Analysis of Polychlorinated Biphenyl Mixtures (PCB) and Metals in Water Samples Collected from the Bayou Creek System on February 19-20, 2001

Wesley J. Birge

David J. Price

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Jon Maybrier

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INTRODUCTION

Water samples (71 samples) were taken from Big and Little Bayou Creeks on February 19-20, 2001 for PCB and metal analyses. A total of 11 sites were sampled from Big Bayou Creek (stations BB1A through BB9) and 5 sites were included for Little Bayou Creek (stations LB2A through LB4). A new reference station, upstream of BB1 and designated BB1A, was added to this stream survey. In addition, Massac Creek (MC) was sampled and served as a possible reference station independent of the Bayou Creek system. The MC station was on the West Fork of Massac Creek. During this sampling event, the station used by DOE on Massac Creek (MCDOE) also was located and sampled. Water samples were taken at each station for general water quality analyses which included pH, conductivity, alkalinity, and hardness. Two water samples per station were collected for PCB assays, and two separate water samples per station were collected for metal analysis. Three Aroclors (*i.e.* 1248, 1254, and 1260) and 9 metals (*i.e*. Ag, Be, Cd, Cr, Cu, Fe, Ni, Pb and Zn) were analyzed for each sample.

METHODS

Water Collection

General Water Quality: Samples for water quality measurements were collected in 1-L "Cubitainer" receptacles and were placed on ice until delivery to the laboratory.

PCBs: Water samples for PCB analyses were collected in chemically cleaned, 1-L amber glass jars with teflon-lined caps. New jars were obtained from I-Chem®. Samples for PCB determinations were placed on ice until delivery to the laboratory and maintained under refrigeration (4°C) until extraction.

Metals: Water samples for metal assays were collected in acid-cleaned 250-mL polyethylene bottles. Samples were preserved with concentrated HNO_3 upon collection and analyzed for total recoverable (TR) metals.

General Water Quality

Water quality parameters included pH, conductivity, alkalinity and hardness that were measured according to procedures described by APHA (1995). The measurements were performed with a pH meter (Orion Research EA920), a conductivity meter (Amber Science Model 604), the bromocresol green-methyl red titrimetric, and the EDTA titrimetric procedures, respectively.

PCB Water Extractions

Liquid-liquid extractions were performed in separatory funnels following SW-846 Method 3510C (U.S. EPA, 1997). Water samples were extracted within 7 days of collection. One-liter aqueous samples were extracted three times with 60-mL methylene chloride and concentrated to near dryness in a Roto-evaporator (Buchi Model RE121). The reconstituted samples (2.0 mL in iso-octane) were cleaned of interferences as described below and then analyzed by gas chromatography.

Sample Cleanup

Lipid and pesticide cleanup was performed by eluting a 2.0 mL sample through a micro-column of 2.0 g activated 100-200 mesh Florisil® (100 ^{o}C/24 h) with 10.0 mL hexane and evaporated to 2.0 mL (Erickson, 1997; U.S EPA, 1997 Method 3620B). Elemental sulfur was removed by shaking 2-propanol (2 mL) and tetrabutylammonium sulfite (2 mL);

adding ultra-pure water (8 mL); and reshaking. The organic extract was removed and mixed with 2.0 mL concentrated sulfuric acid (Jensen *et al.*, 1977; U.S EPA, 1997 Method 3660B). A 4 μL sub-sample was analyzed by gas chromatography.

PCB Determinations

Samples were analyzed for Aroclors 1248, 1254, and 1260 according to SW-846 Method 8082 (U.S. EPA, 1997). Analyses were performed using a Hewlett-Packard (HP) Model 5890A gas chromatograph equipped with an electron capture detector and an HP Model 7673A Automatic Sampler. Samples were analyzed using a 60m X 0.53mm ID SPB-5 (0.5μm film) fused silica megabore column (Supelco, Inc.) with ultra-high purity helium and nitrogen as carrier and makeup gases, respectively. The temperature program was regulated at 160 °C to 235 °C at 10 °C/min, then 235 °C to 260 °C at 0.9 °C/min, and held for 10 min. Injector temperature was 280 °C and detector temperature was 300 °C. PCB peak heights were quantified using an HP Model 3396A integrator. Aroclor levels were calculated from heights of 6 to 9 peaks for Aroclors 1248 and 1260 and 4-6 peaks for Aroclor 1254. Five external standards for each Aroclor were used for calibration curves and for every tenth sample either a solvent blank or a standard was analyzed. Statistical quantitation of peak heights was determined by multiple-peak linear regression analysis, which was performed with Lotus-123® software. The Lotus program regresses data from PCB standards to the sample being analyzed. Each peak selected for each Aroclor class was statistically analyzed (*e.g.,* standard deviation; standard error; relative deviation). Chromatographs and bench records for all PCB assays will be maintained as given below under quality assurance.

Water Metal Determinations

Nine metals, including silver (Ag), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), iron, (Fe), lead (Pb), nickel (Ni), and zinc (Zn), were determined. Metal analysis was performed by atomic absorption spectrophotometry (AAS), using graphite furnace atomization techniques and a Varian AAS (Model Spectra AA-20) equipped with a GTA-96 graphite furnace. All gases used were ultra pure carrier grade. Calibration curves were based on five standards. The instrument was programmed to take three readings per sample and average the absorbance. Instrument blanks (0.5 % HNO_3) and check standards were processed with all samples. Sample concentrations were then corrected for deviations from the standards and sample weights were factored into the calculations of final values.

Quality Assurance

Permanent bench records were kept of all assays and annotated as required under Good Laboratory Practices (*Federal Register*, 40 CFR, Part 160, August 17, 1989). All printouts and graphic recordings were filed and are open for inspection. These bench records will be archived within two years after the close of the project but retrievable upon request. Chain of Custody was maintained for all samples collected.

RESULTS

Water Quality

The results for general water quality parameters are given in Table 1. Overall, pH was slightly higher for samples from Little Bayou Creek, as compared with pH readings for Big Bayou Creek. However, all pH values were within the preferred range of 6.5-8.5.

Conductivity ranged from 25 to 573 µMHOs/cm and was highest at BB6. The latter was attributed to electrolytes contained in the 001 effluent. Alkalinity was in the "moderate" range and varied from 40 to 56 mg $CaCO_3$/L in Big Bayou Creek and 28 to 76 mg $CaCO_3$/L in Little Bayou Creek. Station LB2A had the highest alkalinity. Hardness ranged from 48 to 144 mg $CaCO_3$/L and 36 to 76 mg $CaCO_3$/L for Big and Little Bayou Creeks, respectively. Hardness levels were highest for stations BB6, BB7 and BB8. The mean values were 56.6 ± 7.5 for stations upstream of effluent 001 and 121 ± 21.6 for stations below this outfall. In a previous study (Birge and Price, August 29, 2001a), an extensive database on water hardness in the Bayou Creek system was analyzed and interpreted for best use in risk assessment for chronic effects of metals. The recommendation on water hardness values to use in calculating hardness-related metal limits were 70 mg $CaCO_3$/L upstream of effluent 001 and 100 mg $CaCO_3$/L downstream thereof. Based on recent data, it is suggested that hardness values of 50 and 100 be used for these stream sectors when corresponding hardness data are lacking. This small margin of conservatism is justified on the basis that multiple metal stressors occur in this surface water system; that additive effects have been shown to occur (Birge *et al.*, 2000) in Big Bayou Creek; and that a complex array of point sources occur in close proximity. Hardness (mg $CaCO_3$/L) for Little Bayou Creek averaged 60.8 ± 13.5.

PCB Contamination

Results for PCB analyses of water samples are given in Tables 2 and 3 for Big and Little Bayou Creeks, respectively. No PCBs were detected in any of the water samples collected, observing detection limits of 0.08 to 0.09 µg PCB/L. These results

are interesting in view of the PCB residues found in fish collected during the same time period (Birge and Price, 2001b). In Big Bayou Creek, PCBs were detected in 26 of 33 fish analyzed (*i.e.* fillet samples) and total PCB concentrations ranged up to 0.26 µg/g. PCB residues were observed in fish from all 9 stations monitored. Concerning Little Bayou Creek, all fish collected from stations LB2, LB3 and LB4 contained fillet concentrations of total PCBs that ranged up to 1.24 µg/g (LB2). As most of these fish were one year of age or less, it was clear that contamination of bioavailable PCBs was current and pervasive.

Still more revealing are the results obtained with the stoneroller minnow, which we use as an instream sentinel monitor (Birge and Price, 2001c). PCBs were detected in all 22 specimens taken from Big Bayou Creek and whole-body mean concentrations for total PCB (µg/g) were 0.60 at BB1A and 0.85, 0.80 and 0.65 at stations BB4, BB5 and BB9, respectively. Maximum values for whole-body concentrations (µg/g) of PCB were 1.18, 1.03, 0.63, 0.72 and 0.71 for stations BB4, BB5, BB6, BB7 and BB8. These results also show PCB pollution to be current and extending downstream 10 Km to BB9, the last monitoring station. Concerning Little Bayou Creek, mean values (µg/g) for total PCB were 2.14 and 0.74 at stations LB2 and LB3. Maximum values were 2.57 and 0.92 µg/g, respectively.

These data clearly show that detection of harmful levels of bioavailable PCB cannot be based solely on water assays. Furthermore, it should be noted that U.S. EPA and State of Kentucky criteria for protection of aquatic life are 0.014 and 0.0014 µg/L, respectively (Kentucky Division of Water, 1995). These values are well below detection limits for assays by gas chromatography.

Metals

Results for metal assays of water samples are given in Tables 4 and 5 for Big and Little Bayou Creeks, respectively. At the new upstream site on Massac Creek (MC), there was substantially more contamination with metals (*e.g.* Ni, Zn) than at the site normally used in DOE studies (MCDOE, Table 4). Therefore, these results (*i.e.* station MC) were not used as reference values.

Silver displayed elevated concentrations at and below station BB6 on Big Bayou Creek. Effluent 001 was the likely source. Maximum concentrations (µg/L) were 0.60, 0.62, 0.44 and 0.25 at stations BB6, BB7, BB8, BB9, respectively. These values are at or above the threshold for chronic effects on aquatic biota, which is in the range of 0.2 µg/L (Andren and Bober, 1999).

Beryllium (Be) concentrations also increased at station BB6, which is situated just downstream of effluent 001. Maximum values (µg/L) were 1.74, 1.94, 1.60 and 1.03 at stations BB6, BB7, BB8 and BB9. All of these values exceeded by wide margins the U.S. EPA Region IV surface water chronic value for Be, which is 0.53 µg/L (U.S. EPA Region IV, 2000). These results suggest further concern for Be contamination at PGDP. Beryllium contamination has be associated with nuclear facilities and linked to chronic beryllium disease (CBD) and cancer (U.S. EPA, 1998). The maximum contaminant level for drinking water is 4.0 µg/L (4 ppb) and this compound is listed as a Group B2 carcinogen (U.S. EPA, 1994, 1998, 2001).

Cadmium (Cd), chromium (Cr) and copper (Cu) also were increased in Big Bayou Creek at stations downstream of effluent 001 (Table 4). Maximum concentrations

(µg/L) were 0.14 for Cd (BB6); 2.45 (BB7) and 2.04 (BB9) for Cr; and 4.13 for Cu (BB6). While these values are below State limits for freshwater systems, there is clear evidence of additive effects of these and other metals in Big Bayou Creek (Birge *et al.*, 2000). Lead (Pb) concentrations (µg/L) were as high as 1.10, 1.06 and 0.62 at stations BB7, BB8 and BB9. Pb was not detected in water samples taken upstream of BB7. Values for Fe, Ni and Zn were variable through the system, although Ni concentrations increased at and below station BB6 (Table 4). Zinc (Zn) values also were higher at BB6 than for the upstream stations (*i.e.* BB1A, BB1). The values reported for Fe may be of concern in view of the State standard of 1.0 mg/L to protect biota form chronic effects (Kentucky Division of Water, 1995). The mean concentration of Fe was 1632 µg/L (*i.e.* 1.63 mg/L) at station BB9.

Silver and Be were detected at all stations on Little Bayou Creek but concentrations were too low to quantitate accurately (Table 5). Cd and Pb were not detected at any of the five stations. However, Cr, Cu, Pb, Ni and Zn were present in all assays. Nickel ranged as high as 15.6 µg/L at station LB2A (Table 5). Mean values for metal concentrations are given in Tables 6 and 7. It should be noted that mean Fe concentrations exceed 1 mg/L at most stations in Little Bayou Creek. Further details regarding metal contamination in the water column of the Bayou drainage are included in the report on sediment metal contamination (Birge and Price, January 4, 2002).

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Table 1. Water quality results for stream water samples from the Bayou Creek system collected February 19-20, 2001.

Station	pH	Conductivity (µMHOs/cm)	Alkalinity (mg $CaCO_3$/L)	Hardness (mg $CaCO_3$/L)
MC	6.88	145	24	48
MCDOE[1]	7.05	127	36	48
BB1A	6.96	70	44	56
BB1	6.96	167	44	60
BB2	6.82	131	36	48
BB2A	6.70	168	40	56
BB3	6.82	181	40	56
BB4	6.85	225	52	72
BB5	7.05	241	56	48
BB6	6.96	573	52	136
BB7	6.97	122	52	144
BB8	7.12	25	44	116
BB9	7.01	339	52	88
LB1	7.33	83	28	36
LB2	7.32	230	56	64
LB2A	7.27	209	76	68
LB3	7.58	268	64	76
LB4	7.58	218	52	60

[1] Massac Creek was sampled at both the UK site (MC) and at the DOE site which was

designated MCDOE.

Table 2. PCB results for water samples from Big Bayou Creek collected February 19-20, 2001.

			Aroclor Concentration (μg/L)		
Station	Date	Sample	1248	1254	1260
MC	02/19/01	PWS1	<0.082	<0.082	<0.082
MC	02/19/01	PWS2	<0.092	<0.092	<0.092
MCDOE[1]	02/20/01	PWS1	<0.080	<0.080	<0.080
MCDOE	02/20/01	PWS2	<0.089	<0.089	<0.089
BB1A	02/19/01	PWS1	<0.080	<0.080	<0.080
BB1A	02/19/01	PWS2	<0.094	<0.094	<0.094
BB1	02/19/01	PWS1	<0.081	<0.081	<0.081
BB1	02/19/01	PWS2	<0.095	<0.095	<0.095
BB2	02/19/01	PWS1	<0.082	<0.082	<0.082
BB2	02/19/01	PWS2	<0.090	<0.090	<0.090
BB2A	02/19/01	PWS1	<0.081	<0.081	<0.081
BB2A	02/19/01	PWS2	<0.089	<0.089	<0.089
BB3	02/19/01	PWS1	<0.084	<0.084	<0.084
BB3	02/19/01	PWS2	<0.095	<0.095	<0.095
BB4	02/19/01	PWS1	<0.085	<0.085	<0.085
BB4	02/19/01	PWS2	<0.092	<0.092	<0.092
BB5	02/19/01	PWS1	<0.082	<0.082	<0.082
BB5	02/19/01	PWS2	<0.090	<0.090	<0.090
BB6	02/19/01	PWS1	<0.082	<0.082	<0.082
BB6	02/19/01	PWS2	<0.091	<0.091	<0.091
BB7	02/19/01	PWS1	<0.082	<0.082	<0.082
BB7	02/19/01	PWS2	<0.091	<0.091	<0.091
BB8	02/19/01	PWS1	<0.086	<0.086	<0.086
BB8	02/19/01	PWS2	<0.093	<0.093	<0.093
BB9	02/19/01	PWS1	<0.081	<0.081	<0.081
BB9	02/19/01	PWS2	<0.090	<0.090	<0.090

[1] Massac Creek was sampled at both the UK site (MC) and at the DOE site, which was designated MCDOE.

Table 3. PCB results for water samples from Little Bayou Creek collected February 20, 2001.

Station	Date	Sample	Aroclor Concentration (μg/L) 1248	1254	1260
LB1	02/20/01	PWS1	<0.081	<0.081	<0.081
LB1	02/20/01	PWS2	<0.090	<0.090	<0.090
LB2A	02/20/01	PWS1	<0.080	<0.080	<0.080
LB2A	02/20/01	PWS2	<0.090	<0.090	<0.090
LB2	02/20/01	PWS1	<0.080	<0.080	<0.080
LB2	02/20/01	PWS2	<0.090	<0.090	<0.090
LB3	02/20/01	PWS1	<0.081	<0.081	<0.081
LB3	02/20/01	PWS2	<0.091	<0.091	<0.091
LB4	02/20/01	PWS1	<0.084	<0.084	<0.084
LB4	02/20/01	PWS2	<0.092	<0.092	<0.092

Table 4. Metal concentrations in water samples from Big Bayou Creek collected February 19-20, 2001.

			Water Metal Conc. (µg/L)[1]								
Station	Date	Sample	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
MCDOE[2]	02/20/01	MWS1	<0.250	0.997	<0.250	<1.000	<1.000	<1000.0	<0.500	8.932	2.407
MC	02/19/01	MWS1	0.049*	0.790*	<0.250	1.608	1.396	1063.4	<0.500	14.412	13.435
MC	02/19/01	MWS2	0.049*	0.731*	<0.250	1.388	1.495	1063.4	<0.500	15.632	22.188
BB1A	02/19/01	MWS1	0.069*	0.790*	<0.250	1.033	1.516	1063.4	<0.500	9.793	3.961
BB1A	02/19/01	MWS2	0.020*	0.731*	<0.250	1.221	1.495	1142.5	<0.500	10.632	6.871
BB1	02/19/01	MWS1	0.020*	0.753*	<0.250	1.409	1.330	1380.3	<0.500	9.314	8.271
BB1	02/19/01	MWS2	0.028*	0.671*	<0.250	1.240	1.393	1673.0	<0.500	9.491	3.990
BB2	02/19/01	MWS1	0.038*	0.547*	<0.250	1.161	1.236	1426.7	<0.500	8.244	4.428
BB2	02/19/01	MWS2	0.066*	0.516*	<0.250	<1.000	1.258	1426.7	<0.500	8.156	4.234
BB2A	02/19/01	MWS1	0.075*	0.683*	<0.250	<1.000	1.258	1426.7	<0.500	7.638	7.372
BB2A	02/19/01	MWS2	0.104*	0.621*	<0.250	1.634	1.258	1426.7	<0.500	9.903	7.056
BB3	02/19/01	MWS1	0.100*	0.591*	<0.250	1.012	<1.000	1306.8	<0.500	9.705	6.533
BB3	02/19/01	MWS2	0.130*	0.610*	<0.250	1.343	<1.000	1391.6	<0.500	10.465	5.301
BB4	02/19/01	MWS1	0.070*	0.566*	<0.250	<1.000	1.319	1137.4	<0.500	11.090	8.653
BB4	02/19/01	MWS2	0.150*	0.484*	<0.250	<1.000	1.340	1222.1	<0.500	8.811	9.599
BB5	02/19/01	MWS1	0.060*	0.667*	<0.250	1.012	1.287	1052.8	<0.500	8.628	9.771
BB5	02/19/01	MWS2	0.110*	0.610*	<0.250	1.042	1.456	1052.8	<0.500	8.695	9.656

[1] Asterisk represent samples where metal concentrations were detected but were below the minimum quantitation limit (MQL).
[2] Massac Creek was sampled at both the UK site (MC) and at the DOE site, which was designated MCDOE.

Table 4, continued. Metal concentrations in water samples Big Bayou Creek collected February 19-20, 2001.

			Water Metal Conc. (µg/L)[1]								
Station	Date	Sample	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
BB6	02/19/01	MWS1	0.604	1.739	0.143*	2.126	3.258	<1000.0	<0.500	16.935	11.314
BB6	02/19/01	MWS2	0.528	1.720	0.082*	2.205	4.135	<1000.0	<0.500	15.138	12.530
BB7	02/19/01	MWS1	0.623	1.863	0.112*	2.451	3.674	<1000.0	1.099	19.698	8.394
BB7	02/19/01	MWS2	0.613	1.944	0.102*	2.116	3.506	<1000.0	0.821	18.606	8.589
BB8	02/19/01	MWS1	0.443	1.460	0.092*	1.447	2.382	1181.0	0.833	17.146	6.642
BB8	02/19/01	MWS2	0.443	1.596	0.092*	1.496	2.258	1099.2	1.062	20.160	6.667
BB9	02/19/01	MWS1	0.245	1.031	0.051*	1.998	2.213	1673.0	<0.500	12.460	5.450
BB9	02/19/01	MWS2	0.255	1.000	0.041*	2.037	2.000	1590.8	0.623	13.182	4.453

[1] Asterisk represent samples where metal concentrations were detected but were below the minimum quantitation limit (MQL).

Table 5. Metal concentrations in water samples from Little Bayou Creek collected February 20, 2001.

			Water Metal Conc. (µg/L)[1]								
Station	Date	Sample	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
LB1	02/20/01	MWS1	0.090*	0.767*	<0.250	2.725	2.152	2498.5	<0.500	7.444	16.275
LB1	02/20/01	MWS2	<0.250	0.654*	<0.250	2.104	1.561	2584.0	<0.500	7.685	22.034
LB2A	02/20/01	MWS1	0.150*	0.712*	<0.250	2.451	1.514	2002.0	<0.500	15.603	18.305
LB2A	02/20/01	MWS2	0.110*	0.687*	<0.250	2.539	1.526	2084.3	<0.500	13.362	20.862
LB2	02/20/01	MWS1	0.150*	0.521*	<0.250	2.568	1.503	<1000.0	<0.500	9.562	15.603
LB2	02/20/01	MWS2	0.130*	0.534*	<0.250	2.568	<1.000	<1000.0	<0.500	9.360	15.690
LB3	02/20/01	MWS1	0.140*	0.660*	<0.250	2.535	1.814	1222.1	<0.500	10.080	8.567
LB3	02/20/01	MWS2	0.190*	0.654*	<0.250	3.126	1.867	1391.6	<0.500	8.660	9.169
LB4	02/20/01	MWS1	0.120*	0.881*	<0.250	4.228	2.120	2327.6	<0.500	11.206	11.318
LB4	02/20/01	MWS2	0.090*	0.925*	<0.250	3.557	1.941	2071.7	<0.500	10.420	5.788

[1] Asterisk represent samples where metal concentrations were detected but were below the minimum quantitation limit (MQL).

Table 6. Mean metal concentrations ± standard deviations[1] in water samples from Big Bayou Creek collected February 19-20, 2001.

	Mean Water Metal Conc. (µg/L)[2]								
Station	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
MCDOE	<0.250	0.997	<0.250	<1.000	<1.000	<1000.0	<0.500	8.932	2.407
MC	0.049*	0.761*	<0.250	1.498	1.445	1063.4	<0.500	15.022	17.812
	---	0.042	---	0.155	0.070	0.0	---	0.863	6.189
BB1A	0.045*	0.761*	<0.250	1.127	1.505	1102.9	<0.500	10.212	5.416
	0.035	0.042	---	0.133	0.016	56.0	---	0.593	2.058
BB1	0.024*	0.712*	<0.250	1.325	1.361	1526.6	<0.500	9.402	6.131
	0.006	0.058	---	0.120	0.045	207.0	---	0.125	3.027
BB2	0.052*	0.531*	<0.250	1.161	1.247	1426.7	<0.500	8.200	4.331
	0.020	0.022	---	---	0.016	0.0	---	0.062	0.138
BB2A	0.090*	0.652*	<0.250	1.634	1.258	1426.7	<0.500	8.771	7.214
	0.021	0.044	---	---	0.000	0.0	---	1.602	0.224
BB3	0.115*	0.601*	<0.250	1.177	<1.000	1349.2	<0.500	10.085	5.917
	0.021	0.013	---	0.234	---	59.9	---	0.537	0.871
BB4	0.110*	0.525*	<0.250	<1.000	1.329	1179.8	<0.500	9.951	9.126
	0.057	0.058	---	---	0.015	59.9	---	1.611	0.669
BB5	0.085*	0.638*	<0.250	1.027	1.371	1052.8	<0.500	8.662	9.713
	0.035	0.040	---	0.021	0.119	0.0	---	0.047	0.081

[1] Standard deviations given below the means.
[2] Samples designated with asterisks indicate metals detected but were below the minimum quantitation limit (MQL).

Table 6, continued. Mean metal concentrations ± standard deviations[1] in water samples from Big Bayou Creek collected February 19-20, 2001.

	Mean Water Metal Conc. (µg/L)[2]								
Station	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
BB6	0.566	1.730	0.112*	2.165	3.697	<1000.0	<0.500	16.036	11.922
	0.054	0.013	0.043	0.056	0.620	---	---	1.270	0.860
BB7	0.618	1.904	0.107*	2.283	3.590	<1000.0	0.960	19.152	8.491
	0.007	0.057	0.007	0.237	0.119	---	0.196	0.773	0.138
BB8	0.443	1.528	0.092*	1.471	2.320	1140.1	0.948	18.653	6.655
	0.000	0.097	0.000	0.035	0.087	57.9	0.161	2.131	0.017
BB9	0.250	1.016	0.046*	2.018	2.107	1631.9	0.623	12.821	4.951
	0.007	0.022	0.007	0.028	0.151	58.1	---	0.510	0.705

[1] Standard deviations given below the means.
[2] Samples designated with asterisks indicate metals detected but were below the minimum quantitation limit (MQL).

Table 7. Mean metal concentrations ± standard deviations[1] in water samples from Little Bayou Creek collected February 20, 2001.

	Mean Water Metal Conc. (µg/L)[2]								
Station	Ag	Be	Cd	Cr	Cu	Fe	Pb	Ni	Zn
LB1	0.090*	0.711*	<0.250	2.415	1.857	2541.2	<0.500	7.565	19.155
	---	0.080	---	0.439	0.418	60.5	---	0.171	4.072
LB2A	0.130*	0.699*	<0.250	2.495	1.520	2043.1	<0.500	14.482	19.583
	0.028	0.017	---	0.062	0.008	58.3	---	1.585	1.808
LB2	0.140*	0.528*	<0.025	2.568	1.503	<1000.0	<0.500	9.461	15.647
	0.014	0.009	---	0.000	---	---	---	0.143	0.061
LB3	0.165*	0.657*	<0.250	2.831	1.841	1306.9	<0.500	9.370	8.868
	0.035	0.004	---	0.418	0.037	119.9	---	1.005	0.425
LB4	0.105*	0.903*	<0.250	3.893	2.031	2199.6	<0.500	10.813	8.553
	0.021	0.031	---	0.475	0.127	180.9	---	0.556	3.910

[1] Standard deviations given below the means.
[2] Samples designated with asterisks indicate metals detected but were below the minimum quantitation limit (MQL).