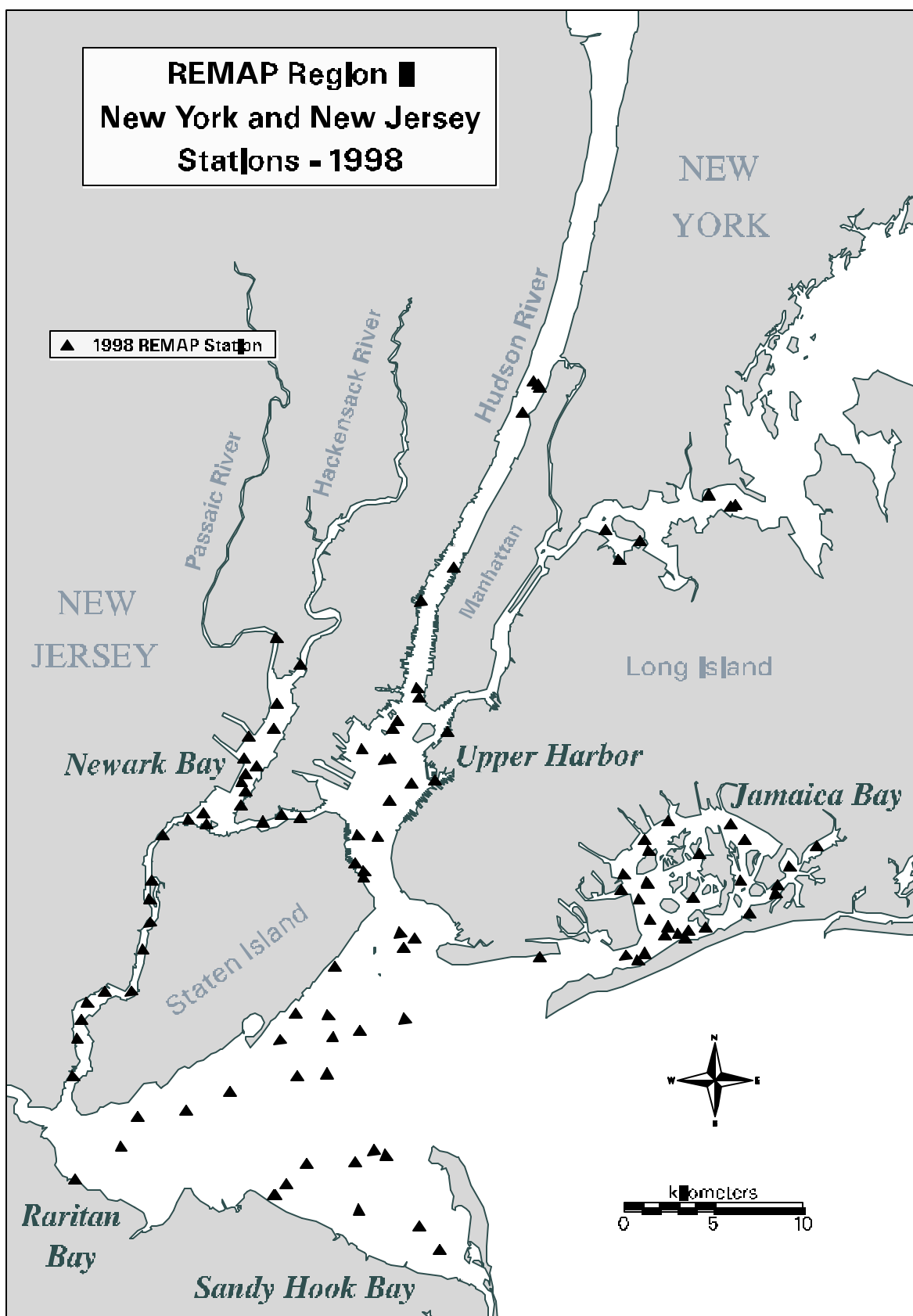
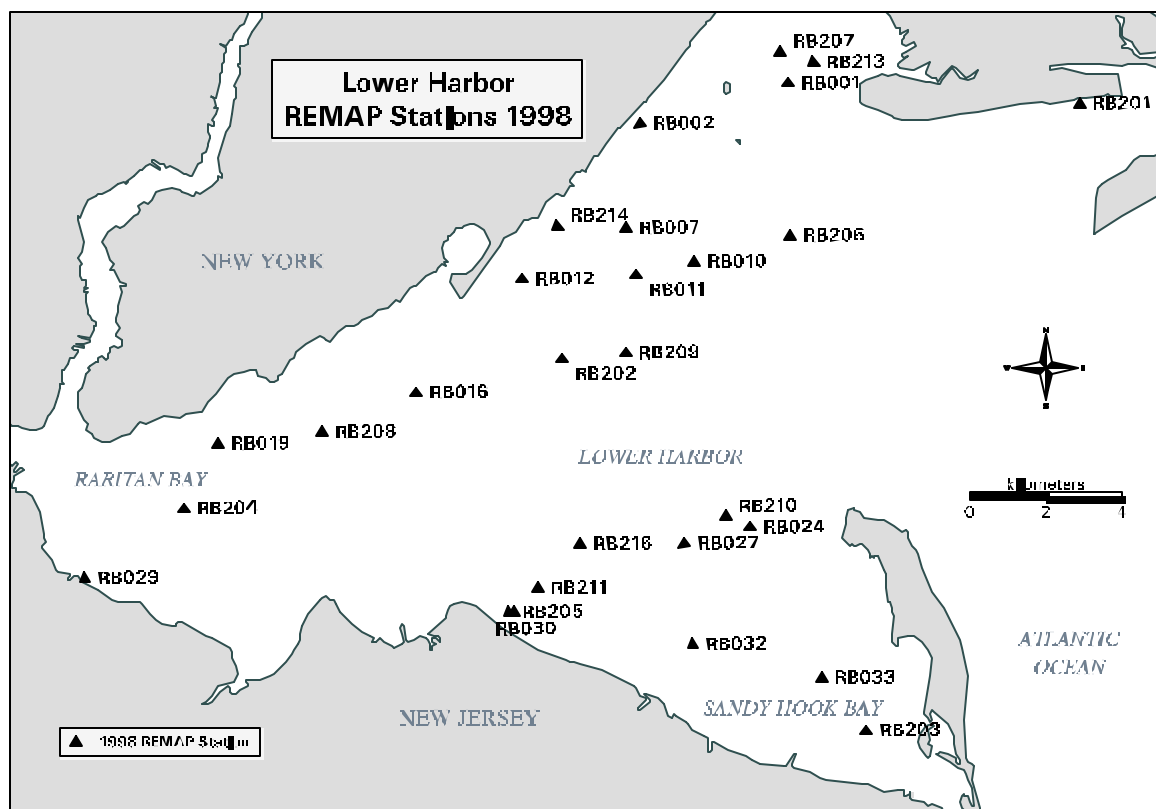
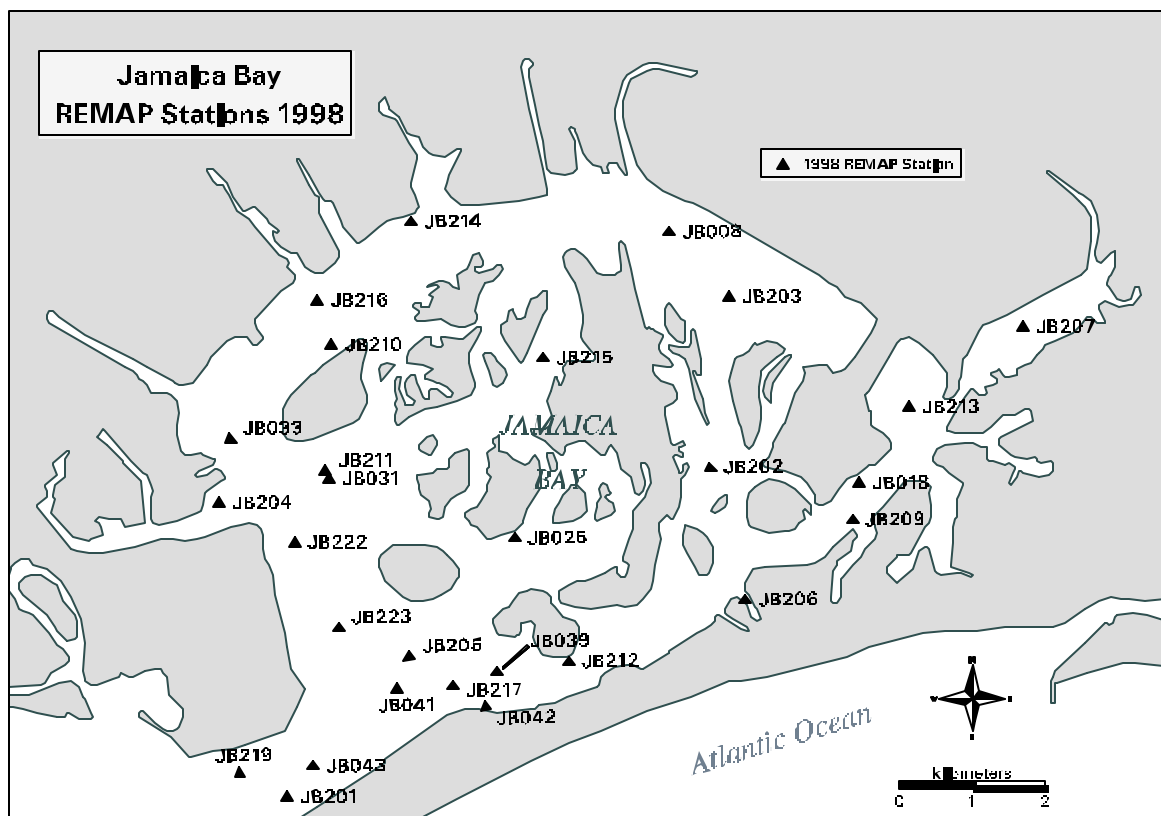
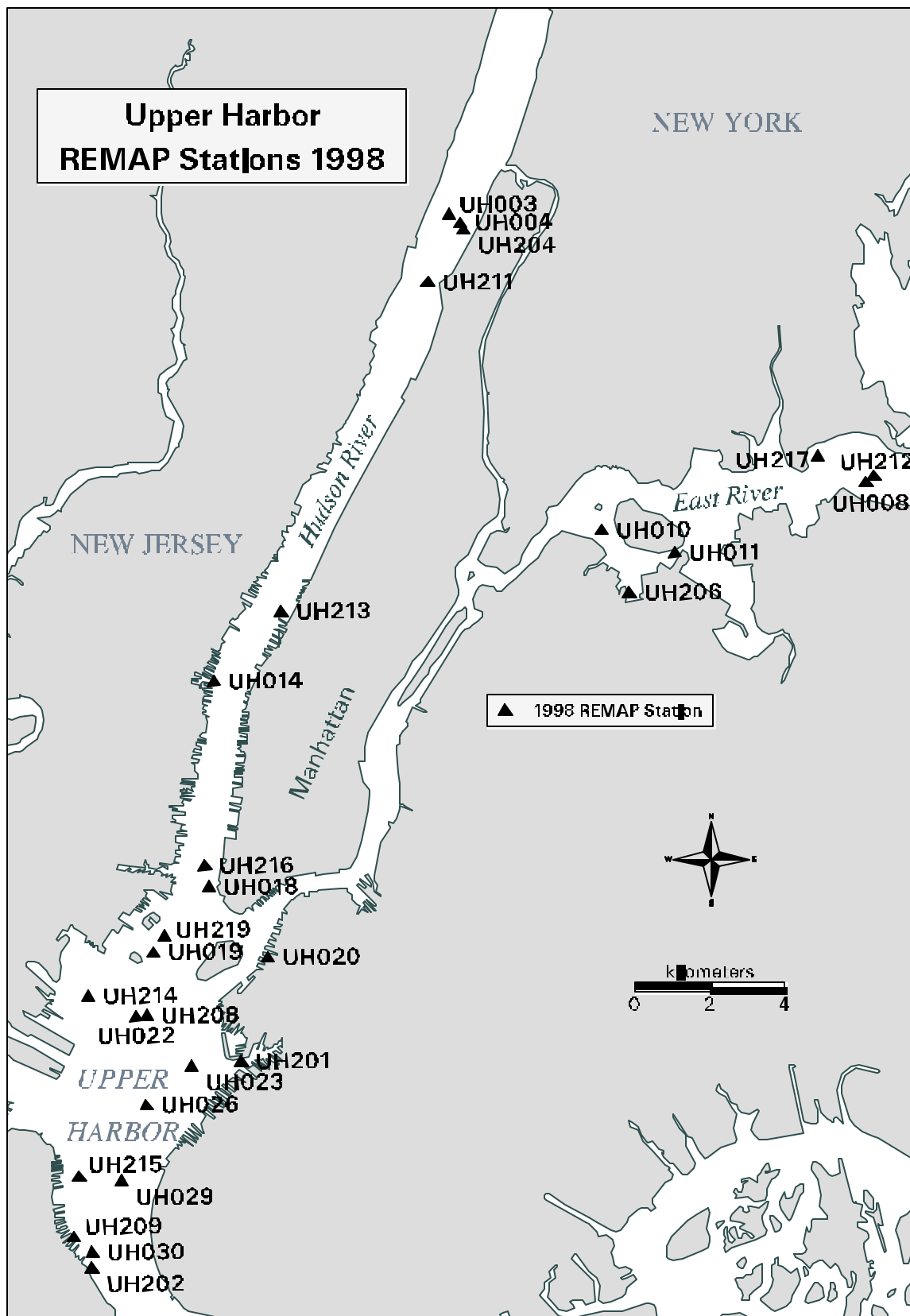


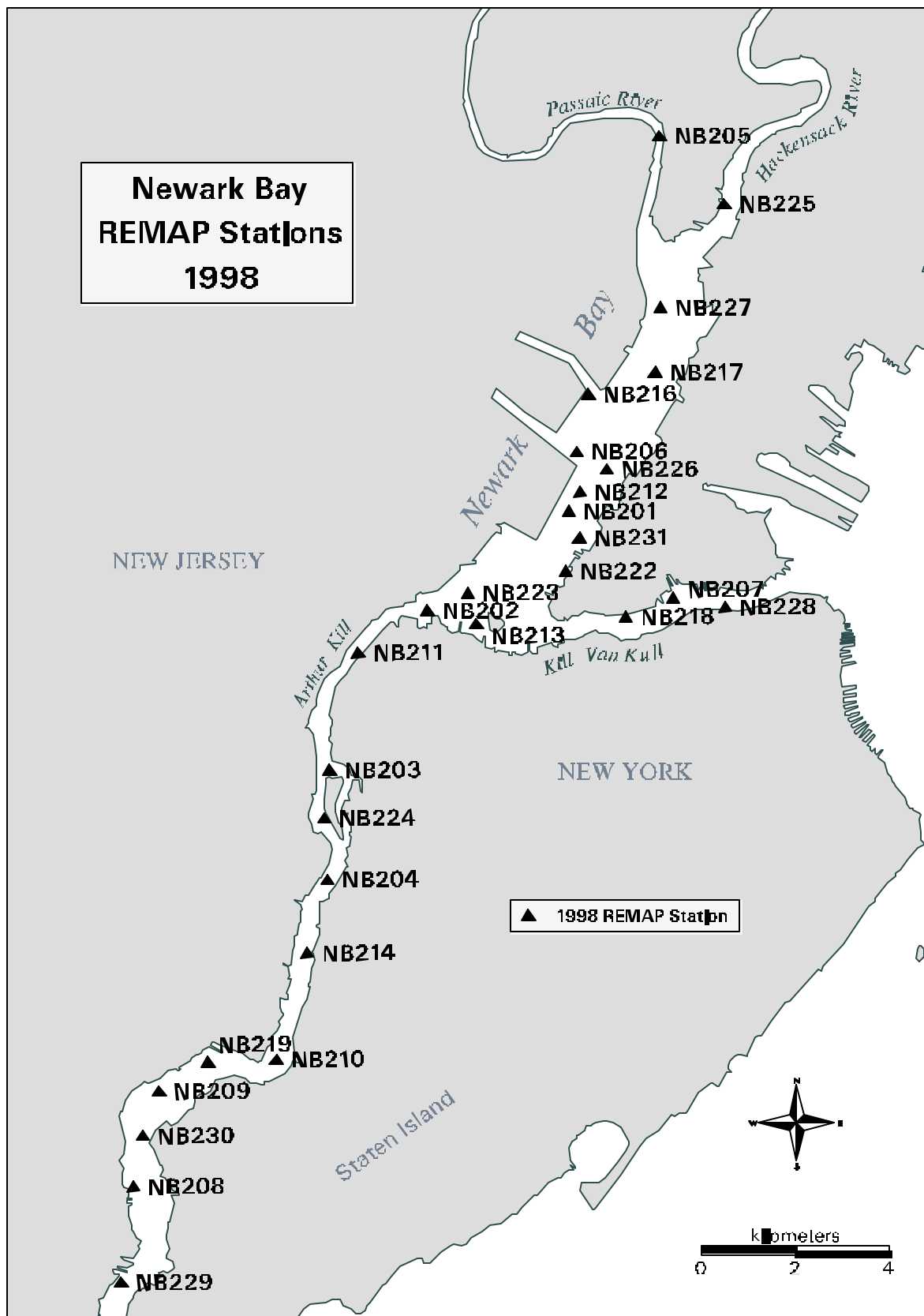
US EPA ARCHIVE DOCUMENT

APPENDIX A
Station Maps









APPENDIX B
Means and Percent of Area Exceedances of ERM_s

Appendix B-1

Area-Weighted Mean Sediment Contaminant Concentrations for the 1993/4 and 1998 Investigations

(± represent 90% confidence intervals)

NA - not analyzed

ND- not detected

* total metal in 1993/4 and total recoverable in 1998

	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
METALS (ug/g,dry wt.)	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Aluminum	43456 ±4229	37490 ±5012	31862 ±3761	34736 ±4092	64633 ±4207	48375 ±3571	38706 ±6466	32611 ±5714	56705 ±4551	50100 ±3706
Antimony	1.49 ±0.48	1.13 ±0.58	0.84 ±0.52	0.65 ±0.14	6.27 ±6.80	2.13 ±0.47	1.24 ±0.30	1.01 ±0.26	1.11 ±0.18	1.42 ±0.39
Arsenic	10.33 ±2.05	9.26 ±1.67	5.07 ±1.26	6.85 ±1.66	25.51 ±20.15	13.51 ±1.93	10.01 ±2.49	9.40 ±2.40	9.04 ±1.14	8.62 ±0.94
Cadmium	0.79 ±0.13	0.67 ±0.43	0.95 ±0.53	0.58 ±0.15	2.52 ±0.58	1.81 ±0.40	0.54 ±0.18	0.45 ±0.14	0.93 ±0.18	1.06 ±0.25
Chromium	78.09 ±10.11	78.18 ±4.26	50.96 ±9.17	55.84 ±8.74	137.31 ±14.08	121.54 ±11.07	71.48 ±15.32	71.39 ±15.35	92.44 ±12.27	95.70 ±10.42
Copper*	72.53 ±17.40	47.64* ±3.72	55.15 ±35.09	34.54* ±10.34	226.69 ±105.28	141.61* ±31.40	47.29 ±16.01	43.5* ±15.92	110.12 ±57.65	81.25* ±20.08
Iron*	23483.6 ±2897.0	19651.0* ±72.53	16883.4 ±3230.7	15043.9* ±3471.4	33980.2 ±3830.8	23535.7* ±2432.2	22170.9 ±4405.9	18937.9* ±4526.3	27269.04 ±3208.9	22725.0* ±2261.5
Lead	78.84 ±12.83	82.23 ±4.81	63.29 ±37.42	57.00 ±13.29	193.92 ±60.70	137.72 ±21.19	63.78 ±17.47	65.26 ±17.27	96.55 ±18.40	128.33 ±34.16
Manganese	495.26 ±44.14	499.82 ±64.16	390.86 ±66.24	499.82 ±60.40	427.94 ±53.12	443.00 ±38.63	481.32 ±63.71	461.11 ±61.98	605.71 ±78.59	654.71 ±80.06
Mercury	0.74 ±0.14	0.86 ±0.54	0.29 ±0.13	0.34 ±0.09	2.59 ±0.58	2.70 ±0.49	0.61 ±0.21	0.67 ±0.24	0.80 ±0.16	1.10 ±0.21

B-1 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Nickel	24.07 ±2.90	25.17 ±2.20	17.80 ±10.31	18.82 ±3.09	50.81 ±8.72	39.01 ±3.39	20.08 ±4.03	21.84 ±3.99	30.92 ±3.80	33.98 ±3.59
Selenium	3.82 ±1.02	0.53 ±0.14	1.34 ±0.56	0.54 ±0.16	10.98 ±4.14	0.89 ±0.13	3.60 ±1.50	0.47 ±0.15	3.41 ±1.28	0.62 ±0.11
Silicon	354788 ±16077	328679 ±16789	349968 ±26009	334607 ±20405	315399 ±16061	319071 ±10002	367569 ±24327	352536 ±19006	330116 ±17836	308500 ±13062
Silver	1.59 ±0.30	1.57 ±0.74	1.14 ±0.42	1.09 ±0.31	2.98 ±0.61	2.52 ±0.33	1.29 ±0.44	1.28 ±0.46	2.28 ±0.46	2.40 ±0.33
Thallium	NA	0.302 ±0.05	NA	0.30 ±0.05	NA	0.41 ±0.05	NA	0.27 ±0.05	NA	0.37 ±0.04
Tin	4.96 ±1.54	10.30 ±5.07	2.84 ±1.43	2.72 ±0.51	15.29 ±13.27	18.15 ±3.60	3.43 ±1.40	6.68 ±2.06	7.45 ±4.44	13.66 8.59
Zinc	170.06 ±25.56	171.21 ±6.58	134.89 ±74.55	113.65 ±25.77	308.04 ±55.85	276.79 ±38.41	162.56 ±37.38	157.52 ±35.03	166.68 ±26.28	206.71 ±37.77
ORGANICS (ng/g,dry wt.)										
Parent DDT	9.57 ±9.38	11.49 ±1.35	0.92 ±0.15	0.11 ±0.18	132.97 ±147.29	175.86 ±135.35	1.28 ±0.31	0.19 ±0.18	0.99 ±0.19	0.71 ±1.17
Total DDD	14.16 ±5.98	4.46 ±2.77	2.83 ±1.32	0.60 ±0.69	122.41 ±89.5	46.72 ±26.9	5.71 ±2.60	1.74 ±1.08	11.94 ±3.60	1.49 ±1.42
DDE	8.53 ±2.54	4.25 ±1.22	3.18 ±1.60	3.05 ±1.25	65.20 ±35.7	24.88 ±9.89	4.04 ±1.66	3.36 ±1.14	7.32 ±2.04	1.18 ±1.09
Total DDT	31.59 ±16.6	20.87 ±2.12	5.95 ±2.90	3.76 ±1.73	320.31 ±257	258.04 ±174	10.28 ±4.52	5.30 ±2.02	19.84 ±5.07	3.38 ±3.02

B-1 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Chlordane	5.11 ±1.01	0.64 ±0.70	5.19 ±2.50	0.61 ±0.54	21.64 ±2.83	1.51 ±1.90	2.95 ±1.21	0.20 ±0.13	6.60 ±1.77	1.74 ±2.70
Dieldrin	0.80 ±0.12	0.02 ±0.13	0.73 ±0.35	ND	2.34 ±0.36	0.12 ±0.14	0.53 ±0.13	ND	1.19 ±0.33	0.08 ±0.14
Endrin	0.67 ±0.19	ND	0.47 ±0.04	ND	0.76 ±0.42	ND	0.51 ±0.05	ND	1.22 ±0.90	ND
Acenaphthene	82.78 ±65.43	36.93 ±3.98	45.05 ±48.02	3.57 ±4.13	92.82 ±30.15	67.14 ±31.46	17.81 ±5.69	2.43 ±2.78	294.62 ±312.96	147.86 ±106.62
Acenaphthylene	122.93 ±41.89	145.85 ±8.47	50.00 ±34.26	25.61 ±14.71	202.46 ±30.69	217.25 ±84.37	40.84 ±14.13	35.21 ±14.98	381.64 ±195.75	515.39 ±465.35
Anthracene	365.05 ±220.76	203.86 ±9.10	151.36 ±144.73	52.32 ±25.17	511.49 ±163.77	517.89 ±305.75	63.54 ±26.52	61.00 ±23.41	1335.14 ±1054.25	594.82 ±460.62
Benzo(a)anthracene	486.83 ±129.35	435.47 ±14.39	231.11 ±185.03	134.14 ±57.68	905.11 ±199.37	754.96 ±286.91	141.74 ±50.53	106.61 ±36.66	1525.6 ±593.1	1475.54 ±1398.60
Benzo(a)pyrene	303.05 ±83.12	571.24 ±16.34	138.96 ±111.32	123.61 ±74.25	516.92 ±79.50	1022.71 ±364.34	113.25 ±40.94	159.68 ±52.97	889.96 ±375.20	1889.11 ±1751.20
Benzo(b,k)fluoranthene	781.78 ±177.51	793.22 ±468.46	531.68 ±415.14	431.57 ±148.29	1669.94 ±264.54	1663.64 ±565.41	294.28 ±99.79	254.54 ±85.43	2107.79 ±769.94	2329.57 ±1750.4
Benzo(g,h,i)perylene	302.69 ±72.98	176.15 ±8.65	186.48 ±173.51	78.57 ±48.01	579.08 ±101.00	298.61 ±176.59	112.75 ±41.96	67.04 ±25.37	849.14 ±315.35	515.11 ±381.15
Biphenyl	32.16 ±11.74	13.97 ±2.61	38.86 ±42.83	5.18 ±3.55	45.73 ±7.67	24.14 ±6.70	15.02 ±4.21	4.82 ±3.43	77.14 ±51.31	42.71 ±25.28
Chrysene	544.76 ±145.85	470.95 ±14.70	313.48 ±271.91	174.32 ±67.00	1076.9 ±217.0	807.46 ±277.92	161.69 ±56.44	121.29 ±38.86	1653.2 ±664.7	1567.00 ±1455.40

Table B-1 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Dibenz(a,h)anthracene	79.42 ±31.10	NA	17.32 ±6.72	NA	146.12 ±25.41	NA	26.66 ±9.59	NA	247.84 ±146.29	NA
2,6-Dimethylnaphthalene	198.15 ±57.34	103.42 ±6.70	582.37 ±382.91	249.14 ±97.93	181.20 ±52.59	104.04 ±29.97	135.41 ±62.49	61.30 ±28.26	219.79 ±95.74	165.25 ±100.37
Fluoranthene	743.25 ±278.61	603.19 ±16.01	568.79 ±481.83	273.93 ±105.42	1280.0 ±397.6	1341.11 ±564.11	201.34 ±80.22	201.79 ±65.30	2308.0 ±1292.0	1748.64 ±1520.30
Fluorene	176.41 ±182.11	38.43 ±4.70	77.62 ±87.06	2.79 ±4.58	107.72 ±23.17	79.32 ±50.95	28.20 ±13.07	7.00 ±8.44	693.43 ±873.05	137.75 ±105.90
Ideno(1,2,3-c,d) pyrene	291.62 ±90.08	143.74 ±9.00	132.04 ±106.36	32.68 ±39.33	575.81 ±74.23	248.64 ±205.51	117.62 ±42.01	32.79 ±20.82	806.89 ±409.94	499.79 ±474.65
2-Methylnaphthalene	89.91 ±42.02	44.81 ±4.62	95.08 ±122.30	12.46 ±6.95	114.36 ±21.63	67.29 ±18.34	33.04 ±13.05	17.79 ±9.20	253.21 ±189.86	134.86 ±94.79
1-Methylnaphthalene	46.37 ±24.30	25.55 ±3.41	59.61 ±81.69	0.96 ±1.59	47.24 ±6.97	31.75 ±9.52	15.16 ±4.83	2.11 ±2.47	135.10 ±109.67	106.20 ±75.66
1-Methylphenanthrene	156.10 ±88.28	44.03 ±5.02	130.93 ±187.12	ND	150.03 ±84.70	75.36 ±90.80	9.65 ±3.57	0.19 ±0.32	615.18 ±414.55	187.89 ±204.98
Naphthalene	163.96 ±100.34	81.79 ±5.81	96.04 ±92.26	31.96 ±11.28	217.87 ±28.42	140.36 ±40.25	48.90 ±16.84	36.61 ±16.30	528.57 ±477.41	224.04 ±133.01
Perylene	333.54 ±113.69	270.29 ±10.81	113.98 ±55.94	117.05 ±43.34	608.35 ±173.42	549.82 ±165.28	127.84 ±47.68	89.18 ±30.08	975.43 ±523.23	805.57 ±699.14
Phenanthrene	628.06 ±520.48	307.76 ±10.46	363.98 ±412.31	129.18 ±43.60	417.30 ±61.09	676.50 ±286.28	116.85 ±45.44	118.29 ±46.65	2368.6 ±2489.5	852.68 ±470.65
Pyrene	767.60 ±269.73	746.74 ±18.02	508.73 ±440.02	288.75 ±116.98	1144.7 ±288.8	1284.32 ±436.20	202.19 ±77.94	207.39 ±66.24	2491.0 ±1255.0	2431.89 ±2106.70

B-1 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
2,3,5-Trimethylnaphthalene	47.00 ±29.87	4.79 ±1.75	183.02 ±287.39	ND	70.47 ±37.44	1.68 ±2.76	9.82 ±2.60	ND	91.21 ±57.89	22.49 ±25.91
Total PAHs	7177.4 ±2607.9	5327.08 ±47.55	4838.5 ±4279.8	2103.47 ±790.81	11471 ±1836.3	10195.82 ±3637.5	2179.2 ±723.5	1605.97 ±532.19	22141 ±12165	16627.29 ±13969

Appendix B-2

Percent of Area Exceeding Sediment Contaminant ERMs (Long & Morgan, 1991; Long et al., 1995a)

($\pm$ represent 90% confidence intervals)

* Copper is total metal in 1993/4 and total recoverable in 1998

	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
METALS	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Antimony	1 (-1-2)	0	0 (0-8)	0	12 (-8-32)	0	0 (0-8)	0	0 (0-8)	0
Arsenic	1 (-1-2)	0	0 (0-8)	0	12 (-8-32)	0	0 (0-8)	0	0 (0-8)	0
Cadmium	0 (0-0)	0	0 (0-8)	0	2 (-1-4)	0	0 (0-8)	0	0 (0-8)	0
Chromium	0 (0-0)	0	0 (0-8)	0	0 (0-0)	0	0 (0-8)	0	0 (0-8)	0
Copper*	3 (1-5)	1.20 ± 0.87	4 (0-13)	0	32 (8-56)	7.14 ± 7.98	0 (0-8)	0	4 (0-13)	3.57 ± 5.75
Lead	4 (2-6)	3.43 ± 1.16	4 (0-13)	0	35 (11-59)	7.14 ± 7.98	0 (0-8)	0	7 (2-18)	14.29 ± 10.85
Mercury	34 (24-44)	41.71 ± 4.18	4 (0-13)	3.57 ± 5.75	91 (82-99)	96.43 ± 5.75	29 (17-42)	32.14 ± 14.47	46 (33-60)	71.43 ± 14.00
Nickel	4 (2-6)	2.17 ± 1.02	4 (0-13)	0	52 (30-73)	10.71 ± 9.59	0 (0-8)	0	4 (0-13)	7.14 ± 7.98
Silver	13 (6-20)	6.41 ± 3.07	7 (2-18)	0	32 (8-56)	17.86 ± 11.87	11 (4-22)	7.14 ± 7.98	18 (9-31)	3.57 ± 5.75

B-2 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Zinc	3 (1-4)	2.17 ±1.02	4 (0-13)	0	35 (11-59)	10.71 ±9.59	0 (0-8)	0	0 (0-8)	7.14 ±7.98
ORGANICS										
Parent DDT	3 (2-4)	3.19 ±0.41	0 (0-8)	0	46 (24-67)	50 ±15.5	0 (0-8)	0	0 (0-8)	0
DDD	12 (6-18)	3.25 ±0.91	0 (0-8)	0	73 (52-94)	39.29 ±15.14	7 (2-18)	0	14 (6-27)	0
p,p'-DDE	3 (2-5)	2.79 ±0.91	0 (0-8)	0	51 (29-73)	32.14 ±14.47	0 (0-8)	0	0 (0-8)	0
Total DDE	13 (7-19)	4.16 ±0.92	4 (0-13)	0	79 (58-99)	53.57 ±15.46	7 (2-18)	0	14 (6-27)	3.57 ±5.75
Total DDT	8 (4-12)	3.93 ±0.92	0 (0-8)	0	65 (44-87)	50 ±15.5	4 (0-13)	0	7 (2-18)	3.57 ±5.75
Chlordane	32 (23-42)	3.93 ±0.92	29 (17-42)	3.57 ±5.75	91 (82-99)	3.57 ±5.75	25 (14-38)	0	39 (27-53)	3.57 ±5.75
Dieldrin	0 (0-0)	0	0 (0-8)	0	0 (0-0)	0	0 (0-8)	0	0 (0-8)	0
Endrin	0 (0-0)	0	0 (0-8)	0	0 (0-0)	0	0 (0-8)	0	0 (0-8)	0

B-2 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998	1993/4	1998
Acenaphthene	1 (0-2)	1.49 ±0.96	4 (0-13)	0	1 (0-1)	0	0 (0-8)	0	4 (0-13)	7.14 ±7.98
Anthracene	6 (3-9)	3.89 ±1.18	4 (0-13)	0	12 (-7-32)	14.29 ±10.85	0 (0-8)	0	21 (12-35)	14.29 ±10.85
Acenaphthylene	3 (1-5)	4.25 ±1.22	0 (0-8)	0	1 (0-1)	10.71 ±9.59	0 (0-8)	0	14 (6-27)	17.14 ±11.87
Benzo(a)anthracene	7 (4-10)	5.14 ±1.26	4 (0-13)	0	10 (0-20)	10.71 ±9.59	0 (0-8)	0	29 (17-42)	21.43 ±12.72
Benzo(a)pyrene	6 (3-9)	6.34 ±1.30	4 (0-13)	0	6 (0-11)	17.14 ±11.87	0 (0-8)	0	25 (14-38)	25.00 ±13.42
Chrysene	4 (2-7)	1.94 ±1.01	4 (0-13)	0	1 (0-1)	7.14 ±7.98	0 (0-8)	0	18 (9-31)	7.14 ±7.98
Dibenz(a,h)anthracene	5 (2-7)	3.43 ±1.16	0 (0-8)	0	3 (0-6)	7.14 ±7.98	0 (0-8)	0	21 (12-35)	14.29 ±10.85
Fluoranthene	3 (0-5)	1.43 ±0.88	4 (0-13)	0	0 (0-0)	10.71 ±9.59	0 (0-8)	0	11 (4-22)	3.57 ±5.75
Fluorene	2 (0-4)	1.71 ±1.00	4 (0-13)	0	1 (0-1)	3.57 ±5.75	0 (0-8)	0	7 (2-18)	7.14 ±7.98
2-Methylnaphthalene	1 (0-2)	0.74 ±0.82	4 (0-13)	0	1 (0-1)	0	0 (0-8)	0	4 (0-13)	3.57 ±5.75
Naphthalene	1 (0-2)	0	0 (0-8)	0	0 (0-8)	0	0 (0-8)	0	4 (0-13)	0

B-2 Continued.	Harbor		Jamaica Bay		Newark Bay		Lower Harbor		Upper Harbor	
Phenanthrene	6 (3-8)	4.63 ±1.23	4 (0-13)	0	1 (0-1)	14.29 ±10.85	0 (0-8)	0	25 (14-38)	17.86 ±11.87
Pyrene	6 (3-9)	5.14 ±1.26	4 (0-13)	0	7 (-2-17)	10.71 ±9.59	0 (0-8)	0	25 (14-38)	21.43 ±12.72
Low molec. wt. PAHs	9 (5-12)	2.23 ±1.06	0 (0-8)	0	4 (0-8)	0	0 (0-8)	0	39 (27-53)	3.57 ±5.75
High molec. wt. PAHs	12 (9-16)	7.59 ±1.36	4 (0-13)	3.57 ±5.75	46 (23-68)	32.14 ±14.47	0 (0-8)	0	43 (30-57)	25.00 ±13.42
Total PAHs	3 (0-5)	0.97 ±0.86	4 (0-13)	0	1 (0-1)	3.57 ±5.75	0 (0-8)	0	11 (4-22)	3.57 ±5.75

APPENDIX C

Lists of Pollution-sensitive and Pollution-indicative benthic organisms for the Harbor

Pollution-Sensitive and Pollution-Indicative Taxa

Pollution-Sensitive Taxa		
Mollusca	Polychaeta	
<i>Acteocina canaliculata</i>	<i>Ampharete arctica</i>	<i>Ninoe nigripes</i>
<i>Tellina agilis</i>	<i>Aricidea catherinae</i>	<i>Polygordius spp.</i>
<i>Spisula solidissima</i>	<i>Caulleriella spp.</i>	<i>Sabaco elongatus</i>
Arthropoda	<i>Clymenella torquata</i>	<i>Scalibregma inflatum</i>
<i>Ampelisca agassizi</i>	<i>Glycinde solitaria</i>	<i>Spiophanes bombyx</i>
<i>Ampelisca verrilli</i>	<i>Levinsenia gracilis</i>	
<i>Byblis serrata</i>	<i>Macroclymene zonalis</i>	
<i>Rheopoxynius hudsoni</i>	<i>Nephtys picta</i>	
Pollution-Indicative Taxa		
Mollusca	Polychaeta	
<i>Mulinia lateralis</i>	<i>Capitella spp.</i>	
Oligochaeta	<i>Polydora cornuta</i>	
Oligochaetes	<i>Streblospio benedicti</i>	

APPENDIX D
Benthic Index Values for Individual Stations

REMAP Benthic Index (B-IBI) Value by Station

Station	B-IBI
JB008	2.20
JB018	1.40
JB026	3.00
JB031	3.00
JB033	3.00
JB039	3.00
JB041	3.00
JB042	3.00
JB043	3.00
JB201	2.60
JB202	3.00
JB203	1.80
JB204	2.60
JB205	3.00
JB206	2.20
JB207	2.60
JB209	3.00
JB210	3.40
JB211	3.40
JB212	2.20
JB213	1.40
JB214	2.60
JB215	3.00
JB216	3.40
JB217	3.00
JB219	2.60
JB222	2.20
JB223	1.80
NB201	1.80
NB202	1.00
NB203	1.40
NB204	1.80
NB205	1.00
NB206	1.40
NB207	1.80
NB208	3.00
NB209	2.60

Station	B-IBI
NB210	2.60
NB211	2.20
NB212	1.80
NB213	1.40
NB214	2.20
NB216	1.00
NB217	1.80
NB218	2.60
NB219	1.80
NB222	1.40
NB223	1.80
NB224	3.40
NB225	2.60
NB226	1.00
NB227	1.80
NB228	3.00
NB229	2.20
NB230	2.20
NB231	1.00
RB001	3.40
RB002	3.40
RB007	4.20
RB010	4.20
RB011	3.40
RB012	4.20
RB016	3.40
RB019	2.60
RB024	3.40
RB027	3.40
RB029	2.20
RB030	3.00
RB032	3.40
RB033	3.40
RB201	3.00
RB202	3.40
RB203	2.60
RB204	3.00

Station	B-IBI
RB205	4.20
RB206	5.00
RB207	3.80
RB208	2.60
RB209	3.80
RB210	3.00
RB211	3.00
RB213	3.80
RB214	3.00
RB216	2.60
UH004	2.60
UH008	1.80
UH010	1.00
UH011	2.60
UH014	1.00
UH018	3.40
UH019	3.40
UH020	3.40
UH022	3.00
UH023	3.00
UH026	3.40
UH029	3.00
UH030	3.40
UH201	1.00
UH202	2.60
UH206	1.00
UH208	3.80
UH209	3.00
UH211	1.80
UH212	2.20
UH213	2.60
UH215	5.00
UH216	3.80
UH217	1.80
UH219	3.80