HY-37	01/01/84	HY-37	◇	●	●	◇	●			●			●	●	●	
CBMSQS	HY-42	01/01/84	HY-42	●	●	●	◇	●	●		●	●		●	●	●	
CBMSQS	HY-43	01/01/84	HY-43	◇	●	●	◇				●			●	●	●	
CBMSQS	HY-44	01/01/84	HY-44	◇	◇	◇	◇	●							●		
CBMSQS	HY-47	01/01/84	HY-47	●	●	●	●				●	●	●	●	●	●	●
CBMSQS	HY-50	01/01/84	HY-50	◇	◇	●	◇							●	●	●	
CBMSQS	MD-12	01/01/84	MD-12	◇	●	◇	◇				●				●	●	
CBMSQS	MI-11	01/01/84	MI-11	●	◇	◇	◇	●			●				●		
CBMSQS	MI-13	01/01/84	MI-13	◇	◇	●	◇	●							●		
CBMSQS	MI-15	01/01/84	MI-15	●	◇	●	◇							●	●	●	
CBMSQS	RS-12	01/01/84	RS-12	◇	◇	◇	◇	●							●		
CBMSQS	RS-13	01/01/84	RS-13	●	◇	◇	●	●	●			●	●		●	●	
CBMSQS	RS-14	01/01/84	RS-14	◇	◇	◇	◇								●		
CBMSQS	RS-18	01/01/84	RS-18	●	●	●	●	●	●		●	●	●	●	●	●	●
CBMSQS	RS-19	01/01/84	RS-19	●	●	●	●	●			●	●	●	●	●	●	●
CBMSQS	RS-20	01/01/84	RS-20	◇	●	●	◇	●			●			●	●	●	
CBMSQS	RS-22	01/01/84	RS-22	◇		◇	◇				●				●	●	
CBMSQS	RS-24	01/01/84	RS-24	●		◇	◇				●	●			●	●	
CBMSQS	SI-11	01/01/84	SI-11	◇	●	●	◇				●			●	●	●	
CBMSQS	SI-12	01/01/84	SI-12	●	●	●	◇	●			●	●		●	●	●	
CBMSQS	SI-15	01/01/84	SI-15	●	◇	◇	◇								●		
CBMSQS	SP-11	01/01/84	SP-11	◇	●	●	◇				●			●	●	●	
CBMSQS	SP-12	01/01/84	SP-12	◇	◇	●	●								●		
CBMSQS	SP-14	01/01/84	SP-14	●	●	●	●				●	●	●	●	●	●	●
CBMSQS	SP-15	01/01/84	SP-15	●	●	●	●				●	●	●	●	●	●	●
CBMSQS	SP-16	01/01/84	SP-16	●	●	●	●				●	●	●	●	●	●	●

Figure B-1a. Observed and predicted adverse biological effects for all chemicals (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECT				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
DUWRIV1	DR-01	04/15/85	DR-01	◇							●		●	●		●	
DUWRIV1	DR-02	04/15/85	DR-02	◇											●		
DUWRIV1	DR-03	04/15/85	DR-03	◇											●		
DUWRIV1	DR-04	04/15/85	DR-04	◇											●		
DUWRIV1	DR-05	04/15/85	DR-05	◇													
DUWRIV1	DR-06	04/15/85	DR-06	◇											●		
DUWRIV1	DR-07	04/15/85	DR-07	●											●		
DUWRIV1	DR-08	04/15/85	DR-08	●				●	●		●	●	●	●	●	●	●
DUWRIV1	SQ-09	04/19/85	SQ-09	◇													
DUWRIV2	DR-10	07/01/85	CA1	●				●	●	●	●	●	●	●	●	●	●
DUWRIV2	DR-11	07/01/85	CA2	●				●	●		●			●	●	●	
DUWRIV2	DR-12	07/01/85	CA3	◇													
DUWRIV2	DR-13	07/01/85	CB1	◇				●			●			●	●	●	
DUWRIV2	DR-14	07/01/85	CB2	◇				●	●		●		●	●	●	●	
DUWRIV2	DR-15	07/01/85	CB3	◇													
DUWRIV2	DR-16	07/01/85	CB4	●													
DUWRIV2	DR-17	07/01/85	CB5	◇													
DUWRIV2	DR-18	07/01/85	CC1	◇				●			●			●	●	●	
DUWRIV2	DR-19	07/01/85	CC2	◇				●						●	●	●	
DUWRIV2	DR-20	07/01/85	CC3	◇													
DUWRIV2	DR-21	07/01/85	CC4	◇													
DUWRIV2	DR-22	07/01/85	CC5	◇				●			●			●	●	●	
DUWRIV2	DR-23	07/01/85	CD1	◇				●	●		●		●	●	●	●	
DUWRIV2	DR-24	07/01/85	CD2	◇											●		
DUWRIV2	DR-25	07/01/85	CE1	●				●	●		●		●	●	●	●	
DUWRIV2	DR-26	07/01/85	CE2	●				●			●	●	●	●	●	●	●
DUWRIV2	DR-27	07/01/85	CE3	●				●			●	●	●	●	●	●	●
DUWRIV2	DR-28	07/01/85	CF1	◇				●	●		●		●	●	●	●	
DUWRIV2	DR-29	07/01/85	CF2	●				●	●		●	●		●	●	●	
DUWRIV2	DR-30	07/01/85	CF3	◇				●	●		●			●	●	●	
DUWRIV2	DR-31	07/01/85	CF4	◇				●	●		●			●	●	●	
DUWRIV2	DR-32	07/01/85	CF5	◇				●						●	●	●	
DUWRIV2	DR-33	07/01/85	CG1	◇				●	●		●			●	●	●	
DUWRIV2	DR-34	07/01/85	CG2	◇				●	●		●			●	●	●	
DUWRIV2	DR-35	07/01/85	CG3	◇				●	●		●			●	●	●	
DUWRIV2	DR-36	07/01/85	CG4	◇				●	●		●		●	●	●	●	
DUWRIV2	DR-37	07/01/85	CG5	◇											●		
DUWRIV2	DR-38	07/01/85	CH1	◇				●	●		●			●	●	●	
DUWRIV2	DR-39	07/01/85	CW/A1	◇				●					●	●	●	●	
DUWRIV2	SQ-21	07/01/85	SEQUIM	◇													
EBCHEM	AB-01	09/26/85	AB-01	●				●	●		●	●	●	●	●	●	●
EBCHEM	AB-02	09/26/85	AB-02	◇	◇			●	●				●		●	●	
EBCHEM	AB-03	09/26/85	AB-03	◇	●									●	●	●	
EBCHEM	AB-04	09/26/85	AB-04	◇	●									●	●	●	
EBCHEM	DR-01	09/30/85	DR-01	◇				●					●	●	●	●	
EBCHEM	DR-02	09/30/85	DR-02	●							●		●	●	●	●	
EBCHEM	DR-03	09/30/85	DR-03	◇				●					●	●	●	●	
EBCHEM	DR-04	09/30/85	DR-04	◇				●						●	●	●	
EBCHEM	DR-06	10/09/85	DR-06	◇				●	●				●	●	●	●	
EBCHEM	DR-07	09/30/85	DR-07	◇				●	●		●		●	●	●	●	
EBCHEM	DR-09	09/30/85	DR-09	◇				●					●	●	●	●	
EBCHEM	DR-11	09/30/85	DR-11	◇				●					●	●	●	●	
EBCHEM	DR-13	09/30/85	DR-13	●				●	●			●	●	●	●	●	●
EBCHEM	DR-14	09/30/85	DR-14	●									●	●	●	●	
EBCHEM	DR-15	09/30/85	DR-15	●				●					●	●	●	●	
EBCHEM	DR-16	09/30/85	DR-16	●				●			●		●	●	●	●	
EBCHEM	DR-17	09/30/85	DR-17	◇				●					●	●	●	●	
EBCHEM	DR-25	10/10/85	DR-25	●							●	●	●	●	●	●	●
EBCHEM	EW-01	10/09/85	EW-01	◇				●	●				●	●	●	●	
EBCHEM	EW-02	10/04/85	EW-02	●	●			●	●	●	●	●	●	●	●	●	●
EBCHEM	EW-03	10/04/85	EW-03	◇				●					●	●	●	●	
EBCHEM	EW-04	10/14/85	EW-04	●	●			●	●		●		●	●	●	●	
EBCHEM	EW-05	10/14/85	EW-05	●	●			●			●	●	●	●	●	●	●
EBCHEM	EW-05		EW-05	●	●			●	●	●	●	●	●	●	●	●	●
EBCHEM	EW-06	10/04/85	EW-06	●	●			●			●	●	●	●	●	●	●
EBCHEM	EW-07	10/14/85	EW-07	●	●			●			●	●	●	●	●	●	●
EBCHEM	EW-08	10/14/85	EW-08	●	●			●			●	●	●	●	●	●	●
EBCHEM	EW-09	10/14/85	EW-09	●	●			●			●	●	●	●	●	●	●

Figure B-1b. Observed and predicted adverse biological effects for all chemicals (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECT				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	EW-10	10/14/85	EW-10	●	◇			●					●	●	●	●	
EBCHEM	EW-11	10/14/85	EW-11	●	●			●					●	●	●	●	
EBCHEM	EW-12	10/15/85	EW-12	◇	◇			●	●				●	●	●	●	
EBCHEM	EW-13	10/15/85	EW-13	◇	◇			●					●	●	●	●	
EBCHEM	EW-14	10/15/85	EW-14	◇	◇			●	●				●	●	●	●	
EBCHEM	EW-15	10/15/85	EW-15	◇	◇			●					●	●	●	●	
EBCHEM	EW-16	10/15/85	EW-16	●	◇							●		●	●	●	
EBCHEM	KG-01	09/25/85	KG-01	◇	●			●			●		●	●	●	●	
EBCHEM	KG-02	10/09/85	KG-02	●									●		●	●	
EBCHEM	KG-03	09/25/85	KG-03	●	◇			●					●	●	●	●	
EBCHEM	KG-04	10/09/85	KG-04	◇				●					●	●	●	●	
EBCHEM	KG-05	09/30/85	KG-05	●	●			●			●	●	●	●	●	●	●
EBCHEM	KG-06	09/30/85	KG-06	◇	●			●	●		●		●	●	●	●	
EBCHEM	KG-07	09/30/85	KG-07	◇	●			●					●	●	●	●	
EBCHEM	KG-08	10/01/85	KG-08	◇	●			●					●	●	●	●	
EBCHEM	KG-09	10/01/85	KG-09	●	◇			●					●	●	●	●	
EBCHEM	KG-10	10/08/85	KG-10	●							●	●	●	●	●	●	
EBCHEM	KG-11	10/01/85	KG-11	●	●			●					●	●	●	●	●
EBCHEM	MG-01	09/26/85	MG-01	◇	●									●	●	●	
EBCHEM	MG-02	09/26/85	MG-02	◇	●								●	●	●	●	
EBCHEM	MG-03	09/26/85	MG-03	◇	●									●	●	●	
EBCHEM	MG-04	09/26/85	MG-04	◇	●									●	●	●	
EBCHEM	NH-01	10/15/85	NH-01	◇	●			●			●		●	●	●	●	
EBCHEM	NH-02	10/15/85	NH-02	●	●			●					●	●	●	●	
EBCHEM	NH-03	10/16/85	NH-03	●	●			●	●		●	●	●	●	●	●	●
EBCHEM	NH-04	10/15/85	NH-04	●	●			●	●		●	●	●	●	●	●	●
EBCHEM	NH-05	10/15/85	NH-05	●	●			●					●	●	●	●	
EBCHEM	NH-06	10/16/85	NH-06	●	●			●	●	●	●	●	●	●	●	●	●
EBCHEM	NH-07	10/09/85	NH-07	◇				●	●		●		●		●	●	
EBCHEM	NH-08	10/16/85	NH-08	●	●			●	●	●	●	●	●	●	●	●	●
EBCHEM	NH-09	10/16/85	NH-09	●	◇			●					●	●	●	●	
EBCHEM	NH-10	10/08/85	NH-10	◇				●	●	●	●			●	●	●	
EBCHEM	NH-11	10/15/85	NH-11	●	●			●	●					●	●	●	
EBCHEM	NS-01	10/08/85	NS-01	●				●				●	●	●	●	●	●
EBCHEM	NS-02	09/27/85	NS-02	◇	◇			●	●				●	●	●	●	
EBCHEM	NS-03	10/04/85	NS-03	◇	◇			●	●				●	●	●	●	
EBCHEM	NS-05	10/04/85	NS-05	◇	◇			●						●	●	●	
EBCHEM	NS-06	09/27/85	NS-06	●							●	●	●	●	●	●	●
EBCHEM	NS-07	10/04/85	NS-07	●	◇			●				●	●	●	●	●	
EBCHEM	NS-08	09/26/85	NS-08	●	●			●	●				●	●	●	●	
EBCHEM	PS-01	10/12/85	PS-01	◇	◇												
EBCHEM	PS-01		PS-01	◇	◇												
EBCHEM	PS-02	10/12/85	PS-02	◇	◇									●	●	●	
EBCHEM	PS-03	10/12/85	PS-03	◇	◇									●		●	
EBCHEM	PS-04	10/12/85	PS-04	◇	◇												
EBCHEM	SS-01	10/16/85	SS-01	◇	◇			●							●		
EBCHEM	SS-03	10/04/85	SS-03	●	●			●	●		●	●	●	●	●	●	●
EBCHEM	SS-04	10/04/85	SS-04		●			●			●	●	●	●	●	●	
EBCHEM	SS-05	10/03/85	SS-05	◇	◇			●					●	●	●	●	
EBCHEM	SS-05		SS-05	◇	◇			●					●	●	●	●	
EBCHEM	SS-06	10/03/85	SS-06	●	●			●			●	●	●	●	●	●	●
EBCHEM	SS-07	10/03/85	SS-07	●	◇			●				●	●	●	●	●	
EBCHEM	SS-08	09/27/85	SS-08	●	●			●	●	●	●	●	●	●	●	●	●
EBCHEM	SS-09	09/27/85	SS-09	●	●			●			●	●	●	●	●	●	●
EBCHEM	SS-11	09/27/85	SS-11	◇	◇			●					●	●	●	●	
EBCHEM	SS-12	09/27/85	SS-12	◇	◇								●	●	●	●	
EBCHEM	WW-01	10/01/85	WW-01	◇	●			●						●	●	●	
EBCHEM	WW-02	10/09/85	WW-02	●				●	●		●	●	●	●	●	●	●
EBCHEM	WW-03	10/01/85	WW-03	◇	●			●						●	●	●	
EBCHEM	WW-04	10/01/85	WW-04	◇	●			●	●	●	●		●	●	●	●	
EBCHEM	WW-05	10/01/85	WW-05	◇	●			●	●		●		●	●	●	●	
EBCHEM	WW-06	10/01/85	WW-06	◇	●			●			●		●	●	●	●	
EBCHEM	WW-06		WW-06	◇	●			●	●				●	●	●	●	
EBCHEM	WW-08	10/01/85	WW-08	●	●			●					●	●	●	●	
EBCHEM	WW-09	10/02/85	WW-09	●	●			●	●		●	●	●	●	●	●	●
EBCHEM	WW-10	10/02/85	WW-10	◇	●			●			●		●	●	●	●	
EBCHEM	WW-11	10/02/85	WW-11	●	●			●			●	●	●	●	●	●	●
EBCHEM	WW-12	10/02/85	WW-12	●	●			●	●		●	●	●	●	●	●	●
EBCHEM	WW-13	10/02/85	WW-13	◇	◇			●					●	●	●	●	
EBCHEM	WW-14	10/02/85	WW-14		●			●			●	●	●	●	●	●	●
EBCHEM	WW-15	10/08/85	WW-15	◇							●		●		●	●	

Figure B-1c. Observed and predicted adverse biological effects for all chemicals (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECT				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	WW-16	10/02/85	WW-16	◇	●			●			●		●	●	●	●	
EBCHEM	WW-17	10/03/85	WW-17	◇	●			●					●	●	●	●	
EBCHEM	WW-18	10/03/85	WW-18	◇	●			●			●		●	●	●	●	
EBCHEM	WW-19	10/03/85	WW-19	◇	●			●					●	●	●	●	
EBCHEM	WW-20	10/03/85	WW-20	◇	●			●			●		●	●	●	●	
EHCHEM	BH-01	06/01/85	B1	◇	◇			●						●	●	●	
EHCHEM	BH-02	06/01/85	B1	◇	◇									●	●	●	
EHCHEM	EH-01	06/01/85	B1	◇	◇									●	●	●	
EHCHEM	EH-02	06/01/85	B1	◇	●									●	●	●	
EHCHEM	EH-03	06/01/85	V6	◇	●			●							●		
EHCHEM	EH-05	06/01/85	V1	◇	●			●	●		●		●	●	●	●	
EHCHEM	EH-06	06/01/85	V6	◇	●			●			●		●	●	●	●	
EHCHEM	EH-08	06/01/85	V1	●	●			●	●	●	●	●	●	●	●	●	●
EHCHEM	EH-15	06/01/85	V1	◇	●			●	●	●	●		●	●	●	●	
EHCHEM	EH-16	06/01/85	V1	◇	●			●			●		●	●	●	●	
EIGHTBAY	BH-03	04/23/84	BH-03	◇							●		●	●	●	●	
EIGHTBAY	BH-04	04/23/84	BH-04	◇									●	●	●	●	
EIGHTBAY	BH-05	04/23/84	BH-05	●							●		●	●	●	●	
EIGHTBAY	BH-07	04/23/84	BH-07	◇				●			●		●	●	●	●	
EIGHTBAY	BH-11	04/30/84	BH-11	◇							●			●	●	●	
EIGHTBAY	BH-12	04/30/84	BH-12	◇									●	●	●	●	
EIGHTBAY	BH-23	04/30/84	BH-23	●							●			●	●	●	
EIGHTBAY	BH-24	04/30/84	BH-24	◇							●			●	●	●	
EIGHTBAY	CS-01	05/29/84	CS-01	●							●		●		●	●	
EIGHTBAY	CS-11	05/29/84	CS-11	●													
EIGHTBAY	CS-15	05/29/84	CS-15	●											●		
EIGHTBAY	CS-17	05/29/84	CS-17	●											●		
EIGHTBAY	DB-01	05/22/84	DB-01	◇													
EIGHTBAY	DB-05	05/22/84	DB-05	◇													
EIGHTBAY	DB-07	05/22/84	DB-07	●											●		
EIGHTBAY	DB-15	05/22/84	DB-15	●							●				●		
EIGHTBAY	EL-09	05/08/84	EL-09	◇				●			●			●	●	●	
EIGHTBAY	EL-10	05/08/84	EL-10	◇				●			●		●	●	●	●	
EIGHTBAY	EL-12	05/08/84	EL-12	◇											●		
EIGHTBAY	EL-17	05/08/84	EL-17	◇				●						●	●	●	
EIGHTBAY	EL-20	05/15/84	EL-20	◇				●			●		●	●	●	●	
EIGHTBAY	EL-22	05/15/84	EL-22	◇				●						●	●	●	
EIGHTBAY	EL-23	05/15/84	EL-23	◇				●						●		●	
EIGHTBAY	EL-24	05/15/84	EL-24	◇											●		
EIGHTBAY	EV-01	05/01/84	EV-01	●							●	●			●		
EIGHTBAY	EV-02	05/01/84	EV-02	●											●		
EIGHTBAY	EV-03	05/01/84	EV-03	●							●		●	●	●	●	
EIGHTBAY	EV-04	05/01/84	EV-04	●							●	●	●	●	●	●	●
EIGHTBAY	EV-05	05/07/84	EV-05	●				●				●	●	●	●	●	
EIGHTBAY	EV-06	05/07/84	EV-06	◇											●		
EIGHTBAY	EV-07	05/07/84	EV-07	◇											●		
EIGHTBAY	EV-11	05/07/84	EV-11	●											●		
EIGHTBAY	SC-06	05/16/84	SC-06	●				●	●				●	●	●	●	
EIGHTBAY	SC-07	05/16/84	SC-07	◇				●			●		●	●	●	●	
EIGHTBAY	SC-08	05/16/84	SC-08	●				●			●		●	●	●	●	
EIGHTBAY	SC-14	05/16/84	SC-14	●				●	●		●		●	●	●	●	
EIGHTBAY	SC-17	05/21/84	SC-17	●				●					●	●	●	●	
EIGHTBAY	SC-18	05/21/84	SC-18	●				●					●	●	●	●	
EIGHTBAY	SC-19	05/21/84	SC-19	◇									●	●	●	●	
EIGHTBAY	SC-20	05/21/84	SC-20	●				●	●				●	●	●	●	
EIGHTBAY	SM-01	04/24/84	SM-01	●							●	●	●	●	●	●	●
EIGHTBAY	SM-03	04/24/84	SM-03	●										●		●	
EIGHTBAY	SM-07	04/24/84	SM-07	●													
EIGHTBAY	SM-20	04/24/84	SM-20	●										●		●	
EIGHTBAY	SQ-14	05/29/84	SQ-14	◇													
EIGHTBAY	SQ-17	05/29/84	SQ-17	◇											●		
EIGHTBAY	SQ-18	05/29/84	SQ-18	◇											●		
EIGHTBAY	SQ-20	05/29/84	SQ-20	◇													
EVCHEM	ES-01	10/06/86	ES-01G	◇							●				●	●	
EVCHEM	ES-02	10/06/86	ES-02G	◇							●				●	●	
EVCHEM	ES-03	10/06/86	ES-03G	◇							●		●	●	●	●	
EVCHEM	EW-01	10/07/86	EW-01G	●	●						●	●	●	●	●	●	●
EVCHEM	EW-04	09/30/86	EW-04G	●	●			●			●	●	●	●	●	●	●

Figure B-1d. Observed and predicted adverse biological effects for all chemicals (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECT				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EVCHEM	EW-07	09/30/86	EW-07G	●	●			●			●	●	●	●	●	●	●
EVCHEM	EW-10	10/01/86	EW-10G	●	●						●	●	●	●	●	●	●
EVCHEM	EW-12	10/01/86	EW-12G	◇	●						●		●	●	●	●	
EVCHEM	EW-14	10/01/86	EW-14G		●			●			●	●	●	●	●	●	●
EVCHEM	NG-01	10/02/86	NG-01G	◇	◇								●		●	●	
EVCHEM	NG-02	10/02/86	NG-02G	◇	●						●		●	●	●	●	
EVCHEM	NG-03	10/02/86	NG-03G	◇	●						●		●	●	●	●	
EVCHEM	NG-04	10/02/86	NG-04G	●	●						●		●	●	●	●	
EVCHEM	NG-06	10/08/86	NG-06G	●	◇							●			●	●	
EVCHEM	NG-10	10/03/86	NG-10G	◇	◇			●					●	●	●	●	
EVCHEM	NG-12	10/15/86	NG-12G	◇								●			●		
EVCHEM	NG-13	10/15/86	NG-13G	◇									●		●	●	
EVCHEM	NG-14	10/15/86	NG-14G	◇				●	●		●		●	●	●	●	
EVCHEM	NG-15	10/15/86	NG-15G	◇							●		●	●	●	●	
EVCHEM	OG-03	10/09/86	OG-03G	●							●	●	●	●	●	●	●
EVCHEM	PS-02	10/13/86	PS-02G	◇	◇										●		
EVCHEM	PS-03	10/13/86	PS-03G	◇	◇										●		
EVCHEM	PS-04	10/10/86	PS-04G	◇	◇										●		
EVCHEM	SD-01	10/09/86	SD-01G	◇	●										●		
EVCHEM	SD-02	10/07/86	SD-02G		◇							●	●	●	●	●	
EVCHEM	SR-01	10/06/86	SR-01G	◇											●		
EVCHEM	SR-02	10/06/86	SR-02G	◇										●	●	●	
EVCHEM	SR-04	10/06/86	SR-04G	◇							●		●	●	●	●	
EVCHEM	SR-07	10/03/86	SR-07G		●						●	●	●	●	●	●	●
EVCHEM	SR-08	10/03/86	SR-08G	◇	●						●		●	●	●	●	
EVCHEM	SS-01	10/06/86	SS-01G	◇											●		
EVCHEM	SS-03	10/06/86	SS-03G	◇							●	●	●	●	●	●	
EVERETT1	EV-20	01/01/85	EV-20	◇				●			●		●	●	●	●	
EVERETT1	EV-21	01/01/85	EV-21	◇							●		●		●	●	
EVERETT1	EV-22	01/01/85	EV-22	◇											●		
EVERETT1	EV-23	01/01/85	EV-23	◇							●				●		
EVERETT1	EV-24	01/01/85	EV-24	●											●		
EVERETT1	EV-25	01/01/85	EV-25	◇											●		
TPPS3AB	EB-33	03/15/82	1779	●				●	●		●	●	●	●	●	●	●
TPPS3AB	EB-33	07/15/82	2080	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-35	03/15/82	1775	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-35	07/15/82	2079	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-36	03/15/82	1776	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-36	07/15/82	2072	●				●	●		●	●	●	●	●	●	●
TPPS3AB	EB-38	03/15/82	1778	◇				●	●			●	●	●	●	●	
TPPS3AB	EB-38	07/15/82	2074	●				●	●		●	●	●	●	●	●	●
TPPS3AB	WP-01	07/15/82	2088	◇				●				●		●	●	●	
TPPS3AB	WP-02	07/15/82	2089	◇				●	●			●	●	●	●	●	
TPPS3AB	WP-03	07/15/82	2090	●				●				●		●	●	●	
TPPS3AB	WP-04	07/15/82	2091	◇				●	●			●	●	●	●	●	
TPPS3AB	WP-05	07/15/82	2092		◇			●	●			●	●	●	●	●	
TPPS3AB	WP-06	07/15/82	2084		◇			●	●			●	●	●	●	●	
TPPS3AB	WP-07	07/15/82	2093		◇			●	●			●	●	●	●	●	
TPPS3AB	WP-08	07/15/82	2083		●			●	●	●	●	●	●	●	●	●	●
TPPS3AB	WP-09	07/15/82	2082		◇			●	●			●	●	●	●	●	
TPPS3AB	WP-10	07/15/82	2076		◇			●	●	●		●	●	●	●	●	
TPPS3AB	WP-12	03/15/82	1786		◇			●			●	●	●	●	●	●	
TPPS3AB	WP-12	07/15/82	2069		◇			●			●	●	●	●	●	●	
TPPS3AB	WP-13	03/15/82	1784		◇			●	●		●	●		●	●	●	
TPPS3AB	WP-13	07/15/82	2070		◇			●				●	●	●	●	●	
TPPS3AB	WP-14	03/15/82	1785		◇						●	●			●		
TPPS3AB	WP-15	03/15/82	1817		◇			●			●	●	●	●	●	●	
TPPS3AB	WP-15	07/15/82	2094		◇			●	●		●	●	●	●	●	●	
TPPS3AB	WP-16	03/15/82	1816		●			●			●	●	●	●	●	●	
TPPS3AB	WP-16	07/15/82	2086		◇			●			●			●	●	●	

BIOLOGICAL EFFECTS

- No biological data available
- No adverse biological effect observed ◇
- Adverse biological effect observed ●

PREDICTIONS

- No adverse biological effect predicted
- Adverse biological effect predicted ●
- No TOC data available for normalizing sediment quality valves –

Figure B-1e. Observed and predicted adverse biological effects for all chemicals (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
ALKI	AP-01	05/25/84	AP-01		◇									
ALKI	AP-02	05/25/84	AP-02		◇									
ALKI	AP-03	05/25/84	AP-03		◇									
ALKI	AP-04	05/25/84	AP-04		●							●		
ALKI	AP-05	05/25/84	AP-05		◇									
ALKI	AP-06	05/25/84	AP-06		◇									
ALKI	AP-07	05/25/84	AP-07		◇									
ALKI	PW-01	05/26/84	PW-01		◇									
ALKI	PW-02	05/26/84	PW-02		◇									
ALKI	PW-03	05/26/84	PW-03		◇									
ALKI	PW-04	05/26/84	PW-04		◇									
CBBLAIR	B03	06/01/84	B03	◇	◇		◇				●	●	●	
CBBLAIR	B04	06/01/84	B04	◇	◇		◇				●	●	●	
CBBLAIR	B09	06/01/84	B09	◇	◇		◇				●	●	●	
CBBLAIR	B10	06/01/84	B10	◇	◇		●					●		
CBBLAIR	B12	06/01/84	B12	◇	◇		◇				●	●	●	
CBBLAIR	B15	06/01/84	B15	●	◇		◇		●		●	●	●	
CBMSQS	BL-11	01/01/84	BL-11	◇	◇	◇	◇					●		
CBMSQS	BL-13	01/01/84	BL-13	◇	◇	●	◇				●	●	●	
CBMSQS	BL-21	01/01/84	BL-21	◇	◇	◇	◇					●		
CBMSQS	BL-25	01/01/84	BL-25	●	◇	◇	◇					●		
CBMSQS	BL-28	01/01/84	BL-28	◇	◇	◇	◇					●		
CBMSQS	BL-31	01/01/84	BL-31	◇	◇	●	◇					●		
CBMSQS	CI-11	01/01/84	CI-11	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	CI-13	01/01/84	CI-13	◇	●	●	●	●		●	●	●	●	
CBMSQS	CI-16	01/01/84	CI-16		●	●	●	●	●	●	●	●	●	●
CBMSQS	CI-17	01/01/84	CI-17	◇	●	●	◇	●			●	●	●	
CBMSQS	CI-20	01/01/84	CI-20	●	◇	◇	●		●	●		●	●	
CBMSQS	CI-22	01/01/84	CI-22	◇	◇	◇	◇					●		
CBMSQS	CR-11	01/01/84	CR-11	◇	◇	◇	◇					●		
CBMSQS	CR-12	01/01/84	CR-12	◇	◇	◇	◇			●		●		
CBMSQS	CR-13	01/01/84	CR-13	◇	◇	◇	◇					●		
CBMSQS	CR-14	01/01/84	CR-14	◇	◇	◇	◇					●		
CBMSQS	HY-12	01/01/84	HY-12		◇	●	●		●		●	●	●	
CBMSQS	HY-14	01/01/84	HY-14	◇	●	●	◇	●			●	●	●	
CBMSQS	HY-17	01/01/84	HY-17	◇	●	●	●	●		●	●	●	●	
CBMSQS	HY-22	01/01/84	HY-22	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	HY-23	01/01/84	HY-23	●	●	●	●	●		●	●	●	●	
CBMSQS	HY-24	01/01/84	HY-24	◇	●	●	◇	●			●	●	●	
CBMSQS	HY-28	01/01/84	HY-28	◇	●	◇	◇	●				●	●	
CBMSQS	HY-32	01/01/84	HY-32	◇	●	◇	◇	●				●	●	
CBMSQS	HY-37	01/01/84	HY-37	◇	●	●	◇	●			●	●	●	
CBMSQS	HY-42	01/01/84	HY-42	●	●	●	◇	●	●		●	●	●	
CBMSQS	HY-43	01/01/84	HY-43	◇	●	●	◇	●			●	●	●	
CBMSQS	HY-44	01/01/84	HY-44	◇	◇	◇	◇					●		
CBMSQS	HY-47	01/01/84	HY-47	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	HY-50	01/01/84	HY-50	◇	◇	●	◇				●	●	●	
CBMSQS	MD-12	01/01/84	MD-12	◇	●	◇	◇	●				●	●	
CBMSQS	MI-11	01/01/84	MI-11	●	◇	◇	◇					●		
CBMSQS	MI-13	01/01/84	MI-13	◇	◇	●	◇				●	●	●	
CBMSQS	MI-15	01/01/84	MI-15	●	◇	●	◇					●		
CBMSQS	RS-12	01/01/84	RS-12	◇	◇	◇	◇					●		
CBMSQS	RS-13	01/01/84	RS-13	●	◇	◇	●		●	●		●	●	
CBMSQS	RS-14	01/01/84	RS-14	◇	◇	◇	◇					●		
CBMSQS	RS-18	01/01/84	RS-18	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	RS-19	01/01/84	RS-19	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	RS-20	01/01/84	RS-20	◇	●	●	◇	●			●	●	●	
CBMSQS	RS-22	01/01/84	RS-22	◇		◇	◇	●				●	●	
CBMSQS	RS-24	01/01/84	RS-24	●		◇	◇	●	●			●	●	
CBMSQS	SI-11	01/01/84	SI-11	◇	●	●	◇	●			●	●	●	
CBMSQS	SI-12	01/01/84	SI-12	●	●	●	◇	●	●		●	●	●	
CBMSQS	SI-15	01/01/84	SI-15	●	◇	◇	◇		●			●	●	
CBMSQS	SP-11	01/01/84	SP-11	◇	●	●	◇	●			●	●	●	
CBMSQS	SP-12	01/01/84	SP-12	◇	◇	●	●				●	●	●	
CBMSQS	SP-14	01/01/84	SP-14	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	SP-15	01/01/84	SP-15	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	SP-16	01/01/84	SP-16	●	●	●	●	●	●	●	●	●	●	●

Figure B-2a. Observed and predicted adverse biological effects for all chemicals (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
DUWRIV1	DR-01	04/15/85	DR-01	◇										
DUWRIV1	DR-02	04/15/85	DR-02	◇										
DUWRIV1	DR-03	04/15/85	DR-03	◇								●		
DUWRIV1	DR-04	04/15/85	DR-04	◇								●		
DUWRIV1	DR-05	04/15/85	DR-05	◇										
DUWRIV1	DR-06	04/15/85	DR-06	◇								●		
DUWRIV1	DR-07	04/15/85	DR-07	●										
DUWRIV1	DR-08	04/15/85	DR-08	●					●	●	●	●	●	●
DUWRIV1	SQ-09	04/19/85	SQ-09	◇										
DUWRIV2	DR-10	07/01/85	CA1	●					●	●	●	●	●	●
DUWRIV2	DR-11	07/01/85	CA2	●							●	●	●	
DUWRIV2	DR-12	07/01/85	CA3	◇										
DUWRIV2	DR-13	07/01/85	CB1	◇							●	●	●	
DUWRIV2	DR-14	07/01/85	CB2	◇							●	●	●	
DUWRIV2	DR-15	07/01/85	CB3	◇										
DUWRIV2	DR-16	07/01/85	CB4	●										
DUWRIV2	DR-17	07/01/85	CB5	◇										
DUWRIV2	DR-18	07/01/85	CC1	◇										
DUWRIV2	DR-19	07/01/85	CC2	◇							●	●	●	
DUWRIV2	DR-20	07/01/85	CC3	◇										
DUWRIV2	DR-21	07/01/85	CC4	◇										
DUWRIV2	DR-22	07/01/85	CC5	◇							●		●	
DUWRIV2	DR-23	07/01/85	CD1	◇						●	●	●	●	
DUWRIV2	DR-24	07/01/85	CD2	◇										
DUWRIV2	DR-25	07/01/85	CE1	●							●	●	●	
DUWRIV2	DR-26	07/01/85	CE2	●					●	●	●	●	●	●
DUWRIV2	DR-27	07/01/85	CE3	●					●	●	●	●	●	●
DUWRIV2	DR-28	07/01/85	CF1	◇						●	●	●	●	
DUWRIV2	DR-29	07/01/85	CF2	●						●	●	●	●	
DUWRIV2	DR-30	07/01/85	CF3	◇							●	●	●	
DUWRIV2	DR-31	07/01/85	CF4	◇							●	●	●	
DUWRIV2	DR-32	07/01/85	CF5	◇										
DUWRIV2	DR-33	07/01/85	CG1	◇						●	●	●	●	
DUWRIV2	DR-34	07/01/85	CG2	◇						●	●	●	●	
DUWRIV2	DR-35	07/01/85	CG3	◇							●	●	●	
DUWRIV2	DR-36	07/01/85	CG4	◇						●	●	●	●	
DUWRIV2	DR-37	07/01/85	CG5	◇										
DUWRIV2	DR-38	07/01/85	CH1	◇						●	●	●	●	
DUWRIV2	DR-39	07/01/85	CW/A1	◇						●	●	●	●	
DUWRIV2	SQ-21	07/01/85	SEQUIM	◇										
EBCHEM	AB-01	09/26/85	AB-01	●				●	●	●	●	●	●	●
EBCHEM	AB-02	09/26/85	AB-02	◇	◇							●		
EBCHEM	AB-03	09/26/85	AB-03	◇	●									
EBCHEM	AB-04	09/26/85	AB-04	◇	●									
EBCHEM	DR-01	09/30/85	DR-01	◇						●	●	●	●	
EBCHEM	DR-02	09/30/85	DR-02	●				●		●	●	●	●	
EBCHEM	DR-03	09/30/85	DR-03	◇						●	●	●	●	
EBCHEM	DR-04	09/30/85	DR-04	◇							●	●	●	
EBCHEM	DR-06	10/09/85	DR-06	◇							●	●	●	
EBCHEM	DR-07	09/30/85	DR-07	◇						●	●	●	●	
EBCHEM	DR-09	09/30/85	DR-09	◇						●	●	●	●	
EBCHEM	DR-11	09/30/85	DR-11	◇						●	●	●	●	
EBCHEM	DR-13	09/30/85	DR-13	●					●	●	●	●	●	●
EBCHEM	DR-14	09/30/85	DR-14	●						●	●	●	●	
EBCHEM	DR-15	09/30/85	DR-15	●					●	●	●	●	●	●
EBCHEM	DR-16	09/30/85	DR-16	●				●		●	●	●	●	
EBCHEM	DR-17	09/30/85	DR-17	◇						●	●	●	●	
EBCHEM	DR-25	10/10/85	DR-25	●				●	●	●	●	●	●	●
EBCHEM	EW-01	10/09/85	EW-01	◇						●	●	●	●	
EBCHEM	EW-02	10/04/85	EW-02	●	●			●	●	●	●	●	●	●
EBCHEM	EW-03	10/04/85	EW-03	◇						●	●	●	●	
EBCHEM	EW-04	10/14/85	EW-04	●	●				●	●	●	●	●	
EBCHEM	EW-05	10/14/85	EW-05	●	●			●	●	●	●	●	●	●
EBCHEM	EW-05		EW-05	●	●			●	●	●	●	●	●	●
EBCHEM	EW-06	10/04/85	EW-06	●	●			●	●	●	●	●	●	●
EBCHEM	EW-07	10/14/85	EW-07	●	●			●	●	●	●	●	●	●
EBCHEM	EW-08	10/14/85	EW-08	●	●			●	●	●	●	●	●	●
EBCHEM	EW-09	10/14/85	EW-09	●	●			●	●	●	●	●	●	●

Figure B-2b. Observed and predicted adverse biological effects for all chemicals (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	EW-10	10/14/85	EW-10	●	◇					●	●	●	●	
EBCHEM	EW-11	10/14/85	EW-11	●	●				●	●	●	●	●	
EBCHEM	EW-12	10/15/85	EW-12	◇	◇					●	●	●	●	
EBCHEM	EW-13	10/15/85	EW-13	◇	◇					●	●	●	●	
EBCHEM	EW-14	10/15/85	EW-14	◇	◇					●	●	●	●	
EBCHEM	EW-15	10/15/85	EW-15	◇	◇					●	●	●	●	
EBCHEM	EW-16	10/15/85	EW-16	●	◇				●		●	●	●	
EBCHEM	KG-01	09/25/85	KG-01	◇	●			●		●	●	●	●	
EBCHEM	KG-02	10/09/85	KG-02	●								●		
EBCHEM	KG-03	09/25/85	KG-03	●	◇					●	●	●	●	
EBCHEM	KG-04	10/09/85	KG-04	◇						●	●	●	●	
EBCHEM	KG-05	09/30/85	KG-05	●	●			●	●	●	●	●	●	●
EBCHEM	KG-06	09/30/85	KG-06	◇	●			●		●	●	●	●	
EBCHEM	KG-07	09/30/85	KG-07	◇	●					●	●	●	●	
EBCHEM	KG-08	10/01/85	KG-08	◇	●					●	●	●	●	
EBCHEM	KG-09	10/01/85	KG-09	●	◇					●	●	●	●	
EBCHEM	KG-10	10/08/85	KG-10	●						●	●	●	●	●
EBCHEM	KG-11	10/01/85	KG-11	●	●			●	●	●	●	●	●	
EBCHEM	MG-01	09/26/85	MG-01	◇	●							●		
EBCHEM	MG-02	09/26/85	MG-02	◇	●									
EBCHEM	MG-03	09/26/85	MG-03	◇	●									
EBCHEM	MG-04	09/26/85	MG-04	◇	●									
EBCHEM	NH-01	10/15/85	NH-01	◇	●					●	●	●	●	
EBCHEM	NH-02	10/15/85	NH-02	●	●					●	●	●	●	
EBCHEM	NH-03	10/16/85	NH-03	●	●			●	●	●	●	●	●	●
EBCHEM	NH-04	10/15/85	NH-04	●	●			●	●	●	●	●	●	●
EBCHEM	NH-05	10/15/85	NH-05	●	●			●	●	●	●	●	●	
EBCHEM	NH-06	10/16/85	NH-06	●	●			●	●	●	●	●	●	●
EBCHEM	NH-07	10/09/85	NH-07	◇								●	●	
EBCHEM	NH-08	10/16/85	NH-08	●	●			●	●	●	●	●	●	●
EBCHEM	NH-09	10/16/85	NH-09	●	◇					●	●	●	●	
EBCHEM	NH-10	10/08/85	NH-10	◇							●	●	●	
EBCHEM	NH-11	10/15/85	NH-11	●	●						●	●	●	
EBCHEM	NS-01	10/08/85	NS-01	●					●	●	●	●	●	●
EBCHEM	NS-02	09/27/85	NS-02	◇	◇					●	●	●	●	
EBCHEM	NS-03	10/04/85	NS-03	◇	◇					●	●	●	●	
EBCHEM	NS-05	10/04/85	NS-05	◇	◇						●	●	●	
EBCHEM	NS-06	09/27/85	NS-06	●				●	●	●	●	●	●	●
EBCHEM	NS-07	10/04/85	NS-07	●	◇				●	●	●	●	●	
EBCHEM	NS-08	09/26/85	NS-08	●	●					●	●	●	●	
EBCHEM	PS-01	10/12/85	PS-01	◇	◇									
EBCHEM	PS-01		PS-01	◇	◇									
EBCHEM	PS-02	10/12/85	PS-02	◇	◇						●			
EBCHEM	PS-03	10/12/85	PS-03	◇	◇							●	●	
EBCHEM	PS-04	10/12/85	PS-04	◇	◇									
EBCHEM	SS-01	10/16/85	SS-01	◇	◇									
EBCHEM	SS-03	10/04/85	SS-03	●	●			●	●	●	●	●	●	●
EBCHEM	SS-04	10/04/85	SS-04		●			●	●	●	●	●	●	●
EBCHEM	SS-05	10/03/85	SS-05	◇	◇					●	●	●	●	
EBCHEM	SS-05		SS-05	◇	◇					●	●	●	●	
EBCHEM	SS-06	10/03/85	SS-06	●	●			●	●	●	●	●	●	●
EBCHEM	SS-07	10/03/85	SS-07	●	◇				●	●	●	●	●	
EBCHEM	SS-08	09/27/85	SS-08	●	●			●	●	●	●	●	●	●
EBCHEM	SS-09	09/27/85	SS-09	●	●			●	●	●	●	●	●	●
EBCHEM	SS-11	09/27/85	SS-11	◇	◇					●	●	●	●	
EBCHEM	SS-12	09/27/85	SS-12	◇	◇					●	●	●	●	
EBCHEM	WW-01	10/01/85	WW-01	◇	●						●	●	●	
EBCHEM	WW-02	10/09/85	WW-02	●				●	●	●	●	●	●	●
EBCHEM	WW-03	10/01/85	WW-03	◇	●						●	●	●	
EBCHEM	WW-04	10/01/85	WW-04	◇	●			●		●	●	●	●	
EBCHEM	WW-05	10/01/85	WW-05	◇	●			●		●	●	●	●	
EBCHEM	WW-06	10/01/85	WW-06	◇	●			●		●	●	●	●	
EBCHEM	WW-06		WW-06	◇	●					●	●	●	●	
EBCHEM	WW-08	10/01/85	WW-08	●	●					●	●	●	●	
EBCHEM	WW-09	10/02/85	WW-09	●	●			●	●	●	●	●	●	●
EBCHEM	WW-10	10/02/85	WW-10	◇	●			●		●	●	●	●	
EBCHEM	WW-11	10/02/85	WW-11	●	●			●	●	●	●	●	●	●
EBCHEM	WW-12	10/02/85	WW-12	●	●			●	●	●	●	●	●	●
EBCHEM	WW-13	10/02/85	WW-13	◇	◇					●	●	●	●	
EBCHEM	WW-14	10/02/85	WW-14		●			●	●	●	●	●	●	●
EBCHEM	WW-15	10/08/85	WW-15	◇								●		

Figure B-2c. Observed and predicted adverse biological effects for all chemicals (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	WW-16	10/02/85	WW-16	◇	●			●		●	●	●	●	
EBCHEM	WW-17	10/03/85	WW-17	◇	●					●	●	●	●	
EBCHEM	WW-18	10/03/85	WW-18	◇	●			●		●	●	●	●	
EBCHEM	WW-19	10/03/85	WW-19	◇	●			●		●	●	●	●	
EBCHEM	WW-20	10/03/85	WW-20	◇	●			●		●	●	●	●	
EHCHEM	BH-01	06/01/85	B1	◇	◇						●	●	●	
EHCHEM	BH-02	06/01/85	B1	◇	◇						●	●	●	
EHCHEM	EH-01	06/01/85	B1	◇	◇						●	●	●	
EHCHEM	EH-02	06/01/85	B1	◇	●						●	●	●	
EHCHEM	EH-03	06/01/85	V6	◇	●									
EHCHEM	EH-05	06/01/85	V1	◇	●			●		●	●	●	●	
EHCHEM	EH-06	06/01/85	V6	◇	●			●		●	●	●	●	
EHCHEM	EH-08	06/01/85	V1	●	●			●	●	●	●	●	●	●
EHCHEM	EH-15	06/01/85	V1	◇	●			●		●	●	●	●	
EHCHEM	EH-16	06/01/85	V1	◇	●			●		●	●	●	●	
EIGHTBAY	BH-03	04/23/84	BH-03	◇						●	●			
EIGHTBAY	BH-04	04/23/84	BH-04	◇						●	●	●	●	
EIGHTBAY	BH-05	04/23/84	BH-05	●						●	●	●	●	
EIGHTBAY	BH-07	04/23/84	BH-07	◇						●	●	●	●	
EIGHTBAY	BH-11	04/30/84	BH-11	◇							●	●	●	
EIGHTBAY	BH-12	04/30/84	BH-12	◇						●	●	●	●	
EIGHTBAY	BH-23	04/30/84	BH-23	●							●	●	●	
EIGHTBAY	BH-24	04/30/84	BH-24	◇							●	●	●	
EIGHTBAY	CS-01	05/29/84	CS-01	●						●		●	●	
EIGHTBAY	CS-11	05/29/84	CS-11	●								●	●	
EIGHTBAY	CS-15	05/29/84	CS-15	●								●		
EIGHTBAY	CS-17	05/29/84	CS-17	●								●		
EIGHTBAY	DB-01	05/22/84	DB-01	◇										
EIGHTBAY	DB-05	05/22/84	DB-05	◇										
EIGHTBAY	DB-07	05/22/84	DB-07	●										
EIGHTBAY	DB-15	05/22/84	DB-15	●								●		
EIGHTBAY	EL-09	05/08/84	EL-09	◇						●	●	●		
EIGHTBAY	EL-10	05/08/84	EL-10	◇						●	●	●	●	
EIGHTBAY	EL-12	05/08/84	EL-12	◇								●	●	
EIGHTBAY	EL-17	05/08/84	EL-17	◇							●	●		
EIGHTBAY	EL-20	05/15/84	EL-20	◇						●	●	●	●	
EIGHTBAY	EL-22	05/15/84	EL-22	◇							●	●	●	
EIGHTBAY	EL-23	05/15/84	EL-23	◇							●	●	●	
EIGHTBAY	EL-24	05/15/84	EL-24	◇									●	
EIGHTBAY	EV-01	05/01/84	EV-01	●					●	●	●	●		
EIGHTBAY	EV-02	05/01/84	EV-02	●								●	●	
EIGHTBAY	EV-03	05/01/84	EV-03	●						●	●	●		
EIGHTBAY	EV-04	05/01/84	EV-04	●					●	●	●	●	●	●
EIGHTBAY	EV-05	05/07/84	EV-05	●					●	●	●	●	●	
EIGHTBAY	EV-06	05/07/84	EV-06	◇								●	●	
EIGHTBAY	EV-07	05/07/84	EV-07	◇						●	●	●		
EIGHTBAY	EV-11	05/07/84	EV-11	●							●	●	●	
EIGHTBAY	SC-06	05/16/84	SC-06	●						●	●	●	●	
EIGHTBAY	SC-07	05/16/84	SC-07	◇						●	●	●	●	
EIGHTBAY	SC-08	05/16/84	SC-08	●						●	●	●	●	
EIGHTBAY	SC-14	05/16/84	SC-14	●						●	●	●	●	
EIGHTBAY	SC-17	05/21/84	SC-17	●						●	●	●	●	
EIGHTBAY	SC-18	05/21/84	SC-18	●						●	●	●	●	
EIGHTBAY	SC-19	05/21/84	SC-19	◇						●	●	●	●	
EIGHTBAY	SC-20	05/21/84	SC-20	●					●	●	●	●	●	●
EIGHTBAY	SM-01	04/24/84	SM-01	●						●	●	●	●	
EIGHTBAY	SM-03	04/24/84	SM-03	●							●	●	●	
EIGHTBAY	SM-07	04/24/84	SM-07	●										
EIGHTBAY	SM-20	04/24/84	SM-20	●								●	●	
EIGHTBAY	SQ-14	05/29/84	SQ-14	◇										
EIGHTBAY	SQ-17	05/29/84	SQ-17	◇								●		
EIGHTBAY	SQ-18	05/29/84	SQ-18	◇								●		
EIGHTBAY	SQ-20	05/29/84	SQ-20	◇							●			
EVCHEM	ES-01	10/06/86	ES-01G	◇				●				●	●	
EVCHEM	ES-02	10/06/86	ES-02G	◇				●				●	●	
EVCHEM	ES-03	10/06/86	ES-03G	◇				●		●	●	●	●	
EVCHEM	EW-01	10/07/86	EW-01G	●	●			●	●	●	●	●	●	●
EVCHEM	EW-04	09/30/86	EW-04G	●	●			●	●	●	●	●	●	●

Figure B-2d. Observed and predicted adverse biological effects for all chemicals (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EVCHEM	EW-07	09/30/86	EW-07G	●	●			●	●	●	●	●	●	●
EVCHEM	EW-10	10/01/86	EW-10G	●	●			●	●	●	●	●	●	●
EVCHEM	EW-12	10/01/86	EW-12G	◇	●			●		●	●	●	●	
EVCHEM	EW-14	10/01/86	EW-14G		●			●	●	●	●	●	●	●
EVCHEM	NG-01	10/02/86	NG-01G	◇	◇							●		
EVCHEM	NG-02	10/02/86	NG-02G	◇	●			●		●	●	●	●	
EVCHEM	NG-03	10/02/86	NG-03G	◇	●			●		●	●	●	●	
EVCHEM	NG-04	10/02/86	NG-04G	●	●			●		●	●	●	●	
EVCHEM	NG-06	10/08/86	NG-06G	●	◇							●		
EVCHEM	NG-10	10/03/86	NG-10G	◇	◇					●	●	●	●	
EVCHEM	NG-12	10/15/86	NG-12G	◇								●		
EVCHEM	NG-13	10/15/86	NG-13G	◇						●		●	●	
EVCHEM	NG-14	10/15/86	NG-14G	◇				●		●	●	●	●	
EVCHEM	NG-15	10/15/86	NG-15G	◇				●		●	●	●	●	
EVCHEM	OG-03	10/09/86	OG-03G	●				●	●	●	●	●	●	●
EVCHEM	PS-02	10/13/86	PS-02G	◇	◇							●		
EVCHEM	PS-03	10/13/86	PS-03G	◇	◇							●		
EVCHEM	PS-04	10/10/86	PS-04G	◇	◇							●		
EVCHEM	SD-01	10/09/86	SD-01G	◇	●							●		
EVCHEM	SD-02	10/07/86	SD-02G		◇					●	●	●	●	
EVCHEM	SR-01	10/06/86	SR-01G	◇								●		
EVCHEM	SR-02	10/06/86	SR-02G	◇								●		
EVCHEM	SR-04	10/06/86	SR-04G	◇				●		●	●	●	●	
EVCHEM	SR-07	10/03/86	SR-07G		●			●	●	●	●	●	●	●
EVCHEM	SR-08	10/03/86	SR-08G	◇	●			●		●	●	●	●	
EVCHEM	SS-01	10/06/86	SS-01G	◇				●			●	●	●	
EVCHEM	SS-03	10/06/86	SS-03G	◇						●	●	●	●	
EVERETT1	EV-20	01/01/85	EV-20	◇						●	●	●	●	
EVERETT1	EV-21	01/01/85	EV-21	◇								●		
EVERETT1	EV-22	01/01/85	EV-22	◇								●		
EVERETT1	EV-23	01/01/85	EV-23	◇										
EVERETT1	EV-24	01/01/85	EV-24	●								●		
EVERETT1	EV-25	01/01/85	EV-25	◇								●		
TPPS3AB	EB-33	03/15/82	1779	●				●		●	●	●	●	●
TPPS3AB	EB-33	07/15/82	2080	●				●		●	●	●	●	●
TPPS3AB	EB-35	03/15/82	1775	●				●		●	●	●	●	●
TPPS3AB	EB-35	07/15/82	2079	●				●		●	●	●	●	●
TPPS3AB	EB-36	03/15/82	1776	●				●		●	●	●	●	●
TPPS3AB	EB-36	07/15/82	2072	●				●		●	●	●	●	
TPPS3AB	EB-38	03/15/82	1778	◇						●	●	●	●	
TPPS3AB	EB-38	07/15/82	2074	●						●	●	●	●	
TPPS3AB	WP-01	07/15/82	2088	◇							●	●	●	
TPPS3AB	WP-02	07/15/82	2089	◇						●	●	●	●	
TPPS3AB	WP-03	07/15/82	2090	●							●	●	●	
TPPS3AB	WP-04	07/15/82	2091	◇							●	●	●	
TPPS3AB	WP-05	07/15/82	2092		◇						●	●	●	
TPPS3AB	WP-06	07/15/82	2084		◇						●	●	●	
TPPS3AB	WP-07	07/15/82	2093		◇					●	●	●	●	
TPPS3AB	WP-08	07/15/82	2083		●					●	●	●	●	
TPPS3AB	WP-09	07/15/82	2082		◇						●	●	●	
TPPS3AB	WP-10	07/15/82	2076		◇					●	●	●	●	
TPPS3AB	WP-12	03/15/82	1786		◇					●	●	●	●	
TPPS3AB	WP-12	07/15/82	2069		◇						●	●	●	
TPPS3AB	WP-13	03/15/82	1784		◇						●	●	●	
TPPS3AB	WP-13	07/15/82	2070		◇					●	●	●	●	
TPPS3AB	WP-14	03/15/82	1785		◇							●	●	
TPPS3AB	WP-15	03/15/82	1817		◇					●	●	●	●	
TPPS3AB	WP-15	07/15/82	2094		◇						●	●	●	
TPPS3AB	WP-16	03/15/82	1816		●						●	●	●	
TPPS3AB	WP-16	07/15/82	2086		◇						●	●	●	

BIOLOGICAL EFFECTS

- No biological data available
- No adverse biological effect observed ◇
- Adverse biological effect observed ●

PREDICTIONS

- No adverse biological effect predicted
- Adverse biological effect predicted ●
- No TOC data available for normalizing sediment quality valves –

Figure B-2e. Observed and predicted adverse biological effects for all chemicals (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
ALKI	AP-01	05/25/84	AP-01		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-02	05/25/84	AP-02		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-03	05/25/84	AP-03		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-04	05/25/84	AP-04		●			–	–	–	–	–	–	–	–	–	–
ALKI	AP-05	05/25/84	AP-05		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-06	05/25/84	AP-06		◇			–	–	–	–	–	–	–	–	–	–
ALKI	AP-07	05/25/84	AP-07		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-01	05/26/84	PW-01		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-02	05/26/84	PW-02		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-03	05/26/84	PW-03		◇			–	–	–	–	–	–	–	–	–	–
ALKI	PW-04	05/26/84	PW-04		◇			–	–	–	–	–	–	–	–	–	–
CBBLAIR	B03	06/01/84	B03	◇	◇		◇										
CBBLAIR	B04	06/01/84	B04	◇	◇		◇	●									
CBBLAIR	B09	06/01/84	B09	◇	◇		◇	●									
CBBLAIR	B10	06/01/84	B10	◇	◇		●										
CBBLAIR	B12	06/01/84	B12	◇	◇		◇										
CBBLAIR	B15	06/01/84	B15	●	◇		◇	●									
CBMSQS	BL-11	01/01/84	BL-11	◇	◇	◇	◇	●									
CBMSQS	BL-13	01/01/84	BL-13	◇	◇	●	◇	●									
CBMSQS	BL-21	01/01/84	BL-21	◇	◇	◇	◇	●									
CBMSQS	BL-25	01/01/84	BL-25	●	◇	◇	◇	●									
CBMSQS	BL-28	01/01/84	BL-28	◇	◇	◇	◇	●									
CBMSQS	BL-31	01/01/84	BL-31	◇	◇	●	◇	●									
CBMSQS	CI-11	01/01/84	CI-11	●	●	●	●	●									
CBMSQS	CI-13	01/01/84	CI-13	◇	●	●	●	●									
CBMSQS	CI-16	01/01/84	CI-16		●	●	●	●									
CBMSQS	CI-17	01/01/84	CI-17	◇	●	●	◇	●									
CBMSQS	CI-20	01/01/84	CI-20	●	◇	◇	●	●									
CBMSQS	CI-22	01/01/84	CI-22	◇	◇	◇	◇	●	●						●		
CBMSQS	CR-11	01/01/84	CR-11	◇	◇	◇	◇										
CBMSQS	CR-12	01/01/84	CR-12	◇	◇	◇	◇										
CBMSQS	CR-13	01/01/84	CR-13	◇	◇	◇	◇										
CBMSQS	CR-14	01/01/84	CR-14	◇	◇	◇	◇										
CBMSQS	HY-12	01/01/84	HY-12		◇	●	●	●									
CBMSQS	HY-14	01/01/84	HY-14	◇	●	●	◇	●									
CBMSQS	HY-17	01/01/84	HY-17	◇	●	●	●	●									
CBMSQS	HY-22	01/01/84	HY-22	●	●	●	●	●	●					●		●	
CBMSQS	HY-23	01/01/84	HY-23	●	●	●	●	●						●	●	●	
CBMSQS	HY-24	01/01/84	HY-24	◇	●	●	◇	●									
CBMSQS	HY-28	01/01/84	HY-28	◇	●	◇	◇	●									
CBMSQS	HY-32	01/01/84	HY-32	◇	●	◇	◇	●									
CBMSQS	HY-37	01/01/84	HY-37	◇	●	●	◇	●						●	●	●	
CBMSQS	HY-42	01/01/84	HY-42	●	●	●	◇	●	●					●	●	●	
CBMSQS	HY-43	01/01/84	HY-43	◇	●	●	◇										
CBMSQS	HY-44	01/01/84	HY-44	◇	◇	◇	◇										
CBMSQS	HY-47	01/01/84	HY-47	●	●	●	●										
CBMSQS	HY-50	01/01/84	HY-50	◇	◇	●	◇	●									
CBMSQS	MD-12	01/01/84	MD-12	◇	●	◇	◇	●									
CBMSQS	MI-11	01/01/84	MI-11	●	◇	◇	◇	●									
CBMSQS	MI-13	01/01/84	MI-13	◇	◇	●	◇	●									
CBMSQS	MI-15	01/01/84	MI-15	●	◇	●	◇	●									
CBMSQS	RS-12	01/01/84	RS-12	◇	◇	◇	◇	●									
CBMSQS	RS-13	01/01/84	RS-13	●	◇	◇	●	●	●				●		●	●	
CBMSQS	RS-14	01/01/84	RS-14	◇	◇	◇	◇	●									
CBMSQS	RS-18	01/01/84	RS-18	●	●	●	●	●	●						●		
CBMSQS	RS-19	01/01/84	RS-19	●	●	●	●	●							●		
CBMSQS	RS-20	01/01/84	RS-20	◇	●	●	◇	●							●		
CBMSQS	RS-22	01/01/84	RS-22	◇		◇	◇	●									
CBMSQS	RS-24	01/01/84	RS-24	●		◇	◇	●									
CBMSQS	SI-11	01/01/84	SI-11	◇	●	●	◇	●									
CBMSQS	SI-12	01/01/84	SI-12	●	●	●	◇	●									
CBMSQS	SI-15	01/01/84	SI-15	●	◇	◇	◇	●									
CBMSQS	SP-11	01/01/84	SP-11	◇	●	●	◇										
CBMSQS	SP-12	01/01/84	SP-12	◇	◇	●	●										
CBMSQS	SP-14	01/01/84	SP-14	●	●	●	●										
CBMSQS	SP-15	01/01/84	SP-15	●	●	●	●										
CBMSQS	SP-16	01/01/84	SP-16	●	●	●	●		●								

Figure B-3a. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
DUWRIV1	DR-01	04/15/85	DR-01	◇				●									
DUWRIV1	DR-02	04/15/85	DR-02	◇				●									
DUWRIV1	DR-03	04/15/85	DR-03	◇				●									
DUWRIV1	DR-04	04/15/85	DR-04	◇				●									
DUWRIV1	DR-05	04/15/85	DR-05	◇				●									
DUWRIV1	DR-06	04/15/85	DR-06	◇				●									
DUWRIV1	DR-07	04/15/85	DR-07	●				●									
DUWRIV1	DR-08	04/15/85	DR-08	●				●	●		●			●	●	●	
DUWRIV1	SQ-09	04/19/85	SQ-09	◇				●									
DUWRIV2	DR-10	07/01/85	CA1	●				●	●	●	●	●		●	●	●	●
DUWRIV2	DR-11	07/01/85	CA2	●				●	●					●	●	●	
DUWRIV2	DR-12	07/01/85	CA3	◇				●									
DUWRIV2	DR-13	07/01/85	CB1	◇				●						●	●	●	
DUWRIV2	DR-14	07/01/85	CB2	◇				●	●				●	●	●	●	
DUWRIV2	DR-15	07/01/85	CB3	◇				●									
DUWRIV2	DR-16	07/01/85	CB4	●				●									
DUWRIV2	DR-17	07/01/85	CB5	◇				●									
DUWRIV2	DR-18	07/01/85	CC1	◇				●						●		●	
DUWRIV2	DR-19	07/01/85	CC2	◇				●						●		●	
DUWRIV2	DR-20	07/01/85	CC3	◇				●									
DUWRIV2	DR-21	07/01/85	CC4	◇				●									
DUWRIV2	DR-22	07/01/85	CC5	◇				●						●	●	●	
DUWRIV2	DR-23	07/01/85	CD1	◇				●	●		●			●	●	●	
DUWRIV2	DR-24	07/01/85	CD2	◇				●									
DUWRIV2	DR-25	07/01/85	CE1	●				●	●		●			●	●	●	
DUWRIV2	DR-26	07/01/85	CE2	●				●						●	●	●	
DUWRIV2	DR-27	07/01/85	CE3	●				●									
DUWRIV2	DR-28	07/01/85	CF1	◇				●	●		●			●	●	●	
DUWRIV2	DR-29	07/01/85	CF2	●				●	●		●			●	●	●	
DUWRIV2	DR-30	07/01/85	CF3	◇				●	●					●	●	●	
DUWRIV2	DR-31	07/01/85	CF4	◇				●	●					●	●	●	
DUWRIV2	DR-32	07/01/85	CF5	◇				●						●		●	
DUWRIV2	DR-33	07/01/85	CG1	◇				●	●		●			●	●	●	
DUWRIV2	DR-34	07/01/85	CG2	◇				●	●		●			●	●	●	
DUWRIV2	DR-35	07/01/85	CG3	◇				●	●					●	●	●	
DUWRIV2	DR-36	07/01/85	CG4	◇				●	●		●			●	●	●	
DUWRIV2	DR-37	07/01/85	CG5	◇				●									
DUWRIV2	DR-38	07/01/85	CH1	◇				●	●		●			●	●	●	
DUWRIV2	DR-39	07/01/85	CW/A1	◇				●									
DUWRIV2	SQ-21	07/01/85	SEQUIM	◇													
EBCHEM	AB-01	09/26/85	AB-01	●				●	●						●	●	
EBCHEM	AB-02	09/26/85	AB-02	◇	◇			●	●						●		
EBCHEM	AB-03	09/26/85	AB-03	◇	●												
EBCHEM	AB-04	09/26/85	AB-04	◇	●												
EBCHEM	DR-01	09/30/85	DR-01	◇				●						●	●	●	
EBCHEM	DR-02	09/30/85	DR-02	●				●									
EBCHEM	DR-03	09/30/85	DR-03	◇				●						●	●	●	
EBCHEM	DR-04	09/30/85	DR-04	◇				●						●	●	●	
EBCHEM	DR-06	10/09/85	DR-06	◇				●	●					●	●	●	
EBCHEM	DR-07	09/30/85	DR-07	◇				●	●		●			●	●	●	
EBCHEM	DR-09	09/30/85	DR-09	◇				●									
EBCHEM	DR-11	09/30/85	DR-11	◇				●						●	●	●	
EBCHEM	DR-13	09/30/85	DR-13	●				●	●					●	●	●	
EBCHEM	DR-14	09/30/85	DR-14	●				●						●	●	●	
EBCHEM	DR-15	09/30/85	DR-15	●				●						●		●	
EBCHEM	DR-16	09/30/85	DR-16	●				●						●	●	●	
EBCHEM	DR-17	09/30/85	DR-17	◇				●						●	●	●	
EBCHEM	DR-25	10/10/85	DR-25	●													
EBCHEM	EW-01	10/09/85	EW-01	◇				●	●					●	●	●	
EBCHEM	EW-02	10/04/85	EW-02	●	●			●	●	●			●	●	●	●	
EBCHEM	EW-03	10/04/85	EW-03	◇				●						●	●	●	
EBCHEM	EW-04	10/14/85	EW-04	●	●			●	●					●	●	●	
EBCHEM	EW-05	10/14/85	EW-05	●	●			●						●	●	●	
EBCHEM	EW-05		EW-05	●	●			●	●					●	●	●	
EBCHEM	EW-06	10/04/85	EW-06	●	●			●						●	●	●	
EBCHEM	EW-07	10/14/85	EW-07	●	●			●						●		●	
EBCHEM	EW-08	10/14/85	EW-08	●	●			●						●	●	●	
EBCHEM	EW-09	10/14/85	EW-09	●	●			●						●	●	●	

Figure B-3b. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	EW-10	10/14/85	EW-10	●	◇			●						●	●	●	
EBCHEM	EW-11	10/14/85	EW-11	●	●			●						●	●	●	
EBCHEM	EW-12	10/15/85	EW-12	◇	◇			●	●						●		
EBCHEM	EW-13	10/15/85	EW-13	◇	◇			●						●	●	●	
EBCHEM	EW-14	10/15/85	EW-14	◇	◇			●	●				●	●	●	●	
EBCHEM	EW-15	10/15/85	EW-15	◇	◇			●									
EBCHEM	EW-16	10/15/85	EW-16	●	◇			●									
EBCHEM	KG-01	09/25/85	KG-01	◇	●			●						●		●	
EBCHEM	KG-02	10/09/85	KG-02	●													
EBCHEM	KG-03	09/25/85	KG-03	●	◇			●									
EBCHEM	KG-04	10/09/85	KG-04	◇				●									
EBCHEM	KG-05	09/30/85	KG-05	●	●			●									
EBCHEM	KG-06	09/30/85	KG-06	◇	●			●	●		●			●	●	●	
EBCHEM	KG-07	09/30/85	KG-07	◇	●			●									
EBCHEM	KG-08	10/01/85	KG-08	◇	●			●									
EBCHEM	KG-09	10/01/85	KG-09	●	◇			●						●		●	
EBCHEM	KG-10	10/08/85	KG-10	●													
EBCHEM	KG-11	10/01/85	KG-11	●	●			●						●	●	●	
EBCHEM	MG-01	09/26/85	MG-01	◇	●												
EBCHEM	MG-02	09/26/85	MG-02	◇	●												
EBCHEM	MG-03	09/26/85	MG-03	◇	●												
EBCHEM	MG-04	09/26/85	MG-04	◇	●												
EBCHEM	NH-01	10/15/85	NH-01	◇	●			●						●	●	●	
EBCHEM	NH-02	10/15/85	NH-02	●	●			●									
EBCHEM	NH-03	10/16/85	NH-03	●	●			●	●		●			●	●	●	
EBCHEM	NH-04	10/15/85	NH-04	●	●			●	●				●		●	●	
EBCHEM	NH-05	10/15/85	NH-05	●	●			●						●	●	●	
EBCHEM	NH-06	10/16/85	NH-06	●	●			●	●	●			●	●	●	●	
EBCHEM	NH-07	10/09/85	NH-07	◇				●	●				●		●	●	
EBCHEM	NH-08	10/16/85	NH-08	●	●			●	●	●	●		●	●	●	●	
EBCHEM	NH-09	10/16/85	NH-09	●	◇			●						●	●	●	
EBCHEM	NH-10	10/08/85	NH-10	◇				●						●	●	●	
EBCHEM	NH-11	10/15/85	NH-11	●	●			●	●					●	●	●	
EBCHEM	NS-01	10/08/85	NS-01	●				●									
EBCHEM	NS-02	09/27/85	NS-02	◇	◇			●	●				●		●	●	
EBCHEM	NS-03	10/04/85	NS-03	◇	◇			●	●					●	●	●	
EBCHEM	NS-05	10/04/85	NS-05	◇	◇			●						●	●	●	
EBCHEM	NS-06	09/27/85	NS-06	●													
EBCHEM	NS-07	10/04/85	NS-07	●	◇			●						●	●	●	
EBCHEM	NS-08	09/26/85	NS-08	●	●			●	●						●		
EBCHEM	PS-01	10/12/85	PS-01	◇	◇												
EBCHEM	PS-01		PS-01	◇	◇												
EBCHEM	PS-02	10/12/85	PS-02	◇	◇												
EBCHEM	PS-03	10/12/85	PS-03	◇	◇												
EBCHEM	PS-04	10/12/85	PS-04	◇	◇												
EBCHEM	SS-01	10/16/85	SS-01	◇	◇			●									
EBCHEM	SS-03	10/04/85	SS-03	●	●			●	●					●	●	●	
EBCHEM	SS-04	10/04/85	SS-04		●			●						●	●	●	
EBCHEM	SS-05	10/03/85	SS-05	◇	◇			●							●		
EBCHEM	SS-05	10/03/85	SS-05	◇	◇			●						●		●	
EBCHEM	SS-06	10/03/85	SS-06	●	●			●							●		
EBCHEM	SS-07	10/03/85	SS-07	●	◇			●									
EBCHEM	SS-08	09/27/85	SS-08	●	●			●	●	●	●	●	●		●	●	●
EBCHEM	SS-09	09/27/85	SS-09	●	●			●						●	●	●	
EBCHEM	SS-11	09/27/85	SS-11	◇	◇			●									
EBCHEM	SS-12	09/27/85	SS-12	◇	◇			●									
EBCHEM	WW-01	10/01/85	WW-01	◇	●			●						●	●	●	
EBCHEM	WW-02	10/09/85	WW-02	●				●	●					●	●	●	
EBCHEM	WW-03	10/01/85	WW-03	◇	●			●							●		
EBCHEM	WW-04	10/01/85	WW-04	◇	●			●	●	●	●		●	●	●	●	
EBCHEM	WW-05	10/01/85	WW-05	◇	●			●	●		●			●	●	●	
EBCHEM	WW-06	10/01/85	WW-06	◇	●			●						●		●	
EBCHEM	WW-06		WW-06	◇	●			●	●				●		●	●	
EBCHEM	WW-08	10/01/85	WW-08	●	●			●						●	●	●	
EBCHEM	WW-09	10/02/85	WW-09	●	●			●	●				●	●	●	●	
EBCHEM	WW-10	10/02/85	WW-10	◇	●			●						●		●	
EBCHEM	WW-11	10/02/85	WW-11	●	●			●									
EBCHEM	WW-12	10/02/85	WW-12	●	●			●	●					●	●	●	
EBCHEM	WW-13	10/02/85	WW-13	◇	◇			●							●		
EBCHEM	WW-14	10/02/85	WW-14		●			●						●	●	●	
EBCHEM	WW-15	10/08/85	WW-15	◇													

Figure B-3c. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	WW-16	10/02/85	WW-16	◇	●			●						●	●	●	
EBCHEM	WW-17	10/03/85	WW-17	◇	●			●						●	●	●	
EBCHEM	WW-18	10/03/85	WW-18	◇	●			●						●	●	●	
EBCHEM	WW-19	10/03/85	WW-19	◇	●			●						●	●	●	
EBCHEM	WW-20	10/03/85	WW-20	◇	●			●						●		●	
EHCHEM	BH-01	06/01/85	B1	◇	◇			●									
EHCHEM	BH-02	06/01/85	B1	◇	◇												
EHCHEM	EH-01	06/01/85	B1	◇	◇			●									
EHCHEM	EH-02	06/01/85	B1	◇	●			●									
EHCHEM	EH-03	06/01/85	V6	◇	●			●									
EHCHEM	EH-05	06/01/85	V1	◇	●			●	●						●		
EHCHEM	EH-06	06/01/85	V6	◇	●			●									
EHCHEM	EH-08	06/01/85	V1	●	●						●	●	●	●	●	●	●
EHCHEM	EH-15	06/01/85	V1	◇	●			●	●	●	●		●		●	●	
EHCHEM	EH-16	06/01/85	V1	◇	●			●									
EIGHTBAY	BH-03	04/23/84	BH-03	◇				●									
EIGHTBAY	BH-04	04/23/84	BH-04	◇				●									
EIGHTBAY	BH-05	04/23/84	BH-05	●				●									
EIGHTBAY	BH-07	04/23/84	BH-07	◇				●									
EIGHTBAY	BH-11	04/30/84	BH-11	◇				●									
EIGHTBAY	BH-12	04/30/84	BH-12	◇				●									
EIGHTBAY	BH-23	04/30/84	BH-23	●													
EIGHTBAY	BH-24	04/30/84	BH-24	◇													
EIGHTBAY	CS-01	05/29/84	CS-01	●													
EIGHTBAY	CS-11	05/29/84	CS-11	●													
EIGHTBAY	CS-15	05/29/84	CS-15	●													
EIGHTBAY	CS-17	05/29/84	CS-17	●													
EIGHTBAY	DB-01	05/22/84	DB-01	◇													
EIGHTBAY	DB-05	05/22/84	DB-05	◇													
EIGHTBAY	DB-07	05/22/84	DB-07	●													
EIGHTBAY	DB-15	05/22/84	DB-15	●													
EIGHTBAY	EL-09	05/08/84	EL-09	◇				●						●		●	
EIGHTBAY	EL-10	05/08/84	EL-10	◇				●							●		
EIGHTBAY	EL-12	05/08/84	EL-12	◇				●									
EIGHTBAY	EL-17	05/08/84	EL-17	◇				●						●	●	●	
EIGHTBAY	EL-20	05/15/84	EL-20	◇				●	●					●	●	●	
EIGHTBAY	EL-22	05/15/84	EL-22	◇				●						●	●	●	
EIGHTBAY	EL-23	05/15/84	EL-23	◇				●						●		●	
EIGHTBAY	EL-24	05/15/84	EL-24	◇													
EIGHTBAY	EV-01	05/01/84	EV-01	●				●									
EIGHTBAY	EV-02	05/01/84	EV-02	●				●									
EIGHTBAY	EV-03	05/01/84	EV-03	●				●									
EIGHTBAY	EV-04	05/01/84	EV-04	●				●									
EIGHTBAY	EV-05	05/07/84	EV-05	●				●									
EIGHTBAY	EV-06	05/07/84	EV-06	◇				●									
EIGHTBAY	EV-07	05/07/84	EV-07	◇				●									
EIGHTBAY	EV-11	05/07/84	EV-11	●				●									
EIGHTBAY	SC-06	05/16/84	SC-06	●				●	●					●	●	●	
EIGHTBAY	SC-07	05/16/84	SC-07	◇				●						●	●	●	
EIGHTBAY	SC-08	05/16/84	SC-08	●				●						●	●	●	
EIGHTBAY	SC-14	05/16/84	SC-14	●				●	●					●	●	●	
EIGHTBAY	SC-17	05/21/84	SC-17	●				●									
EIGHTBAY	SC-18	05/21/84	SC-18	●				●									
EIGHTBAY	SC-19	05/21/84	SC-19	◇													
EIGHTBAY	SC-20	05/21/84	SC-20	●				●	●				●		●	●	
EIGHTBAY	SM-01	04/24/84	SM-01	●													
EIGHTBAY	SM-03	04/24/84	SM-03	●													
EIGHTBAY	SM-07	04/24/84	SM-07	●													
EIGHTBAY	SM-20	04/24/84	SM-20	●													
EIGHTBAY	SQ-14	05/29/84	SQ-14	◇													
EIGHTBAY	SQ-17	05/29/84	SQ-17	◇													
EIGHTBAY	SQ-18	05/29/84	SQ-18	◇													
EIGHTBAY	SQ-20	05/29/84	SQ-20	◇													
EVCHEM	ES-01	10/06/86	ES-01G	◇													
EVCHEM	ES-02	10/06/86	ES-02G	◇													
EVCHEM	ES-03	10/06/86	ES-03G	◇													
EVCHEM	EW-01	10/07/86	EW-01G	●	●												
EVCHEM	EW-04	09/30/86	EW-04G	●	●			●						●	●	●	

Figure B-3d. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS									
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	LOW EP	MEAN EP	HI EP	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EVCHEM	EW-07	09/30/86	EW-07G	●	●			●									
EVCHEM	EW-10	10/01/86	EW-10G	●	●			●									
EVCHEM	EW-12	10/01/86	EW-12G	◇	●												
EVCHEM	EW-14	10/01/86	EW-14G		●			●							●		
EVCHEM	NG-01	10/02/86	NG-01G	◇	◇												
EVCHEM	NG-02	10/02/86	NG-02G	◇	●												
EVCHEM	NG-03	10/02/86	NG-03G	◇	●												
EVCHEM	NG-04	10/02/86	NG-04G	●	●												
EVCHEM	NG-06	10/08/86	NG-06G	●	◇												
EVCHEM	NG-10	10/03/86	NG-10G	◇	◇			●									
EVCHEM	NG-12	10/15/86	NG-12G	◇													
EVCHEM	NG-13	10/15/86	NG-13G	◇													
EVCHEM	NG-14	10/15/86	NG-14G	◇				●	●				●		●	●	
EVCHEM	NG-15	10/15/86	NG-15G	◇				●									
EVCHEM	OG-03	10/09/86	OG-03G	●													
EVCHEM	PS-02	10/13/86	PS-02G	◇	◇												
EVCHEM	PS-03	10/13/86	PS-03G	◇	◇												
EVCHEM	PS-04	10/10/86	PS-04G	◇	◇												
EVCHEM	SD-01	10/09/86	SD-01G	◇	●												
EVCHEM	SD-02	10/07/86	SD-02G		◇												
EVCHEM	SR-01	10/06/86	SR-01G	◇													
EVCHEM	SR-02	10/06/86	SR-02G	◇													
EVCHEM	SR-04	10/06/86	SR-04G	◇													
EVCHEM	SR-07	10/03/86	SR-07G		●												
EVCHEM	SR-08	10/03/86	SR-08G	◇	●												
EVCHEM	SS-01	10/06/86	SS-01G	◇													
EVCHEM	SS-03	10/06/86	SS-03G	◇													
EVERETT1	EV-20	01/01/85	EV-20	◇				●							●		
EVERETT1	EV-21	01/01/85	EV-21	◇													
EVERETT1	EV-22	01/01/85	EV-22	◇													
EVERETT1	EV-23	01/01/85	EV-23	◇													
EVERETT1	EV-24	01/01/85	EV-24	●													
EVERETT1	EV-25	01/01/85	EV-25	◇													
TPPS3AB	EB-33	03/15/82	1779	●				●	●		●			●	●	●	
TPPS3AB	EB-33	07/15/82	2080	●				●	●	●	●	●		●	●	●	●
TPPS3AB	EB-35	03/15/82	1775	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-35	07/15/82	2079	●				●	●	●	●	●	●	●	●	●	●
TPPS3AB	EB-36	03/15/82	1776	●				●	●	●	●	●		●	●	●	●
TPPS3AB	EB-36	07/15/82	2072	●				●	●		●			●	●	●	
TPPS3AB	EB-38	03/15/82	1778	◇				●	●					●	●	●	
TPPS3AB	EB-38	07/15/82	2074	●				●	●				●	●	●	●	
TPPS3AB	WP-01	07/15/82	2088	◇				●							●		
TPPS3AB	WP-02	07/15/82	2089	◇				●	●				●	●	●	●	
TPPS3AB	WP-03	07/15/82	2090	●				●						●		●	
TPPS3AB	WP-04	07/15/82	2091	◇				●	●				●	●	●	●	
TPPS3AB	WP-05	07/15/82	2092		◇			●	●				●		●	●	
TPPS3AB	WP-06	07/15/82	2084		◇			●	●				●		●	●	
TPPS3AB	WP-07	07/15/82	2093		◇			●	●				●	●	●	●	
TPPS3AB	WP-08	07/15/82	2083		●			●	●	●	●	●		●	●	●	●
TPPS3AB	WP-09	07/15/82	2082		◇			●	●					●	●	●	
TPPS3AB	WP-10	07/15/82	2076		◇			●	●	●			●	●	●	●	
TPPS3AB	WP-12	03/15/82	1786		◇			●									
TPPS3AB	WP-12	07/15/82	2069		◇			●						●		●	
TPPS3AB	WP-13	03/15/82	1784		◇			●	●					●	●	●	
TPPS3AB	WP-13	07/15/82	2070		◇			●						●	●	●	
TPPS3AB	WP-14	03/15/82	1785		◇												
TPPS3AB	WP-15	03/15/82	1817		◇			●						●		●	
TPPS3AB	WP-15	07/15/82	2094		◇			●	●					●	●	●	
TPPS3AB	WP-16	03/15/82	1816		●			●						●	●	●	
TPPS3AB	WP-16	07/15/82	2086		◇			●									

BIOLOGICAL EFFECTS

- No biological data available
- No adverse biological effect observed ◇
- Adverse biological effect observed ●

PREDICTIONS

- No adverse biological effect predicted
- Adverse biological effect predicted ●
- No TOC data available for normalizing sediment quality valves –

Figure B-3e. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to total organic carbon or dry weight as appropriate)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
ALKI	AP-01	05/25/84	AP-01		◇									
ALKI	AP-02	05/25/84	AP-02		◇									
ALKI	AP-03	05/25/84	AP-03		◇									
ALKI	AP-04	05/25/84	AP-04		●									
ALKI	AP-05	05/25/84	AP-05		◇									
ALKI	AP-06	05/25/84	AP-06		◇									
ALKI	AP-07	05/25/84	AP-07		◇									
ALKI	PW-01	05/26/84	PW-01		◇									
ALKI	PW-02	05/26/84	PW-02		◇									
ALKI	PW-03	05/26/84	PW-03		◇									
ALKI	PW-04	05/26/84	PW-04		◇									
CBBLAIR	B03	06/01/84	B03	◇	◇		◇							
CBBLAIR	B04	06/01/84	B04	◇	◇		◇					●		
CBBLAIR	B09	06/01/84	B09	◇	◇		◇							
CBBLAIR	B10	06/01/84	B10	◇	◇		●							
CBBLAIR	B12	06/01/84	B12	◇	◇		◇							
CBBLAIR	B15	06/01/84	B15	●	◇		◇							
CBMSQS	BL-11	01/01/84	BL-11	◇	◇	◇	◇							
CBMSQS	BL-13	01/01/84	BL-13	◇	◇	●	◇							
CBMSQS	BL-21	01/01/84	BL-21	◇	◇	◇	◇							
CBMSQS	BL-25	01/01/84	BL-25	●	◇	◇	◇							
CBMSQS	BL-28	01/01/84	BL-28	◇	◇	◇	◇							
CBMSQS	BL-31	01/01/84	BL-31	◇	◇	●	◇							
CBMSQS	CI-11	01/01/84	CI-11	●	●	●	●			●	●	●	●	
CBMSQS	CI-13	01/01/84	CI-13	◇	●	●	●				●	●	●	
CBMSQS	CI-16	01/01/84	CI-16		●	●	●					●		
CBMSQS	CI-17	01/01/84	CI-17	◇	●	●	◇					●		
CBMSQS	CI-20	01/01/84	CI-20	●	◇	◇	●							
CBMSQS	CI-22	01/01/84	CI-22	◇	◇	◇	◇					●		
CBMSQS	CR-11	01/01/84	CR-11	◇	◇	◇	◇							
CBMSQS	CR-12	01/01/84	CR-12	◇	◇	◇	◇							
CBMSQS	CR-13	01/01/84	CR-13	◇	◇	◇	◇							
CBMSQS	CR-14	01/01/84	CR-14	◇	◇	◇	◇							
CBMSQS	HY-12	01/01/84	HY-12		◇	●	●							
CBMSQS	HY-14	01/01/84	HY-14	◇	●	●	◇					●		
CBMSQS	HY-17	01/01/84	HY-17	◇	●	●	●				●	●	●	
CBMSQS	HY-22	01/01/84	HY-22	●	●	●	●	●		●	●	●	●	
CBMSQS	HY-23	01/01/84	HY-23	●	●	●	●	●		●	●	●	●	
CBMSQS	HY-24	01/01/84	HY-24	◇	●	●	◇				●		●	
CBMSQS	HY-28	01/01/84	HY-28	◇	●	◇	◇							
CBMSQS	HY-32	01/01/84	HY-32	◇	●	◇	◇							
CBMSQS	HY-37	01/01/84	HY-37	◇	●	●	◇				●	●	●	
CBMSQS	HY-42	01/01/84	HY-42	●	●	●	◇	●			●	●	●	
CBMSQS	HY-43	01/01/84	HY-43	◇	●	●	◇							
CBMSQS	HY-44	01/01/84	HY-44	◇	◇	◇	◇							
CBMSQS	HY-47	01/01/84	HY-47	●	●	●	●							
CBMSQS	HY-50	01/01/84	HY-50	◇	◇	●	◇							
CBMSQS	MD-12	01/01/84	MD-12	◇	●	◇	◇					●		
CBMSQS	MI-11	01/01/84	MI-11	●	◇	◇	◇					●		
CBMSQS	MI-13	01/01/84	MI-13	◇	◇	●	◇							
CBMSQS	MI-15	01/01/84	MI-15	●	◇	●	◇							
CBMSQS	RS-12	01/01/84	RS-12	◇	◇	◇	◇					●		
CBMSQS	RS-13	01/01/84	RS-13	●	◇	◇	●					●		
CBMSQS	RS-14	01/01/84	RS-14	◇	◇	◇	◇					●		
CBMSQS	RS-18	01/01/84	RS-18	●	●	●	●	●	●	●	●	●	●	●
CBMSQS	RS-19	01/01/84	RS-19	●	●	●	●							
CBMSQS	RS-20	01/01/84	RS-20	◇	●	●	◇							
CBMSQS	RS-22	01/01/84	RS-22	◇		◇	◇							
CBMSQS	RS-24	01/01/84	RS-24	●		◇	◇							
CBMSQS	SI-11	01/01/84	SI-11	◇	●	●	◇							
CBMSQS	SI-12	01/01/84	SI-12	●	●	●	◇							
CBMSQS	SI-15	01/01/84	SI-15	●	◇	◇	◇							
CBMSQS	SP-11	01/01/84	SP-11	◇	●	●	◇							
CBMSQS	SP-12	01/01/84	SP-12	◇	◇	●	●							
CBMSQS	SP-14	01/01/84	SP-14	●	●	●	●							
CBMSQS	SP-15	01/01/84	SP-15	●	●	●	●							
CBMSQS	SP-16	01/01/84	SP-16	●	●	●	●							

Figure B-4a. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
DUWRIV1	DR-01	04/15/85	DR-01	◇										
DUWRIV1	DR-02	04/15/85	DR-02	◇										
DUWRIV1	DR-03	04/15/85	DR-03	◇										
DUWRIV1	DR-04	04/15/85	DR-04	◇										
DUWRIV1	DR-05	04/15/85	DR-05	◇										
DUWRIV1	DR-06	04/15/85	DR-06	◇										
DUWRIV1	DR-07	04/15/85	DR-07	●										
DUWRIV1	DR-08	04/15/85	DR-08	●				●	●	●	●	●	●	●
DUWRIV1	SQ-09	04/19/85	SQ-09	◇										
DUWRIV2	DR-10	07/01/85	CA1	●				●	●	●	●	●	●	●
DUWRIV2	DR-11	07/01/85	CA2	●							●	●	●	
DUWRIV2	DR-12	07/01/85	CA3	◇										
DUWRIV2	DR-13	07/01/85	CB1	◇							●		●	
DUWRIV2	DR-14	07/01/85	CB2	◇							●	●	●	
DUWRIV2	DR-15	07/01/85	CB3	◇										
DUWRIV2	DR-16	07/01/85	CB4	●										
DUWRIV2	DR-17	07/01/85	CB5	◇										
DUWRIV2	DR-18	07/01/85	CC1	◇										
DUWRIV2	DR-19	07/01/85	CC2	◇							●	●	●	
DUWRIV2	DR-20	07/01/85	CC3	◇										
DUWRIV2	DR-21	07/01/85	CC4	◇										
DUWRIV2	DR-22	07/01/85	CC5	◇							●		●	
DUWRIV2	DR-23	07/01/85	CD1	◇				●		●	●	●	●	
DUWRIV2	DR-24	07/01/85	CD2	◇										
DUWRIV2	DR-25	07/01/85	CE1	●							●	●	●	
DUWRIV2	DR-26	07/01/85	CE2	●							●		●	
DUWRIV2	DR-27	07/01/85	CE3	●										
DUWRIV2	DR-28	07/01/85	CF1	◇				●		●	●	●	●	
DUWRIV2	DR-29	07/01/85	CF2	●				●		●	●	●	●	
DUWRIV2	DR-30	07/01/85	CF3	◇							●	●	●	
DUWRIV2	DR-31	07/01/85	CF4	◇							●	●	●	
DUWRIV2	DR-32	07/01/85	CF5	◇										
DUWRIV2	DR-33	07/01/85	CG1	◇				●		●	●	●	●	
DUWRIV2	DR-34	07/01/85	CG2	◇				●		●	●	●	●	
DUWRIV2	DR-35	07/01/85	CG3	◇							●	●	●	
DUWRIV2	DR-36	07/01/85	CG4	◇				●		●	●	●	●	
DUWRIV2	DR-37	07/01/85	CG5	◇										
DUWRIV2	DR-38	07/01/85	CH1	◇				●		●	●	●	●	
DUWRIV2	DR-39	07/01/85	CW/A1	◇										
DUWRIV2	SQ-21	07/01/85	SEQUIM	◇										
EBCHEM	AB-01	09/26/85	AB-01	●						●	●	●	●	
EBCHEM	AB-02	09/26/85	AB-02	◇	◇							●		
EBCHEM	AB-03	09/26/85	AB-03	◇	●									
EBCHEM	AB-04	09/26/85	AB-04	◇	●									
EBCHEM	DR-01	09/30/85	DR-01	◇							●	●	●	
EBCHEM	DR-02	09/30/85	DR-02	●							●	●	●	
EBCHEM	DR-03	09/30/85	DR-03	◇							●	●	●	
EBCHEM	DR-04	09/30/85	DR-04	◇							●	●	●	
EBCHEM	DR-06	10/09/85	DR-06	◇							●	●	●	
EBCHEM	DR-07	09/30/85	DR-07	◇							●	●	●	
EBCHEM	DR-09	09/30/85	DR-09	◇							●		●	
EBCHEM	DR-11	09/30/85	DR-11	◇							●	●	●	
EBCHEM	DR-13	09/30/85	DR-13	●							●	●	●	
EBCHEM	DR-14	09/30/85	DR-14	●							●	●	●	
EBCHEM	DR-15	09/30/85	DR-15	●							●	●	●	
EBCHEM	DR-16	09/30/85	DR-16	●						●	●	●	●	
EBCHEM	DR-17	09/30/85	DR-17	◇							●	●	●	
EBCHEM	DR-25	10/10/85	DR-25	●										
EBCHEM	EW-01	10/09/85	EW-01	◇							●	●	●	
EBCHEM	EW-02	10/04/85	EW-02	●	●			●	●	●	●	●	●	●
EBCHEM	EW-03	10/04/85	EW-03	◇							●	●	●	
EBCHEM	EW-04	10/14/85	EW-04	●	●					●	●	●	●	
EBCHEM	EW-05	10/14/85	EW-05	●	●			●		●	●	●	●	
EBCHEM	EW-05		EW-05	●	●			●		●	●	●	●	
EBCHEM	EW-06	10/04/85	EW-06	●	●			●		●	●	●	●	
EBCHEM	EW-07	10/14/85	EW-07	●	●						●	●	●	
EBCHEM	EW-08	10/14/85	EW-08	●	●						●	●	●	
EBCHEM	EW-09	10/14/85	EW-09	●	●						●	●	●	

Figure B-4b. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	EW-10	10/14/85	EW-10	●	◇						●	●	●	
EBCHEM	EW-11	10/14/85	EW-11	●	●						●	●	●	
EBCHEM	EW-12	10/15/85	EW-12	◇	◇						●	●	●	
EBCHEM	EW-13	10/15/85	EW-13	◇	◇						●	●	●	
EBCHEM	EW-14	10/15/85	EW-14	◇	◇					●	●	●	●	
EBCHEM	EW-15	10/15/85	EW-15	◇	◇							●		
EBCHEM	EW-16	10/15/85	EW-16	●	◇									
EBCHEM	KG-01	09/25/85	KG-01	◇	●						●	●	●	
EBCHEM	KG-02	10/09/85	KG-02	●										
EBCHEM	KG-03	09/25/85	KG-03	●	◇						●		●	
EBCHEM	KG-04	10/09/85	KG-04	◇										
EBCHEM	KG-05	09/30/85	KG-05	●	●						●	●	●	
EBCHEM	KG-06	09/30/85	KG-06	◇	●			●		●	●	●	●	
EBCHEM	KG-07	09/30/85	KG-07	◇	●					●	●	●	●	
EBCHEM	KG-08	10/01/85	KG-08	◇	●						●		●	
EBCHEM	KG-09	10/01/85	KG-09	●	◇						●	●	●	
EBCHEM	KG-10	10/08/85	KG-10	●								●		
EBCHEM	KG-11	10/01/85	KG-11	●	●						●		●	
EBCHEM	MG-01	09/26/85	MG-01	◇	●									
EBCHEM	MG-02	09/26/85	MG-02	◇	●									
EBCHEM	MG-03	09/26/85	MG-03	◇	●									
EBCHEM	MG-04	09/26/85	MG-04	◇	●									
EBCHEM	NH-01	10/15/85	NH-01	◇	●						●	●	●	
EBCHEM	NH-02	10/15/85	NH-02	●	●						●	●	●	
EBCHEM	NH-03	10/16/85	NH-03	●	●			●	●	●	●	●	●	●
EBCHEM	NH-04	10/15/85	NH-04	●	●					●	●	●	●	
EBCHEM	NH-05	10/15/85	NH-05	●	●					●	●	●	●	
EBCHEM	NH-06	10/16/85	NH-06	●	●			●	●	●	●	●	●	●
EBCHEM	NH-07	10/09/85	NH-07	◇										
EBCHEM	NH-08	10/16/85	NH-08	●	●			●	●	●	●	●	●	●
EBCHEM	NH-09	10/16/85	NH-09	●	◇						●		●	
EBCHEM	NH-10	10/08/85	NH-10	◇							●		●	
EBCHEM	NH-11	10/15/85	NH-11	●	●						●		●	
EBCHEM	NS-01	10/08/85	NS-01	●										
EBCHEM	NS-02	09/27/85	NS-02	◇	◇					●	●	●	●	
EBCHEM	NS-03	10/04/85	NS-03	◇	◇						●		●	
EBCHEM	NS-05	10/04/85	NS-05	◇	◇						●		●	
EBCHEM	NS-06	09/27/85	NS-06	●										
EBCHEM	NS-07	10/04/85	NS-07	●	◇					●	●	●	●	
EBCHEM	NS-08	09/26/85	NS-08	●	●							●		
EBCHEM	PS-01	10/12/85	PS-01	◇	◇									
EBCHEM	PS-01		PS-01	◇	◇									
EBCHEM	PS-02	10/12/85	PS-02	◇	◇									
EBCHEM	PS-03	10/12/85	PS-03	◇	◇									
EBCHEM	PS-04	10/12/85	PS-04	◇	◇									
EBCHEM	SS-01	10/16/85	SS-01	◇	◇									
EBCHEM	SS-03	10/04/85	SS-03	●	●					●	●	●	●	
EBCHEM	SS-04	10/04/85	SS-04		●			●		●	●	●	●	
EBCHEM	SS-05	10/03/85	SS-05	◇	◇					●	●	●	●	
EBCHEM	SS-05		SS-05	◇	◇						●	●	●	
EBCHEM	SS-06	10/03/85	SS-06	●	●			●		●	●	●	●	
EBCHEM	SS-07	10/03/85	SS-07	●	◇					●	●	●	●	
EBCHEM	SS-08	09/27/85	SS-08	●	●			●	●	●	●	●	●	●
EBCHEM	SS-09	09/27/85	SS-09	●	●			●	●	●	●	●	●	●
EBCHEM	SS-11	09/27/85	SS-11	◇	◇					●	●	●	●	
EBCHEM	SS-12	09/27/85	SS-12	◇	◇						●		●	
EBCHEM	WW-01	10/01/85	WW-01	◇	●						●		●	
EBCHEM	WW-02	10/09/85	WW-02	●							●	●	●	
EBCHEM	WW-03	10/01/85	WW-03	◇	●									
EBCHEM	WW-04	10/01/85	WW-04	◇	●			●		●	●	●	●	
EBCHEM	WW-05	10/01/85	WW-05	◇	●			●		●	●	●	●	
EBCHEM	WW-06	10/01/85	WW-06	◇	●						●	●	●	
EBCHEM	WW-06		WW-06	◇	●					●	●	●	●	
EBCHEM	WW-08	10/01/85	WW-08	●	●						●	●	●	
EBCHEM	WW-09	10/02/85	WW-09	●	●			●		●	●	●	●	
EBCHEM	WW-10	10/02/85	WW-10	◇	●						●	●	●	
EBCHEM	WW-11	10/02/85	WW-11	●	●					●	●	●	●	
EBCHEM	WW-12	10/02/85	WW-12	●	●					●	●	●	●	
EBCHEM	WW-13	10/02/85	WW-13	◇	◇					●	●	●	●	
EBCHEM	WW-14	10/02/85	WW-14		●					●	●		●	
EBCHEM	WW-15	10/08/85	WW-15	◇										

Figure B-4c. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EBCHEM	WW-16	10/02/85	WW-16								●	●	●	
EBCHEM	WW-17	10/03/85	WW-17							●	●	●	●	
EBCHEM	WW-18	10/03/85	WW-18								●	●	●	
EBCHEM	WW-19	10/03/85	WW-19								●	●	●	
EBCHEM	WW-20	10/03/85	WW-20								●		●	
EHCHEM	BH-01	06/01/85	B1											
EHCHEM	BH-02	06/01/85	B1											
EHCHEM	EH-01	06/01/85	B1											
EHCHEM	EH-02	06/01/85	B1											
EHCHEM	EH-03	06/01/85	V6											
EHCHEM	EH-05	06/01/85	V1							●	●	●	●	
EHCHEM	EH-06	06/01/85	V6									●		
EHCHEM	EH-08	06/01/85	V1					●	●	●	●	●	●	●
EHCHEM	EH-15	06/01/85	V1							●	●	●	●	
EHCHEM	EH-16	06/01/85	V1							●	●	●	●	
EIGHTBAY	BH-03	04/23/84	BH-03											
EIGHTBAY	BH-04	04/23/84	BH-04											
EIGHTBAY	BH-05	04/23/84	BH-05											
EIGHTBAY	BH-07	04/23/84	BH-07									●		
EIGHTBAY	BH-11	04/30/84	BH-11											
EIGHTBAY	BH-12	04/30/84	BH-12											
EIGHTBAY	BH-23	04/30/84	BH-23											
EIGHTBAY	BH-24	04/30/84	BH-24											
EIGHTBAY	CS-01	05/29/84	CS-01											
EIGHTBAY	CS-11	05/29/84	CS-11											
EIGHTBAY	CS-15	05/29/84	CS-15											
EIGHTBAY	CS-17	05/29/84	CS-17											
EIGHTBAY	DB-01	05/22/84	DB-01											
EIGHTBAY	DB-05	05/22/84	DB-05											
EIGHTBAY	DB-07	05/22/84	DB-07											
EIGHTBAY	DB-15	05/22/84	DB-15											
EIGHTBAY	EL-09	05/08/84	EL-09								●	●	●	
EIGHTBAY	EL-10	05/08/84	EL-10							●	●	●	●	
EIGHTBAY	EL-12	05/08/84	EL-12											
EIGHTBAY	EL-17	05/08/84	EL-17								●	●	●	
EIGHTBAY	EL-20	05/15/84	EL-20								●	●	●	
EIGHTBAY	EL-22	05/15/84	EL-22								●	●	●	
EIGHTBAY	EL-23	05/15/84	EL-23								●		●	
EIGHTBAY	EL-24	05/15/84	EL-24											
EIGHTBAY	EV-01	05/01/84	EV-01							●	●	●	●	
EIGHTBAY	EV-02	05/01/84	EV-02											
EIGHTBAY	EV-03	05/01/84	EV-03								●	●	●	
EIGHTBAY	EV-04	05/01/84	EV-04							●	●	●	●	
EIGHTBAY	EV-05	05/07/84	EV-05								●	●	●	
EIGHTBAY	EV-06	05/07/84	EV-06											
EIGHTBAY	EV-07	05/07/84	EV-07							●	●	●	●	
EIGHTBAY	EV-11	05/07/84	EV-11								●		●	
EIGHTBAY	SC-06	05/16/84	SC-06					●		●	●	●	●	
EIGHTBAY	SC-07	05/16/84	SC-07								●	●	●	
EIGHTBAY	SC-08	05/16/84	SC-08								●	●	●	
EIGHTBAY	SC-14	05/16/84	SC-14					●		●	●	●	●	
EIGHTBAY	SC-17	05/21/84	SC-17								●	●	●	
EIGHTBAY	SC-18	05/21/84	SC-18								●		●	
EIGHTBAY	SC-19	05/21/84	SC-19											
EIGHTBAY	SC-20	05/21/84	SC-20					●	●	●	●	●	●	●
EIGHTBAY	SM-01	04/24/84	SM-01											
EIGHTBAY	SM-03	04/24/84	SM-03											
EIGHTBAY	SM-07	04/24/84	SM-07											
EIGHTBAY	SM-20	04/24/84	SM-20											
EIGHTBAY	SQ-14	05/29/84	SQ-14											
EIGHTBAY	SQ-17	05/29/84	SQ-17											
EIGHTBAY	SQ-18	05/29/84	SQ-18											
EIGHTBAY	SQ-20	05/29/84	SQ-20											
EVCHEM	ES-01	10/06/86	ES-01G											
EVCHEM	ES-02	10/06/86	ES-02G											
EVCHEM	ES-03	10/06/86	ES-03G											
EVCHEM	EW-01	10/07/86	EW-01G											
EVCHEM	EW-04	09/30/86	EW-04G					●	●	●	●	●	●	●

Figure B-4d. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to dry weight)

				BIOLOGICAL EFFECTS				PREDICTIONS						
SURVEY	STATION	DATE	SAMPLE	AMPT	BENA	OYST	MICB	BENA	AMPT	OYST	MICB	ACR	LAET	HAET
EVCHEM	EW-07	09/30/86	EW-07G	●	●					●	●	●	●	
EVCHEM	EW-10	10/01/86	EW-10G	●	●							●		
EVCHEM	EW-12	10/01/86	EW-12G	◇	●									
EVCHEM	EW-14	10/01/86	EW-14G		●					●	●	●	●	
EVCHEM	NG-01	10/02/86	NG-01G	◇	◇									
EVCHEM	NG-02	10/02/86	NG-02G	◇	●									
EVCHEM	NG-03	10/02/86	NG-03G	◇	●									
EVCHEM	NG-04	10/02/86	NG-04G	●	●									
EVCHEM	NG-06	10/08/86	NG-06G	●	◇									
EVCHEM	NG-10	10/03/86	NG-10G	◇	◇									
EVCHEM	NG-12	10/15/86	NG-12G	◇										
EVCHEM	NG-13	10/15/86	NG-13G	◇										
EVCHEM	NG-14	10/15/86	NG-14G	◇										
EVCHEM	NG-15	10/15/86	NG-15G	◇										
EVCHEM	OG-03	10/09/86	OG-03G	●										
EVCHEM	PS-02	10/13/86	PS-02G	◇	◇									
EVCHEM	PS-03	10/13/86	PS-03G	◇	◇									
EVCHEM	PS-04	10/10/86	PS-04G	◇	◇									
EVCHEM	SD-01	10/09/86	SD-01G	◇	●									
EVCHEM	SD-02	10/07/86	SD-02G		◇									
EVCHEM	SR-01	10/06/86	SR-01G	◇										
EVCHEM	SR-02	10/06/86	SR-02G	◇										
EVCHEM	SR-04	10/06/86	SR-04G	◇										
EVCHEM	SR-07	10/03/86	SR-07G		●									
EVCHEM	SR-08	10/03/86	SR-08G	◇	●									
EVCHEM	SS-01	10/06/86	SS-01G	◇										
EVCHEM	SS-03	10/06/86	SS-03G	◇										
EVERETT1	EV-20	01/01/85	EV-20	◇								●		
EVERETT1	EV-21	01/01/85	EV-21	◇										
EVERETT1	EV-22	01/01/85	EV-22	◇										
EVERETT1	EV-23	01/01/85	EV-23	◇										
EVERETT1	EV-24	01/01/85	EV-24	●										
EVERETT1	EV-25	01/01/85	EV-25	◇										
TPPS3AB	EB-33	03/15/82	1779	●				●			●	●	●	
TPPS3AB	EB-33	07/15/82	2080	●				●		●	●	●	●	
TPPS3AB	EB-35	03/15/82	1775	●				●	●	●	●	●	●	●
TPPS3AB	EB-35	07/15/82	2079	●						●	●	●	●	
TPPS3AB	EB-36	03/15/82	1776	●				●	●	●	●	●	●	●
TPPS3AB	EB-36	07/15/82	2072	●							●	●	●	
TPPS3AB	EB-38	03/15/82	1778	◇							●	●	●	
TPPS3AB	EB-38	07/15/82	2074	●						●	●	●	●	
TPPS3AB	WP-01	07/15/82	2088	◇										
TPPS3AB	WP-02	07/15/82	2089	◇							●	●	●	
TPPS3AB	WP-03	07/15/82	2090	●										
TPPS3AB	WP-04	07/15/82	2091	◇										
TPPS3AB	WP-05	07/15/82	2092		◇									
TPPS3AB	WP-06	07/15/82	2084		◇									
TPPS3AB	WP-07	07/15/82	2093		◇									
TPPS3AB	WP-08	07/15/82	2083		●						●		●	
TPPS3AB	WP-09	07/15/82	2082		◇									
TPPS3AB	WP-10	07/15/82	2076		◇									
TPPS3AB	WP-12	03/15/82	1786		◇									
TPPS3AB	WP-12	07/15/82	2069		◇									
TPPS3AB	WP-13	03/15/82	1784		◇						●	●	●	
TPPS3AB	WP-13	07/15/82	2070		◇									
TPPS3AB	WP-14	03/15/82	1785		◇									
TPPS3AB	WP-15	03/15/82	1817		◇						●		●	
TPPS3AB	WP-15	07/15/82	2094		◇						●		●	
TPPS3AB	WP-16	03/15/82	1816		●						●		●	
TPPS3AB	WP-16	07/15/82	2086		◇									

BIOLOGICAL EFFECTS

- No biological data available
- No adverse biological effect observed ◇
- Adverse biological effect observed ●

PREDICTIONS

- No adverse biological effect predicted
- Adverse biological effect predicted ●
- No TOC data available for normalizing sediment quality valves –

Figure B-4e. Observed and predicted adverse biological effects for PCB and phenanthrene (Normalized to dry weight)

APPENDIX C

Tabular Summary of Reliability Results for Various EP, AET, and Other Modified Sediment Quality Values

TABLE C-1. RELIABILITY RESULTS FOR EP, AET, AND ACR SEDIMENT QUALITY VALUES[a] FOR ALL CHEMICALS

[normalized to dry weight (DW) or total organic carbon (TOC)]

Sediment Dataset[b]	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
Benthic Infaunal Abundance				
1989 Lower 95% C.I. EP Values (TOC)	190[c]	70% (75/107[c])	60% (75/125)	57% (108/190)
1989 Mean EP Values (TOC)	190	30% (32/107)	65% (32/49)	52% (98/190)
1989 Upper 95% C.I. EP Values (TOC)	190	13% (14/107)	93% (14/15)	51% (96/190)
1988 Lowest AET (DW)	201	92% (99/108)	64% (99/154)	68% (137/201)
1988 Lowest AET (Mixed DW/TOC)	201	96% (104/108)	64% (104/162)	69% (139/201)
1988 Puget Sound Benthic AET (DW)	201	75% (81/108)	100% (81/81)[d]	87% (174/201)
Independent Benthic AET[e] (DW)	201	75% (81/108)	72% (81/112)	71% (143/201)
1988 Benthic AET (Mixed DW/TOC)	201	77% (83/108)	100% (83/83)[d]	88% (176/201)
1988 Highest AET (DW)	201	40% (43/108)	100% (43/43)	68% (136/201)
1988 Highest AET (Mixed DW/TOC)	201	42% (45/108)	100% (45/45)	69% (138/201)
1989 ACR (DW)	201	94% (102/108)	56% (102/181)	58% (116/201)
1989 ACR (Mixed DW/TOC)	201	99% (107/108)	58% (107/186)	60% (121/201)
Amphipod Mortality Bioassay				
1989 Lower 95% C.I. EP Values (TOC)	287	63% (67/106)	44% (67/154)	56% (161/287)
1989 Mean EP Values (TOC)	287	28% (30/106)	51% (30/59)	63% (182/287)
1989 Upper 95% C.I. EP Values (TOC)	287	8% (8/106)	73% (8/11)	65% (186/287)
1988 Lowest AET (DW)	287	86% (91/106)	44% (91/206)	55% (157/287)
1988 Lowest AET (Mixed DW/TOC)	287	86% (91/106)	42% (91/218)	51% (145/287)
1988 Puget Sound Amphipod AET (DW)	287	58% (62/106)	100% (62/62)[d]	85% (243/287)
Independent Amphipod AET[e] (DW)	287	57% (60/106)	67% (60/90)	74% (211/287)
1988 Amphipod AET (Mixed DW/TOC)	287	55% (58/106)	100% (58/58)[d]	83% (239/287)
1988 Highest AET (DW)	287	43% (46/106)	100% (46/46)	79% (227/287)
1988 Highest AET (Mixed DW/TOC)	287	42% (45/106)	100% (45/45)	79% (226/287)
1989 ACR (DW)	287	96% (102/106)	41% (102/251)	47% (134/287)
1989 ACR (Mixed DW/TOC)	287	95% (101/106)	39% (101/261)	43% (122/287)

TABLE C-1. (Continued)

Sediment Dataset[a]	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
		Microtox Bioassay		
1989 Lower 95% C.I. EP Values (TOC)	50	38% (11/29)	61% (11/18)	50% (25/50)
1989 Mean EP Values (TOC)	50	14% (4/29)	67% (4/6)	46% (23/50)
1989 Upper 95% C.I. EP Values (TOC)	50	3% (1/29)	100% (1/1)	44% (22/50)
1988 Lowest AET (DW)	50	93% (27/29)	77% (27/35)	80% (40/50)
1988 Lowest AET (Mixed DW/TOC)	50	90% (26/29)	100% (26/26)	94% (47/50)
1986 Microtox AET (DW)	50	93% (27/29)	100% (27/27)[d]	96% (48/50)
Independent Microtox AET[e] (DW)	50	93% (27/29)	61% (27/44)	62% (31/50)
1986 Microtox AET (Mixed DW/TOC)	50	90% (26/29)	100% (26/26)[d]	94% (47/50)
1988 Highest AET (DW)	50	31% (9/29)	100% (9/9)	60% (30/50)
1988 Highest AET (Mixed DW/TOC)	50	31% (9/29)	100% (9/9)	60% (30/50)
1989 ACR (DW)	50	100% (29/29)	58% (29/50)	58% (29/50)
1989 ACR (Mixed DW/TOC)	50	100% (29/29)	58% (29/50)	58% (29/50)
		Oyster Larvae Abnormality		
1989 Lower 95% C.I. EP Values (TOC)	56	41% (7/17)	32% (7/22)	55% (31/56)
1989 Mean EP Values (TOC)	56	24% (4/17)	67% (4/6)	73% (41/56)
1989 Upper 95% C.I. EP Values (TOC)	56	6% (1/17)	100% (1/1)	71% (40/56)
1988 Lowest AET (DW)	56	94% (16/17)	40% (16/40)	55% (31/56)
1988 Lowest AET (Mixed DW/TOC)	56	94% (16/17)	42% (16/38)	59% (33/56)
1986 Oyster AET (DW)	56	88% (15/17)	100% (15/15)[d]	96% (54/56)
Independent Oyster AET[e] (DW)	56	88% (15/17)	37% (15/41)	50% (28/56)
1986 Oyster AET (Mixed DW/TOC)	56	82% (14/17)	100% (14/14)[d]	95% (53/56)
1988 Highest AET (DW)	56	53% (9/17)	100% (9/9)	86% (48/56)
1988 Highest AET (Mixed DW/TOC)	56	53% (9/17)	100% (9/9)	86% (48/56)
1989 ACR (DW)	56	100% (17/17)	30% (17/56)	30% (17/56)
1989 ACR (Mixed DW/TOC)	56	100% (17/17)	30% (17/56)	30% (17/56)

[a] See Table 2 for explanations of sediment quality value types.

[b] The mixed DW/TOC dataset includes TOC-normalized AET generated using 1988 data for nonionic organic compounds and dry weight-normalized AET generated for the remaining chemicals (metals and ionizable organic compounds).

[c] The number of samples evaluated for test types normalized to TOC does not include 11 benthic abundance stations from the Alki survey because no TOC data were available for these stations. One of these stations displayed a significant benthic effect, therefore the number of total impacted samples decreases by one compared with tests performed with sediment quality values normalized to sediment dry weight.

[d] By definition, efficiency is 100 percent because all nonimpacted stations in the Puget Sound database for each indicator were included in the calculation of these AET.

[e] Cumulative results for 1) deleting a station from the AET database, 2) recalculating AET using remaining stations, 3) predicting effects at deleted station, 4) restoring the deleted station to the AET database, 5) repeating for each station in the database (U.S. EPA 1988b).

TABLE C-2. RELIABILITY RESULTS FOR EP, AET, AND ACR SEDIMENT QUALITY VALUES[a] FOR PCB AND PHENANTHRENE ONLY

[normalized to total organic carbon (TOC)]

Sediment Dataset[a]	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
Benthic Infaunal Abundance				
1989 Lower 95% C.I. EP Values (TOC)	190[b]	69% (74/107[b])	61% (74/122[b])	57% (109/190)
1989 Mean EP Values (TOC)	190	29% (31/107)	65% (31/48)	52% (98/190)
1989 Upper 95% C.I. EP Values (TOC)	190	11% (12/107)	92% (12/13)	51% (96/190)
1988 Lowest AET (TOC)	190	51% (55/107)	69% (55/80)	60% (114/190)
1988 Benthic AET (TOC)	190	14% (15/107)	100% (15/15)[c]	52% (99/190)
1988 Highest AET (TOC)	190	7% (7/107)	100% (7/7)	48% (91/190)
1989 ACR (TOC)	190	52% (56/107)	68% (56/82)	59% (113/190)
Amphipod Mortality Bioassay				
1989 Mean 95% C.I. EP Values (TOC)	287	62% (66/106)	44% (66/151)	56% (162/287)
1989 Mean EP Values (TOC)	287	27% (29/106)	51% (29/57)	63% (182/287)
1989 Upper 95% C.I. EP Values (TOC)	287	6% (6/106)	75% (6/8)	64% (185/287)
1988 Lowest AET (TOC)	287	45% (48/106)	47% (48/102)	61% (175/287)
1988 Puget Sound Amphipod AET (TOC)	287	3% (3/106)	100% (3/3)[c]	64% (184/287)
1988 Highest AET (TOC)	287	3% (3/106)	100% (3/3)	64% (184/287)
1989 ACR (TOC)	287	46% (49/106)	48% (49/102)	62% (177/287)
Microtox Bioassay				
1989 Lower 95% C.I. EP Values (TOC)	50	34% (10/29)	63% (10/16)	50% (25/50)
1989 Mean EP Values (TOC)	50	14% (4/29)	67% (4/6)	46% (23/50
1989 Upper 95% C.I. EP Values (TOC)	50	3% (1/29)	100% (1/1)	44% (22/50)
1988 Lowest AET (TOC)	50	14% (4/29)	80% (4/5)	48% (24/50)
1986 Microtox AET (TOC)	50	14% (4/29)	100% (4/4)[c]	50% (25/50)
1988 Highest AET (TOC)	50	0% (0/29)	--% (0/0)	42% (21/50)
1989 ACR (TOC)	50	21% (6/29)	75% (6/8)	50% (25/50)

TABLE C-2. (Continued)

Sediment Dataset[a]	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
		Oyster Larvae Abnormality		
1989 Lower 95% C.I. EP Values (TOC)	56	29% (5/17)	26% (5/19)	54% (30/56)
1989 Mean EP Values (TOC)	56	24% (4/17)	67% (4/6)	73% (41/56)
1989 Upper 95% C.I. EP Values (TOC)	56	6% (1/17)	100% (1/1)	71% (40/56)
1988 Lowest AET (TOC)	56	18% (3/17)	60% (3/5)	71% (40/56)
1986 Oyster AET (TOC)	56	6% (1/17)	100% (1/1)[b]	71% (40/56)
1988 Highest AET (TOC)	56	0% (0/17)	--% (0/0)	71% (39/56)
1989 ACR (TOC)	56	29% (5/17)	63% (5/8)	73% (41/56)

[a] See Table 2 for explanations of sediment quality value types.

[b] The number of samples evaluated for test types normalized to TOC does not include 11 benthic abundance stations from the Alki survey because no TOC data were available for these stations. One of these stations displayed a significant benthic effect, therefore the number of total impacted samples decreases by one compared with test performed with sediment quality values normalized to sediment dry weight.

[c] By definition, efficiency is 100 percent because all Puget Sound stations for each indicator were included in the calculation of these AET.

TABLE C-3. RELIABILITY RESULTS FOR AET AND ACR SEDIMENT QUALITY VALUES[a] FOR PCB AND PHENANTHRENE ONLY

[normalized to dry weight (DW)]

Sediment Dataset[a]	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
		Benthic Infaunal Abundance		
1988 Lowest AET (DW)	201	64% (69/108)	75% (69/92)	69% (139/201)
1988 Benthic AET (DW)	201	23% (25/108)	100% (25/25)[b]	59% (118/201)
1988 Highest AET (DW)	201	10% (11/108)	100% (11/11)	52% (104/201)
1989 ACR (DW)	201	63% (68/108)	74% (68/92)	68% (137/201)
		Amphipod Mortality Bioassay		
1988 Lowest AET (DW)	287	60% (64/106)	50% (64/129)	63% (180/287)
1988 Amphipod AET (DW)	287	11% (12/106)	100% (12/12)[b]	67% (193/287)
1988 Highest AET (DW)	287	11% (12/106)	100% (12/12)	67% (193/287)
1989 ACR (DW)	287	58% (62/106)	49% (62/127)	62% (178/287)
		Microtox Bioassay		
1988 Lowest AET (DW)	50	31% (9/29)	100% (9/9)	60% (30/50)
1988 Microtox AET (DW)	50	31% (9/29)	100% (9/9)[b]	60% (30/50)
1988 Highest AET (DW)	50	3% (1/29)	100% (1/1)	44% (22/50)
1989 ACR (DW)	50	38% (11/29)	65% (11/17)	52% (26/50)
		Oyster Larvae Abnormality		
1988 Lowest AET (DW)	56	35% (6/17)	67% (6/9)	75% (42/56)
1988 Oyster AET (DW)	56	24% (4/17)	100% (4/4)[b]	77% (43/56)
1988 Highest AET (DW)	56	6% (1/17)	100% (1/1)	71% (40/56)
1989 ACR (DW)	56	47% (8/17)	44% (8/18)	66% (37/56)

[a] See Table 2 for explanations of sediment quality value types.

[b] By definition, efficiency is 100 percent because all Puget Sound stations for each indicator were included in the calculation of these AET.

TABLE C-4. RELIABILITY RESULTS FOR POOLED BIOLOGICAL EFFECTS[a] FOR EP, AET, AND ACR SEDIMENT QUALITY VALUES[b] FOR ALL CHEMICALS

[normalized to dry weight (DW) or total organic carbon (TOC)]

Sediment Quality Value Type	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
1989 Lower 95% C.I. EP Values (TOC)	314[c]	61% (106/175[c])	59% (106/180)	54% (171/314)
1989 Mean EP Values (TOC)	314	25% (44/175)	57% (44/77)	48% (150/314)
1989 Higher 95% C.I. EP Values (TOC)	314	8% (14/175)	88% (14/16)	48% (151/314)
1988 Lowest AET (DW)	325	85% (150/176)	63% (150/240)	64% (209/325)
1988 Lowest AET (Mixed DW/TOC)	325	88% (154/176)	61% (154/252)	63% (205/325)
1988 Benthic AET (DW)	325	50% (88/176)	91% (88/97)	70% (228/325)
1988 Benthic AET (Mixed DW/TOC)	325	63% (110/176)	71% (110/154)	66% (215/325)
1988 Amphipod AET (DW)	325	39% (68/176)	99% (68/69)	66% (216/325)
1988 Amphipod AET (Mixed DW/TOC)	325	42% (74/176)	80% (74/92)	63% (205/325)
1986 Microtox AET (DW)	325	81% (143/176)	62% (143/230)	63% (205/325)
1986 Microtox AET (Mixed DW/TOC)	325	83% (146/176)	62% (146/236)	63% (205/325)
1986 Oyster AET (DW)	325	67% (118/176)	69% (118/171)	66% (214/325)
1986 Oyster AET (Mixed DW/TOC)	325	67% (118/176)	66% (118/180)	63% (205/325)
1988 Highest AET (DW)	325	32% (57/176)	100% (57/57)	63% (206/325)
1988 Highest AET (Mixed DW/TOC)	325	33% (58/176)	100% (58/58)	64% (207/325)
1989 ACR (DW)	325	94% (166/176)	58% (166/287)	60% (194/325)
1989 ACR (Mixed DW/TOC)	325	97% (171/176)	58% (171/297)	60% (194/325)

[a] A station with significant adverse effects for any one of the four biological indicators was considered an impacted station. If all of the biological indicators tested at a station did not display significant effects, then the station was considered nonimpacted.

[b] See Table 2 for explanations of different sediment quality value types.

[c] The number of samples evaluated for test types normalized to TOC does not include 11 benthic abundance stations from the Alki survey because no TOC data were available for these stations. One of these stations displayed a significant benthic effect, therefore the number of total impacted samples decreases by one compared with tests performed with sediment quality values normalized to sediment dry weight.

TABLE C-5. RELIABILITY RESULTS FOR POOLED BIOLOGICAL EFFECTS[a] FOR EP, AET, AND ACR SEDIMENT QUALITY VALUES[b] FOR PCB AND PHENANTHRENE ONLY

[normalized to dry weight (DW) or total organic carbon (TOC)]

Sediment Quality Value Type	Number of Samples Evaluated	Sensitivity	Efficiency	Overall Reliability
1989 Lower 95% C.I. EP Values (TOC)	314[c]	78% (137/175[c])	57% (137/241)	55% (172/314)
1989 Mean EP Values (TOC)	314	24% (42/175)	56% (42/75)	47% (148/314)
1989 Higher 95% C.I. EP Values (TOC)	314	7% (13/175)	93% (13/14)	48% (151/314)
1988 Lowest AET (DW)	325	56% (99/176)	67% (99/147)	62% (200/325)
1988 Lowest AET (TOC)	314	43% (76/175)	59% (76/128)	52% (163/314)
1988 Benthic AET (DW)	325	18% (32/176)	84% (32/38)	54% (175/325)
1988 Benthic AET (TOC)	314	11% (19/175)	73% (19/26)	48% (151/314)
1988 Amphipod AET (DW)	325	8% (14/176)	100% (14/14)	50% (163/325)
1988 Amphipod AET (TOC)	314	5% (8/175)	100% (8/8)	47% (147/314)
1986 Microtox AET (DW)	325	56% (99/176)	67% (99/147)	62% (200/325)
1986 Microtox AET (TOC)	314	39% (69/175)	59% (69/117)	51% (160/314)
1986 Oyster AET (DW)	325	30% (53/176)	80% (53/66)	58% (189/325)
1986 Oyster AET (TOC)	314	9% (16/175)	62% (16/26)	46% (145/314)
1988 Highest AET (DW)	325	8% (14/176)	100% (14/14)	50% (163/325)
1988 Highest AET (TOC)	314	5% (8/175)	100% (8/8)	47% (147/314)
1989 ACR (DW)	325	55% (96/176)	68% (96/141)	62% (200/325)
1989 ACR (TOC)	314	42% (74/175)	59% (74/125)	52% (162/314)

[a] A station with significant effects for any one of the four biological indicators was considered an impacted station. If all of the biological indicators tested at a station did not display significant effects, then the station was considered nonimpacted.

[b] See Table 2 for explanations of different sediment quality value types.

[c] The number of samples evaluated for test types normalized to TOC does not include 11 benthic abundance stations from the Alki survey because no TOC data were available for these stations. One of these stations displayed a significant benthic effect, therefore the number of total impacted samples decreases by one compared with tests performed with sediment quality values normalized to sediment dry weight.