SEDIMENT CONTAMINANTS
IN
SELECTED SARASOTA BAY
TRIBUTARIES

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Sediment Contaminants in Selected Sarasota Bay Tributaries

As a portion of the monitoring performed for the Sarasota Bay National Estuary Program, Mote Marine Laboratory also conducted a sediment monitoring program. This task was to determine the degree of sediment contamination for selected classes of compounds, in particular toxic metals and organics. Sampling and analyses were performed for 105 stations in 35 different regions. Regions were selected in areas where gradients were expected to be present (tributaries, marina operations, known discharges and the like), but were primarily located within Sarasota Bay proper or only short distances upstream in various tributaries.

In the Point and Non-Point Source Loading Assessment of Sarasota Bay being performed by Camp Dresser & McKee, Inc., the role that tributaries play in transporting contaminants to the Bay was to be investigated. Some removal of pollutants may be expected to occur within the tributaries themselves, and to evaluate this, additional sediment contaminant data was required upstream of the stations collected by MML for the sediment monitoring program. In addition, CDM was interested in sediment nutrient content which was not a portion of the MML program.

Sediment collections for the MML program had already taken place by the time the additional analyses required by CDM had been authorized by the project office. A decision was made, however, to employ whatever data had been already generated, merely filling in parameters as needed. Accordingly, all stations designated with a suffix of "A", "B", or "C", were MML stations. All data presented for these stations were from samples collected during April of 1991, with the exception of sediment nutrient content, which was from samples collected during August, 1991. Some of these stations were also those requested by CDM, but they were not resampled for other than nutrients for monetary reasons.

Those stations requested by CDM and not a portion of the MML program were designated with suffixes of "-1", "-2", and "-3", and all data presented for them were from samples collected in August 1991. Station designations, therefore, range from most upstream to downstream as "-1", "-2", "-3", "A", "B, "C", and are presented in this order in Tables 1 and 2. Data for those stations which are a seaward extension of those requested by CDM are presented as well, but do not have sediment nutrient information. Station positions were drawn from triangulation with identifiable landmarks on shore, transferred to nautical charts or U.S.G.S. quadrangles, and latitude and longitude determined from these positions. Stations are illustrated in Figures 1 through 4. Depth data given are for descriptive purposes only as no tidal corrections were performed. Replicate samples were collected for contaminant analyses at each station, but only one sample was to be analyzed for sediment physical characteristics (grain size, percent moisture, etc.).

Analyses were performed according to Plumb (1981), Folk (1974), and FDER (1987). Percent moisture and percent organics were determined at 105°C and combustion at 550°C, respectively. Sediment grain size data was determined through wet and dry sieving and mean and median particle sizes are given in units of phi, or the negative log (to the base 2) of the particle diameter in millimeters. For this scale, the larger the phi size, the smaller the particle diameter, with 2.0 phi equivalent to 0.25 mm and 4.0 phi to 0.063 mm. Nutrient concentrations were determined on wet sediments and converted to a dry weight basis with station specific percent moisture data.

Metal concentrations, with the exception of mercury, were determined following an extended digestion which included nitric, perchloric, and hydrofluoric acids to obtain complete dissolution of samples. The resulting digestate was then analyzed via atomic absorption spectrophotometry, using both electrothermal and flame atomization, depending on element concentration. Mercury was analyzed from field moist samples, via cold vapor atomic absorption, following an acid and permanganate low temperature digestion. All concentrations are presented on a dry weight basis. The protocols employed for these samples were those specified in the EPA approved Quality Assurance Plan for the MML program.

In addition to the sediment metal concentrations presented in Table 2, an enrichment factor has been calculated according to Schropp and Windom (1988). For this determination, a large number of sediments from "pristine" areas within Florida have been used to determine a log:log regression of metal content of a sediment as a function of the concentration of aluminum. The basis for this relationship is that aluminosilicate minerals contain the bulk of the remaining trace metals in unimpacted environments, and in a sediment sample where high proportions of clay fines are present, both aluminum and remaining metal concentrations would be expected to be high.

From the regressions of aluminum versus metals, 95% confidence intervals have been computed. For any given aluminum value, the highest metal concentration that could still be significantly a part of the relationship developed for pristine sediments can also be computed. The enrichment ratio is then the observed metal concentration, divided by the highest metal to be expected in pristine sediments (based on the observed aluminum concentration). Enrichment ratios less than 1.0 are within the 95% confidence interval for pristine sediments, while those greater than 1.0 could be considered contaminated.

Mercury concentrations, however, do not display the same type of linear relationship with aluminum, and may correlate more strongly with sediment organic content in many instances. FDER has, therefore, and again on the basis of the data base from pristine sediment, assigned a ceiling of 0,2 µg/g, above which sediments are contaminated. Enrichment factors for this element are the observed concentration divided by 0.2.

A magnetic file of these data in dBase III+ format is also supplied. Field identifiers and units of measure are identical to those appearing in Tables 1 and 2 and are listed in Table 3.

Literature Cited

Florida Department of Environmental Regulation. 1987. Estuarine Chemical Handbook. Office of Coastal Management, Tallahassee, FL.

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Plumb, R.H., Jr. 1981. Procedure for Handling and Chemical Analysis of Sediment and Water Samples. Technical Report EPA/CE-81-1. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Schropp, S.J. and H.L. Windom, Editors. 1988. A Guide to the Interpretation of Metal Concentrations in Estuarine Sediments. Florida Department of Environmental Regulation. Tallahassee, FL.

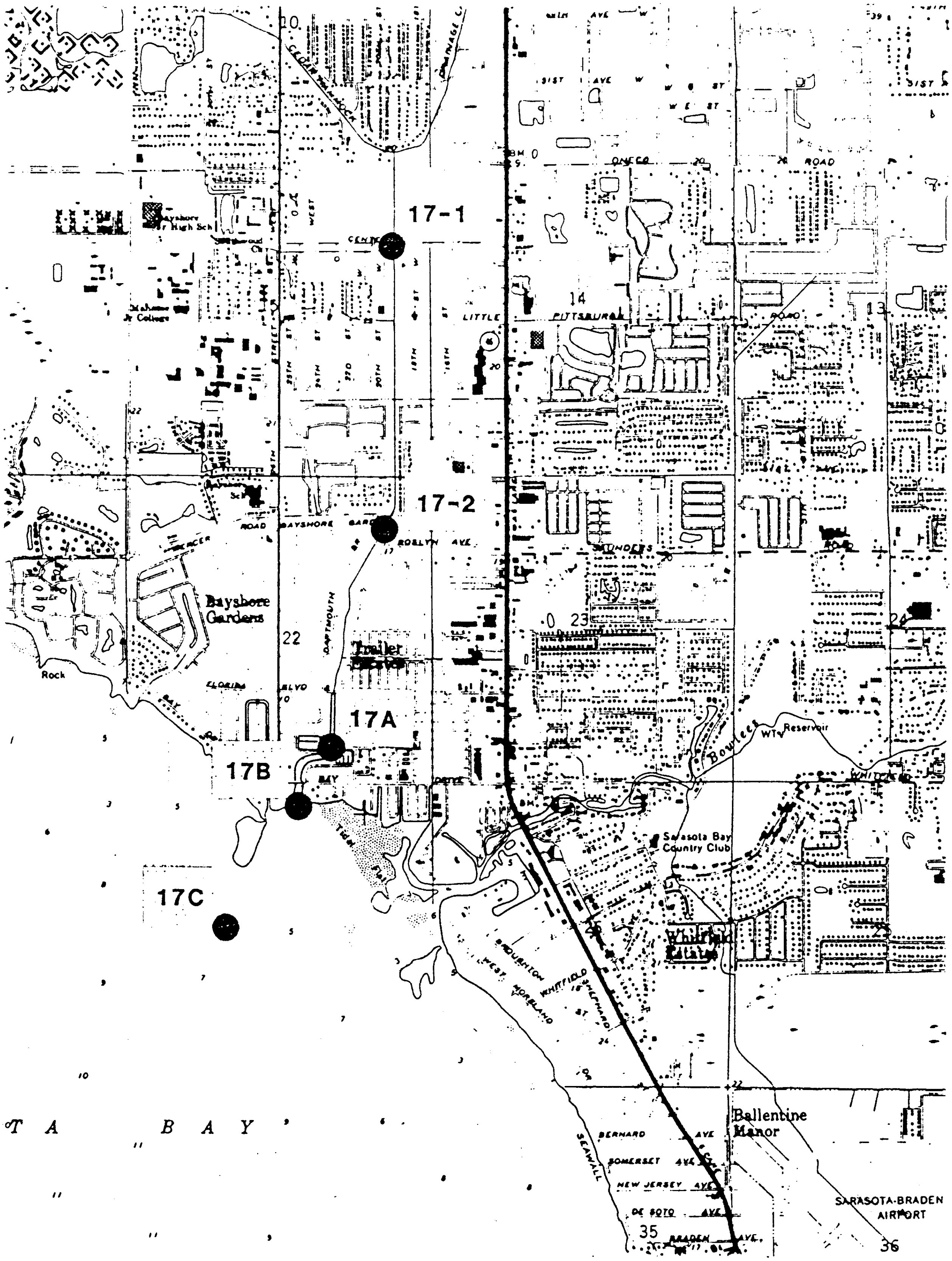

Figure 1. Cedar Hammock sediment contaminant stations.

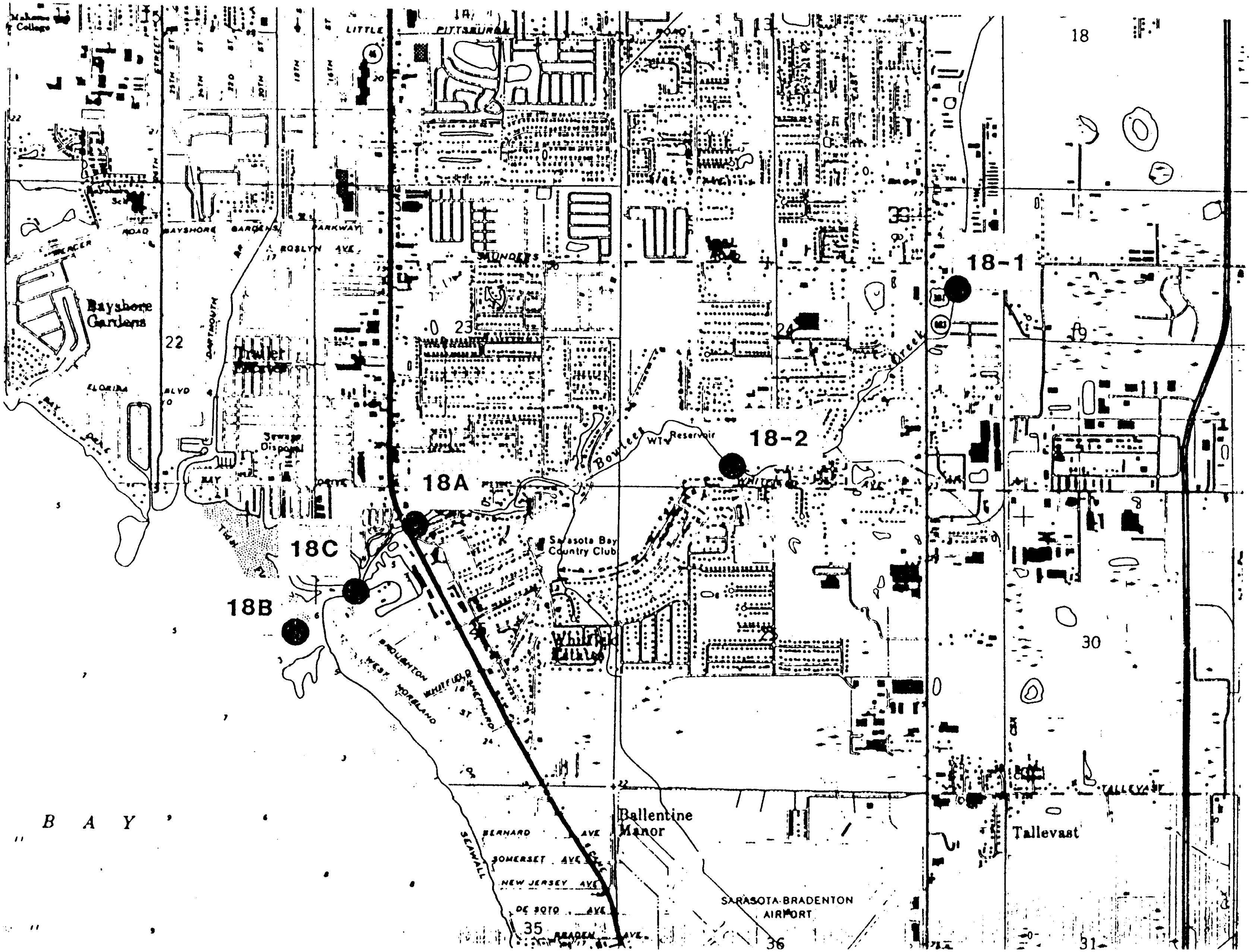

Figure 2. Bowlees Creek sediment contaminant stations.

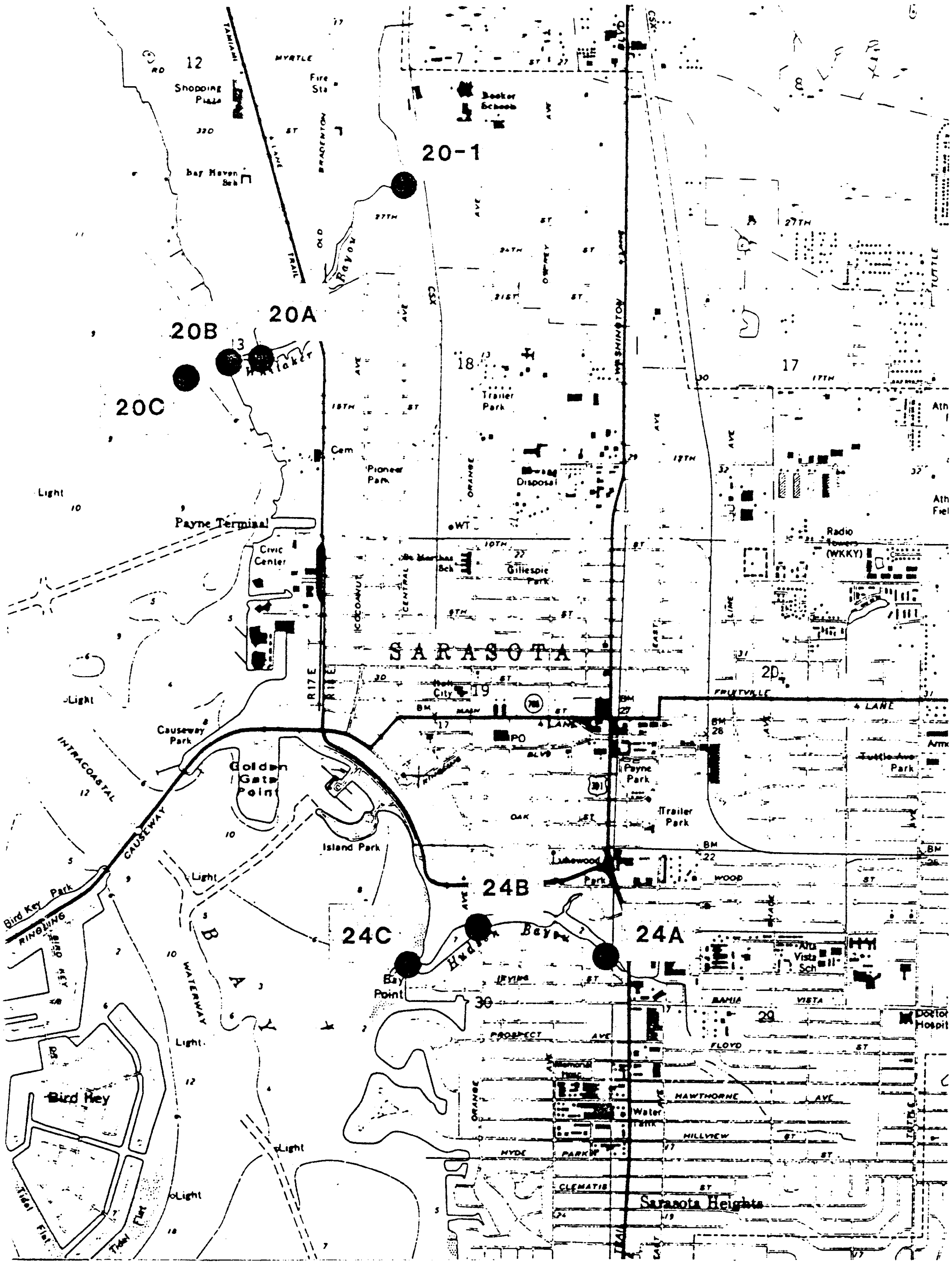

Figure 3. Whitaker Bayou and Hudson Bayou sediment contaminant stations.

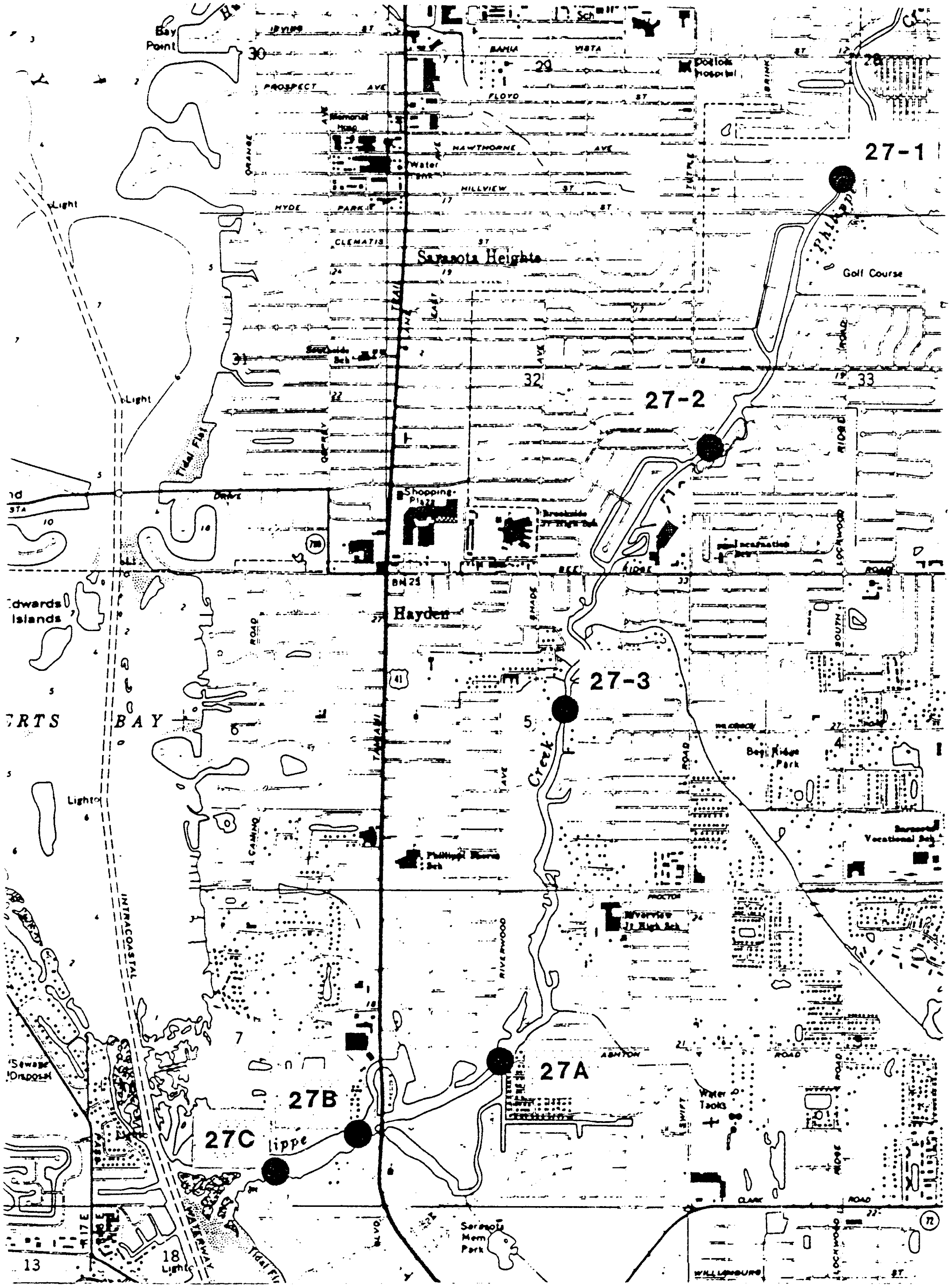

Figure 4. Philippe Creek sediment contaminant stations.

Table 1. Station locations, physical parameters, grain size, and nutrient concentrations of Sarasota Bay tributary sediments. Nutrients are per dry weight of sediment.

Basin	Lat (DDMMSS)	Long (DDMMSS)	Station	Date	Depth (m)	Percent Moisture (%)	Percent Organics (%)	Percent Silt/Clay (%)	Mean (Phi)	Median (Phi)	Skewness (Phi)	Kurtosis	Sorting Coefficient	TKN (mg/g)	Total P (mg/g)
Cedar Hammock	823454	272637	17-1	8/ 6/91	0.8	35.8	1.8	1.5	2.52	2.52	-.15	2.03	.80	.64	1.04
			17-1	8/ 6/91										.85	.16
	823455	272552	17-2	8/ 6/91	1.0	33.9	2.1	3.9	2.58	2.55	.09	1.51	.64	1.05	.45
			17-2	8/ 6/91										1.22	.41
	823511	272511	17A	4/10/91	1.9	79.4	21.0	70.8	3.96	4.29	-.52	1.07	.91	8.08	2.85
			17A	4/10/91										7.71	2.73
	823517	272459	17B	4/10/91	1.5	65.7	12.7	7.7	2.74	2.62	.38	1.41	.67		
			17B	4/10/91											
	823529	272441	17C	4/10/91	1.5	70.2	11.9	28.8	3.16	2.87	.28	.76	1.07		
			17C	4/10/91											
Bowlees Creek	823243	272542	18-1	8/ 6/91	<0.5	25.2	.3	.7	2.74	2.66	.26	1.07	.56	.08	.48
			18-1	8/ 6/91										.09	.67
	823325	272509	18-2	8/ 6/91	0.8	25.8	.4	.9	2.57	2.53	.04	1.37	.68	.12	.47
			18-2	8/ 6/91										.14	.37
	823429	272459	18A	4/10/91	1.8	38.2	2.9	3.9	2.30	2.43	-.34	2.69	1.06	1.81	.73
			18A	4/10/91										1.98	.78
	823439	272447	18B	4/10/91	1.9	76.8	17.0	39.5	3.33	3.29	-.06	.79	1.2		
			18B	4/10/91											
	823447	272442	18C	4/10/91	1.4	68.8	15.1	6.9	2.93	2.82	.26	.86	.71		
			18C	4/10/91											
Whitaker Bayou	823234	272144	20-1	8/ 6/91	1.1	48.3	9.9	34.7	2.85	2.75	-.04	.81	1.59	1.10	2.51
			20-1	8/ 6/91										1.86	3.21
	823302	273612	20A	4/15/91	2.1	74.8	21.2	78.2	4.21	4.36	-.45	1.69	.74	5.55	3.06
			20A	4/15/91										5.42	2.96
	823308	272110	20B	4/15/91	1.9	24.1	.7	1.0	2.11	2.30	-.37	1.58	1.24		
			20B	4/15/91											
	823315	272108	20C	4/15/91	3.5	27.3	1.5	2.4	2.71	2.66	-.01	1.06	.84		
			20C	4/15/91											

Source: Mote Marine Laboratory, 1992.

Table 1. Continued. Station locations, physical parameters, grain size, and nutrient concentrations of Sarasota Bay tributary sediments. Nutrients are per dry weight of sediment.

Basin	Lat (DDMMSS)	Long (DDMMSS)	Station	Date	Depth (m)	Percent Moisture (%)	Percent Organics (%)	Percent Silt/Clay (%)	Mean (Phi)	Median (Phi)	Skewness (Phi)	Kurtosis	Sorting Coefficient	TKN (mg/g)	Total P (mg/g)
Hudson Bayou	823153	271932	24A	4/15/91	1.3	52.6	7.9	15.2	2.18	2.09	.05	1.15	1.60	2.95	1.08
			24A	4/15/91										2.77	1.23
	823218	271935	24B	4/15/91	3.0	74.4	21.7	71.3	4.07	4.30	-.48	1.24	.82	5.09	2.58
			24B	4/15/91										4.93	2.46
	823233	271927	24C	4/15/91	1.4	25.8	1.4	3.4	2.41	2.46	-.06	1.38	.84		
			24C	4/15/91											
Phillippi Creek	823022	271859	27-1	8/ 6/91	1.0	27.4	1.4	2.5	2.74	2.64	.10	1.26	.72	.42	1.23
			27-1	8/ 6/91										.51	1.20
	823115	271732	27-3	8/ 6/91	1.9	23.5	.6	.9	1.46	1.49	-.06	1.38	.79	.15	.88
			27-3	8/ 6/91										.38	1.40
	823126	271633	27A	4/15/91	0.7	26.1	.7	1.1	2.15	2.25	-.23	.82	.63	.28	.98
			27A	4/15/91										.27	1.01
	823157	271621	27B	4/15/91	1.6	23.4	.9	2.0	2.02	2.04	-.04	.81	.71	.44	1.17
			27B	4/15/91										.32	1.25
	823213	271615	27C	4/15/91	1.3	27.4	1.3	1.7	2.10	2.29	-.32	1.40	1.42		
			27C	4/15/91											

Source: Mote Marine Laboratory, 1992.

Table 2. Concentrations and enrichment factors for metals in Sarasota Bay tributary sediments. Units are per dry weight of sediment. Enrichment factors calculated per Schropp and Windom (1988).

	Station	Aluminum (ug/g)	Arsenic (ug/g)	Arsenic Enrich Factor	Cadmium (ug/g)	Cadmium Enrich Factor	Copper (ug/g)	Copper Enrich Factor	Lead (ug/g)	Lead Enrich Factor	Mercury (ug/g)	Mercury Enrich Factor	Zinc (ug/g)	Zinc Enrich Factor
Cedar Hammock	17-1	779	.26	.0	.009	.0	9.43	1.6	9.2	4.1	.019	.1	27.3	4.7
	17-1	828	.27	.0	.028	.1	10.25	1.7	11.4	4.9	.026	.1	41.7	6.9
	17-2	2443	.36	.0	.019	.1	26.20	2.6	32.0	6.3	.044	.2	47.3	3.6
	17-2	2577	.49	.0	.139	.4	16.80	1.6	45.5	8.7	.026	.1	62.4	4.6
	17A	21474	11.62	.2	.714	1.1	140.51	4.8	130.5	5.3	.258	1.3	94.6	1.5
	17A	31914	8.55	.1	.052	.1	166.25	4.7	131.4	4.0	.248	1.2	206.4	2.5
	17B	13938	5.52	.1	.134	.2	43.77	1.9	44.7	2.5	.111	.6	74.5	1.7
	17B	16644	5.92	.1	.337	.6	57.66	2.3	77.0	3.8	.117	.6	103.7	2.0
	17C	23882	5.10	.1	.152	.2	24.62	.8	25.8	1.0	.077	.4	60.3	.9
	17C	18199	11.58	.2	.243	.4	29.39	1.1	30.6	1.4	.081	.4	61.5	1.1
Bowlees Creek	18-1	794	.38	.1	.068	.3	2.28	.4	3.4	1.5	.005	.0	6.3	1.1
	18-1	810	.42	.1	.055	.2	2.10	.3	2.2	1.0	.005	.0	6.3	1.1
	18-2	1257	.36	.0	.107	.4	1.68	.2	9.4	3.0	.007	.0	17.0	2.1
	18-2	1179	.23	.0	.251	.9	2.81	.4	4.4	1.5	.007	.0	11.9	1.5
	18A	7910	2.90	.1	.113	.2	30.00	1.7	108.5	9.2	.045	.2	68.9	2.3
	18A	3753	1.94	.1	.352	.9	21.03	1.7	17.6	2.6	.029	.1	42.4	2.4
	18B	19159	3.91	.1	.356	.6	48.38	1.8	46.9	2.1	.116	.6	101.3	1.8
	18B	26638	10.85	.2	.246	.4	55.50	1.7	57.3	2.0	.159	.8	157.7	2.2
	18C	26652	8.58	.1	.348	.5	46.92	1.5	67.5	2.4	.109	.5	147.4	2.1
	18C	26827	14.92	.2	.358	.5	39.71	1.2	45.6	1.6	.080	.4	105.4	1.5
Whitaker Bayou	20-1	7435	3.53	.1	.112	.2	11.09	.6	24.7	2.2	.074	.4	47.9	1.7
	20-1	12741	3.57	.1	.149	.3	11.10	.5	15.1	.9	.099	.5	41.1	1.0
	20A	16561	8.78	.2	.281	.5	83.09	3.3	66.9	3.3	.230	1.2	189.3	3.7
	20A	15347	7.79	.2	.240	.4	83.39	3.4	73.7	3.9	.210	1.1	202.1	4.2
	20B	788	1.07	.2	.013	.1	6.14	1.0	.7	.3	.007	.0	6.8	1.2
	20B	838	.84	.1	.033	.1	1.45	.2	2.8	1.2	.008	.0	7.8	1.3
	20C	2382	1.20	.1	.051	.2	2.07	.2	5.6	1.1	.018	.1	6.8	.5
	20C	1286	1.50	.2	.006	.0	9.84	1.3	3.0	.9	.018	.1	6.2	.8

Table 2. Continued. Concentrations and enrichment factors for metals in Sarasota Bay tributary sediments. Units are per dry weight of sediment. Enrichment factors calculated per Schropp and Windom (1988).

	Station	Aluminum (ug/g)	Arsenic (ug/g)	Arsenic Enrich Factor	Cadmium (ug/g)	Cadmium Enrich Factor	Copper (ug/g)	Copper Enrich Factor	Lead (ug/g)	Lead Enrich Factor	Mercury (ug/g)	Mercury Enrich Factor	Zinc (ug/g)	Zinc Enrich Factor
Hudson Bayou	24A	3148	3.37	.2	.331	.9	24.25	2.1	117.6	19.4	.080	.4	109.4	7.0
	24A	7392	3.20	.1	.052	.1	43.64	2.5	121.0	10.8	.095	.5	76.4	2.7
	24B	19127	7.99	.2	.127	.2	73.06	2.7	199.2	8.9	.266	1.3	82.4	1.5
	24B	27292	8.81	.1	.599	.9	92.45	2.8	195.1	6.7	.336	1.7	214.1	2.9
	24C	2151	.71	.1	.332	1.0	3.72	.4	6.7	1.5	.009	.0	6.4	.5
	24C	1084	.62	.1	.041	.2	1.94	.3	3.0	1.1	.008	.0	5.9	.8

Phillippi Creek	27-1	3019	.61	.0	.254	.7	6.38	.6	6.6	1.1	.014	.1	13.7	.9
	27-1	3844	.46	.0	.120	.3	6.26	.5	6.2	.9	.011	.1	18.7	1.0
	27-3	1175	.95	.1	.167	.6	4.67	.7	5.3	1.8	.008	.0	7.1	.9
	27-3	2532	1.38	.1	.055	.2	9.30	.9	8.4	1.6	.013	.1	17.7	1.3
	27A	713	.83	.1	.191	.8	3.43	.6	3.8	1.8	.005	.0	4.2	.8
	27A	1247	1.03	.1	.156	.6	2.74	.4	4.5	1.5	.007	.0	6.0	.7
	27B	1626	1.64	.2	.115	.4	5.77	.7	12.0	3.2	.014	.1	7.8	.8
	27B	1724	1.62	.1	.142	.5	3.60	.4	10.0	2.6	.010	.1	6.5	.6
	27C	1208	1.03	.1	.137	.5	.92	.1	2.3	.7	.004	.0	1.9	.2
	27C	1161	1.65	.2	.074	.3	1.32	.2	2.4	.8	.007	.0	3.4	.4

Source: Mote Marine Laboratory, 1992.

Table 3. Field names, contents, and units of file CDMDBSED.DBF

BASIN	Tributary name	NA
LAT	Latitude	DDMMSS
LONG	Longitude	DDMMSS
STATION	Station Identifier	See Text
DATE	Date	MM/DD/YY
DEPTH	Depth	Meters
ALUMINUM	Aluminum	µg/g dry weight
ARSENIC	Arsenic	µg/g dry weight
ASENR	Arsenic Enrichment Factor	unitless
CADMIUM	Cadmium	µg/g dry weight
CDENR	Cadmium Enrichment Factor	unitless
COPPER	Copper	µg/g dry weight
CUENR	Copper Enrichment Factor	unitless
LEAD	Lead	µg/g dry weight
PBENR	Lead Enrichment Factor	unitless
MERCURY	Mercury	µg/g dry weight
HGENR	Mercury Enrichment Factor	unitless
ZINC	Zinc	µg/g dry weight
ZNENR	Zinc Enrichment Factor	unitless
PERMOIS	Percent Moisture	%
PERORG	Percent Organics	%
PERSLTCLY	Percent Silt/Clay (<0.063mm)	%
MEAN	Mean Grain Size	Phi
MEDIAN	Median Grain Size	Phi
SKEW	Skewness of Sediment Distribution	Phi
KURT	Kurtosis of Sediment Distribution	unitless
SORT	Sorting Coefficient	unitless
TKN	Sediment Total Kjeldahl Nitrogen	mg/g dry weight
TOTP	Sediment Total Phosphorous	mg/g dry weight