Polychlorinated Biphenyl (PCB) Residues in Water, Stream Sediments and Floodplain Soils Collected October 1-2, 2004 from the Bayou Creek System

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INTRODUCTION

Water, sediments and floodplain soil samples were taken from Big and Little Bayou Creeks on October 1-2 for PCB analyses. A total of 11 sites were sampled from Big Bayou Creek (stations BB1A through BB9); 4 sites from Little Bayou Creek (stations LB2A through LB4); and effluents 001, 006, 008 and 010+011. Due to low-flow conditions (*i.e.* lack of water) during the October 2004 sampling, the reference station at the west fork of Massac Creek (MC) and station LB1 were not collected. Three Aroclors (*i.e.* 1248, 1254, 1260) were determined for all samples.

METHODS

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 were placed on ice until delivery to the laboratory and maintained under refrigeration (4°C) until extraction. Sediment samples were restricted to the upper 5-10 cm of sediment soil, including depositional areas when found. Floodplain soils samples FP1 were collected next to the stream bank, while FP2 was taken 50-100 yards of the shoreline whenever possible. Both floodplain samples were collected 5-10 cm deep, in areas were flood debris was present. Any surface vegetation was removed prior to sampling floodplain soils. All sediment and floodplain samples were collected in acetone-rinsed 0.47 L glass jars with Teflon-lined lids. Stainless steel spoons and scoops used for collections were acetone-rinsed between sampling stations.

PCB Extraction and Analysis

Extraction and cleanup of water samples followed procedures described by Birge and Price (2002), and were completed within 7 days of collection. Wet sediment or floodplain soil extractions of PCB and sample cleanup were performed following U.S EPA SW-846 Method 3540C (U.S. EPA, 1997; Erickson, 1997) as described previously by Birge and Price (2002). Samples were analyzed for Aroclors 1248, 1254, and 1260 according to SW-846 Method 8082 (U.S. EPA, 1997). Analyses also were performed as described by Birge and Price (2002).

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.

RESULTS

Results for PCB analyses of water samples are given in Tables 1 and 2 for Big and Little Bayou Creeks, respectively. No PCBs were quantifiable in Big Bayou Creek, observing a detection limit of 0.08 µg PCB/L, except for effluent 008 where 1248 was detected at an average concentration of 0.112 µg/L. Aroclor 1248 was detected in water from effluent 008 during the March 2004 collection, however the concentrations were below the minimum quantitation limit (Birge and Price 2005). On Little Bayou Creek, Aroclor 1248 was only detected at station LB2A at an average concentration of 0.148

µg/L.

PCB concentrations for individual wet-extracted sediments for Massac Creek and Big Bayou Creek are given in Table 3. Mean values for PCB in sediments are given in Table 5 and Figures 1 and 2. No PCBs were detected at the upstream stations BB1A through BB3 on Big Bayou Creek. Aroclor 1248 was only detected for sediment samples taken at effluent 001, with a concentration of 19.44 µg/Kg (Table 5). This result is similar to the one obtained during the March 2005 collection (Birge and Price 2005), where effluent 001 had a mean Aroclor 1248 concentration of 13.8 µg/Kg. Aroclor 1254 was detected in 4 of 11 stations in Big Bayou Creek and concentrations ranged from 2.70 to 10.60 µg/Kg. Aroclor 1254 was highest at station BB8. Aroclor 1260 ranged from 5.37 to 12.44 µg/Kg and was highest for effluent 006 (Table 5, Figure 1). In looking at mean total PCB values, the three highest concentrations, in order, were detected for effluents 001, 006, and 008 (Table 5, Figure 2).

PCB concentrations for Little Bayou Creek sediments are presented in Table 4 and mean sediment values are presented in Table 5 and Figure 3. At stations LB2A through LB4, Aroclors 1248 was detected at all of the stations. The highest 1248 concentration was found at LB2 (144.05 µg/Kg), which is similar to results found in March 2005 with LB2 having the highest 1248 concentration of 96.8 µg/Kg (Birge and Price 2005). Aroclor 1254 only was detected at LB4 with a value of 5.87 µg/Kg. Aroclor 1260 was found at all stations except LB4, and the values ranged from 8.42 to 56.21 µg/Kg. In March 2005, Aroclor 1260 ranged from 5.3 to 14.0 µg/Kg.

Results for PCBs in individual floodplain soils from Massac Creek and Big Bayou Creek are presented in Table 6 and Figures 4 and 5. Mean Aroclor concentrations are

given in Table 8. As with the water samples, Aroclor 1248 was only found at effluent 008 with a concentration of 73.45 µg/Kg. Aroclors 1254 and 1260 were detected in 9 of 11 stations in Big Bayou Creek. Aroclor 1254 ranged from 5.16 to 18.68 µg/Kg, and was highest at effluent 001. Aroclor 1260 ranged from 4.08 to 64.29 µg/Kg, and was highest for BB1 and second highest near effluent 001. As observed in the past, floodplain soils near effluent 001 contained elevated PCB concentrations. During the March 2005 collection, floodplain soils near effluent 001 had mean values of 96.1, 73.8, and 83.9 µg/Kg for 1248, 1254, and 1260, respectively (Birge and Price, 2005).

Results for individual floodplain soils from Little Bayou Creek are shown in Table 7 and Figure 6. Mean Aroclor values are given in Table 8. Aroclor 1248 only was detected at station LB2 and LB3, with station LB2 having a concentration of 218.12 µg/Kg. Aroclors 1254 and 1260 were detected at all stations sampled. Aroclor 1254 ranged from 4.47 to 168.78 µg/Kg and 1260 ranged from 8.53 to 237.83 µg/Kg. The highest concentrations of 1254 and 1260 were detected at LB2A (Figure 6). Mean total PCB concentration for LB2A was 406.61 µg/Kg. In March 2005, total PCBs ranged from 17.6 to 137.6 µg/Kg for floodplain soils taken at stations LB2A through LB4 (Birge and Price, 2005).

CONCLUSIONS

The principal findings in this report include a comprehensive documentation of PCB presence or lack thereof in plant effluents and the two receiving streams, Big and Little Bayou Creeks. It is important to include these data into the Commonwealth's continuing computer database on the Paducah project. We find less presence of PCB congeners in the stream and fish tissues than in the earlier years. However, there are several important findings that should be considered.

With respect to the water column, PCBs were detected at stations 008 and LB2A. The residence time for detectable PCBs is very short, measured in minutes to hours. These results, therefore, likely indicate current influx of PCBs into stream water. This requires attention. In Big Bayou Creek, PCB sediment contamination was observed at the location of effluent 008 and all the way down Big Bayou Creek to the last monitoring station at BB9 (Figure 1). Aroclor 1248 was particularly evident in the near vicinity of effluent 001. Aroclor 1248 is subject to faster degradation than either 1254 or 1260 and may indicate more recent outfall of 1248. Total PCB concentrations also were highest at effluent 001 (Figure 2).

Concerning Little Bayou Creek, low concentrations of PCBs were observed from stream station LB2A all the way down to the last stream station (LB4). Aroclor 1248 was most evident, possibly indicating more recent contamination. Station LB2A is situated just downstream of "old" effluent 011 and the source of this PCB could be due to runoff from originally contaminated sediments and floodplain soils. However, most of the PCB contamination in sediments occurred at station LB2, situated just below combined effluents 010/011. This mainly included Aroclor 1248 and total PCBs (figure 3).

Floodplain soils also were contaminated with PCBs (Figures 4, 5, 6). Attention should be directed to these sources of PCB contamination and further monitoring clearly is required. This is especially important as similar patterns of PCB contamination were observed earlier in March (Birge and Price, 2005). Also important was that rather high PCB concentrations were observed in the near floodplain soils. The highest value was 218 ppb at LB2 on Little Bayou Creek. During high flow conditions, the floodplain soils likely have the highest efflux of PCBs into stream water.

REFERENCES

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Table 1. PCBs in water samples from Big Bayou Creek and effluents collected October 1-2, 2004.

			Aroclor Concentration (μg/L)		
Station	Date	Sample	1248	1254	1260
BB1A	10/01/04	PWS1	<0.081	<0.081	<0.081
BB1A	10/01/04	PWS2	<0.082	<0.082	<0.082
BB1	10/01/04	PWS1	<0.082	<0.082	<0.082
BB1	10/01/04	PWS2	<0.083	<0.083	<0.083
BB2A	10/01/04	PWS1	<0.081	<0.081	<0.081
BB2A	10/01/04	PWS2	<0.081	<0.081	<0.081
BB2	10/01/04	PWS1	<0.084	<0.084	<0.084
BB2	10/01/04	PWS2	<0.081	<0.081	<0.081
BB3	10/01/04	PWS1	<0.081	<0.081	<0.081
BB3	10/01/04	PWS2	<0.082	<0.082	<0.082
008	10/01/04	PWS1	0.107	<0.081	<0.081
008	10/01/04	PWS2	0.117	<0.081	<0.081
BB4	10/01/04	PWS1	<0.083	<0.083	<0.083
BB4	10/01/04	PWS2	<0.081	<0.081	<0.081
006	10/01/04	PWS1	<0.081	<0.081	<0.081
006	10/01/04	PWS2	<0.081	<0.081	<0.081
BB5	10/01/04	PWS1	<0.081	<0.081	<0.081
BB5	10/01/04	PWS2	<0.081	<0.081	<0.081
001	10/01/04	PWS1	<0.081	<0.081	<0.081
001	10/01/04	PWS2	<0.081	<0.081	<0.081
BB6	10/01/04	PWS1	<0.080	<0.080	<0.080
BB6	10/01/04	PWS2	<0.081	<0.081	<0.081
BB7	10/02/04	PWS1	<0.082	<0.082	<0.082
BB7	10/02/04	PWS2	<0.081	<0.081	<0.081
BB8	10/02/04	PWS1	<0.081	<0.081	<0.081
BB8	10/02/04	PWS2	<0.080	<0.080	<0.080
BB9	10/02/04	PWS1	<0.080	<0.080	<0.080
BB9	10/02/04	PWS2	<0.081	<0.081	<0.081

Table 2. PCB results for water samples from Little Bayou Creek and effluents collected October 1-2, 2004.

			Aroclor Concentration (μg/L)		
Station	Date	Sample	1248	1254	1260
010+011	10/01/04	PWS1	<0.082	<0.082	<0.082
010+011	10/01/04	PWS2	<0.082	<0.082	<0.082
LB2A	10/01/04	PWS1	0.084	<0.082	<0.082
LB2A	10/01/04	PWS2	0.211	<0.081	<0.081
LB2	10/01/04	PWS1	<0.081	<0.081	<0.081
LB2	10/01/04	PWS2	<0.081	<0.081	<0.081
LB3	10/01/04	PWS1	<0.083	<0.083	<0.083
LB3	10/01/04	PWS2	<0.082	<0.082	<0.082
LB4	10/01/04	PWS1	<0.080	<0.080	<0.080
LB4	10/01/04	PWS2	<0.080	<0.080	<0.080

Table 3. PCB results for stream sediment samples from Big Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample[1]	Sample Wet Wt. (g)	Sample Dry Wt. (g)	% Moisture	Aroclor Conc. (µg/Kg) 1248	1254	1260	Total
BB1A	10/1/04	PSED1	50.17	32.97	34.3	<6.07	<6.07	<6.07	<6.07
BB1A	10/1/04	PSED2	50.84	38.40	24.5	<5.21	<5.21	<5.21	<5.21
BB1	10/1/04	PSED1	50.64	40.64	19.7	<4.92	<4.92	<4.92	<4.92
BB1	10/1/04	PSED2	50.24	40.67	19.0	<4.92	<4.92	<4.92	<4.92
BB2A	10/1/04	PSED1	50.66	40.54	20.0	<4.93	<4.93	<4.93	<4.93
BB2A	10/1/04	PSED2	51.93	39.61	23.7	<5.05	<5.05	<5.05	<5.05
BB2	10/1/04	PSED1	51.74	37.64	27.3	<5.31	<5.31	<5.31	<5.31
BB2	10/1/04	PSED2	51.26	35.27	31.2	<5.67	<5.67	<5.67	<5.67
BB3	10/1/04	PSED1	50.76	40.79	19.6	<4.90	<4.90	<4.90	<4.90
BB3	10/1/04	PSED2	50.85	41.22	18.9	<4.85	<4.85	<4.85	<4.85
008	10/1/04	PSED1	50.50	37.46	25.8	<5.34	6.10	7.06	13.16
008	10/1/04	PSED2	49.39	37.25	24.6	<5.37	<5.37	<5.37	<5.37
BB4	10/1/04	PSED1	51.62	42.07	18.5	<4.75	<4.75	<4.75	<4.75
BB4	10/1/04	PSED2	51.54	40.93	20.6	<4.89	9.30	<4.89	9.30

[1] PSED1 and PSED2 are separate samples from the station.

Table 3, continued. PCB results for stream sediment samples from Big Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample[1]	Sample Wet Wt. (g)	Sample Dry Wt. (g)	% Moisture	Aroclor Conc. (µg/Kg) 1248	1254	1260	Total
006	10/1/04	PSED1	50.21	43.42	13.5	<4.61	10.20	14.06	24.26
006	10/1/04	PSED2	51.04	43.99	13.8	<4.55	6.06	10.82	16.88
BB5	10/1/04	PSED1	51.00	38.93	23.7	<5.14	<5.14	<5.14	<5.14
BB5	10/1/04	PSED2	50.40	40.73	19.2	<4.91	2.70	<4.91	2.70
001	10/1/04	PSED1	51.39	24.40	52.5	<8.20	<8.20	<8.20	<8.20
001	10/1/04	PSED2	49.68	23.98	51.7	19.44	<8.34	8.22	27.66
BB6	10/1/04	PSED1	50.50	40.99	18.8	<4.88	<4.88	<4.88	<4.88
BB6	10/1/04	PSED2	51.48	40.94	20.5	<4.89	<4.89	<4.89	<4.89
BB7	10/2/04	PSED1	50.57	40.85	19.2	<4.90	<4.90	<4.90	<4.90
BB7	10/2/04	PSED2	51.20	39.26	23.3	<5.09	<5.09	6.12	6.12
BB8	10/2/04	PSED1	51.65	38.50	25.5	<5.19	10.60	5.37	15.97
BB8	10/2/04	PSED2	51.10	36.83	27.9	<5.43	<5.43	<5.43	<5.43
BB9	10/2/04	PSED1	51.42	34.44	33.0	<5.81	6.93	<5.81	6.93
BB9	10/2/04	PSED2	51.01	39.42	22.7	<5.07	<5.07	<5.07	<5.07

[1] PSED1 and PSED2 are separate samples from the station.

Table 4. PCB results for stream sediment samples from Little Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample[1]	Sample Wet Wt. (g)	Sample Dry Wt. (g)	% Moisture	Aroclor Conc. (µg/Kg) 1248	1254	1260	Total
LB2A	10/1/04	PSED1	50.02	38.71	22.6	44.34	<5.17	13.29	57.63
LB2A	10/1/04	PSED2	50.29	40.92	18.6	<4.89	<4.89	7.17	7.17
010+011	10/1/04	PSED1	51.01	35.74	29.9	14.57	<5.60	8.07	22.65
010+011	10/1/04	PSED2	50.59	36.71	27.4	35.94	<5.45	14.67	50.61
LB2	10/1/04	PSED1	50.19	37.33	25.6	61.66	<5.36	19.32	80.97
LB2	10/1/04	PSED2	49.73	35.68	28.3	226.45	<5.60	93.10	319.55
LB3	10/1/04	PSED1	51.50	42.43	17.6	18.76	<4.71	5.55	24.32
LB3	10/1/04	PSED2	50.00	35.78	28.4	14.79	<5.59	11.29	26.08
LB4	10/1/04	PSED1	50.09	39.54	21.1	16.20	6.96	<5.06	23.16
LB4	10/1/04	PSED2	50.25	40.25	19.9	8.93	4.79	<4.97	13.71

[1] PSED1 and PSED2 are separate samples from the station.

Table 5. Mean PCB results for stream sediment samples from the Bayou Creek system collected October 1-2, 2004.

	Aroclor Conc. (µg/Kg)			
Station	1248	1254	1260	Total
BB1A	N.D.	N.D.	N.D.	N.D.
BB1	N.D.	N.D.	N.D.	N.D.
BB2A	N.D.	N.D.	N.D.	N.D.
BB2	N.D.	N.D.	N.D.	N.D.
BB3	N.D.	N.D.	N.D.	N.D.
008	N.D.	6.10	7.06	13.16
BB4	N.D.	9.30	N.D.	9.30
006	N.D.	8.13	12.44	20.57
BB5	N.D.	2.70	N.D.	2.70
001	19.44	N.D.	8.22	27.66
BB6	N.D.	N.D.	N.D.	N.D.
BB7	N.D.	N.D.	6.12	6.12
BB8	N.D.	10.60	5.37	7.99
BB9	N.D.	6.93	N.D.	3.46
LB2A	44.34	N.D.	10.23	32.40
010+011	25.26	N.D.	11.37	36.63
LB2	144.05	N.D.	56.21	200.26
LB3	16.78	N.D.	8.42	25.20
LB4	12.57	5.87	N.D.	18.44

Table 6. PCB results for floodplain soils from Big Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample	Sample		%	Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	Moisture	1248	1254	1260	Total
BB1A	10/1/04	PFP1	50.68	50.34	0.7	<3.97	<3.97	<3.97	<3.97
BB1A	10/1/04	PFP2	50.13	48.19	3.9	<4.15	<4.15	<4.15	<4.15
BB1	10/1/04	PFP1	51.09	48.15	5.8	<4.15	4.52	<4.15	4.52
BB1	10/1/04	PFP2	50.22	49.51	1.4	<4.04	31.42	64.29	95.71
BB2A	10/1/04	PFP1	50.45	49.83	1.2	<4.01	<4.01	<4.01	<4.01
BB2A	10/1/04	PFP2	50.15	49.09	2.1	<4.07	5.19	8.87	14.06
BB2	10/1/04	PFP1	49.90	48.64	2.5	<4.11	<4.11	<4.11	<4.11
BB2	10/1/04	PFP2	49.88	48.83	2.1	<4.10	<4.10	<4.10	<4.10
BB3	10/1/04	PFP1	50.39	48.89	3.0	<4.09	<4.09	2.13	2.13
BB3	10/1/04	PFP2	50.70	48.41	4.5	<4.13	5.16	6.03	11.20
008	10/1/04	PFP1	50.28	39.42	21.6	73.45	<5.07	10.86	84.31
008	10/1/04	PFP2	50.09	48.23	3.7	<4.15	10.48	14.93	25.41
BB4	10/1/04	PFP1	50.30	50.00	0.6	<4.00	6.85	10.20	17.05
BB4	10/1/04	PFP2	49.49	49.38	0.2	<4.05	<4.05	<4.05	<4.05

Table 6, continued. PCB results for floodplain soils from Big Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample	Sample		% Moisture	Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)		1248	1254	1260	Total
006	10/1/04	PFP1	49.69	47.44	4.5	<4.22	14.17	9.84	24.02
006	10/1/04	PFP2	49.85	47.87	4.0	<4.18	3.77	6.20	9.97
BB5	10/1/04	PFP1	50.16	47.09	6.1	<4.25	<4.25	4.31	4.31
BB5	10/1/04	PFP2	50.54	49.77	1.5	<4.02	10.14	19.10	29.24
001	10/1/04	PFP1	50.05	41.73	16.6	<4.79	31.79	93.12	124.91
001	10/1/04	PFP2	50.84	47.77	6.0	<4.19	5.57	8.86	14.43
BB6	10/1/04	PFP1	50.36	49.81	1.1	<4.02	<4.02	8.15	8.15
BB6	10/1/04	PFP2	50.64	50.16	0.9	<3.99	18.37	8.29	26.66
BB7	10/2/04	PFP1	50.36	49.66	1.4	<4.03	8.39	32.00	40.39
BB7	10/2/04	PFP2	50.80	50.01	1.6	<4.00	<4.00	5.35	5.35
BB8	10/2/04	PFP1	50.41	48.47	3.8	<4.13	7.64	17.67	25.31
BB8	10/2/04	PFP2	50.32	49.53	1.6	<4.04	4.39	15.39	19.79
BB9	10/2/04	PFP1	50.00	49.15	1.7	<4.07	6.41	10.17	16.58
BB9	10/2/04	PFP2	51.30	50.35	1.9	<3.97	9.01	17.70	26.71

Table 7. PCB results for floodplain soils from Little Bayou Creek, collected October 1-2, 2004.

Station	Date	Sample	Sample			Aroclor Conc. (µg/Kg)			
			Wet Wt. (g)	Dry Wt. (g)	% Moisture	1248	1254	1260	Total
LB2A	10/1/04	PFP1	50.86	48.84	4.0	<4.10	158.56	187.02	345.58
LB2A	10/1/04	PFP2	50.89	47.70	6.3	<4.19	179.00	288.65	467.64
010+011	10/1/04	PFP1	50.51	47.42	6.1	<4.22	<4.22	<4.22	<4.22
010+011	10/1/04	PFP2	49.99	48.48	3.0	<4.13	4.47	8.53	13.00
LB2	10/1/04	PFP1	51.79	49.53	4.4	218.12	<4.04	105.28	323.40
LB2	10/1/04	PFP2	50.30	48.11	4.4	<4.16	21.95	57.50	79.45
LB3	10/1/04	PFP1	51.00	50.31	1.4	104.48	75.71	59.24	239.42
LB3	10/1/04	PFP2	50.98	50.32	1.3	143.09	114.62	158.29	416.00
LB4	10/1/04	PFP1	50.65	45.69	9.8	<4.38	24.69	49.80	74.49
LB4	10/1/04	PFP2	50.52	46.34	8.3	<4.32	23.47	53.72	77.19

Table 8. Mean PCB results for floodplain soil samples from Bayou Creek system collected October 1-2, 2004.

	Aroclor Conc. (µg/Kg)			
Station	1248	1254	1260	Total
BB1A	N.D.	N.D.	N.D.	N.D.
BB1	N.D.	17.97	64.29	50.12
BB2A	N.D.	5.19	8.87	14.06
BB2	N.D.	N.D.	N.D.	N.D.
BB3	N.D.	5.16	4.08	6.66
008	73.45	10.48	12.89	54.86
BB4	N.D.	6.85	10.20	17.05
006	N.D.	8.97	8.02	16.99
BB5	N.D.	10.14	11.70	16.77
001	N.D.	18.68	50.99	69.67
BB6	N.D.	18.37	8.22	17.40
BB7	N.D.	8.39	18.67	22.87
BB8	N.D.	6.02	16.53	22.55
BB9	N.D.	7.71	13.94	21.64
LB2A	N.D.	168.78	237.83	406.61
010+011	N.D.	4.47	8.53	13.00
LB2	218.12	21.95	81.39	201.42
LB3	123.78	95.16	108.76	327.71
LB4	N.D.	24.08	51.76	75.84

Figure 1. Mean PCB concentrations in sediments from Big Bayou Creek collected October 1-2, 2004.

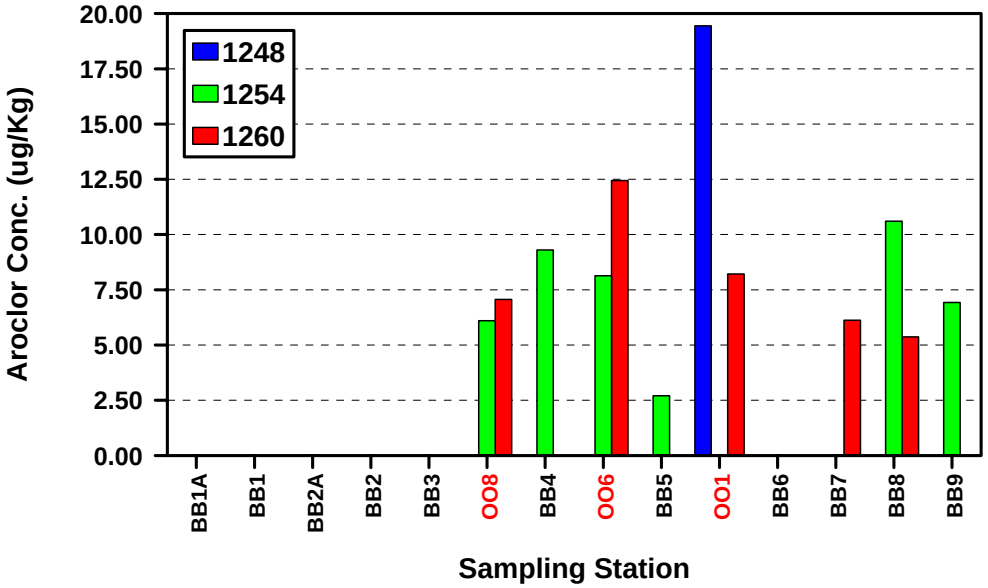

Figure 2. Mean total PCB concentrations in sediments from Big Bayou Creek collected October 1-2, 2004.

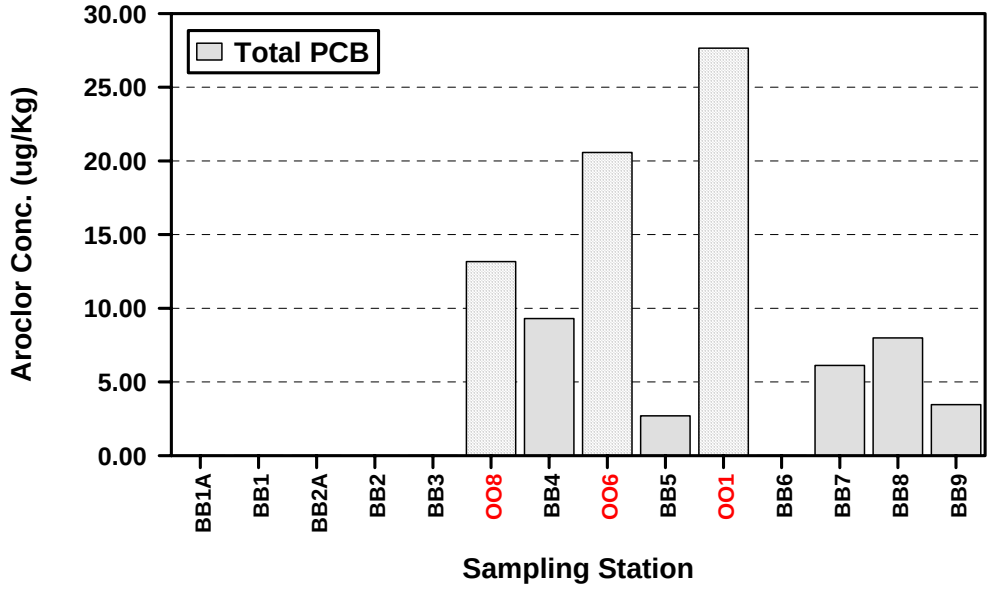

Figure 3. Mean PCB concentrations in sediments from Little Bayou Creek collected October 1-2, 2004.

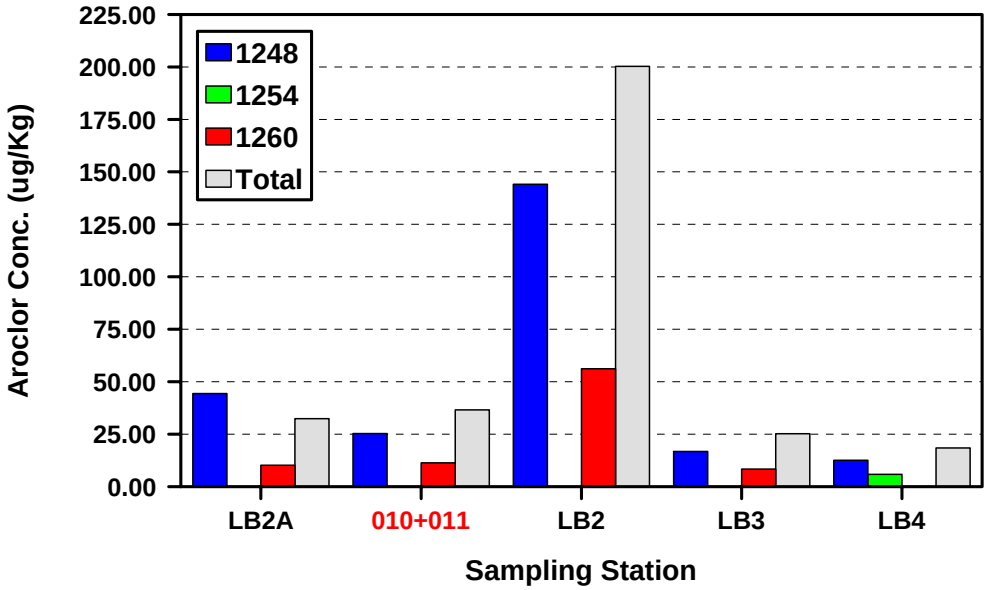

Figure 4. Mean PCB concentrations in floodplain soils from Big Bayou Creek collected October 1-2, 2004.

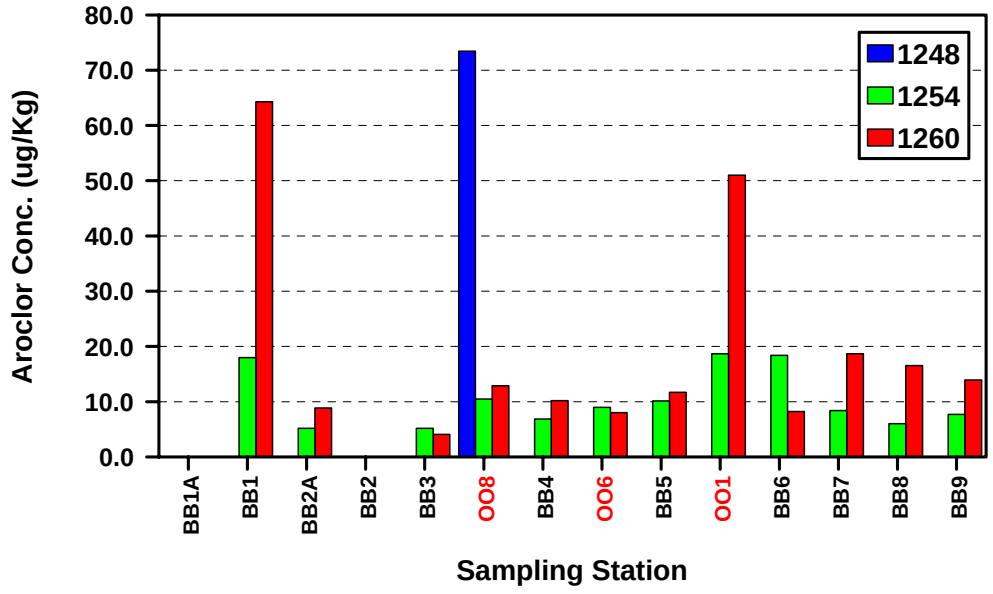

Figure 5. Mean total PCB concentrations in floodplain soils from Big Bayou Creek collected October 1-2, 2004.

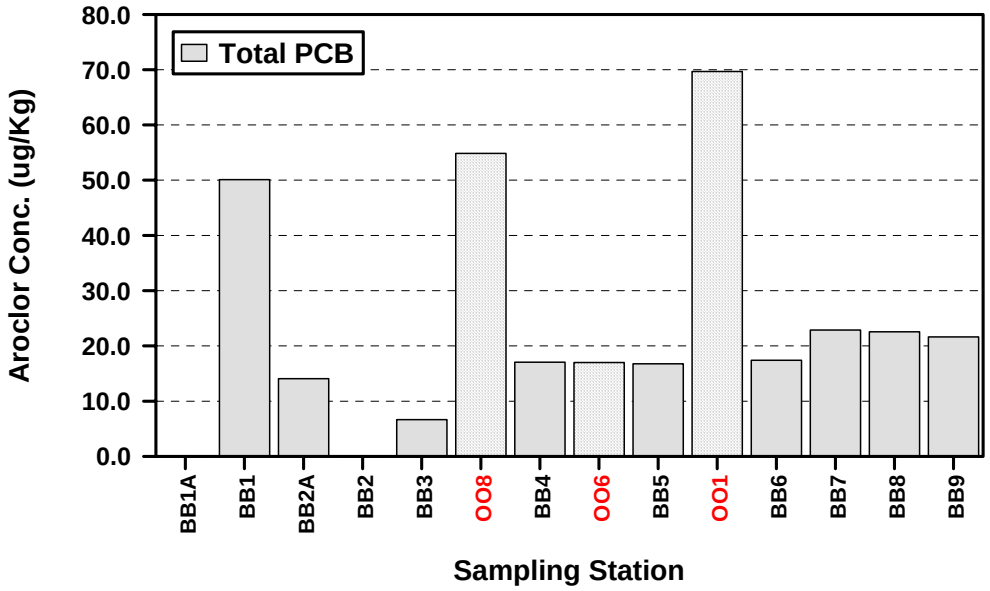

Figure 6. Mean PCB concentrations in floodplain soils from Little Bayou Creek collected October 1-2, 2004.