97-e02

DEPARTMENT OF ECOLOGY

August 26, 1997

TO: Jay Manning, AG DIV and Carl Nuechterlein, ERO

FROM: Brad Hopkins and Art Johnson, EILS

SUBJECT: METAL CONCENTRATIONS IN THE SPOKANE RIVER DURING SPRING 1997

(Waterbody Numbers WA-54-1010, WA-54-1020, WA-57-1010)

Summary

During the unusually high flows experienced in the Spokane River in April - June 1997, dissolved zinc and dissolved lead consistently exceeded EPA 1995 water quality criteria by factors of 2 to 6, from above the stateline in Idaho (river mile 98 7) to Riverside State Park (river mile 66 2) The zinc and lead criteria were also exceeded in a sample collected below Long Lake (river mile 33 3) Dissolved cadmium slightly exceeded criteria at the stateline Dissolved copper was not above criteria The 1995 EPA criteria will replace current state standards in November of this year

The levels of lead, 1 38 - 2 69 ug/L (parts per billion), were higher than all but two measurements since Ecology began monitoring dissolved metals in the river in 1992 The zinc and cadmium levels (42 0 - 119 ug/L and 0 120 - 0 440 ug/L, respectively) are similar to what has been found from previous sampling during the high flow season

Metal concentrations at the stateline were indistinguishable from those measured 2 5 miles upstream in Idaho and comparable to concentrations measured at Post Falls by the U S Geological Survey (USGS), showing the source of contamination is in Idaho The concentrations of dissolved zinc, lead, and cadmium in the Spokane River are 1 to 2 orders of magnitude (i e , factors of 10 -100) higher than other major rivers in Washington The Spokane is the only major river in the state known to exceed water quality criteria for metals

A comparison of results from quarter point and bank sampling demonstrated that the data obtained with the bridge sampling methods used by Ecology's Ambient Monitoring Program are not subject to contamination and are representative of dissolved metals concentrations in the river

Introduction

In response to your request, we obtained data on dissolved zinc, lead, cadmium, and copper in the Spokane River during the unusually high flow conditions that occurred this spring. The objectives of the sampling program were:

1. Increase the amount of data Ecology had on metal concentrations during extreme high flows, when worst-case violations of standards would be expected.
2. Evaluate the potential for contamination due to sampling from bridges
3. Compare results from single, center channel grab samples to results from cross sectional samples.
4. Measure ratios of lead isotopes for possible use in source tracing

Objectives 2 and 3 were in response to questions raised by the Northwest Mining Association in reviewing Ecology's recommendations for Total Maximum Daily Loads (TMDL) for zinc, lead, and cadmium in the Spokane River (Pelletier, 1994). The TMDL study and Ecology's ongoing Ambient Monitoring Program for metals both rely heavily on sampling at bridges. The findings on lead isotopes, Objective 4, will be described in a separate report.

Study Design

The Ambient Monitoring Program has been analyzing dissolved metals in the Spokane River at the Stateline Bridge every other month since 1994 and monthly since February 1997. The river was also monitored at Riverside State Park from October 1995 to August 1996. For the 1997 high flow study, the routine sampling scheduled for the stateline on April, May and June was expanded to include additional sites in the river and supplemented by more intensive sampling in May. Five stations were monitored (Figure 1, Table 1).

In each instance, surface grabs were collected for analysis of dissolved zinc, lead, cadmium, and copper, and for hardness. Copper has not been a water quality problem in the Spokane, but was requested, along with an additional sampling site (T. J. Meenach Bridge) by the Eastern Regional Office. Bridge samples were collected with a closed-open-closed sampler developed by the Ambient Monitoring Program (Hopkins, 1995). Bank samples were collected by hand. Ultra-clean sampling techniques and low-level analytical methods were used.

The bank sampling above Stateline Bridge and in Idaho on May 12 and May 20 provided data to assesses if bridge sampling was a source of contamination. The Stateline Bridge samples of May 12 were collected on a quarter point transect to evaluate the representativeness of the center point samples routinely collected by Ambient

The May 12 and May 20 bank samples (including Riverside State Park) were collected using new, nontalc, nitrile gloves and filtered in a glove box constructed of a PVC frame and polyethylene cover (EPA, 1995) These additional measures, not used for routine Ambient samples, were intended to obviate any remaining concerns that the bank samples could have been contaminated in the field Field quality assurance (QA) samples for this study consisted of bottle blanks, transfer blanks*, filter blanks, and split samples (submitted blind)

Field and Laboratory Methods

Details of the field methods used for metals by the Ambient Monitoring Program are described in Hopkins (1995) Water samples for metals determination were collected directly into pre-cleaned 500 mL teflon bottles For bridge sampling, a teflon bottle was placed in the above-mentioned sampling device with the bottle lid closed The sampler was then lowered to the water surface and allowed to orient with the current so the bottle faced upstream Once submerged, the sampler automatically opens the bottle and then closes it on being lifted out of the water Hardness samples were taken with a separate bottle attached to the sampler, then transferred to 124 mL polyethylene bottles, containing nitric acid as a preservative Bank samples for metals were collected by facing upstream and submerging the sample bottle top first, then righting to fill

Water samples for dissolved metals were vacuum-filtered in the field through a disposable 0 45 um cellulose nitrate filter ((#450-0045, type S) The filtrate was transferred to a clean teflon bottle and preserved to pH <2 with 5 mL sub-boiled 1:1 nitric acid, carried in small teflon vials, one per sample The sample bottles were labeled, double bagged in polyethylene, and placed on ice for transport to Manchester Laboratory Chain of custody was maintained

The teflon bottles, vials, and filter units were pre-cleaned for low-level metals analysis by Manchester; details of the procedures are described by Kammin et al (1995) Briefly, the bottles and vials are soaked in 1:1 nitric acid for 72 hours and rinsed with deionized (DI) water The cleaned bottles are filled with DI water and placed in zip-lock bags The filters are cleaned by allowing 1:1 nitric acid to gravity filter, then vacuum filtering 500 mL of DI water The unit is taken apart, air-dried, reassembled, filter lids secured with tape, and placed in zip-lock bags

*blank water poured between sample containers in the field (intended to mimic the bank sampling procedure)

Metals were analyzed at the Manchester Environmental Laboratory by EPA method 200 8, using a PE-Sciex, ELAN 6000 state-of-the-art ICP-MS (Inductively Coupled Plasma - Mass Spectrometer) Total hardness was determined by Manchester using Standard Methods no 2340B

For dissolved metals analysis, 10 mL of sample is placed into a pre-rinsed plastic sample tube, 20 uL of internal standard solution is mixed with the sample, and the solution placed in a covered autosample tray to await injection into the ICP-MS Once the instrument has passed its daily performance check, it is standardized using a blank and four standards ranging from 2 - 100 ug/L in concentration Each of three replicate analyses performed on the samples and QC consists of 21 separate measurements at each monitored mass' peak

Internal standards are used throughout the analysis to correct for instrument drift If the response varies by more than 25%, samples are either diluted or re-analyzed, or a different internal standard is used Check standards are analyzed at a frequency of 10% and the analysis results rejected if different from the standards by more than 10% Samples are spiked to check for matrix interferences When possible, at least two isotopes are monitored for each analyte

Quality of the Data

All analyses were performed within the EPA Contract Laboratory Program (CLP) holding time for the metals of interest (180 days) Instrument calibration was performed before each analytical run and checked by initial calibration verification standards and blanks Continuing calibration standards and blanks were analyzed at a frequency of 10% during the run and again at the end of the run All initial and continuing calibration verification standards were within relevant CLP control limits

Procedural blanks associated with these samples showed no analytically significant levels of metals Spiked and duplicate spiked sample analyses were performed with each data set All recoveries were within the CLP acceptance limits of +/-25% The results from duplicate spikes and laboratory duplicate sample analyses were within the 20% CLP acceptance window

Analysis of field QA samples (see Results, Table 2) showed no significant levels of metals in the transfer blank or the three filter blanks Results on split samples were in close agreement One of the two bottle blanks analyzed had 0 370 ug/L of copper, a significant amount relative to the concentrations in the field samples Because of the good results achieved on all other QA samples and the close agreement among multiple determinations of copper concentrations in the river, it does not appear that the copper data were compromised The same bottle blank had 8 79 ug/L of zinc and 0 021 ug/L, but these concentrations are not significant compared to results on field samples (EPA five-times rule)

Results and Discussion

River Flows

Washington Water Power reports the following flows for the Spokane River @ Post Falls, Idaho on sampling dates for Ecology's spring 1997 metals study (Gary Stockenger, personal communication):

April 8 - 13,150 cfs
May 6 - 29,960 cfs
May 12 - 31,210 cfs
May 20 - 40,560 cfs
June 3 - 28,080 cfs

According to Mr. Stockenger, flows in the Spokane typically peak during the third week of April at about 26,000 cfs. The runoff during spring 1997 was 170% of normal and the third highest on record (1903).

Concentrations Found

Twenty-one Spokane River water samples were analyzed for the study. The results are shown in Table 2.

Dissolved metal concentrations ranged from 42.0 - 119 ug/L for zinc, 1.38 - 2.69 ug/L for lead, 0.120 - 0.440 ug/L for cadmium, and 0.549 - 0.860 ug/L for copper. An analysis for total recoverable metals, conducted on selected samples from Stateline Bridge, indicated that most of the zinc and cadmium in the river was dissolved (an average of 80% and 71%, respectively), but that most of the lead (an average of 79%) was in particulate form (Appendix A).

Except for the high concentration of zinc on April 8, the level of dissolved metals in the river did not change appreciably over the three-month monitoring period. Only modest decreases in concentrations were observed over the 30 miles between the stateline and Riverside State Park. There may have been some attenuation of zinc, lead, and cadmium through Long Lake, based on a single sample below Long Lake Dam collected May 12.

Metal concentrations on the Idaho side of the stateline, measured on May 12 and 20, were indistinguishable from those at Stateline Bridge. USGS analyzed dissolved metals in the Spokane River @ Post Falls on May 22, 1997 and found 63.6 ug/L of zinc, 2.99 ug/L of lead, and < 1 ug/L of cadmium (Paul Woods, USGS Idaho, personal communication). These findings clearly support the conclusion that the source of contamination is in Idaho.

Violations of Water Quality Standards

Table 2 shows relevant EPA (1995) aquatic life criteria for dissolved metals. These will replace the current state surface water quality standards (WAC 173-201A) in November 1997 (Mark Hicks, Ecology HQ, personal communication) There are two sets of criteria for each metal; acute criteria for short periods of exposure (1-hour average) and lower, chronic criteria for extended exposure (4 days) The criteria for zinc, lead, cadmium, and copper vary with hardness. Other things being equal, the higher the hardness the lower the potential for metals toxicity, due to the complexing action of dissolved salts. Table 2 lists either the acute or chronic criteria values, depending on which was exceeded

During the spring of 1997, all zinc and lead concentrations measured in the Spokane River, from above the stateline to below Long Lake, exceeded EPA criteria for protecting aquatic life. Zinc generally exceeded the acute criterion by a factor of 2, and lead exceeded the chronic criterion by factors of 3 to 6. Fewer exceedances were noted for cadmium and these were restricted to the upper river where the chronic criterion was violated on three of five occasions at the stateline. Copper was never above criteria Figure 2 illustrates the magnitude and frequency with which criteria were exceeded (results from bank, quarter point, and split samples averaged for each sampling date and location).

Previous Spokane River Data

Figures 3 and 4 plot the dissolved zinc, lead, cadmium and copper data for Stateline Bridge available through the Ambient Monitoring Program beginning in May 1994. The EPA acute and chronic criteria for the hardness conditions at time of sample collection are also shown. Appendix B has the complete data

The lead results for spring 1997 stand out as being higher than all but two measurements (1 64 ug/L and 3 87 ug/L) during the previous three years The Ambient data indicate an extended period of substantially elevated lead concentrations also occurred during the spring of 1996 The levels of zinc, cadmium, and copper seen in 1997 were not particularly high compared to the historical record

Earlier data collected by Pelletier (1994) from July 1992 through September 1993 fit the patterns shown in Figures 3 and 4. He observed that water quality criteria were not met between the stateline and Riverside State Park (furthest downstream sample site) for dissolved zinc during both high and low flow seasons, and for dissolved lead during the high flow season. Cadmium criteria were exceeded at high flow in the upper river only Proceeding downstream from the stateline, concentrations generally decrease relative to criteria, mainly due to increasing hardness.

Relationship to Flow

Figures 5 through 8 illustrate how metals concentrations at Stateline Bridge vary with river flow (May 1994 - June 1997 data). Zinc, lead, cadmium, and copper all increase with increasing runoff, over the range of flow normally encountered in the river. Lead continues to increase at extreme high flow, but there appears to be some dilution of zinc, cadmium, and copper sources. This spring USGS observed substantial erosion of fine, lead-rich material into Lake Coeur d'Alene, resulting in high concentrations of colloidal (finely suspended) lead in the lake; zinc sources were characterized as being more diffuse than lead (Paul Woods, personal communication). This is one possible explanation for the flow-related differences in occurrence of these two metals.

Comparison with Other Washington Rivers

The metals concentrations found in the Spokane River do not occur in any other major river in Washington State. Table 3 summarizes data from rivers monitored by the Ambient Program over the past three years. Concentrations of dissolved zinc, lead, and cadmium in the Spokane River @ Stateline Bridge (as well as further downstream at least to Riverside State Park) are 1 to 2 orders of magnitude higher than 21 other rivers recently sampled. More limited data on other eastern Washington rivers, such as the Yakima, Sanpoil, Colville, Okanogan, and Walla Walla, also show metals concentrations to be low (Johnson, 1994; Johnson, 1996; Johnson et al., 1988; Ambient Monitoring Program, unpublished data). Copper concentrations in the Spokane are similar to other rivers.

With the lone exception of the Columbia River @ Northport, prior to corrective actions taken at upstream industry in British Columbia, no violations of water quality criteria for metals have been detected in any of the rivers mentioned above.

Accuracy of Bridge Sampling Data

Table 4 summarizes data obtained from the comparative bridge and bank sampling on May 12. There were no significant differences (Mann-Whitney, $p<0.05$) in the concentrations of zinc, lead, cadmium, or copper measured from Stateline Bridge compared to samples collected above the bridge. These results are consistent with findings from a previous Ecology study in western Washington that showed the bridge sampling methods used by the Ambient Monitoring Program do not introduce contamination in the samples (Hopkins, 1995).

Results from quarter point bridge sampling demonstrate the river is well-mixed laterally with respect to dissolved metals. Concentrations measured at the center of Stateline Bridge varied from those on either side by less than 5% for zinc and lead, less than 1% for cadmium, and less than 14% for copper. This type of variability is comparable to what was found in split samples.

Similar close agreement was seen in right and left right bank samples collected 2.5 miles upstream in Idaho. The previously mentioned USGS results for May 22 -- which are based on width- and depth-integrated sampling -- provide additional evidence that Ambient's center point bridge data are representative of dissolved metal concentrations in the Spokane River.

Acknowledgments

Samples for this study were analyzed by Manchester Laboratory's Jim Ross, Randy Knox, and Sally Cull; director Bill Kammin. Dave Hallock and Dale Clark of the Ambient Program collected the samples of April 8, May 6, and June 3. Ambient's Bill Ehinger prepared Figures 3 and 4. Greg Pelletier, Watershed Assessments Section, advised on sampling design. This report was reviewed by Greg Pelletier, Larry Goldstein, Dale Norton, and Bill Yake. We appreciate the good work of all these people.

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cc: Tony Grover, Fritz Clarke, Mary McCrae, Ken Merrill, Jani Gilbert, Ken Dzinbal, Larry Goldstein, Greg Pelletier, Dave Hallock, Dale Clark, Jim Cubbage

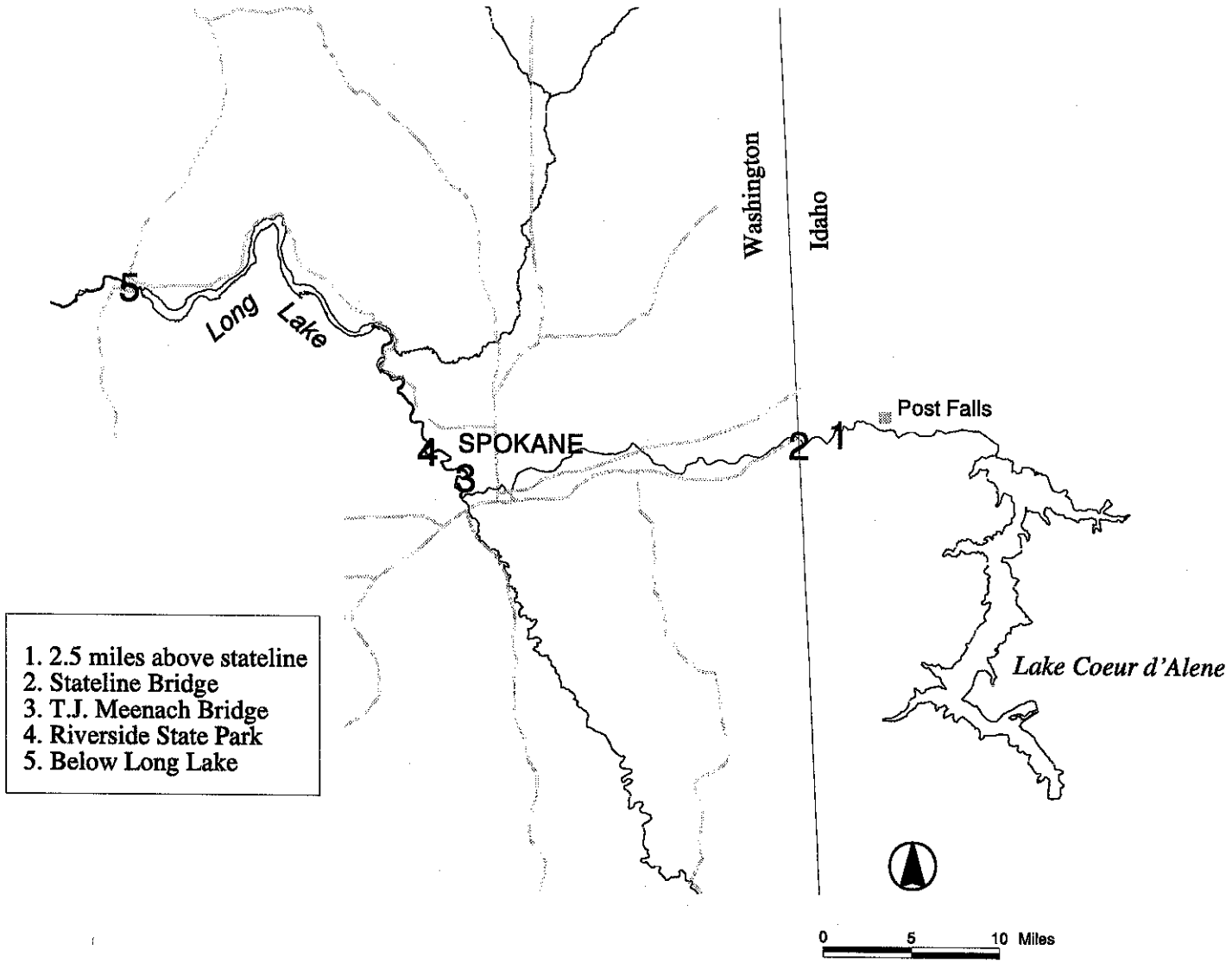

Figure 1. Location of Ecology Spokane River Spring 1997 Samples

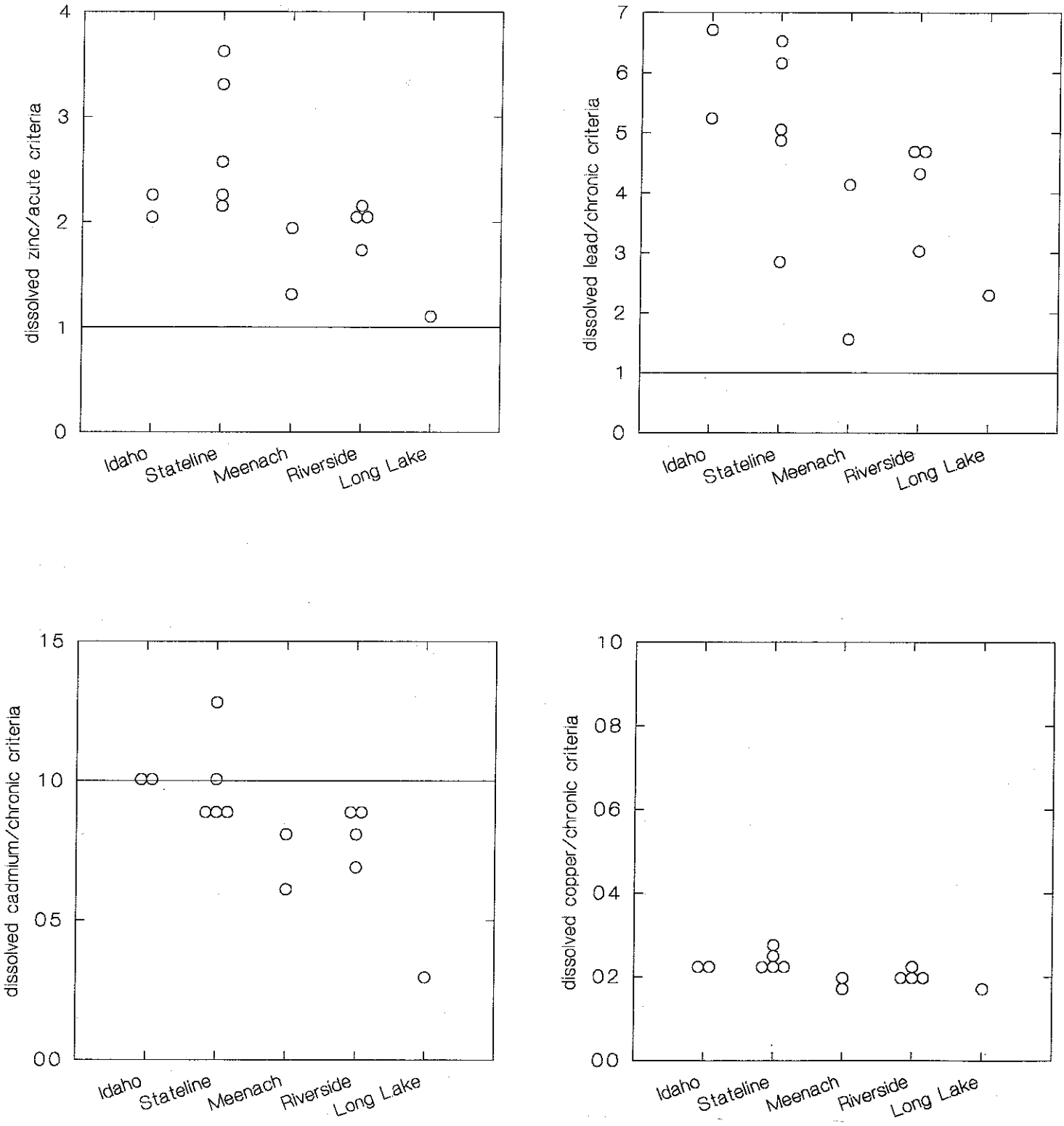

Figure 2 Exceedances of Water Quality Criteria in the Spokane River, April - June 1997

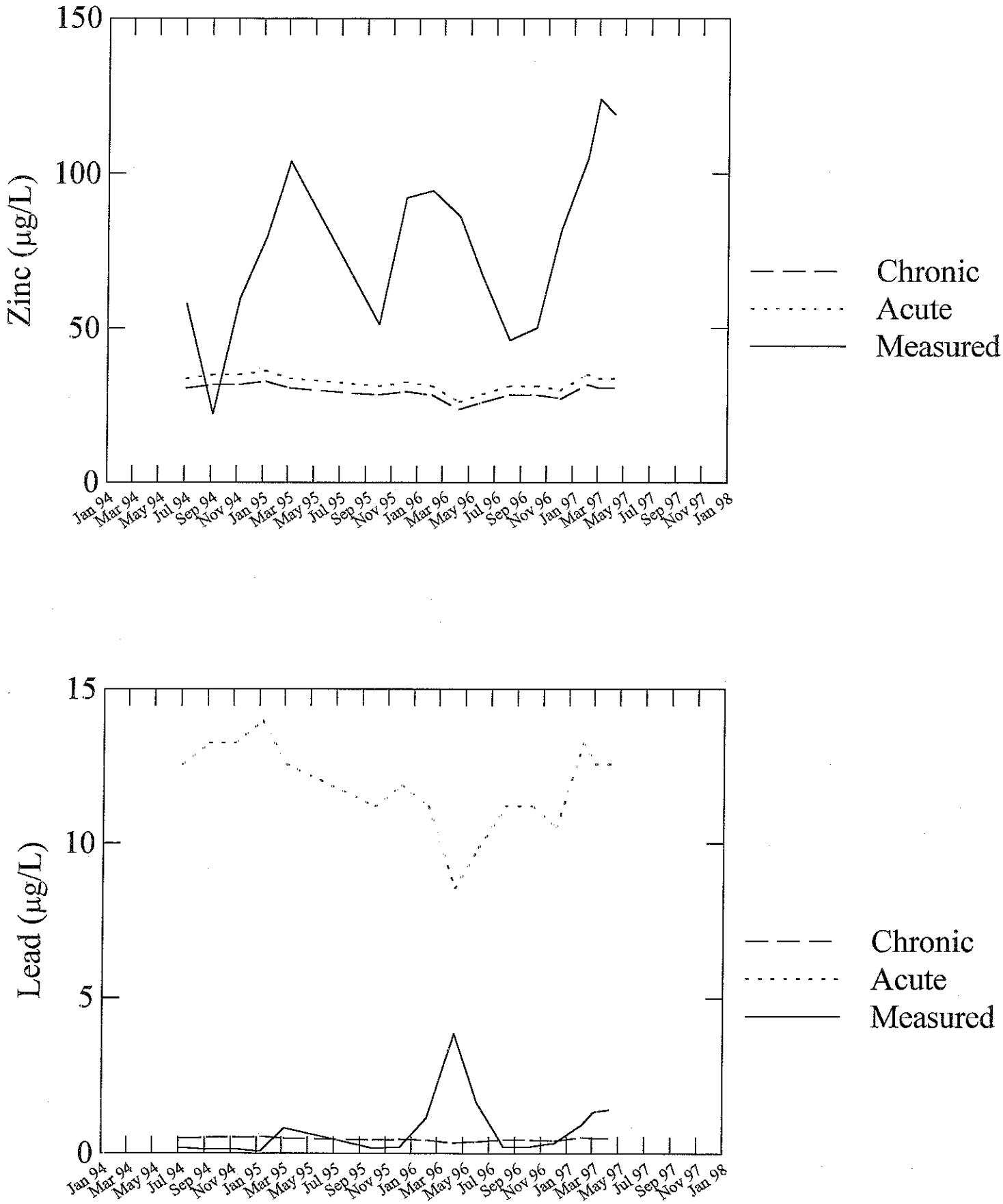

Figure 3 Dissolved Zinc and Lead Concentrations in the Spokane River @ Stateline Bridge, May 1994 - April 1977 (showing EPA water quality criteria)

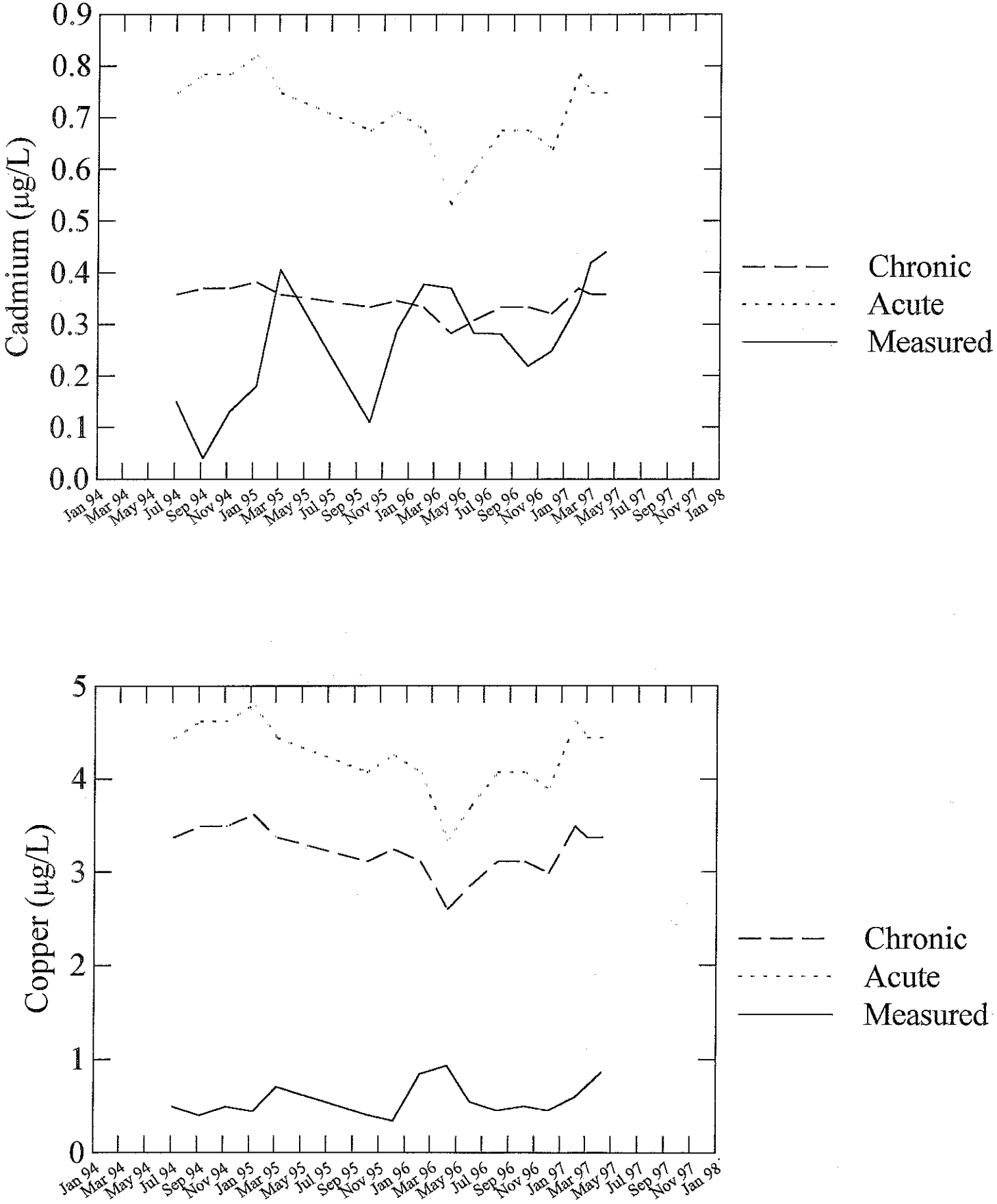

Figure 4 Dissolved Cadmium and Copper Concentrations in the Spokane River @ Stateline Bridge, May 1994 - April 1997 (showing EPA water quality criteria)

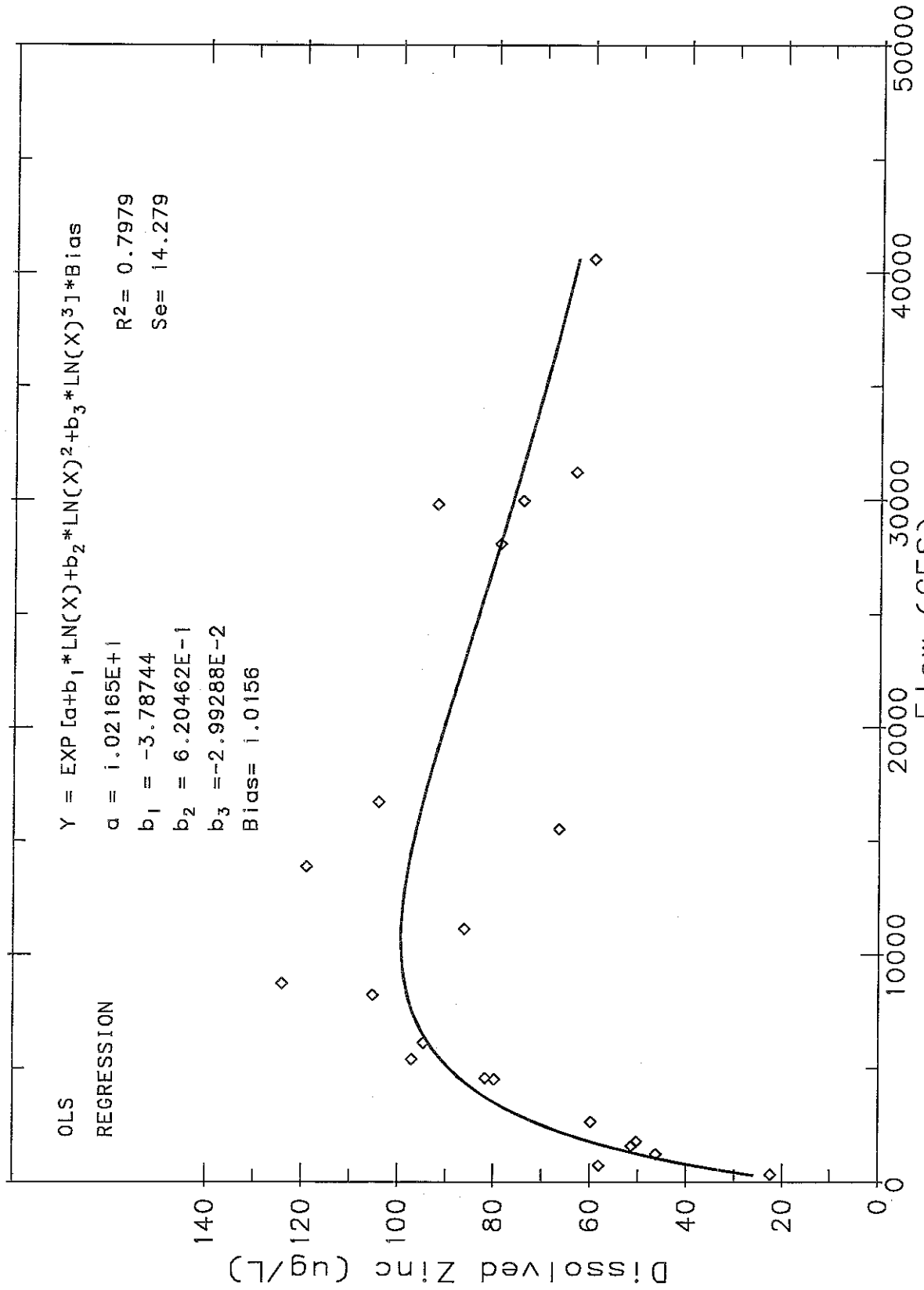

Figure 5. Dissolved Zinc vs. Flow, Spokane River @ Stateline Bridge, May 1994 - June 1997

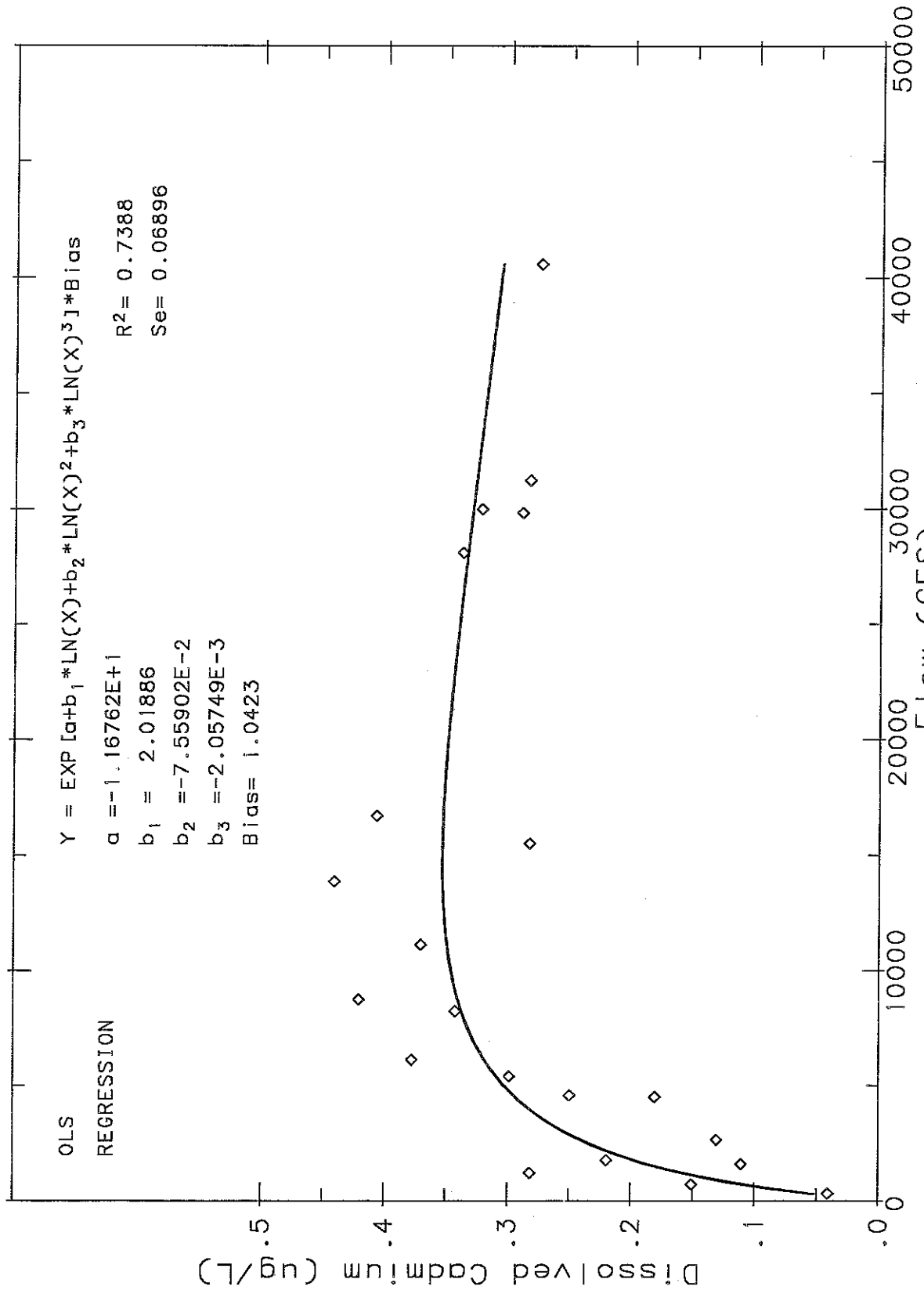

Figure 7. Dissolved Cadmium vs Flow, Spokane River @ Stateline Bridge, May 1994 - June 1997

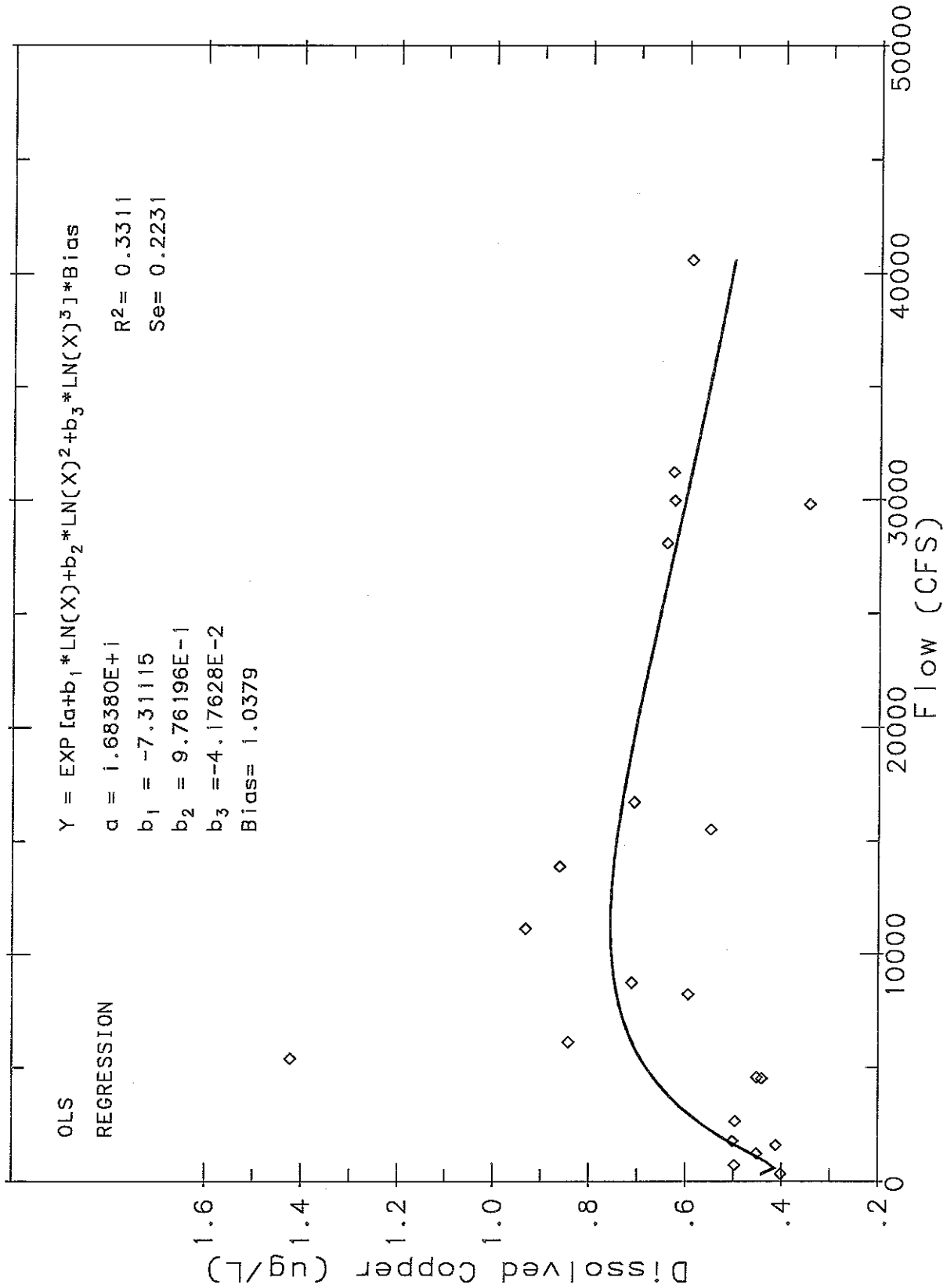

Figure 8 Dissolved Copper vs Flow, Spokane River @ Stateline Bridge, May 1994 - June 1997

Table 1.Ecology Spokane River Sampling Locations, Spring 1997

Location	River Mile	Sample Type	Sampling Date(s) 4/8	5/6	5/12	5/20	6/3
Idaho,approximately 2 5 miles above stateline, @ Pleasant View Road	98 7	right & left bank*			x	x	
Stateline, approximately 0 1 miles above Stateline Bridge	96 1	right bank			x	x	
Stateline Bridge, @ Stateline Village Road	96 0	bridge	x	x	x		x
T J Meenach Bridge, Ft George Wright Drive	69 8	bridge			x		x
Riverside State Park above Bowl & Pitcher foot bridge	66 2	right bank		x	x	x	x
Below Long Lake Dam, @ Highway 231 bridge	33 3	bridge			x		

*facing downstream

Table 2. Ecology Spokane River Metals Data, April - June 1997

Date	Location	Sample Number	Hardness (mg/L)	Dissolved Metals (ug/L)				EPA 1995 Water Quality Criteria (ug/L)			
				Zinc	Lead	Cadmium	Copper	Zinc (acute)	Lead (chronic)	Cadmium (chronic)	Copper (chronic)
8-Apr	Stateline Bridge - center	156172	23.2	**119**	**1.41**	**0.440**	**0.860**	33	0.50	0.35	3.3
	filter blank	156175	- -	0.53	< 0.02	< 0.02	< 0.05				
6-May	Stateline Bridge - center	196172	20.3	**74.5**	**2.69**	**0.318**	**0.632**	29	0.42	0.31	2.9
	field split of above sample	196174	20.0	**74.1**	**2.50**	**0.326**	**0.617**	29	0.42	0.31	2.9
	Riverside State Park - right bank	196177	25.1	**73.9**	**2.47**	**0.307**	**0.659**	35	0.54	0.37	3.5
	filter blank	196176	- -	0.25	< 0.02	< 0.02	< 0.05				
	bottle blank	196175	- -	< 0.2	< 0.02	< 0.02	< 0.05				
12-May	2.5 mi. above stateline - right bank	208085	19.0	**61.8**	**2.01**	**0.283**	**0.549**	28	0.40	0.30	2.8
	2.5 mi. above stateline - left bank	208084	18.3	**63.7**	**2.01**	**0.278**	**0.599**	27	0.37	0.29	2.6
	Stateline - right bank, above bridge	208083	18.8	**62.7**	**1.97**	**0.283**	**0.610**	28	0.40	0.30	2.8
	Stateline Bridge - right	208080	18.8	**64.8**	**1.89**	**0.282**	**0.580**	28	0.40	0.30	2.8
	Stateline Bridge - center	208081	19.3	**61.0**	**1.93**	**0.275**	**0.576**	28	0.40	0.30	2.8
	lab split of above sample	208090	18.4	**62.7**	**1.93**	**0.289**	**0.740**	27	0.37	0.29	2.6
	Stateline Bridge - left	208082	18.9	**63.9**	**1.99**	**0.284**	**0.658**	28	0.40	0.30	2.8
	T.J. Meenach Bridge - center	208086	22.4	**61.3**	**1.93**	**0.282**	**0.636**	32	0.47	0.34	3.1
	Riverside State Park - right bank	208087	23.4	**61.3**	**1.84**	**0.281**	**0.628**	33	0.50	0.35	3.3
	lab split of above sample	208093	18.4	**59.9**	**1.87**	**0.289**	**0.570**	27	0.37	0.29	2.6
	Bridge bw. Long Lk. Dam - center	208089	27.8	**42.0**	**1.38**	**0.120**	**0.653**	39	0.61	0.40	3.8
	filter blank	208091	- -	0.78	< 0.02	< 0.02	< 0.05				
	transfer blank	208094	- -	< 0.2	< 0.02	< 0.02	< 0.05				
	bottle blank	208092	- -	8.79	0.021	< 0.02	0.370				
20-May	2.5 mi. above stateline - right bank	218005	18.3	**58.0**	**2.47**	**0.277**	**0.582**	27	0.37	0.29	2.6
	Stateline - right bank, above bridge	218006	18.2	**59.9**	**2.41**	**0.275**	**0.591**	27	0.37	0.29	2.6
	Riverside State Park- right bank	218008	21.6	**54.2**	**2.17**	**0.250**	**0.728**	32	0.47	0.34	3.1
3-Jun	Stateline Bridge - center	236172	16.3	**78.9**	**1.65**	**0.337**	**0.640**	24	0.33	0.27	2.4
	T.J. Meenach Bridge - center	236177	38.0	**67.2**	**1.41**	**0.288**	**0.771**	50	0.87	0.50	5.0
	Riverside State Park - right bank	236176	24.0	**72.1**	**1.51**	**0.310**	**0.608**	33	0.50	0.35	3.3

Table 3. Metal Concentrations in the Spokane River Compared to Other Washington Rivers
(Source: Ecology Ambient Monitoring Program)

Location	Period of Record (n=)	Dissolved Metals (ug/L) Zinc median (90th percentile)	Lead median (90th percentile)	Cadmium median (90th percentile)	Copper median (90th percentile)
Spokane River @ Stateline Bridge	5/94-4/97 (17)	78 9 (116)	0 82 (2 56)	0 283 (0 420)	0 59 (0 92)
Columbia River @ Northport	5/94-4/97 (17)	3 0 (4 4)	0 10 (0 31)	0 049 (0 084)	1 16 (1 72)
Columbia River @ Vernita	10/95-4/97 (10)	3 2 (6 5)	0 06 (0 21)	0 04 (0 075)	0 92 (1 21)
Similkameen River @ Oroville	10/95-4/97 (9)	1 1 (5 0)	0 03 (0 72)	0 022 (0 077)	0 97 (5 21)
Western Washington Rivers (18)	1994-97 (94)	1 2 (5 0)	0 03 (0 12)	0 03 (0 04)	0 74 (1 28)

Table 4. Bank vs. Bridge Sampling, Spokane River, May 12, 1997 (mean+/-2 standard deviations)

Sample Location	Sample Type	N =	Dissolved Metals (ug/L) Zinc	Lead	Cadmium	Copper
Above Stateline Bridge	Right and left bank	3	62 7+/-1 9	2 00+/- 05	281+/- 006	586+/- 065
Stateline Bridge	Quarter points	3	63 5+/-3 1	1 94+/- 10	283+/- 002	632+/- 090

Appendix A. Total Recoverable Metals Data for Ecology Spring 1997 Spokane River Samples

Date	Location	Sample Number	Hardness (mg/L)	Total Recoverable Metals (ug/L)			
				Zinc	Lead	Cadmium	Copper
6-May	Stateline Bridge - center	196172	20.3	**87.4**	**12.3**	**0.45**	na
12-May	Stateline Bridge - center	208081	19.3	**75.8**	**9.2**	**0.37**	na
20-May	Stateline - right bank, above bridge	218006	18.2	**79.5**	**12.2**	**0.41**	na

na = not analyzed

Appendix B

Ecology Ambient Monitoring Program
Metals Data for the Spokane River
May 1994 - April 1997

Station No.: 57A150 SPOKANE R @ STATELINE BR Water Class: A Latitude: 47 41 55.0

Water Body No.: WA-57-1010 River Mile: 96.00 Longitude: 117 02 37.0

Date	Time	Flow (CFS)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Cadmium (ug/L)	Cadmium Dissol. (ug/L)	Copper Dissol. (ug/L)	Lead Dissol (ug/L)	Zinc Dissol. (ug/L)
94/04/05	1010	7090.0								
94/05/03	0950	5380.0					0.298 P	1.420	0.209	96.900
94/06/07	1010	3900.0								
94/07/06	0955	697.0					0.150 P	0.496 P	0.180 P	58.000
94/08/02	1020	366.0								
94/09/06	1000	303.0					0.040 U	0.400 P	0.120 P	22.300
94/10/10	1105	1450.0								
94/11/07	1040	2630.0					0.130 P	0.495 P	0.143 P	59.700
94/12/05	1135	1460.0								
95/01/09	1015	4490.0	14.0 P	20.0 U	79.5	3.00 U	0.180 P	0.440 P	0.064 P	79.700
95/02/06	1100	14400.0								
95/03/06	1115	16700.0					0.406	0.706	0.818	104.000
95/04/03	1125	12700.0								
95/05/02	1120	9020.0								
95/06/05	0930	5800.0								
95/07/10	0820	3080.0								
95/08/07	1050	746.0								
95/09/05	0820	424.0								
95/10/02	1010	1570.0	0.4	1.4	48.4 N	0.16	0.110	0.410	0.172	51.200
95/11/06	0940	3680.0								
95/12/04	0945	29800.0	0.6	3.7	102.0 B	0.47	0.289	0.345	0.212	92.100
96/01/08	1010	8370.0								
96/02/05	0920	6100.0	0.9	5.4	89.6	0.46	0.377	0.841	1.150	94.500
96/03/04	1010	16000.0								
96/04/09	0945	11100.0	1.1	14.8	82.3	0.40	0.370	0.931	3.870	86.100
96/05/06	0955	19800.0								
96/06/03	1100	15500.0	0.9	5.6	67.1 J	0.34	0.282	0.547	1.640	66.500
96/07/08	1205	3070.0								
96/08/05	1010	1200.0	1.1	1.4	45.7	0.45	0.281	0.450	0.206	46.100
96/09/03	1105	615.0								
96/10/08	0945	1750.0	0.8 J	1.2	46.9 J	0.18	0.219	0.500	0.227	50.200 J
96/11/05	0940	2780.0								
96/12/03	0930	4550.0	0.6	1.5	78.6	0.30	0.249	0.450	0.340	81.600
97/01/14	0945	13300.0								
97/02/04	0945	8210.0	0.7	3.1	110.0 J	0.34	0.342	0.593	0.914	105.000

Remarks: U,K - Below reporting limit; B - analyte in blank; X - background organisms; J - Estimate; S - Spreader colonies, P - below quantitation limit.

57A150 Spokane R @ Stateline Br continued: more dates.

Date	Time	Flow (CFS)	Copper (ug/L)	Lead (ug/L)	Zinc (ug/L)	Cadmium (ug/L)	Cadmium Dissol. (ug/L)	Copper Dissol. (ug/L)	Lead Dissol (ug/L)	Zinc Dissol. (ug/L)
97/03/04	0945	8720.0					0.420	0.710	1.340	124.000
97/04/08	0950	15000.0					0.440	0.860	1.410	119.000

Remarks: U,K - Below reporting limit; B - analyte in blank; X - background organisms; J - Estimate; S - Spreader colonies, P - below quantitation limit.

Station No.: 54A120 SPOKANE R @ RIVERSIDE STATE PK Water Class: A Latitude: 47 41 48.0
Water Body No.: WA-54-1020 River Mile: 66.00 Longitude: 117 29 48.0

Date	Time	Flow (CFS)	Hardnes (mg/L)	Cadmium Dissol. (ug/L)	Copper Dissol. (ug/L)	Lead Dissol (ug/L)	Zinc Dissol. (ug/L)
95/10/02	1415	1720.0	74	0.044	0.488	0.110	24.100
95/11/06	1315	3790.0					
95/12/04	1330	26800.0	24	0.239	0.416	0.232	80.900
96/01/08	1345	8320.0					
96/02/05	1305	6540.0	42	0.283	0.698	0.966	73.000
96/03/04	1205	16000.0					
96/04/09	1330	11000.0	30	0.290	0.931	4.270	66.800
96/05/06	1325	19200.0					
96/06/03	1520	15100.0	29	0.254	0.510	1.470	53.800
96/07/08	1745	3610.0					
96/08/05	1400	1660.0	59	0.091	0.450	0.087	19.000

Remarks: U,K - Below reporting limit; B - analyte in blank; X - background organisms; J - Estimate; S - Spreader colonies, P - below quantitation limit.