HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

DECEMBER 2000

For

U.S. Environmental Protection Agency
Region 2
and
U.S. Army Corps of Engineers
Kansas City District

Book 2 of 6
Tables and Figures

TAMS Consultants, Inc.

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CHAPTER 1

Table 1-1
Phase 1 and Phase 2 Reassessment RI/FS Reports

- Phase 1 Report - Interim Characterization and Evaluation (USEPA, 1991a). Responsiveness Summary (USEPA, 1992).

- Database Report-Volume 2A (USEPA, 1995). The database itself is updated periodically, incorporating data generated for this RRI/FS, as well as data generated by others (e.g., NYSDEC and GE). The database release utilized for the FS is Release 5.0 (October 2000). Responsiveness Summary for Volumes 2A, 2B, and 2C (USEPA, 1998a).

- Preliminary Model Calibration Report (PMCR)-Volume 2B (USEPA, 1996a). Responsiveness Summary for Volumes 2A, 2B, and 2C (USEPA 1998a). Response to Peer Review Comments (USEPA, 2000g).

- Data Evaluation and Interpretation Report (DEIR)-Volume 2C (USEPA, 1997a). Responsiveness Summary for Volumes 2A, 2B, and 2C (USEPA, 1998a). Response to Peer Review Comments (USEPA, 2000j).

- Landfill/Treatment Facility Siting Survey (USEPA, 1997b).

- Low Resolution Sediment Coring Report (LRC)-Volume 2C-A , Addendum to the DEIR, (USEPA, 1998b). Responsiveness Summary (USEPA, 1999b). Response to Peer Review Comments (USEPA, 2000j).

- Baseline Modeling Report (BMR)-Volume 2D (USEPA, 1999a). Responsiveness Summary (USEPA, 2000b). Superseded by the Revised Baseline Modeling Report (RBMR) (USEPA, 2000a). Response to Peer Review Comments (USEPA, 2000n).

- Baseline Ecological Risk Assessment (ERA)-Volume 2E (USEPA, 1999c). Responsiveness Summary (USEPA, 2000c). Response to Peer Review Comments (USEPA, 2000k). Baseline Ecological Risk Assessment for Future Risks in the Lower Hudson River- Volume 2E (USEPA, 1999e). Responsiveness Summary (USEPA, 2000c). Revised ERA (USEPA, 2000q)

- Evaluation of Removal Action Alternatives-Thompson Island Pool-Early Action Assessment (USEPA, 1999n).

- Human Health Risk Assessment (HHRA)-Volume 2F, Revised HHRA (USEPA, 2000g). Responsiveness Summary, March 2000. (USEPA, 2000d). Response to Peer Review Comments (USEPA, 2000m). Human Health Risk Assessment for the Mid-Hudson River-Volume 2F-A (USEPA, 1999f). Responsiveness Summary (USEPA, 2000i) Revised HHRA, Vol 2F (USEPA, 2000p).

Table 1-2

NYSDEC *Hot Spot*[1] Summary

Hot Spot Number	Location River Mile[2]		Location Description
1 - 4			See Note 3
5	193.2	193.4	Along west bank, extending almost to east bank
6	192.0	193.1	Both sides of river; west bank RM 192.5 to 193.1; east bank RM 192.0 to 192.8
7	192.2	192.4	West bank
8	191.2	192.0	East bank
9	191.3	191.5	West bank
10	190.9	191.1	West bank
11	190.8	190.8	East bank
12	190.6	190.7	East bank
13	190.5	190.5	West channel at north end of Griffin Island
14	189.9	190.4	East bank main stem, east of Griffin Island
15	189.1	189.6	South end of Griffin Island, along west bank
16	189.1	189.5	West bank
17	189.0	189.0	East side main stem, north Thompson Island, west of canal cut
18	188.5	189.0	West bank
19	188.5	188.5	North end of Thompson Island, center (north) of TI Dam
20	188.5	188.5	West bank main stem, immediately north of TI Dam
21	188.3	188.4	West bank of west channel (west of Thompson Island)
22	188.0	188.2	West bank of Thompson Island (east channel)
23	187.8	187.8	West bank of Thompson Island (east channel)
24	187.5	187.7	Southern end of Thompson Island, near (but not on) west bank
25	187.1	187.4	East bank (entire eastern side of) Galusha Island
26	186.3	186.8	West bank, north of Fort Miller Dam
27	186.3	186.7	East bank, north of Fort Miller Dam
28	185.7	186.1	East bank, includes southern mouth of navigation channel at Lock 6
29	185.3	185.4	East bank
30	184.8	184.9	West bank
31	184.5	184.9	East bank
32	184.5	184.6	West bank
33	184.0	184.2	East bank
34	183.5	184.2	West bank, north of Northumberland Dam
35	183.4	183.8	East bank, north of Northumberland Dam
36	169.4	170.1	East bank and east channel, north of Stillwater Dam/Lock 4
37	166.0	166.6	West bank, immediately north of Lock 3
38	164.4	164.7	West bank of west channel, opposite southern half of Champlain Island
39	163.6	164.2	West bank, opposite Quack Island (north of Lock 2)
40	163.7	164.2	East bank, opposite Quack Island (north of Lock 2)

Notes:

1. *Hot Spot* numbering and locations based on 1984/1977 DEC survey
2. River Miles approximate, based on Plates 1-7
3. *Hot Spots* 1 through 4 are not shown since their continued existence is highly uncertain due to channel maintenance dredging subsequent to NYSDEC's 1977/78 sampling.

Table 1-3
Aroclor Composition and Properties

Homologue Group	Aroclor Number: 1016		1221		1232		1242		1248		1254		1260	
Biphenyl	<0.1%	0	11	10	<0.1%	5%?	<0.1%	0	0	0	<0.1%	0	0	0
Monochlorobiphenyl	1	2	51	50	31	26	1	1	0	0	<0.1%	0	0	0
Dichlorobiphenyl	20	19	32	35	24	29	16	13	2	1	0.5%	0	0	0
Trichlorobiphenyl	57	57	4	4	28	24	49	45	18	2 (?)	1	1	0	0
Tetrachlorobiphenyl	21	22	2	1	12	15	25	31	40	49	21	15	1	0
Pentachlorobiphenyl	1	0	<0.5%	0	4	0	8	10	36	27	48	53	12	12
Hexachlorobiphenyl	<0.1%	0	0	0	<0.1%	0	1	0	4	2	23	26	38	42
Heptachlorobiphenyl	0	0	0	0	0	0	<0.1%	0	0	0	6	4	41	38
Octachlorobiphenyl	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Nonachlorobiphenyl	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Decachlorobiphenyl	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Molecular Weight (avg)	257	258	192	200.7	221	232.5	261	266.5	288	299.5	327	328.4	370	361
Percent Chlorine	41		20.5 - 21.5		32		42		48		54		60	
Density (specific gravity)	1.33 - 1.40		1.15 - 1.19		1.24 - 1.28		1.35 - 1.42		1.40 - 1.44		1.49 - 1.50		1.57 - 1.62	
Melting Point (deg C)	No Data		1		-35.5		-19		-7		10		31	
Boiling range (deg C)	323 - 356		275 - 320		270 - 325		325 - 366		340 - 375		365 - 390		385 - 420	
Log Koc	4.25 - 5.26		2.44 - 3.76		2.83 - 3.85		3.36 - 4.09		4.74 - 5.44		4.8 - 6.6		5.54 - 6.83	
Log Kow	4.38 - 5.88		2.8 - 4.7		3.2 - 5.2		4.0 - 5.8		5.6 - 6.3		6.0 - 6.8		6.11 - 7.15	
Water solubility (mg/L@ 20 C)	0.05 - 0.91		0.2 - 40		1.45		0.045 - 0.75		0.052 - 0.32		0.012	0.07	0.0027 - 0.08	
Vapor Pressure (mm Hg @ 20 C)	4.0E-04		6.7E-03		4.6E-03		4.0E-04		1.7E-04		7.0E-05		4.1E-05	
Henry's Constant (atm m3/mol)	1.2E-03		3.2E-04		8.6E-04		5.6E-04		3.5E-04		2.5E-03		7.2E-03	

Notes:
Aroclor Composition:
Values in left-hand column from Hutzinger (Hutzinger, Safe, McDonald, 1974) as cited in Montgomery and Welkom, 1990
Values in right-hand column from Brinkman and DeKok, 1980, as cited in Erickson, 1997.
Other data from various secondary sources as cited in Erickson (1997); Mackay, Shiu, and Ma (1992); and Montgomery and Welkom (1990)
Only limited data available for Aroclors 1262 and 1268; these are not known to have been discharged into the Hudson River and are not included in the tabulation.

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Table 1-4
Properties of PCB Homologue Groups

Homologue	CAS Number	Number of Chlorines	Molecular Weight	Weight % Chlorine	Density	Melting Point (deg C)	Boiling Point (deg C)	Solubility (mg/L)
Biphenyl		0	154.21	0.00%	0.866	71	256	
Chlorobiphenyl	27323-18-8	1	188.66	18.79%	1.15	25 - 78	274 - 285	0.06 - 9.5
Dichlorobiphenyl	25512-42-9	2	223.11	31.78%	1.3	24 - 149	312 - 324	0.06 - 2.0
Trichlorobiphenyl	25323-68-6	3	257.56	41.29%	ND	28 - 88	337 - (avg)	0.015 - 1.09
Tetrachlorobiphenyl	26914-33-0	4	292.02	48.56%	1.5	83 - 172	360 - (avg)	0.0008-0.26
Pentachlorobiphenyl	25429-29-2	5	326.47	54.30%	1.5	Conflicting data	381 - (avg)	0.004 - 0.099
Hexachlorobiphenyl	26601-64-9	6	360.92	58.94%	1.6	77 - 160	400 - (avg)	0.0004 - 0.038
Heptachlorobiphenyl	286655-71-2	7	395.38	62.77%	1.7	122.4 - 149	417 - (avg)	0.00045 - 0.014
Octachlorobiphenyl	31472-83-0	8	464.28	65.99%	1.7	159 - 162	432 - (avg)	0.0002 - 0.02
Nonachlorobiphenyl	53742-07-7	9	464.28	68.73%	1.8	182.6 - 206	445 - (avg)	0.00018 - 0.002
Decachlorobiphenyl	2051-24-3	10	498.93	71.04%	1.507	300 - 310	456 - Calc	4E-07 to 7.6E-04

Sources:
CRC Handbook, 64th Edition (1983)
Patty's Industrial Hygiene and Toxicology (3rd Edition), 1981
Mackay, Shiu, Ma (1992)

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Table 1-5
Congener-specific Aroclor Composition

Congener	1016 (%)	1221 (%)	1232 (%)	1242 (%)	1248 (%)	1254 (%)	1260 (%)
BZ#1	0.707	35.813	18.125	0.535			
BZ#2							
BZ#3		17.438	10.225	0.234			
BZ#4	3.625	4.856	3.875	2.863			
BZ#5		1.218	0.444			0.036	0.020
BZ#6	1.513	2.581	2.050	1.240	0.209		
BZ#7		1.444	0.937				
BZ#8 *	8.519	10.181	9.588	6.581	0.608	0.062	0.075
BZ#9	0.669	1.563	1.066	0.530	0.038		
BZ#10	0.258	0.576	0.379	0.202			
BZ#12	0.083	0.436	0.311	0.083			
BZ#15	2.144	2.525	2.713	1.669	0.161		0.043
BZ#16	3.056	0.351	1.338	2.438	0.756	0.038	0.035
BZ#17	3.763	0.503	1.675	2.994	1.028		0.042
BZ#18 *	10.569	1.142	4.400	7.969	3.931	0.117	0.078
BZ#19	0.980	0.144	0.459	0.766	0.223		
BZ#20	0.972	0.175	0.615	0.901	0.418	0.047	0.032
BZ#22	3.050	0.279	1.406	2.369	1.154	0.059	0.050
BZ#23NT	0.066	0.064	0.063	0.067	0.061	0.057	
BZ#24NT							
BZ#25	0.619	0.115	0.311	0.503	0.112		0.048
BZ#26	1.725	0.244	0.843	1.394	0.479	0.045	0.039
BZ#27	0.581	0.088	0.284	0.486	0.134		
BZ#28 *	9.456	0.831	3.950	7.319	3.644	0.104	0.081
BZ#29	0.149	0.043	0.077	0.123			
BZ#31	8.294	0.734	3.488	6.450	4.463	0.214	0.088
BZ#32NT	2.048	0.370	1.036	1.671	0.756	0.019	0.015
BZ#33	5.369	0.536	2.400	4.256	1.888	0.065	0.054
BZ#34NT	0.028			0.018			
BZ#37	1.313	0.196	1.017	1.688	0.634	0.040	0.040
BZ#40		0.063	0.287			0.038	0.023
BZ#41	1.975	0.085	0.383	1.606	2.281	0.208	0.043
BZ#42	1.215	0.101	0.531	1.003	1.431	0.159	0.031
BZ#44 *	4.125	0.288	1.750	3.300	6.069	2.250	0.058
BZ#45	1.198	0.110	0.484	0.943	1.185	0.075	0.024
BZ#47	0.841	0.106	0.373	0.670	1.131	0.200	
BZ#48NT	1.672	0.135	0.674	1.315	1.766	0.186	0.029
BZ#49 *	3.425	0.276	1.400	2.675	4.400	1.309	0.035
BZ#51NT	0.325	0.050	0.151	0.257	0.308	0.034	
BZ#52 *	3.950	0.307	1.681	3.138	6.356	5.044	0.251
BZ#53	0.921		0.320	0.688	1.036	0.080	
BZ#56	0.060	0.133	0.798	1.519	2.525	0.388	0.046
BZ#58NT							
BZ#60NT	0.019	0.045	0.260	0.541	0.847	0.182	0.049
BZ#63NT	0.044		0.059	0.127	0.193	0.040	
BZ#64NT	1.811	0.112	0.749	1.549	2.796	0.582	0.015
BZ#66 *	0.358	0.244	1.625	3.163	5.369	1.038	0.063
BZ#67NT	0.073	0.038	0.074	0.138	0.162		

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Table 1-5
Congener-specific Aroclor Composition

Congener	1016 (%)	1221 (%)	1232 (%)	1242 (%)	1248 (%)	1254 (%)	1260 (%)
BZ#69NT							
BZ#70	0.624	0.288	1.738	3.413	6.888	3.275	0.063
BZ#74	0.411	0.156	0.853	1.738	3.044	0.864	0.038
BZ#75	0.116	0.049	0.060	0.102	0.119	0.038	
BZ#77		0.043	0.163	0.319	0.421		
BZ#82		0.041	0.139	0.324	0.865	1.381	
BZ#83		0.028	0.057	0.100	0.224	0.412	
BZ#84	0.069	0.051	0.214	0.454	1.147	2.125	0.124
BZ#85		0.054	0.151	0.357	0.859	1.179	0.039
BZ#87 *		0.103	0.257	0.555	1.369	3.825	0.464
BZ#91	0.120	0.045	0.101	0.211	0.923	1.149	0.059
BZ#92	0.030	0.030	0.074	0.153	0.371	1.279	0.329
BZ#95	0.636	0.033		0.067	2.000	8.819	3.181
BZ#96NT	0.092		0.043	0.076	0.136	0.073	
BZ#97		0.054	0.184	0.438	1.164	2.519	0.111
BZ#99	0.028	0.066	0.220	0.569	1.431	3.019	0.056
BZ#101/BZ#90 *	0.046	0.087	0.404	0.932	2.456	8.738	3.031
BZ#105 *		0.058	0.179	0.507	1.369	2.563	0.058
BZ#107			0.043	0.090	0.191	0.553	
BZ#110		0.107	0.419	0.998	2.881	10.075	1.481
BZ#114NT			0.011	0.051	0.104	0.209	
BZ#115		0.046	0.047	0.091	0.225	0.380	
BZ#118 *		0.076	0.236	0.696	1.756	6.038	
BZ#119			0.044	0.051	0.079	0.112	
BZ#122		0.041	0.017	0.049	0.081		0.494
BZ#123			0.027	0.044	0.068		
BZ#126					0.053		
BZ#128 *			0.041	0.072	0.110	1.193	0.474
BZ#129				0.041	0.060	0.385	0.127
BZ#135						0.909	1.413
BZ#136			0.036	0.045	0.082	0.668	1.363
BZ#137				0.054	0.066	0.432	
BZ#138 *		0.039	0.106	0.183	0.388	6.919	8.538
BZ#140NT							
BZ#141			0.059	0.059	0.101	0.788	1.713
BZ#143							
BZ#144NT						0.250	0.540
BZ#146NT			0.008	0.012	0.036	0.575	0.895
BZ#149		0.035	0.111	0.118	0.313	4.381	8.944
BZ#151			0.023			0.202	2.713
BZ#153 *		0.027	0.095	0.111	0.233	4.206	9.588
BZ#156				0.040	0.073	0.738	
BZ#157				0.081	0.068	0.168	0.521
BZ#158			0.034	0.055	0.083	0.776	0.636
BZ#167				0.032	0.052	0.589	0.371
BZ#169NT							
BZ#170 *				0.052	0.058		3.569
BZ#171						0.134	1.363

Table 1-5
Congener-specific Aroclor Composition

Congener	1016 (%)	1221 (%)	1232 (%)	1242 (%)	1248 (%)	1254 (%)	1260 (%)
BZ#172NT						0.093	0.585
BZ#174			0.054		0.041	0.451	4.381
BZ#175NT							0.145
BZ#177			0.044		0.038	0.271	2.194
BZ#178			0.100	0.051	0.053	0.151	1.136
BZ#180 *					0.077		9.844
BZ#183 *			0.032		0.029	0.246	2.050
BZ#184NT *							0.087
BZ#185						0.075	0.534
BZ#187 *			0.047		0.033	0.308	4.556
BZ#189							0.137
BZ#190					0.041		0.689
BZ#191						0.050	0.233
BZ#193							0.311
BZ#194					0.031		1.631
BZ#195 *					0.051		0.706
BZ#196					0.036		0.911
BZ#197NT							
BZ#198							0.133
BZ#199						0.047	0.283
BZ#200					0.064	0.071	
BZ#201						0.076	1.644
BZ#202						0.043	0.349
BZ#203NT							1.046
BZ#205							0.112
BZ#206 *					0.044		0.553
BZ#207							0.077
BZ#208							0.138
BZ#209 *							0.081
Total (%)	93.739	88.092	91.141	91.364	91.033	96.532	88.242

Notes:

BZ# (after Ballschmiter and Zell) is equivalent to IUPAC # for all congeners except three octachlorobiphenyls (#199 - 201).

NT = Non-Target congener. Quantitated relative to BZ#52; identification confirmed by retention time standard.

Blank spaces indicate that the indicated analyte was not detected.

BZ#101 co-elutes with BZ#90; BZ#90 not believed to be a significant part of this pair.

Total % is the sum of all listed congeners. Difference between the Total % and 100% can be assumed to be comprised of the 69 congeners not analyzed.

Data from average of pure Aroclor standards analyzed for Hudson River RI/FS by Aquatec for TAMS, April 1994.

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Table 1-6
Hudson River Sampling Investigations Summary

Water Samples

Organization	Sampler	Year(s)	Quantity	Matrix Notes	Analysis
USEPA	TAMS	1993	106	Dissolved Phase	PCB Congeners
USEPA	TAMS	1993	109	Suspended (Particulate)	PCB Congeners
GE		1991 - 2000	3,873	3667 Whole Water; 206 Dissolved I	PCB Congeners; Aroclors
USGS		1974 - 1997	7,576	Waterford to Glens Falls	Aroclors
Total Water Samples			11,664		

Sediment Samples

Organization	Sampler	Year(s)	Quantity	Matrix Notes	Analysis
NYSDEC		1977	1,613	Cores and Grabs	Aroclors; grain size; %solids
NYSDEC		1984	1,941	Cores and Grabs	Aroclors; %solids
USEPA	TAMS	1993 -1994	929	Cores; RM 154 - RM 195	PCB Congeners; radionuclides; metals; grain size
GE		1988 -1999	1,500	Cores and Composites	PCB Congeners; Aroclors
Total Sediment Samples			5,983		

Biota Samples

Organization	Sampler	Year(s)	Quantity	Matrix Notes	Analysis
NYSDEC		1970 - 1999	16,793	Predominantly Fish	PCB Congeners; Aroclors; metals; organics; dioxin/furan
NYSDOH		1973 - 1985	777	Invertebrates	Aroclors
GE		1977 - 1999	1,041	Predominantly Fish	PCB Congeners; Aroclors; lipids
USEPA	TAMS	1993	203	Fish, invertebrates	PCB Congeners; lipids
NOAA		1993 - 1995	235	Fish	PCB Congeners; lipids
USFWS		1994 - 1997	96	Avian, invertebrates	PCB Congeners; pesticides; dioxin/furan; lipids
Total Biota Samples			19,145		

Notes:
GE = General Electric Company
NOAA = National Oceanographic and Atmospheric Administration
NYSDEC = New York State Department of Environmental Conservation
NYSDOH = New York State Department of Health
TAMS = TAMS Consultants, Inc.
USEPA = United States Environmental Protection Agency
USFWS = United States Fish and Wildlife Service
USGS = United States Geological Survey

Sample quantities based on data in Hudson River Database, Release (5.0), (October, 2000)

Only principal analyses are listed. Some samples in may have been analyzed for additional parameters

Table 1-7
Average Total PCB Concentrations in Water from GE Monitoring, January 1999—March 2000

Station	River Mile	Average Concentration (ng/L)
Fenimore Bridge above Hudson Falls	197	6.4
Rt. 197 bridge, Rogers Island	194.4	17.1
Thompson Island Dam West	189	117.7
Below Thompson Island Dam, center channel (PRW2)	188.4	45
Rt. 29 Bridge, Schuylerville	181.4	65.5

Note:
Averages calculated with non-detects set to one-half the detection limit of 11 ng/L.

Table 1-8a
Average Fish Tissue Concentrations from 1998 NYSDEC Sampling in the Upper Hudson River, Reported as mg/kg Wet Weight and Converted to a Consistent Estimator of Tri+ PCBs

Species	Thompson Island Pool RM 188 - 193	Stillwater Reach RM 168 – 176	Waterford Reach RM 155 – 157	Below Federal Dam RM 142 – 153.2
Brown Bullhead	11.2	8.25	2.98	1.85
Carp	28.64	41.25	18.92	11.01
Largemouth Bass	16.06	6.92	3.27	9.7
Pumpkinseed	8.64	4.77		4.5
Yellow Perch	7.59	1.62		1.16

Table 1-8b
Average Fish Tissue Concentrations from 1998 NYSDEC Sampling in the Upper Hudson River, Reported as mg/kg-Lipid and Converted to a Consistent Estimator of Tri+ PCBs

Species	Thompson Island Pool RM 188 - 193	Stillwater Reach RM 168 – 176	Waterford Reach RM 155 – 157	Below Federal Dam RM 142 – 153.2
Brown Bullhead	304	230	104	36
Carp	243	312	197	81
Largemouth Bass	1128	436	230	289
Pumpkinseed	253	125		134
Yellow Perch	365	96		90

Table 1-9
Human Health Risk Assessment Summary
Upper Hudson River

Table 1-9a: Cancer Risk Summary

Point Estimate Cancer Risk Summary*		
Pathway	**Central Tendency Risk**	**RME Risk**
Ingestion of Fish		
Total*	3×10^{-5} (3 in 100,000)	1×10^{-3} (1 in 1,000)
Adult	1×10^{-5} (1 in 100,000)	6×10^{-4} (6 in 10,000)
Adolescent	7×10^{-6} (7 in 1,000,000)	4×10^{-4} (4 in 10,000)
Young Child	1×10^{-5} (1 in 100,000)	4×10^{-4} (4 in 10,000)
Exposure to Sediment		
Baseline Recreator	2×10^{-7} (2 in 10,000,000)	2×10^{-6} (2 in 1,000,000)
Avid Recreator	1×10^{-6} (1 in 1,000,000)	9×10^{-6} (9 in 1,000,000)
Exposure to Water		
Baseline Recreator	3×10^{-8} (3 in 100,000,000)	2×10^{-7} (2 in 10,000,000)
Avid Recreator	1×10^{-7} (1 in 10,000,000)	1×10^{-6} (1 in 1,000,000)
Inhalation of Air	2×10^{-8} (2 in 100,000,000)	1×10^{-6} (1 in 1,000,000)

*Total risk for young child (aged 1-6), adolescent (aged 7-18), and adult (over 18).

Table 1-9b: Non-Cancer Hazard Summary

Point Estimate Non-Cancer Hazard Summary*		
Pathway	**Central Tendency Non-Cancer Hazard Index**	**RME Non-Cancer Hazard Index**
Ingestion of Fish		
Adult	7	65
Adolescent	8	71
Child	12	104
Exposure to Sediment		
Baseline Recreator	0.03	0.04
Avid Recreator	0.2	0.3
Exposure to Water		
Baseline Recreator	0.01	0.02
Avid Recreator	0.06	0.1
Inhalation of Air**	Not Calculated	Not Calculated

Note: All Values from Revised HHRA (USEPA, 2000p)

*Values for child or adolescent, which are higher than adult for these pathways.

**Non-cancer hazards were not calculated for the inhalation pathway due to a lack of non-cancer toxicity values for this pa

Table 1-10
Human Health Risk Assessment Summary
Mid-Hudson River

Table 1-10a: Cancer Risk Summary

Point Estimate Cancer Risk Summary		
Pathway	**Central Tendency Risk**	**RME Risk**
Ingestion of Fish		
Total*	1×10^{-5} (1 in 100,000)	7×10^{-4} (7 in 10,000)
Adult	6×10^{-6} (6 in 1,000,000)	3×10^{-4} (3 in 10,000)
Adolescent	3×10^{-6} (3 in 1,000,000)	2×10^{-4} (2 in 10,000)
Child	5×10^{-6} (5 in 1,000,000)	2×10^{-4} (2 in 10,000)
Swimming/Wading		
Exposure to Sediment*	2×10^{-8} (2 in 100,000,000)	2×10^{-7} (2 in 10,000,000)
Exposure to Water*	9×10^{-9} (9 in 1,000,000,000)	6×10^{-8} (6 in 100,000,000)
Consumption of Drinking Water*	3×10^{-8} (3 in 100,000,000)	1×10^{-7} (1 in 10,000,000)

*Total risk for young child (aged 1-6), adolescent (aged 7-18), and adult (over 18).

Table 1-10b: Non-Cancer Hazard Summary

Point Estimate Non-Cancer Hazard Summary		
Pathway	**Central Tendency Non-Cancer Hazard Index**	**RME Non-Cancer Hazard Index**
Ingestion of Fish		
Adult	3	34
Adolescent	4	37
Child	6	53
Swimming/Wading		
Exposure to Sediment*	0.002	0.004
Exposure to Water*	0.005	0.007
Consumption of Drinking Water*	0.01	0.02

Note: All Values from Revised HHRA (USEPA, 2000p)

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

LIST OF TABLES
CHAPTER 2

Table 2-1a
Chemical-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
RIVER WATER			
Safe Drinking Water Act, 42 U.S.C. §§ 300f - 300j-26	40 CFR § 141.61	ARAR	The Maximum Contaminant Level (MCL) for PCBs in finished drinking water supplied to consumers of public water supply is 0.0005 ppm (0.5 μg/L).
Clean Water Act [Federal Water Pollution Control Act, as amended], 33 U.S.C. §§ 1251-1387	40 CFR § 129.105(a)(4)	ARAR	The ambient water criterion for navigable waters is 0.001 μg/L total PCBs.
New York State Environmental Conservation Law (ECL) Article 15, Title 3 and Article 17, Titles 3 and 8	6 NYCRR Parts 700 through 706	ARAR	Establishes New York Ambient Water Quality Standards for almost 200 contaminants. For PCBs in surface water the values are (a) 1×10^{-6} μg/L (ppb) for protection of health of human consumers of fish; (b) 0.09 μg/L for protection of human health and drinking water sources; and (c) 1.2×10^{-4} μg/L for protection of wildlife.
AIR			
No promulgated chemical-specific ARARs identified for air.			
SEDIMENT			
No promulgated chemical-specific ARARs identified for sediment			

Note: The tolerance level of 2 ppm PCBs in fish and shellfish (edible portion) shipped in interstate commerce (21 CFR § 109.30(a)(7)) is not an ARAR for this site because the Federal Food, Drug and Cosmetic Act, 21 U.S.C. § 301-393, the statute under which the tolerance level is promulgated, is not a Federal environmental law or a State environmental law or facility siting law.

Table 2-1b
Chemical-Specific
Criteria, Advisories and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
BIOTA			
International Joint Commission - United States and Canada	Great Lakes Water Quality Agreement of 1978, as amended	To Be Considered	The concentration of total PCBs in fish tissue (whole fish, wet weight basis) should not exceed 0.1 μg/g for the protection of birds and animals that consume fish.
NOAA - Damage Assessment Center	Reproductive, Developmental and Immunotoxic Effects of PCBs in Fish: a Summary of Laboratory and Field Studies, March 1999 (Monosson, E.)	To Be Considered	The effective concentrations for reproductive and developmental toxicity fall within the ranges of the PCB concentrations found in some of the most contaminated Hudson River fish. There are currently an insufficient number of studies to estimate the immunotoxicity of PCBs in fish. Improper functioning of the reproductive system and adverse effects on development may result from adult fish liver concentrations of 25 to 71 ppm Aroclor 1254. PCB Congener BZ #77: 0.3 to 5 ppm (wet wt) in adult fish livers reduces egg deposition, pituitary gonadotropin, and gonadosomatic index, alters retinoid concentration (Vitamin A), and reduces larval survival. 1.3 ppm in eggs reduces larval survival.
NYSDEC Division of Fish and Wildlife	Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife, Technical Report 87-3, July 1987, pp. 41-48 and Table 26 (Newell *et al.*)	To Be Considered	Provides a method for calculating PCB concentration in fish flesh for the protection of wildlife. The final fish flesh criterion is 0.11 mg/kg PCBs wet wt..
SEDIMENT			
EPA Office of Emergency and Remedial Response	Guidance on Remedial Actions for Superfund Sites with PCB Contamination, EPA/540/G-90/007, August 1990 (OSWER Dir. No. 9355.4-01).	To Be Considered	Provides guidance in the investigation and remedy selection process for PCB-contaminated Superfund sites. Provides preliminary remediation goals for various contaminated media, including sediment (pp. 34-36) and identifies other considerations important to protection of human health and the environment.

Table 2-1b
Chemical-Specific
Criteria, Advisories and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
NOAA - Damage Assessment Office	Development and Evaluation of Consensus-Based Sediment Effect Concentrations for PCBs in the Hudson River, MacDonald Environmental Services Ltd., March 1999	To Be Considered	Estuarine, freshwater and saltwater sediment effects concentrations for total PCBs: Threshold Effect Concentration: 0.04 mg/kg Mid-range Effect Concentration: 0.4 mg/kg Extreme Effect Concentration: 1.7 mg/kg
NOAA	Screening Quick Reference Tables for Organics (SQRTs)	To Be Considered	PCB concentrations in freshwater sediment (dry weight basis): Lowest ARCS *H. azteca* TEL is 31.6 ppb Threshold Effects Level (TEL) is 34.1 ppb Probable Effects Level (PEL) is 277 ppb Upper Effects Threshold (UET) is 26 ppb (Microtox bioassay).
EPA Great Lakes National Program Office, Assessment and Remediation of Contaminated Sediments (ARCS) Program	Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the midge *Chironomus riparius*, EPA 905-R96-008, September 1996	To Be Considered	Provides sediment effects concentrations (SECs), which are defined as the concentrations of a contaminant in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. Freshwater: Threshold Effect Level is 32 ng/g total PCBs Probable Effect Level is 240 ng/g total PCBs No Effect Concentration is 190 ng/g total PCBs
NYSDEC Division of Fish, Wildlife and Marine Resources	Technical Guidance for Screening Contaminated Sediment, January 1999	To Be Considered	Includes a methodology to establish sediment criteria for the purpose of identifying contaminated sediments. Provides sediment quality screening values for non-polar organic compounds, such as PCBs, and metals to determine whether sediments are contaminated (above screening criteria) or clean (below screening criteria). Screening values are not cleanup goals. Also discusses the use of sediment criteria in risk management decisions.

Table 2-2a
Location-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
Section 404 of the Clean Water Act [Federal Water Pollution Control Act, as amended], 33 U.S.C. § 1344	33 CFR Parts 320-329	ARAR	Includes requirements for issuing permits for the discharge of dredged or fill material into navigable waters of the United States. A permit is required for construction of any structure in a navigable water.
Clean Water Act Section 404, 33 U.S.C. § 1344	40 CFR Part 230	ARAR	No activity which adversely affects an aquatic ecosystem, including wetlands, shall be permitted if a practicable alternative that has less adverse impact is available. If there is no other practical alternative, impacts must be minimized.
Toxic Substances Control Act (TSCA), Title I, 15 U.S.C. § 2601	40 CFR §§ 761.65 - 761.75	ARAR	TSCA facility requirements: Establishes siting guidance and criteria for storage (761.65), chemical waste landfills (761.75), and incinerators (761.70).
Statement of Procedures on Floodplain Management and Wetlands Protection	40 CFR Part 6, Appendix A	ARAR	Sets forth EPA policy and guidance for carrying out Executive Orders 11990 and 11988. Executive Order 11988: Floodplain Management requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists. Executive Order 11990: Protection of Wetlands requires federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands if a practicable alternative exists. Federal agencies are required to avoid adverse impacts or minimize them if no practicable alternative exists.

Table 2-2a
Location-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531- 1544	50 CFR Part 17, Subpart I; 50 CFR Part 402	ARAR	Federal agencies are required to verify that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of a critical habitat of such species, unless such agency has been granted an appropriate exemption by the Endangered Species Committee (16 U.S.C. § 1536). No federally-listed or proposed threatened or endangered species are known to exist in the Upper Hudson River. However, the shortnose sturgeon (*Acipenser brevirostrum*) is found in the Lower Hudson River south of the Federal Dam at Troy. Further consultation with the National Marine Fisheries Service may be necessary to determine the need for any additional consideration under the ESA.
Fish and Wildlife Coordination Act, 16 U.S.C. § 662	N/A	ARAR	Whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose, by any department or agency of the United States, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State in which the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources.
Farmland Protection Policy Act of 1981, 7 U.S.C. § 4201.	7 CFR Part 658	ARAR	Regulates the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses.

Table 2-2a
Location-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
National Historic Preservation Act, 16 U.S.C. § 470 et seq.	36 CFR Part 800	ARAR	Proposed remedial actions must take into account effect on properties in or eligible for inclusion in the National Registry of Historic Places. Federal agencies undertaking a project having an effect on a listed or eligible property must provide the Advisory Council on Historic Preservation a reasonable opportunity to comment pursuant to section 106 of the National Historic Preservation Act of 1966, as amended. While the Advisory Council comments must be taken into account and integrated into the decision-making process, program decisions rest with the agency implementing the undertaking. A Stage 1A cultural resource survey is expected to be necessary for any active remediation to identify historic properties along the river banks and to determine if any areas should be the subject of further consideration under NHPA.
New York State Freshwater Wetlands Law, Environmental Conservation Law (ECL) Article 24, Title 7	6 NYCRR Parts 662- 665	ARAR	Defines procedural requirements for undertaking different activities in and adjacent to freshwater wetlands, and establishes standards governing the issuance of permits to alter or fill freshwater wetlands.
New York State ECL Article 3, Title 3; Article 27, Titles 7 and 9	6 NYCRR § 373-2.2	ARAR	Establishes construction requirements for hazardous waste facilities in 100-year floodplain.
New York State ECL Article 11, Title 5	6 NYCRR Part 182	ARAR	The taking of any endangered or threatened species is prohibited, except under a permit or license issued by NYSDEC. The destroying or degrading the habitat of a protected animal likely constitutes a "taking" of that animal under NY ECL § 11-0535.

Table 2-2b
Location-Specific
Criteria, Advisories and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS
EPA Office of Solid Waste and Emergency Response	Policy on Floodplains and Wetland Assessments for CERCLA Actions, August 1985	To Be Considered	Superfund actions must meet the substantive requirements of the Floodplain Management Executive Order (E.O. 11988) and the Protection of Wetlands Executive Order (E.O. 11990) (see Table 2-2A: Location-Specific ARARs). This memorandum discusses situations that require preparation of a floodplains or wetlands assessment, and the factors that should be considered in preparing an assessment, for response actions taken pursuant to Section 104 or 106 of CERCLA. For remedial actions, a floodplain/wetlands assessment must be incorporated into the analysis conducted during the planning of the remedial action.
No Other Location-Specific To-Be-Considered Criteria Identified.			

Table 2-3a
Action-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
Toxic Substances Control Act (TSCA), Title I, 15 U.S.C. § 2605	40 CFR § 761.50	ARAR	Identifies disposal requirements for various PCB waste types.
TSCA, 15 U.S.C. § 2605	40 CFR § 761.61	ARAR	Cleanup and disposal options for PCB remediation waste, which includes PCB-contaminated sediments and dredged materials. Disposal options for PCB remediation waste include disposal in a high-temperature incinerator, an approved chemical waste landfill, or a facility with a coordinated approval under 40 CFR § 761.77. PCB remediation waste containing PCBs at concentrations less than 50 ppm may be disposed of off-site in an approved land disposal facility for the management of municipal solid waste, or in a disposal facility approved under 40 CFR part 761. 40 CFR § 761.61(c) allows an EPA Regional Administrator to approve a risk-based disposal method that will not pose an unreasonable risk of injury to human health or the environment.
TSCA, 15 U.S.C. § 2605	40 CFR § 761.65	ARAR	Storage requirements: Establishes technical requirements for temporary storage of PCB wastes prior to treatment or disposal.
TSCA, 15 U.S.C. § 2605	40 CFR § 761.70	ARAR	Incineration requirements: Establishes requirements for thermal destruction of PCBs in incinerators (boilers are not permitted for non-liquid PCBs, including dredged material).
TSCA, 15 U.S.C. § 2605	40 CFR § 761.75	ARAR	Chemical Waste Landfill Requirements: Establishes approval and technical requirements for land disposal (landfilling) of PCBs.
TSCA, 15 U.S.C. § 2605	40 CFR § 761.79	ARAR	Decontamination standards and procedures for removing PCBs that are regulated for disposal from water, organic liquids, and other materials.
Section 3004 of the Resource Conservation and Recovery Act [Solid Waste Disposal Act, as amended], 42 U.S.C. § 6924	40 CFR § 264.13(b)(8)	ARAR	Owner or operator of a facility that treats, stores or disposes of hazardous wastes must develop and follow a written waste analysis plan.

Table 2-3a
Action-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
Section 3004 of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. § 6924	40 CFR § 264.232	ARAR	Owners and operators shall manage all hazardous waste placed in a surface impoundments in accordance with 40 CFR Subparts BB (Air Emission Standards for Equipment Leaks) and CC (Air Emission Standards for Tanks, Surface Impoundments and Containers).
Section 404(b) of the Clean Water Act, 33 U.S.C. § 1344(b)	40 CFR Part 230	ARAR	Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Except as otherwise provided under Clean Water Act Section 404(b)(2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. Includes criteria for evaluating whether a particular discharge site may be specified.
Section 404(c) of the Clean Water Act, 33 U.S.C. § 1344(c)	40 CFR Part 231, 33 CFR Parts 320, 323, and 325	ARAR	These regulations apply to all existing, proposed, or potential disposal sites for discharges of dredged or fill materials into U.S. waters, which include wetlands. Includes special policies, practices, and procedures to be followed by the U.S. Army Corps of Engineers in connection with the review of applications for permits to authorize the discharge of dredged or fill material into waters of the United States pursuant to Section 404 of the Clean Water Act.
Section 10, Rivers and Harbors Act, 33 U.S.C. § 403	33 CFR Part 322	ARAR	U.S. Army Corps of Engineers approval is generally required to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States.
Hazardous Materials Transportation Act, as amended , 49 U.S.C. §§ 5101 - 5127	49 CFR Part 171	ARAR	Department of Transportation Rules for Transportation of Hazardous Materials, including procedures for the packaging, labeling, manifesting and transporting of hazardous materials.
New York State ECL Article 27, Title 7	6 NYCRR Part 360 Solid Waste Management Facilities	ARAR	New York State regulations for design, construction, operation, and closure requirements for solid waste management facilities.

Table 2-3a
Action-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
New York State ECL Article 27, Title 11	6 NYCRR Part 361 Siting of Industrial Hazardous Waste Facilities	ARAR	Establishes criteria for siting industrial hazardous waste treatment, storage and disposal facilities. Regulates the siting of new industrial hazardous waste facilities located wholly or partially within New York State. Identifies criteria by which the facilities siting board will determine whether to approve a proposed industrial hazardous waste facility.
New York State ECL Article 27, Title 3	6 NYCRR Part 364 Standards for Waste Transportation	ARAR	Regulations governing the collection, transport and delivery of regulated wastes, including hazardous wastes.
New York State ECL Article 27, Title 9	6 NYCRR Parts 370 and 371, Standards for Hazardous Waste Management	ARAR	New York State regulations for activities associated with hazardous waste management. All dredged materials and other solid wastes containing 50 ppm by weight (on a dry weight basis for other than liquid wastes) or greater of PCBs are listed hazardous wastes, excluding small capacitors and PCB articles drained in accordance with applicable NY State regulations.
New York State ECL Article 3, Title 3; Article 27, Titles 7 and 9	6 NYCRR Part 372 Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities	ARAR	Includes Hazardous Waste Manifest System requirements for generators, transporters, and treatment, storage or disposal facilities, and other requirements applicable to generators and transporters of hazardous waste.
New York State ECL Article 3, Title 3; Article 27, Titles 7 and 9	6 NYCRR Part 373 Hazardous Waste Management Facilities	ARAR	These regulations establish requirements for treatment, storage, and disposal of hazardous waste; permit requirements; and construction and operation standards for hazardous waste management facilities.
New York State ECL Article 27, Title 13 Hazardous Waste Site Remediation Projects	6 NYCRR Part 375 Inactive Hazardous Waste Disposal Sites	ARAR	Establishes standards for the development and implementation of inactive hazardous waste disposal site remedial programs.
New York State ECL Article 27, Title 9	6 NYCRR Part 376	ARAR	Land Disposal Restrictions. PCB wastes including dredge spoils containing PCBs greater than 50 ppm must be disposed of in accordance with federal regulations at 40 CFR Part 761.

Table 2-3a
Action-Specific
Potential Applicable or Relevant and Appropriate Requirements (ARARs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
New York State ECL, Article 19, Title 3 - Air Pollution Control Law. Promulgated pursuant to the Federal Clean Air Act, 42 USC § 7401	6 NYCRR Parts 200, 202, 205, 211, 212, 219, and 257. Air Pollution Control Regulations	ARAR	The emissions of air contaminants that jeopardize human, plant, or animal life, or is ruinous to property, or causes a level of discomfort is strictly prohibited.
New York State ECL Article 15, Title 5, and Article 17, Title 3	6 NYCRR Part 608 Use and Protection of Waters	ARAR	A permit is required to change, modify, or disturb any protected stream, its bed or banks, or remove from its bed or banks sand or gravel or any other material; or to excavate or place fill in any of the navigable waters of the state. Any applicant for a federal license or permit to conduct any activity which may result in any discharge into navigable waters must obtain a State Water Quality Certification under Section 401 of the Federal Water Pollution Control Act, 33 USC § 1341.
New York State ECL Article 17, Title 8	6 NYCRR Parts 750 - 758 New York State Pollutant Discharge Elimination System (SPDES) Requirements	ARAR	Standards for Storm Water Runoff, Surface Water, and Groundwater Discharges. In general, no person shall discharge or cause a discharge to NY State waters of any pollutant without a permit under the New York State Pollutant Discharge Elimination System (SPDES) program.
New York State ECL Article 17, Title 5	N/A	ARAR	It shall be unlawful for any person, directly or indirectly, to throw, drain, run or otherwise discharge into such waters organic or inorganic matter that shall cause or contribute to a condition in contravention of applicable standards identified at 6 NYCRR § 701.1.
New York State ECL Article 11, Title 5	NY ECL § 11-0503	ARAR	Fish & Wildlife Law against water pollution. No deleterious or poisonous substances shall be thrown or allowed to run into any public or private waters in quantities injurious to fish life, protected wildlife or waterfowl inhabiting those waters, or injurious to the propagation of fish, protected wildlife or waterfowl therein.

Table 2-3b
Action-Specific
Criteria, Advisories, and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
USEPA	Covers for Uncontrolled Hazardous Waste Sites (EPA/540/2-85-002; September 1985)	To Be Considered	Covers for Uncontrolled Hazardous Waste Sites should include a vegetated top cover, middle drainage layer, and low permeability layer.
USEPA	Rules of Thumb for Superfund Remedy Selection (EPA 540-R-97-013, August 1997)	To Be Considered	Describes key principles and expectations, as well as "best practices" based on program experience, for the remedy selection process under Superfund. Major policy areas covered are risk assessment and risk management, developing remedial alternatives, and ground-water response actions.
USEPA	Land Use in the CERCLA Remedy Selection Process (OSWER Directive No. 9355.7-04, May 1995)	To Be Considered	Presents information for considering land use in making remedy selection decisions at NPL sites.
USEPA	Contaminated Sediment Strategy (EPA-823-R-98-001, April 1998)	To Be Considered	Establishes an Agency-wide strategy for contaminated sediments, with the following four goals: 1) prevent the volume of contaminated sediments from increasing; 2) reduce the volume of existing contaminated sediment; 3) ensure that sediment dredging and dredged material disposal are managed in an environmentally sound manner; and 4) develop scientifically sound sediment management tools for use in pollution prevention, source control, remediation, and dredged material management. The strategy includes the Hudson River in its case studies of human health risks.
USEPA	Structure and Components of Five-Year Reviews (OSWER Directive 9355.7-02, May 1991) Supplemental Five-Year Review Guidance (OSWER Directive 9355.7-02A, July 1994) Second Supplemental Five-Year Review Guidance (OSWER 9355.7-03A, December 1995)	To Be Considered	Provides guidance on conducting Five-Year Reviews for sites at which hazardous substances, pollutants, or contaminants remain on-site above levels that allow for unrestricted use and unlimited exposure. The purpose of the Five-Year Review is to evaluate whether the selected response action continues to be protective of public health and the environment and is functioning as designed.

Table 2-3b
Action-Specific
Criteria, Advisories, and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
NYSDEC	Air Guide 1 - Guidelines for the Control of Toxic Ambient Air Contaminants, 2000	To Be Considered	Provides guidance for the control of toxic ambient air contaminants in New York State. Current annual guideline concentrations (AGCs) for PCBs are 0.01 $\mu g/m^3$ for inhalation of evaporative congeners (Aroclor 1242 and below) and 0.002 $\mu g/m^3$ for inhalation of persistent highly chlorinated congeners (Aroclor 1248 and above) in the form of dust or aerosols.
NYSDEC	Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values	To Be Considered	Provides guidance for ambient water quality standards and guidance values for pollutants.
NYSDEC	Technical and Operational Guidance Series (TOGS) 1.2.1 Industrial SPDES Permit Drafting Strategy for Surface Waters	To Be Considered	Provides guidance for writing permits for discharges of wastewater from industrial facilities and for writing requirements equivalent to SPDES permits for discharges from remediation sites.
NYSDEC	Technical and Operational Guidance Series (TOGS) 1.3.1 Waste Assimilative Capacity Analysis & Allocation for Setting Water Quality Based Effluent Limits	To Be Considered	Provides guidance to water quality control engineers in determining whether discharges to waterbodies have a reasonable potential to violate water quality standards and guidance values.
NYSDEC	Technical and Operational Guidance Series (TOGS) 1.3.2 Toxicity Testing in the SPDES Permit Program	To Be Considered	Describes the criteria for deciding when toxicity testing will be required in a permit and the procedures which should be followed when including toxicity testing requirements in a permit.
NYSDEC	Technical and Operational Guidance Series (TOGS) 1.3.7 Analytical Detectability & Quantitation Guidelines for Selected Environmental Parameters	To Be Considered	Provides method detection limits and practical quantitation limits for pollutants in distilled water.

Table 2-3b
Action-Specific
Criteria, Advisories, and Guidance to be Considered (TBCs)
Hudson River PCBs Reassessment RI/FS

MEDIUM/ AUTHORITY	CITATION	STATUS	REQUIREMENT SYNOPSIS
NYSDEC	Technical and Administrative Guidance Memorandum (TAGM) 4031 Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites	To Be Considered	Provides guidance on fugitive dust suppression and particulate monitoring for inactive hazardous waste sites.
NYSDEC	Interim Guidance on Freshwater Navigational Dredging, October 1994	To Be Considered	Provides guidance for navigational dredging activities in freshwater areas.
NYSDEC Division of Fish, Wildlife and Marine Resources	Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA), October 1994	To Be Considered	Provides rationale and methods for sampling and evaluating impacts of a site on fish and wildlife during the remedial investigation and other stages of the remedial process.

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Table 3-1
Data Sources Used in the Selection of Areas for Remediation

Data Source	Data Type	Areas Studied (Section No.)	Areas Where Applied (Section No.)	Coverages				Metrics Calculated				Notes
				"Surface" Cores	Full Cores	Grab Samples	Composites	"Surface" Conc.	Max. Conc.	LWA	MPA	
NYSDEC 1976-1978 Upper Hudson Survey	Sediment PCB Levels	1, 2, 3	2, 3	43	232	555		Y (0-10 cm)	Y	Y (30cm)	Y (30cm)	Density estimated for some MPA values. Core depths limited to 30cm.
NYSDEC 1984 TI Pool Survey	Sediment PCB Levels	1	1		407	730		Y (0-30 cm)	Y	Y	Y	Grab depths extrapolated to 12 to 16 inches based on sediment texture. Density Measured.
General Electric 1991 Sediment Composite Survey	Sediment PCB Levels	1, 2, 3	1, 2, 3				132	Y (0-5 cm)				Composites at 0-5, 5-10 and 10-25 cm. Composites cover long distances and cross river. Center channel composite samples are grabs.
Scan Sonar Survey	Sediment Properties	1, 2	1, 2									Defined fine-grained (cohesive) and coarse-grained (noncohesive) areas.
Bathymetric Survey	Water depth	1, 2	1, 2									
USEPA 1994 Low Resolution Core Study	Sediment PCB Levels	1, 2, 3	1, 2, 3		170			Y (0-23 cm)	Y	Y	Y	Selected areas in TI Pool. Hot Spots 25, 28, 31, 34, 35, 37 & 39. Core depth confirmation by Cs-137. MPA used measured density.
General Electric 1998 Sediment Composites	PCB "Surface" Concentration	1	1				30	Y (0-5 cm)				Composites at 0-2 and 2-5 cm. Composites cover long distances.
General Electric 1998-1999 Sediment Cores	Sediment PCB Levels	1, 2	1, 2	20 (15 cm)		4		Y (0-5, 0–15cm)				Twenty cores at hot spots 14 and 16. Four high resolution cores

Table 3-2
Upper Hudson Data Sets and Their Application

River Section	Main PCB Data Set	Metric	Supplementary PCB Data Sets	Additional Data
1 RM 194.5 to 188.5	NYSDEC 1984	"Surface" Concentration MPA LWA Maximum Concentration	GE 1991 USEPA 1994 GE 1998	USEPA 1992 Bathymetry USEPA 1992 Side Scan Sonar
2 RM 188.5 to 183	USEPA 1994 (*Hot Spots* 25, 28, 31, 34 and 35) NYSDEC 1976-1978 (all other areas)	"Surface" Concentration MPA LWA Maximum Concentration "Surface" Concentration MPA LWA	GE 1991 GE 1998	USEPA 1992 Bathymetry USEPA 1992 Side Scan Sonar
3 RM 183 to 156	USEPA 1994 (*Hot Spots* 37 and 39) NYSDEC 1976-1978 (all other areas)	"Surface" Concentration MPA LWA Maximum Concentration "Surface" Concentration MPA LWA	GE 1991	

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Table 3-3

Theoretical Limits of Impact of Various MPA Remediation Criteria on PCB Mass and Sediment Area in TI Pool

PCB Mass (kg)

Remediation Threshold	All Sediments		Cohesive Sediments		Non-cohesive Sediments	
	Mass Remediated	Percent Remediated	Mass Remediated	Percent Remediated[1]	Mass Remediated	Percent Remediated[2]
0 g/m2	15,400	100%	8,800	100%	6,800	100%
3 g/m2	14,200	92%	8,500	97%	5,700	84%
10 g/m2	10,200	66%	7,800	89%	2,500	37%

Area (acre)

Remediation Threshold	All Sediments		Cohesive Sediments		Non-cohesive Sediments	
	Area Remediated	Percent Affected	Area Remediated	Percent Affected[1]	Area Remediated	Percent Affected[2]
0 g/m2	506	100%	146	100%	360	100%
3 g/m2	232	46%	88	60%	144	40%
10 g/m2	85	17%	54	37%	32	9%

Note:

1. Percent represents fraction of cohesive sediment area or mass.

2. Percent represents fraction of non-cohesive area or mass.

Table 3-4
Summary of Targeted Contamination

	Remediation Scale			No Action/ MNA
	Full-Section	Expanded Hot Spot	Hot Spot	
Targeted Sediment Volume (cy)				
River Section 1	2,030,000	1,516,000	965,000	0
River Section 2	1,105,000	723,000	538,000	0
River Section 3	NA (Note 1)	571,000	431,000	0
Overall - Upper Hudson (total River Sections 1, 2, and 3)	3,135,000	2,239,000	1,934,000	0
Sediment Remediation Areas (acres)				
River Section 1 - Total Area (all sediments)	534	534	534	534
Total Area Selected (acres)	470	270	150	0
Percent Selected	88%	51%	28%	0%
River Section 2 - Total Area (all sediments)	488	488	488	488
Total Area Selected (acres)	316	115	74	0
Percent Selected	65%	24%	15%	0%
River Section 3 - Total Area (all sediments)	2,880	2,880	2,880	2,880
Total Area Selected (acres)	NA (Note 1)	134	97	0
Percent Selected	NA (Note 1)	5%	3%	0%
Contaminant (PCB) Mass (kg)				
River Section 1 - Total PCBs in Section (Note 2)	15,400	15,400	15,400	15,400
Total PCBs (kg) above MPA in Section	15,000	11,600	8,600	0
Percent exceeding MPA criterion in Section	97%	75%	56%	0%
River Section 2 (Note 3)				
Total PCBs (kg) above MPA in Section	>35,000 (Note 4)	31,200	23,600	0
Percent exceeding MPA criterion in Section	NA	NA	NA	NA
River Section 3 (Note 3)				
Total PCBs (kg) above MPA in Section	NA	10,700	6,700	0
Percent exceeding MPA criterion in Section	NA	NA	NA	NA
Overall - Upper Hudson				
Total PCBs above MPA Criterion	NA (Note 1)	53,500	38,900	0

Notes:
1 No full-section remediation is anticipated in River Section 3.
2 PCB mass in River Section 1 estimated using 1984 data
3 PCB mass in River Sections 2 and 3 estimated using 1994 data; only *hot spots* were sampled.
Total mass of PCBs in Sections 2 and 3 cannot be estimated accurately from 1994 data; therefore % removal cannot be calculated.
4 This estimate combines the 1994 data for areas >$3 g/m^2$ with the 1977 data for areas <$3 g/m^2$. Because of the uncertainties associated with the 1977 data, (*i.e.*, shallow coring depths and potential sediment inventory changes), one half of the mass estimated from the 1977 data (3.65 of 7.3 metric tons) was used as a part of the lower bound estimate given here.

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Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
No Action	No Action involves deferral of remedial action. Institutional controls are not implemented as part of No Action option.	No Action alternative retained to provide baseline for analysis as required under NCP.	Yes
Institutional Controls	Institutional controls include monitoring and site use restrictions. Institutional controls can be implemented as part of natural attenuation option, or an alternative with active remediation.	Monitoring is effective for evaluating concentrations and effects of PCBs in the river in the long term. Site use restrictions, if completely complied with, are effective in controlling use of and/or disturbance to sediments, water, or fish contaminated with PCBs.	Yes
Natural Attenuation	Natural attenuation refers to the reduction of volume and toxicity of contaminants in sediments by naturally occurring biological, chemical, or physical processes. Extensive site monitoring and modeling are conducted to document contaminant reduction.	Natural attenuation processes may be effective in areas where natural attenuation processes have been observed, and where there are no adverse impacts on potential human or ecological receptors.	Yes
Containment			
Subaqueous Capping	Capping involves using inert material, active material, or sealing agents to contain sediments *in situ*. Besides capping materials, other considerations for *in situ* capping include cap thickness, cap placement techniques, cap armoring, and monitoring.	A properly designed cap can be effective in minimizing diffusion, bioturbation, and erosive transport of contaminant in sediments.	Yes
Retaining Dikes/Berms	Retaining dikes and berms include permanent subaqueous or full-depth embankments, bulkheads, sheet piling, and spur dikes constructed either perpendicular to stream flow or parallel to the shore to control downstream transport of contaminated sediments.	Properly designed and constructed dikes can be effective in trapping and increasing deposition of sediments suspended in water column. Dikes and berms constructed parallel to shoreline can be used to isolate contaminated sediments left in place in depositional areas from the river flow.	Yes

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
***In Situ* Treatment**			
Bioremediation	Bioremediation involves manipulation of physical, chemical, and biological conditions in the contaminated sediments to accelerate biodegradation of contaminants. *In situ* bioremediation may include addition and mixing of microbes and/or nutrients to sediments to enhance biodegradation.	Results from an in situ bioremediation field study at the site indicate that complete biodegradation of PCBs may be difficult to achieve within a reasonable time frame. In addition, this technology has several implementability limitations, including: difficulty in addition and effective distribution of microbes and/or nutrients, and problems in monitoring and controlling biodegradation process during treatment.	No
Solvent Extraction	This technology involves injection of a solvent to extract contaminants from sediment matrix *in situ*, and recovering the contaminant-bearing spent solvent for treatment or destruction *ex situ*. Containment structures to control migration of the solvent may be required during extraction.	This technology has several implementability limitations, including: difficulty in solvent application and effective distribution to all sediments to be treated, problems in monitoring of extraction effectiveness, and difficulty in complete recovery of solvent after treatment.	No
Chemical Dechlorination	Dechlorination is a process where chlorine molecules are removed from chlorinated compounds through the addition of a chemical reagent under alkaline conditions. This technology involves injection and mixing of reagents to the sediments *in situ* to achieve dechlorination. Dechlorination can be combined with immobilization (described below) to treat PCBs in sediments.	This technology has several implementability limitations, including: difficulty in reagents application and effective distribution to all sediments to be treated and problems in monitoring of extraction effectiveness. Unlike solvent extraction, recovery of the reagents may not be required because the reaction of the reagents with PCBs produces glycol ether and a chloride salt which are water soluble and of low toxicity.	No
Immobilization	Immobilization includes processes that physically or chemical reduce mobility of contaminants. Immobilization includes solidification, stabilization, and encapsulation processes. Solidification involves addition of reagents to a contaminated matrix to produce a solid block; stabilization involves conversion of contaminated material to a more chemically stable form; encapsulation involves enclosure of contaminant particle with an additive or binder. *In situ* immobilization involves mixing setting agents such as cement, quicklime, grout, as well as reagents, with sediments in place to solidify or fix contaminants in the matrix. Solidification has been combined with dechlorination (described above) to treat PCBs in sediments.	This technology has several limitations including: difficulty in setting agents and reagents application and effective distribution to all sediments to be treated, volume increase of river bed, release of reagents to water column during mixing, solidified mass interference with future dredging activities and with habitat re-establishment.	No

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
Removal			
Excavation	Excavation methods would apply to sediment removal from shallow, near shore areas where the work zone can be isolated and dewatered.	Excavation can be an effective way to remove contaminated sediments from areas that are inaccessible to dredges. Excavation may be difficult to implement due to lack of access to the river from the land side.	Yes
Dredging	Environmental dredging involves removal of contaminated sediments in a way that minimizes release of sediments and contaminants to the aquatic environment. Dredge types evaluated are classified as *conventional, large-scale, and specialty. Conventional* dredges include mechanical dredges, which remove sediments by direct mechanical means; and hydraulic dredges, which collect sediments mixed with water in a slurry using centrifugal pumps. Large scale dredges are primarily used for navigational dredging. Specialty dredges are designed to address specific project needs.	Environmental dredging can be an effective method to remove contaminated sediments from the river.	Yes
Soil Freezing	Containment cells are placed in the sediment, and refrigerant is circulated within the contained cell of sediments. When the sediment is sufficiently frozen, the entire cell can be removed with minimal sediment resuspension. Once the cells are retrieved, the sediment is dewatered and ready for further treatment or disposal.	Soil freezing would likely be costly, provide relatively low removal rates, and apply only to areas where hydrodynamic conditions would permit freezing to occur. Practical application of this technology is likely very difficult.	No
***Ex Situ* Treatment**			
Bioremediation	Bioremediation involves manipulation of physical, chemical, and biological conditions in the contaminated sediments to accelerate biodegradation of contaminants. *Ex situ* bioremediation approaches evaluated include a slurry phase bioreactor and a land-based approach which includes land farming and composting.	Bioremediation results from pilot scale tests conducted at other sites indicate that complete biodegradation of PCBs may be difficult to achieve within a reasonable time frame for the anticipated volume of dredged sediments.	No

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
Sediment Washing	Sediment washing is a water-based treatment process which extracts contaminants from sediments as well as separates fine fraction of sediments from coarser particles, thereby concentrating the contaminants and reducing volume of material requiring additional treatment or disposal. Soil/ sediment washing solutions can include solvents, chelating compounds, surfactants, acids/bases in addition to water, depending on the type of contaminant being extracted.	Sediment washing can be effective in removing PCBs from sediments as wells as reducing volume of material requiring additional treatment or disposal if the appropriate reagents and mechanical washing processes are used.	Yes
Solvent Extraction	This technology involves dissolution of contaminants from the sediment matrix using a solvent, recovery and treatment or destruction of the contaminant-bearing solvent. The most common solvents used for PCB extraction are kerosene, propane, methanol, ethanol, dimethylformamide, ethylenediamine, triethylamine, and freon mixtures.	Solvent extraction can be very effective in removing PCBs from sediments if the appropriate solvent is used.	Yes
Chemical Dechlorination	Chemical dechlorination involves removal of chlorine molecules from chlorinated compounds through the addition of a chemical reagent under alkaline conditions. Two types of dechlorination processes are evaluated: APEG and base-catalyzed decomposition. Dechlorination is often used in combination with thermal desorption (described below). Dechlorination has also been used with solidification (described below).	APEG process often results in partial dechlorination, with residual compounds that are water soluble and slightly toxic; this process can also sometimes form dioxins and furans. Base-catalyzed decomposition is effective in treating PCBs without forming dioxins, furans, or other toxic by-products. Combined thermal desorption/ dechlorination processes can be more effective than thermal desorption or dechlorination alone. Combined dechlorination/ solidification has not been demonstrated beyond bench scale for treating PCBs in sediments.	Yes
Thermal Desorption	Thermal desorption involves heating sediments to below combustion temperatures (200° F to 1000° F) to volatilize organic contaminants. Vaporized organics are recovered by condensation or carbon adsorption for additional treatment. Thermal desorption is often used in combination with dechlorination (described above).	Thermal desorption has been demonstrated to be effective in removing PCBs from sediments. Combined thermal desorption/dechlorination processes can be more effective than thermal desorption or dechlorination alone.	Yes
Thermal Destruction	Thermal destruction uses high temperatures (typically over 1000° F) to destroy contaminants in sediments. The products of thermal destruction vary depending on the type of material being burned and destruction operating parameters.	Thermal destruction has been demonstrated to be very effective in destroying PCBs in soils and sediments.	Yes

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
Immobilization	Immobilization includes processes that physically or chemical reduce mobility of contaminants. Immobilization includes solidification, stabilization, and encapsulation processes. Solidification involves addition of reagents to a contaminated matrix to produce a solid block; stabilization involves conversion of contaminated material to a more chemically stable form; encapsulation involves enclosure of contaminant particle with an additive or binder. *Ex situ* immobilization involves mixing setting agents such as cement, quicklime, grout, as well as reagents, with sediments in an immobilization system. Solidification has been combined with dechlorination (described above) to treat PCBs in sediments.	The effectiveness of immobilization technologies is variable depending on the characteristics of the contaminated sediments and the type of additives used. Solidification/ stabilization can potentially be effective for PCBs because of strong adsorption characteristics to sediments. Combined dechlorination/solidification has not been demonstrated beyond bench scale for treating PCBs in sediments.	Yes
Beneficial Use			
Landfill Cover/ Construction Fill/Mine Reclamation	These beneficial use options involve using dredged sediment in its original form, i.e., the sediment may be treated to remove contaminants prior to being put to use, but its essential form will still be that of a sediment material. Options evaluated include cover material for solid waste landfill, fill material for construction projects, and fill material for abandoned mine land reclamation. It is likely that any beneficial use option will require meeting certain appropriate criteria for the specific use.	Because of the potentially large volume of dredged material which will be generated, more than one beneficial use option may be selected and implemented to provide sufficient capacity. Another option is to consider smaller components of the total dredged volume, such as separated coarse-grained material through sediment washing or solids classification. Other treatment may be required to meet certain criteria for the specific beneficial use option.	Yes
Manufacture of Commercial Products	These technologies combine thermal treatment processes to destroy contaminants in sediments with some further physical/chemical process to convert the decontaminated sediment into a useable commercial product. The technologies evaluated involve production of cement, light weight aggregate, and glass tile from treated sediment.	These technologies combine the effectiveness of thermal destruction with the attractive features of beneficial use options, i.e., no product for disposal and potential recovery of processing costs through sale of the useable product.	Yes

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-1
Initial Technology Evaluation and Screening

General Response Action/ Remedial Technology	Description	Evaluation	Retained
Disposal			
Land Disposal	Dredged sediment land disposal options evaluated include confined disposal facilities (CDFs) and landfills. CDFs can be upland (outside the river 100-year floodplain) or near-shore (within the 100-year floodplain or in shallow, non-navigation areas of the river). Landfills evaluated include off-site TSCA and non-TSCA facilities.	Siting of CDFs in the vicinity of the Upper Hudson River may be problematic because of potential large land area requirement and local residents opposition. Off-site landfill disposal of sediments requires dewatering and transportation to the landfill site.	Yes
Aquatic Disposal	This technology involves disposal of dredged material in a contained aquatic disposal (CAD) facility. In a CAD, dredged sediments are placed on the bottom or in excavated depressions in the river, which are capped to prevent contaminant release.	Because of the potentially large volume of dredged material which will be generated, there is likely insufficient area in the river to place the total dredged volume without significantly changing the nature and hydraulic characteristics of the river in the vicinity of the disposal sites.	No

Note: Remedial technologies that are not retained in the screening are represented by the hatched shading.

Table 4-2
List of Process Options for Capping

Capping Material Used	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Erosion Potential	Capital or O & M Intensive	Availability	Cost	Representative Recent Projects	Special or Unique Features
Active Materials: activated carbon or chemicals	Yes	Pilot	No	No	O&M	Readily available	Variable depending on site parameters		Needs to be covered with inert materials to obtain stability. Can be applied at surface or mixed with sediment. Usually applied as a composite capping method and is used to help prevent transport or advection of contaminants.
Armored Materials	Yes	Pilot	No	No	O&M	Readily available	Variable depending on site parameters	Sheboygan River GM Central Foundry Division Superfund Site, St. Lawrence River	Involves use of armor stone such as riprap or gravel applied by surface discharge. Can be used in combination with inert materials such as sand as the lower layer. Armoring used in navigation channels or high flow situations to prevent erosion.
Inert Materials: geotextile or geomembrane	Yes - Tested for PCBs in sediments at pilot scale	Full-Scale	No	No unless overlain with a sand or clay material	O&M	Readily available	Variable, depending on site parameters and amount of geotextile material to be used	Sheboygan River Manistique River	Has been applied in layers in which geotextile is used as the bottom and top layer with fill material placed in the middle. Geotextile is applied by subsurface discharge. Can be used with armoring materials as the top layer.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-2
List of Process Options for Capping

Capping Material Used	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Erosion Potential	Capital or O & M Intensive	Availability	Cost	Representative Recent Projects	Special or Unique Features
Inert Materials: clay, silt, sand	Yes	Full-Scale	No	Yes	O&M	Readily available	Variable depending on size of area to be capped and inert material utilized	New Bedford Harbor Sheboygan River Simpson-Tacoma, WA Eagle Harbor St. Lawrence River	Local material is placed above the contaminated spots at a thickness of 1.5 ft. Material is applied by subaqueous discharge.
Inert Materials: Aquablock	Yes - Tested for PCBs in sediments at pilot scale	Pilot	No	No	O&M	Limited due to lack of technology demonstration in the field	$40,000 - $45,000 per acre	Ottawa River Project Fort Richardson Army Base, Alaska	Aquablock is a proprietary combination of bentonite clay, polymer, and a solid gravel core. Consists of pellets that expand to form a continuous cohesive layer when released in water. Can be applied by surface discharge or by subaqueous discharge.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-2
List of Process Options for Capping

Capping Material Used	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Erosion Potential	Capital or O & M Intensive	Availability	Cost	Representative Recent Projects	Special or Unique Features
Sealing Agents: Polymer Films	Not tested for PCBs in sediments	Not available	No	Yes	O&M	Limited due to design and construction constraints	Variable depending on site parameters		Uses a barge mounted application system with coagulable polymers, hot melt materials or pre-formed films that applies materials by subaqueous discharge.
Sealing Agents : Subsurface Grouting	Not tested for PCBs in sediments	Not available	No	Yes	O&M	Readily available	Variable depending on site parameters		Mixed with top layer to form crust ; inert materials placed over crust. Applied by subaqueous discharge.
Thin Layer Capping	Yes- Tested for PCBs in sediments at Pilot Scale	Not available	No	Yes	O&M	Readily available	Variable depending on site parameters and required cap thickness	Pier 64 Seattle, Washington	Process also referred to as particle broadcasting; refers to cap thickness of 6" or less.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-3
List of Process Options for Bioremediation

Process Name	Vendor Name	Applicability to Treat PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O&M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Aerobic Biotreatment System (ABS)	Bio-Genesis Technologies	Not tested for PCBs in sediments	Pilot scale	No	Both	Readily available	No available information	$1200 on annual basis: cost of nutrients, microbes and mixing technology to biodegrade waste		in situ or ex situ Utilizes GT-1000 biostimulation/ bioaugumentation technology. Does not treat metals.
Anaerobic PCB Dechlorinating Granular Consortia	MBI International	Yes - Tested at bench scale for PCBs in sediments	Bench-scale	No	O&M	Available	24 weeks to reduce 100 ppm PCBs to levels < 10 ppm	<$100 per ton		in situ Utilizes anaerobic, dechlorinating microbes. Bioremediation/ dechlorination process.
B&S Achieve-B&S Industrial	B&S Research, Inc.	Not tested for PCBs in sediments	Pilot	No	O&M	Readily available	No available information	$8 - $25 per CY		in situ/ potentially ex situ Does not treat heavy metals.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-3
List of Process Options for Bioremediation

Process Name	Vendor Name	Applicability to Treat PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O&M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Bevrox Biotreatment - Liquid-solid contact (LSC) digestion process	Bogart Environmental Services, Inc.	Not tested for PCBs in sediments	Bench Scale	No	O&M	Readily available	300 - 500 CY/day	$18/CY; costs directly related to volume of material treated		ex situ Does not treat metals.
Bio-Integration	Interstate Remediation Services	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	3 to 12 weeks; depends on amount to be remediated	$20 to $75 per ton		ex situ/in situ Substrate-specific aerobic microbes grown in bioreactors on site.
Bioremediation Solid-Phase	Arctech, Inc.	Not tested for PCBs in sediments: Tested for PCBs in soil and sludge at bench scale	Pilot scale	No - collected waters need to be treated at WTP	Both	Limited	No available information	$32 - $150 per CY		ex situ Technology uses idea of composting. Transportable and does not treat metals.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-3
List of Process Options for Bioremediation

Process Name	Vendor Name	Applicability to Treat PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O&M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Catalytic Air Oxidation	Environmental Catalyst Company	Not tested for PCBs in sediment	Pilot	No	Both	Limited	Two to three months depending on initial and final concentrations	$7/lb; 50 lb cost $350 and treats about 250,000 CY		in situ- bubble in oxygen or ex situ by dredging and tilling to supply oxygen. Catalyst is a Fe complex which destroys hydrocarbons in contaminant.
Enhanced Bioremediation Technology	ETUS, Inc., Enhanced Bioremediation	Not tested for PCBs in sediments: Tested for PCBs in sludge at pilot scale	Commercial	No	O&M	Readily available	0.037 - 3.7 CY/batch	$20 - $40 per CY		in situ/ex situ Ambient air temp. of <50° F required. Uses biological activator solution (CNP-PLUS).
EnviroMech Gold Biocatalytic Contaminant Degradation	Eco-Tec, Inc.	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	Variable depending on type and conc. of the targeted contaminant	$28 - $32 per ton		in situ or applied ex situ Can be combined with soil washing.
Fluid Extraction - Biological Degradation (FEBD)	Institute of Gas Technology	Not tested for PCBs in sediments	Pilot	No	Both	Limited	No available information	No available information		ex situ Combines contaminant extraction with biodegradation.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-3
List of Process Options for Bioremediation

Process Name	Vendor Name	Applicability to Treat PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O&M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Phyto-Remediation		Yes-presently being tested for PCBs in dredged material	Pilot	No	Both	Limited	Information not available	Information not available		ex situ Involves use of plants to reduce contaminant concentrations; for PCBs, the mulberry plant is being tested and the hackberry for PCB congeners.
PCB-REM	Institute of Gas Technology	Not tested for PCBs in sediments: Tested for PCBs in soil at Pilot Scale	Pilot	No	Both	Limited	Information not available	$250 - $400 per ton		ex situ Process combines extraction using surfactants, chemical oxidation, and biological treatment.
Soil and Sediment Washing Process	BioGenesis Enterprises Inc.	Yes - Tested for PCBs in sediments at bench-scale and presently being tested at pilot scale	Commercial	Yes	Both	Readily available	40 CY/hr	$74/CY	NY/NJ Harbor (1997, 1999)	ex situ Soil washing/ biodegradation process;

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-3
List of Process Options for Bioremediation

Process Name	Vendor Name	Applicability to Treat PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O&M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
White Rot Fungus	Intech One Eighty	Not tested for PCBs in sediments	Commercial	No	O&M	Readily available	No available information	$150 - $200 per ton		ex situ
X-19	Advanced Solutions for Environmental Treatment (ASET)	Not tested for PCBs in sediments	Pilot (soil)	No	O&M	Readily available	5,000 CY/acre at one time or 1,000,000 CY per year of soil treated; 7 months	$30/CY or $20 per ton		ex situ X-19 is a microbiological humic polymer. No tilling or additional handling required.

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Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-4
List of Process Options for Solvent Extraction Technologies

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
B.E.S.T. Process	Resources Conservation Company	Yes - Tested for PCBs in sediments	Commercial	Yes	Both	Readily available	70 tons/day (operating 24 hrs/day)	$90 - $280 per ton	Grand Calumet River	ex situ Uses secondary or tertiary amines.
Biotherm Process	American Biotherm Company, LLC	Not tested for PCBs in sediments	Commercial (Sludge drying process = Biotherm Process) Pilot (Solvent extraction process) Bench (PCB demonstration level)	Yes	Both	Readily available	50-200 tons/day	$200 - $500 per ton		ex situ Uses second generation Carver Greenfield Process.
Detergent Extraction of NAPLS (DNAPLS)	S.S. Papadopulos & Associates, Inc.	Not applicable for PCBs in sediments	Pilot	No - only waste stream is spent activated carbon canisters	Both	Readily available	No available information	$11/ square yard for bedrock		in situ Removes nonaqueous phase organic compounds.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-4
List of Process Options for Solvent Extraction Technologies

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Fluid Extraction - Biological Degradation (FEBD)	Institute of Gas Technology	Not tested for PCBs in sediments	Pilot	No	Both	Limited	No available information	No available information		ex situ Combines contaminant extraction with biodegradation.
L.E.E.P. (Low Energy Extraction Process)	Enviro-Sciences (formerly ART International)	Yes - Tested for PCBs in sediments	Pilot (LEEP PCB Plant) Full (LEEP Tar Plant)	Yes	Both	Readily available (Commercial plant in development for LEEP PCB Plant)	Full scale - 10 tons/hr. Mobile unit - 7.7 tons/hr. Pilot scale - 200 lb/hr.	$95-$300 per ton	Waukegan Harbor - LEEP performed treatability study; achieved 99.9% DRE at initial PCB concentration of 3.4%.	ex situ Does not treat heavy metals. Treats matrices containing as much as 90% water.
Light Activated Reduction of Chemicals (LARC)	Arctech, Inc.	Not tested for PCBs in sediments	Pilot	No	Both	Readily available	64-lamp pilot-scale LARC unit has capacity of 30 gallons	$85/ton		ex situ Does not treat metals.
Methanol Extraction Process	Environmental Treatment and Technologies Corporation	Yes - Tested for PCBs in sediments	Pilot	No	Both	Unknown. latest data known as of 1986. Unable to contact vendor.	No available information	No available information	USEPA Region III Clean-up at Minden, West Virginia	ex situ Uses methanol solution to extract organic contaminants.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-4
List of Process Options for Solvent Extraction Technologies

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
ORG-X	Metcalf & Eddy, Inc.	Not tested for PCBs in sediments but has been used to treat PCBs in clay loam at full scale	Full Scale - treatment of 1000 tons Pilot Scale - treatment of 200 tons Facilities operated in Europe	Yes - need to dispose of spent solvent and fines which contain the contaminants	Both	Readily available	4 tons/hr capable of operating 24 hours per day	$200 per ton for 2,000 tons <$100 per ton for 100,000 tons		ex situ Has been used in combination with Hydro-SEP sediment washing process and SOLFIX, a heavy metal stabilization process.
SELPhOX	Institute of Gas Technology	Not tested for PCBs in sediments	Pilot scale	No	Both	Limited	Field test unit can handle 10 to 20 kg batches in semi-continuous mode	$200/ton		ex situ Process combines supercritical fluid extraction of contaminants and wet air oxidation destruction of extracted contaminants.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-4
List of Process Options for Solvent Extraction Technologies

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Solvated Electron Technology	Commodore Environmental Services, Inc. which is a subsidiary of Commodore Applied Technologies (CAT)	Not tested for PCBs in sediments	Bench Scale	No	Both	Readily available	No available information	$100-$175 per ton	New Bedford Harbor - this technology selected to be part of the FS study however no follow up contract has been issued	ex situ Commodore uncertain if test results apply to or can be duplicated for large-scale applications. SET unsuitable for aqueous waste streams.
Solvent Extraction Soil Remediation (SESR)	National Research Council of Canada	Not tested for PCBs in sediments: Tested for PCBs in soil at bench scale	Bench Scale	Yes	Both	Limited - only at bench scale	Pilot expected to run at 5 ton per hour	$140/ton Canadian for the planned pilot system		ex situ Process involves the separation of fine particles from the extracting solvent using a liquid phase agglomeration technique.
Solvent Extraction Treatment System	Terra-Kleen Response Group, Inc.	Not tested for PCBs in sediments	Commercial	Yes	Both	Readily available	1-1,000 CY per batch	$165 - $600 per ton		ex situ Does not treat metals. Soils containing > 20% clays or fines decrease effectiveness.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-4
List of Process Options for Solvent Extraction Technologies

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
SoPE (Solid Organic Phase Extraction)	Envirogen, Inc.	Not tested for PCBs in sediments	Commercial	Yes	Both	Readily available	50 CY/day	$90 - $140 per ton		ex situ Works best for high sand, low moisture content.
Supercritical Fluid Extraction (SFE)	Syracuse University	Yes- Tested for PCBs in sediments at bench scale	Bench Scale	Yes	Both	Readily available	Bench Scale 1 kg Lab Scale 10 g Expected Full scale 15,695 CY/yr	$288 - $353 /CY	St. Lawrence River Hudson River	ex situ Moisture content affects initial extraction rates but not the final extraction efficiency.

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Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-5
List of Process Options for Chemical Dechlorination

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Base Catalyzed Decomposition (BCD)	National Risk Management Research Laboratory	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	20 tons/day	$245 per ton		ex situ Developed by USEPA/US Navy.
APEG-PLUS	Galson Remediation Corporation	Not tested for PCBs in sediments	Commercial	Yes	Both	Readily available	160 - 200 tons/day	$200 - $500 per ton		ex situ Not cost-effective for large waste volumes. High clay and water content affect performance.
Dechlorination and Immobilization Process	Funderburk and Associates (formerly HAZCON)	Not tested for PCBs in sediments	Commercial	No	O&M	Inactive for last 5 years; Readily available	60 CY/hr 120 tons/hr	$98 - $206 per ton		ex situ Dechlorination and solidification/ stabilization process.
Solvated Electron Technology (SET) (Agent 313)	Commodore Applied Technologies	Not tested for PCBs in sediments	Pilot scale. Presently completing construction and testing of full-scale system	No	Both	Limited. Design and Planning phase for full scale soil decontamination system	Batches of 100 - 600 lb (0.05 - 0.3 ton)	$100 - $175 per ton		ex situ Does not treat heavy metals. Process designed for separation of radioactive wastes.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-5
List of Process Options for Chemical Dechlorination

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Gas Phase Chemical Reduction Process	Eco-Logic	Yes - Tested for PCBs in sediments at bench scale	Pilot scale. Full Scale exists but does not process large amounts; New system under development	Yes	Both	Readily Available (pilot). Larger system at full scale to be available in 12 to 18 months.	5 - 10 tons per day (pilot). Present full scale process at 70 - 90 tons/hr	$550 per ton	New Bedford Harbor	ex situ Thermal desorption and gas phase chemical reaction (dechlorination) process.
KPEG	SDTX Technologies, Inc.	Not tested for sediments	Pilot scale (field tested)	No	Both	Not offered currently	No available information.	Not given		ex situ Usually used in combination with SoilTech ATP (thermal desorption).
XeChlor Process	Xetex Corporation	Not tested for sediments	Pilot scale	No - produces biphenyl	O&M	Limited	No available information.	$259 per ton		ex situ Process utilizes a titanocene dichloride catalyst.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-6
List of Process Options for Solidification/Stabilization

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Chemical Fixation/ Stabilization	Chemfix Technologies	Not tested for PCBs in sediments	Commercial	No	O&M	Readily available	40 - 75 CY/hr	$30-$50 per ton		in situ Treats matrices ranging between 8-75% solids. Waste must be pumpable.
Mectool Remediation System	Millgard Corporation	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	>15 CY/hr	$40-$150 per CY		in situ Soil mixing technology which enhances bioremediation. Inject solidification compounds to stabilize contaminants.
Mobile Injection Treatment Unit (MITU)	CBA Environmental Services	Not tested for PCBs in sediments	Commercial	Yes	Both	Readily available	18.5 - 370 CY/hr depending on size unit utilized	$19 per ton		in situ/ex situ Bioremediation and Stabilization process. Inject biochemicals to enhance bioremediation or stabilization compounds to stabilize waste.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-6
List of Process Options for Solidification/Stabilization

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Solidification Stabilization	Geo-Con, Inc.	Not tested for PCBs in sediment: Tested for PCBs in soil at bench scale	Commercial	No	Both	Readily available	18 - 45 tons per hour	$40 - $50 per CY		in situ Best suited for inorganics. Capping of treated waste required.
Solidification Stabilization	Soliditech, Inc.	Yes - Tested for PCBs in sediments	Pilot	No	O&M	Technology not offered currently	Determined by size of batch mixer used	$152 per cubic yard	New Bedford Harbor	in situ/ex situ Adds SVOCs to treated waste.
Solidification Stabilization / Chemical Fixation	STC Remediation	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	500-1000 CY/day (ex situ)	$190 - $330 per CY		ex situ in situ
Dechlorination and Immobilization Process	Funderburk and Associates (formerly HAZCON)	Not tested for PCBs in sediments	Commercial	No	O&M	Inactive for last 5 years; Readily available	60 CY/hr 120 tons/hr	$98 - $206 per ton		ex situ Dechlorination and solidification/ stabilization process.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

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Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Excavation Equipment										
Backhoe Clamshell Front end loader	Numerous	May be suitable for shoreline sediments accessible from landside	Can remove sediments from within dewatered working areas	Negligible inside work area	Dependent upon scale of equipment	in-situ	Readily available	Relatively low capital and O&M	Willow Run Creek Marathon Battery GM Central Foundry	Requires dewatering.
Conventional Dredges										
Enclosed Clamshell	Cable Arm, Inc.	Equipment can be scaled to meet river access requirements	Some applicability to soft sediments located in deeper portions of river (channel)	Low	Depends on bucket size and operating conditions	Spoils near in-situ density	Readily available	$20,000/mth	Ford Outfall Many Canadian projects Sheboygan River United Heckathorn	Generally considered to be more effective on debris laden sediments than hydraulic dredges.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Hydraulically Operated Backhoe or Bucket	Hitachi, Caterpillar, Case, Komatsu, BEAN	Equipment can be scaled to meet river access requirements	Useful on both soft and hard sediments at all river depths	Depends on operating conditions	Relatively slow production rate due to bucket size limitations	Spoils near in-situ density	Components are readily available. However, project-specific unit may need to be developed	$700,000 (Large Excavator) $380,000 (Med. Excavator)	Sheboygan River GM Central Foundry Bayou Bonafouca	Easily transportable to site via truck. Minimal draft requirements when barge mounted.
Cutterhead Dredge	Elicott International Numerous others	Equipment can be scaled to meet river access requirements	Applicable on most sediment types if they are debris free	Dependent upon relation between suction and dredging rates High pump rate leads to low resuspension rate	Various based on pump and pipeline sizes as well as on site characteristics including sediment types and presence of debris	Low spoils density due to substantial water entrainment (usually <10-20% solids)	Readily available	$650,000	New Bedford Harbor LTV Steel	Able to remove most sediment types. Several have covers or shrouds to limit resuspension. Transportable to site via truck.
Suction Dredge	Dredge America Elicott International	Equipment can be scaled to meet river access requirements	May not be suitable on consolidated sediments such as those in Upper Hudson	Relatively low as there is no equipment for dislodging sediment	Depends on pump size	Low spoils density due to substantial water entrainment (typically 5-15% solids)	Readily available	$625,000	Manistique River and Harbor (some diver assisted) LTV Steel (some diver assisted)	Can be diver held/assisted. Can be self propelled. Truck transportable units are available.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Large Scale Dredges										
Bucket Ladder Bucket Wheel Dipper Dragline Dustpan Sidecasting	Several	Configuration not typically compatible with use on Hudson River Dredges are usually large and have significant draft requirements	NA	High	High	Variable	Readily available	Unit costs are low when used for navigational dredging projects	NA	NA

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Specialty Mechanical Dredges										
Amphibious Excavators	Aquarius Systems IHC Holland Normrock Industries (Amphibex)	Versatile dredge can access most areas of river while afloat or while using its legs/spuds	Useful on both soft and hard sediments at most river depths	Dependent upon dredging method employed	Low due to scale of equipment	Dependent upon dredge head employed	Units would likely need to be constructed for this project	$355,000	Scarborough Bluffs, Ontario (47,250 cy from waters as shallow as 19.5 inches) Welland River	Easily transportable to site via truck. Low draft. Equipped with wide range of accessories including backhoe bucket and cutterhead equipped hydraulic intake.
Visor Dredging Grab	HAM Dredging of the Netherlands	When mounted on barge, likely to have minimal draft requirements and be able to access most portions of river	May not be suitable on "hard-packed" sediments such as those in Upper Hudson	Low due to hydraulically sealed bucket	Low due to scale of equipment	Spoils near in-situ density	Some availability	$700,000 (Large Excavator) $380,000 (Med. Excavator)	No projects conducted in US	Hydraulically sealed bucket (barrel) designed for contaminated silt removal.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Auger-Cutterhead Dredges										
Horizontal Auger Dredge	Ellicot International (Mudcat) ESG Manufacturing Others	Equipment can be scaled to meet river access requirements	Applicable to areas of debris free sediments May not be applicable to "hard packed" sediments	Can be low depending on operating procedures	Various based on pump and pipeline sizes as well as on-site characteristics including sediment types and presence of debris	Low spoils density due to substantial water entrainment	Readily available	$350,000-$400,000	Manistique River Marathon Battery Grasse River Cumberland Bay	Easily transportable to site via truck. Low draft.
Clean-Up System Refresher System Delta Dredge Waterless Dredge	NA	NA	Suitable for removal of most sediment types	Low due to shrouds over cutterheads	Dependent upon operating conditions		Not readily available	NA	Successfully used outside the US	Uses shielded, horizontal auger. Sophistacated instrumentation and controls.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Submersible Pumps										
Submersible Pump Eddy Pump	Dredge America Elicott International	Equipment can be scaled to meet river access requirements	May not be suitable on consolidated sediments such as those in Upper Hudson	Relatively low as there is no equipment for dislodging sediment	Depends on pump size	Low spoils density due to substantial water entrainment (10-15% solids)	Submersible pumps readily available Eddy Pump not readily available	NA	Petit Creek Flume	Can be diver held/assisted. Can be self propelled. Truck transportable units are available.
Specialty Suction Dredges										
Matchbox Dredge Wide Sweeper Cutterless	NA	NA	May not be effective on consolidated sediments in river	Generally low	Dependent upon operational and site conditions	NA	Not readily available	NA	New Bedford Harbor (Matchbox)	Generally use shrouds to limit resuspension. Sophisticated positioning equipment.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

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Table 4-7
List of Dredging Technology Options

Process Name	Vendor Name(s)	Ability to Access Hudson River Sediments	Applicability to Removal of Hudson River Sediments	Sediment Resuspension Rate	Sediment Removal Rate	Spoil Density	Availability	Cost	Representative Recent Projects	Special or Unique Features
Pneumatic Dredges										
Pneuma Pump Oozer Pump Airlift Dredge	NA	Equipment can be scaled to meet river access requirements	Performs best on loosely consolidated silts and clays at significant water depths, generally >12 ft.	Generally low if cutting attachments are not used	Dependent upon operational and site parameters	High solid content	Not readily available in U.S.	NA	Substantial use outside of US	Uses compressed air or pressure differential to draw in sediment and force to surface.
Sediment Freezing										
Eriksson System	Eriksson Sediment Systems, Inc.	NA	Suitable for PCB contaminated sediments Less effective on debris laden sediments	Minimal since there is no cutting/digging	Slow, as freezing requires 24-hr.	in-situ	Low	High	Bench scale demonstration conducted at Port Hope Harbor, Ontario	Difficult to use on sediments laden with large debris or rocky areas. Requires offshore electrical generating and refrigeration unit.

Note: Technologies which are shaded on the table are potentially applicable for use at the site.

Table 4-8
List of Suspended Sediment Containment Technology Options During Sediment Removal

Option Name	Vendor Name(s)	Applicability to Hudson River Conditions	Setup Requirements	Capital Cost	Representative Recent Projects	Special or Unique Features
Cofferdam/ Caissons	NA	Applicable to the control of suspended sediments	Significant equipment and crew requirements	High	Housatonic River	Minimal passage of suspended sediments from work area. Installation may induce some suspension.
Berms- Rock/Earth	NA	Applicable to containment of areas to be dewatered and remediated "in the dry"	Significant equipment and crew requirements	Medium	Tennessee Products Marathon Battery	
Oil Containment Boom	Brockton Equip./Spilldam, Inc.	Low applicability to PCB contaminated sediments	Small equipment and crew requirements	Low	Manistique River Grasse River	Only effective at containing floating product.
Portable Dam	Portadam	Applicable to containment of areas to be dewatered and remediated "in the dry" 9 ft depth limitation	Few laborers and minimal equipment required	Medium	GM Central Foundry (dry excavation) Tennessee Products (unsuccessful)	Modular impermeable, fabric barrier supported by steel framework.
Sheet Piling	Macro Enterprises, Ltd. Jet-Drive Contracting	Applicable to the control of suspended sediments Applicable to containment of areas to be dewatered and remediated "in the dry"	Significant equipment requirements including driving rig and crew	$500 - $1200/linear ft of sheeting	GM Central Foundry (silt control) Willow Run Creek (dry excavation) Petit Creek Flume (silt control)	Minimal passage of suspended sediments from work area. Installation may induce some suspension.

Table 4-8
List of Suspended Sediment Containment Technology Options During Sediment Removal

Option Name	Vendor Name(s)	Applicability to Hudson River Conditions	Setup Requirements	Capital Cost	Representative Recent Projects	Special or Unique Features
Silt Screen/Curtain	Brockton Equipment/ Spilldam, Inc. (Turbidity Barrier)	Applicable to the control of suspended sediments	5 - 10 laborers and work boats including barge and positioning craft required	\$10 - \$20/linear ft of curtain/ screen plus cost of anchoring materials	Numerous silt screen operations Formosa Plastics (silt curtain)	Screen is geotextile which blocks sediment only. Curtain is impervious to both water and sediment.
Water Filled Barriers	GeoCHEM, Inc.	Applicable to the control of suspended sediments Applicable to containment of areas to be dewatered and remediated "in the dry" 7 - 10 ft depth limitation	5 - 11 laborers and minimal equipment required	Medium	Marathon Battery	Multiple impermeable inner tubes filled with water for mass weight.

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Table 4-9
List of Process Options for Sediment Washing

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
GHEA Associates Soil Washing Technology	GHEA Associates	Not tested for PCBs in sediments. Tested for PCBs in soil at pilot scale	Pilot scale	Yes	Capital	Readily available	Information not available	$50-$80 per ton at full scale		ex situ Process uses selected surfactants similar to detergent-like-chemicals.
Hydro-Sep Soil Washing Process	Metcalf and Eddy	Not tested for PCBs in sediments	Commercial	Yes	Both	Readily available	2-20 tons/hr.	$50 - $125 per ton		ex situ Effective with moisture content <25%.
PCB-REM	Institute of Gas Technology	Not tested for PCBs in sediments. Tested for PCBs in soil at pilot scale	Pilot	No	Both	Limited	Information not available	$250 - $400 per ton		ex situ Process combines extraction using surfactants, chemical oxidation, and biological treatment.
Soil Washing	Westinghouse Remediation Services	Not tested for PCBs in sediments. Tested for PCBs in soil at pilot scale	Commercial	Yes	Both	Readily available	(Large unit) 20 tons/hr. (Small Unit) 2 - 4 tons/hr	$150 - $250 per ton		ex situ Trailer mounted. Handles clay well.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-9
List of Process Options for Sediment Washing

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Soil and Sediment Washing Process	BioGenesis Enterprises Inc.	Yes - Tested for PCBs in sediments	Commercial	Yes	Both	Readily available	40 CY/hr.	$74 per CY	NY/NJ Harbor (1997, 1999 Current Pilot study)	ex situ Combination of soil washing and bioremediation.
Soil Remediation System (SRS)	Environmental Remediation International (EnRem),Ltd.	Not applicable	Pilot	Yes	Both	Readily available	10-20 tons per hour	Not Given		ex situ Recovers hydrocarbons for reuse. Uses EnRem-17 chemical surfactant.
Soil Washing	ARCADIS Geraghty & Miller, Inc., Soil Washing Technology	Not tested for PCBs in sediments: Tested for PCBs in soils at bench scale	Commercial	Yes	Both	Readily available	30 tons/hr	$136-$226 per ton		ex situ Transportable
Soil / Sediment Washing	Formerly Bergmann USA - Currently available from Linatex, Inc.	Yes - Tested for PCBs in sediments at pilot scale	Commercial	Yes	Both	Readily available	30 CY/day Full scale - 300 tons/hr Pilot scale - 5 tons/hr	$75 - $125 per ton	Saginaw Bay-Tested PCBs in SITE Demonstration	ex situ Suitable for river sediments with <40% silt or clay.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-9
List of Process Options for Sediment Washing

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Trozone Soil Remediation System	Kinit Enterprises	Not tested for PCBs in sediments	Commercial	No	Both	Readily available	25 CY/hr (Full-Scale)	$30 - $1000 per ton		ex situ Process uses a mixture of ozonolysis, reverse osmosis and enzymes.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
AST Thermal Desorption System	Advanced Soil Technologies	Not yet tested for PCBs in sediments	Commercial	No; Collected off-gas is processed in a baghouse and then sent to a thermal oxidizer for contaminant destruction	Both	RIMS unable to contact vendor	8-30 tons per hour	\$35-\$150 per ton		ex situ Process uses a counter-flow rotary kiln at 900° F. Can not process inorganics or hydrocarbons with boiling point > 900° F.
DAVES Process (Desorption and Vapor Extraction System)	Recycling Sciences International, Inc.	Yes - tested for PCBs in sediments at pilot scale	Commercial	Yes ; Contaminants enter into gas stream and are then treated in the gas treatment system at 320°F where solids, organic vapors, and vaporized water are extracted from	Both	Readily available	3-12 tons/hr (original system) 73 tons/hr (larger system)	\$150 - \$600 per ton	Waukegan Harbor Superfund Site	ex situ Combines Thermal Desorption and Vapor Extraction. Does not treat metals. Process uses low temp. fluidized bed with hot air at 100° F-1400°F.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
DuraTherm Desorption Technology	DuraTherm, Inc.	Not yet tested for PCBs in sediments	Pilot scale Has been used to demonstrate full-scale cleanups	Yes ; Contaminants are vaporized and then swept out the vapor exit by a counter-current nitrogen purge and then the gas is condensed	Both	Readily available	30,000 tons per year	$100-$350 per ton		ex situ Process uses a rotating drum to volatilize contaminants at high temp. using a non-oxidizing atm. at temperature as high as 1400°F.
Enviro-Tech Thermal Desorption	CMI Corporation	Not tested for PCBs in sediments: Process used to treat organics and hydrocarbons	Commercial	No; Volatilized contaminants pass through a thermal dust conductor and then into a thermal oxidizer for combustion	Both	Readily available	8-120 tons per hour	No cost given		ex situ Process is a thermal treatment technology which can operate in two different modes depending on contaminant. Uses a rotary desorber with variable temp. depending on the contaminant.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Gas Phase Chemical Reduction Process	Eco-Logic	Yes - Tested for PCBs in sediments	Pilot Full scale exists but does not process large amounts New system under development	Yes; Contaminants are desorbed and then reduced in the gas phase using hydrogen	Both	Readily available (pilot) Larger system at full scale to be available in 12 to 18 months	5 - 10 tons per day (pilot) Present full scale process at 70 - 90 tons/hr	$550 per ton	New Bedford Harbor	ex situ Thermal desorption and gas phase chemical reaction process. Sediments are fed into a thermal destruction mill where the contaminants are desorbed and then sent into the reactor where the PCBs are destroyed at >850° C.
GEM 1000	Midwest Soil Remediation, Inc.	Not yet tested for PCBs in sediments	Commercial	No; Gas stream filtered through pulse jet baghouse and then into a thermal oxidizer which converts contaminants into CO_2, H_2O, and HCl	Both	Readily available	11-15 tons per hour			ex situ Process uses a counter-current rotary desorber at temperature ranging from 400° F to 900° F.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
High Capacity Indirect Thermal Desorption Unit	Midwest Soil Remediation, Inc.	Not yet tested for PCBs in sediments	Commercial	Yes; PCB contaminants are recovered in an off-gas condensing recovery system	Both	Readily available	25 tons per hour	\$125 - \$225/ton		ex situ Process uses an indirect heated processor at 1000° F. System pressure is kept negative to avoid unwanted emissions.
HRUBOUT Process	Hrubetz Environmental Services, Inc.	Not applicable: PCBs are not totally removed due to higher temp. required for removal	Pilot scale	No; Exhaust gas enters a thermal oxidizer where contaminants are destroyed	Both	Readily available	1100 CY per batch or 60 tons per batch	\$40 - \$50 per CY		ex situ Process involves injection of heat at temp. up to 1200° F into the soil pile and removal of volatilized contaminants through a vacuum. Process does not treat metals.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Indirect System	Maxymillian Technologies, Inc.	Not yet tested for PCBs in sediments. Has been used to treat PCBs in soil at full-scale level	Commercial	Yes; Process off-gases are condensed and liquid then need to be disposed of and excess gas is passed through carbon filters	Both	Readily available	10 - 20 tons per hour	$70-$150/ton		ex situ Process treats media in a rotary drum volatilizer by applying heat indirectly through burners located between the inner and outer shell at a temperature range of 250° F to 1000° F.
IRV-100, IRV-150, and IRHV-200 Thermal Desorption Systems	McLaren/Hart Environmental Engineering Corp.	Not yet tested for PCBs in sediments	Commercial	Yes; Purge gas containing the contaminants from the process enters a cooling loop and a carbon filtration system	Both	Readily available	(IRV-100) 3-5 tons per hour (IRHV-200) 10 -20 tons per hour	$50-$150 per ton		ex situ Process uses an infrared heating carriage. Moisture content > 20% will increase run times from 30 min. to one hour. Treats VOCs and SVOCs. Media treated until target temp. to volatilize contaminants is obtained.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Low Temperature Thermal Desorption (CMI80-120)	Midwest Soil Remediation, Inc.	Not yet tested for PCBs in sediments	Commercial	No; Volatilized contaminants are destroyed in a combustion system operating between 400° F -1800° F	Both	Readily available	80 - 120 tons per hour			ex situ Process uses a rotary desorber with self-regulated temp. control to be adjusted for specific contaminant to convert to vapor phase.
Low Temperature Thermal Desorption (CMI ET-650)	Midwest Soil Remediation, Inc.	Not yet tested for PCBs in sediments	Commercial	Yes; Volatilized contaminants pass through a baghouse, carbon adsorption, de-humidification chamber, and then are scrubbed with HCl	Both	Readily available	90 tons per hour			ex situ Process uses an indirectly fired rotary desorber at temp. between 400° F - 1000° F.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Low Temperature Thermal Desorption	Environmental Soil Management	Not tested for PCBs in sediment. Has been tested at bench scale for PCBs in soil.	Commercial	Yes; Contaminants are volatilized and destroyed in a thermal oxidizer at 1500° F forming products of combustion	Both	Readily available	85 tons per hour	$50-$100 per ton		ex situ Rotary Dryer operates between 500° F - 800° F. High clay content clumps and reduces DRE.
Low Temperature Oxidation	Carson Environmental	Not yet tested for PCBs in sediments	Bench Scale	No; Off-gases are condensed and treated with activated carbon filters and organic or ozone vapors are treated with manganese dioxide; system produces CO_2 byproducts	Both	Limited	20 tons/day	Not stated		ex situ Process uses reactivity of hydroxyl radicals in gas phase mixtures of hydrogen peroxide, ozone, and UV light to oxidize pollutants at temp < 200° F due to reactivity of oxidizing vapors.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Low Temperature Thermal Desorption Plant (LTTDP)	On-site Thermal Services Division of Soil Restoration and Recycling, LLC.	Not yet tested for PCBs in sediments	Commercial	No; Exhaust gases containing contaminants are sent through a baghouse and a catalytic oxidizer for combustion of organic compounds	Both	Readily available	10-40 tons per hour	$40-$250 per ton		ex situ Process uses a rotary dryer between 500° F -800° F. Process used to treat petroleum hydrocarbons, pesticides, and chlorinated hydrocarbons.
Low Temperature Thermal Aeration System (LTTA)	Smith Technologies Corporation	Not tested for PCBs in sediments	Commercial	Yes	Both	Company filed Chapter 11 bankruptcy in 1997	50 tons/hr	$133 - $209 per ton		ex situ Rotary Dryer
Low Temperature Thermal Desorption (LTTD) system	ASTEC/SPI Division	Not yet tested for PCBs in sediments	Commercial	No; Particulates are filtered from the gas stream and then the gas stream is treated in an oxidizer operating at 1400° F - 2300° F producing CO_2 and H_2O	Both	Readily available	10-40 tons per hour	$25-$75 per ton		ex situ Process uses a primary treatment unit which heats the media to temp ranging from 650° F - 1200° F to volatilize contaminants. Does not treat inorganics

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Low Temperature Thermal Desorber	Contamination Technologies, Inc. (CTI)	Not tested for PCBs in sediments. Process used for treatment of petroleum contaminated soils.	Not known due to inability to contact vendor	No; Process sends vaporized contaminants through a cyclone, afterburner at 1400° F, and then a baghouse	Both	Not known due to inability to contact vendor	1200 tons per day	$50 - $150 per ton		ex situ Process uses a rotary kiln thermal stripping technology High moisture content slows the processing time.
Medium Temperature Thermal Desorption (MTTD)	Carlo Environmental Technologies, Inc. (CET)	Not applicable for chlorinated organics. Used to treat hydrocarbons such as fuels, gasoline, and diesel oil.	Commercial	No; Volatilized contaminants are destroyed by high temperature oxidation	Both	Readily available	30 tons per hour	$30-$69 per ton		ex situ Process uses direct heat exchange in a rotary kiln to heat waste material to volatilize contaminants.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Mobile Retort Unit	Covenant Environmental Technologies, Inc.	Not yet tested for PCBs in sediments	Pilot scale. Has been used to demonstrate full-scale cleanups.	Yes; Contaminants are drawn out of the retort zone by an induction fan and then passed through a baghouse and into a heat exchanger for condensation	Both	Readily available	3-12 tons/hr	$100-$800 per ton		ex situ Process utilizes a retort chamber which heats the media allowing the contaminants to vaporize. Does not treat any heavy metals except mercury due to temperature.
Plasma Technique	Eagle Environmental Technologies, Ltd.	Not tested for PCBs in sediments	Design phase	No; Treated materials converted into benign or monatonic molecules that may form the basis of usable products	Both	Limited ; technology under current development	8.9 kg per hour	Not given		ex situ Process uses a direct current plasma generator at temp. as high as 8280° F and is used in combination with oxygen as the oxidizing agent.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Portable Anaerobic Thermal Desorption Unit (ATDU)	Purgo, Inc.	Not tested for PCBs in sediments	Commercial	Yes; Gas stream directed through a dual-coil condenser and is collected for eventual reuse in soil cooling process	Both	Readily available	20 tons/hr	\$60 - \$300 per ton		ex situ Process uses a counterflow or parallel flow rotary drum at temp. up to 1400° F and is operated at negative pressure. Does not treat metals. Soil with moisture content >30% will require pretreatment or addition of lime.
Soil Roaster	ConTeck Environmental Services, Inc.	Not tested for PCBs in sediments. Process is designed for treatment of petroleum-contaminated soils.	Commercial	No; Process sends volatilized contaminants through a baghouse and into an after-burner at 1400° F - 1900° F to degrade hydrocarbons into CO_2 and H_2O	Both	Readily available	10 - 60 tons per hour	\$22 - \$65 per ton		ex situ Process uses a rotating desorber drum at 500° F - 1000° F. Additional wet scrubbing required for organic-bound chlorine compounds. Failure has occurred due to condensation in the baghouse.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Soil Tech ATP	Smith Technology Corporation	Yes - Tested for PCBs in sediments	Commercial	Yes; Contaminants are removed from aqueous condensate by filtration, oxidation, and adsorption	Both	Readily available	5 - 25 tons per hour	\$150 - \$250/ton	Waukegan Harbor Superfund Site	ex situ Process uses indirectly fired rotary kiln at 1200° F - 1450° F. Treats media with contaminants that vaporize at 1100° F. Has been used in combination with APEG.
STRATEX	ARCADIS Geraghty and Miller, Inc.	Not yet tested for PCBs in sediments	Bench scale	Yes; Gas stream is treated in non-contact condenser, a reheater, fabric filter and an adsorber before discharge to the atmosphere	Both	Limited - No performance record to date	5-10 tons per hour	\$125-\$150 per ton		ex situ Process uses a treatment chamber at 332° F - 407° F and a residence time of 1 to 2 hours. Stabilization items such as quick lime can be added to the chamber to enhance treatment and increase solids temp. Uses concept of stream stripping, S/S, and thermal desorption.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
System 64MT Low Temperature Thermal Desorption	Advanced Environmental Services, Inc.	Not yet tested for PCBs in sediments	Commercial	No; Exhaust gas is filtered for particulates and then directed to a thermal oxidizer operating at 1800° F - 2000° F for contaminant destruction	Both	Readily available	22-25 tons per hour	$50 - $125 per ton		ex situ Process uses a counter-current flow rotary dryer at a temperature range of 800° F to 1000° F. Heavily contaminated soils with high BTU are damaging to effectiveness of process.
Thermal Desorption	ETTS EcoTechniek Thermal Treatment	Yes - Tested for PCBs in sediments	Commercial	Yes	Both	Readily available	20 - 40 tons per hour	$60 - $200 per ton		ex situ Process uses a rotary kiln thermal treatment system which operates in two zones - a heat exchanger and a combustion zone. Does not treat metals.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Thermal Phase Separation Unit (TPS)	SCC Environmental	Not yet tested for PCBs in sediments. Process has been tested on PCBs in soil.	Commercial	Yes; Vapors collected during desorption are first cooled in quench chamber resulting in condensation and then are sent through carbon adsorption beds	Both	Readily available	4 tons per hour	$250-$350 per ton		ex situ Process uses extraction chamber that is indirectly heated by propane fuel and operates at temp. of 932° F. System capable of treating organic concentrations of less than 30% and particle size less than 0.75 in. in diameter.
Thermal Desorption	IT Corporation	Not tested for PCBs in sediments. Tested for PCBs in soil.	Pilot scale	No; Contaminants volatilize and are then sent to a gas treatment system where the off-gas is treated by secondary combustion or physical/ chemical treatment	Both	Readily available	15 - 150 lb/hr	$80/ ton		ex situ Process uses a gas-fired furnace which indirectly heats media to temp. greater then the boiling point of the contaminants. Chlorinated furans produced if process conditions not controlled.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Thermal Desorption	Westinghouse Remediation Services	Not tested for PCBs in sediments	Pilot (soil and sludge)	Yes; Contaminants are desorbed into the vapor phase at temp. above their boiling points and then the contaminants are condensed and disposed of off-site	Both	Readily available	10 tons/hr.	$150 - $300 per ton		ex situ Process uses infrared heating at 400° F to 1000° F and operates below atmospheric pressure in an oxygen-deficient environment in the primary heating chamber.
Thermal Distillation and Recovery Process (TDR)	Caswan Environmental Services, Ltd.	Not yet tested for PCBs in sediments	Commercial	Yes; Extracted vapors are condensed and removed or taken out by activated carbon filters	Both	Limited; used in full-scale clean-up in 1995 but RIMS unable contact vendor to determine current status	Full scale: 10 - 15 tons/hr. Pilot scale: 50 - 220 lb./hr.	$75- $300 per ton		ex situ Process uses nitrogen as a purge gas to remove oxygen and then uses an indirect-fired rotary kiln to remove organics at temperature as high as 500° F. Does not treat inorganics.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Thermal Desorption System	Maxymillian Technologies, Inc.	Not yet tested for PCBs in sediments	Commercial	No; Gas treatment containing the contaminants is passed through a cyclone, a gas-fired afterburner at 1800° F, a quench tower and a baghouse	Both	Readily available	16 - 22 tons per hour	$40 - $300 per ton		ex situ Process uses a direct-fired, co-current thermal desorber based on rotary kiln technology and operates between 600° F - 1000° F. Need minimum of 60% solids in feed material.
Thermo-O-Detox Medium Temperature Thermal Desorption	ETG Environmental Inc.	Not tested for PCBs in sediments	Commercial	Yes; Contaminants are removed at temp. below their boiling points and then disposed of	Both	Readily available	2 Batches of 25 to 75 CY per day	$150 - $250 per ton		ex situ Process is a non-oxidative thermal desorption system that operates under a high vacuum at 750° F to 950° F. Can be combined and used with BCD process.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-10
List of Process Options for Thermal Desorption

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Two-stage Tandem Soil Remediation Unit (TDU)	Thermotech Systems Corporation	Not yet tested for PCBs in sediments. Has been used to treat PCBs in soil	Commercial	No; Collected off-gas passes through inertial separator, baghouse, and thermal oxidizer where contaminants are destroyed	Both	Readily available	20-50 tons per hour depending on which model is used	$40 - $150 per ton		ex situ Process uses a counter-flow rotary drum where temp. varies depending on contaminant and model used. Four different models available and operate at 600° F, 850° F, 1000° F, or 1400° F.
XTRAX	Waste Management Inc.	Yes- Tested for PCBs in sediments at pilot and full scale at EPA SITE Demonstration	Commercial	Yes; Contaminants are volatilized and then cooled to form a liquid condensate where organics are settled out and removed for disposal	Both	Readily available	250 tons per day	$150-$250 per ton	Re-Solve Superfund Site	ex situ Process uses a indirectly fired rotary dryer operating between 250° C - 450° C. Does not treat or remove metals.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
AGGCOM	Institute of Gas Technology	Not yet tested for PCBs in sediments	Pilot scale	Yes	Both	Readily available	6 tons per day	Not given		ex situ Process uses fluidized bed/cyclonic agglomerating combustor at temperature of 2000° F - 3000° F
Circulating Fluidized Bed Combustor (CFBC)	Cintec Environment Inc.	Not yet tested for PCBs in sediments; tested for PCBs in soil	Commercial	Yes	Both	Readily available	5 tons per hour	Varies with media, conc. PCBs, volume		ex situ Process uses a high turbulence incineration bed at 1337° F
Circulating Bed Combustor (CBC)	General Atomics (GA)	Not yet tested for PCBs in sediments; tested for PCBs in soil	Commercial	Yes	Both	Limited: GA not pursuing this technology in the US but maintains technical and related capabilities	100 tons/day	$150 - $300 per ton		ex situ Process uses a fluidized bed incinerator which uses high velocity air to create a turbulent zone for destruction at 1600° F

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
CPMC Process	Combustion Process Manufact-uring Corporation	Not yet tested for PCBs in sediments	Commercial	Yes	Both	Unavailable due to lack of case study information	84 to 840 tons per day	Not given		ex situ Process uses two separate burning stages: low temp. starved air and high temp. excess air phase
Cyclone Furnace Vitrification	B&W Services, Inc.	Not yet tested for PCBs in sediments	Pilot scale. Full-scale has been designed	Yes	Both	Readily available	0.1 tons per hour	$465 - $600 per ton		ex situ Process uses a water-cooled cyclone furnace at 800° F and 6-million BTU/hr input
Hybrid Thermal Treatment System (HTTS)	IT Corporation	Not yet tested for PCBs in sediments	Commercial	Yes	Both	Readily available	17.87 tons per hour	$230 per ton		ex situ Process uses a rotary kiln combined with intense heating for incineration

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
Thermal Oxidation Treatment Unit*	Bennett Environment - RECUPER SOLS	Yes	Commercial	No - plant does not produce dioxins or furans	Both	Readily available	10 tons per hour or 240 to 300 tons per day	$250 per ton		ex situ Uses rotary kiln. Off-site (St. Ambrose, Quebec). Truck wastes to facility at cost of $70/ton
Incineration *	Onyx Environ-mental Services Port Arthur, TX	Not yet used for disposal of PCBs in sediments	Commercial (soil, sludge, liquids)	Yes	Both	Readily available	120 tons/day; Would take 50 years to burn one million tons	$900 per ton for PCB soil		ex situ Off-site Send waste dry Cost dependent on amount of material sent-working with GE presently
Incineration *	Safety-Kleen (Aragonite), Inc. Salt Lake City, Utah	Yes	Commercial	Yes	Both	Readily available	For bulk solids: 4.75 ton per hr	$560 per ton		ex situ Off-site Rail access 10 miles from site. Uses slagging rotary kiln. Fastest burn rate of all Safety-Kleen facilities.

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
Incineration *	Safety-Kleen (Coffeyville) Inc. Coffeyville, KS	Yes	Commercial	Yes	Both	Presently idle (11/99), expected to begin operation in Spring 2000	2.5 ton/hr	$640 per ton for PCB waste		ex situ Off-site Waste must arrive dry. This facility usually used for dioxin waste.
Incineration *	Safety-Kleen (Deer Park), Inc.; Deer Park, TX		Commercial	Yes	Both					ex situ Off-site
Infrared Incineration	IT Corporation	Not tested for PCBs in sediments. Used to treat PCBs in soil	Commercial (soil)	Yes	Both	Readily available	210 tons/day	$250 - $350 per ton		ex situ Near river Fuel oil required if BTU content <2000 BTU/lb.
Plasma Arc Centrifugal Treatment (PACT) System	Retech, Incorporated	Not yet tested for PCBs in sediments	Commercial status abroad Plans for constructing a commercial plant in the US	Yes	Both	Readily available	0.05 to 0.9 tons per hour	$800 - $1800 per ton		ex situ Near river Process uses a plasma torch to treat waste at 1982° F - 2432° F.

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
Pyrokiln Thermal Encapsulation	Smith Technology Corporation	Not yet tested for PCBs in sediments	Batch	Yes	Both	Limited	1 ton per hour (pilot planned feed rate)	Not given		ex situ Near river Process uses a rotary kiln combined with fluxing agents at 1800° F - 2200° F.
Rotary Cascading Bed Incineration	Pedco, Inc.	Not yet tested for PCBs in sediments	Development status is uncertain due to problems contacting vendor	Yes	Both	Availability uncertain	Information not available	Not given		ex situ Near river Process uses direct solid-to-gas contact by lifting and cascading solids through hot gas stream.
Shirco Infrared Thermal Destructive System	Shirco Infrared Systems, Inc.	Not yet tested for PCBs in sediments. Has been used to treat PCBs in soil and on equipment	Commercial	Yes	Both	Limited: no longer available through US vendor, available from Gruppo Italimpresse in Italy	100 tons/day	$197 per ton		ex situ Near river Electric infrared process. Waste must be sized from 5 microns to 2 inches to be treated.

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-11
List of Process Options for Thermal Destruction

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Repre-sentative Recent Projects	Special or Unique Features
Thermal Destruction Unit	IT Corporation	Not yet tested for PCBs in sediments. Has been used on PCBs in soil.	Commercial (soil)	Yes	Both	Readily available	210 tons/day	$250 - $350 per ton		ex situ Near river Infrared incineration
Transportable Incineration System	Roy F. Weston, Inc.	Not yet tested for PCBs in sediments. Has been used on PCBs in soil.	Commercial (soil)	Yes	Both	Readily available	2 Systems: TIS-5 at 7 tph; TIS-20 at 4 - 30 tph	$150 - $250 per ton		ex situ Near river Rotary kiln incinerator
Universal Demercuri-zation Process (UNIDEMP)	Battelle Memorial Institute	Not yet tested for PCBs in sediments	Pilot scale	Yes	Both	Readily available	5000 tons per year commercial plant	$300 - $600 per ton		ex situ Oxidative thermal treatment; uses counter-current rotating furnace at 857° F - 1007° F.

Note: Shaded options have been tested for applied to freshwater sediments and/or PCB-contaminated sediments. *Commercial TSCA permitted facility.

Table 4-12
List of Options for Beneficial Use

Beneficial Use Option	Applicability to Use PCB Contaminated Sediments	Availability	Processing Rate	Cost	Representative Recent Projects	Special Requirements or Unique Features
Agriculture	Not applicable due to levels of contamination in the Hudson	NA	NA	NA	NA	PCB concentration must be low enough to not affect humans or biota if used
Construction Fill	Potentially applicable. May have issues with the extent of contamination and liability	May be limited to government/ public projects	Vary depending upon selected use and the amount of material required for the specific project		Jersey Gardens Mall Site, Elizabeth, NJ; used 850,000 CY of treated dredged material for parking lot base	Potential to be used in government projects involving roadways or airports which allow sediment to be encapsulated. Fine material may not be appropriate as road base or construction fill.
Habitat Development	Not applicable due to levels of contamination in the Hudson	NA	NA	$5 - $35/CY	NA	PCB concentration must be low enough to not affect humans or biota if used.
Parks and Recreation	Not applicable due to levels of contamination in the Hudson	NA	NA	NA	NA	PCB concentration must be low enough to not effect humans or biota if used.
Solid Waste Landfill Cover	Applicable. May be limited to sediments with PCB levels below applicable criteria	Available	2700 - 7500 tons per day	$29/CY	Dredged sediments from the Erie Canal used as cover material in the Mohawk Region	Sediment would require settling and dewatering to moisture content of 13%.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-12
List of Options for Beneficial Use

Beneficial Use Option	Applicability to Use PCB Contaminated Sediments	Availability	Processing Rate	Cost	Representative Recent Projects	Special Requirements or Unique Features
Mine Reclamation	Applicable but can only accept PCBs < 4 ppm	Limited. Further advancement depends on groundwater data and public opinion from current demonstration project	Present pilot-scale project using 20,000 CY of dredged material. Large project to be conducted with of 200,000 to 250,000 CY of NY Harbor dredged material.	$42 - $86 per CY	Consolidating Technologies currently conducting a demonstration project using 20,000 CY of dredged sediments from Port of NY/NJ	Reclamation projects conducted in Pa. Involves closing and backfilling mine openings, backfilling open pits, and grading and revegetating abandoned mine sites.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-13
List of Process Options for Thermal Destruction/Beneficial Use

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Cement Lock - Technology	IGT/Endesco	Yes - Tested at pilot scale for sediments contaminated with PCBs	Pilot	No	Both	Readily Available	30,000 CY/yr (rate of demonstration project at the NY/NJ Harbor) Commercial to process 500,000 CY/yr	Treatment $35-50/CY Cement Processing $50/ton Market price cement $50/ton	NY/NJ Harbor	ex situ Uses a rotary kiln melter. Forms material appropriate for manufacturing of construction grade cement.
In situ Vitrification	Geo-Safe Corporation (aka GeoMelt)	Not tested for PCBs in sediments	Commercial (soil)	No	Both	Readily available	4 - 6 tons/hr. Up to mass of 1,400 tons	$55 - $77 per ton		in situ/ex situ Rain or snow have negative impact. Mobile No beneficial use stated at this time from this process.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-13
List of Process Options for Thermal Destruction/Beneficial Use

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Manufacture of lightweight aggregate	JCI/Upcycle	Yes - Tested at bench scale for sediments contaminated with PCBs	Pilot (fall of 1999)	No	Both	Limited - dependent upon completion of scheduled pilot scale demonstration	Commercial to process 500,000 CY/yr	Not yet available	Expected to be used at NY/NJ Harbor as Demonstration project pending results of pilot scale study in Fall 1999	ex situ Uses a rotary kiln thermal process. Process produces lightweight aggregate.
Plasma Energy Pyrolysis System (PEPS)	Vanguard Research Corp.	Not yet tested for PCBs in sediments	Pilot Currently demonstrating technology for the US Army	No- Process forms clean gas and treated water as by-products	Both	Limited		Not yet available		ex situ Technology operates by forming an electrical arc between two electrodes causing the temp. to increase to 3000° F. Produces a synthetic gas rich in hydrogen which can be used as a clean fuel to produce steam or electricity.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-13
List of Process Options for Thermal Destruction/Beneficial Use

Process Name	Vendor Name	Applicability to PCBs in Freshwater Sediments	Development Status	Hazardous or Toxic Residuals Produced	Capital or O & M Intensive	Availability	Processing Rate or Cleanup Time	Cost	Representative Recent Projects	Special or Unique Features
Plasma Arc Vitrification	Westinghouse	Yes - Tested at bench scale for sediments contaminated with PCBs	Pilot	No	Both	Readily Available	Demonstration plant 99,404 CY/yr Full-scale facility to process 497,021 CY/yr	$915-$1220/ton	NY/NJ Harbor	ex situ Uses plasma arc torch to melt contaminated material. Process produces a molten glass that is used to manufacture tile and fiberglass.
Thermo-chemical Decontamination Process	Institute of Gas Technology	Not yet tested for PCBs in sediments	Pilot	No	Both	Limited - dependant upon results from demonstration project	30,000 CY/yr Scalable to 100,000 CY/yr	Not yet available	Newark Bay/Lower Passaic River: using this process with 500 CY of dredged material from this river body	ex situ Process uses a rotary kiln which produces a pozzolanic material that can be mixed with Portland cement to produce a construction-grade blended cement.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-14
List of Disposal Facilities
Non-TSCA-Permitted Landfills

Near River Disposal Facilities

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Upland Confined Disposal Facility (CDF)	Various potential locations along Upper Hudson River	Yes - Depending on permit requirement - likely limited to <50 ppm PCBs	NA	Potential capacity depends on size of CDFs	NA	Capacity depends on size of CDFs	\$15 - \$50 per CY	NA	Sheboygan River - used CDF to enhance bioremediation in sediments Buffalo River- polymer added to sediments prior to being pumped into the CDF	Likely significant local opposition to any near river disposal facility.
Near Shore Confined Disposal Facility	Remnant Deposits; other potential locations in 100-yr floodplain or non-navigable areas of River.	Yes - Depending on permit requirement - likely limited to <50 ppm PCBs	NA	Potential capacity depends on size of CDFs	NA	Varies: Depends on size of near shore area utilized	\$15 - \$50 per CY	NA	New Bedford Harbor- stored PCB contaminated sediments for several years in a CDF until final disposal in an off-site landfill	Likely significant local opposition to any near river disposal facility.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Al Turi LF, Inc.	Orange County - Goshen, NY	NA	NA	Presently Awaiting Expansion	NA	NA	NA	NA	NA	Not accepting any new accounts as of 11/99.
BFI Waste Systems of North Anerica, Inc. Niagara Falls Landfill (formerly CECOS Landfill)	Kenmore, NY	Yes (Accept C&D, sludges, and all non-hazardous wastes)	Yes - rail access exists into landfill	None	Next 20 years	Accept 500 tons/day or 90,000 tons/7-mth dredge yr.	$30 - $60 per ton - this is cost for unloading RR cars and disposal	None		Waste sent must be at least 20% solids. Waste must pass TCLP tests. Equipped for gondola cars.
CINTEC	LaSalle, Quebec	Yes	Yes - rail access exists into landfill	More space to expand	6-7 years but will increase once more space is acquired					Can not accept waste from the US - would need to go through Laidlaw

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Colonie LF	Albany County - Newtonville NY	No	NA	NA	NA	NA	$60/ton	NA	NA	Can not accept contaminated soils.
Delaware County SLF	Delaware County - Delhi, NY	No	No	Active cell almost full: one new cell to open up	7-10 yrs.	NA	free	NA	NA	No MSW from outside county is allowed. Does not accept contaminated soil.
Enfoui-Bec (Becancour)	Quebec-along St.Lawrence River	Yes	No; has indirect access to a port	Do not expect to close; May expand permit to aquire more cells	No expected closure data	Have space available for 300,000 metric tons but may expand permit	$40/metric ton (Canadian) Discount rate for large amounts of material	Additional $10 for weight of trucks plus 7%TPS and TUQ 7.5%		Need to be able to shovel the sediments. Private firm (PROGESTEC) decides wastes received.

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Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Franklin Co. Regional	Franklin County - Constable, NY	Yes - Strict regulations by NYDEC on allowable PCB concentrations. Quoted to be in the ppb range	Closest rail siting is 6 miles away; then truck to site at own expense	750,000 tons: Expected to increase if permits approved from DEC for rest of land in area.	14 years left to operate with available space for 750,000 tons of waste	Up to 95 tons/day or 43,000 tons/year	$85/ton	Fees depend on quantity of material disposed		Must dewater sediments first. Does accept PCB contaminated wastes.
Fresh Kills SLF	Richmond County - SI, NY				Currently being phased out					Unable to contact this landfill.

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Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Fulton County LF	Fulton County -Johnstown, NY	No	No	NA	70 years	NA	$25/truck after get permit or $50/ton	Permit cost of $50		Do not accept waste from outside Fulton county. Not a hazardous waste landfill and never have and do not forsee accepting PCB waste in the future.
Greater Albany SLF	Albany, NY	No	No	Presently trying to get permit approval to extend another 12-15 years	Expected reach maximum capacity in March'2000	100 tons/day	$40/ton if dispose of 100 tons/day; if less, then $50/ton	No		NA

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Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Horizon Environment	Grandes Piles, Quebec	Yes	Yes - located 2.5 miles from site; need to truck from there	Yes - could be adding 2-3 more cells to increase available capacity of 500,000 tons	Expect to reach maximum capacity in 12 years	No limits on amount of material they recieve	$50/ton disposal but varies case by case; can arrange transportation and would add to above cost	No taxes from NY; only taxed if waste from Mass.	Lake Champlain - Cumberland Bay: have received 100,000 tons PCB sediments	No free liquid allowed in soil (pass paint filter test)
Clinton County Landfill: New England Waste Services (formerly Schuyler Falls LF)	Morrisonville, NY	No	No	NA	20 years	NA	$54.75/ton within county $63/ton outside of county	NA		Can not accept PCB waste. Classified as a MSW landfill in accordance with NY State Regulations Part 360.

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-14
List of Disposal Facililities
Non-TSCA Permitted Landfills

NYS Facilites not near the Hudson River*

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Planned Additional Capacity	Year Expected to Close or Permit Expiration	Capacity Limits (per day/month/ year)	Cost	Additional Taxes and Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Sullivan County LF	Sullivan County - Monticello, NY	No	No	Planing Expansion Presently	8 years	NA	$55/ton	NA		Do not accept contaminated soil.

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-14
List of Disposal Facilities
Non-TSCA Permitted Landfills

Out-of-State Facilities*

State	Type of Landfill	Total Number of Landfills	State Contact Information
Vermont	Municipal, Industrial, C&D	5 Municipal (as of 11/99) : 3 small unlined and 2 lined landfills 2 Industrial (5/94) 2 C&D (5/94)	VT Department of Environmental Conservation 802-241-3477 Waste Management Division 802-241-3888 www.anr.state.vt.us/dec
Massachusetts	Municipal, C&D	39 Total (as of 4/99) 38 Municipal (4/99) 1 C&D (4/99)	MA Dept. of Environmental Protection 617-292-5961 www.state.ma.us/dep
Maine	Municipal, Commercial, Industrial	2 Commercial (as of 11/99) Municipal (11/99) Industrial (11/99) * only commercial landfills permitted to accept PCB waste	ME Dept. of Environmental Protection 207-287-2651 Bureau of Remediation and Waste Management
New Hampshire	Municipal	19 Total (as of 2/99) 0 Industrial (2/99) 0 C&D (2/99)	NH Dept. of Environmental Services 603-271-3503 Waste Management Division 603-271-2900
Connecticut	Municipal, Industrial, Bulky, and Special	4 Municipal (as of 11/99) 39 Bulky Waste (11/99) 1 Industrial (11/99) 6 Special Waste (11/99)	CT Dept. of Environmental Protection 860-424-3009 Waste Bureau 860-424-3366 //dep.state.ct.us/

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-14
List of Disposal Facilities
Non-TSCA Permitted Landfills

Out-of-State Facilities*

State	Type of Landfill	Total Number of Landfills	State Contact Information
New Jersey	Municipal, Industrial, C&D	14 Total (as of 11/99) : Out of 14, some have cells which except C&D and Industrial wastes 7 Industrial (5/94) 3 C&D (5/94)	NJ Dept. of Environmental Protection 609-530-8591 Bureau of Landfill and Recycling 609-984-6650 www.state.nj.us/dep
Pennsylvania	Municipal	53 Municipal (as of 10/99) : 10 of the 53 are located in eastern Pennsylvania	PA Division of Municipal and Residential Wastes 717-783-7381 Bureau of Land Recycling and Waste Management www.dep.state.pa.us/
Virginia	Municipal, Industrial, C&D	67 Municipal (as of 11/99) 30 Industrial (11/99) 23 C&D (11/99)	VA Dept. of Environmental Quality 804-698-4000 www.deq.state.va.us/
West Virginia	Municipal, C&D	20 Municipal (as of 11/99) 2 Not yet constructed (11/99) 4 C&D / Tire Monofill (11/99)	WV Division of Environmental Protection 304-558-5929 Waste Management Division
Ohio	Municipal, Industrial, C&D	44 Municipal (as of 11/99) 9 Industrial (11/99) 16 Residual Industrial (11/99) 74 C&D (11/99)	Division of Solid & MW Management 614-644-2621 www.epa.state.oh.us/dsiwm/98faclst/99summar

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-14
List of Disposal Facilities
Non-TSCA Permitted Landfills

Out-of-State Facilities*

State	Type of Landfill	Total Number of Landfills	State Contact Information
Michigan	Municipal, Industrial, C&D	100 Municipal (as of 11/99) 27 Industrial (5/94) 5 C&D (5/94)	Waste Management Division Dept. of Natural Resources 517-373-9523

Notes: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.
* Active Solid Waste Landfills listed for New York State; States were selected based on a 600 mile radius from Albany, NY which is consistent with the distance included in the Early Action Report (1998).

Table 4-15
List of Disposal (Off-site) Facilities
TSCA-Permitted Landfills

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Additional Capacity	Year Expected to Close (Permit Expiration)	Cost	Additional Taxes or Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Chemical Waste Management (CWM)	Emmelle, AL	Yes	No- located 11 miles away from site and can be trucked from there using CWM contractor for an additional cost	Available: 2,350 acres - Present trench contains 5×10^6 cy with 15-20% used and have two more trenches in planning for the future	100+ years Capacity limit of 600,000 tons/yr	$50/ton (Disposal) + cost of trucking 11 miles from RR spur	PCB material tax $51/ton	Presently accepts PCB waste but not sediments with PCBs	Upon arrival waste must pass the paint filter test; no stagnant water. Capable of unloading gondola rail cars.
Chemical Waste Management	Kettleman City, CA	Yes	No	Presently adding land to extend lifetime by 5 years	20 Years	For TSCA PCB solids: $80/ton If > 1000 ppm: $204.50/ton	Kings Town local tax of 10%; plus state tax of %10.75/ton if waste concentration >1000 ppm		Material must be dry (must pass the paint filter test; no stagnant water). Discounted rates available for large amounts of disposal wastes.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-15
List of Disposal (Off-site) Facilities
TSCA-Permitted Landfills

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Additional Capacity	Year Expected to Close (Permit Expiration)	Cost	Additional Taxes or Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Chemical Waste Management of the Northwest	Arlington, OR	Yes	Yes	Still filling up cells and have lots of land yet to develop	No current capacity constraints	Established case by case; depends on waste stream, contaminants, required treatment prior to disposal, quantity, and quality of waste	Included in the cost		Waste must arrive dry. Can solidify on site but adds to the cost. Chemical Waste Management landfills require wastes to be permitted and profiled prior to disposal.
Waste Management Model City Facility	Model City, NY (10 miles from Niagara Falls)	Yes	No	Increasing size of landfill: waiting for zone approval to expand permits	20 Years - expect to close in 2020 No current capacity constraints	Budgetary cost of $75/ton assuming 100,000 tons	6% town tax on disposal cost	Constantly accepting PCB waste	Upon arrival waste must pass the paint filter test; no stagnant water . Ability to accept 1.6×10^6 cy material.
Envirosafe Services Inc. of Idaho	Boise, ID	Yes	No -RR tansfer station 35 miles up street; truck to landfill from there-included in total cost	800,000 cy capacity left. Presently siting new cell of 2×10^6 cy to be available in 3-4 yrs.	8-9 years at minimum No current capacity constraints.	$50 - $80 per ton (Disposal + trucking cost from RR spur)	State tax of $25 - $30 per ton	Constantly accepting PCB waste	Waste must arrive dry and pass the paint filter test. Special discounted rates for larger volumes. Can handle gondola RR cars.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-15
List of Disposal (Off-site) Facilities
TSCA-Permitted Landfills

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Additional Capacity	Year Expected to Close (Permit Expiration)	Cost	Additional Taxes or Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Safety-Kleen Grassy Mountain Facility	Knolls, UT	Yes	Yes- located across street from landfill. Trucking into landfill would be included in final cost.	Total available capacity = 1.5 million cy Avaliable land to expand onto when this area is full.	+ 25 years (Realistically, 70 yrs. when expand and open up new cells) No capacity limits.	$70/ton ($45/ton if sent 1×10^6 cy) + $19/ton for additional trucking into landfill from RR spur across street	State tax of $4.75/ton If RCRA waste, state tax of $28/ton	GM Central Foundry Division Superfund Site, Massena, NY	Waste must be sent and received 100% dry. Discount rate for large quantities. Capable of handling gondola cars.
Safety-Kleen Lone Mountain Facility	Waynoka, OK	Yes	Yes	Just built new cell; plan to add three more cells	In operation until 2020	$60/ton	If hazardous waste, $9/ton non-regualted waste, no tax		Must receive waste dry - pass the paint filter test
U.S. Ecology, Inc.	Beatty, NV	Yes	No -Rail Yard located in Las Vegas which is 110 miles away; truck from there	Another cell to open	Minimum of 25 years	$180/ton - includes tax, and trucking from rail yard	Included in costs	Presently lots of contracts where they take PCB oils, transformers, etc.	Must send dewatered sediments (upon arrival waste must pass the paint filter test; no stagnant water).

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-15
List of Disposal (Off-site) Facilities
TSCA-Permitted Landfills

Name	Location	Ability to Accept Sediments Contaminated with PCBs	Rail Access Existing or Planned	Additional Capacity	Year Expected to Close (Permit Expiration)	Cost	Additional Taxes or Costs	Representative Projects Utilizing Landfill	Special Handling or Unique Features
Waste Control Specialists, LLC	Andrews, TX	Yes	Yes - directly into landfill	Space available. Ability to receive 1×10^6 cy	Will close in excess of 50 years No capacity limits.	$40-$45/ton	Taxes dependent upon waste classification: $7.50/ton	Constantly accepting PCB waste.	Upon arrival waste must pass the paint filter test. Can unload 30 gondola cars/day. Can increase if need.
Wayne Disposal Facility	Belleville, MI	Yes	No - Rail Spur located 10 miles away from facility; would need to truck from there.		20-25 years	$120/ton	$10/ton Michigan Hazardous Waste tax		Must receive waste as a solid material. Discounted rate for larger volumes of material.

Note: Options that are shaded on the table have been tested for or applied to freshwater sediments and/or PCB contaminated sediments.

Table 4-16
Effectiveness, Implementability, and Cost Evaluation
Screening of Technologies

Technology/Process Option	Description	Effectiveness	Implementability	Cost	Retained
No Action	No Action involves deferral of remedial action. Institutional controls are not implemented as part of No Action option.	Does not meet remedial action objectives. No Action alternative retained to provide baseline for analysis as required under NCP.	Technically implementable. Significant resistance may be expected from potential users and others concerned about the River.	Minimal	Yes
Institutional Control	Institutional controls include monitoring and site use restrictions. Institutional controls can be implemented as part of natural attenuation option, or with active remediation.	Monitoring is effective in tracking contaminants but does not meet remedial action objectives. Institutional controls, if complied with, may prevent exposure to PCBs in the Hudson River, although studies conducted by New York Statehave indicated that the existing fish consumption advisories are not fully effective. In addition, institutional controls do nothing to prevent exposure of the environment to PCBs.	Implementable. Enforcement of site use restrictions may be difficult in the long term.	Low capital; low O&M	Yes
Natural Attenuation	Natural attenuation refers to the reduction of volume and toxicity of contaminants in sediments by naturally occurring biological, chemical, physical processes. Extensive site monitoring and modeling are conducted to document contaminant reduction.	Effectiveness depends on how well naturally occurring processes such as biodegradation and burial reduce PCB levels in the river. Monitoring and analysis required as part of this option are effective in tracking trends in PCB dynamics, but do not remediate contaminated sediments for the Hudson River PCB site. Natural attenuation will be evaluated in conjunction with a separate non-time critical removal action for source control in the vicinity of GE's Hudson Falls facility.	Implementable.	Low capital; low O&M	Yes
Containment					
Subaqueous Capping	Capping involves using inert material, active material, or sealing agents to contain sediments *in situ*.	If properly designed, installed, and maintained capping is effective in containing PCBs in sediments, particularly if groundwater flux is not a significant component.	Potentially implementable in deeper areas. May significantly modify shoreline and affect hydraulics of river if implemented in shallow areas.	Varies depending on cap materials. Low O&M costs.	Yes
Retaining Dikes/Berms	Retaining dikes and berms include subaqueous or full-depth embankments, bulkheads, sheet piling, and spur dikes constructed either perpendicular to stream flow or parallel to the shore to control downstream transport of contaminated sediments.	Effective for reducing downstream sediment transport. Will not reduce diffusive flux of PCBs from sediment to water column.	Implementable in limited areas. May impede navigation. Rocky soils may hinder implementability of containment options such as sheet piling.	Low capital; low O&M	No
Removal					
Excavation	Excavation methods would apply to sediment removal from shallow, near shore areas where the work zone can be isolated and dewatered.	Excavation can be an effective way to remove contaminated sediments from areas that are inaccessible to dredges.	Implementable. Excavation work zones may require isolation from river and dewatering. Lack of land side access will require excavation work to be set up from the water side.	Low to moderate costs depending on type of equipment, volume removed.	Yes

Note: Remedial Technologies that are not retained in the screening are represented by the hatched shading.

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Table 4-16
Effectiveness, Implementability, and Cost Evaluation
Screening of Technologies

Technology/Process Option	Description	Effectiveness	Implementability	Cost	Retained
Dredging	Environmental dredging involves removal of contaminated sediments in a way that minimizes release of sediments and contaminants to the aquatic environment. Dredge types evaluated are classified as conventional, large-scale, and specialty. Conventional dredges include mechanical dredges, which remove sediments by direct mechanical means; and hydraulic dredges, which collect sediments mixed with water in a slurry using centrifugal pumps. Large scale dredges are primarily used for navigational dredging. Specialty dredges are designed to address specific project needs.	Environmental dredging can be an effective method to remove contaminated sediments from the river.	Implementable.	Low to moderate costs depending on type and size of dredge, volume dredged.	Yes
***Ex Situ* Treatment**					
Sediment Washing	Sediment washing is a water-based (as opposed to solvent-based) treatment process which extracts contaminants from sediments as well as separates fine fraction of sediments from coarser particles, thereby concentrating the contaminants and reducing volume of material requiring additional treatment or disposal. Soil/sediment washing solutions can include solvents, chelating compounds, surfactants, acids/bases in addition to water, depending on the type of contaminant being extracted.	PCB removal efficiency up to 95% has been reported for treating PCB contaminated sediments at pilot scale. Potentially effective for concentrating contaminants into a fine particle fraction for secondary treatment. Not effective for material with high content of fines.	Implementable. Existing full scale commercial systems can operate at rates up to 300 tph.	Low to moderate processing costs.	Yes
Solvent Extraction	This technology involves dissolution of contaminants from the sediment matrix using a solvent, recovery and treatment or destruction of the contaminant-bearing solvent. The most common solvents used for PCB extraction are kerosene, propane, methanol, ethanol, dimethylformamide, ethylenediamine, triethylamine, and freon mixtures.	Effective. The effectiveness of this technology for treating PCB contaminated sediments has been demonstrated at pilot scale, where PCB removal efficiency up to 99.9% has been reported, and at full scale, where removal efficiencies of greater than 98% have been reported.	Implementable. May be limited by processing rate of currently available equipment. Existing full scale continuous systems can operate at rates up to 10 tph. Subsequent treatment of PCB-containing solvent may be required.	Moderate to high processing costs.	Yes
Chemical Dechlorination	Chemical dechlorination involves removal of chlorine molecules from chlorinated compounds through the addition of a chemical reagent under alkaline conditions. Base-catalyzed decomposition was retained after the initial screening. Dechlorination is often used in combination with thermal desorption (described below).	Effective. BCD in combination with thermal desorption, was used in full-scale project to treat PCB contaminated soil. PCB levels were reduced from a high of 2,917 ppm to average of less than 2 ppm.	Implementable. May be limited by processing rate of currently available equipment. One existing BCD/thermal desorption system has a reported treatment rate of about 20 tpd.	Moderate to high processing costs.	Yes
Thermal Desorption	Thermal desorption involves heating sediments to below combustion temperatures (200 to 1000° F) to volatilize organic contaminants. Vaporized organics are recovered by condensation or carbon adsorption for additional treatment. Thermal desorption is often used in combination with dechlorination (described above).	Effective. Thermal desorption has been demonstrated at pilot- and full-scale for treating PCB contaminated sediments, where PCB removal efficiency of more than 99% has been reported.	Implementable. Existing full scale commercial systems can operate at rates up to 90 tph. Final treatment or disposal of desorbed PCBs will be required.	Moderate to high processing costs.	Yes
Thermal Destruction	Thermal destruction uses high temperatures (typically greater than 1000° F) to destroy contaminants in sediments. The products of thermal destruction vary depending on the type of material being burned and destruction operating parameters.	Effective. Demonstrated technology in treatment of PCB contaminated sediments.	Permitting and public acceptance are expected implementability issues for on-site incineration. Flue gas and residual ash treatment will be required. Implementability of off-site incineration may be limited by transportation issues.	Moderate to very high processing costs.	No

Note: Remedial Technologies that are not retained in the screening are represented by the hatched shading.

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Table 4-16
Effectiveness, Implementability, and Cost Evaluation
Screening of Technologies

Technology/Process Option	Description	Effectiveness	Implementability	Cost	Retained
Immobilization	Immobilization includes processes that physically or chemically reduce mobility of contaminants in a contaminated material through the addition of binding agents. *Ex situ* immobilization involves mixing setting agents such as cement, quicklime, grout, as well as reagents, with sediments in an immobilization system. Solidification can be combined with dechlorination (described above) to treat PCBs in sediments.	Potentially effective. May be difficult to determine whether remedial goals are attained because of PCBs tendency to adsorb to sediments so that leach test results may not differ between treated and untreated matrix. Solidification/ stabilization can be applied for water absorption in dredged sediments for transport and landfill disposal.	Implementable. May result in significant increase in volume and weight of treated material. Treated material may still require landfill disposal because PCBs are not removed or destroyed.	Low to moderate processing costs, depending on sediment characteristics and type of additives and binders.	Not retained as treatment option, retained as support technology.
Beneficial Use					
Landfill Cover/ Construction Fill/Mine Reclamation	These beneficial use options involve using dredged sediment in its original form, *i.e.*, the sediment may be treated to remove contaminants prior to being put to use, but its essential form will still be that of a sediment material. Options evaluated include cover material for solid waste landfill, fill material for construction projects, and fill material for abandoned mine land reclamation.	Effective disposal option for dewatered dredged sediments.	Potential large volume may require implementation of more than one beneficial use option or to consider smaller components of the total dredged volume. Treatment may be required to meet certain criteria for disposal.	Low costs	Yes
Manufacture of Commercial Products	These technologies combine thermal treatment processes to destroy contaminants in sediments with some further physical/chemical process to convert the decontaminated sediment into a useable commercial product. The technologies evaluated involve production of cement, light weight aggregate, and glass tile from treated sediment.	Effective disposal option for dredged sediments. Thermal processes effectively destroy PCBs. All three options (i.e., production of cement, light weight aggregate, and glass tile) have been demonstrated at pilot scale, and are in the process or will be demonstrated at full-scale in the immediate future.	Implementable. The three options evaluated are process specific and offered by certain vendors.	Low to very high costs for processing. Potential recovery of processing costs through sale of useable product.	Yes
Disposal					
Land Disposal	Dredged sediment land disposal options evaluated include near river confined disposal facilities (CDFs) and off site landfills. CDFs can be upland (outside the river 100-year floodplain) or near-shore (within the 100-year floodplain or in shallow, non-navigation areas of the river). Landfills evaluated include off-site TSCA and non-TSCA facilities.	Effective disposal option for dredged sediments.	Siting of CDFs in the vicinity of the Upper Hudson River may be problematic because of potential large land area requirement and local residents opposition. Off-site landfill disposal of sediments requires dewatering and transportation to the landfill site.	Low to moderate costs for off-site landfill disposal. Low costs for disposal at CDFs.	Off site landfill disposal retained. Near river CDF disposal not retained.

Note: Remedial Technologies that are not retained in the screening are represented by the hatched shading.

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

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Table 6-1
Summary of Alternatives Screening Results

Alternative Name (Model Scenario)	Total Area Targeted for Remediation (Acres)	Total Area Capped (Acres)	Volume Remediated (CY)	Volume Removed (CY)	PCB Mass Remediated (kg)	PCB Mass Removed (kg)	Length of Shoreline Disturbed (Miles)	Mass of PCBs over Federal Dam in 2011 (kg)	Mass of PCBs over Federal Dam in 2035 (kg)	PCBs in Water Column at TID in 2011 (ng/L)	PCBs in Water Column at NUD in 2011 (ng/L)	Water Column at Federal Dam in 2011 (ng/L)	Weighted Average Fish Concentration in 2011 at TID (mg/kg)	Weighted Average Fish Concentration in 2011 at NUD (mg/kg)	Weighted Average Fish Concentration in 2011 at Federal Dam	Keep for Detailed Analysis?
No Action	0	0	0	0	0	0	0	103.8	62.5	20.78	21.64	8.61	2.98	3.69	0.52	Yes
Upper Bound Estimate of No Action	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	4.33	5.91	0.52	NA
Monitored Natural Attenuation	0	0	0	0	0	0	0	71.8	23.5	9.3	11.44	5.56	1.92	3.16	0.39	Yes
Upper Bound Estimate of MNA	0	0	0	0	0	0	0	NA	NA	NA	NA	NA	3.40	5.81	0.39	NA
Capping with Dredging Alternatives																
CAP-0/MNA/MNA (R03S2)	470	174	2,030,000	1,420,000	15,000	10,000	18.5	48.2	19.5	3.36	5.65	3.71	0.39	2.84	0.31	No
CAP-3/10/10 (R09S2)	441	208	2,485,000	1,531,000	41,900	30,000	15.4	42.4	20.0	5.59	5.85	3.73	0.65	0.86	0.31	Yes
CAP-0/10/MNA (R02S2)	544	226	2,568,000	1,711,000	38,600	26,300	21.5	36.4	18.4	3.36	4.09	3.24	0.40	0.77	0.29	No
CAP-0/10/10 (R06S2)	641	226	2,999,000	2,100,000	45,300	33,000	23.9	35.7	18.4	3.38	4.07	3.19	0.40	0.77	0.29	No
Removal Alternatives																
REM-10/MNA/MNA (R10S2)	150	NA	965,000	965,000	8,600	8,600	6.6	62.5	22.2	7.67	9.48	4.91	1.06	3.04	0.36	No
REM-0/MNA/MNA (R03S2)	470	NA	2,030,000	2,030,000	15,000	15,000	18.5	48.2	19.5	3.36	5.65	3.71	0.39	2.84	0.31	No
REM-3/10/10 (R09S2)	441	NA	2,485,000	2,485,000	41,900	41,900	15.4	42.4	20.0	5.59	5.85	3.73	0.65	0.86	0.31	Yes
REM-0/10/MNA (R02S2)	544	NA	2,568,000	2,568,000	38,600	38,600	21.5	36.4	18.4	3.36	4.09	3.24	0.40	0.77	0.29	No
REM-0/10/10 (R06S2)	641	NA	2,999,000	2,999,000	45,300	45,300	23.9	35.7	18.4	3.38	4.07	3.19	0.40	0.77	0.29	No
REM-0/0/3 (R08S2)	920	NA	3,706,000	3,706,000	60,700	60,700	33.0	33.7	18.2	3.4	3.7	3.08	0.40	0.50	0.28	Yes

Notes:
TID = Former Thompson Island Dam location (RM 188.5) (southern end of River Section 1)
NUD = RM 182.6 (southern end of River Section 2)
Federal Dam = RM 153.9 (southern end of River Section 3)
PCB mass remediated and removed are total PCBs
PCB mass over dams and concentrations are Tri+ congeners only (trichlorobiphenyls through decachlorobiphenyl homologues; excludes mono- and dichlorobiphenyls)
All water column data are in ng/L (nanograms per liter, or parts per trillion by weight)
Cumulative mass of PCBs over Federal Dam from modeling runs as specifed
Model results (*i.e.*, PCB mass over Federal Dam, PCB water column concentration, fish concentration) for REM alternatives also represent for CAP alternatives with equivalent target areas for screening-level evaluation.

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Table 6-2
Comparison of Remedial Alternatives by River Section

Alternative Name	Area Remediated (acres) - by River Section and Total Upper Hudson				Area Capped (acres) - by River Section and Total Upper Hudson				Sediment Volume Removed (cy) - by River Section and Total Upper Hudson				PCB Mass Removed (kg) - by River Section and Total Upper Hudson (2)			
	In River Section 1	In River Section 2	In River Section 3	In River Sections 1, 2, and 3	In River Section 1	In River Section 2	In River Section 3	In River Sections 1, 2, and 3	In River Section 1	In River Section 2	In River Section 3	In River Sections 1, 2, and 3	In River Section 1	In River Section 2	In River Section 3	In River Sections 1, 2, and 3
Capping with Dredging Alternatives																
CAP-0/MNA/MNA	470	0	0	470	174	0	0	174	1,420,000	0	0	1,420,000	10,000	0	0	10,000
CAP-3/10/10	270	74	97	441	156	52	0	208	850,000	292,000	389,000	1,531,000	7,000	16,300	6,700	30,000
CAP-0/10/MNA	470	74	0	544	174	52	0	226	1,420,000	292,000	0	1,712,000	10,000	16,300	0	26,300
CAP-0/10/10	470	74	97	641	174	52	0	226	1,420,000	292,000	389,000	2,101,000	10,000	16,300	6,700	33,000
Removal Alternatives																
REM-10/MNA/MNA	150	0	0	150	NA	NA	NA	NA	965,000	0	0	965,000	8,600	0	0	8,600
REM-0/MNA/MNA	470	0	0	470	NA	NA	NA	NA	2,030,000	0	0	2,030,000	15,000	0	0	15,000
REM-3/10/10	270	74	97	441	NA	NA	NA	NA	1,516,000	538,000	431,000	2,485,000	11,600	23,600	6,700	41,900
REM-0/10/MNA	470	74	0	544	NA	NA	NA	NA	2,030,000	538,000	0	2,568,000	15,000	23,600	0	38,600
REM-0/10/10	470	74	97	641	NA	NA	NA	NA	2,030,000	538,000	431,000	2,999,000	15,000	23,600	6,700	45,300
REM-0/0/3	470	316	134	920	NA	NA	NA	NA	2,030,000	1,105,000	571,000	3,706,000	15,000	35,000	10,700	60,700

Notes:

TIP: Thompson Island Pool
TID: Thompson Island Dam
NUD: Northumberland Dam
FD: Federal Dam
RM: River Mile

Table 6-3
Areas of Sediments, Volumes of Sediments, and Mass of PCBs Remediated by Alternative

Alternative/River Section	Target Criteria	Area Remediated (Acres)			Area Capped (Acres)			Volume Sediments Removed (CY)			PCB Mass Remediated (kg)			PCB Mass Removed (kg)		
		Contaminant Removal	Channel Dredging	Total	Contaminant Removal	Channel Dredging	Total	Contaminant Removal	Channel Dredging	Total	Contaminant Removal	Channel Dredging	Total	Contaminant Removal	Channel Dredging	Total
CAP-3/10/Select																
River Section 1	3 g/m^2	266	15	282	156	NA	156	849,200	66,100	915,300	11,600	200	11,800	7,100	200	7,300
River Section 2	10 g/m^2	74	2	76	52	NA	52	292,000	15,400	307,400	23,600	700	24,300	15,600	700	16,300
River Section 3	HS 36, 37, part of 39	92	43	135	-	NA	-	392,900	117,300	510,200	6,700	2,800	9,500	6,700	2,800	9,500
Total for Alternative		432	61	493	207	NA	207	1,534,100	198,800	1,732,900	41,900	3,700	45,600	29,400	3,700	33,100
REM-3/10/Select																
River Section 1	3 g/m^2	266	15	282	NA	NA	-	1,495,300	66,100	1,561,400	11,600	200	11,800	11,600	200	11,800
River Section 2	10 g/m^2	74	2	76	NA	NA	-	564,700	15,400	580,100	23,600	700	24,300	23,600	700	24,300
River Section 3	HS 36, 37, part of 39	92	43	135	NA	NA	-	392,900	117,300	510,200	6,700	2,800	9,500	6,700	2,800	9,500
Total for Alternative		432	61	493	NA	NA	-	2,452,900	198,800	2,651,700	41,900	3,700	45,600	41,900	3,700	45,600
REM-0/0/3																
River Section 1	Full-Section	470	-	470	NA	NA	-	2,029,500	-	2,029,500	15,000	-	15,000	15,000	-	15,000
River Section 2	Full-Section	316	-	316	NA	NA	-	1,105,200	-	1,105,200	>35,000 (1)	-	>35,000 (1)	>35,000 (1)	-	>35,000 (1)
River Section 3	3 g/m^2	134	43	177	NA	NA	-	571,100	117,300	688,400	10,700	2,800	13,500	10,700	2,800	13,500
Total for Alternative		921	43	964	NA	NA	-	3,705,800	117,300	3,823,100	>60,700	2,800	>63,500	>60,700	2,800	>63,500

Note:

1 This estimate combines the 1994 data for areas >3g/m^2 with the 1977 data for areas <3g/m^2. Because of the uncertainties associated with the 1977 data (*i.e.*, shallow coring depths and potential sediment inventory changes), one half of the mass estimated from the 1977 data (3.65 of 7.3 metric tons) was used as a part of the lower bound estimate given here.

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Table 7-1
Time Frame Used to Calculate Risks and Hazards

Human Health Exposure Modeled Time Frame	**Cancer RME** **40 years**		**Cancer CT/Non-Cancer CT** **12 years**		**Non-Cancer CT** **7 years**	
	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3
River Section 1	2008-2047	2009-2048	2008-2019	2009-2020	2008-2014	2009-2015
River Section 2	2009-2048	2011-2050	2009-2020	2011-2022	2009-2015	2011-2017
River Section 3	2010-2049	2012-2051	2010-2021	2012-2023	2010-2016	2012-2018
Upper Hudson Average	2009-2048	2011-2050	2009-2020	2011-2022	2009-2015	2011-2017

Ecological Exposure Modeled Time Frame	**Bald Eagle and Eagle Egg** **25 years**		**Mink** **25 years**		**River Otter** **25 years**	
	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3	No Action, MNA, CAP-3/10/S, REM-3/10/S, and all sensitivity runs	No Action, MNA, and REM-0/0/3
River Section 1	2008-2032	2009-2033	2008-2032	2009-2033	2008-2032	2009-2033
River Section 2	2009-2033	2011-2035	2009-2033	2011-2035	2009-2033	2011-2035
River Section 3	2010-2034	2012-2036	2010-2034	2012-2036	2010-2034	2012-2036

Table 7-2
Values Used For Daily Intake Calculations
Upper Hudson River Fish - Adult Angler

Scenario Timeframe: Post-Remediation
Medium: Fish
Exposure Medium: Fish
Exposure Point: Upper Hudson Fish
Receptor Population: Angler
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C_{fish}-C	PCB Concentration in Fish (Cancer)	mg/kg wet weight	variable	Range in Upper Hudson	variable	Range in Upper Hudson	Average Daily Intake (mg/kg-day) =
	C_{fish}-NC	PCB Concentration in Fish (Non-cancer)	mg/kg wet weight	variable	Range in Upper Hudson	variable	Range in Upper Hudson	C_{fish} x IR_{fish} x (1 - Loss) X FS x EF x ED x CF x 1/BW x 1/AT
	IR_{fish}	Ingestion Rate of Fish	grams/day	31.9	90th percentile value, based on 1991 NY Angler survey.	4.0	50th percentile value, based on 1991 NY Angler survey.	
	Loss	Cooking Loss	g/g	0	Assumes 100% PCBs remains in fish.	0.2	Assumes 20% PCBs in fish is lost through cooking.	
	FS	Fraction from Source	unitless	1	Assumes 100% fish ingested is from Upper Hudson.	1	Assumes 100% fish ingested is from Upper Hudson.	
	EF	Exposure Frequency	days/year	365	Fish ingestion rate already averaged over one year.	365	Fish ingestion rate already averaged over one year.	
	ED	Exposure Duration (Cancer)	years	40	95th percentile value, based on 1991 NY Angler and 1990 US Census data.	12	50th percentile value, based on 1991 NY Angler and 1990 US Census data.	
	ED	Exposure Duration (Noncancer)	years	7	Based on the maximum chronic exposure PCB concentration (see HHRA for details).	12	50th percentile value, based on 1991 NY Angler and 1990 US Census data.	
	CF	Conversion Factor	kg/g	1.00E-03	--	1.00E-03	--	
	BW	Body Weight	kg	70	Mean adult body weight, males and females (USEPA, 1989b).	70	Mean adult body weight, males and females (USEPA, 1989b).	
	AT-C	Averaging Time (Cancer)	days	25,550	70-year lifetime exposure x 365 d/yr (USEPA, 1989b).	25,550	70-year lifetime exposure x 365 d/yr (USEPA, 1989b).	
	AT-NC	Averaging Time (Noncancer)	days	2,555	ED (years) x 365 days/year.	4,380	ED (years) x 365 days/year.	

Note:
Species-weighted fish PCB concentration averaged over river location.

Table 7-3
Modeled Post-Remediation PCB Concentrations in Fish
Upper Hudson River

PCB Concentrations in Fish (mg/kg wet weight)						Species-weighted Concentration (mg/kg wet weight)			
Location	Species		Min	Mean	Max	C RME (40-yr)	C CT (12-yr)	NC RME (7-yr)	NC CT (12-yr)
No Action (Start Year 2009)									
RM 189	Brown Bullhead	44%	0.8-2.1	2.0-3.6	6.9-7.2	2.2-3.4	3.0-4.2	3.0-4.3	3.0-4.2
	Largemouth Bass	47%	1.8-2.2	2.9-3.4	6.6				
	Yellow Perch	9%	1.5-2.0	2.8-3.3	6.7				
RM 184	Brown Bullhead	44%	1.2-3.6	3.3-6.4	13	1.9-4.4	3.1-5.5	3.5-5.8	3.1-5.5
	Largemouth Bass	47%	0.8-1.9	1.8-3.1	7.2				
	Yellow Perch	9%	0.6-1.5	1.4-2.6	5.3-5.4				
RM 154	Brown Bullhead	44%	0.3-0.2	0.5	1.9	0.33	0.44	0.48	0.44
	Largemouth Bass	47%	0.2	0.4	1.3				
	Yellow Perch	9%	0.1	0.3	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						1.5-2.7	2.2-3.4	2.3-3.5	2.2-3.4
Monitored Natural Attenuation (Start Year 2009)									
RM 189	Brown Bullhead	44%	0.2-1.8	1.4-3.3	6.9-7.2	1.0-2.3	1.8-3.1	1.9-3.3	1.8-3.1
	Largemouth Bass	47%	0.3-0.8	1.3-1.9	6.6				
	Yellow Perch	9%	0.3-0.9	1.3-1.9	6.7				
RM 184	Brown Bullhead	44%	0.2-3.5	2.4-6.4	13	1.2-4.2	2.5-5.4	3.0-5.7	2.5-5.4
	Largemouth Bass	47%	0.1-1.7	1.3-3.0	7.2				
	Yellow Perch	9%	0.1-1.4	1.0-2.5	5.3-5.4				
RM 154	Brown Bullhead	44%	0.1	0.3	1.9	0.16	0.29	0.35	0.29
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.2	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.76	1.50	1.75	1.50
No Action (Start Year 2011)									
RM 189	Brown Bullhead	44%	0.8-2.1	2.0-3.6	6.9-7.2	2.1-3.2	2.7-3.9	2.8-4.0	2.7-3.9
	Largemouth Bass	47%	1.8-2.2	2.9-3.4	6.6				
	Yellow Perch	9%	1.5-2.0	2.8-3.3	6.7				
RM 184	Brown Bullhead	44%	1.2-3.6	3.3-6.4	13	1.8-4.2	2.8-5.2	3.1-5.5	2.8-5.2
	Largemouth Bass	47%	0.8-1.9	1.8-3.1	7.2				
	Yellow Perch	9%	0.6-1.5	1.4-2.6	5.3-5.4				
RM 154	Brown Bullhead	44%	0.3	0.5	1.9	0.31	0.40	0.42	0.40
	Largemouth Bass	47%	0.2	0.4	1.3				
	Yellow Perch	9%	0.1	0.3	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						1.40	1.96	2.10	1.96
Monitored Natural Attenuation (Start Year 2011)									
RM 189	Brown Bullhead	44%	0.2-1.8	1.4-3.3	6.9-7.2	0.9-2.2	1.5-2.9	1.7-3.1	1.5-2.9
	Largemouth Bass	47%	0.3-0.8	1.3-1.9	6.6				
	Yellow Perch	9%	0.3-0.9	1.3-1.9	6.7				
RM 184	Brown Bullhead	44%	0.2-3.5	2.4-6.4	13	1.0-4.1	2.1-5.1	2.5-5.4	2.1-5.1
	Largemouth Bass	47%	0.1-1.7	1.3-3.0	7.2				
	Yellow Perch	9%	0.1-1.4	1.0-2.5	5.3-5.4				
RM 154	Brown Bullhead	44%	0.1	0.3	1.9	0.14	0.24	0.28	0.24
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.2	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.67	1.28	1.48	1.28

Table 7-3
Modeled Post-Remediation PCB Concentrations in Fish
Upper Hudson River

PCB Concentrations in Fish (mg/kg wet weight)						Species-weighted Concentration (mg/kg wet weight)			
Location	Species		Min	Mean	Max	C RME (40-yr)	C CT (12-yr)	NC RME (7-yr)	NC CT (12-yr)
CAP-3/10/Select (Start Year 2009)									
RM 189	Brown Bullhead	44%	0.1	0.9	6.9	0.46	0.68	0.74	0.68
	Largemouth Bass	47%	0.3	1.0	6.6				
	Yellow Perch	9%	0.3	1.0	6.7				
RM 184	Brown Bullhead	44%	0.2	1.7	13	0.46	0.85	0.99	0.85
	Largemouth Bass	47%	0.1	0.9	7.2				
	Yellow Perch	9%	0.1	0.7	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.11	0.19	0.24	0.19
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.34	0.58	0.65	0.58
CAP-3/10/Select 15% (Start Year 2009)									
RM 189	Brown Bullhead	44%	0.1	0.9	6.9	0.48	0.74	0.81	0.74
	Largemouth Bass	47%	0.3	1.1	6.6				
	Yellow Perch	9%	0.3	1.0	6.7				
RM 184	Brown Bullhead	44%	0.2	1.7	13	0.49	0.90	1.05	0.90
	Largemouth Bass	47%	0.1	0.9	7.2				
	Yellow Perch	9%	0.1	0.7	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.11	0.20	0.24	0.20
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.36	0.61	0.70	0.61
CAP-3/10/Select 25% (Start Year 2009)									
RM 189	Brown Bullhead	44%	0.1	0.9	6.9	0.52	0.82	0.91	0.82
	Largemouth Bass	47%	0.3	1.1	6.6				
	Yellow Perch	9%	0.3	1.0	6.7				
RM 184	Brown Bullhead	44%	0.2	1.8	13	0.55	1.04	1.22	1.04
	Largemouth Bass	47%	0.1	1.0	7.2				
	Yellow Perch	9%	0.1	0.8	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.12	0.20	0.25	0.20
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.40	0.69	0.79	0.69
REM-3/10/Select									
RM 189	Brown Bullhead	44%	0.1	0.9	6.9	0.45	0.66	0.72	0.66
	Largemouth Bass	47%	0.3	1.0	6.6				
	Yellow Perch	9%	0.3	1.0	6.7				
RM 184	Brown Bullhead	44%	0.2	1.6	13	0.39	0.68	0.77	0.68
	Largemouth Bass	47%	0.1	0.9	7.2				
	Yellow Perch	9%	0.1	0.7	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.11	0.19	0.23	0.19
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.32	0.51	0.57	0.51

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Table 7-3
Modeled Post-Remediation PCB Concentrations in Fish
Upper Hudson River

PCB Concentrations in Fish (mg/kg wet weight)						Species-weighted Concentration (mg/kg wet weight)			
Location	Species		Min	Mean	Max	C RME (40-yr)	C CT (12-yr)	NC RME (7-yr)	NC CT (12-yr)
REM-3/10/S (0 ppm)									
RM 189	Brown Bullhead	44%	0.1	0.9	6.9	0.42	0.59	0.63	0.59
	Largemouth Bass	47%	0.3	1.0	6.6				
	Yellow Perch	9%	0.3	1.0	6.7				
RM 184	Brown Bullhead	44%	0.2	1.6	13	0.36	0.60	0.68	0.60
	Largemouth Bass	47%	0.1	0.9	7.2				
	Yellow Perch	9%	0.1	0.7	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.11	0.18	0.22	0.18
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.29	0.46	0.51	0.46
REM-3/10/S (2 ppm)									
RM 189	Brown Bullhead	44%	0.1	1.0	6.9	0.60	1.0	1.1	1.0
	Largemouth Bass	47%	0.3	1.1	6.6				
	Yellow Perch	9%	0.3	1.1	6.7				
RM 184	Brown Bullhead	44%	0.2	1.8	13	0.56	1.1	1.2	1.1
	Largemouth Bass	47%	0.1	1.0	7.2				
	Yellow Perch	9%	0.1	0.8	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.12	0.21	0.26	0.21
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.42	0.76	0.88	0.76
REM-3/10/S (5 ppm)									
RM 189	Brown Bullhead	44%	0.1	1.2	6.9	0.80	1.5	1.7	1.5
	Largemouth Bass	47%	0.3	1.2	6.6				
	Yellow Perch	9%	0.3	1.2	6.7				
RM 184	Brown Bullhead	44%	0.2	2.0	13	0.78	1.6	1.9	1.6
	Largemouth Bass	47%	0.1	1.1	7.2				
	Yellow Perch	9%	0.1	0.9	5.3				
RM 154	Brown Bullhead	44%	0.1	0.3	1.9	0.14	0.24	0.29	0.24
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.2	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.57	1.09	1.29	1.09
REM-0/0/3									
RM 189	Brown Bullhead	44%	0.1	0.8	6.9	0.34	0.42	0.42	0.42
	Largemouth Bass	47%	0.3	1.0	6.6				
	Yellow Perch	9%	0.2	0.9	6.7				
RM 184	Brown Bullhead	44%	0.2	1.6	13	0.25	0.38	0.42	0.38
	Largemouth Bass	47%	0.1	0.9	7.2				
	Yellow Perch	9%	0.1	0.7	5.3				
RM 154	Brown Bullhead	44%	0.0	0.3	1.9	0.08	0.13	0.16	0.13
	Largemouth Bass	47%	0.0	0.2	1.3				
	Yellow Perch	9%	0.0	0.1	1.0				
Upper Hudson River Average (River Sections 1, 2, and 3)						0.22	0.31	0.33	0.31

Notes: Ranges of bounding estimate concetrations are presented for the No action and MNA alternatives.
There is no bounding range presented for the No Action and MNA alternatives in River Section 3 because there are no cohesive sediments in this segment and therefore no bounding range could be calculated.
C RME: Cancer - Reasonable Maximum Exposure
C CT: Cancer - Central Tendency
NC RME: Non-Cancer - Reasonable Maximum Exposure
NC CT: Non-Cancer - Central Tendency

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Table 7-4
Species-Weighted Fish Fillet Average PCB Concentration (in mg/kg)

Year	No Action			Estimated Upper Bound of No Action			MNA			Estimated Upper Bound of MNA			CAP-3/10/Select			REM-3/10/Select			REM-0/0/3		
	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)	River Section 1 (RM 189)	River Section 2 (RM 184)	River Section 3 (RM 154)
1998	6.774	9.659	1.529	6.801	9.747	1.529	6.774	9.659	1.529	6.801	9.747	1.529	6.774	9.659	1.529	6.774	9.659	1.529	6.774	9.659	1.529
1999	6.621	8.877	1.501	6.796	9.253	1.501	6.621	8.877	1.501	6.796	9.253	1.501	6.621	8.877	1.501	6.621	8.877	1.501	6.621	8.877	1.501
2000	5.563	8.028	1.292	5.917	8.870	1.292	5.563	8.028	1.292	5.917	8.870	1.292	5.563	8.028	1.292	5.563	8.028	1.292	5.563	8.028	1.292
2001	4.924	7.210	1.171	5.535	8.445	1.171	4.924	7.210	1.171	5.535	8.445	1.171	4.924	7.210	1.171	4.924	7.210	1.171	4.924	7.210	1.171
2002	4.705	6.571	1.047	5.447	8.072	1.047	4.705	6.571	1.047	5.447	8.072	1.047	4.705	6.571	1.047	4.705	6.571	1.047	4.705	6.571	1.047
2003	4.290	6.090	0.980	5.117	7.708	0.980	4.290	6.090	0.980	5.117	7.708	0.980	4.290	6.088	0.980	4.290	6.088	0.980	4.290	6.088	0.980
2004	5.025	5.958	0.948	5.982	7.519	0.948	5.084	5.934	0.942	6.030	7.520	0.942	5.027	5.923	0.937	5.021	5.922	0.937	5.014	5.921	0.937
2005	4.368	5.647	0.857	5.364	7.219	0.857	3.739	5.523	0.812	4.763	7.200	0.812	3.454	5.461	0.797	3.435	5.456	0.795	3.475	5.445	0.792
2006	3.691	5.171	0.778	4.756	6.914	0.778	2.890	4.904	0.716	3.971	6.814	0.716	1.837	4.037	0.687	1.753	3.893	0.685	1.923	4.765	0.676
2007	4.023	4.848	0.736	5.148	6.716	0.736	2.862	4.489	0.654	4.083	6.599	0.654	1.077	2.161	0.610	0.972	1.869	0.606	1.014	4.165	0.595
2008	3.982	4.596	0.684	5.214	6.505	0.684	2.774	4.168	0.586	4.090	6.390	0.586	1.013	1.424	0.532	0.911	1.092	0.526	0.581	2.881	0.518
2009	3.887	4.377	0.637	5.106	6.344	0.637	2.616	3.877	0.519	3.958	6.218	0.519	0.988	1.276	0.453	0.894	0.972	0.444	0.552	1.236	0.432
2010	3.613	4.070	0.564	4.885	6.171	0.564	2.321	3.533	0.440	3.722	6.033	0.440	0.909	1.178	***0.370***	0.824	0.906	***0.362***	0.510	0.585	***0.343***
2011	2.982	3.690	0.519	4.330	5.908	0.519	1.921	3.164	***0.388***	3.399	5.810	***0.388***	0.711	1.056	0.314	0.642	0.815	0.305	0.400	0.517	0.283
2012	2.899	3.445	0.451	4.242	5.767	0.451	1.851	2.879	0.324	3.308	5.651	0.324	0.717	0.975	0.254	0.652	0.759	0.247	0.412	0.480	0.226
2013	2.574	3.155	0.416	3.848	5.552	0.416	1.682	2.601	0.287	3.068	5.467	0.287	0.591	0.883	0.219	0.537	0.689	0.212	***0.344***	0.435	***0.191***
2014	2.741	2.976	***0.392***	3.877	5.415	***0.392***	1.666	2.396	0.258	2.968	5.314	0.258	0.603	0.822	***0.192***	0.555	0.645	***0.185***	0.371	0.407	0.164
2015	2.558	2.833	0.378	3.701	5.267	0.378	1.535	2.229	0.237	2.837	5.171	0.237	0.548	0.771	0.173	0.506	0.607	0.167	0.345	***0.384***	0.146
2016	2.831	2.793	0.382	4.024	5.175	0.382	1.610	2.126	0.231	2.963	5.067	0.231	0.627	0.749	0.167	0.584	0.596	0.160	0.406	0.378	0.139
2017	2.970	2.683	0.384	4.161	5.128	0.384	1.573	1.978	0.221	2.928	4.995	0.221	0.667	0.712	0.158	0.625	0.573	0.151	0.441	0.367	0.129
2018	2.757	2.495	0.382	3.938	5.027	0.382	1.437	1.765	0.210	2.813	4.903	0.210	0.611	0.658	0.147	0.573	0.537	0.141	0.405	0.352	0.119
2019	3.071	2.395	0.377	4.222	4.977	0.377	1.497	1.619	0.200	2.861	4.824	0.200	0.688	0.624	0.139	0.651	0.520	0.133	0.474	0.346	0.112
2020	2.699	2.253	0.361	3.836	4.867	0.361	1.270	1.480	***0.182***	2.611	4.736	***0.182***	0.582	0.582	0.126	0.551	0.487	0.120	0.407	0.326	0.100
2021	2.274	2.120	0.355	3.451	4.729	0.355	1.080	1.365	0.171	2.470	4.624	0.171	0.478	0.538	0.117	0.452	0.451	0.112	0.336	0.304	0.093
2022	2.397	2.089	0.359	3.582	4.653	0.359	1.093	1.296	0.166	2.469	4.539	0.166	0.497	0.518	0.114	0.472	0.437	0.109	0.357	0.296	0.090
2023	2.559	2.037	0.360	3.723	4.609	0.360	1.088	1.225	0.158	2.452	4.477	0.158	0.532	0.497	0.108	0.509	0.421	0.104	0.390	0.289	0.085
2024	2.230	1.930	0.325	3.387	4.529	0.325	0.939	1.123	0.139	2.316	4.397	0.139	0.458	0.465	0.095	0.438	***0.396***	0.091	0.339	0.275	0.074
2025	2.022	1.788	0.315	3.191	4.399	0.315	0.842	1.019	0.129	2.227	4.307	0.129	0.414	0.426	0.089	***0.397***	0.365	0.085	0.309	0.254	0.070
2026	1.829	1.736	0.316	3.006	4.336	0.316	0.757	0.952	0.124	2.135	4.231	0.124	***0.360***	0.406	0.085	0.345	0.351	0.082	0.270	0.248	0.067
2027	2.503	1.765	0.321	3.609	4.332	0.321	0.888	0.920	0.121	2.247	4.188	0.121	0.496	0.406	0.084	0.478	0.353	0.081	0.386	0.254	0.066
2028	2.617	1.726	0.303	3.710	4.290	0.303	0.863	0.875	0.111	2.205	4.133	0.111	0.512	***0.392***	0.077	0.496	0.343	0.074	0.413	0.248	0.061
2029	2.185	1.613	0.298	3.269	4.155	0.298	0.720	0.801	0.105	2.062	4.050	0.105	0.412	0.363	0.074	0.400	0.319	0.071	0.332	0.232	0.059
2030	1.743	1.541	0.302	2.877	4.090	0.302	0.620	0.735	0.103	1.982	3.982	0.103	0.330	0.341	0.073	0.319	0.302	0.070	0.261	0.224	0.059
2031	2.132	1.503	0.289	3.245	4.071	0.289	0.679	0.675	0.095	2.012	3.929	0.095	0.416	0.326	0.068	0.404	0.292	0.066	0.340	0.220	0.055
2032	1.933	1.412	0.285	3.043	3.972	0.285	0.602	0.610	0.091	1.929	3.856	0.091	0.363	0.302	0.066	0.354	0.272	0.064	0.300	0.208	0.053
2033	1.845	1.373	0.279	2.935	3.919	0.279	0.560	0.564	0.086	1.880	3.798	0.086	0.342	0.289	0.063	0.333	0.262	0.061	0.284	0.204	0.052
2034	1.921	1.318	0.270	2.987	3.877	0.270	0.545	0.521	0.082	1.858	3.735	0.082	0.355	0.274	0.061	0.347	0.250	0.060	0.302	***0.196***	0.051
2035	1.497	1.242	0.277	2.605	3.766	0.277	0.443	0.475	0.089	1.754	3.664	0.089	0.275	0.255	0.070	0.268	0.234	0.069	0.231	0.186	0.060
2036	1.899	1.234	0.272	2.981	3.744	0.272	0.504	0.446	0.104	1.804	3.614	0.104	0.345	0.249	0.088	0.338	0.230	0.086	0.300	0.185	0.078
2037	1.543	1.170	0.263	2.637	3.652	0.263	0.427	0.410	0.101	1.732	3.556	0.101	0.289	0.233	0.086	0.284	0.217	0.085	0.249	0.176	0.077
2038	1.843	1.134	0.260	2.888	3.599	0.260	0.456	***0.386***	0.098	1.725	3.500	0.098	0.331	0.223	0.084	0.325	0.208	0.083	0.293	0.171	0.076
2039	1.505	1.104	0.262	2.587	3.550	0.262	***0.382***	0.363	0.096	1.663	3.446	0.096	0.267	0.215	0.083	0.263	0.201	0.082	0.234	0.167	0.075
2040	1.410	1.096	0.261	2.488	3.499	0.261	0.352	0.346	0.092	1.627	3.398	0.092	0.250	0.210	0.080	0.246	***0.198***	0.079	0.221	0.166	0.072
2041	1.991	1.155	0.273	2.998	3.521	0.273	0.461	0.347	0.092	1.696	3.377	0.092	0.359	0.218	0.083	0.354	0.207	0.082	0.322	0.176	0.072
2042	2.130	1.152	0.263	3.139	3.488	0.263	0.486	0.337	0.084	1.727	3.347	0.084	0.390	0.216	0.080	0.385	0.205	0.079	0.356	0.176	0.067
2043	1.675	1.099	0.253	2.678	3.429	0.253	0.386	0.316	0.078	1.607	3.298	0.078	0.302	0.205	0.073	0.298	0.195	0.072	0.275	0.168	0.062
2044	1.328	1.023	0.238	2.359	3.335	0.238	0.301	0.289	0.074	1.525	3.237	0.074	0.232	***0.189***	0.066	0.229	0.180	0.065	0.210	0.156	0.059
2045	1.536	1.013	0.236	2.542	3.301	0.236	0.329	0.278	0.071	1.539	3.197	0.071	0.266	0.186	0.063	0.264	0.178	0.062	0.245	0.155	0.057
2046	1.454	1.006	0.232	2.412	3.267	0.232	0.319	0.269	0.067	1.521	3.154	0.067	0.252	0.183	0.058	0.249	0.175	0.058	0.232	0.154	0.055
2047	1.764	0.998	0.239	2.603	3.223	0.239	0.474	0.261	0.066	1.632	3.117	0.066	0.286	0.180	0.058	0.284	0.173	0.057	0.264	0.154	0.055
2048	2.063	1.032	0.244	2.704	3.222	0.244	0.612	0.263	0.066	1.515	3.094	0.066	0.324	0.184	0.056	0.321	0.178	0.056	0.299	0.159	0.054
2049	1.993	1.034	0.244	2.673	3.195	0.244	0.574	0.259	0.063	1.505	3.068	0.063	0.319	0.183	0.054	0.316	0.177	0.054	0.298	0.160	0.052
2050	1.750	1.013	0.237	2.467	3.153	0.237	0.498	0.251	0.060	1.454	3.034	0.060	0.282	0.179	0.051	0.280	0.173	0.051	0.263	0.156	***0.049***
2051	1.635	0.991	0.222	2.382	3.110	0.222	0.457	0.242	0.055	1.426	2.995	0.055	0.266	0.174	***0.047***	0.264	0.169	***0.046***	0.248	0.153	0.045
2052	1.465	0.990	0.225	2.236	3.061	0.225	0.402	0.236	0.054	1.387	2.960	0.054	0.235	0.173	0.046	0.233	0.168	0.046	0.220	0.153	0.044
2053	2.090	1.051	0.239	2.836	3.097	0.239	0.494	0.244	0.055	1.479	2.946	0.055	0.348	0.182	0.047	0.346	0.177	0.047	0.332	0.163	0.046
2054	1.779	1.023	0.237	2.547	3.039	0.237	0.430	0.235	0.053	1.424	2.916	0.053	0.293	0.177	0.046	0.292	0.172	0.046	0.279	0.159	0.045
2055	1.621	1.018	0.236	2.393	3.008	0.236	0.383	0.231	0.052	1.380	2.887	0.052	0.266	0.175	0.045	0.265	0.171	0.045	0.254	0.159	0.044
2056	1.835	1.049	0.241	2.621	2.986	0.241	0.407	0.233	0.051	1.418	2.861	0.051	0.305	0.180	0.045	0.303	0.176	0.045	0.292	0.164	0.044
2057	1.804	1.055	0.242	2.573	2.974	0.242	0.397	0.231	0.050	1.383	2.838	0.050	0.300	0.180	0.045	0.299	0.176	0.045	0.288	0.165	0.044
2058	1.469	1.041	0.241	2.207	2.917	0.241	0.337	0.226	0.050	1.321	2.804	0.050	0.237	0.177	0.045	0.236	0.174	0.044	0.227	0.163	0.043
2059	1.991	1.065	0.235	2.717	2.936	0.235	0.422	0.228	***0.047***	1.389	2.783	***0.047***	0.339	0.181	0.043	0.337	0.177	0.043	0.328	0.167	0.042
2060	1.480	0.985	0.222	2.239	2.836	0.222	0.316	0.209	0.044	1.305	2.731	0.044	0.245	0.167	0.040	0.244	0.163	0.040	0.237	0.154	0.039
2061	1.372	0.952	0.220	2.148	2.790	0.220	0.286	0.200	0.043	1.273	2.693	0.043	0.224	0.161	0.040	0.224	0.158	0.039	0.220	0.149	0.038
2062	1.505	0.956	0.226	2.268	2.766	0.226	0.297	***0.197***	0.043	1.277	2.663	0.043	0.249	0.161	0.040	0.249	0.158	0.040	0.260	0.150	0.039
2063	1.501	0.962	0.228	2.255	2.743	0.228	0.296	0.196	0.043	1.267	2.639	0.043	0.250	0.162	0.040	0.250	0.159	0.040	0.266	0.151	0.039
2064	1.575	0.981	0.234	2.321	2.725	0.234	0.306	0.196	0.044	1.271	2.613	0.044	0.263	0.164	0.041	0.262	0.161	0.041	0.278	0.154	0.040
2065	1.474	1.001	0.243	2.194	2.715	0.243	0.283	0.195	0.045	1.244	2.595	0.045	0.243	0.167	0.042	0.242	0.165	0.042	0.257	0.158	0.042
2066	2.057	1.018	0.234	2.741	2.717	0.234	0.377	0.195	0.043	1.304	2.575	0.043	0.343	0.169	0.041	0.342	0.167	0.041	0.353	0.161	0.040
2067	1.616	0.973	0.243	2.331	2.577	0.243	0.301	0.183	0.044	1.245	2.461	0.044	0.267	0.161	0.042	0.266	0.159	0.042	0.279	0.154	0.041

Note: ***Bold-Italicized*** value indicates first occurrence of species-weighted fish fillet average PCB concentration below human-health based fish ingestion PRG (0.05 mg/kg, 1 meal/week), and other targets (0.2mg/kg, 1 meal/month; 0.4 mg/kg, 1 meal/ 2 months).

400994

Table 7-5
Years to Achieve Human Health Based Target Levels
Comparison of Alternatives - Upper Hudson River

	No Action	Monitored Natural Attenuation	CAP/SR-3/10/Select	CAP/SR-3/10/Select (15%)	CAP/SR-3/10/Select (25%)	REM-3/10/Select	REM-3/10/Select (0 ppm)	REM-3/10/Select (2 ppm)	REM-3/10/Select (5 ppm)	REM-0/0/3
River Section 1- RM 189 (Start Year 2008)										
Human Health risk-based PRG 0.05 mg/kg	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
Fish Target Concentration 0.2 mg/kg	>60	>60	>60	>60	>60	>60	>60	>60	>60	>60
Fish Target Concentration 0.4 mg/kg	>60	32 - >60	19	19	19	18	18	23	28	6
River Section 2- RM 184 (Start Year 2009)										
Human Health risk-based PRG 0.05 mg/kg	>59	>59	>59	>59	>59	>59	>59	>59	>59	>59
Fish Target Concentration 0.2 mg/kg	>59	54 - >59	36	36	36	32	32	32	32	26
Fish Target Concentration 0.4 mg/kg	>59	31 - >59	20	21	22	16	15	22	26	7
River Section 3- RM 154 (Start Year 2010)										
Human Health risk-based PRG 0.05 mg/kg	>58	50	42	42	42	42	42	42	42	41
Fish Target Concentration 0.2 mg/kg	>58	11	5	5	5	5	5	5	5	4
Fish Target Concentration 0.4 mg/kg	5	2	1	1	1	1	1	1	1	1

Notes:

The same starting year is used for comparison for all alternatives, although REM-0/0/3 starts one to two years later than other alternatives.

> 58, 59, or 60 indicates that action levels are not achieved within the human health modeling time frame, extending until 2067.

Range of years calculated using bounding estimates are presented for the No Action and MNA alternatives.

400995

Table 7-6a
Long-Term Fish Ingestion Non-Cancer Health Hazards
Reasonable Maximum Exposure and Central Tendency
Upper Hudson River Fish - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Upper Hudson River (RMs 189-154)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Non-Cancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient	Percent Hazard Reduction compared to No Action	Percent Hazard Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2009)	2.3-3.5	1.1E-03-1.6E-03	2.0E-05	53-80		
No Action (2011)	2.1-3.3	9.6E-04-1.5E-.03	2.0E-05	48-75		
MNA (2009)	1.7-3.1	8.0E-04-1.4E-03	2.0E-05	40-71	11%-50%	
MNA (2011)	1.5-2.9	6.8E-04-1.3E-04	2.0E-05	34-66	12%-55%	
CAP-3/10/Select (2009)	0.65	3.0E-04	2.0E-05	15	72%-81%	63%-79%
CAP-3/10/Select (15%) (2009)	0.70	3.2E-04	2.0E-05	16	70%-80%	60%-77%
CAP-3/10/Select (25%) (2009)	0.79	3.6E-04	2.0E-05	18	66%-77%	55%-75%
REM-3/10/Select (2009)	0.57	2.6E-04	2.0E-05	13	75%-84%	67%-82%
REM-3/10/Select (0 ppm residual) (2009)	0.51	2.3E-04	2.0E-05	12	78%-85%	71%-84%
REM-3/10/Select (2 ppm residual) (2009)	0.9	4.0E-04	2.0E-05	20	62%-75%	50%-72%
REM-3/10/Select (5 ppm residual) (2009)	1.3	5.9E-04	2.0E-05	29	45-63%	26%-59%
REM-0/0/3 (2011)	0.33	1.5E-04	2.0E-05	7.6	84%-90%	77%-88%
Central Tendency						
No Action (2009)	2.2-3.4	9.9E-05-1.5E-04	2.0E-05	5.0-7.7		
No Action (2011)	2.0-3.2	8.9E-05-1.5E-04	2.0E-05	4.5-7.3		
MNA (2009)	1.5-2.9	6.9E-05-1.3E-04	2.0E-05	3.4-6.7	13%-56%	
MNA (2011)	1.3-2.7	5.8E-05-1.3E-04	2.0E-05	2.9-6.3	14%-60%	
CAP-3/10/Select (2009)	0.58	2.6E-05	2.0E-05	1.3	73%-83%	62%-80%
CAP-3/10/Select (15%) (2009)	0.61	2.8E-05	2.0E-05	1.4	72%-82%	59%-79%
CAP-3/10/Select (25%) (2009)	0.69	3.2E-05	2.0E-05	1.6	68%-79%	54%-76%
REM-3/10/Select (2009)	0.51	2.3E-05	2.0E-05	1.2	76%-85%	66%-83%
REM-3/10/Select (0 ppm residual) (2009)	0.46	2.1E-05	2.0E-05	1.0	79%-86%	69%-84%
REM-3/10/Select (2 ppm residual) (2009)	0.8	3.5E-05	2.0E-05	1.7	65%-77%	50%-74%
REM-3/10/Select (5 ppm residual) (2009)	1.1	5.0E-05	2.0E-05	2.5	50%-67%	27%-63%
REM-0/0/3 (2011)	0.31	1.4E-05	2.0E-05	0.71	84%-90%	76%-89%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-6b
Long-Term Fish Ingestion Non-Cancer Health Hazards
Reasonable Maximum Exposure and Central Tendency
River Section 1 - Thompson Island Pool - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Thompson Island Pool (RM 189)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Non-Cancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient	Percent Hazard Reduction compared to No Action	Percent Hazard Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2008)	3.2-4.5	1.5E-03-2.1E-03	2.0E-05	74-100		
No Action (2009)	3.0-4.3	1.4E-03-2.0E-03	2.0E-05	69-98		
MNA (2008)	2.1-3.5	9.7E-04-1.6E-03	2.0E-05	48-80	20%-52%	
MNA (2009)	1.9-3.3	8.8E-04-1.5E-03	2.0E-05	44-76	22%-55%	
CAP-3/10/Select (2008)	0.74	3.4E-04	2.0E-05	17	77%-84%	65%-79%
CAP-3/10/Select (15%) (2008)	0.81	3.7E-04	2.0E-05	18	75%-82%	62%-77%
CAP-3/10/Select (25%) (2008)	0.91	4.1E-04	2.0E-05	21	72%-80%	57%-74%
REM-3/10/Select (2008)	0.72	3.3E-04	2.0E-05	16	78%-84%	66%-80%
REM-3/10/Select (0 ppm residual) (2008)	0.63	2.9E-04	2.0E-05	14	81%-86%	70%-82%
REM-3/10/Select (2 ppm residual) (2008)	1.1	5.2E-04	2.0E-05	26	65%-75%	47%-68%
REM-3/10/Select (5 ppm residual) (2008)	1.7	7.8E-04	2.0E-05	39	47%-62%	19%-51%
REM-0/0/3 (2009)	0.42	1.9E-04	2.0E-05	10	86%-90%	78%-87%
Central Tendency						
No Action (2008)	3.1-4.3	1.4E-04-2.0E-04	2.0E-05	7.0-9.8		
No Action (2009)	3.0-4.2	1.4E-04-1.9E-04	2.0E-05	6.8-9.6		
MNA (2008)	1.9-3.2	8.6E-05-1.5E-04	2.0E-05	4.3-7.4	24%-56%	
MNA (2009)	1.7-3.1	8.0E-05-1.4E-04	2.0E-05	4.0-7.1	26%-58%	
CAP-3/10/Select (2008)	0.68	3.1E-05	2.0E-05	1.6	78%-84%	64%-79%
CAP-3/10/Select (15%) (2008)	0.74	3.4E-05	2.0E-05	1.7	76%-83%	61%-77%
CAP-3/10/Select (25%) (2008)	0.82	3.8E-05	2.0E-05	1.9	73%-81%	56%-75%
REM-3/10/Select (2008)	0.66	3.0E-05	2.0E-05	1.5	78%-85%	65%-80%
REM-3/10/Select (0 ppm residual) (2008)	0.59	2.7E-05	2.0E-05	1.3	81%-86%	69%-82%
REM-3/10/Select (2 ppm residual) (2008)	1.0	4.6E-05	2.0E-05	2.3	67%-77%	47%-69%
REM-3/10/Select (5 ppm residual) (2008)	1.5	6.7E-05	2.0E-05	3.4	52%-66%	21%-55%
REM-0/0/3 (2009)	0.42	1.9E-05	2.0E-05	1.0	86%-90%	76%-86%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-6d
Long-Term Fish Ingestion Non-Cancer Health Hazards
Reasonable Maximum Exposure and Central Tendency
River Section 3 - Lock 5 to Troy Dam - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Troy Dam (RM 154)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Non-Cancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient	Percent Hazard Reduction compared to No Action	Percent Hazard Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2010)	0.44	2.0E-04	2.0E-05	10		
No Action (2012)	0.40	1.8E-04	2.0E-05	9.1		
MNA (2010)	0.31	1.4E-04	2.0E-05	7.0	30%	
MNA (2012)	0.25	1.2E-04	2.0E-05	5.8	37%	
CAP-3/10/Select (2010)	0.24	1.1E-04	2.0E-05	5.4	46%	23%
CAP-3/10/Select (15%) (2010)	0.24	1.1E-04	2.0E-05	5.5	45%	21%
CAP-3/10/Select (25%) (2010)	0.25	1.1E-04	2.0E-05	5.6	44%	20%
REM-3/10/Select (2010)	0.23	1.1E-04	2.0E-05	5.3	47%	24%
REM-3/10/Select (0 ppm residual) (2010)	0.22	1.0E-04	2.0E-05	5.1	49%	27%
REM-3/10/Select (2 ppm residual) (2010)	0.26	1.2E-04	2.0E-05	5.9	42%	17%
REM-3/10/Select (5 ppm residual) (2010)	0.29	1.3E-04	2.0E-05	6.5	35%	7%
REM-0/0/3 (2012)	0.16	7.2E-05	2.0E-05	3.6	60%	37%
Central Tendency						
No Action (2010)	0.41	1.9E-05	2.0E-05	0.94		
No Action (2012)	0.38	1.8E-05	2.0E-05	0.88		
MNA (2010)	0.26	1.2E-05	2.0E-05	0.60	37%	
MNA (2012)	0.22	1.0E-05	2.0E-05	0.50	42%	
CAP-3/10/Select (2010)	0.19	8.9E-06	2.0E-05	0.44	53%	26%
CAP-3/10/Select (15%) (2010)	0.20	9.1E-06	2.0E-05	0.46	52%	24%
CAP-3/10/Select (25%) (2010)	0.20	9.3E-06	2.0E-05	0.47	51%	22%
REM-3/10/Select (2010)	0.19	8.7E-06	2.0E-05	0.44	54%	27%
REM-3/10/Select (0 ppm residual) (2010)	0.18	8.4E-06	2.0E-05	0.42	56%	30%
REM-3/10/Select (2 ppm residual) (2010)	0.21	9.7E-06	2.0E-05	0.49	48%	19%
REM-3/10/Select (5 ppm residual) (2010)	0.24	1.1E-05	2.0E-05	0.55	42%	8%
REM-0/0/3 (2012)	0.13	6.1E-06	2.0E-05	0.30	65%	40%

Table 7-6c
Long-Term Fish Ingestion Non-Cancer Health Hazards
Reasonable Maximum Exposure and Central Tendency
River Section 2 - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: RM 184
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Non-Cancer) (mg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient	Percent Hazard Reduction compared to No Action	Percent Hazard Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2009)	3.5-5.8	1.6E-03-2.6E-03	2.0E-05	80-130		
No Action (2011)	3.1-5.5	1.4E-03-2.5E-03	2.0E-05	70-120		
MNA (2009)	3.0-5.7	1.3E-03-2.6E-03	2.0E-05	67-130	0%-48%	
MNA (2011)	2.5-5.4	1.1E-03-2.4E-03	2.0E-05	57-120	0%-53%	
CAP-3/10/Select (2009)	0.99	4.5E-04	2.0E-05	22	72%-83%	67%-83%
CAP-3/10/Select (15%) (2009)	1.1	4.8E-04	2.0E-05	24	70%-82%	64%-81%
CAP-3/10/Select (25%) (2009)	1.2	5.6E-04	2.0E-05	28	65%-79%	59%-79%
REM-3/10/Select (2009)	0.77	3.5E-04	2.0E-05	18	78%-87%	74%-86%
REM-3/10/Select (0 ppm residual) (2009)	0.68	3.1E-04	2.0E-05	16	80%-88%	77%-88%
REM-3/10/Select (2 ppm residual) (2009)	1.2	5.7E-04	2.0E-05	28	64%-78%	58%-78%
REM-3/10/Select (5 ppm residual) (2009)	1.9	8.5E-04	2.0E-05	43	47%-68%	37%-67%
REM-0/0/3 (2011)	0.42	1.9E-04	2.0E-05	9.7	86%-92%	83%-92%
Central Tendency						
No Action (2009)	3.1-5.5	1.4E-04-2.5E-04	2.0E-05	7.1-12		
No Action (2011)	2.7-5.2	1.3E-04-2.4E-04	2.0E-05	6.3-12		
MNA (2009)	2.5-5.3	1.1E-04-2.4E-04	2.0E-05	5.6-12	0%-53%	
MNA (2011)	2.1-5.1	9.5E-05-2.3E-04	2.0E-05	4.7-12	0%-61%	
CAP-3/10/Select (2009)	0.85	3.9E-05	2.0E-05	1.9	73%-84%	66%-84%
CAP-3/10/Select (15%) (2009)	0.90	4.1E-05	2.0E-05	2.1	71%-83%	63%-83%
CAP-3/10/Select (25%) (2009)	1.0	4.8E-05	2.0E-05	2.4	66%-81&	58%-81%
REM-3/10/Select (2009)	0.68	3.1E-05	2.0E-05	1.5	78%-88%	73%-87%
REM-3/10/Select (0 ppm residual) (2009)	0.60	2.8E-05	2.0E-05	1.4	80%-89%	76%-89%
REM-3/10/Select (2 ppm residual) (2009)	1.1	4.8E-05	2.0E-05	2.4	66%-81%	57%-80%
REM-3/10/Select (5 ppm residual) (2009)	1.6	7.2E-05	2.0E-05	3.6	49%-71%	37%-71%
REM-0/0/3 (2011)	0.38	1.7E-05	2.0E-05	0.87	86%-93%	82%-92%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-7a
Long-Term Fish Ingestion Cancer Risks
Reasonable Maximum Exposure and Central Tendency
Upper Hudson River Fish - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Upper Hudson River (RMs 189-154)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Cancer) (mg/kg-day)	Cancer Slope Factor (mg/kg-day)	Cancer Risk	Percent Risk Reduction compared to No Action	Percent Risk Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2009)	1.5-2.7	3.9E-04-7.0E-04	2	7.8E-04-1.4E-03		
No Action (2011)	1.4-2.6	3.7E-04-6.7E-04	2	7.3E-04-1.3E-03		
MNA (2009)	0.76-2.2	2.0E-04-5.8E-04	2	4.0E-04-1.2E-03	14%-71%	
MNA (2011)	0.66-2.1	1.7E-04-5.5E-04	2	3.5E-04-1.1E-03	15%-73%	
CAP-3/10/Select (2009)	0.34	9.0E-05	2	1.8E-04	77%-87%	55%-84%
CAP-3/10/Select (15%) (2009)	0.36	9.4E-05	2	1.9E-04	76%-86%	53%-84%
CAP-3/10/Select (25%) (2009)	0.40	1.0E-04	2	2.1E-04	73%-85%	48%-82%
REM-3/10/Select (2009)	0.32	8.3E-05	2	1.7E-04	79%-88%	58%-86%
REM-3/10/Select (0 ppm residual) (2009)	0.29	7.7E-05	2	1.5E-04	80%-89%	61%-87%
REM-3/10/Select (2 ppm residual) (2009)	0.42	1.1E-04	2	2.2E-04	72%-84%	44%-81%
REM-3/10/Select (5 ppm residual) (2009)	0.57	1.5E-04	2	3.0E-04	62%-79%	25%-74%
REM-0/0/3 (2011)	0.22	5.8E-05	2	1.2E-04	84%-91%	66%-89%
Central Tendency						
No Action (2009)	2.2-3.4	1.7E-05-2.6E-05	1	1.7E-05-2.6E-05		
No Action (2011)	2.0-3.2	1.5E-05-2.5E-05	1	1.5E-05-2.5E-05		
MNA (2009)	1.5-2.9	1.2E-05-2.3E-05	1	1.2E-05-2.3E-05	12%-54%	
MNA (2011)	1.3-2.7	1.0E-05-2.1E-05	1	1.0E-05-2.1E-05	16%-60%	
CAP-3/10/Select (2009)	0.58	4.5E-06	1	4.5E-06	73%-83%	62%-80%
CAP-3/10/Select (15%) (2009)	0.61	4.8E-06	1	4.8E-06	72%-82%	59%-79%
CAP-3/10/Select (25%) (2009)	0.69	5.4E-06	1	5.4E-06	68%-79%	54%-76%
REM-3/10/Select (2009)	0.51	4.0E-06	1	4.0E-06	76%-85%	66%-83%
REM-3/10/Select (0 ppm residual) (2009)	0.46	3.6E-06	1	3.6E-06	79%-86%	69%-84%
REM-3/10/Select (2 ppm residual) (2009)	0.76	5.9E-06	1	5.9E-06	65%-77%	50%-74%
REM-3/10/Select (5 ppm residual) (2009)	1.1	8.6E-06	1	8.6E-06	50%-67%	27%-63%
REM-0/0/3 (2011)	0.31	2.4E-06	1	2.4E-06	84%-90%	76%-89%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-7b
Long-Term Fish Ingestion Cancer Risks
Reasonable Maximum Exposure and Central Tendency
River Section 1 - Thompson Island Pool - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Thompson Island Pool (RM 189)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Cancer) (mg/kg-day)	Cancer Slope Factor (mg/kg-day)	Cancer Risk	Percent Risk Reduction compared to No Action	Percent Risk Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2008)	2.3-3.4	5.9E-04-8.9E-04	2	1.2E-03-1.8E-03		
No Action (2009)	2.2-3.3	5.8E-04-8.7E-04	2	1.2E-03-1.7E-03		
MNA (2008)	1.0-2.3	2.6E-04-6.1E-04	2	5.3E-04-1.2E-03	33%-71%	
MNA (2009)	0.95-2.3	2.5E-04-5.9E-04	2	5.0E-04-1.2E-03	29%-71%	
CAP-3/10/Select (2008)	0.46	1.2E-04	2	2.4E-04	80%-87%	54%-80%
CAP-3/10/Select (15%) (2008)	0.48	1.3E-04	2	2.5E-04	79%-86%	52%-79%
CAP-3/10/Select (25%) (2008)	0.52	1.4E-04	2	2.7E-04	77%-85%	48%-78%
REM-3/10/Select (2008)	0.45	1.2E-04	2	2.3E-04	80%-87%	55%-81%
REM-3/10/Select (0 ppm residual) (2008)	0.42	1.1E-04	2	2.2E-04	82%-88%	59%-82%
REM-3/10/Select (2 ppm residual) (2008)	0.60	1.6E-04	2	3.1E-04	74%-82%	41%-74%
REM-3/10/Select (5 ppm residual) (2008)	0.80	2.1E-04	2	4.2E-04	65%-76%	20%-66%
REM-0/0/3 (2009)	0.34	8.7E-05	2	1.7E-04	85%-90%	65%-85%
Central Tendency						
No Action (2008)	3.1-4.3	2.4E-05-3.4E-05	1	2.4E-05-3.4E-05		
No Action (2009)	3.0-4.2	2.3E-05-3.3E-05	1	2.3E-05-3.3E-05		
MNA (2008)	1.9-3.2	1.5E-05-2.5E-05	1	1.5E-05-2.5E-05	26%-56%	
MNA (2009)	1.7-3.1	1.4E-05-2.4E-05	1	1.4E-05-2.4E-05	27%-58%	
CAP-3/10/Select (2008)	0.68	5.4E-06	1	5.4E-06	78%-84%	64%-79%
CAP-3/10/Select (15%) (2008)	0.74	5.8E-06	1	5.8E-06	76%-83%	61%-77%
CAP-3/10/Select (25%) (2008)	0.82	6.4E-06	1	6.4E-06	73%-81%	56%-75%
REM-3/10/Select (2008)	0.66	5.2E-06	1	5.2E-06	78%-85%	65%-80%
REM-3/10/Select (0 ppm residual) (2008)	0.59	4.6E-06	1	4.6E-06	81%-86%	69%-82%
REM-3/10/Select (2 ppm residual) (2008)	1.00	7.8E-06	1	7.8E-06	67%-77%	47%-69%
REM-3/10/Select (5 ppm residual) (2008)	1.47	1.2E-05	1	1.2E-05	52%-66%	21%-55%
REM-0/0/3 (2009)	0.42	3.3E-06	1	3.3E-06	86%-90%	76%-86%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-7c
Long-Term Fish Ingestion Cancer Risks
Reasonable Maximum Exposure and Central Tendency
River Section 2 - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: RM 184
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Cancer) (mg/kg-day)	Cancer Slope Factor (mg/kg-day)	Cancer Risk	Percent Risk Reduction compared to No Action	Percent Risk Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2009)	1.9-4.4	5.0E-04-1.1E-03	2	1.0E-03-2.3E-03		
No Action (2011)	1.8-4.2	4.6E-04-1.1E-03	2	9.1E-04-2.2E-03		
MNA (2009)	1.2-4.2	3.1E-04-1.1E-03	2	6.1E-04-2.2E-03	4%-73%	
MNA (2011)	1.0-4.1	2.6E-04-1.1E-03	2	5.2E-04-2.1E-03	5%-76%	
CAP-3/10/Select (2009)	0.46	1.2E-04	2	2.4E-04	76%-89%	61%-89%
CAP-3/10/Select (15%) (2009)	0.49	1.3E-04	2	2.6E-04	74%-89%	58%-88%
CAP-3/10/Select (25%) (2009)	0.55	1.4E-04	2	2.9E-04	71%-87%	53%-87%
REM-3/10/Select (2009)	0.39	1.0E-04	2	2.0E-04	80%-91%	67%-91%
REM-3/10/Select (0 ppm residual) (2009)	0.36	9.4E-05	2	1.9E-04	81%-92%	69%-91%
REM-3/10/Select (2 ppm residual) (2009)	0.56	1.5E-04	2	2.9E-04	71%-87%	53%-87%
REM-3/10/Select (5 ppm residual) (2009)	0.78	2.0E-04	2	4.1E-04	59%-82%	34%-82%
REM-0/0/3 (2011)	0.25	6.6E-05	2	1.3E-04	86%-94%	75%-94%
Central Tendency						
No Action (2009)	3.1-5.5	2.4E-05-4.3E-05	1	2.4E-05-4.3E-05		
No Action (2011)	2.7-5.2	2.2E-05-4.1E-05	1	2.2E-05-4.1E-05		
MNA (2009)	2.5-5.3	1.9E-05-4.2E-05	1	1.9E-05-4.2E-05	2%-56%	
MNA (2011)	2.1-5.1	1.6E-05-4.0E-05	1	1.6E-05-4.0E-05	2%-61%	
CAP-3/10/Select (2009)	0.85	6.6E-06	1	6.6E-06	73%-84%	66%-84%
CAP-3/10/Select (15%) (2009)	0.90	7.1E-06	1	7.1E-06	71%-83%	63%-83%
CAP-3/10/Select (25%) (2009)	1.0	8.2E-06	1	8.2E-06	66%-81%	58%-81%
REM-3/10/Select (2009)	0.68	5.3E-06	1	5.3E-06	78%-88%	73%-87%
REM-3/10/Select (0 ppm residual) (2009)	0.60	4.7E-06	1	4.7E-06	80%-89%	76%-89%
REM-3/10/Select (2 ppm residual) (2009)	1.1	8.3E-06	1	8.3E-06	66%-81%	57%-80%
REM-3/10/Select (5 ppm residual) (2009)	1.6	1.2E-05	1	1.2E-05	49%-71%	37%-71%
REM-0/0/3 (2011)	0.38	3.0E-06	1	3.0E-06	86%-93%	82%-92%

Notes:
Concentrations were averaged across all three river sections - see text for discussion.
Ranges of bounding estimate hazard quotients are presented for the No Action and MNA alternatives.

Table 7-7 d
Long-Term Fish Ingestion Cancer Risks
Reasonable Maximum Exposure and Central Tendency
River Section 3 - Lock 5 to Troy Dam - Adult Angler

Scenario Time Frame: Long-Term Post-Remediation
Exposure Medium: Fish
Exposure Point: Troy Dam (RM 154)
Exposure Route: Ingestion
Chemical of Potential Concern: PCBs
Receptor: Adult Angler

Remedial Alternative (with starting year for evaluation)	PCB Conc. in Fish (mg/kg ww)	Intake (Cancer) (mg/kg-day)	Cancer Slope Factor (mg/kg-day)	Cancer Risk	Percent Risk Reduction compared to No Action	Percent Risk Reduction compared to MNA
Reasonable Maximum Exposure						
No Action (2010)	0.32	8.3E-05	2	1.7E-04		
No Action (2012)	0.30	7.9E-05	2	1.6E-04		
MNA (2010)	0.15	3.8E-05	2	7.7E-05	54%	
MNA (2012)	0.13	3.4E-05	2	6.8E-05	57%	
CAP-3/10/Select (25%) (2010)	0.12	3.0E-05	2	6.1E-05	64%	21%
CAP-3/10/Select (2010)	0.11	2.9E-05	2	5.8E-05	65%	25%
CAP-3/10/Select (15%) (2010)	0.11	3.0E-05	2	5.9E-05	64%	23%
REM-3/10/Select (2010)	0.11	2.9E-05	2	5.7E-05	66%	26%
REM-3/10/Select (0 ppm residual) (2010)	0.11	2.8E-05	2	5.5E-05	67%	28%
REM-3/10/Select (2 ppm residual) (2010)	0.12	3.1E-05	2	6.3E-05	62%	18%
REM-3/10/Select (5 ppm residual) (2010)	0.14	3.5E-05	2	7.1E-05	58%	8%
REM-0/0/3 (2012)	0.08	2.2E-05	2	4.3E-05	73%	36%
Central Tendency						
No Action (2010)	0.41	3.2E-06	1	3.2E-06		
No Action (2012)	0.38	3.0E-06	1	3.0E-06		
MNA (2010)	0.26	2.1E-06	1	2.1E-06	37%	
MNA (2012)	0.22	1.7E-06	1	1.7E-06	42%	
CAP-3/10/Select (2010)	0.19	1.5E-06	1	1.5E-06	53%	26%
CAP-3/10/Select (15%) (2010)	0.20	1.6E-06	1	1.6E-06	52%	24%
CAP-3/10/Select (25%) (2010)	0.20	1.6E-06	1	1.6E-06	51%	22%
REM-3/10/Select (2010)	0.19	1.5E-06	1	1.5E-06	54%	27%
REM-3/10/Select (0 ppm residual) (2010)	0.18	1.4E-06	1	1.4E-06	56%	30%
REM-3/10/Select (2 ppm residual) (2010)	0.21	1.7E-06	1	1.7E-06	48%	19%
REM-3/10/Select (5 ppm residual) (2010)	0.24	1.9E-06	1	1.9E-06	42%	8%
REM-0/0/3 (2012)	0.13	1.0E-06	1	1.0E-06	65%	40%

Table 7-8
Time to Reach Ecological Target Concentrations

		No Action	Monitored Natural Attenuation	CAP/SR-3/10/Select	CAP-3/10/Select (15%)	CAP-3/10/Select (25%)	REM-3/10/Select	REM-3/10/Select (residual of 0 ppm)	REM-3/10/Select (2 ppm)	REM-3/10/Select (5 ppm)	REM-0/0/3
River Section 1 (RM 189) beginning in 2008 for all alternatives											
Mink	LOAEL	> 60	22->60	5	5	6	4	3	13	16	2
	NOAEL	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60
River Otter	LOAEL	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60
	NOAEL	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60	> 60
River Section 2 (RM 184) beginning in 2009 for all alternatives											
Mink	LOAEL	21->59	10->59	0	0	0	0	0	0	4	0
	NOAEL	> 59	> 59	> 59	> 59	> 59	> 59	> 59	> 59	> 59	52
River Otter	LOAEL	> 59	> 59	52	52	52	52	43	52	> 59	35
	NOAEL	> 59	> 59	> 59	> 59	> 59	> 59	> 59	> 59	> 59	> 59
River Section 3 (RM 154) beginning in 2010 for all alternatives											
Mink	LOAEL	0	0	0	0	0	0	0	0	0	0
	NOAEL	> 58	12	5	6	6	5	4	7	9	4
River Otter	LOAEL	> 58	14	8	8	9	8	7	10	11	5
	NOAEL	> 58	> 58	> 58	> 58	> 58	> 58	> 58	> 58	> 58	> 58

Notes:
Range of years calculated using bounding estimates are presented for the No Action and MNA alternatives.
There is no bounding range presented for the No Action and MNA alternatives in River Section 3 because there are no cohesive sediments in this segment and therefore no bounding range could be calculated.

Table 7-9
Average of PCB Toxicity Quotients - Ecological Receptors (25-Year Time Frame)

		No Action - Start Year 2008	No Action - Start Year 2009	MNA - Start Year 2008	MNA - Start Year 2009	CAP-3/10/Select	CAP-3/10/Select (15%)	CAP-3/10/Select (25%)	REM-3/10/Select	REM-3/10/Select (0 ppm)	REM-3/10/Select (2 ppm)	REM-3/10/Select (5 ppm)	REM-0/0/3
River Section 1 (RM 189) Modeling Timeframe is 2008-2032 except for REM-0/0/3 which is 2009-2033													
Mink	LOAEL	**4.6-5.3**	**4.5-5.2**	**1.7-2.6**	**1.6-2.5**	0.9	**1.0**	**1.1**	0.95	0.90	**1.2**	**1.5**	0.70
	NOAEL	**46-53**	**45-52**	**17-26**	**16-25**	**9.4**	**10**	**11**	**9.5**	**9.0**	**12**	**15**	**7.0**
River Otter	LOAEL	**24-30**	**23-29**	**9.7-15**	**9.1-14**	**5.3**	**5.5**	**5.8**	**5.2**	**4.8**	**6.5**	**8.3**	**3.7**
	NOAEL	**240-300**	**230-290**	**97-150**	**91-140**	**53**	**55**	**58**	**52**	**48**	**65**	**83**	**37**
River Section 2 (RM 184) Modeling Timeframe is 2009-2033 except for REM-0/0/3 which is 2011-2035													
Mink	LOAEL	**1.5-2.7**	**1.3-2.6**	0.94-2.5	0.79-2.4	0.36	0.39	0.43	0.31	0.28	0.44	0.62	0.19
	NOAEL	**15-27**	**13-26**	**9.4-25**	**7.9-24**	**3.6**	**3.9**	**4.3**	**3.1**	**2.8**	**4.4**	**6.2**	**1.9**
River Otter	LOAEL	**14-27**	**12-26**	**9.2-24**	**7.8-23**	**3.5**	**3.7**	**4.2**	**2.9**	**2.7**	**4.3**	**6.1**	**1.8**
	NOAEL	**140-270**	**120-260**	**92-240**	**78-230**	**35**	**37**	**42**	**29**	**27**	**43**	**61**	**18**
River Section 3 (RM 154) Modeling Timeframe is 2010-2034 except for REM-0/0/3 which is 2012-2036													
Mink	LOAEL	0.21	0.20	0.11	0.09	0.07	0.08	0.08	0.08	0.07	0.08	0.10	0.06
	NOAEL	**2.1**	**2.0**	**1.1**	0.9	0.75	0.79	0.81	0.75	0.72	0.84	0.96	0.55
River Otter	LOAEL	**2.4**	**2.3**	**1.2**	**1.1**	0.87	0.90	0.92	0.86	0.82	0.97	**1.1**	0.62
	NOAEL	**24**	**23**	**12**	**11**	**8.7**	**9.0**	**9.2**	**8.6**	**8.2**	**9.7**	**11**	**6.2**

Notes:
TQs above the target level of 1.0 are bolded.
Range of years calculated using bounding estimates are presented for the No Action and MNA alternatives.
There is no bounding range presented for the No Action and MNA alternatives in River Section 3
because there are no delineated cohesive sediments in this segment and therefore no bounding range could be calculated.

Table 7-10

Probabilistic Dose-Response Analysis - Selected Output for Probability of Reduction of Fecundity of the Female River Otter - River Section 1

	Year : 2011							Year : 2021							Year : 2036						
Percentile Reduction in Fecundity	No Action Upper Bound	No Action	MNA Upper Bound	MNA	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3	No Action Upper Bound	No Action	MNA Upper Bound	MNA	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3	No Action Upper Bound	No Action	MNA Upper Bound	MNA	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3
2%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
4%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
8%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
15%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	100%	100%	99%	100%	100%	100%	100%	99%	99%	99%
25%	100%	100%	100%	100%	100%	100%	98%	100%	100%	100%	100%	99%	99%	96%	100%	100%	100%	99%	97%	97%	96%
30%	100%	100%	100%	100%	100%	100%	95%	100%	100%	100%	100%	97%	97%	90%	100%	100%	100%	97%	93%	93%	90%
35%	100%	100%	100%	100%	99%	99%	89%	100%	100%	100%	100%	94%	93%	82%	100%	100%	100%	94%	86%	86%	81%
40%	100%	100%	100%	100%	98%	97%	81%	100%	100%	100%	99%	88%	86%	71%	100%	100%	100%	88%	77%	77%	70%
45%	100%	100%	100%	100%	95%	93%	71%	100%	100%	100%	97%	80%	78%	59%	100%	100%	99%	81%	67%	66%	58%
50%	100%	100%	100%	100%	91%	89%	60%	100%	100%	100%	95%	71%	68%	47%	100%	100%	98%	71%	55%	54%	46%
55%	100%	100%	100%	99%	85%	82%	49%	100%	100%	99%	91%	60%	57%	36%	100%	100%	96%	61%	44%	43%	35%
60%	100%	100%	100%	99%	78%	73%	38%	100%	100%	98%	86%	49%	46%	26%	100%	100%	93%	50%	33%	32%	25%
65%	100%	100%	100%	97%	69%	63%	28%	100%	100%	97%	78%	38%	35%	18%	100%	100%	88%	39%	24%	23%	17%
70%	100%	100%	99%	95%	58%	52%	19%	100%	99%	94%	69%	28%	25%	11%	100%	99%	82%	29%	16%	15%	11%
75%	100%	100%	98%	92%	47%	41%	12%	100%	99%	90%	59%	19%	17%	7%	100%	99%	73%	20%	9.9%	9.5%	6.4%
80%	100%	99%	97%	86%	35%	29%	7.2%	99%	97%	84%	47%	12%	10%	4%	99%	97%	63%	13%	5.6%	5.3%	3.4%
85%	99%	98%	93%	77%	23%	19%	3.6%	98%	95%	74%	34%	6.6%	5.6%	1.6%	97%	94%	50%	6.9%	2.7%	2.6%	1.5%
90%	98%	95%	86%	63%	13%	10%	1.4%	95%	89%	60%	21%	2.9%	2.3%	0.5%	94%	88%	34%	3.1%	1.0%	1.0%	0.5%
92%	97%	93%	82%	56%	9.4%	6.9%	0.9%	92%	85%	53%	16%	1.8%	1.5%	0.3%	91%	84%	28%	2.0%	0.6%	0.6%	0.3%
94%	95%	89%	75%	47%	6.2%	4.4%	0.5%	88%	79%	44%	11%	1.0%	0.8%	0.2%	87%	78%	21%	1.1%	0.3%	0.3%	0.1%
96%	91%	84%	66%	36%	3.5%	2.4%	0.2%	82%	71%	33%	6.8%	0.5%	0.4%	0.1%	81%	69%	14%	0.5%	0.1%	0.1%	0.1%
98%	83%	72%	50%	23%	1.3%	0.8%	0.1%	70%	56%	20%	2.9%	0.1%	0.1%	0.0%	68%	54%	6.9%	0.2%	0.0%	0.0%	0.0%

Note: Percentiles shown for various alternative represent the probability of the associated reduction in fecundity. For example, the No Action alternative in 2011 has a 100% probability of a 50% reduction in fecundity.

Table 7-11

Probabilistic Dose-Response Analysis - Selected Output for Probability of Reduction of Fecundity of the Female River Otter - River Section 2

	Year : 2011							Year : 2021							Year : 2036						
Percentile Reduction in Fecundity	No Action Upper Bound	No Action	MNA Upper Bound	MNA	CAP-3/10/S	REM-3/10/S	REM-0/0/3	No Action Upper Bound	No Action	MNA Upper Bound	MNA	REM-3/10/S	CAP-3/10/S	REM-0/0/3	No Action Upper Bound	No Action	MNA Upper Bound	MNA	CAP-3/10/S	REM-3/10/S	REM-0/0/3
2%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
4%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
8%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%
10%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	98%	96%
15%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	96%	100%	100%	100%	99%	91%	89%	79%
20%	100%	100%	100%	100%	100%	100%	98%	100%	100%	100%	100%	96%	98%	85%	100%	100%	100%	96%	76%	72%	57%
25%	100%	100%	100%	100%	100%	99%	94%	100%	100%	100%	100%	89%	95%	69%	100%	100%	100%	90%	57%	53%	36%
30%	100%	100%	100%	100%	99%	98%	87%	100%	100%	100%	100%	79%	88%	52%	100%	100%	100%	80%	40%	35%	22%
35%	100%	100%	100%	100%	98%	95%	77%	100%	100%	100%	100%	67%	79%	37%	100%	100%	100%	68%	26%	22%	12%
40%	100%	100%	100%	100%	96%	90%	65%	100%	100%	100%	99%	53%	67%	24%	100%	99%	100%	55%	17%	13%	6.4%
45%	100%	100%	100%	100%	93%	83%	52%	100%	100%	100%	97%	41%	54%	15%	100%	98%	100%	42%	9.9%	7.5%	3.3%
50%	100%	100%	100%	100%	88%	75%	40%	100%	100%	100%	95%	30%	42%	9.2%	100%	96%	100%	31%	5.6%	4.0%	1.6%
55%	100%	100%	100%	100%	81%	65%	30%	100%	99%	100%	91%	21%	31%	5.2%	100%	92%	100%	21%	3.1%	2.1%	0.7%
60%	100%	100%	100%	100%	73%	54%	21%	100%	98%	100%	86%	14%	22%	2.8%	100%	87%	100%	14%	1.6%	1.0%	0.3%
65%	100%	100%	100%	99%	63%	43%	14%	100%	96%	100%	78%	8.4%	15%	1.4%	100%	81%	99%	8.8%	0.8%	0.5%	0.1%
70%	100%	100%	100%	99%	52%	32%	8.4%	100%	93%	100%	69%	4.9%	9.0%	0.6%	99%	72%	99%	5.1%	0.3%	0.2%	0.1%
75%	100%	99%	100%	97%	40%	23%	4.8%	100%	89%	99%	58%	2.6%	5.1%	0.3%	99%	61%	98%	2.7%	0.1%	0.1%	0.0%
80%	100%	98%	100%	95%	29%	15%	2.4%	99%	81%	99%	46%	1.2%	2.6%	0.1%	97%	49%	95%	1.3%	0.1%	0.0%	0.0%
85%	99%	95%	99%	90%	19%	8.2%	1.0%	98%	71%	97%	33%	0.5%	1.1%	0.0%	95%	36%	91%	0.5%	0.0%	0.0%	0.0%
90%	98%	90%	98%	82%	10%	3.7%	0.3%	95%	56%	94%	20%	0.1%	0.4%	0.0%	89%	23%	84%	0.2%	0.0%	0.0%	0.0%
92%	97%	86%	97%	76%	7.1%	2.4%	0.2%	93%	49%	91%	15%	0.1%	0.2%	0.0%	85%	17%	79%	0.1%	0.0%	0.0%	0.0%
94%	96%	80%	95%	69%	4.6%	1.4%	0.1%	89%	40%	87%	11%	0.0%	0.1%	0.0%	79%	12%	72%	0.0%	0.0%	0.0%	0.0%
96%	92%	72%	91%	59%	2.5%	0.7%	0.0%	83%	30%	80%	6.3%	0.0%	0.0%	0.0%	70%	7.5%	62%	0.0%	0.0%	0.0%	0.0%
98%	85%	57%	83%	43%	0.9%	0.2%	0.0%	71%	18%	67%	2.7%	0.0%	0.0%	0.0%	55%	3.3%	46%	0.0%	0.0%	0.0%	0.0%

Note: Percentiles shown for various alternative represent the probability of the associated reduction in fecundity. For example, the No Action alternative in 2011 has a 100% probability of a 50% reduction in fecundity.

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Table 7-12
Reduction in Ecological Toxicity Quotients as Compared to the No Action and MNA Alternatives

		Monitored Natural Attenuation	CAP-3/10/Select	CAP-3/10/Select (15%)	CAP-3/10/Select (25%)	REM-3/10/Select	REM-3/10/Select (0 ppm)	REM-3/10/Select (2 ppm)	REM-3/10/Select (5 ppm)	REM-0/0/3
River Section 1 (RM 189) Modeling Timeframe is 2008-2032 except for REM-0/0/3 which is 2009-2033										
Risk Reduction as compared to the No Action Alternative										
Mink	LOAEL	52%-63%	80%-82%	78%-82%	77%-80%	79%-82%	80%-83%	74%-78%	68%-72%	84%-87%
	NOAEL	52%-63%	80%-82%	78%-82%	77%-80%	79%-82%	80%-83%	74%-78%	68%-72%	84%-87%
River Otter	LOAEL	51%-60%	78%-82%	77%-82%	76%-81%	78%-83%	80%-84%	73%-78%	65%-72%	84%-87%
	NOAEL	51%-60%	78%-82%	77%-82%	76%-81%	78%-83%	80%-84%	73%-78%	65%-72%	84%-87%
Risk Reduction as compared to the MNA Alternative										
Mink	LOAEL		45%-64%	41%-61%	38%-59%	44%-63%	47%-65%	31%-54%	13%-42%	59%-73%
	NOAEL		45%-64%	41%-61%	38%-59%	44%-63%	47%-65%	31%-54%	13%-42%	59%-73%
River Otter	LOAEL		45%-64%	43%-63%	40%-61%	46%-65%	50%-67%	33%-56%	14%-44%	62%-75%
	NOAEL		45%-64%	43%-63%	40%-61%	46%-65%	50%-67%	33%-56%	14%-44%	62%-75%
River Section 2 (RM 184) Modeling Timeframe is 2009-2033 except for REM-0/0/3 which is 2011-2035										
Risk Reduction as compared to the No Action Alternative										
Mink	LOAEL	7%-36%	76%-87%	74%-86%	70%-84%	79%-89%	81%-90%	70%-84%	58%-77%	86%-93%
	NOAEL	7%-36%	76%-87%	74%-86%	70%-84%	79%-89%	81%-90%	70%-84%	58%-77%	86%-93%
River Otter	LOAEL	9%-33%	75%-87%	73%-86%	70%-84%	79%-89%	81%-90%	69%-84%	56%-77%	86%-93%
	NOAEL	9%-33%	75%-87%	73%-86%	70%-84%	79%-89%	81%-90%	69%-84%	56%-77%	86%-93%
Risk Reduction as compared to the MNA Alternative										
Mink	LOAEL		62%-86%	59%-85%	54%-83%	67%-88%	70%-89%	53%-83%	34%-75%	79%-92%
	NOAEL		62%-86%	59%-85%	54%-83%	67%-88%	70%-89%	53%-83%	34%-75%	79%-92%
River Otter	LOAEL		62%-86%	60%-85%	54%-83%	68%-88%	71%-89%	53%-82%	34%-75%	80%-93%
	NOAEL		62%-86%	60%-85%	54%-83%	68%-88%	71%-89%	53%-82%	34%-75%	80%-93%
River Section 3 (RM 154) Modeling Timeframe is 2010-2034 except for REM-0/0/3 which is 2012-2036										
Risk Reduction as compared to the No Action Alternative										
Mink	LOAEL	51%	65%	63%	62%	65%	66%	61%	55%	73%
	NOAEL	51%	65%	63%	62%	65%	66%	61%	55%	73%
River Otter	LOAEL	49%	64%	63%	62%	65%	66%	60%	54%	73%
	NOAEL	49%	64%	63%	62%	65%	66%	60%	54%	73%
Risk Reduction as compared to the MNA Alternative										
Mink	LOAEL		29%	25%	23%	28%	31%	20%	9%.	47%
	NOAEL		29%	25%	23%	28%	31%	20%	9%	47%
River Otter	LOAEL		29%	27%	25%	30%	33%	21%	9%	49%
	NOAEL		29%	27%	25%	30%	33%	21%	9%	49%

Notes:

Range shown is based on HUDTOX and trend analysis results for the No Action alternative.

There is no bounding range presented for the No Action and MNA alternatives in River Section 3 because there are no cohesive sediments in this segment and therefore no bounding range could be calculated.

401008

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

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CHAPTER 8

Table 8-1
Tri+ PCB Load Over Thompson Island Dam (in kg)

Year	No Action	Monitored Natural Attenuation	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3
1998	224.82	224.82	224.82	224.82	224.82
1999	109.34	109.34	109.34	109.34	109.34
2000	123.43	123.43	123.65	123.65	123.65
2001	135.08	135.08	135.20	135.20	135.20
2002	106.04	106.04	105.88	105.88	105.88
2003	103.50	103.50	103.71	103.71	103.71
2004	90.99	90.99	88.28	88.22	87.99
2005	93.07	51.81	40.86	40.56	38.31
2006	99.72	57.19	35.37	34.68	27.13
2007	98.93	56.80	28.11	27.24	17.48
2008	78.73	38.11	20.81	20.24	12.68
2009	79.26	37.68	20.45	19.90	12.63
2010	96.12	50.72	26.29	25.60	15.15
2011	87.84	43.72	22.91	22.31	13.77
2012	85.25	40.47	21.67	21.14	13.38
2013	85.98	40.35	21.59	21.10	13.41
2014	78.44	33.15	18.74	18.36	12.34
2015	76.47	31.06	17.95	17.60	12.05
2016	66.38	23.84	15.14	14.87	10.73
2017	66.72	23.25	14.33	14.10	10.48
2018	70.59	26.37	15.55	15.28	11.01
2019	62.91	20.77	13.36	13.16	9.95
2020	67.32	22.33	14.44	14.24	10.69
2021	64.49	20.46	13.65	13.47	10.28
2022	60.43	17.57	12.19	12.05	9.60
2023	59.84	16.86	11.71	11.59	9.41
2024	66.97	20.75	13.68	13.52	10.54
2025	61.31	17.02	12.07	11.95	9.71
2026	61.36	16.74	12.07	11.96	9.77
2027	59.20	15.27	11.15	11.06	9.30
2028	60.80	15.76	11.60	11.51	9.64
2029	60.26	15.19	11.42	11.34	9.60
2030	61.52	14.95	11.41	11.34	9.72
2031	62.41	16.04	11.65	11.57	9.79
2032	59.61	14.26	10.97	10.90	9.46
2033	58.15	13.31	10.50	10.44	9.20
2034	60.10	13.51	10.89	10.83	9.57
2035	59.97	13.49	10.79	10.74	9.49
2036	60.03	13.61	10.73	10.68	9.49
2037	60.12	13.75	10.53	10.49	9.39
2038	57.06	12.07	9.94	9.91	9.03
2039	62.34	14.17	10.87	10.83	9.75
2040	56.29	11.62	9.73	9.70	8.96
2041	58.02	11.52	9.91	9.89	9.19
2042	52.57	9.98	8.88	8.86	8.35
2043	61.92	12.92	10.61	10.59	9.76
2044	60.29	12.39	10.26	10.24	9.52
2045	57.69	11.63	9.74	9.72	9.09
2046	56.38	10.62	9.50	9.49	8.97
2047	55.74	10.64	9.33	9.32	8.85
2048	56.86	11.74	9.39	9.37	8.91
2049	54.31	10.78	8.96	8.95	8.57
2050	58.16	12.07	9.59	9.57	9.11
2051	59.14	11.90	9.72	9.71	9.29
2052	54.60	10.29	8.96	8.95	8.63
2053	53.57	9.97	8.78	8.77	8.49
2054	53.49	9.83	8.77	8.77	8.50
2055	56.99	10.76	9.37	9.36	9.03
2056	51.42	8.90	8.42	8.42	8.23
2057	54.78	9.58	9.09	9.08	8.86
2058	54.29	9.53	8.75	8.75	8.53
2059	53.62	9.34	8.73	8.73	8.54
2060	57.88	10.29	9.44	9.43	9.20
2061	59.63	10.60	9.76	9.76	9.51
2062	53.15	9.08	8.65	8.64	8.50
2063	53.15	9.03	8.60	8.60	8.51
2064	52.67	8.94	8.68	8.68	8.60
2065	56.05	9.42	9.00	8.99	8.90
2066	53.82	9.04	8.73	8.73	8.64
2067	52.65	8.83	8.18	8.17	8.11
Total Loads	4902.04	2076.82	1713.81	1704.64	1561.85

401010

Table 8-2
Tri+ PCB Load Over Northumberland Dam (in kg)

Year	No Action	Monitored Natural Attenuation	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3
1998	274.41	274.41	274.41	274.41	274.41
1999	126.60	126.60	126.60	126.60	126.60
2000	151.83	151.91	151.91	151.91	151.91
2001	180.14	180.36	180.36	180.36	180.36
2002	122.98	122.72	122.72	122.72	122.72
2003	122.41	122.88	122.88	122.88	122.88
2004	99.18	98.74	96.29	96.24	96.04
2005	104.70	67.44	57.78	57.51	55.48
2006	117.06	77.81	57.64	57.01	50.06
2007	123.60	84.47	52.43	51.14	46.65
2008	81.71	45.07	23.78	22.75	20.53
2009	83.37	45.75	23.54	22.44	18.86
2010	117.75	73.65	33.90	31.78	19.27
2011	105.32	63.00	29.07	27.24	16.91
2012	97.04	54.07	26.12	24.72	15.77
2013	99.41	55.09	26.34	24.92	15.78
2014	84.44	41.09	21.39	20.50	13.75
2015	82.00	38.43	20.33	19.51	13.26
2016	67.34	28.08	16.01	15.46	11.08
2017	65.55	25.36	15.05	14.59	10.75
2018	76.82	34.57	17.86	17.03	11.89
2019	63.03	23.94	14.12	13.67	10.14
2020	69.66	26.53	15.63	15.15	11.13
2021	67.07	24.89	14.74	14.29	10.64
2022	59.54	19.32	12.51	12.23	9.57
2023	57.70	17.68	11.84	11.60	9.27
2024	71.54	25.64	15.17	14.71	11.14
2025	61.48	19.26	12.54	12.26	9.73
2026	63.03	19.69	12.75	12.46	9.92
2027	57.11	16.06	11.16	10.97	9.06
2028	60.97	17.56	11.95	11.73	9.62
2029	60.71	16.95	11.76	11.55	9.58
2030	60.41	16.08	11.51	11.34	9.55
2031	65.11	18.89	12.53	12.28	10.13
2032	60.38	15.91	11.32	11.15	9.48
2033	57.61	14.38	10.64	10.50	9.09
2034	60.54	14.64	11.13	11.01	9.58
2035	60.02	14.55	11.01	10.89	9.48
2036	60.93	14.89	11.07	10.94	9.57
2037	60.42	14.78	10.80	10.69	9.43
2038	55.55	12.36	9.79	9.72	8.77
2039	64.40	15.59	11.40	11.28	10.02
2040	55.44	12.02	9.62	9.56	8.74
2041	55.60	11.47	9.62	9.57	8.81
2042	48.92	9.58	8.36	8.32	7.79
2043	63.96	14.08	11.09	11.01	10.04
2044	61.51	13.27	10.57	10.51	9.66
2045	57.97	12.24	9.90	9.84	9.11
2046	55.50	10.81	9.42	9.38	8.82
2047	54.58	10.80	9.21	9.17	8.64
2048	55.60	11.81	9.25	9.21	8.70
2049	52.68	10.72	8.73	8.70	8.27
2050	58.50	12.50	9.72	9.68	9.14
2051	58.78	12.14	9.73	9.69	9.21
2052	52.79	10.21	8.72	8.70	8.34
2053	51.72	9.86	8.52	8.50	8.18
2054	51.88	9.76	8.53	8.51	8.21
2055	57.40	11.14	9.48	9.45	9.07
2056	47.94	8.43	7.86	7.85	7.65
2057	53.88	9.64	8.84	8.82	8.58
2058	51.09	9.05	8.38	8.36	8.13
2059	51.60	9.15	8.44	8.43	8.21
2060	57.65	10.46	9.44	9.42	9.15
2061	61.01	11.08	10.00	9.98	9.69
2062	50.95	8.83	8.31	8.30	8.14
2063	50.67	8.73	8.25	8.24	8.14
2064	51.79	8.92	8.43	8.42	8.33
2065	52.90	8.99	8.60	8.59	8.48
2066	51.88	8.81	8.43	8.43	8.33
2067	49.04	8.31	7.94	7.94	7.86
Total Loads	5204.08	2483.93	2005.20	1984.72	1841.24

401011

Table 8-3
Tri+ PCB Load Over Federal Dam (in kg)

Year	No Action	Monitored Natural Attenuation	CAP-3/10/Select	REM-3/10/Select	REM-0/0/3
1998	330.29	330.29	330.29	330.29	330.29
1999	157.67	157.67	157.67	157.67	157.67
2000	205.50	205.50	205.50	205.50	205.50
2001	236.73	236.73	236.73	236.73	236.73
2002	137.85	137.85	137.85	137.85	137.85
2003	130.51	130.51	130.51	130.51	130.51
2004	95.66	95.66	94.59	94.64	94.55
2005	111.39	92.33	87.26	87.13	86.10
2006	129.01	105.04	92.75	92.37	88.17
2007	128.92	103.76	82.22	81.37	78.54
2008	71.28	50.58	39.15	38.63	37.60
2009	67.57	46.87	33.51	32.88	32.04
2010	131.00	93.72	59.90	58.16	49.68
2011	103.84	71.76	43.17	41.65	33.93
2012	101.03	65.69	40.60	39.37	32.15
2013	104.58	67.45	40.93	39.61	31.86
2014	83.79	49.22	31.00	30.15	24.42
2015	80.29	45.07	28.11	27.32	21.88
2016	52.56	26.72	17.45	17.01	13.93
2017	51.68	24.65	16.35	15.97	13.10
2018	64.02	33.48	19.15	18.42	14.24
2019	48.73	22.19	14.24	13.86	11.18
2020	63.30	28.54	17.94	17.46	13.74
2021	60.01	26.06	16.28	15.83	12.48
2022	47.03	18.27	12.18	11.91	9.67
2023	45.15	16.65	11.33	11.10	9.10
2024	72.84	29.43	18.30	17.80	14.03
2025	53.41	19.57	12.85	12.55	10.11
2026	53.64	19.36	12.62	12.32	9.91
2027	45.34	14.99	10.38	10.18	8.43
2028	53.61	17.76	12.08	11.84	9.71
2029	53.93	17.24	11.90	11.68	9.66
2030	52.09	15.92	11.29	11.10	9.30
2031	58.19	18.57	12.37	12.11	10.00
2032	51.49	15.28	10.69	10.51	8.86
2033	46.98	13.31	9.61	9.46	8.08
2034	56.74	15.36	11.46	11.31	9.75
2035	62.56	23.52	19.75	19.59	17.57
2036	74.58	33.27	28.99	28.81	26.31
2037	69.94	29.50	25.25	25.09	22.91
2038	54.47	20.71	18.08	17.98	16.48
2039	72.67	27.07	22.70	22.55	20.56
2040	49.56	16.38	14.00	13.92	12.78
2041	49.04	15.01	14.07	14.00	12.04
2042	37.54	10.43	10.72	10.68	8.61
2043	67.28	19.45	18.20	18.10	14.94
2044	64.24	19.84	15.92	15.82	15.15
2045	52.70	15.60	12.43	12.34	12.24
2046	52.07	14.17	11.83	11.76	11.74
2047	45.97	11.96	9.90	9.84	9.75
2048	46.61	12.25	9.57	9.52	9.38
2049	41.90	10.37	8.34	8.30	8.17
2050	51.65	12.84	10.02	9.96	9.71
2051	55.90	13.43	10.74	10.69	10.44
2052	41.10	9.22	7.68	7.65	7.46
2053	39.34	8.51	7.20	7.17	6.99
2054	40.70	8.60	7.38	7.35	7.16
2055	50.26	10.69	9.03	8.99	8.70
2056	34.20	6.69	6.11	6.10	5.97
2057	45.82	9.01	8.14	8.12	7.92
2058	41.92	8.15	7.44	7.43	7.23
2059	42.28	8.13	7.41	7.40	7.21
2060	54.58	10.63	9.58	9.55	9.29
2061	59.16	11.41	10.33	10.31	10.02
2062	40.22	7.46	6.95	6.94	6.79
2063	39.55	7.27	6.82	6.81	6.70
2064	40.12	7.32	6.89	6.88	6.78
2065	41.83	7.56	7.21	7.20	7.08
2066	42.20	7.59	7.25	7.24	7.13
2067	37.66	6.74	6.44	6.43	6.35
Total Loads	5077.28	2919.86	2512.58	2494.78	2372.32

401012

Table 8-4
Cost Analysis
No Action

Cost Item	Quantity	Unit Cost	Unit	Cost
Review Costs				
Review - Every 5 Years				
Five-Year Review	6	$ 76,856	Event	$ 461,136
Total O&M Costs				$ 461,136
Annual O&M (for 30 years over O&M period of 2004 through 2033)				$ 15,371
Present Worth of Costs				
Review - Every 5 Years (Years 2004 to 2033)				
Five-Year Review				$ 139,555
Total Present Worth Costs for Alternative				**$ 139,555**
Round To				**$ 140,000**

Table 8-5
Cost Analysis
Monitored Natural Attenuation

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Monitoring				
Model Development	1	$ 507,500	EA	$ 507,500
Total Capital Costs				$ 507,500
Monitoring Costs				
Sediment Monitoring - Conducted in Years 2004, 2007, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	7	$ 2,020,678	Event	$ 14,144,746
Monitoring - Annual				
Water Monitoring	30	$ 1,916,514	Year	$ 57,495,420
Fish Monitoring	30	$ 893,378	Year	$ 26,801,340
Annual Reporting	30	$ 45,045	Year	$ 1,351,350
Survey - Every 3 Years				
Geophysical Survey (includes Multibeam Survey & Bathymetry)	10	$ 707,764	Event	$ 7,077,640
Modeling and Review - Every 5 Years				
Modeling	6	$ 176,473	Event	$ 1,058,838
Five-Year Review	6	$ 76,856	Event	$ 461,136
Total O&M Costs				$ 108,390,470
Annual O&M (for 30 years over O&M period of 2004 through 2033)				$ 3,613,016
Present Worth of Costs				
Pre-Monitoring				
Model Development (Year 2003)				$ 416,648
Sediment Monitoring - Conducted in Years 2004, 2007, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 5,471,872
Monitoring - Annual (Years 2004 to 2033)				
Water Monitoring				$ 19,931,319
Fish Monitoring				$ 9,290,932
Annual Reporting				$ 468,458
Survey - Every 3 Years (Years 2004 to 2033)				
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 2,616,502
Modeling and Review - Every 5 Years (Years 2004 to 2033)				
Modeling				$ 320,439
Five-Year Review				$ 139,555
Total Present Worth Costs for Alternative				$ 38,655,726
Round To				**$ 39,000,000**

Table 8-6
Areas of Sediments, Volumes of Sediments, and Mass of PCBs Remediated: CAP-3/10/Select

River Section/Parameter	Target Criteria	Contaminant Removal	Channel Dredging	Total
River Section 1				
Area Remediated (Acres)	3 g/m^2	266	15	282
Area Capped (Acres)	3 g/m^2	156	NA	156
Volume Sediments Removed (CY)	3 g/m^2	849,200	66,100	915,300
PCB Mass Remediated (kg)	3 g/m^2	11,600	200	11,800
PCB Mass Removed (kg)	3 g/m^2	7,100	200	7,300
River Section 2				
Area Remediated (Acres)	10 g/m^2	74	2	76
Area Capped (Acres)	10 g/m^2	52	NA	52
Volume Sediments Removed (CY)	10 g/m^2	292,000	15,400	307,400
PCB Mass Remediated (kg)	10 g/m^2	23,600	700	24,300
PCB Mass Removed (kg)	10 g/m^2	15,600	700	16,300
River Section 3				
Area Remediated (Acres)	HS 36, 37, part of 39	92	43	135
Area Capped (Acres)	HS 36, 37, part of 39	-	NA	-
Volume Sediments Removed (CY)	HS 36, 37, part of 39	392,900	117,300	510,200
PCB Mass Remediated (kg)	HS 36, 37, part of 39	6,700	2,800	9,500
PCB Mass Removed (kg)	HS 36, 37, part of 39	6,700	2,800	9,500
Total for alternative				
Area Remediated (Acres)		432	61	493
Area Capped (Acres)		207	-	207
Volume Sediments Removed (CY)		1,534,100	198,800	1,732,900
PCB Mass Remediated (kg)		41,900	3,700	45,600
PCB Mass Removed (kg)		29,400	3,700	33,100

Table 8-7
Engineering Parameters: CAP-3/10/Select

Removal	**Sediment Volume Removed ($x10^3$ cy)**	PCB >33ppm		722
		PCB< 33ppm		1,011
		PCB<10ppm		631
		Total Volume		1,733
	Removal Operations	Number of Mechanical Dredges		4
		Total Mechanical Dredging Hours		45,900
Transportation	**Transportation in River** [1]	Barge Loads to SF/Day		2
		Barge Loads to NF/Day		10
	Transportation on Land [1]	Rail Cars From SF/Day		14
		Rail Cars From NF/Day		15
Reconstruction	**Backfill Quantities**	Quantities ($x10^3$ cy)	Sand	122
			Gravel	122
			Silty Material	197
			S/G[2]	192
			Total	633
		AquaBlok ($x10^3$ tonnage)		150
	Shoreline Stabilization in ($x10^3$ LF)	< 2' - Hydroseeding		78
		>2' - Vegetative Mattress		13
		Total		91
	Planting in Acres	Type A [3]		21.0
		Type B [3]		21.0
		Type C [3]		54.8
		Total		96.8

Notes:
1. SF and NF refer to southern and northern transfer facilities, respectively
2. S/G- Sand and gravel mixtures
3. Type A - Critical area/shallow rooted vegetation
   Type B- Critical area/emergent vegetation
   Type C- Shallow area planting

Table 8-8a
Cost Analysis
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,732,820	$ 28.21	CY	$ 48,875,485
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,732,820	$ 22.37	CY	$ 38,761,904
Stabilization	1,732,820	$ 26.76	CY	$ 46,370,678
Transport/Landfill Fee				
Load RR Car	1,871,446	$ 2.44	CY	$ 4,568,086
Transportation/Disposal >33 ppm - Texas	1,091,543	$ 119.20	tons	$ 130,111,189
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	715,478	$ 55.16	tons	$ 39,463,262
Sediment Sample & Analysis	2,620,024	$ 0.42	tons	$ 1,098,678
Water Treatment	1	$ 1,166,701	LS	$ 1,166,701
Backfilling	441,174	$ 55.00	CY	$ 24,262,928
Capping	207	$ 174,302.80	ACRES	$ 36,080,679
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 504,126,401
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 322,364,211
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 368,485,596**
Round To				**$ 370,000,000**

401017

Table 8-8b
Cost Analysis - Beneficial Use of Non-TSCA Material
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,732,820	$ 28.21	CY	$ 48,875,485
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,352,120	$ 23.50	CY	$ 31,776,553
Stabilization	1,352,122	$ 27.46	CY	$ 37,125,461
Transport/Landfill Fee				
Load RR Car	1,460,291	$ 2.44	CY	$ 3,564,482
Transportation/Disposal >33 ppm - Texas	1,091,543	$ 119.20	tons	$ 130,111,189
Transportation/Beneficial Use (<10 ppm PCBs material)	952,862	$ 30.89	tons	$ 29,431,658
Transportation/Beneficial Use (10 to 33 ppm PCBs material)	532,977	$ 48.55	tons	$ 25,875,252
Sediment Sample & Analysis	2,577,386	$ 0.33	tons	$ 857,300
Water Treatment	1	$ 1,165,840	LS	$ 1,165,840
Backfilling	441,174	$ 55.00	CY	$ 24,262,928
Capping	207	$ 180,916.01	ACRES	$ 37,449,614
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 459,020,228
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 291,962,137
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 338,083,522**
Round To				**$ 338,000,000**

401018

Table 8-9

Areas of Sediments, Volumes of Sediments, and Mass of PCBs Remediated: REM-3/10/Select

River Section/Parameter	Target Criteria	Contaminant Removal	Channel Dredging	Total
River Section 1				
Area Remediated (Acres)	3 g/m^2	266	15	282
Volume Sediments Removed (CY)	3 g/m^2	1,495,300	66,100	1,561,400
PCB Mass Removed (kg)	3 g/m^2	11,600	200	11,800
River Section 2				
Area Remediated (Acres)	10 g/m^2	74	2	76
Volume Sediments Removed (CY)	10 g/m^2	564,700	15,400	580,100
PCB Mass Removed (kg)	10 g/m^2	23,600	700	24,300
River Section 3				
Area Remediated (Acres)	HS 36, 37, part of 39	92	43	135
Volume Sediments Removed (CY)	HS 36, 37, part of 39	392,900	117,300	510,200
PCB Mass Removed (kg)	HS 36, 37, part of 39	6,700	2,800	9,500
Total for alternative				
Area Remediated (Acres)		432	61	493
Volume Sediments Removed (CY)		2,452,900	198,800	2,651,700
PCB Mass Removed (kg)		41,900	3,700	45,600

Table 8-10a
Engineering Parameters: REM-3/10/Select
(Mechanical Removal)

Mechanical Removal	Sediment Volume Removed ($x10^3$ cy)	PCB >33ppm		1,113
		PCB< 33ppm		1,539
		PCB<10 ppm		928
		Total Volume		2,652
	Removal Operations	Number of Dredges		4
		Total Dredging Hours		48,600
Transportation	Transportation in River [1]	Barge Loads to SF/Day		4
		Barge Loads to NF/Day		8-9
	Transportation on Land [1]	Rail Cars From SF/Day		29
		Rail Cars From NF/Day		16
Reconstruction	Backfill Quantities	Quantities ($x10^3$ cy)	Sand	327
			Gravel	327
			Silty Material	197
			Total	851
	Shoreline Stabilization in ($x10^3$ LF)	< 2' - Hydroseeding		17
		2-2.5' - Vegetative Mattress		47
		> 3.0' - Veg. Mattress & Revetment		27
		Total		91
	Planting in Acres	Type A [2]		22
		Type B [2]		22
		Type C [2]		55
		Total		99

Notes:
1. SF and NF refer to southern and northern transfer facilities, respectively
2. Type A - Critical area/shallow rooted vegetation
   Type B- Critical area/emergent vegetation
   Type C- Shallow area planting

Table 8-10b
Engineering Parameters: REM-3/10/Select (Hydraulic Removal)

Removal Operations	**Sediment Volume Removed ($x10^3$ cy)**	PCB >33ppm		1,118
		PCB< 33ppm		1,534
		PCB< 10ppm		928
		Total Volume		2,652
	Mechanical Removal Operations	Number of Dredges		3
		Total Dredging Hours		14,400
	Hydraulic Removal Operations	Number of Dredges		1
		Total Dredging Hours		10,260
Transportation	**Transportation in River [1,3]**	Barge Loads to SF/Day (Year 1)		6
		Barge Loads to SF/Day (Years 2-5)		3
		Barge Loads to NF/Day		0
	Transportation on Land [1,3]	Rail Cars From SF/Day (Year 1)		43
		Rail Cars From SF/Day (Years 2-5)		26
		Rail Cars From NF/Day (Years 2-5)		16
Reconstruction	**Backfill Quantities**	Quantities ($x10^3$ cy)	Sand	327
			Gravel	327
			Silty Material	197
			Total	851
	Shoreline Stabilization in ($x10^3$ LF)	< 2' - Hydroseeding		17
		2-2.5' - Vegetative Mattress		47
		> 3.0' - Veg. Mattress & Revetment		27
		Total		91
	Planting in Acres	Type A [2]		22
		Type B [2]		22
		Type C [2]		55
		Total		99

Notes:
1. SF and NF refer to southern and northern transfer facilities, respectively
2. Type A - Critical area/shallow rooted vegetation
   Type B- Critical area/emergent vegetation
   Type C- Shallow area planting
3. It has been assumed that mechanical dredging equipment will be used in River Section 3 during the first construction season

Table 8-11a
Cost Analysis
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,651,730	$ 20.67	CY	$ 54,822,487
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	2,651,730	$ 21.49	CY	$ 56,987,426
Stabilization	2,651,730	$ 25.90	CY	$ 68,679,950
Transport/Landfill Fee				
Load RR Car	2,863,868	$ 2.44	CY	$ 6,990,528
Transportation/Disposal >33 ppm - Texas	1,682,659	$ 119.20	tons	$ 200,571,817
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	1,513,754	$ 55.16	tons	$ 83,493,373
Sediment Sample & Analysis	4,099,416	$ 0.41	tons	$ 1,681,305
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 658,379,928
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 426,322,045
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 461,856,907**
Round To				**$ 460,000,000**

401022

Table 8-11b
Cost Analysis - Beneficial Use of Non-TSCA Material
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,651,730	$ 20.67	CY	$ 54,822,487
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	2,041,015	$ 22.23	CY	$ 45,375,826
Stabilization	2,041,015	$ 26.38	CY	$ 53,851,681
Transport/Landfill Fee				
Load RR Car	2,204,296	$ 2.44	CY	$ 5,380,553
Transportation/Disposal >33 ppm - Texas	1,682,659	$ 119.20	tons	$ 200,571,817
Transportation/Beneficial Use (<10 ppm PCBs material)	1,403,355	$ 30.89	tons	$ 43,346,324
Transportation/Beneficial Use (10 to 33 ppm PCBs material)	855,001	$ 47.41	tons	$ 40,531,904
Sediment Sample & Analysis	3,941,016	$ 0.33	tons	$ 1,294,087
Water Treatment	1	$ 1,106,530	LS	$ 1,106,530
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 585,483,999
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 377,189,358
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 412,724,221**
Round To				**$ 413,000,000**

Table 8-11c
Cost Analysis - Hydraulic Dredging
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 36,112,752	LS	$ 36,112,752
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,651,730	$ 16.70	CY	$ 44,285,908
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	1,623,030	$ 27.26	CY	$ 44,249,277
Dewater Hydraulic Dredged Material	2,141,527	$ 15.15	CY	$ 32,437,386
Transportation to Transfer Facility and Stabilization	510,203	$ 70.42	CY	$ 35,928,810
Transport/Landfill Fee				
Load RR Car	2,692,546	$ 2.44	CY	$ 6,572,342
Transportation/Disposal >33 ppm - Texas	1,587,067	$ 119.20	tons	$ 189,177,315
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	1,369,493	$ 55.16	tons	$ 75,536,441
Sediment Sample & Analysis	3,769,561	$ 0.45	tons	$ 1,681,305
Water Treatment[1]	1	$ 2,359,116	LS	$ 2,359,116
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 637,297,868
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	EA	$ 1,128,465
Post Construction O&M - Annual				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 412,112,496
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 779,699
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 447,925,023**
Round To				**$ 448,000,000**

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Table 8-12
Areas of Sediments, Volumes of Sediments, and Mass of PCBs Remediated: REM-0/0/3

River Section/Parameter	Target Criteria	Contaminant Removal	Channel Dredging	Total
River Section 1				
Area Remediated (Acres)	Full section	470	-	470
Volume Sediments Removed (CY)	Full section	2,029,500	-	2,029,500
PCB Mass Removed (kg)	Full section	15,000	-	15,000
River Section 2				
Area Remediated (Acres)	Full section	316	-	316
Volume Sediments Removed (CY)	Full section	1,105,200	-	1,105,200
PCB Mass Removed (kg)	Full section	>35,000 (1)	-	>35,000 (1)
River Section 3				
Area Remediated (Acres)	3 g/m^2	134	43	177
Volume Sediments Removed (CY)	3 g/m^2	571,100	117,300	688,400
PCB Mass Removed (kg)	3 g/m^2	10,700	2,800	13,500
Total for alternative				
Area Remediated (Acres)		921	43	964
Volume Sediments Removed (CY)		3,705,800	117,300	3,823,100
PCB Mass Removed (kg)		>60,700	2,800	>63,500

NOTES:

1 This estimate combines the 1994 data for areas >3g/m^2 with the 1977 data for areas <3g/m^2. Because of the uncertainties associated with the 1977 data (*i.e.*, shallow coring depths and potential sediment inventory changes), one half of the mass estimated from the 1977 data (3.65 of 7.3 metric tons) was used as a part of the lower bound estimate given here.

Table 8-13a
Engineering Parameters: REM-0/0/3
(Mechanical Removal)

Mechanical Removal	Sediment Volume Removed ($x10^3$ cy)	PCB >33ppm		1,415
		PCB< 33ppm		2,408
		PCB< 10ppm		1501
		Total Volume		3,823
	Removal Operations	Number of Dredges		5
		Total Dredging Hours		73,080
Transportation	Transportation in River [1]	Barge Loads to SF/Day		4
		Barge Loads to NF/Day		8
	Transportation on Land [1]	Rail Cars From SF/Day		30
		Rail Cars From NF/Day		16
Reconstruction	Backfill Quantities	Quantities ($x10^3$ cy)	Sand	617
			Gravel	617
			Silty Material	245
			Total	1,479
	Shoreline Stabilization in ($x10^3$ LF)	< 2' - Hydroseeding		93
		2-2.5' - Vegetative Mattress		50
		> 3.0' - Veg. Mattress & Revetment		32
		Total		175
	Planting in Acres	Type A [2]		37
		Type B [2]		37
		Type C [2]		114
		Total		188

Notes:
1. SF and NF refer to southern and northern transfer facilities, respectively
2. Type A - Critical area/shallow rooted vegetation
   Type B- Critical area/emergent vegetation
   Type C- Shallow area planting

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Table 8-13b
Engineering Parameters: REM-0/0/3
(Hydraulic Removal)

Removal Operations	**Sediment Volume Removed ($x10^3$ cy)**	PCB >33ppm		1,415
		PCB< 33ppm		2,498
		PCB< 10ppm		1,591
		Total Volume		3,913
	Mechanical Removal Operations	Number of Dredges		3
		Total Dredging Hours		20,160
	Hydraulic Removal Operations	Number of Dredges		1
		Total Dredging Hours		17,100
Transportation	**Transportation in River [1,3]**	Barge Loads to SF/Day (Years 1-2)		4
		Barge Loads to SF/Day (Years 3-7)		4
		Barge Loads to NF/Day		0
	Transportation on Land [1,3]	Rail Cars From SF/Day (Years 1-2)		29
		Rail Cars From SF/Day (Years 3-7)		34
		Rail Cars From NF/Day (Years 3-7)		16
Reconstruction	**Backfill Quantities**	Quantities ($x10^3$ cy)	Sand	617
			Gravel	617
			Silty Material	245
			Total	1,479
	Shoreline Stabilization in ($x10^3$ LF)	< 2' - Hydroseeding		93
		2-2.5' - Vegetative Mattress		50
		> 3.0' - Veg. Mattress & Revetment		32
		Total		175
	Planting in Acres	Type A [2]		37
		Type B [2]		37
		Type C [2]		114
		Total		188

Notes:
1. SF and NF refer to southern and northern transfer facilities, respectively
2. Type A - Critical area/shallow rooted vegetation
   Type B- Critical area/emergent vegetation
   Type C- Shallow area planting
3. It has been assumed that Mechanical Equipment will be used in River Section 3 during the first two construction seasons

Table 8-14a
Cost Analysis
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,823,060	$ 22.76	CY	$ 87,021,936
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	3,823,060	$ 22.45	CY	$ 85,829,051
Stabilization	3,823,060	$ 25.85	CY	$ 98,838,282
Transport/Landfill Fee				
Load RR Car	4,128,905	$ 2.44	CY	$ 10,078,407
Transportation/Disposal >33 ppm - Texas	2,140,433	$ 119.20	tons	$ 255,138,169
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	2,506,034	$ 55.16	tons	$ 138,224,064
Sediment Sample & Analysis	5,780,467	$ 0.42	tons	$ 2,423,976
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 929,395,662
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 533,693,749
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 568,671,820**
Round To				**$ 570,000,000**

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Table 8-14b
Cost Analysis - Beneficial Use of Non-TSCA Material
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,823,060	$ 22.76	CY	$ 87,021,936
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	2,916,189	$ 23.41	CY	$ 68,267,376
Stabilization	2,916,189	$ 26.47	CY	$ 77,188,008
Transport/Landfill Fee				
Load RR Car	3,149,484	$ 2.44	CY	$ 7,687,700
Transportation/Disposal >33 ppm - Texas	2,140,433	$ 119.20	tons	$ 255,138,169
Transportation/Beneficial Use (<10 ppm PCBs material)	2,268,845	$ 25.86	tons	$ 58,666,358
Transportation/Beneficial Use (10 to 33 ppm PCBs material)	1,269,619	$ 47.41	tons	$ 60,187,063
Sediment Sample & Analysis	5,678,897	$ 0.43	tons	$ 2,423,976
Water Treatment	1	$ 1,548,535	LS	$ 1,548,535
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 805,872,821
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 460,696,989
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 495,675,060**
Round To				**$ 496,000,000**

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Table 8-14c
Cost Analysis - Hydraulic Dredging
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 36,112,752	LS	$ 36,112,752
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,913,060	$ 17.01	CY	$ 66,571,820
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	2,472,880	$ 26.41	CY	$ 65,312,999
Dewater Hydraulic Dredged Material	3,224,706	$ 15.15	CY	$ 48,844,134
Transportation to Transfer Facility and Stabilization	688,354	$ 76.47	CY	$ 52,641,451
Transport/Landfill Fee				
Load RR Car	3,968,128	$ 2.44	CY	$ 9,685,821
Transportation/Disposal >33 ppm - Texas	2,065,463	$ 119.20	tons	$ 246,201,795
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	2,355,915	$ 55.16	tons	$ 129,944,026
Sediment Sample & Analysis	5,555,378	$ 0.45	tons	$ 2,481,039
Water Treatment	1	$ 3,056,877	LS	$ 3,056,877
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,476	LS	$ 1,472,476
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 896,055,967
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 513,991,403
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,706,826
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				$ **549,510,375**
Round To				$ **550,000,000**

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HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

LIST OF TABLES
CHAPTER 9

Table 9-1
Comparison of Costs

Base Case Alternatives - Mechanical Removal and Landfill Disposal

Alternative	Total Capital Costs	Present Worth of Capital Costs	Total O&M Costs	Average Annual O&M Costs	Present Worth of O&M Costs	Total Project Costs	Present Worth of Project Costs	Present Worth of Project Costs - Rounded
No Action	$ -	$ -	$ 461,136	$ 15,371	$ 139,555	$ 461,136	$ 139,555	$ 140,000
Monitored Natural Attenuation	$ 507,500	$ 416,648	$ 108,390,470	$ 3,613,016	$ 38,239,077	$ 108,897,970	$ 38,655,726	$ 39,000,000
Alternative CAP-3/10/Select	$ 504,126,401	$ 344,414,122	$ 86,152,463	$ 3,446,099	$ 24,071,475	$ 590,278,864	$ 368,485,596	$ 370,000,000
Alternative REM-3/10/Select	$ 658,379,928	$ 448,386,006	$ 32,012,299	$ 3,201,230	$ 13,470,902	$ 690,392,227	$ 461,856,907	$ 460,000,000
Alternative REM-0/0/3	$ 929,395,662	$ 556,135,092	$ 33,504,580	$ 3,350,458	$ 12,536,728	$ 962,900,242	$ 568,671,820	$ 570,000,000

Beneficial Use Alternatives

Alternative	Total Capital Costs - Beneficial Use	Present Worth of Capital Costs - Beneficial Use	Total O&M Costs - Beneficial Use	Average Annual O&M Costs - Beneficial Use	Present Worth of O&M Costs - Beneficial Use	Total Project Costs - Beneficial Use	Present Worth of Project Costs - Beneficial Use	Present Worth of Project Costs - Beneficial Use - Rounded
No Action	NA	NA	NA	NA	NA	NA	NA	NA
Monitored Natural Attenuation	NA	NA	NA	NA	NA	NA	NA	NA
Alternative CAP-3/10/Select	$ 459,020,228	$ 314,012,047	$ 86,152,463	$ 3,446,099	$ 24,071,475	$ 545,172,691	$ 338,083,522	$ 338,000,000
Alternative REM-3/10/Select	$ 585,483,999	$ 399,253,319	$ 32,012,299	$ 3,201,230	$ 13,470,902	$ 617,496,298	$ 412,724,221	$ 413,000,000
Alternative REM-0/0/3	$ 805,872,821	$ 483,138,331	$ 33,504,580	$ 3,350,458	$ 12,536,728	$ 839,377,401	$ 495,675,060	$ 496,000,000

Hydraulic Removal and Landfill Disposal Alternatives

Alternative	Total Capital Costs - Hydraulic Removal	Present Worth of Capital Costs - Hydraulic Removal	Total O&M Costs - Hydraulic Removal	Average Annual O&M Costs - Hydraulic Removal	Present Worth of O&M Costs - Hydraulic Removal	Total Project Costs - Hydraulic Removal	Present Worth of Project Costs - Hydraulic Removal	Present Worth of Project Costs - Hydraulic Removal - Rounded
No Action	NA	NA	NA	NA	NA	NA	NA	NA
Monitored Natural Attenuation	NA	NA	NA	NA	NA	NA	NA	NA
Alternative CAP-3/10/Select	NA	NA	NA	NA	NA	NA	NA	NA
Alternative REM-3/10/Select	$ 637,297,868	$ 434,176,457	$ 32,012,299	$ 3,201,230	$ 13,748,566	$ 669,310,167	$ 447,925,023	$ 448,000,000
Alternative REM-0/0/3	$ 896,055,967	$ 536,432,746	$ 33,504,580	$ 3,350,458	$ 13,077,629	$ 929,560,547	$ 549,510,375	$ 550,000,000

Table 9-2
Non-TSCA Safety Margin Sensitivity Analysis: Disposal Quantities

CAP-3/10/Select

	Original	+50 ppm criteria
Volume Removed (cy)	1,732,820	1,732,820
Disposal <50 ppm PCBs (tons)	1,528,476	1,712,033
Disposal >50 ppm PCBs (tons)	1,091,549	907,992
Total Disposal (tons)	2,620,024	2,620,024

REM-3/10/Select

	Original	+50 ppm criteria
Volume Removed (cy)	2,651,727	2,651,727
Disposal <50 ppm PCBs (tons)	2,326,748	2,620,696
Disposal >50 ppm PCBs (tons)	1,682,664	1,388,716
Total Disposal (tons)	4,009,412	4,009,412

REM-0/0/3

	Original	+50 ppm criteria
Volume Removed (cy)	3,823,059	3,823,059
Disposal <50 ppm PCBs (tons)	3,601,447	3,970,236
Disposal >50 ppm PCBs (tons)	2,179,019	1,810,229
Total Disposal (tons)	5,780,466	5,780,466

Table 9-3a
Non-TSCA Safety Margin Sensitivity Analysis: Cost Analysis
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,732,820	$ 28.21	CY	$ 48,875,485
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,732,820	$ 22.37	CY	$ 38,761,904
Stabilization	1,732,820	$ 26.76	CY	$ 46,370,678
Transport/Landfill Fee				
Load RR Car	1,871,446	$ 2.44	CY	$ 4,568,086
Transportation/Disposal >50 ppm - Texas	907,992	$ 119.20	tons	$ 108,232,068
Transportation/Disposal <50 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <50 ppm - Southeast	899,030	$ 55.16	tons	$ 49,587,323
Sediment Sample & Analysis	2,620,024	$ 0.42	tons	$ 1,098,678
Water Treatment	1	$ 1,166,701	LS	$ 1,166,701
Backfilling	441,174	$ 55.00	CY	$ 24,262,928
Capping	207	$ 174,302.80	ACRES	$ 36,080,679
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 492,371,341
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 314,441,167
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 360,562,552**
Round To				**$ 361,000,000**

Table 9-3b
Non-TSCA Safety Margin Sensitivity Analysis: Cost Analysis
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,651,730	$ 20.67	CY	$ 54,822,487
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	2,651,730	$ 21.49	CY	$ 56,987,426
Stabilization	2,651,730	$ 25.90	CY	$ 68,679,950
Transport/Landfill Fee				
Load RR Car	2,863,868	$ 2.44	CY	$ 6,990,529
Transportation/Disposal >50 ppm - Texas	1,388,716	$ 119.20	tons	$ 165,534,016
Transportation/Disposal <50 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <50 ppm - Southeast	1,807,698	$ 55.16	tons	$ 99,706,279
Sediment Sample & Analysis	4,009,416	$ 0.41	tons	$ 1,644,393
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 639,518,122
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 413,608,973
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 449,143,835**
Round To				**$ 449,000,000**

Table 9-3c
Non-TSCA Safety Margin Sensitivity Analysis: Cost Analysis
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,823,060	$ 22.76	CY	$ 87,021,936
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	3,823,060	$ 22.45	CY	$ 85,829,051
Stabilization	3,823,060	$ 25.85	CY	$ 98,838,282
Transport/Landfill Fee				
Load RR Car	4,128,905	$ 2.44	CY	$ 10,078,407
Transportation/Disposal >50 ppm - Texas	1,810,230	$ 119.20	tons	$ 215,778,183
Transportation/Disposal <50 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <50 ppm - Southeast	2,836,237	$ 55.16	tons	$ 156,436,896
Sediment Sample & Analysis	5,780,467	$ 0.42	tons	$ 2,423,976
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 908,248,507
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 521,196,677
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 556,174,748**
Round To				**$ 556,000,000**

Table 9-4
Remediation Boundary Adjustment Sensitivity Analysis: Quantities

CAP-3/10/Select

	Original	+50 feet	-50 feet
Volume Removed (cy)	1,732,820	1,970,785	1,175,131
Disposal <50 ppm PCBs (tons)	1,528,476	1,738,384	1,036,556
Disposal >50 ppm PCBs (tons)	1,091,549	1,241,443	740,242
Total Disposal (tons)	2,620,024	2,979,827	1,776,798

REM-3/10/Select

	Original	+50 feet	-50 feet
Volume Removed (cy)	2,651,727	2,953,187	2,077,169
Disposal <50 ppm PCBs (tons)	2,326,748	2,632,411	1,851,546
Disposal >50 ppm PCBs (tons)	1,682,664	1,832,808	1,289,133
Total Disposal (tons)	4,009,412	4,465,219	3,140,680

REM-0/0/3

	Original	+50 feet	-50 feet
Volume Removed (cy)	3,823,059	3,879,909	3,592,456
Disposal <50 ppm PCBs (tons)	3,601,447	3,694,161	3,420,470
Disposal >50 ppm PCBs (tons)	2,179,019	2,172,261	2,011,324
Total Disposal (tons)	5,780,466	5,866,422	5,431,793

Table 9-5a
Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Plus 50 Feet): Cost Analysis
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,970,785	$ 28.21	CY	$ 55,587,466
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,970,785	$ 22.37	CY	$ 44,085,005
Stabilization	1,970,785	$ 26.76	CY	$ 52,738,678
Transport/Landfill Fee				
Load RR Car	2,128,448	$ 2.44	CY	$ 5,195,413
Transportation/Disposal >33 ppm - Texas	1,241,443	$ 119.20	tons	$ 147,979,111
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	925,382	$ 55.16	tons	$ 51,040,854
Sediment Sample & Analysis	2,979,827	$ 0.42	tons	$ 1,249,557
Water Treatment	1	$ 1,166,701	LS	$ 1,166,701
Backfilling	501,760	$ 55.00	CY	$ 27,594,912
Capping	219	$ 174,302.80	ACRES	$ 38,172,313
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 558,176,821
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 358,794,810
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 404,916,195**
Round To				**$ 405,000,000**

Table 9-5b
Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Minus 50 Feet): Cost Analysis
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				-
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,175,131	$ 28.21	CY	$ 33,145,449
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,175,131	$ 22.37	CY	$ 26,286,813
Stabilization	1,175,131	$ 26.76	CY	$ 31,446,787
Transport/Landfill Fee				
Load RR Car	1,269,141	$ 2.44	CY	$ 3,097,898
Transportation/Disposal >33 ppm - Texas	740,242	$ 119.20	tons	$ 88,236,333
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	223,554	$ 55.16	tons	$ 12,330,467
Sediment Sample & Analysis	1,776,798	$ 0.42	tons	$ 745,081
Water Treatment	1	$ 1,166,701	LS	$ 1,166,701
Backfilling	299,187	$ 55.00	CY	$ 16,454,172
Capping	179	$ 174,302.80	ACRES	$ 31,200,201
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 377,476,712
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 237,000,878
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 283,122,263**
Round To				**$ 283,000,000**

Table 9-5c
Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Plus 50 Feet): Cost Analysis
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,953,187	$ 20.67	CY	$ 61,054,880
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	2,953,187	$ 21.49	CY	$ 63,465,936
Stabilization	2,953,187	$ 25.90	CY	$ 76,487,703
Transport/Landfill Fee				
Load RR Car	3,189,442	$ 2.44	CY	$ 7,785,234
Transportation/Disposal >33 ppm - Texas	1,832,808	$ 119.20	tons	$ 218,469,420
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	1,819,409	$ 55.16	tons	$ 100,352,245
Sediment Sample & Analysis	4,465,219	$ 0.41	tons	$ 1,831,333
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	948,450	$ 57.24	CY	$ 54,292,394
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 720,141,880
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 467,950,304
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 503,485,167**
Round To				**$ 503,000,000**

TAMS

Table 9-5d
Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Minus 50 Feet): Cost Analysis
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	2,077,169	$ 20.67	CY	$ 42,943,878
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	2,077,169	$ 21.49	CY	$ 44,639,731
Stabilization	2,077,169	$ 25.90	CY	$ 53,798,789
Transport/Landfill Fee				
Load RR Car	2,243,343	$ 2.44	CY	$ 5,475,863
Transportation/Disposal >33 ppm - Texas	1,289,133	$ 119.20	tons	$ 153,663,790
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	1,038,544	$ 55.16	tons	$ 57,282,479
Sediment Sample & Analysis	3,140,680	$ 0.41	tons	$ 1,288,096
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	667,107	$ 57.24	CY	$ 38,187,381
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 533,682,743
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 342,274,722
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 377,809,584**
Round To				**$ 378,000,000**

Table 9-5e
Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Plus 50 Feet): Cost Analysis
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				-
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,879,909	$ 22.76	CY	$ 88,315,954
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	3,879,909	$ 22.45	CY	$ 87,105,331
Stabilization	3,879,909	$ 25.85	CY	$ 100,308,010
Transport/Landfill Fee				
Load RR Car	4,190,302	$ 2.44	CY	$ 10,228,273
Transportation/Disposal >33 ppm - Texas	2,172,261	$ 119.20	tons	$ 258,932,068
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	2,560,161	$ 55.16	tons	$ 141,209,532
Sediment Sample & Analysis	5,866,422	$ 0.42	tons	$ 2,460,020
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,500,828	$ 51.47	CY	$ 77,250,658
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 941,532,853
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 540,866,315
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 575,844,385**
Round To				**$ 576,000,000**

Table 9-5f

Remediation Boundary Adjustment Sensitivity Analysis (MPA Target Area Minus 50 Feet): Cost Analysis Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	3,592,456	$ 22.76	CY	$ 81,772,841
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	3,592,456	$ 22.45	CY	$ 80,651,910
Stabilization	3,592,456	$ 25.85	CY	$ 92,876,434
Transport/Landfill Fee				
Load RR Car	3,879,852	$ 2.44	CY	$ 9,470,485
Transportation/Disposal >33 ppm - Texas	2,011,324	$ 119.20	tons	$ 239,748,422
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	2,286,470	$ 55.16	tons	$ 126,113,672
Sediment Sample & Analysis	5,431,793	$ 0.42	tons	$ 2,277,764
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,389,636	$ 51.47	CY	$ 71,527,345
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 880,161,879
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 504,598,671
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 539,576,742**
Round To				**$ 540,000,000**

Table 9-6
Cap Thickness Reduction Sensitivity Analysis: Quantities

CAP-3/10/Select

	Original	6" Cap Thickness
Capping Area (acres)	207	207
Removal Volume (cy)	1,732,820	1,625,820
Disposal <50 ppm PCBs (tons)	1,528,476	1,434,099
Disposal >50 ppm PCBs (tons)	1,091,549	1,024,141
Total Disposal (tons)	2,620,024	2,458,240

Table 9-7
Cap Thickness Reduction Sensitivity Analysis: Cost Analysis
Alternative CAP-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				-
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,841,805	LS	$ 14,841,805
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,782,821	LS	$ 3,782,821
Site Prep and Facility Construction - North	1	$ 16,870,755	LS	$ 16,870,755
Site Prep and Facility Construction - South	1	$ 8,020,003	LS	$ 8,020,003
Dredging	1,625,820	$ 28.21	CY	$ 45,857,470
Testing and Monitoring (during remediation)	1	$ 11,594,641	LS	$ 11,594,641
Barging	1,625,820	$ 22.37	CY	$ 36,368,393
Stabilization	1,625,820	$ 26.76	CY	$ 43,507,332
Transport/Landfill Fee				
Load RR Car	1,755,886	$ 2.44	CY	$ 4,286,011
Transportation/Disposal >33 ppm - Texas	1,024,141	$ 119.20	tons	$ 122,076,946
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	621,097	$ 55.16	tons	$ 34,257,514
Sediment Sample & Analysis	2,458,240	$ 0.42	tons	$ 1,030,836
Water Treatment	1	$ 1,166,701	LS	$ 1,166,701
Backfilling	441,174	$ 55.00	CY	$ 24,262,928
Capping	207	$ 87,151.40	ACRES	$ 18,040,340
Habitat & Vegetation Replacement	1	$ 3,668,899	LS	$ 3,668,899
River Bank Stabilization	1	$ 337,591	LS	$ 337,591
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 464,221,281
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring	6	$ 662,588	Event	$ 3,975,528
Geophysical Survey (includes Multibeam Survey & Bathymetry)	6	$ 360,130	Event	$ 2,160,780
Post Construction O&M - Annual (for 25 years after construction is complete)				
Cap O&M (Visual Inspection)	25	$ 34,193	Year	$ 854,825
Water Monitoring	25	$ 1,907,912	Year	$ 47,697,800
Fish Monitoring	25	$ 893,378	Year	$ 22,334,450
Annual Reporting	25	$ 45,045	Year	$ 1,126,125
Post Construction - Every 5 Years (for 25 years after construction is complete)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)	5	$ 1,384,231	Event	$ 6,921,155
Modeling	5	$ 139,504	Event	$ 697,520
Five-Year Review	5	$ 76,856	Event	$ 384,280
Total O&M Costs				$ 86,152,463
Annual O&M (for 25 years over O&M period of 2009 through 2033)				$ 3,446,099
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,012,951
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 295,467,706
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017, 2022, 2027, 2032				
Sediment Monitoring				$ 1,233,363
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 670,358
Post Construction O&M - Annual (Years 2009 to 2033)				
Cap O&M (Visual Inspection)				$ 239,868
Water Monitoring				$ 13,384,257
Fish Monitoring				$ 6,267,166
Annual Reporting				$ 315,997
Post Construction - Every 5 Years (Years 2009 to 2033)				
Cap O&M (Cap Repair and Side Scan Sonar Survey)				$ 1,695,461
Modeling				$ 170,870
Five-Year Review				$ 94,136
Total Present Worth Costs for Alternative				**$ 341,589,091**
Round To				**$ 342,000,000**

Table 9-8
Depth of Removal Adjustment Sensitivity Analysis: Quantities

REM-3/10/Select

	Original	+1 foot	-1 foot
Volume Removed (cy)	2,651,727	3,348,690	1,954,770
Disposal <50 ppm PCBs (tons)	2,326,748	2,984,955	1,742,442
Disposal >50 ppm PCBs (tons)	1,682,664	2,078,265	1,213,170
Total Disposal (tons)	4,009,412	5,063,219	2,955,612

REM-0/0/3

	Original	+1 foot	-1 foot
Volume Removed (cy)	3,823,059	5,308,940	2,337,180
Disposal <50 ppm PCBs (tons)	3,601,447	5,054,778	2,225,289
Disposal >50 ppm PCBs (tons)	2,179,019	2,972,339	1,308,527
Total Disposal (tons)	5,780,466	8,027,117	3,533,816

Table 9-9a

Depth of Removal Adjustment Sensitivity Analysis (Original Depth of Removal Plus 1 Foot): Cost Analysis Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	3,348,690	$ 20.67	CY	$ 69,231,601
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	3,348,690	$ 21.49	CY	$ 71,965,556
Stabilization	3,348,690	$ 25.90	CY	$ 86,731,252
Transport/Landfill Fee				
Load RR Car	3,616,585	$ 2.44	CY	$ 8,827,865
Transportation/Disposal >33 ppm - Texas	2,078,265	$ 119.20	tons	$ 247,727,747
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	2,171,953	$ 55.16	tons	$ 119,797,304
Sediment Sample & Analysis	5,063,219	$ 0.41	tons	$ 2,076,592
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 791,510,960
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 516,053,877
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 551,588,739**
Round To				**$ 552,000,000**

Table 9-9b
Depth of Removal Adjustment Sensitivity Analysis (Original Depth of Removal Minus 1 Foot): Cost Analysis
Alternative REM-3/10/Select

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 14,857,830	LS	$ 14,857,830
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 3,350,454	LS	$ 3,350,454
Construction Management	1	$ 9,321,669	LS	$ 9,321,669
Mobilization/Demobilization	1	$ 3,788,167	LS	$ 3,788,167
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 9,234,334	LS	$ 9,234,334
Dredging	1,954,770	$ 20.67	CY	$ 40,413,373
Testing and Monitoring (during remediation)	1	$ 13,191,268	LS	$ 13,191,268
Barging	1,954,770	$ 21.49	CY	$ 42,009,296
Stabilization	1,954,770	$ 25.90	CY	$ 50,628,648
Transport/Landfill Fee				
Load RR Car	2,111,152	$ 2.44	CY	$ 5,153,193
Transportation/Disposal >33 ppm - Texas	1,213,170	$ 119.20	tons	$ 144,609,017
Transportation/Disposal <33 ppm - Northeast	813,002	$ 55.16	tons	$ 44,842,345
Transportation/Disposal <33 ppm - Southeast	929,440	$ 55.16	tons	$ 51,264,684
Sediment Sample & Analysis	2,955,612	$ 0.41	tons	$ 1,212,194
Water Treatment	1	$ 1,107,907	LS	$ 1,107,907
Backfilling	851,634	$ 57.24	CY	$ 48,750,306
Habitat & Vegetation Replacement	1	$ 3,734,322	LS	$ 3,734,322
River Bank Stabilization	1	$ 1,150,693	LS	$ 1,150,693
Construction Monitoring	1	$ 5,364,654	LS	$ 5,364,654
Total Capital Costs				$ 520,443,447
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring	3	$ 662,588	Event	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 376,155	Event	$ 1,128,465
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	Event	$ 279,008
Five-Year Review	2	$ 76,856	Event	$ 153,712
Total O&M Costs				$ 32,012,299
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,201,230
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,027,002
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2008)				$ 333,351,285
Post Construction Sediment Monitoring - Conducted in Years 2009, 2012, 2017				
Sediment Monitoring				$ 884,323
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 502,035
Post Construction O&M - Annual (Years 2009 to 2018)				
Water Monitoring				$ 7,994,229
Fish Monitoring				$ 3,743,290
Annual Reporting				$ 188,740
Post Construction - Every 5 Years (Years 2009 to 2018)				
Modeling				$ 102,058
Five-Year Review				$ 56,226
Total Present Worth Costs for Alternative				**$ 368,886,147**
Round To				**$ 369,000,000**

Table 9-9c
Depth of Removal Adjustment Sensitivity Analysis (Original Depth of Removal Plus 1 Foot): Cost Analysis
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	5,308,940	$ 22.76	CY	$ 120,844,098
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	5,308,940	$ 22.45	CY	$ 119,187,583
Stabilization	5,308,940	$ 25.85	CY	$ 137,253,014
Transport/Landfill Fee				
Load RR Car	5,733,655	$ 2.44	CY	$ 13,995,505
Transportation/Disposal >33 ppm - Texas	2,972,339	$ 119.20	tons	$ 354,300,787
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	3,920,778	$ 55.16	tons	$ 216,256,414
Sediment Sample & Analysis	8,027,117	$ 0.42	tons	$ 3,366,084
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 1,217,045,263
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 703,682,465
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 738,660,536**
Round To				**$ 739,000,000**

Table 9-9d
Depth of Removal Adjustment Sensitivity Analysis (Original Depth of Removal Minus 1 Foot): Cost Analysis
Alternative REM-0/0/3

Cost Item	Quantity	Unit Cost	Unit	Cost
Capital Costs				
Pre-Construction Studies and Design				
Design Support Testing	1	$ 15,288,250	LS	$ 15,288,250
Design (includes Treatability Study and Model Development)	1	$ 11,007,500	LS	$ 11,007,500
Construction				
Contractor Work Plans	1	$ 363,674	LS	$ 363,674
Health & Safety	1	$ 4,682,861	LS	$ 4,682,861
Construction Management	1	$ 13,024,085	LS	$ 13,024,085
Mobilization/Demobilization	1	$ 5,512,389	LS	$ 5,512,389
Site Prep and Facility Construction - North	1	$ 15,087,919	LS	$ 15,087,919
Site Prep and Facility Construction - South	1	$ 11,466,128	LS	$ 11,466,128
Dredging	2,337,180	$ 22.76	CY	$ 53,199,774
Testing and Monitoring (during remediation)	1	$ 20,172,039	LS	$ 20,172,039
Barging	2,337,180	$ 22.45	CY	$ 52,470,519
Stabilization	2,337,180	$ 25.85	CY	$ 60,423,550
Transport/Landfill Fee				
Load RR Car	2,524,154	$ 2.44	CY	$ 6,161,308
Transportation/Disposal >33 ppm - Texas	1,308,527	$ 119.20	tons	$ 155,975,527
Transportation/Disposal <33 ppm - Northeast	1,134,000	$ 55.16	tons	$ 62,547,471
Transportation/Disposal <33 ppm - Southeast	1,091,289	$ 55.16	tons	$ 60,191,694
Sediment Sample & Analysis	3,533,816	$ 0.42	tons	$ 1,481,867
Water Treatment	1	$ 1,550,606	LS	$ 1,550,606
Backfilling	1,478,838	$ 51.47	CY	$ 76,118,770
Habitat & Vegetation Replacement	1	$ 7,255,607	LS	$ 7,255,607
River Bank Stabilization	1	$ 1,472,475	LS	$ 1,472,475
Construction Monitoring	1	$ 6,292,003	LS	$ 6,292,003
Total Capital Costs				$ 641,746,016
O&M Costs				
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring	3	$ 662,588	EA	$ 1,987,764
Geophysical Survey (includes Multibeam Survey & Bathymetry)	3	$ 873,582	EA	$ 2,620,746
Post Construction O&M - Annual (for 10 years after construction is complete)				
Water Monitoring	10	$ 1,907,912	Year	$ 19,079,120
Fish Monitoring	10	$ 893,378	Year	$ 8,933,780
Annual Reporting	10	$ 45,045	Year	$ 450,450
Post Construction - Every 5 Years (for 10 years after construction is complete)				
Modeling	2	$ 139,504	EA	$ 279,008
Five-Year Review	2	$ 76,856	EA	$ 153,712
Total O&M Costs				$ 33,504,580
Annual O&M (for 10 years over O&M period of 2009 through 2018)				$ 3,350,458
Present Worth of Costs				
Pre-Construction Studies and Design				
Design Support Testing (Year 2002)				$ 13,404,384
Design (includes Treatability Study and Model Development) (Year 2003)				$ 9,036,959
Construction (Years 2004 to 2010)				$ 363,705,007
Post Construction Sediment Monitoring - Conducted in Years 2011, 2014, 2019				
Sediment Monitoring				$ 775,354
Geophysical Survey (includes Multibeam Survey & Bathymetry)				$ 1,165,926
Post Construction O&M - Annual (Years 2011 to 2020)				
Water Monitoring				$ 7,009,155
Fish Monitoring				$ 3,282,030
Annual Reporting				$ 165,483
Post Construction - Every 5 Years (Years 2011 to 2020)				
Modeling				$ 89,482
Five-Year Review				$ 49,298
Total Present Worth Costs for Alternative				**$ 398,683,078**
Round To				**$ 399,000,000**

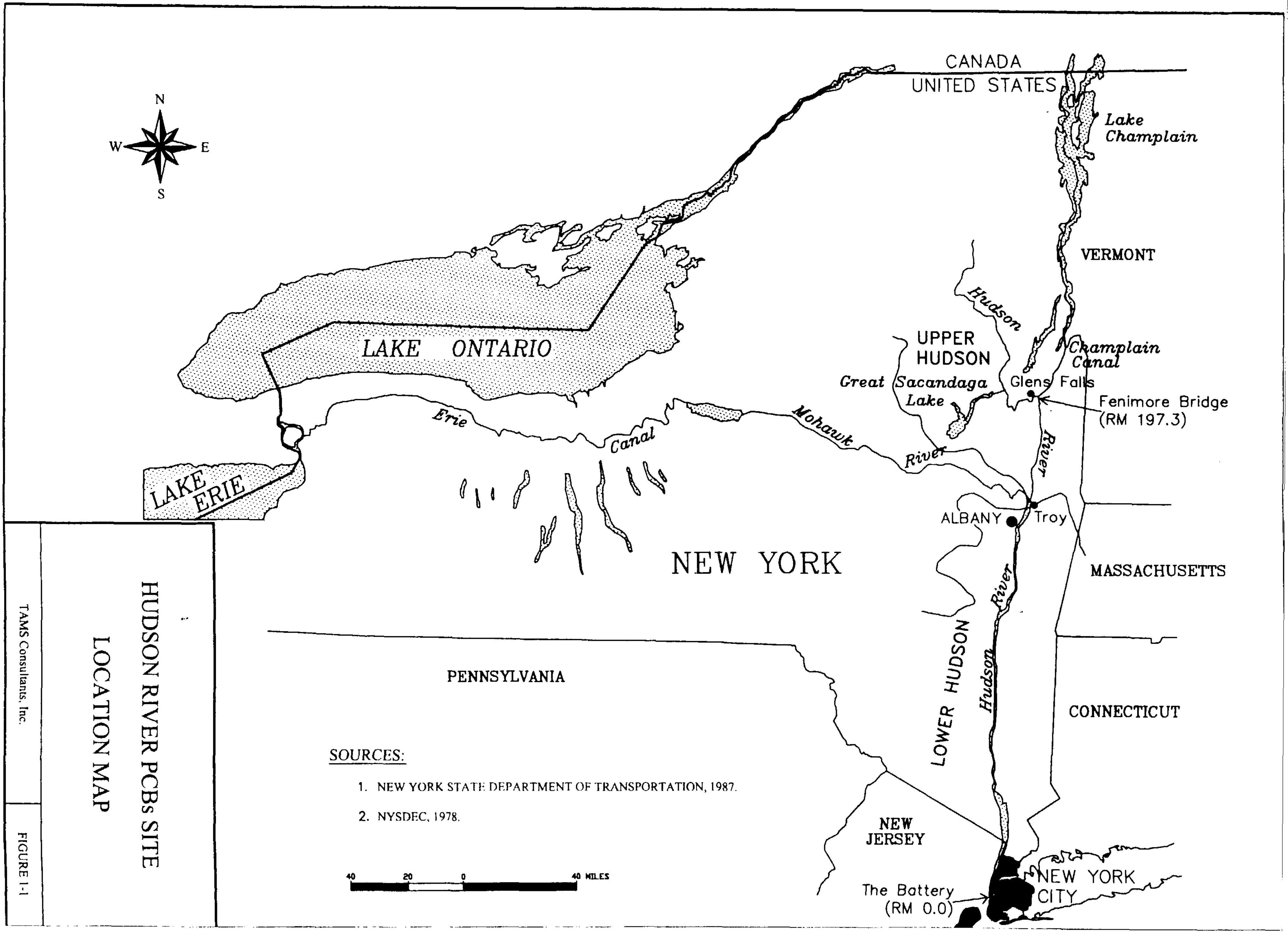
Table 9-10
Summary of Cost Sensitivity Analyses

Alternative	Present Worth of Total Costs - Rounded	Original Depth of Removal Plus 1 Foot	Original Depth of Removal Minus 1 Foot	MPA Target Area Plus 50 Feet	MPA Target Area Minus 50 Feet	TSCA Disposal Criteria at 50 ppm instead of 33 ppm	Cap Thickness of 6 Inches Instead of 1 Foot
No Action	$ 140,000	NA	NA	NA	NA	NA	NA
Monitored Natural Attenuation	$ 39,000,000	NA	NA	NA	NA	NA	NA
Alternative CAP-3/10/Select	$ 370,000,000	NA	NA	$ 405,000,000	$ 283,000,000	$ 361,000,000	$ 342,000,000
Alternative REM-3/10/Select	$ 460,000,000	$ 552,000,000	$ 369,000,000	$ 503,000,000	$ 378,000,000	$ 449,000,000	NA
Alternative REM-0/0/3	$ 570,000,000	$ 739,000,000	$ 399,000,000	$ 576,000,000	$ 540,000,000	$ 556,000,000	NA

401052

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

LIST OF FIGURES
CHAPTER 1



HUDSON RIVER PCBs SITE
LOCATION MAP

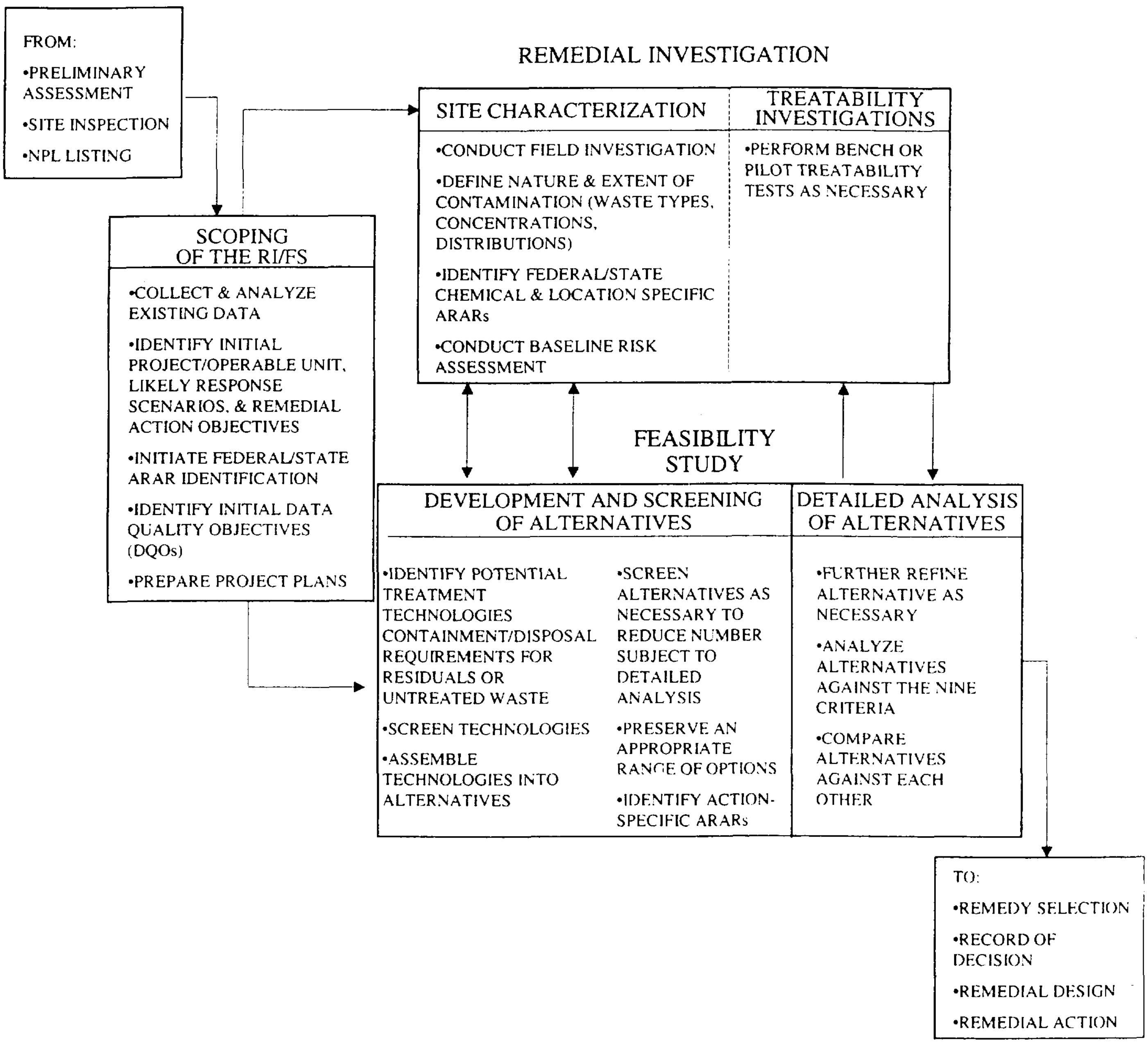
TAMS Consultants, Inc.

FIGURE 1-1

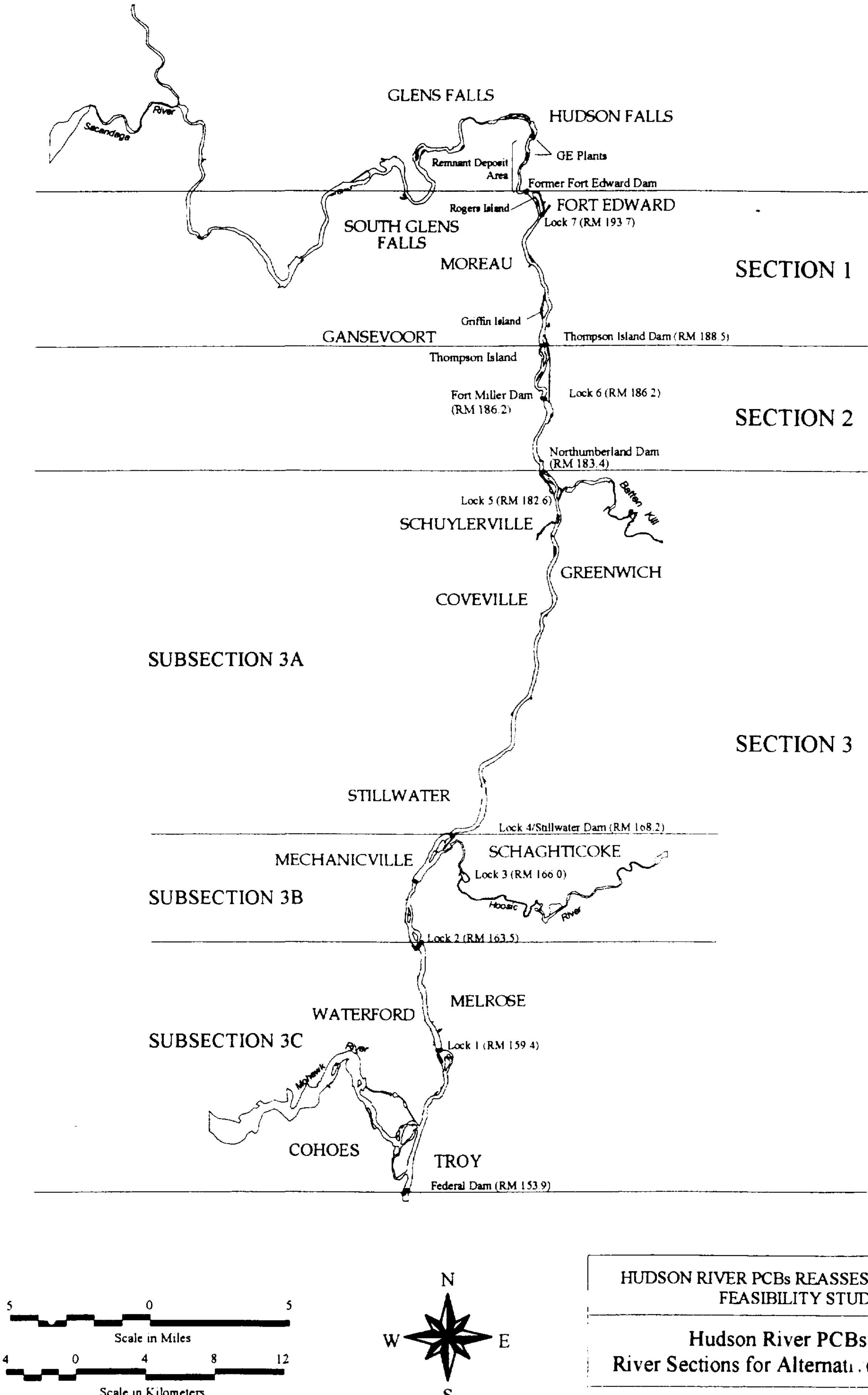
401054

FIGURE 1-2

PHASED RI/FS PROCESS



From: Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. USEPA, 1988.



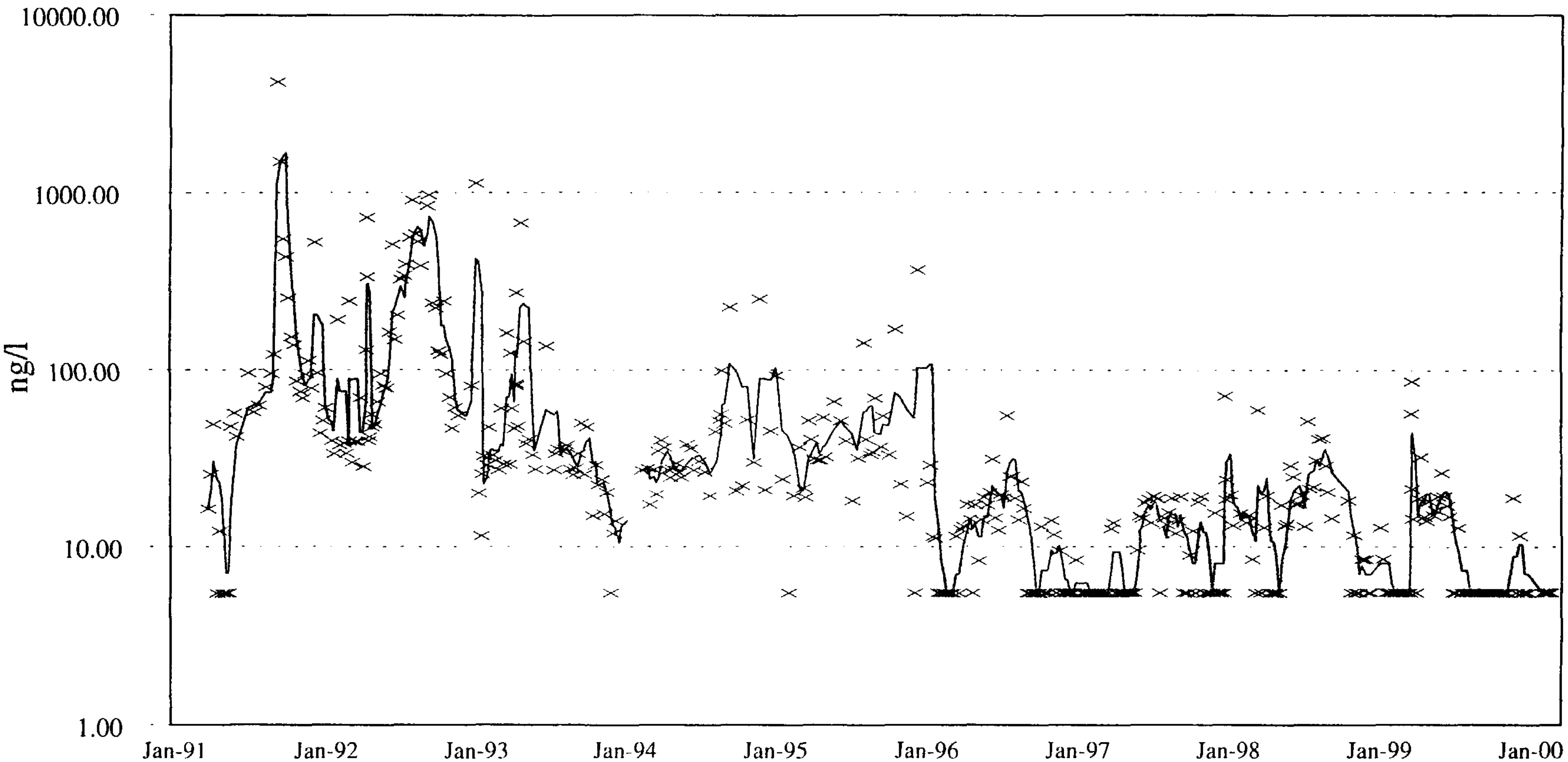
HUDSON RIVER PCBs REASSESSEMENT RI/FS
FEASIBILITY STUDY

Hudson River PCBs Site
River Sections for Alternatives Evaluation

TAMS CONSULTANTS, Inc. | Figure 1-3

401056

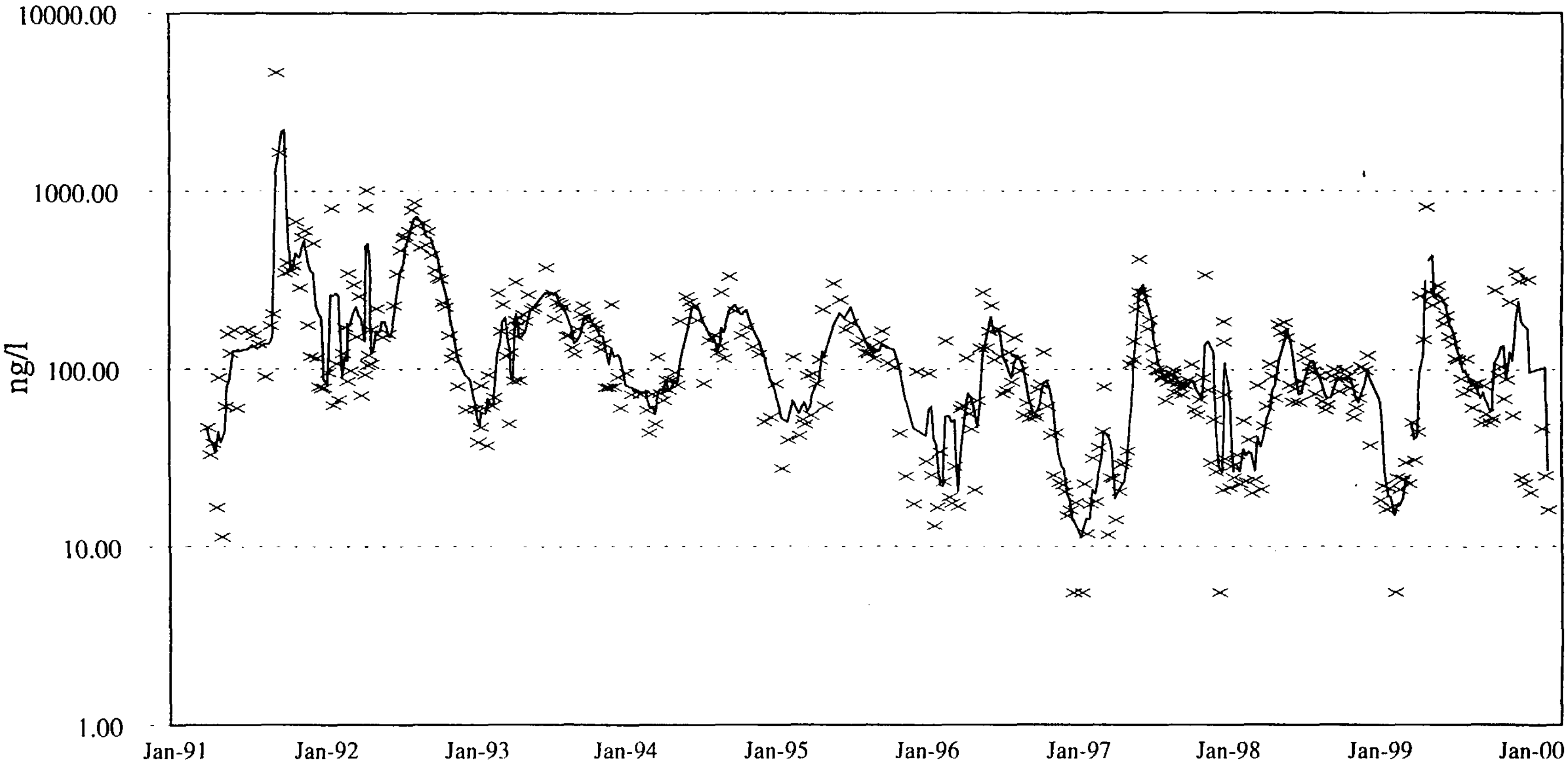
Figure 1-4. Total PCB Concentrations at Rogers Island, Observations and Moving Average



Source: GE Database Release 000403

401057

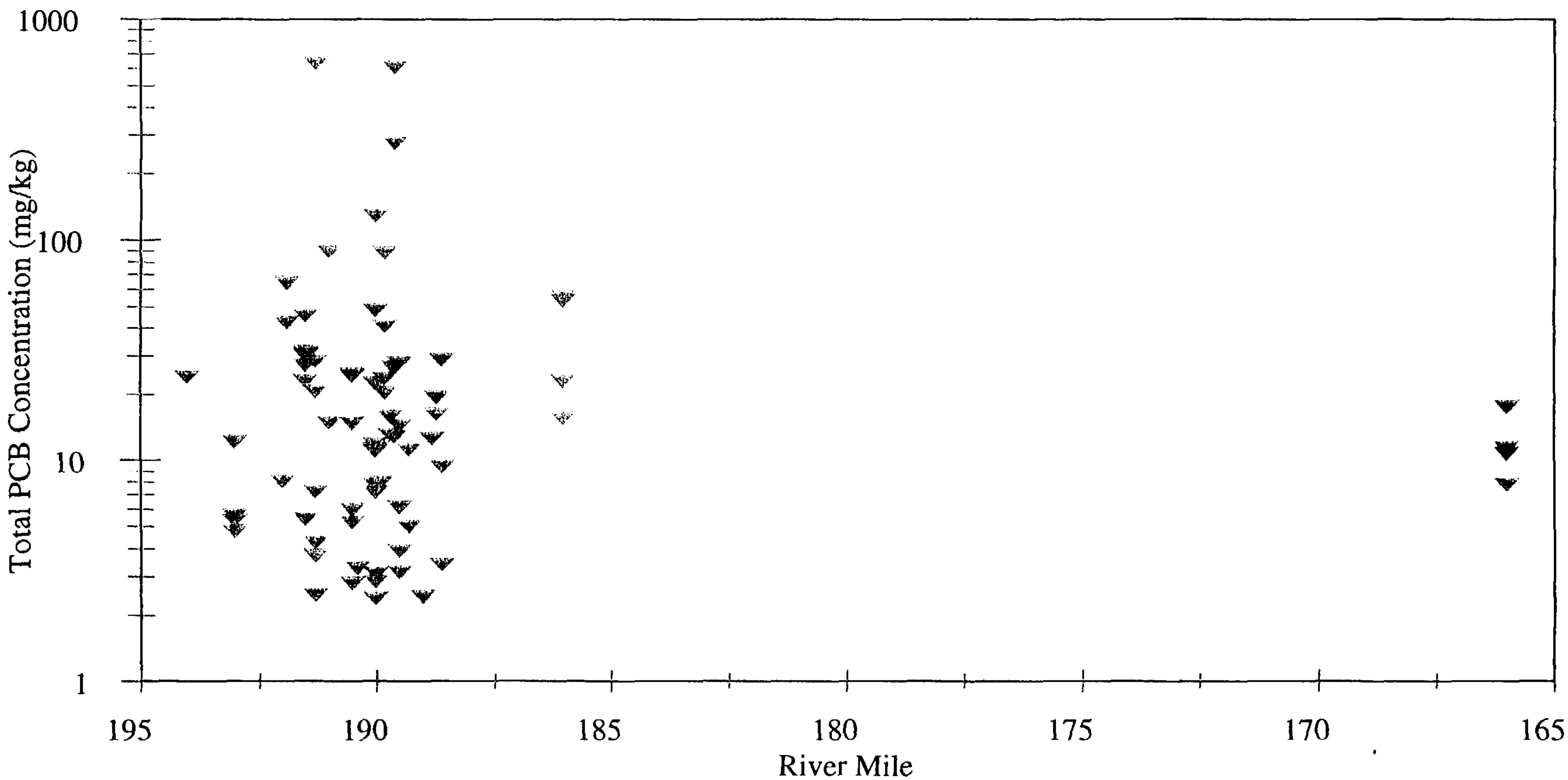
Figure 1-5. Total PCB Concentrations at TID-West, Observations and Moving Average



Source: GE Database Release 000403

401058

Figure 1-6. Total PCB Surface Sediment Concentrations from GE 1998-99 Samples in the Upper Hudson

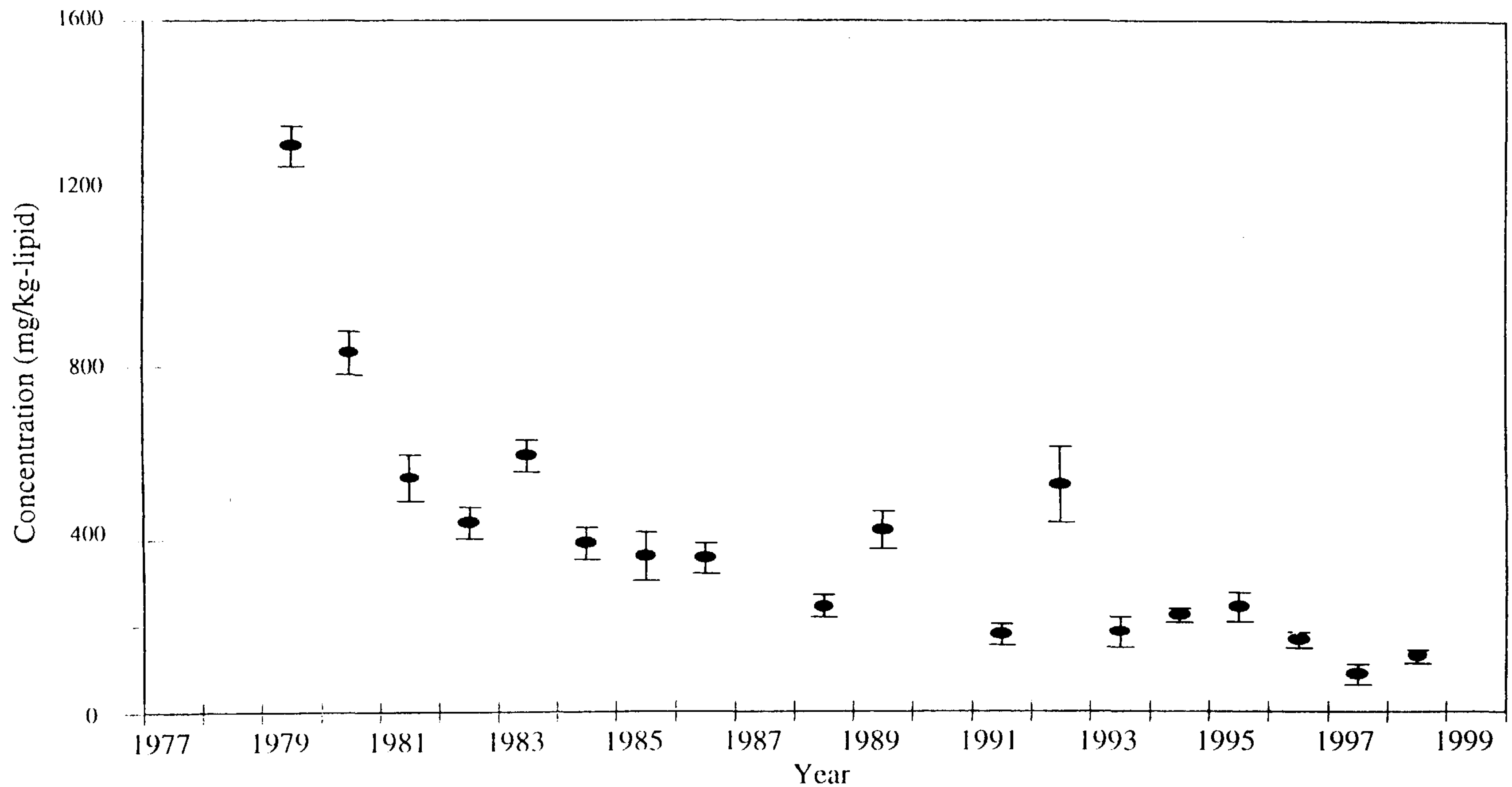


Source: GE Database Release 000403

401059

Figure 1-7

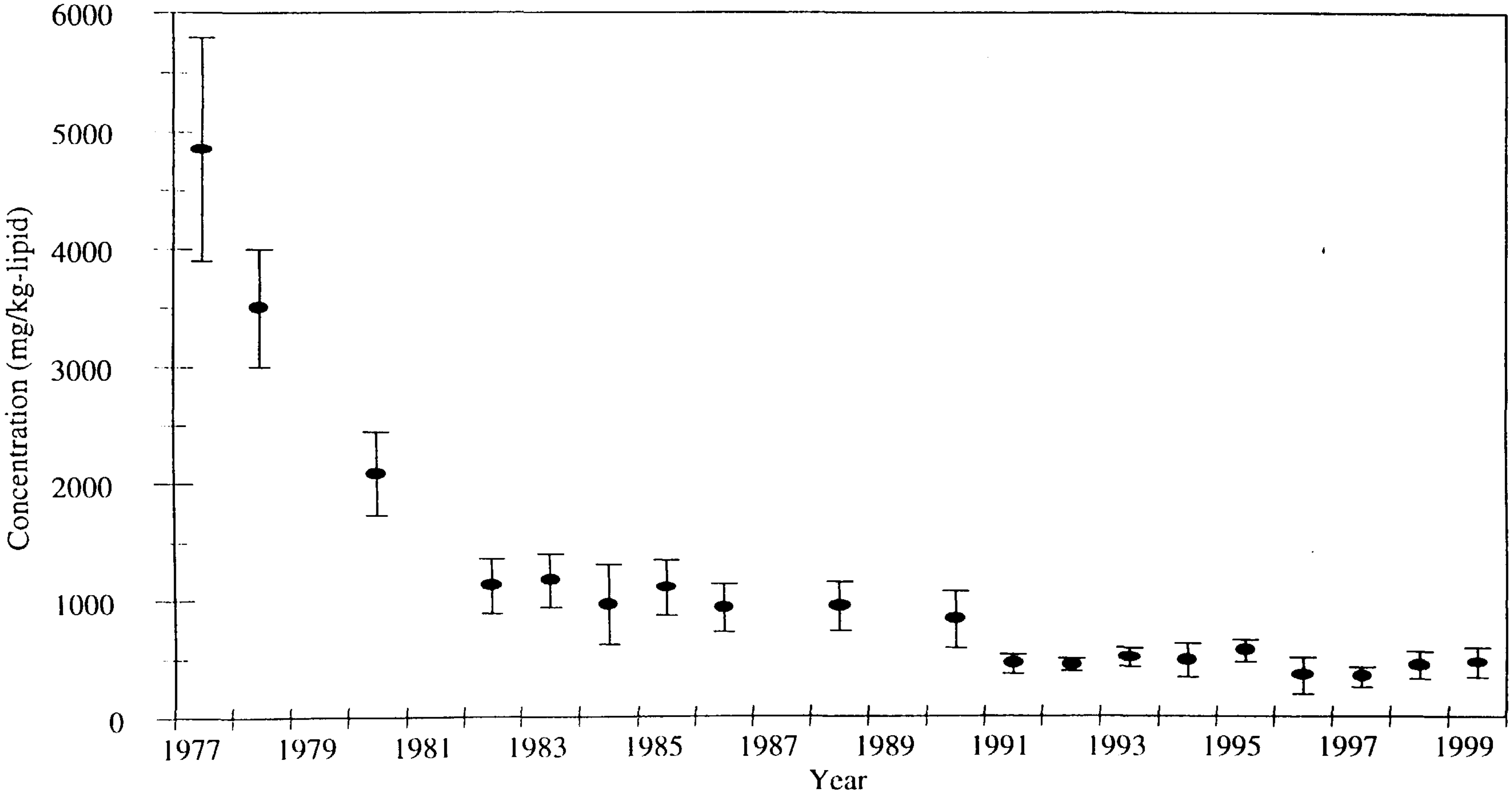
NYSDEC PCB Results for Pumpkinseed from Stillwater to Coveville, Converted to Tri+ Basis



Observations displayed as lipid-based mean concentration with 95% confidence limits on the mean. Source: NYSDEC Database Release 6_2000

Figure 1-8

NYSDEC PCB Results for Largemouth Bass from Stillwater to Coveville, Converted to Tri+ Basis

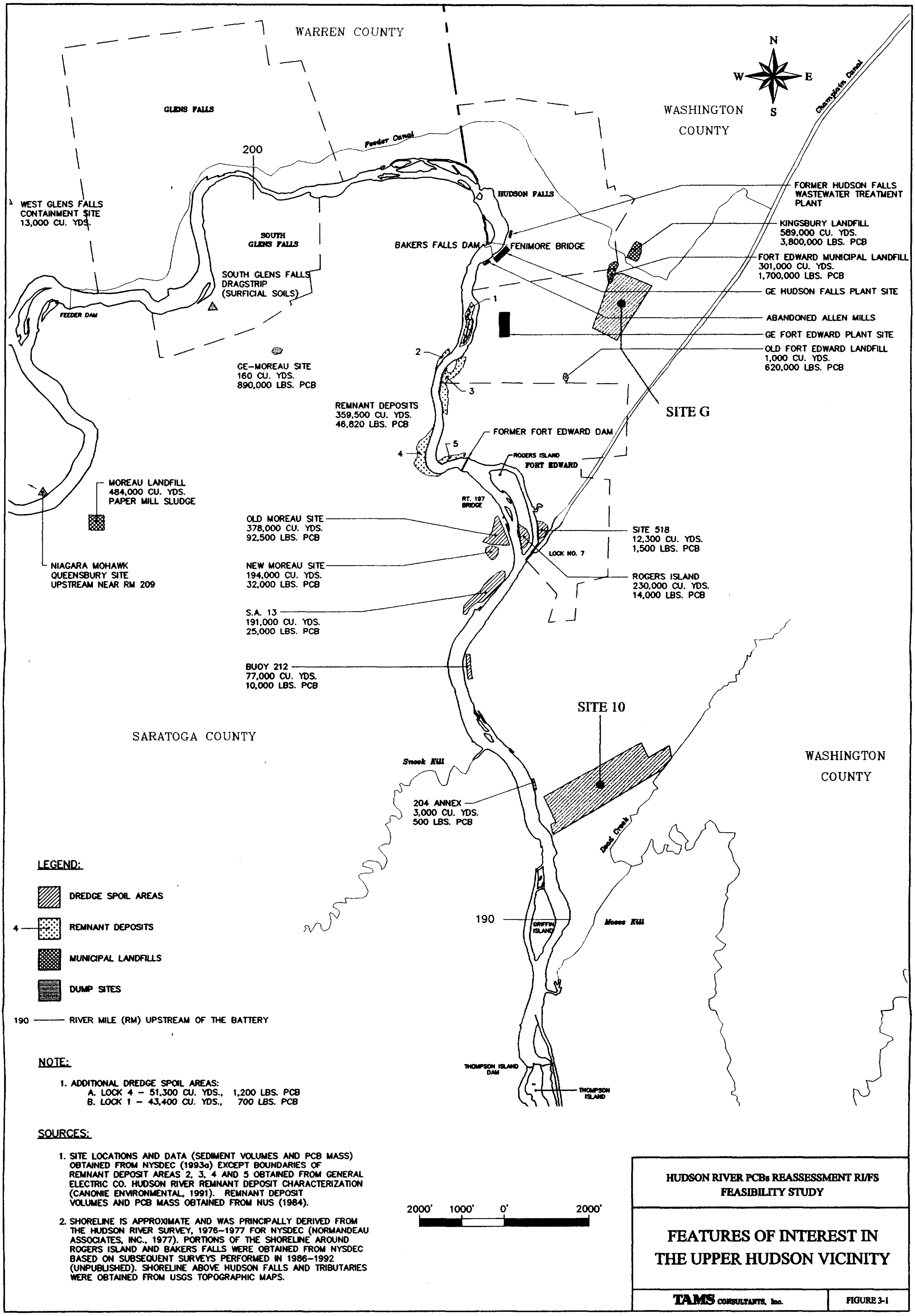


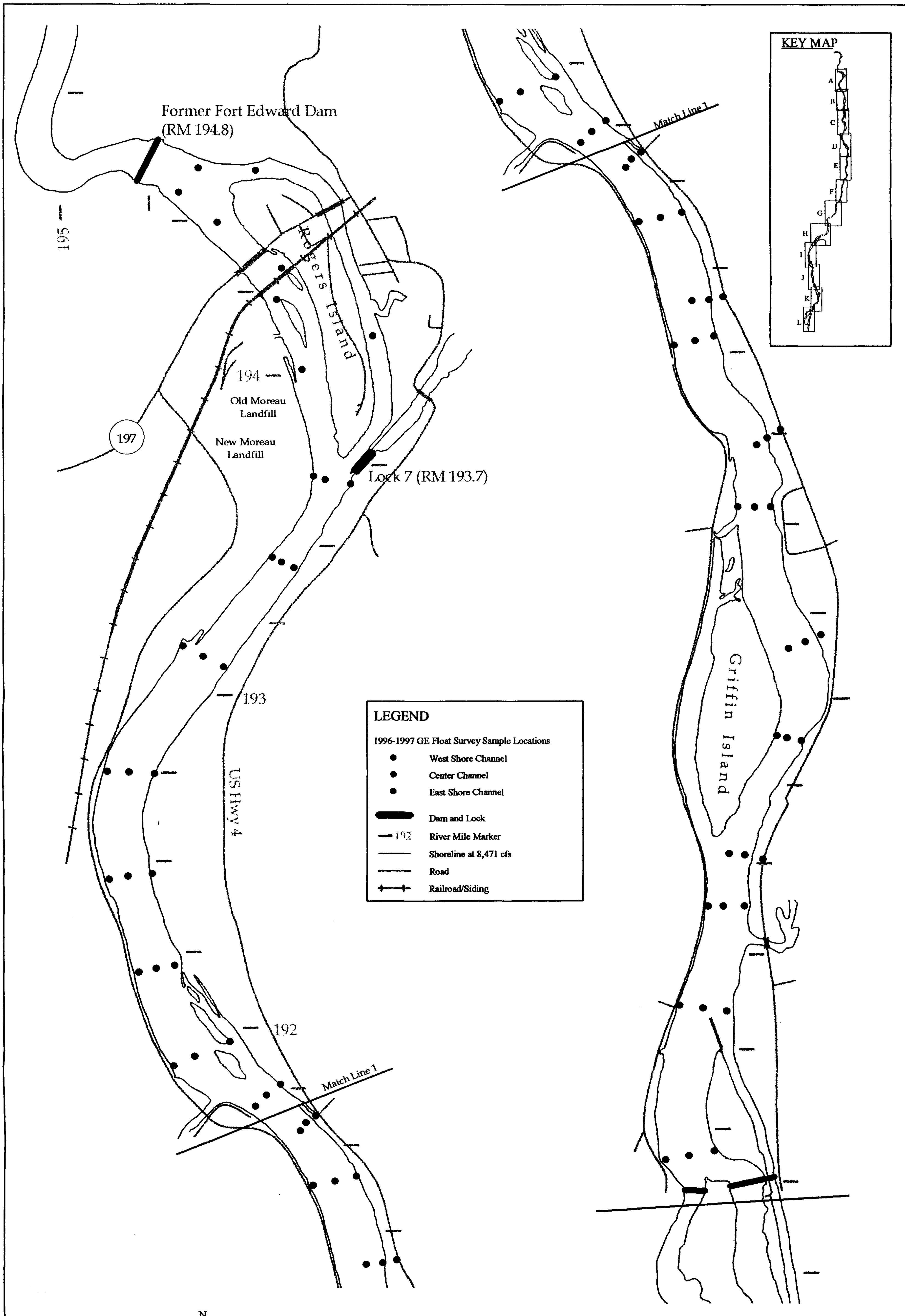
Observations displayed as lipid-based mean concentration with 95% confidence limits on the mean. Source: NYSDEC Database Release 6_2000

401061

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

LIST OF FIGURES
CHAPTER 3


WARREN COUNTY
WASHINGTON COUNTY
N
W
E
S
Champlain Canal
GLENS FALLS
Feeder Canal
200
HUDSON FALLS
WEST GLENS FALLS CONTAINMENT SITE 13,000 CU. YDS.
SOUTH GLENS FALLS
FORMER HUDSON FALLS WASTEWATER TREATMENT PLANT
KINGSBURY LANDFILL 589,000 CU. YDS. 3,800,000 LBS. PCB
BAKERS FALLS DAM
FENIMORE BRIDGE
FORT EDWARD MUNICIPAL LANDFILL 301,000 CU. YDS. 1,700,000 LBS. PCB
SOUTH GLENS FALLS DRAGSTRIP (SURFICIAL SOILS)
GE HUDSON FALLS PLANT SITE
FEEDER DAM
ABANDONED ALLEN MILLS
GE FORT EDWARD PLANT SITE
OLD FORT EDWARD LANDFILL 1,000 CU. YDS. 620,000 LBS. PCB
GE–MOREAU SITE 160 CU. YDS. 890,000 LBS. PCB
REMNANT DEPOSITS 359,500 CU. YDS. 46,820 LBS. PCB
SITE G
FORMER FORT EDWARD DAM
ROGERS ISLAND
FORT EDWARD
MOREAU LANDFILL 484,000 CU. YDS. PAPER MILL SLUDGE
RT. 197 BRIDGE
OLD MOREAU SITE 378,000 CU. YDS. 92,500 LBS. PCB
SITE 518 12,300 CU. YDS. 1,500 LBS. PCB
LOCK NO. 7
NIAGARA MOHAWK QUEENSBURY SITE UPSTREAM NEAR RM 209
NEW MOREAU SITE 194,000 CU. YDS. 32,000 LBS. PCB
ROGERS ISLAND 230,000 CU. YDS. 14,000 LBS. PCB
S.A. 13 191,000 CU. YDS. 25,000 LBS. PCB
BUOY 212 77,000 CU. YDS. 10,000 LBS. PCB
SITE 10
SARATOGA COUNTY
WASHINGTON COUNTY
Snook Kill
204 ANNEX 3,000 CU. YDS. 500 LBS. PCB
Dead Creek
190
GRIFFIN ISLAND
Moses Kill
THOMPSON ISLAND DAM
THOMPSON ISLAND
LEGEND:
DREDGE SPOIL AREAS
4 REMNANT DEPOSITS
MUNICIPAL LANDFILLS
DUMP SITES
190 RIVER MILE (RM) UPSTREAM OF THE BATTERY
NOTE:
1. ADDITIONAL DREDGE SPOIL AREAS:
A. LOCK 4 – 51,300 CU. YDS., 1,200 LBS. PCB
B. LOCK 1 – 43,400 CU. YDS., 700 LBS. PCB
SOURCES:
1. SITE LOCATIONS AND DATA (SEDIMENT VOLUMES AND PCB MASS) OBTAINED FROM NYSDEC (1993a) EXCEPT BOUNDARIES OF REMNANT DEPOSIT AREAS 2, 3, 4 AND 5 OBTAINED FROM GENERAL ELECTRIC CO. HUDSON RIVER REMNANT DEPOSIT CHARACTERIZATION (CANONIE ENVIRONMENTAL, 1991). REMNANT DEPOSIT VOLUMES AND PCB MASS OBTAINED FROM NUS (1984).
2. SHORELINE IS APPROXIMATE AND WAS PRINCIPALLY DERIVED FROM THE HUDSON RIVER SURVEY, 1976–1977 FOR NYSDEC (NORMANDEAU ASSOCIATES, INC., 1977). PORTIONS OF THE SHORELINE AROUND ROGERS ISLAND AND BAKERS FALLS WERE OBTAINED FROM NYSDEC BASED ON SUBSEQUENT SURVEYS PERFORMED IN 1986–1992 (UNPUBLISHED). SHORELINE ABOVE HUDSON FALLS AND TRIBUTARIES WERE OBTAINED FROM USGS TOPOGRAPHIC MAPS.
2000' 1000' 0' 2000'
HUDSON RIVER PCBs REASSESSMENT RI/FS
FEASIBILITY STUDY
FEATURES OF INTEREST IN THE UPPER HUDSON VICINITY
TAMS CONSULTANTS, Inc.
FIGURE 3-1



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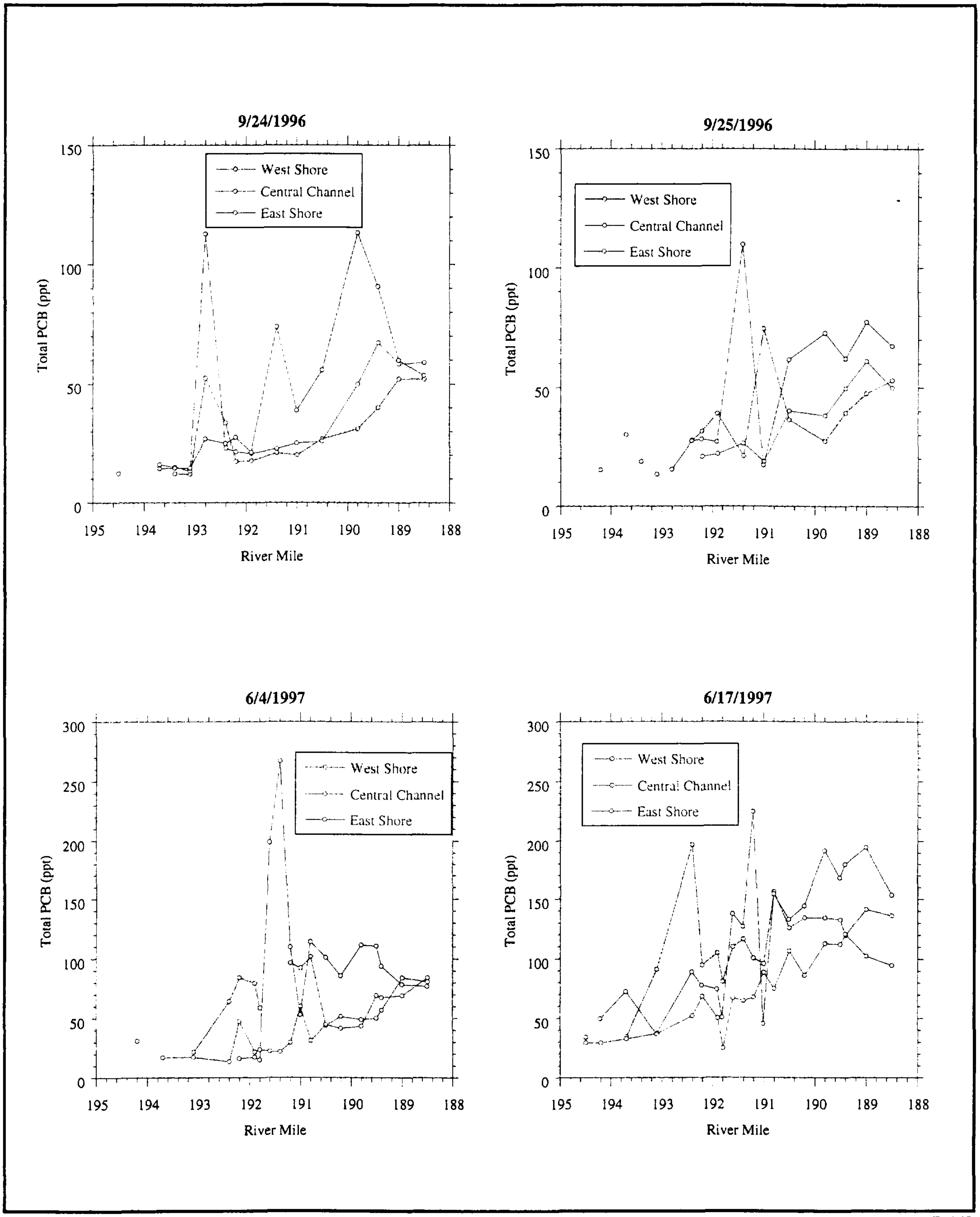
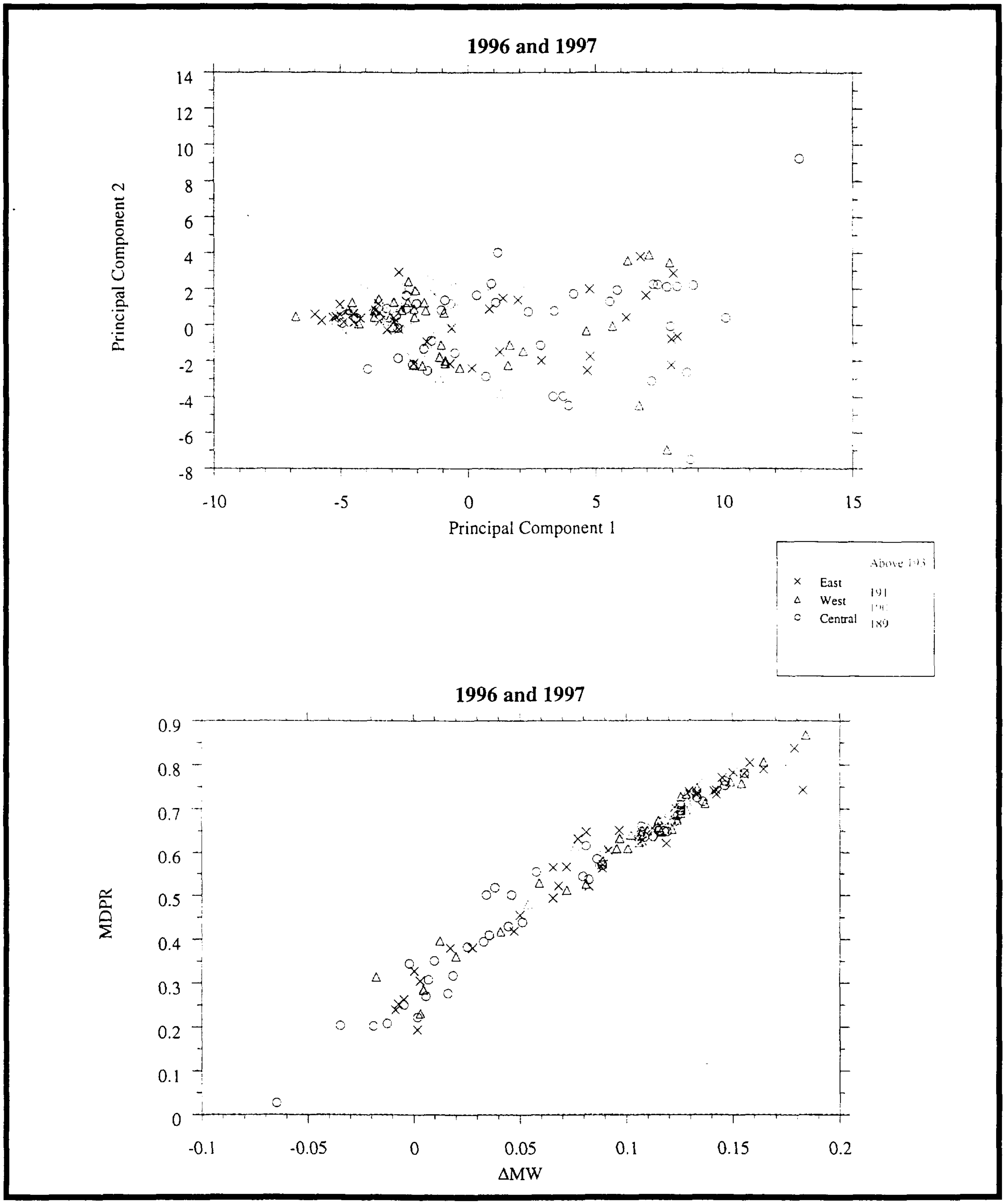
Hudson River PCBs Reassessment Feasibility Study	Figure 3-2 Locations of 1996 and 1997 GE Float Survey Samples	Sheet 1 of 1 RM 194.8 - 188.5



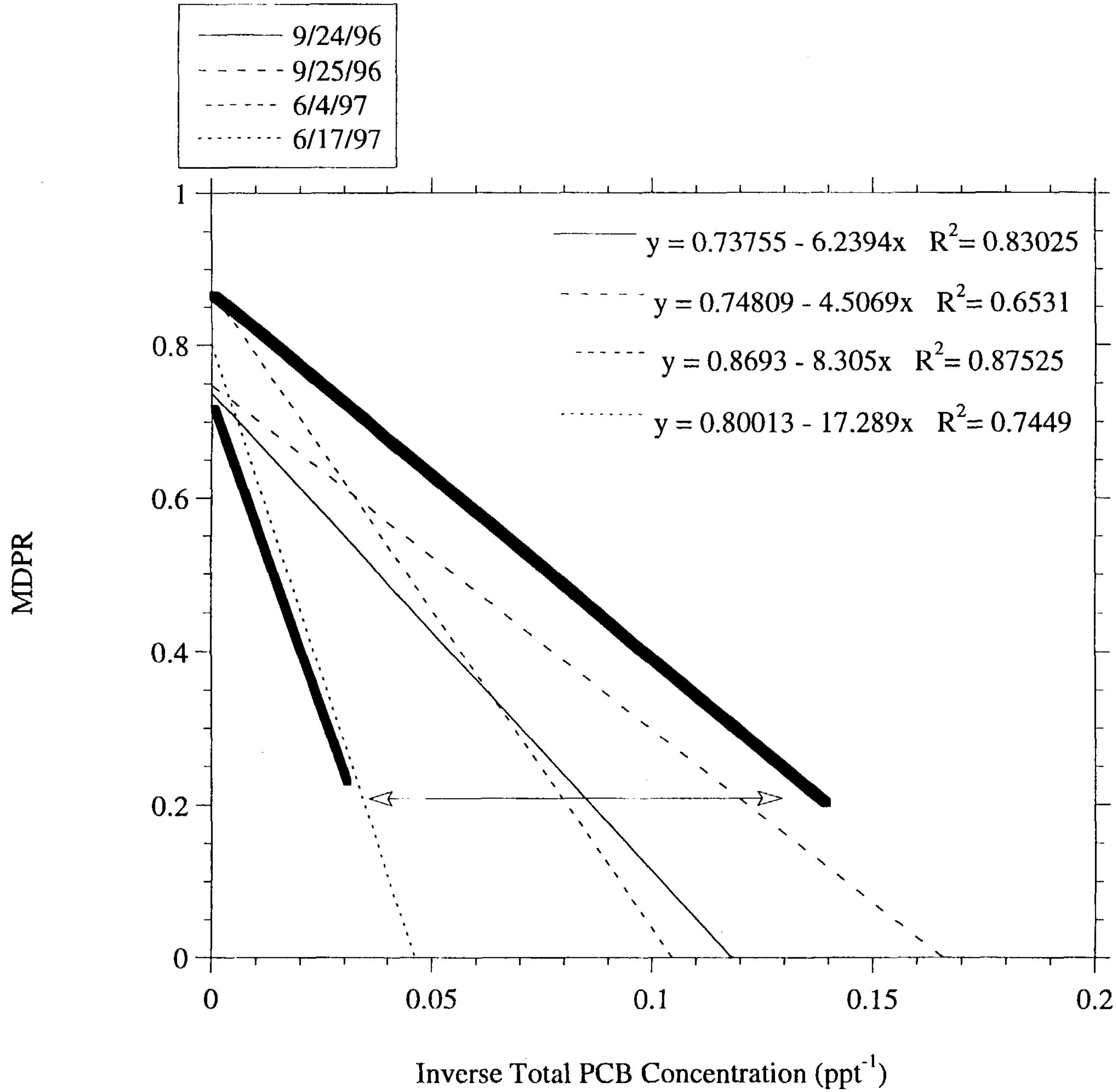
TAMS

Figure 3-3
GE Float Survey Results for the TI Pool



TAMS

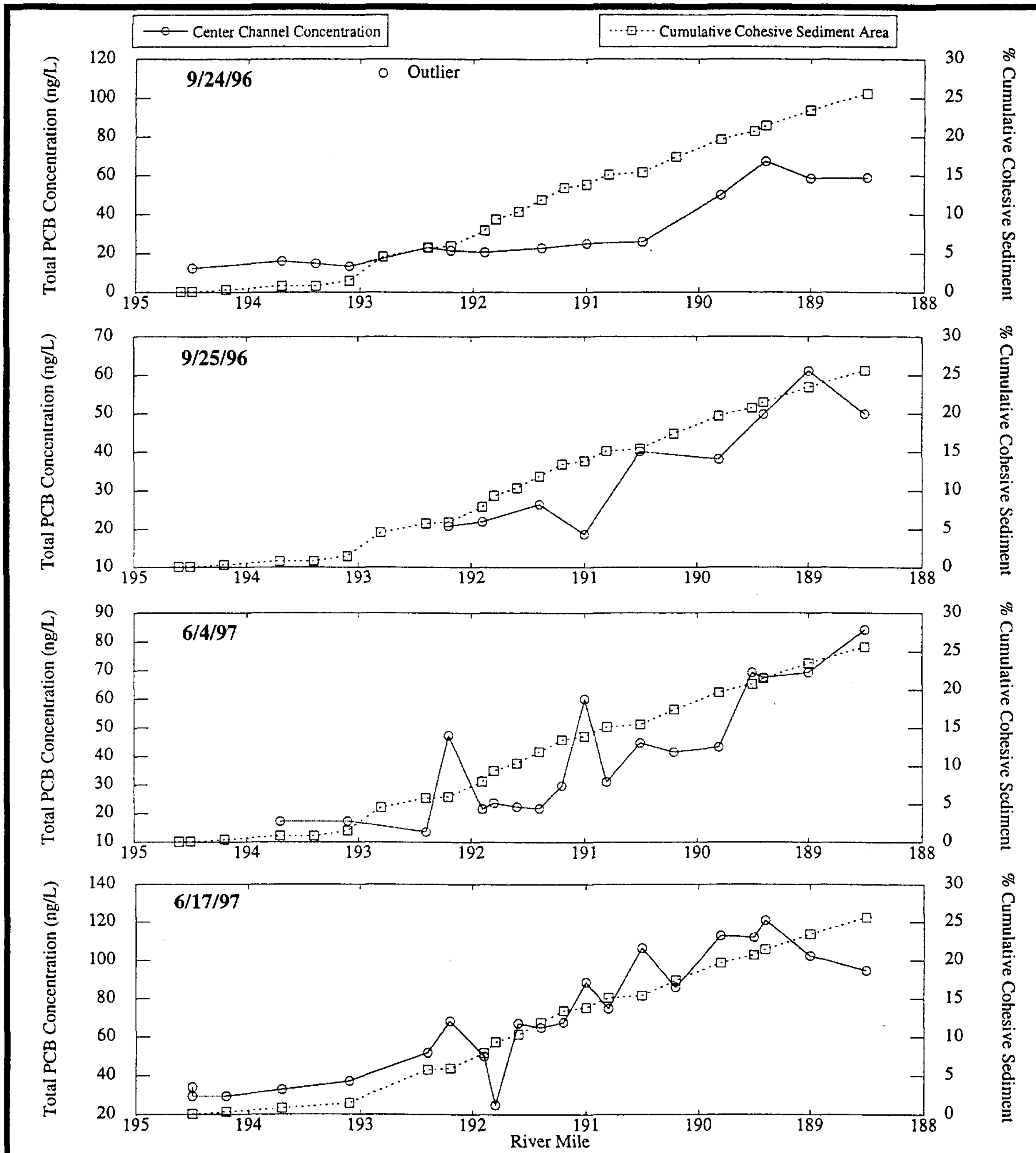
Figure 3-4
Principal Component 1 versus Principal Component 2 and MDPR versus ΔMW for GE Float Survay Data



TAMS

Figure 3-5
Effective Rogers Island Concentration on Mixing Curve

401067

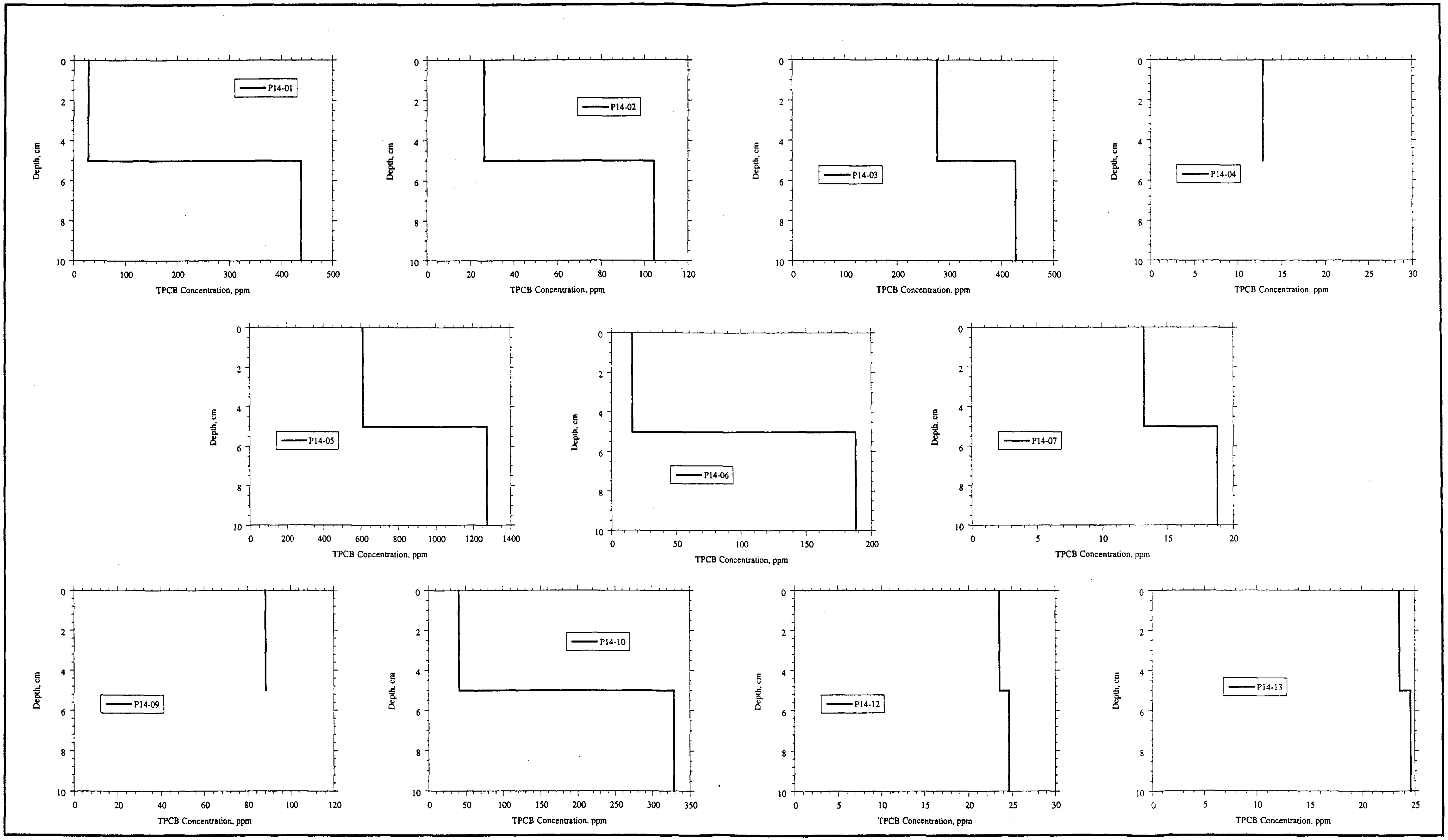


Source: GE Database Transmittal June 2000 (Werth, 2000) GE 1996-1997 Float Surveys of the TI Pool
USEPA Sidescan Sonar Survey Hudson River Database Release 5, October 2000

Note: Cumulative cohesive sediment is based on the side-scan sonar surveys (Flood, 1993) and is normalized to the total surface area of the TI Pool

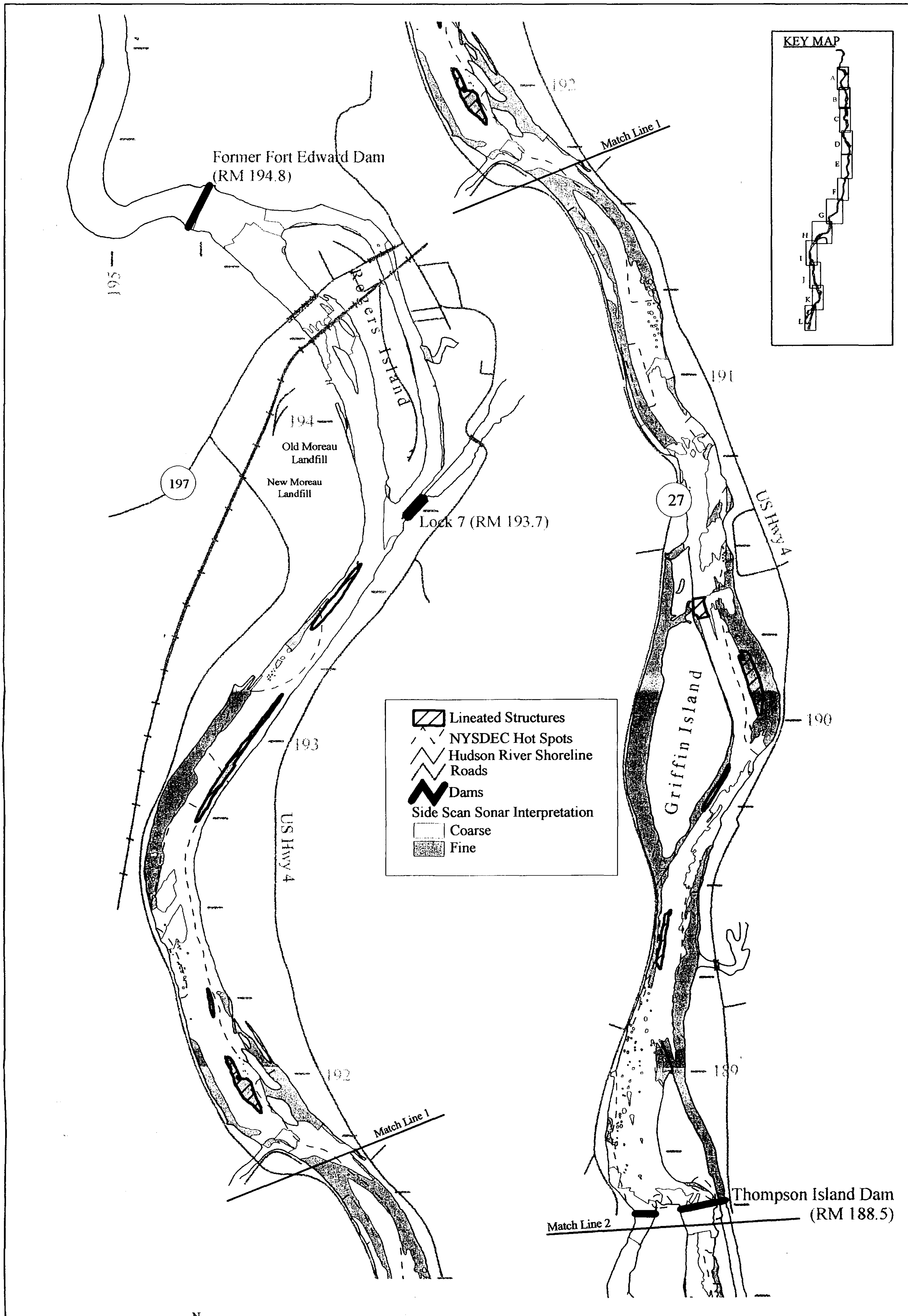
Figure 3-6
Cohesive Sediment Area and Central Channel Total PCBs as a Function of River Mile

TAMS



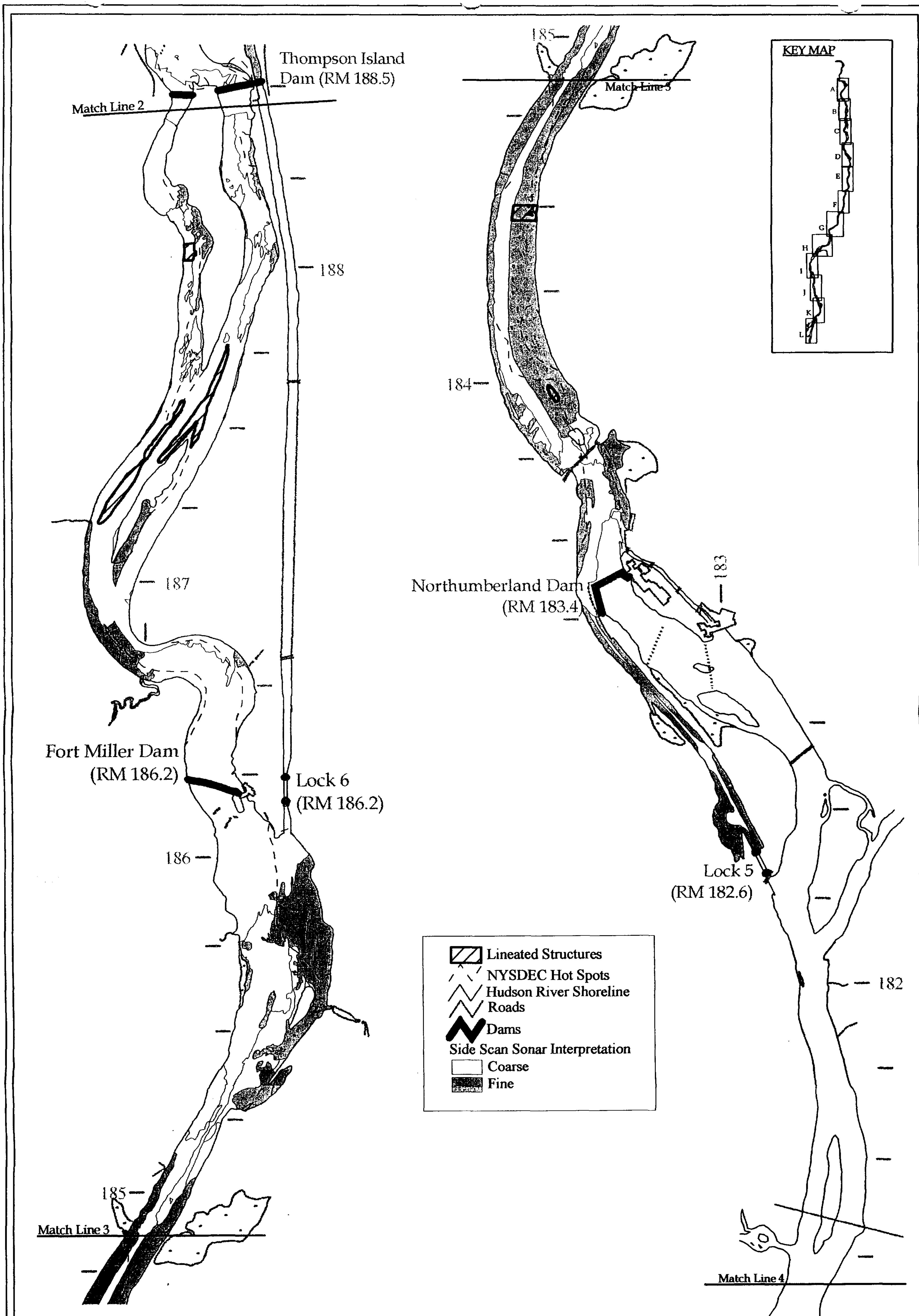
TAMS

Figure 3-7
1999 Coring Results in Hot Spot 14



TAMS TAMS Consultants, Inc.	N W E S	1000 0 1000 Scale in Feet 300 0 300 Scale in Meters	Hudson River PCBs Reassessment Feasibility Study	Figure 3-8 Erosion Area in TI Pool As indentified by Side Scan Sonar	Sheet 1 of 2 RM 194.8 - 188.5

401070



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Hudson River PCBs Reassessment Feasibility Study	Figure 3-8 Erosion Area in TI Pool As indentified by Side Scan Sonar	Sheet 2 of 2 (RM 188.5 - 181.0)

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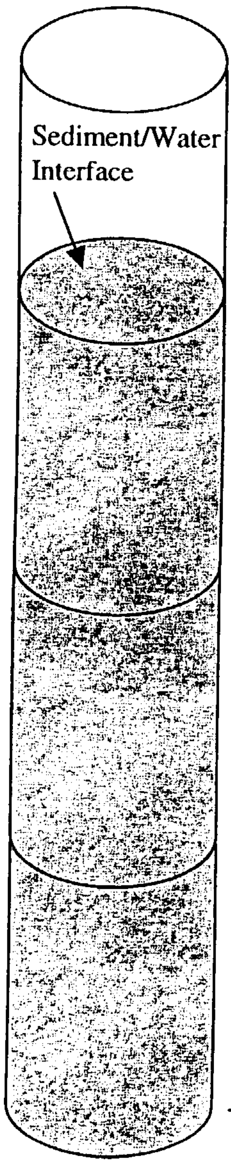
Figure 3-9 Length Weighted Average Concentration and Mass per Unit Area Calculations



Length	×	PCBs Concentration[1]	=	Product of Above Two	×	Solid Specific Weight	×	Unit Corrections	=	Mass PCBs Per Unit Area
25 cm	×	1,352 µg/g	=	33,800	×	0.52 g/cm³	×	10⁻⁶ × 10⁴ cm²/m²	=	179 g/m²
25 cm	×	343 µg/g	=	8,575 cm*	×	0.74 g/cm³	×	10⁻⁶ g/µg × 10⁴ cm²/m²	=	64 g/m²
25 cm	×	5 µg/g	=	125 cm*	×	0.88 g/cm³	×	10⁻⁶ g/µg × 10⁴ cm²/m²	=	1 g/m²

Total: 42,500 cm* µg/g

/ 75

Length Weighted Average Concentration: **567**

Total Mass per Unit Area in Core: **244 g/m²**

1. PCB concentration represents parts-per-million.

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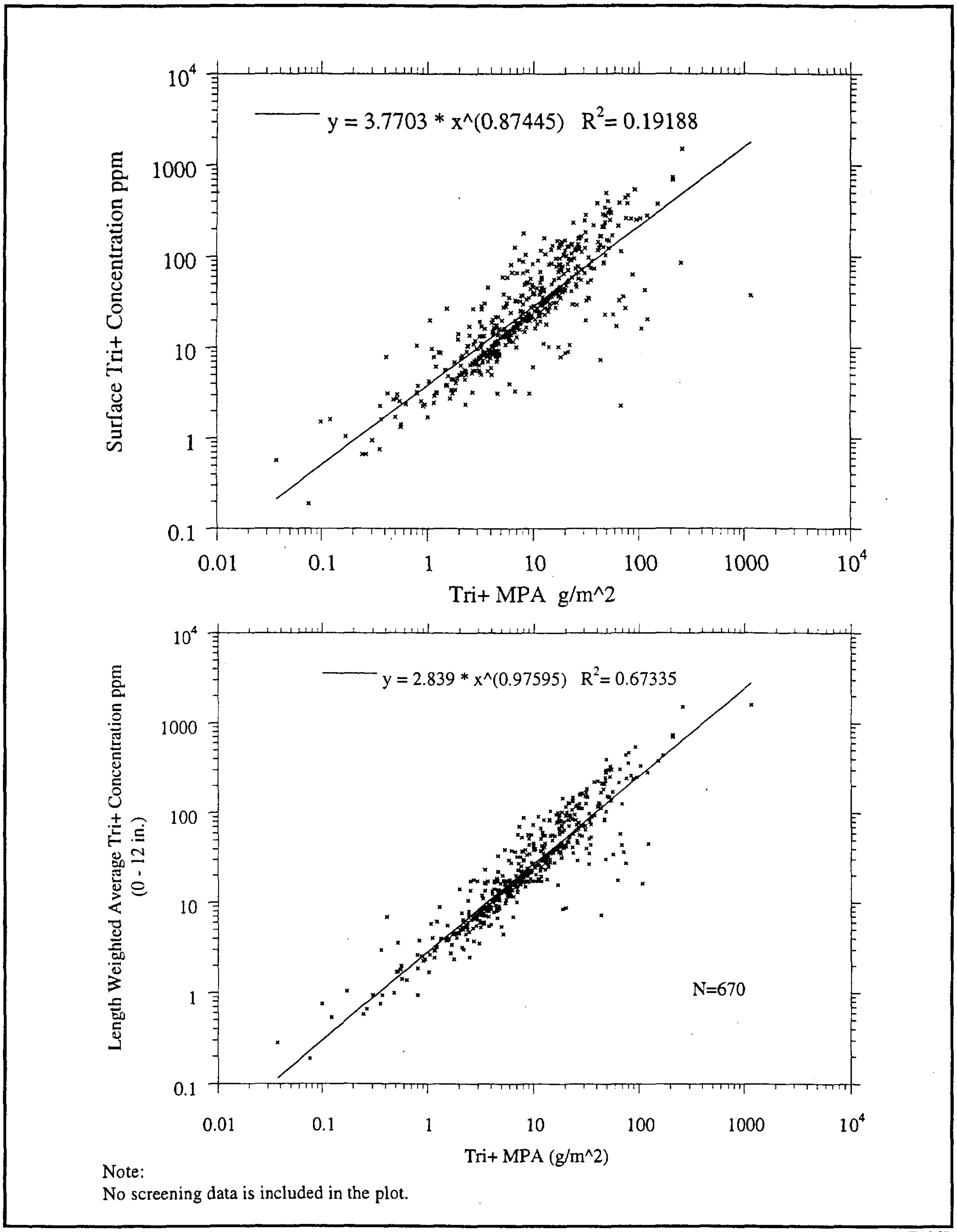
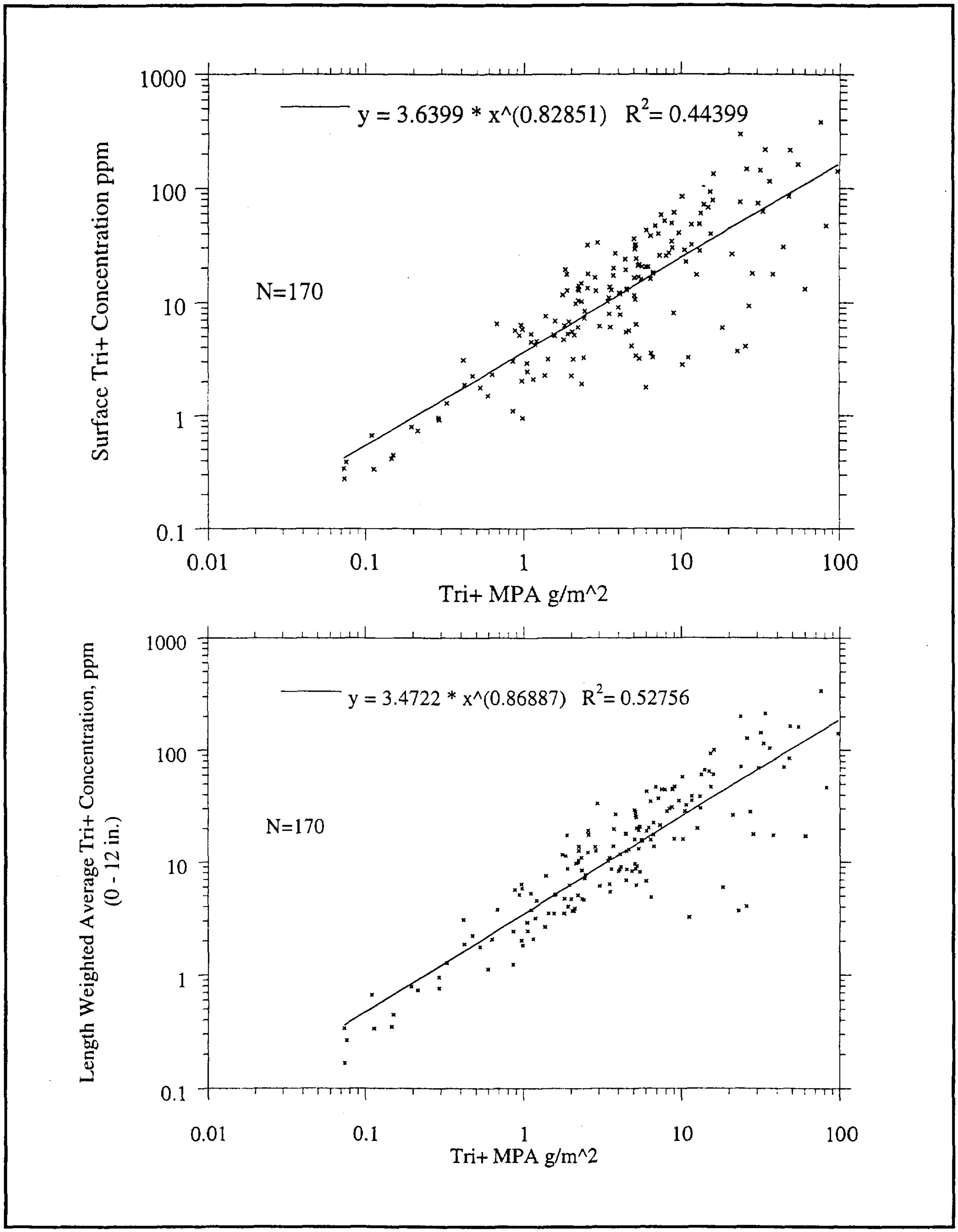
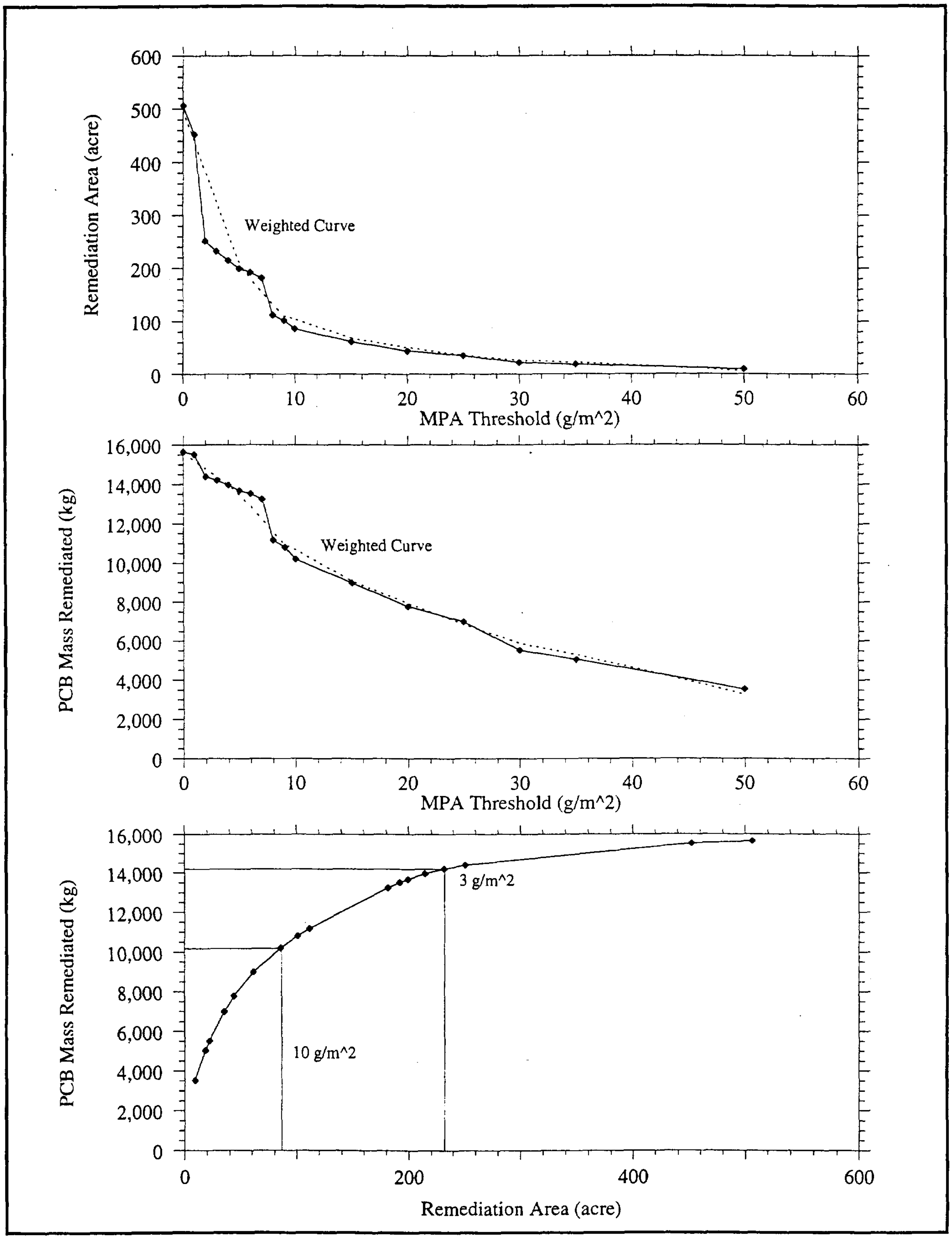


Figure 3-10
Correlations Among PCB Metrics for 1984 NYSDEC Sediment Survey



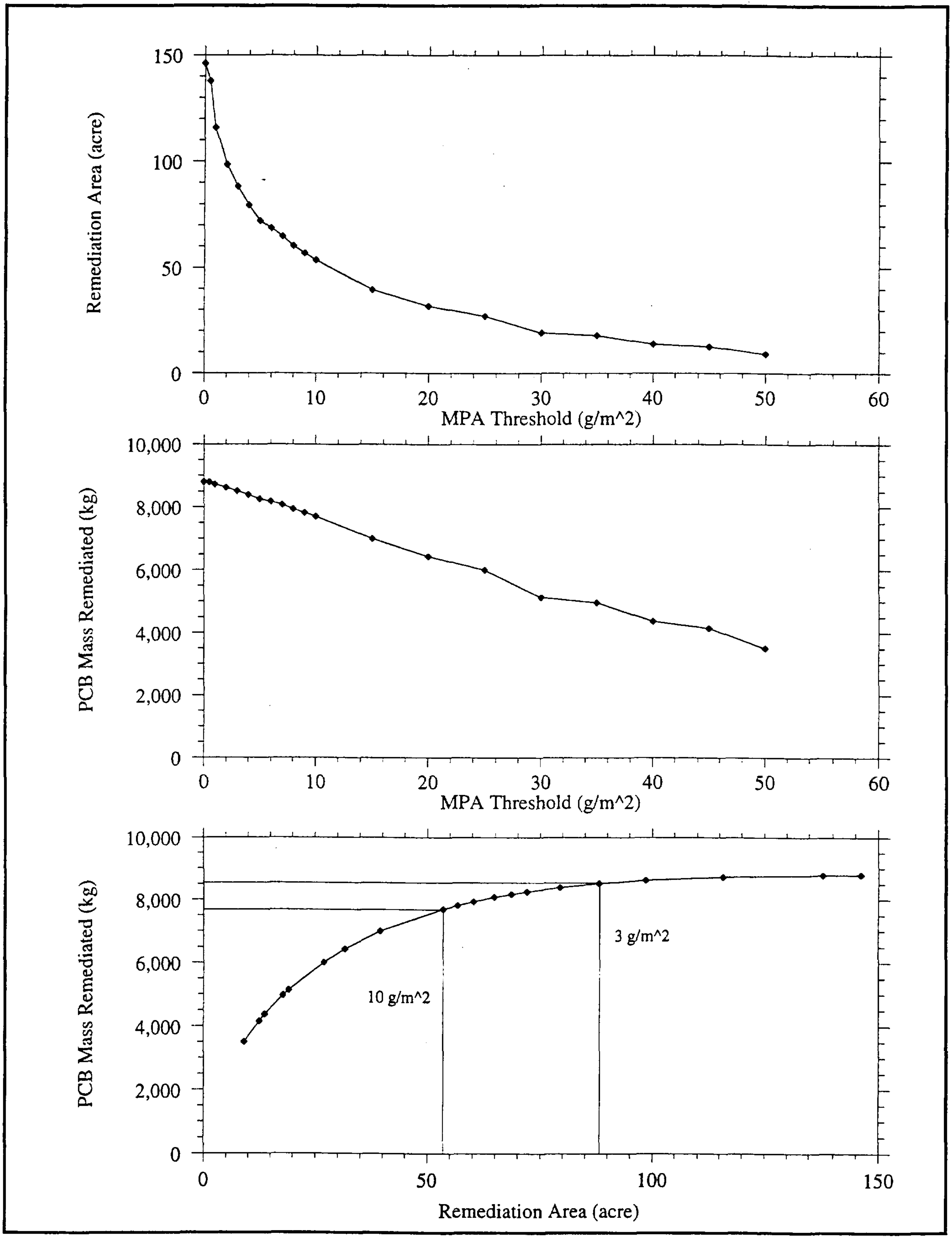
TAMS

Figure 3-11
Correlations Among PCB Metrics for USEPA Low Resolution Sediment Coring Survey



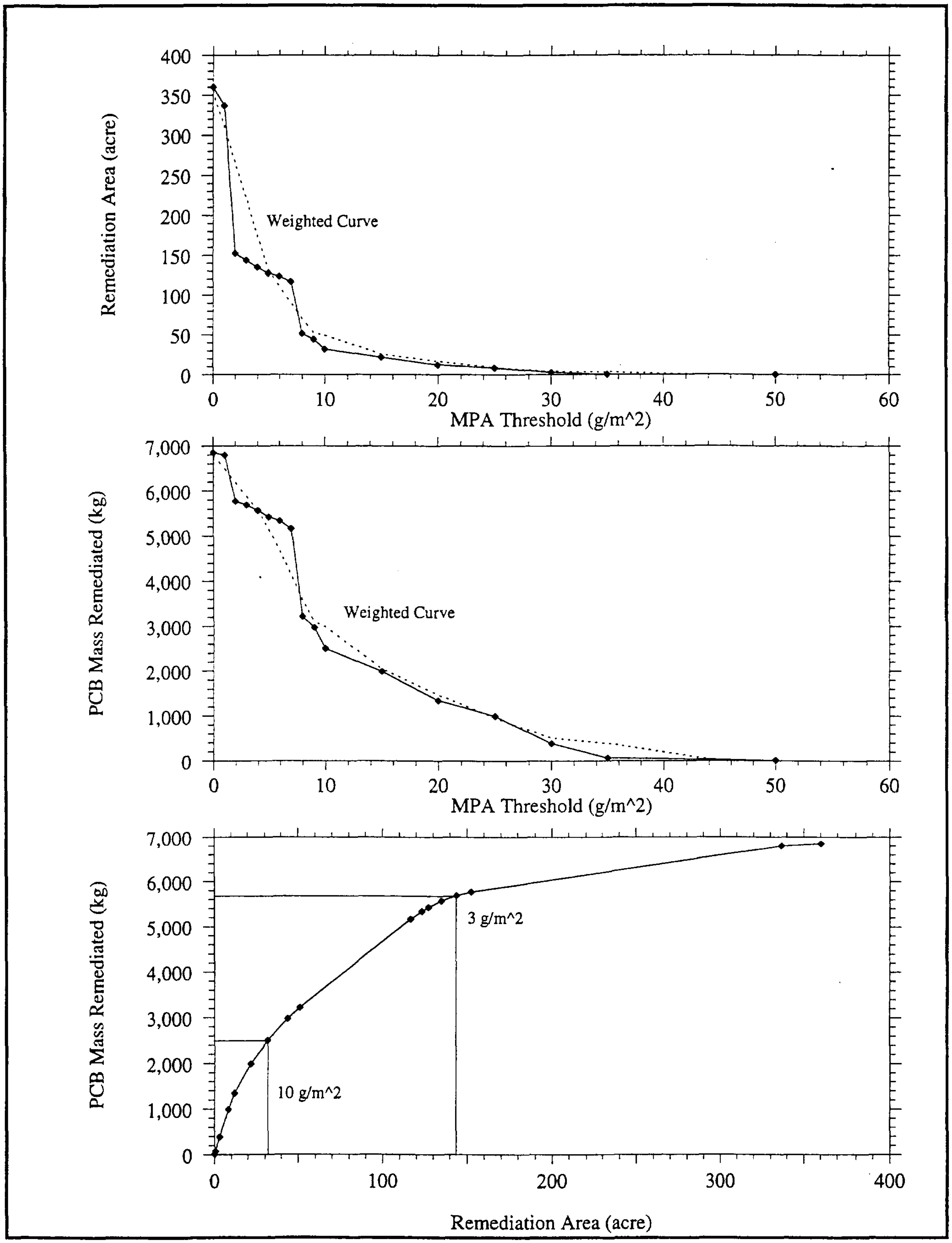
TAMS

Figure 3-12
Relationship among MPA, PCB Mass and Sediment Area in TI Pool
(based on 1984 sediment survey)



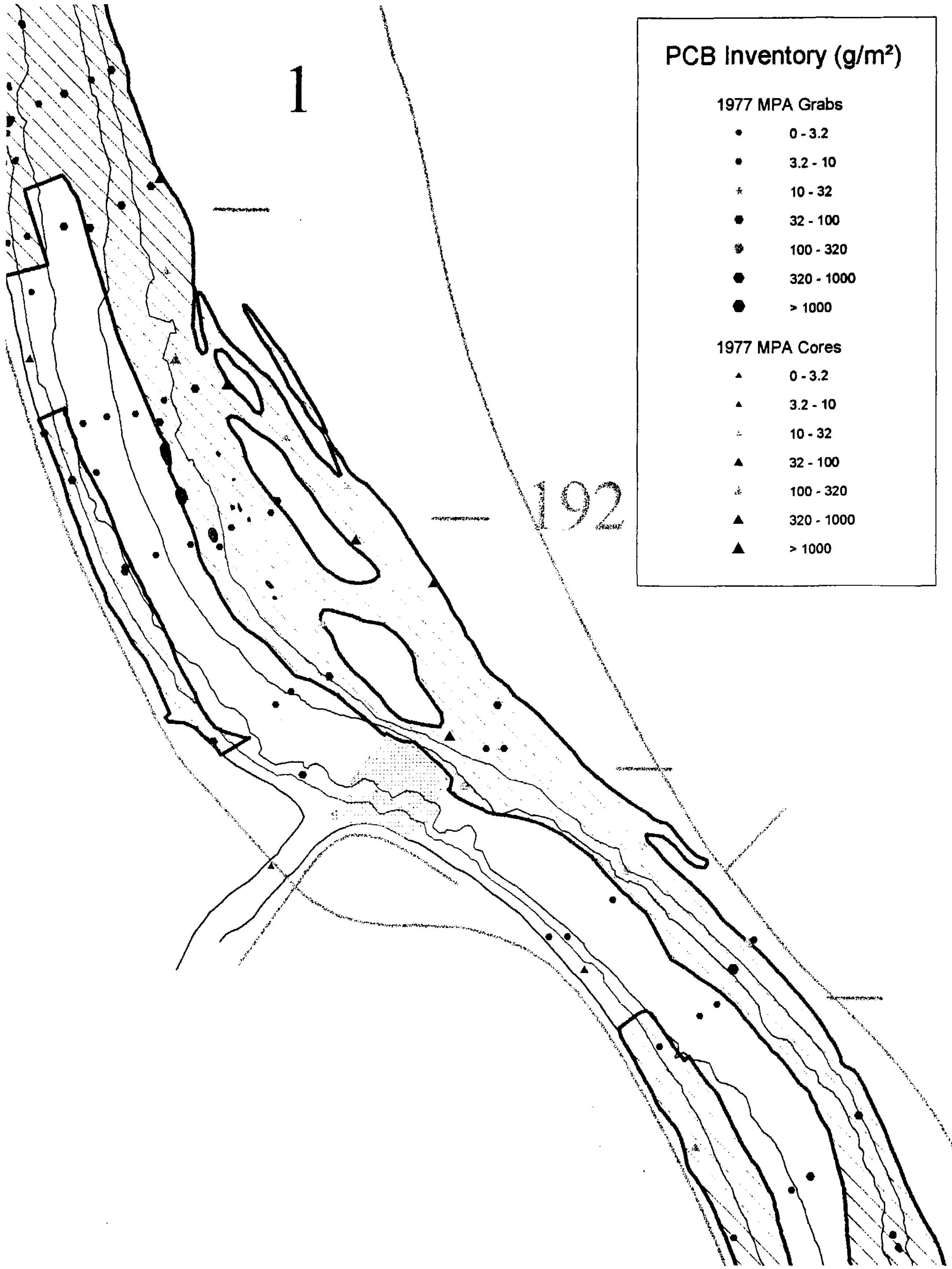
TAMS

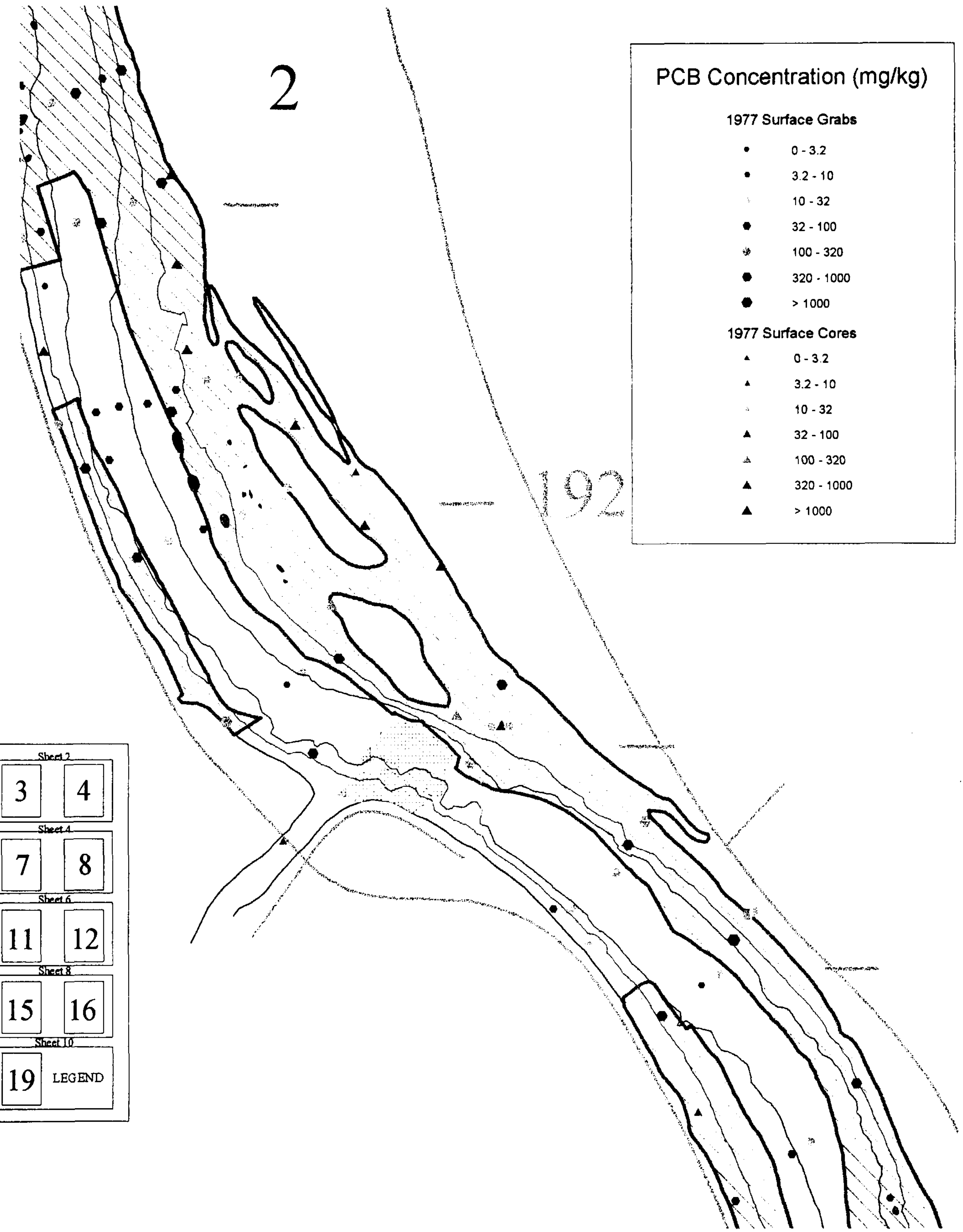
Figure 3-13
Relationship among MPA, PCB Mass and Sediment Area in the Cohesive Area in the TI Pool (based on 1984 sediment survey)



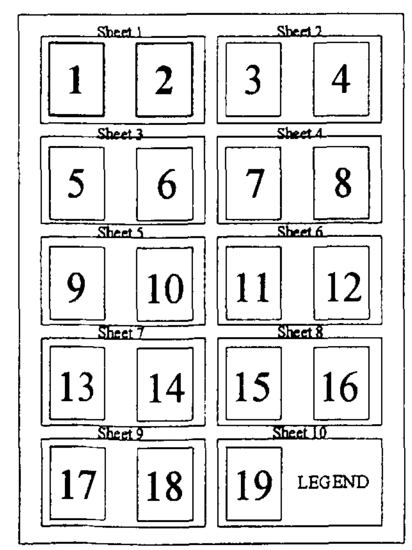
TAMS

Figure 3-14
Relationship among MPA, PCB Mass and Sediment Area in the Non-cohesive Area in the TI Pool (based on 1984 sediment survey)





KEY MAP



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N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 1 of 10

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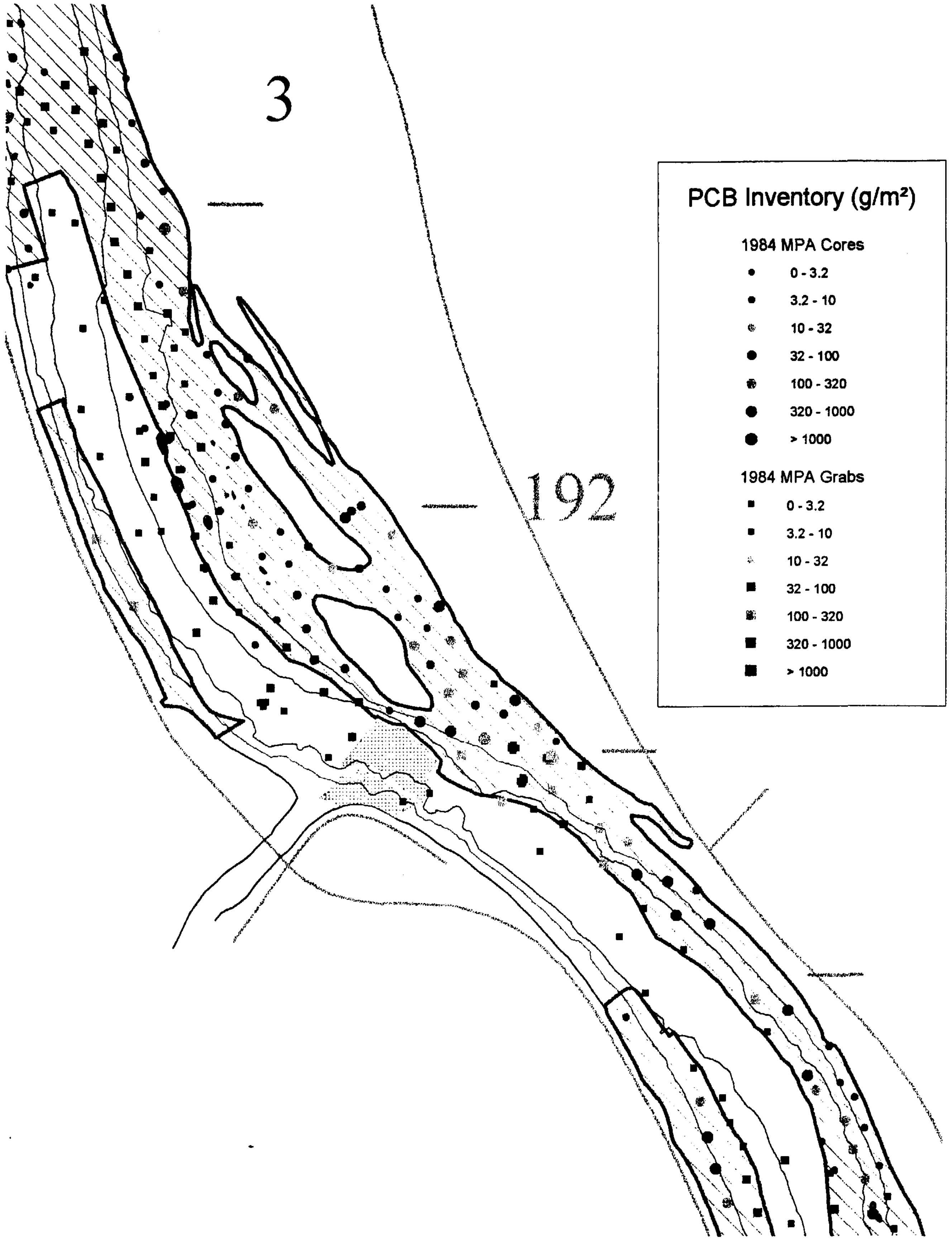
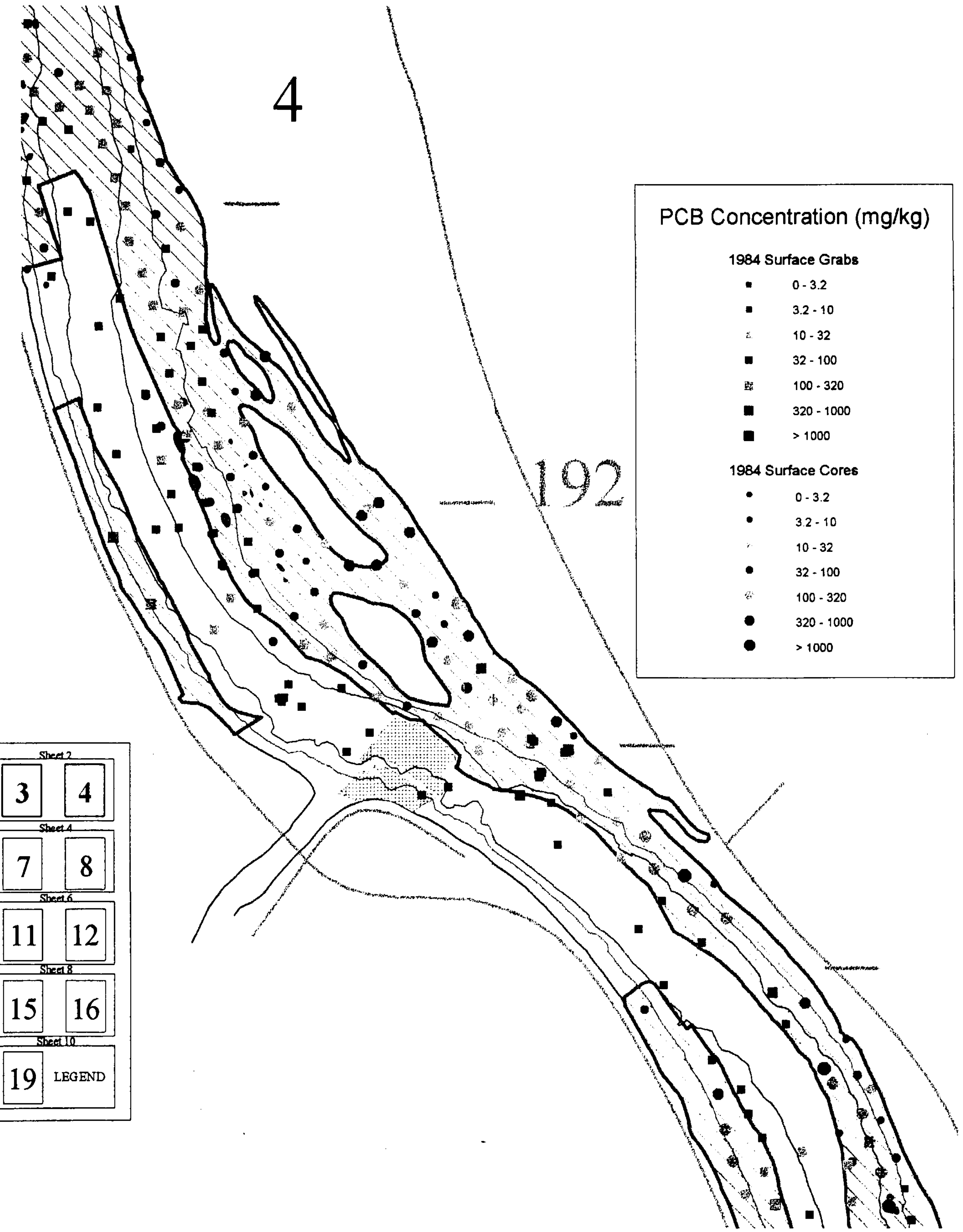
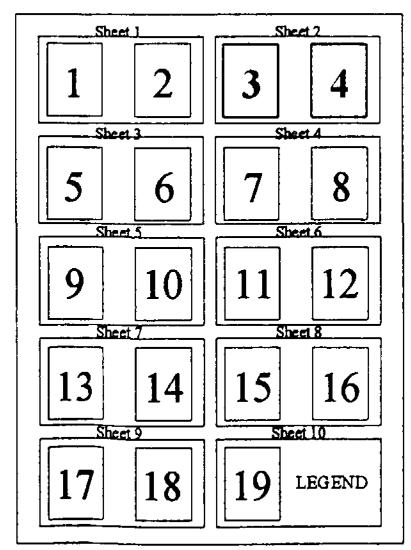




KEY MAP



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W E
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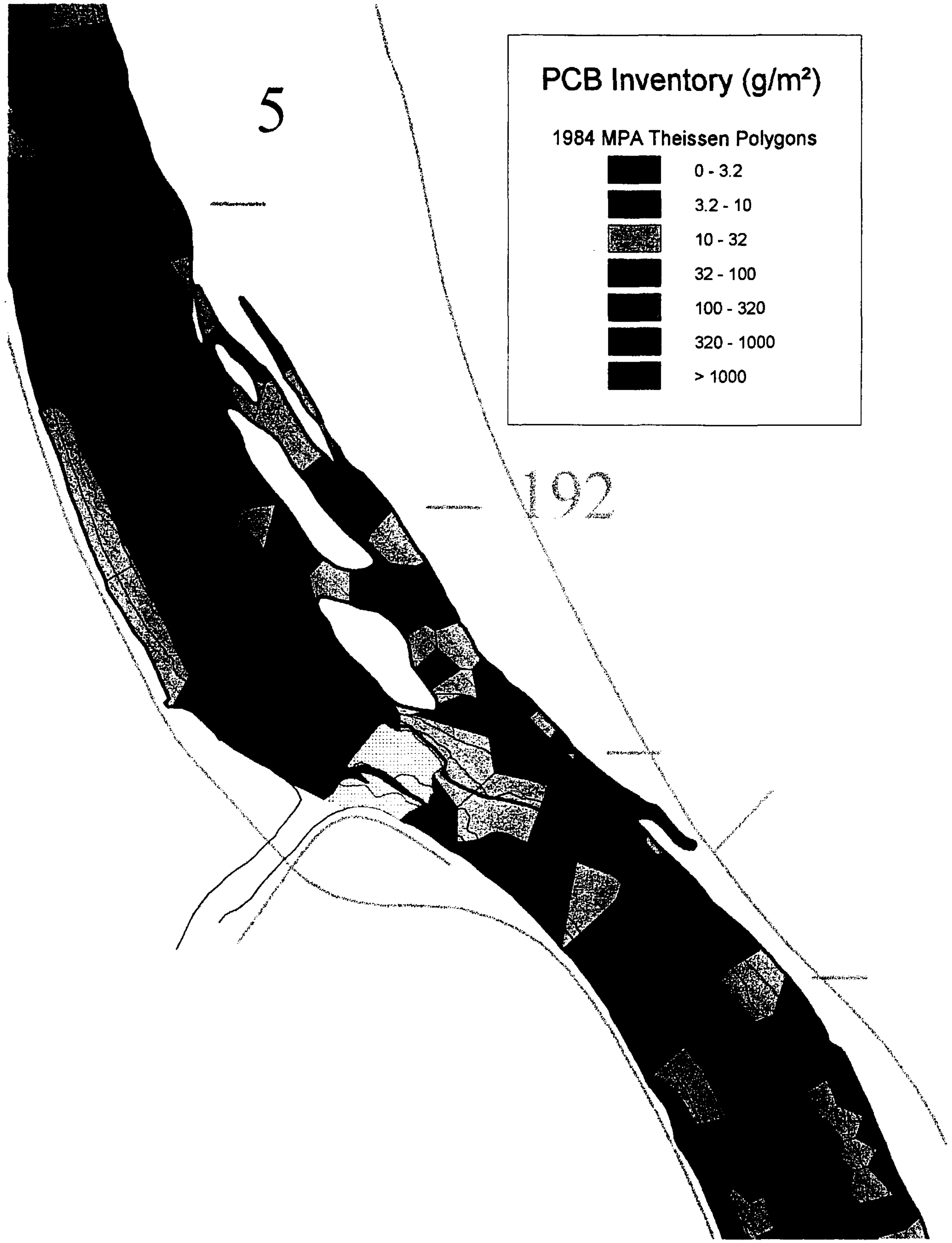
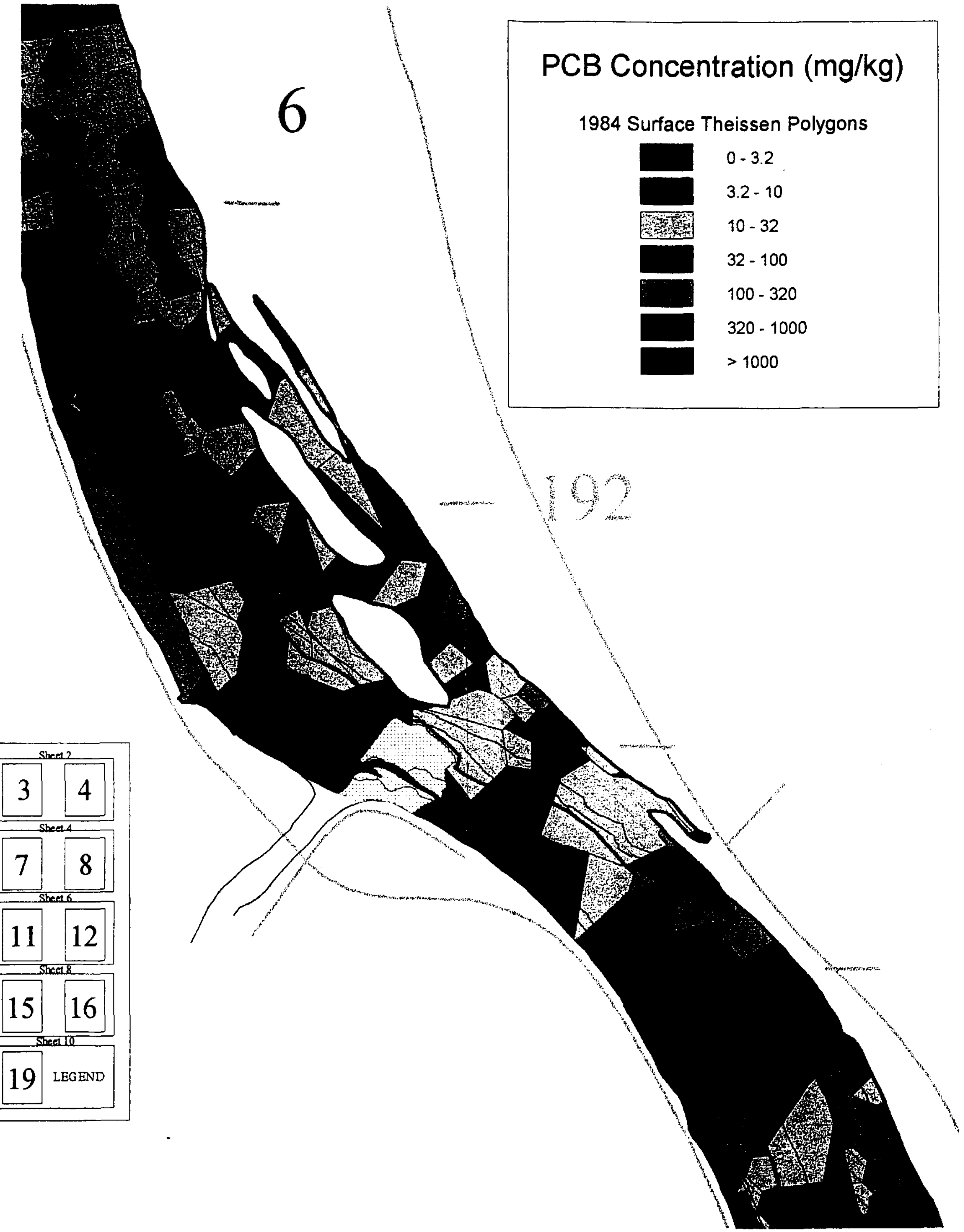
Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 2 of 10

401079





KEY MAP

Sheet 1		Sheet 2	
1	2	3	4
Sheet 3		**Sheet 4**	
5	6	7	8
Sheet 5		**Sheet 6**	
9	10	11	12
Sheet 7		**Sheet 8**	
13	14	15	16
Sheet 9		**Sheet 10**	
17	18	19	LEGEND

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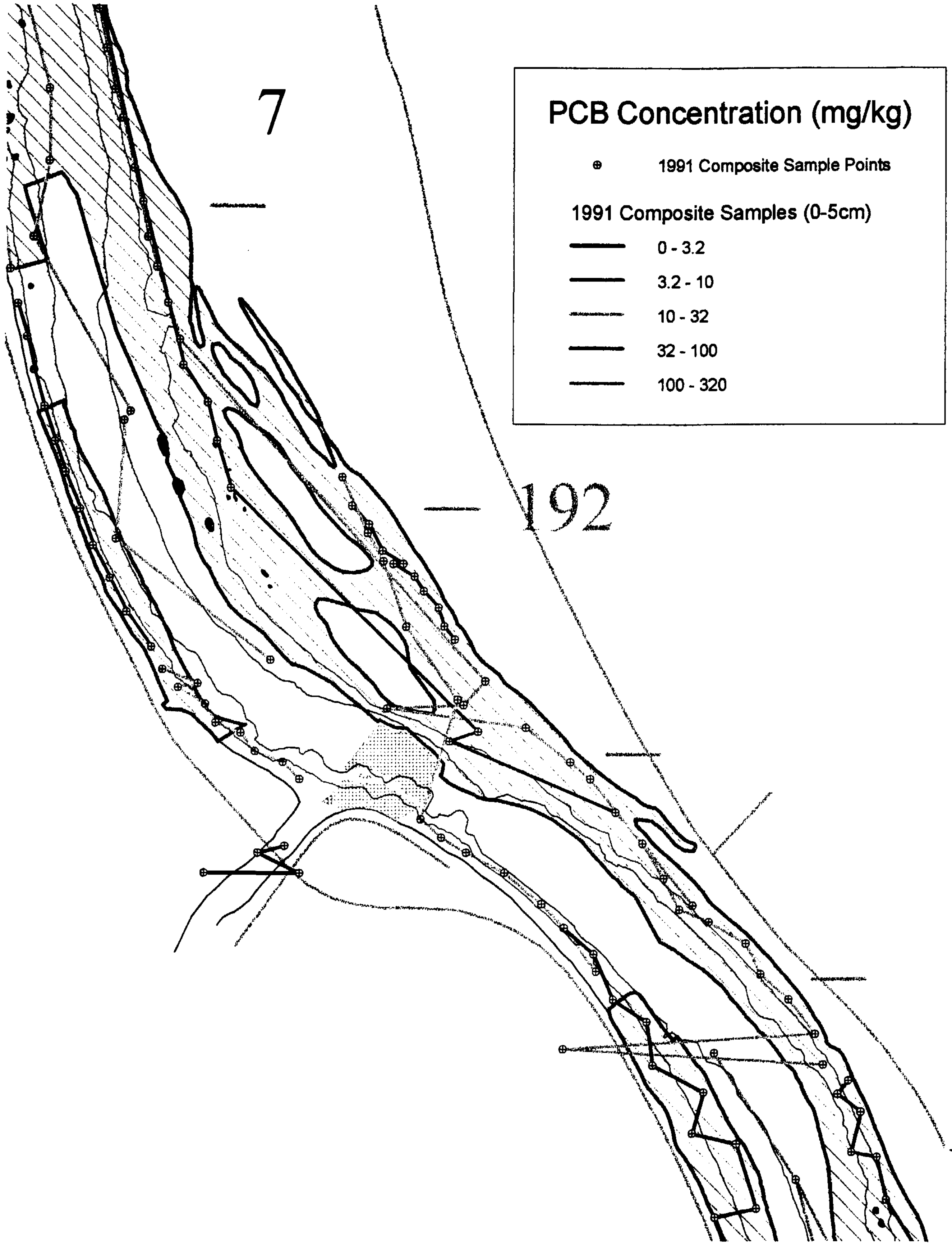
N W E S

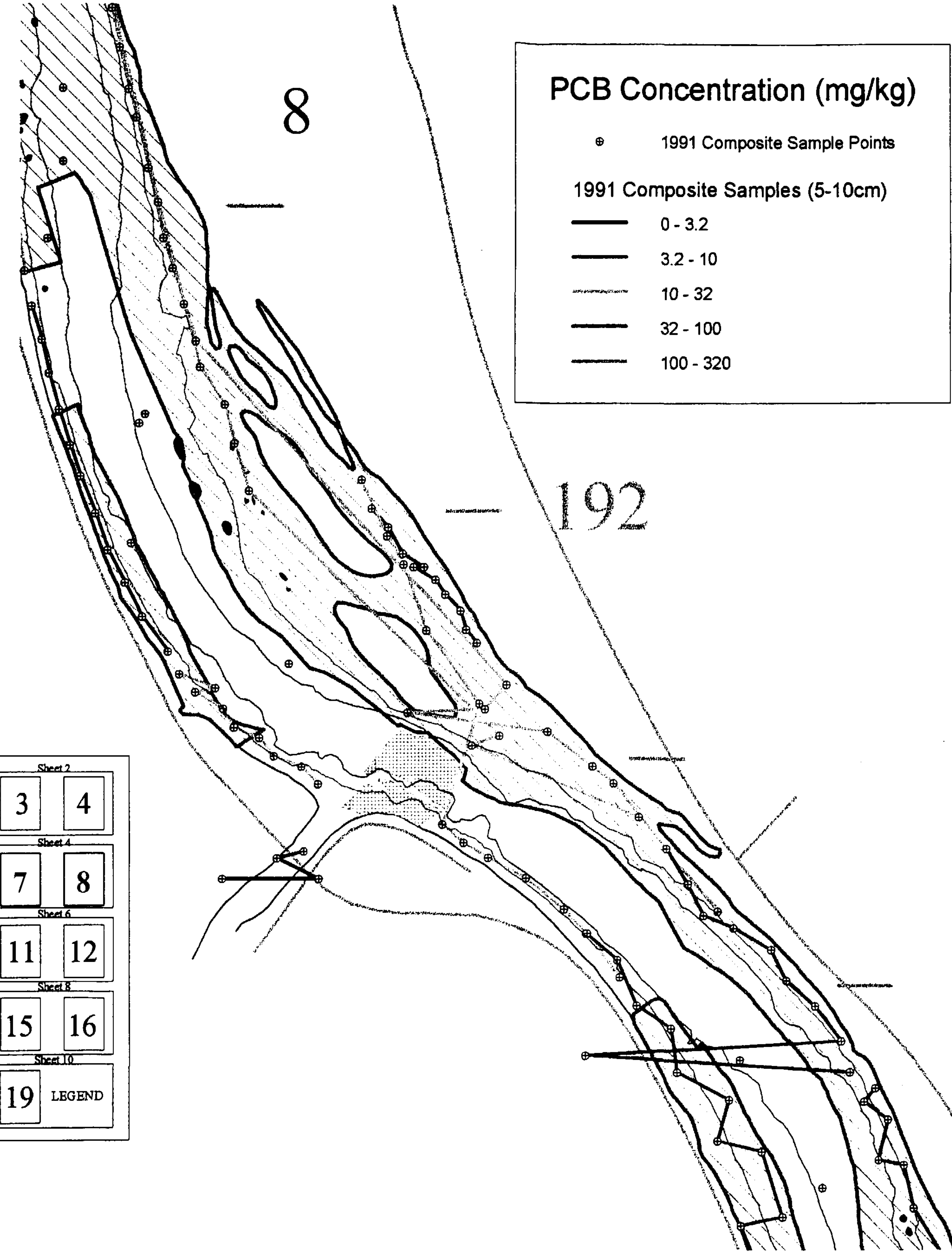
Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 3 of 10

401080





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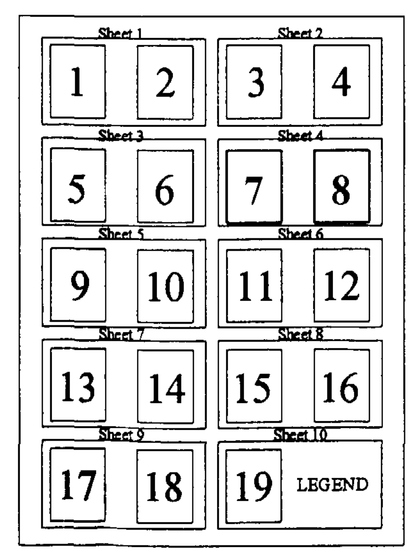

TAMS
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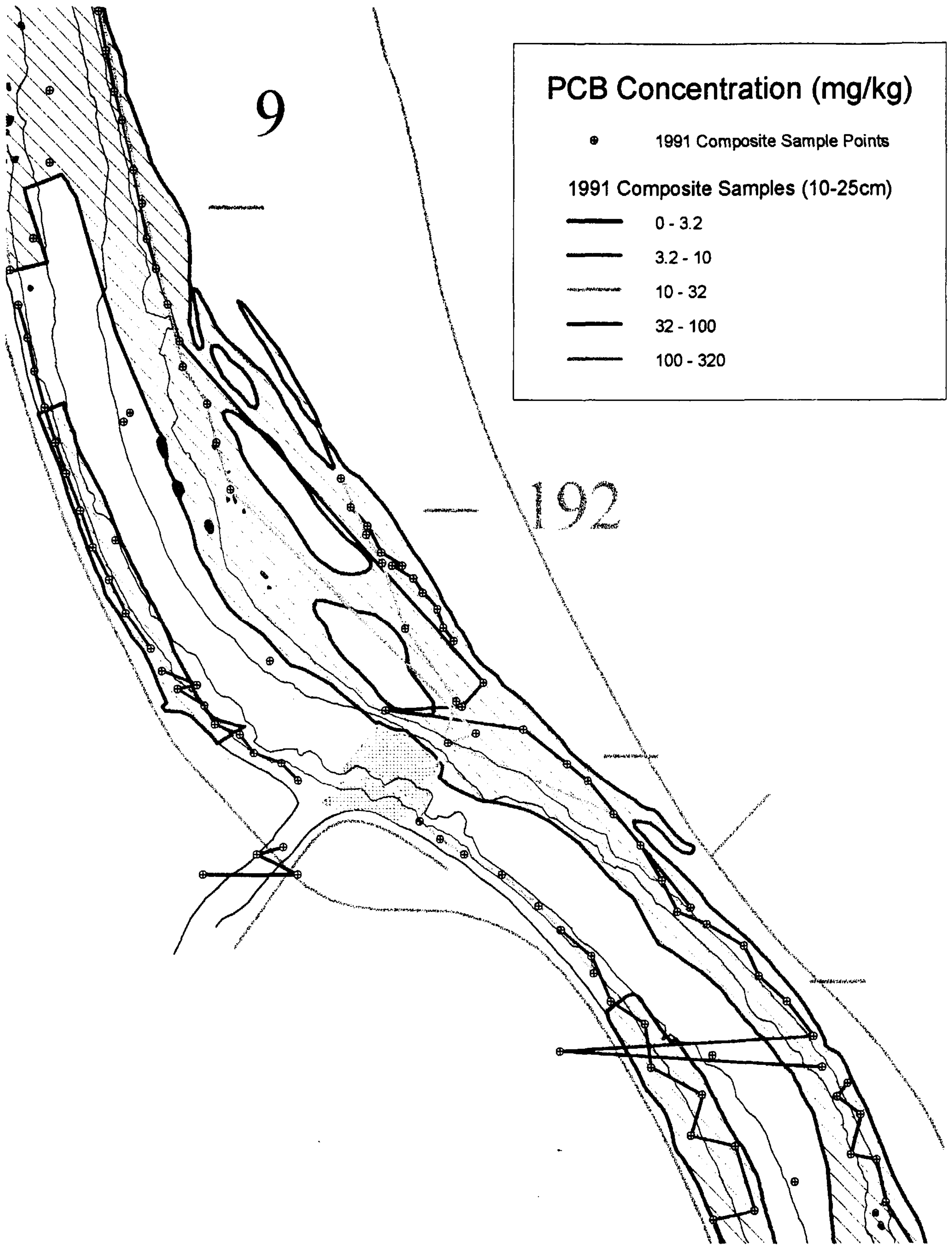
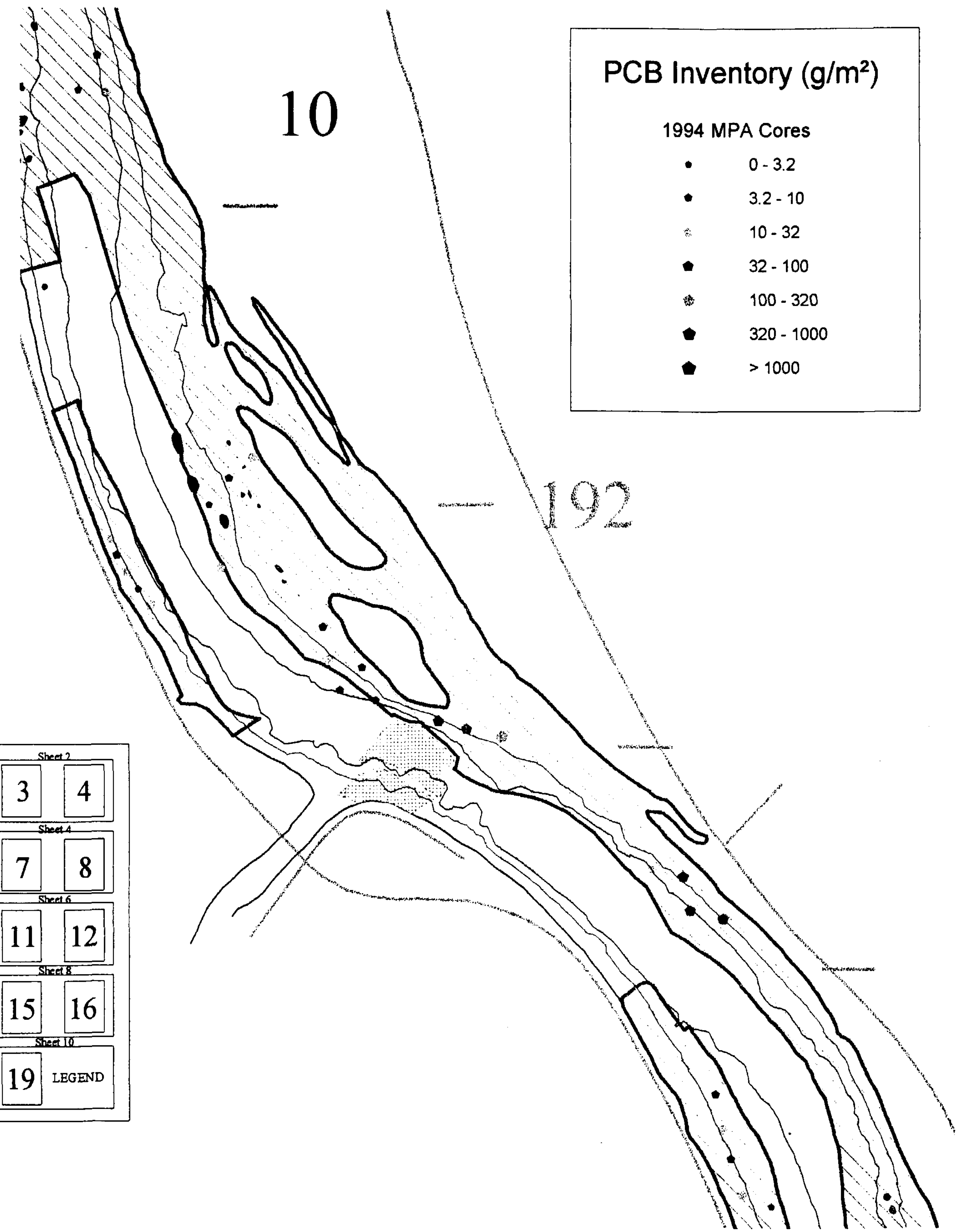
Note: See General Legend on Sheet 10.

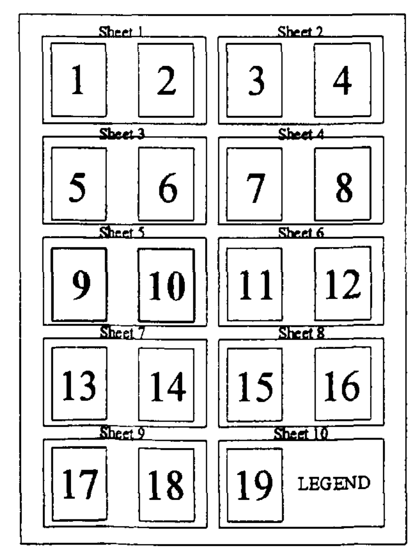
200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

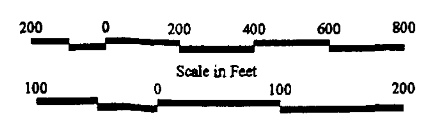
Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 4 of 10

401081









TAMS

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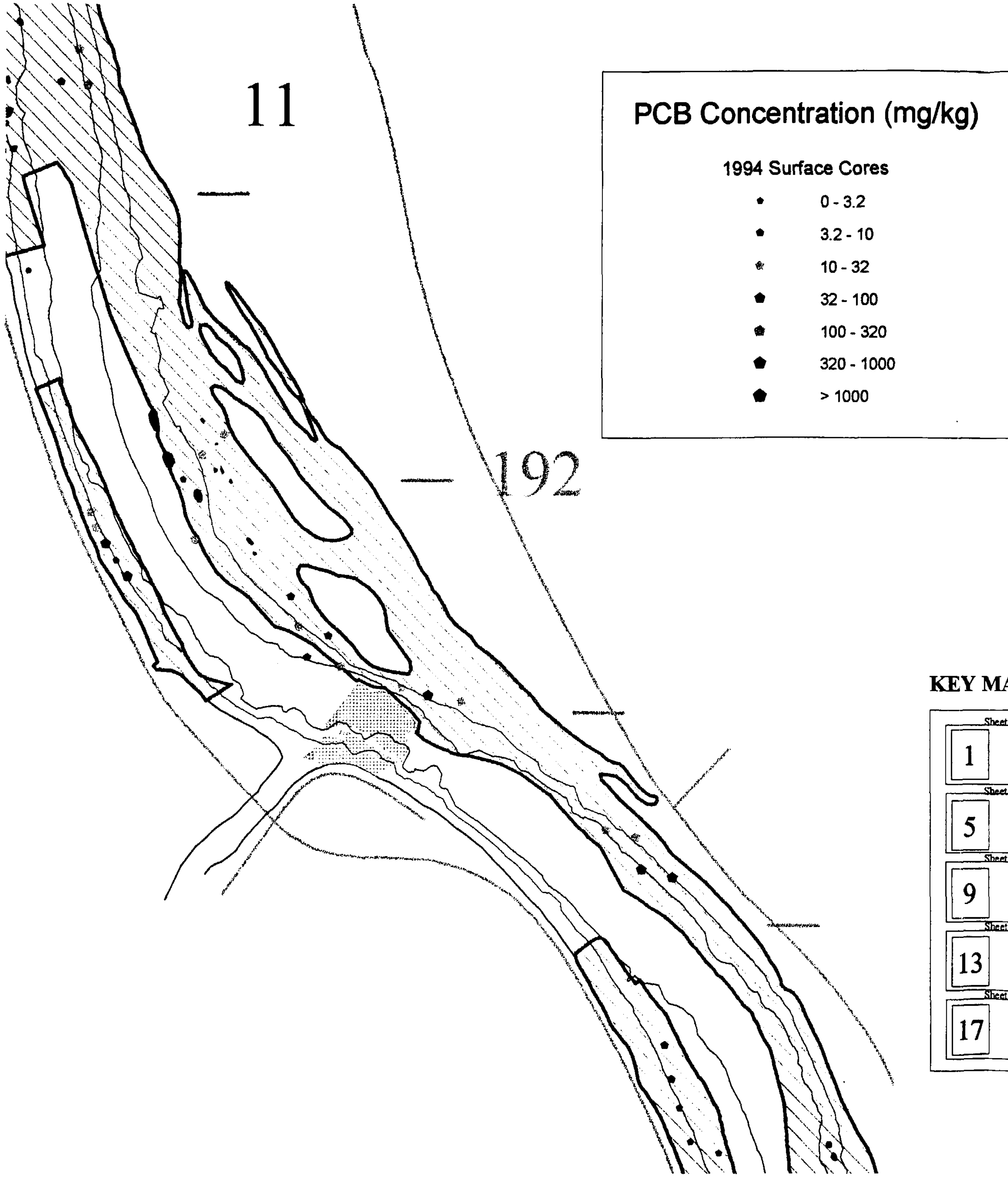
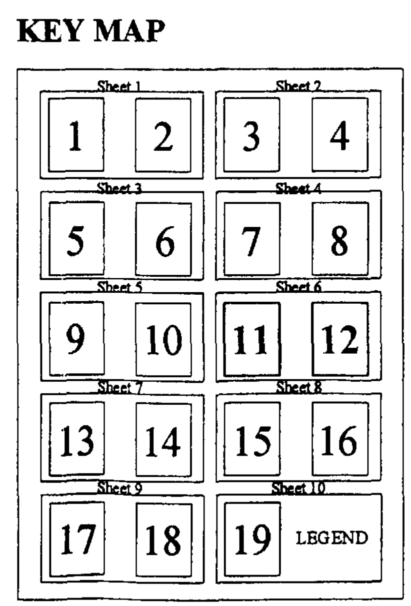
N W E S

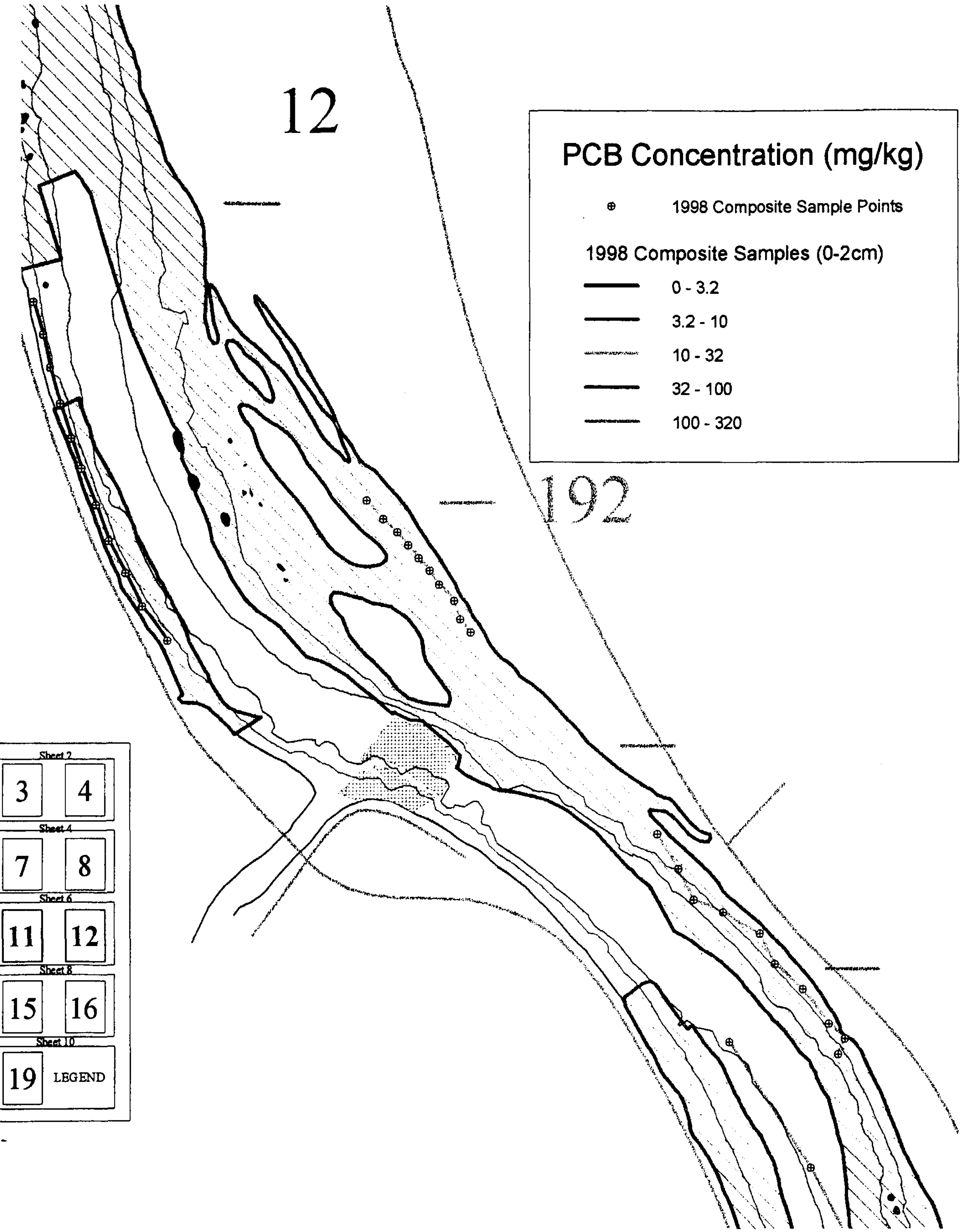
Note: See General Legend on Sheet 10.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 5 of 10

401082







TAMS
TAMS Consultants, Inc.

N
W E
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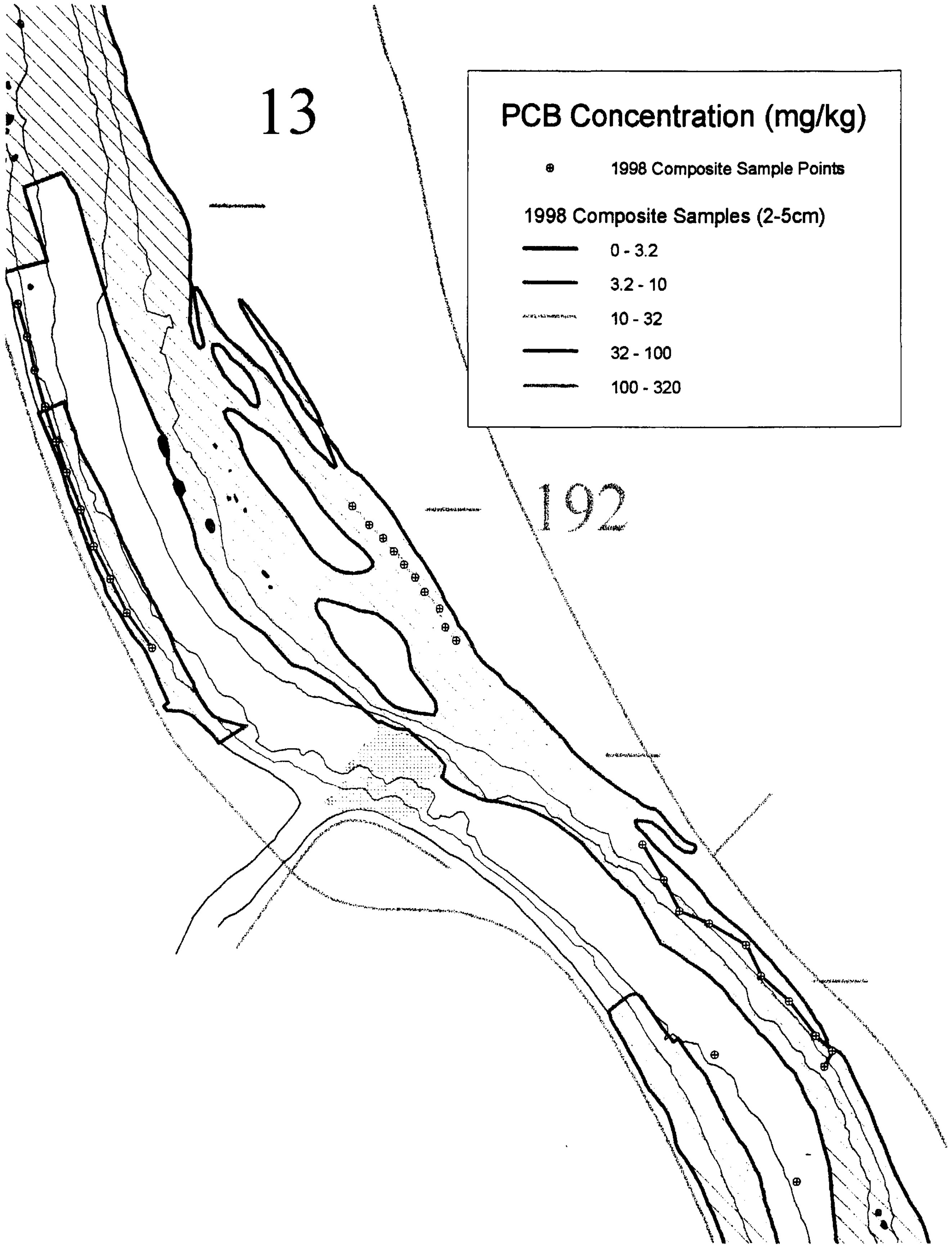
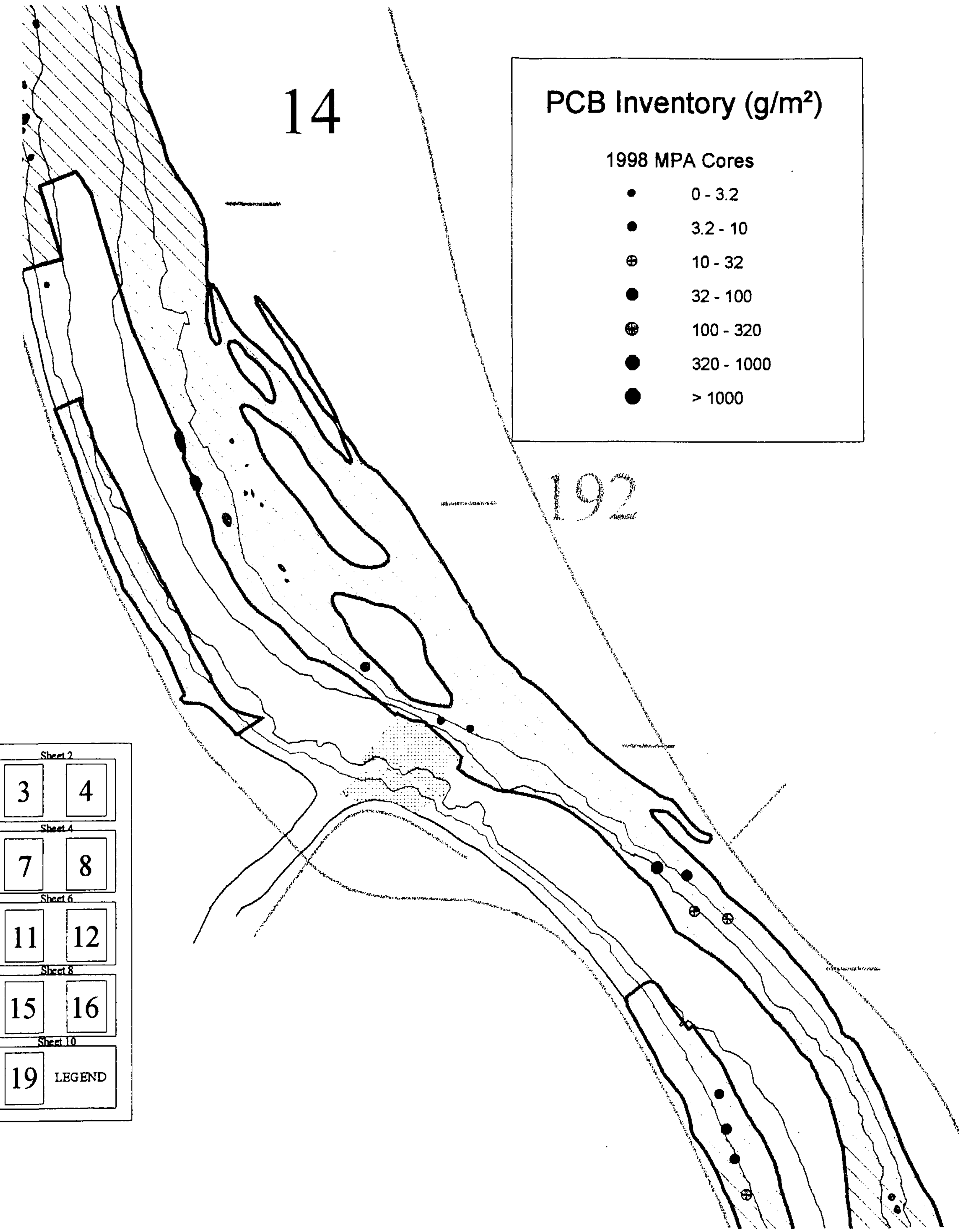
Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

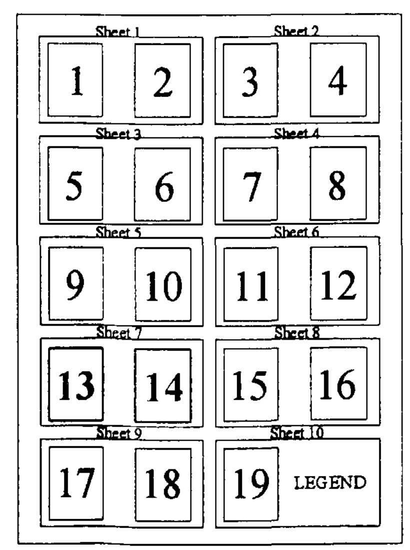
Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 6 of 10

401083





KEY MAP



TAMS

TAMS Consultants, Inc.

N
W E
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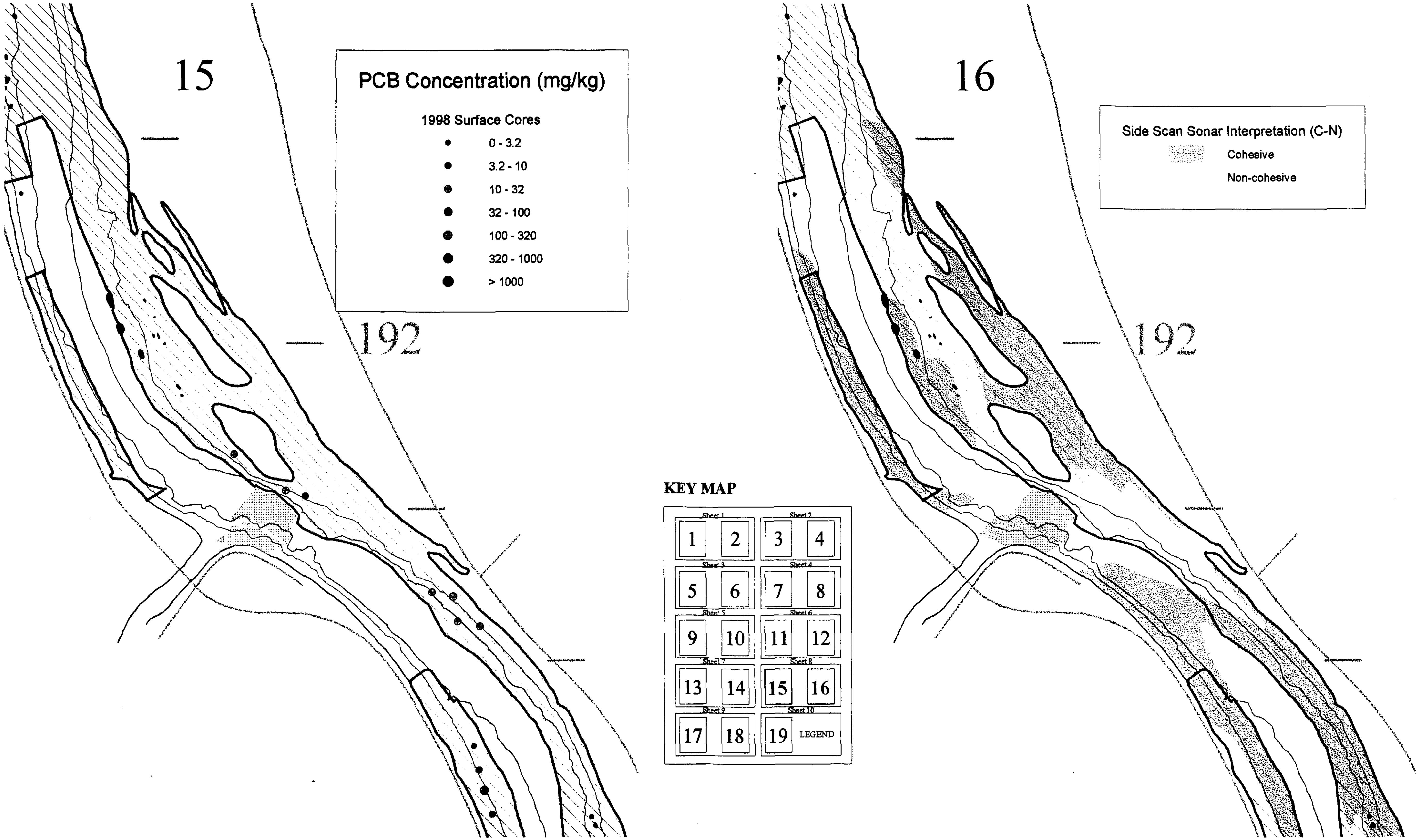
Note: See General Legend on Sheet 10.

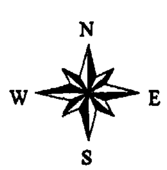
200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 7 of 10

401084



TAMS
TAMS Consultants, Inc.



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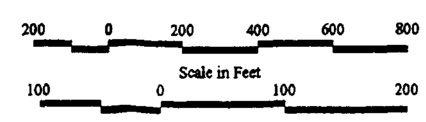
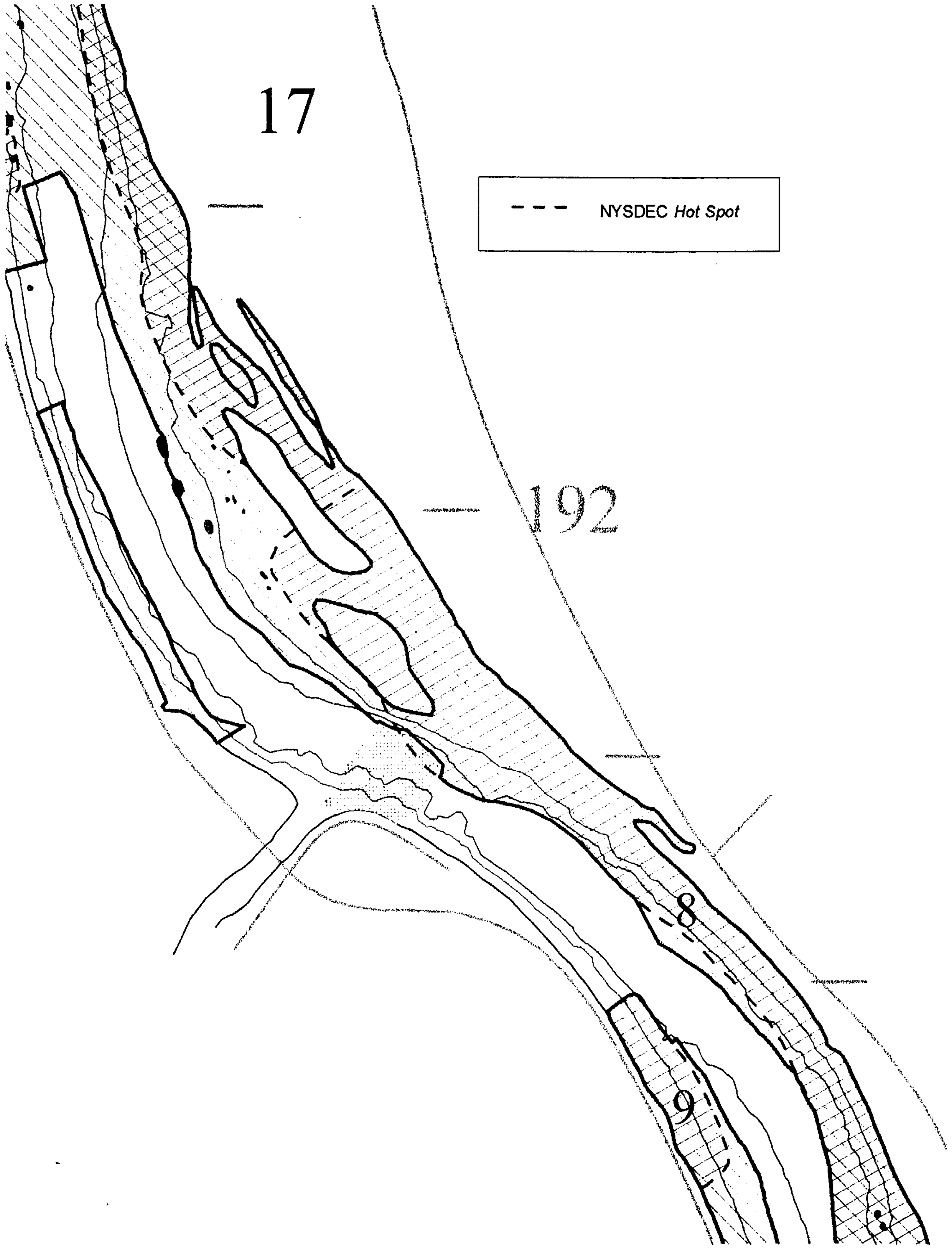
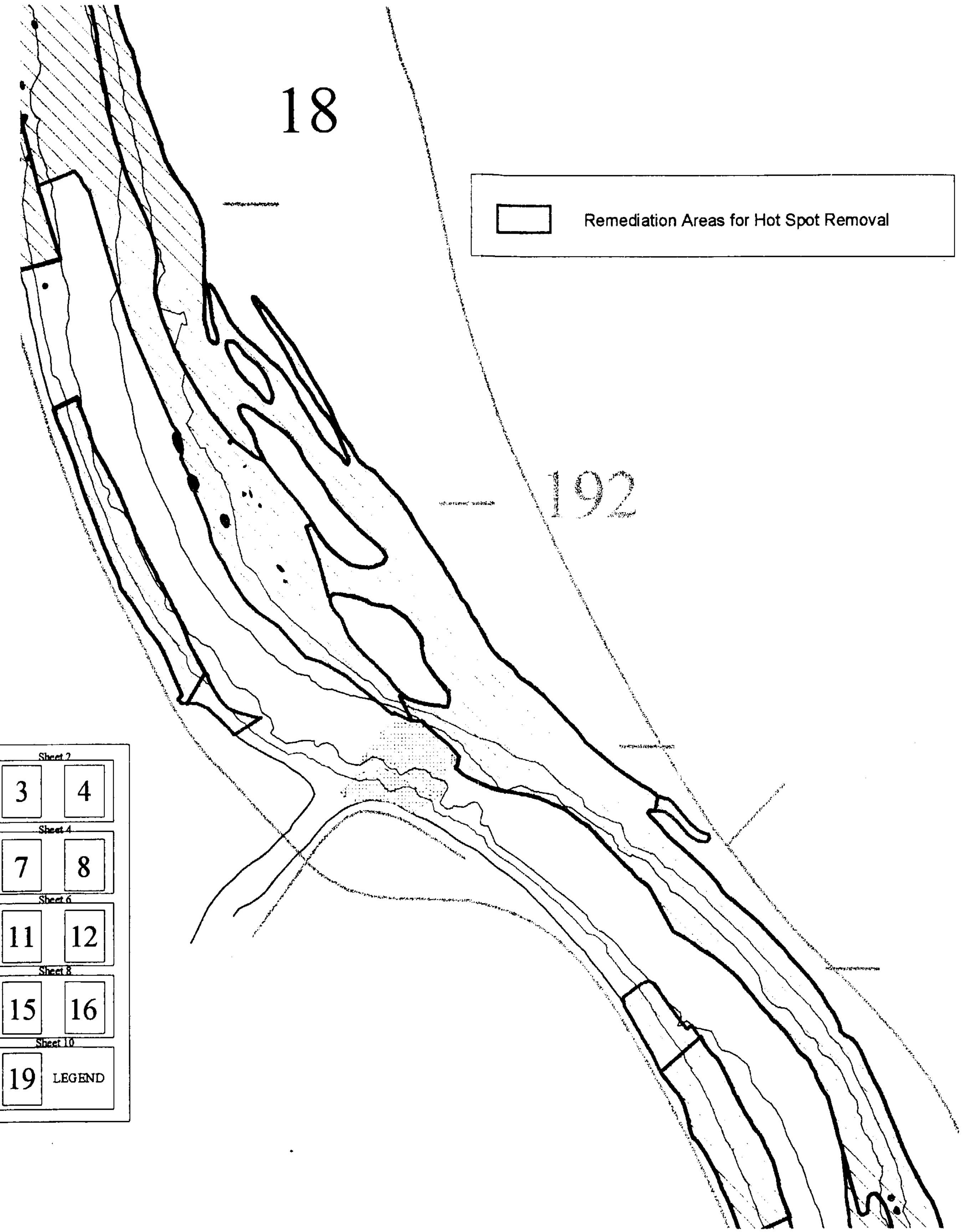


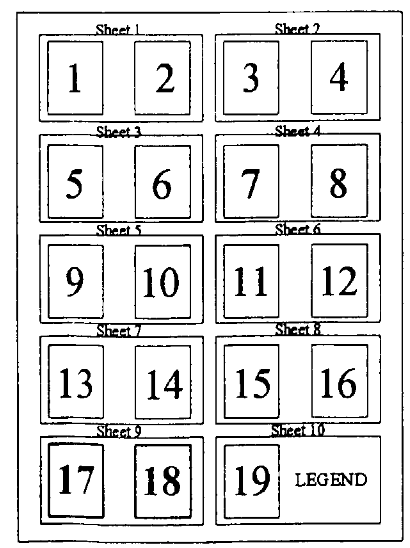
Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 8 of 10

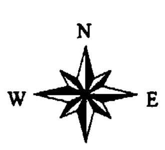
401085

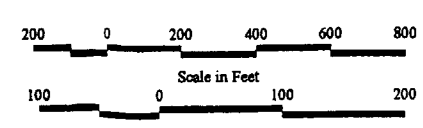




KEY MAP



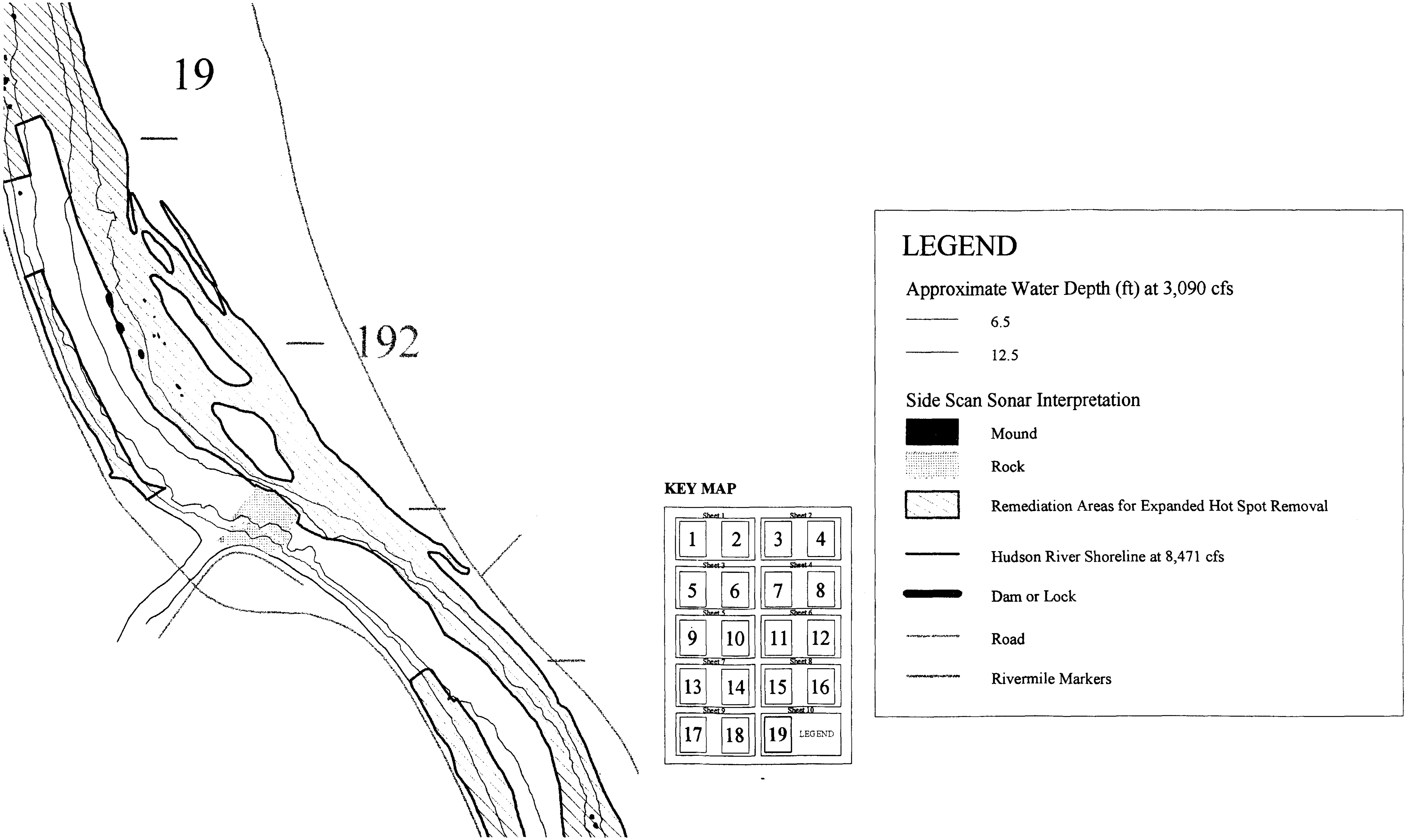




TAMS
TAMS Consultants, Inc.

Note: See General Legend on Sheet 10.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 9 of 10



TAMS

TAMS Consultants, Inc.

N W E S

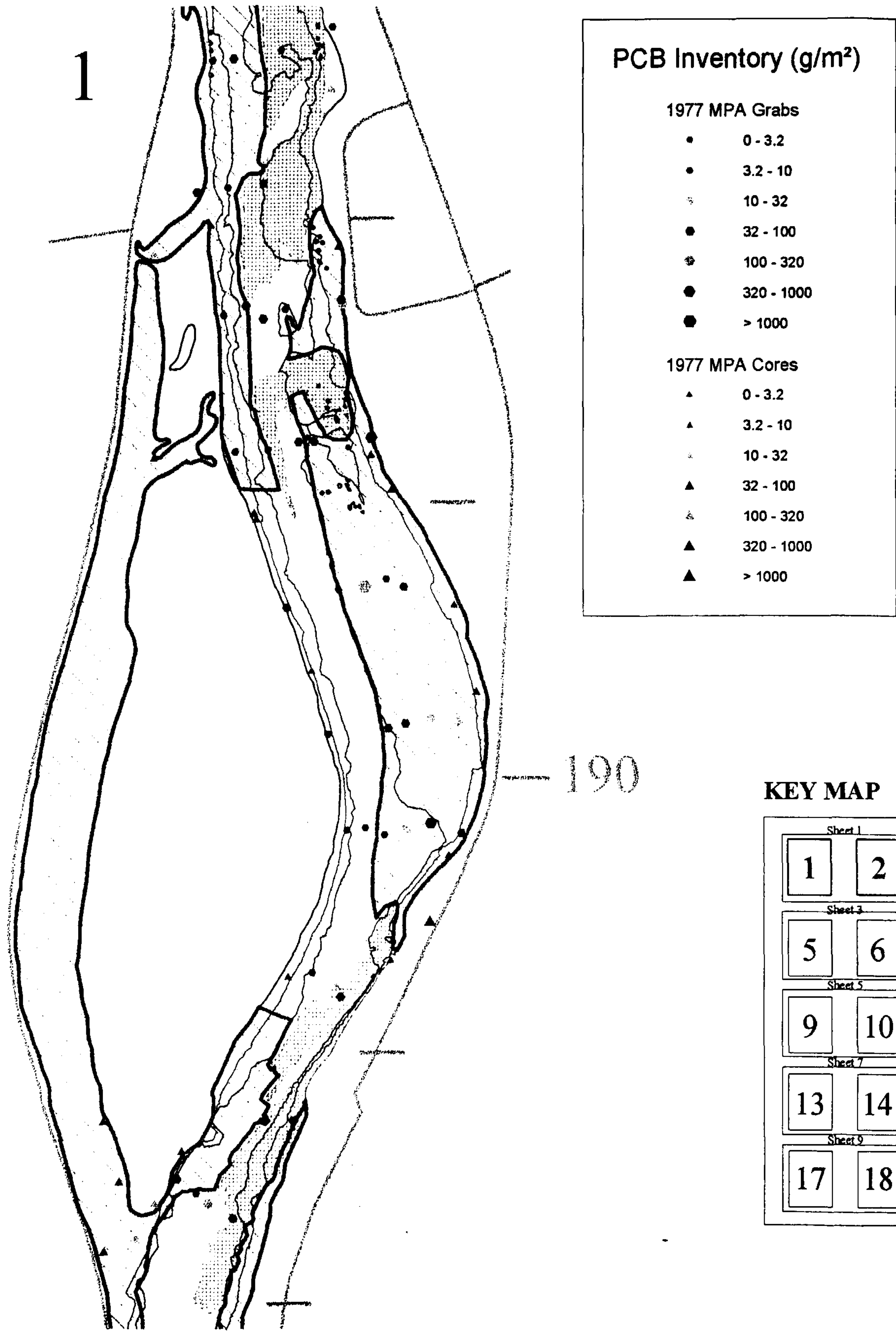
200 0 200 400 600 800

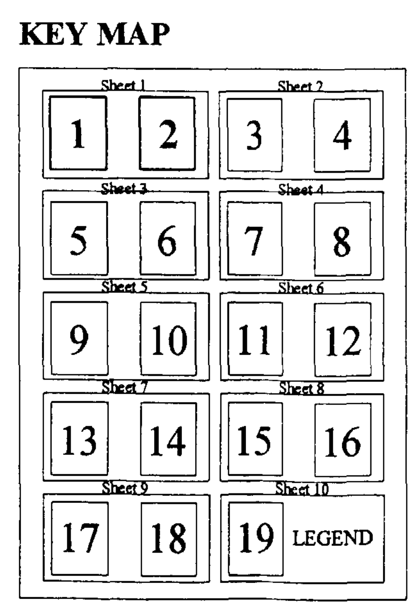
Scale in Feet

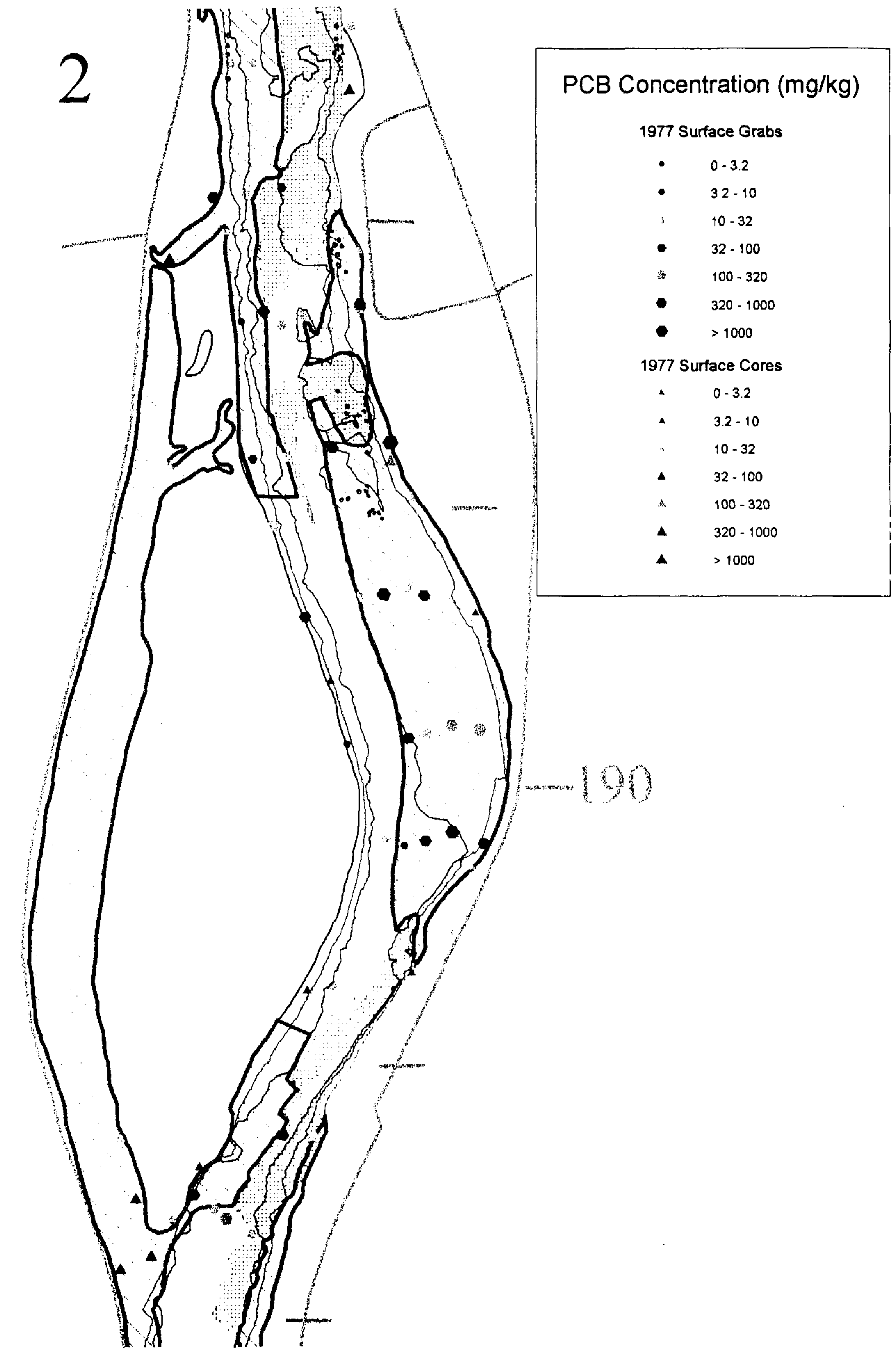
100 0 100 200

Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-15 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 8*	Sheet 10 of 10







TAMS

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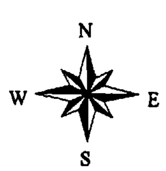
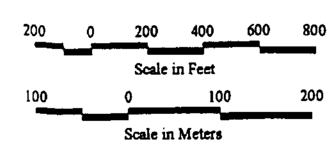


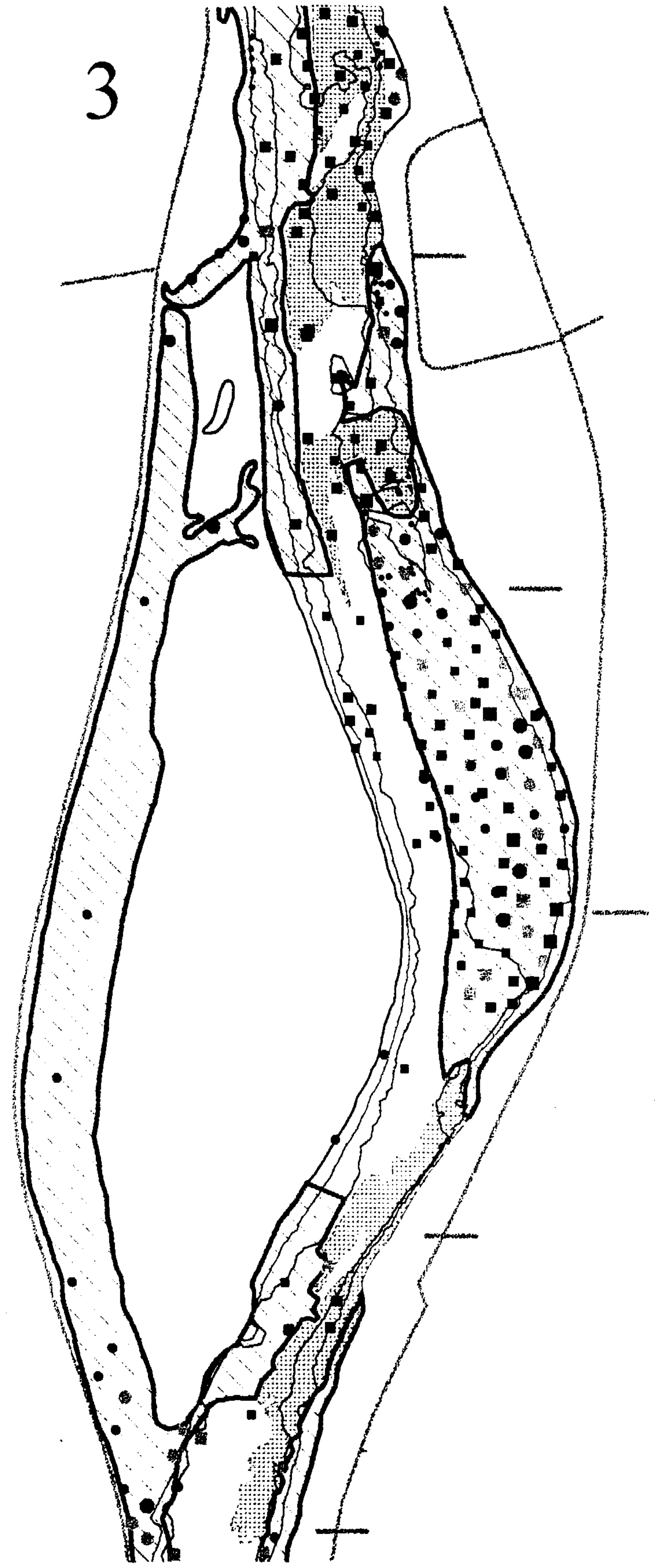
Note: See General Legend on Sheet 10.



Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 1 of 10

401088

3



PCB Inventory (g/m²)

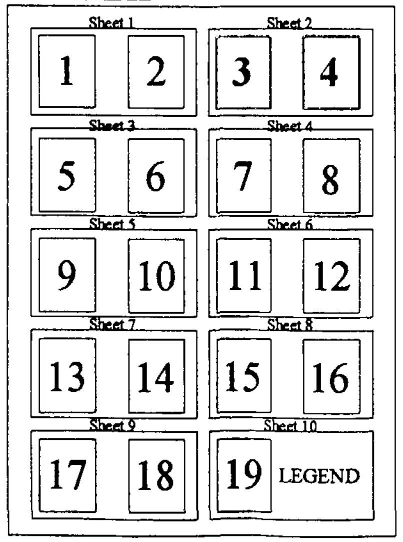
1984 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1984 MPA Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

KEY MAP



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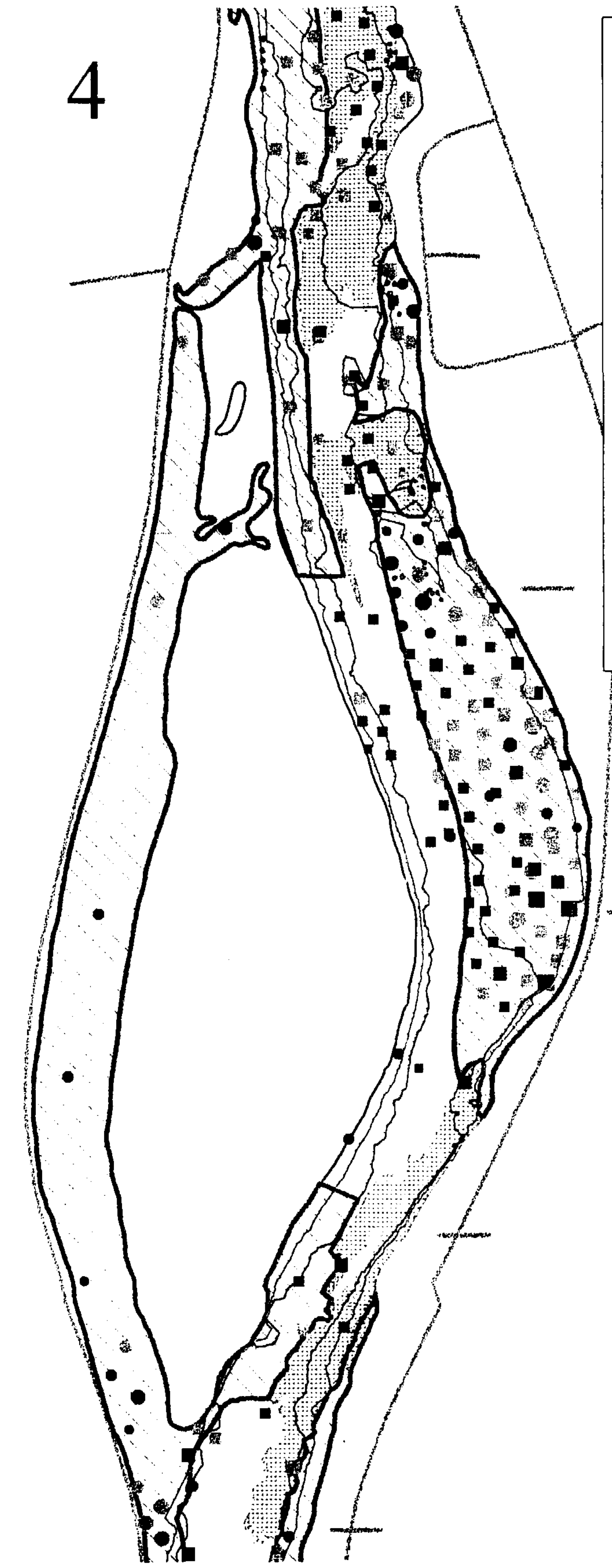


PCB Concentration (mg/kg)

1984 Surface Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1984 Surface Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

TAMS

TAMS Consultants, Inc.

N W E S

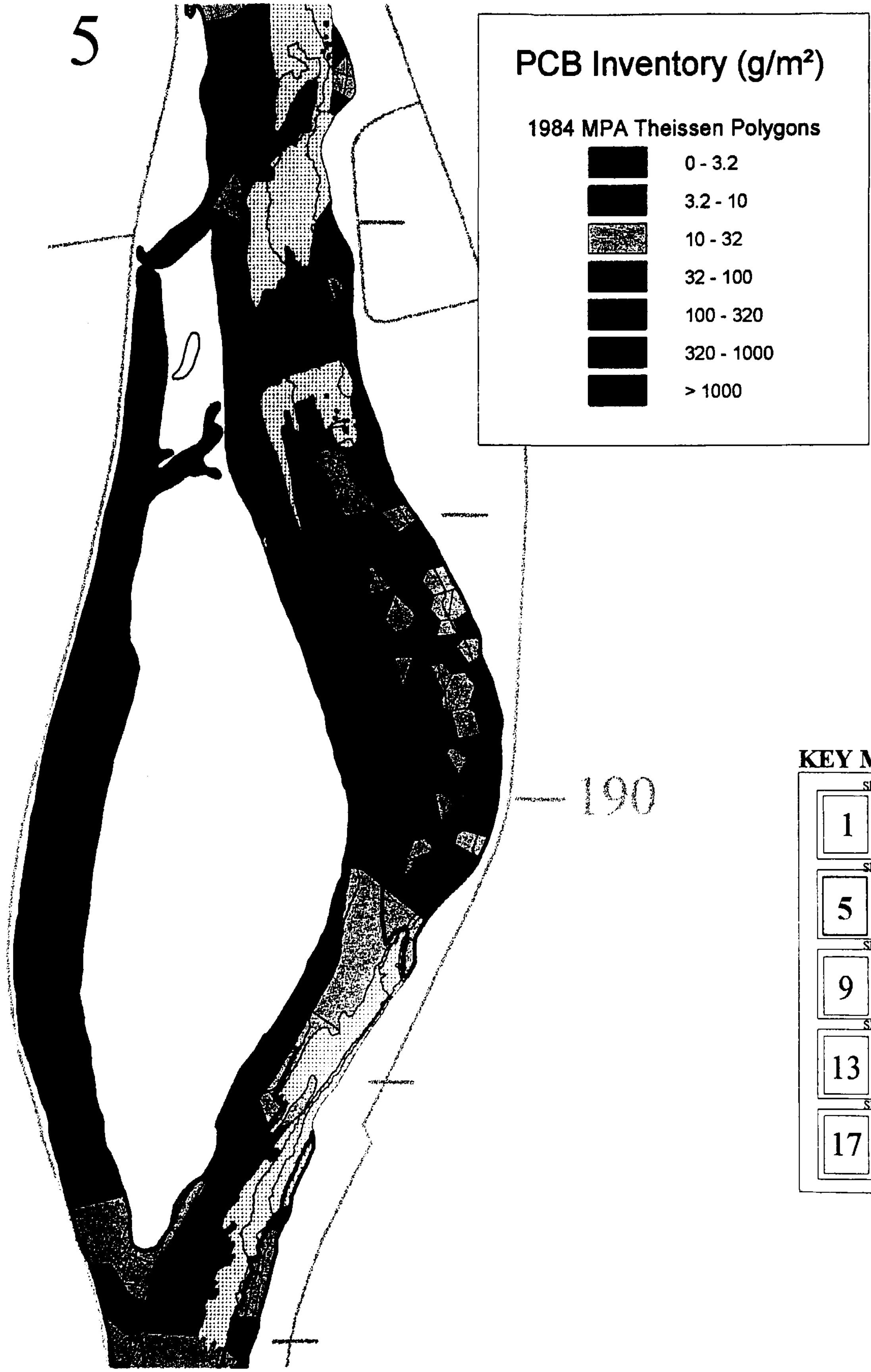
Note: See General Legend on Sheet 10.

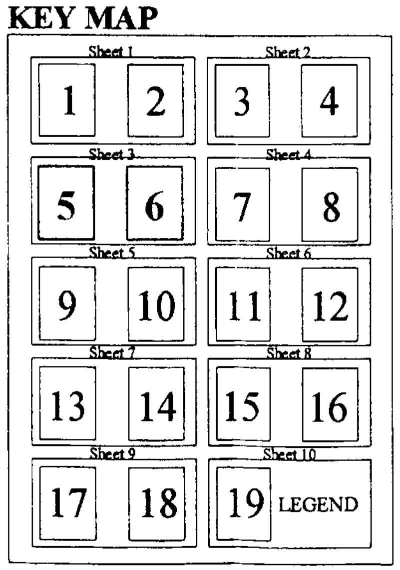
200 0 200 400 600 800
Scale in Feet

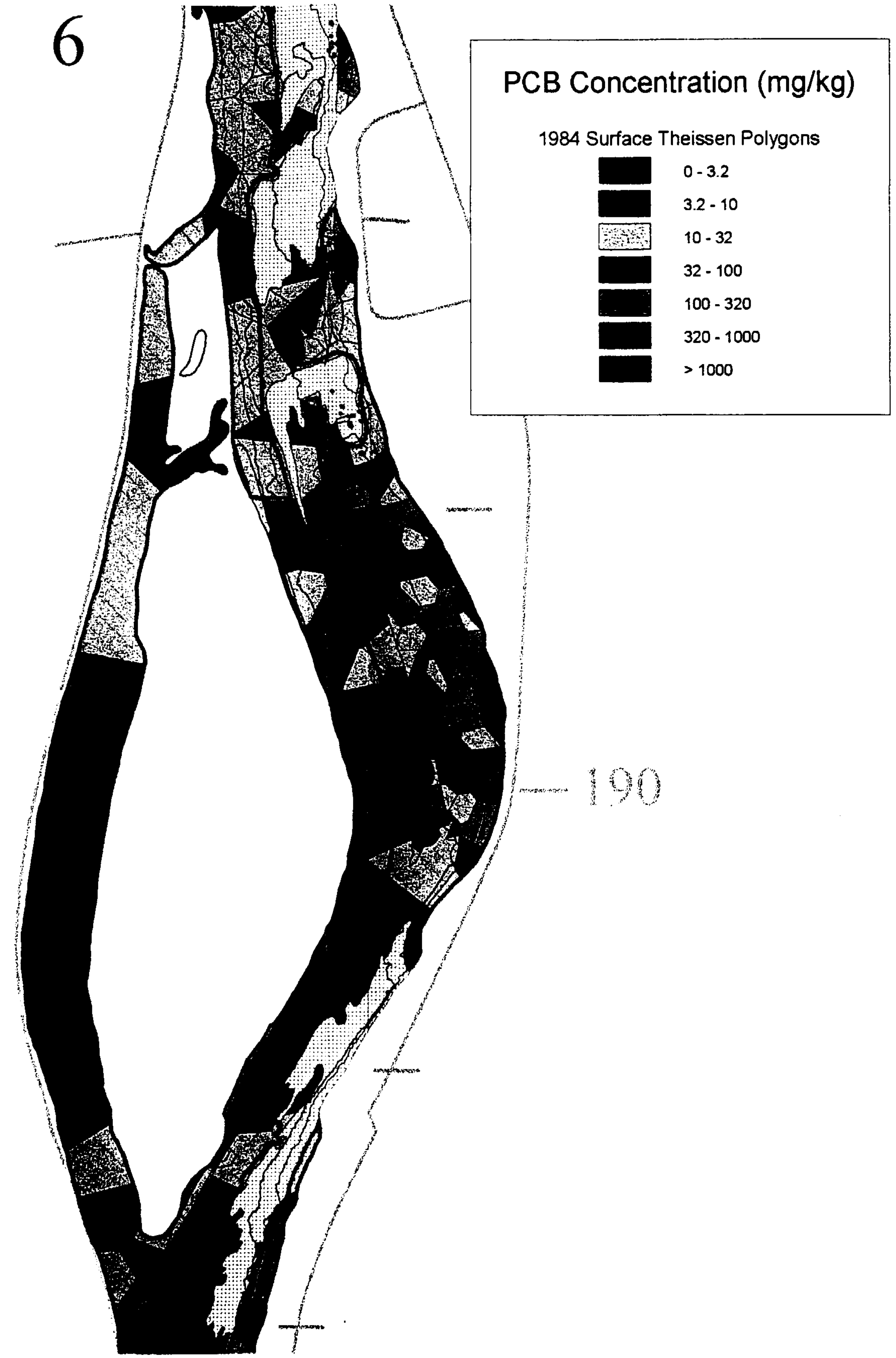
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 2 of 10

401089







TAMS

TAMS Consultants, Inc.

N W E S

Note: See General Legend on Sheet 10.

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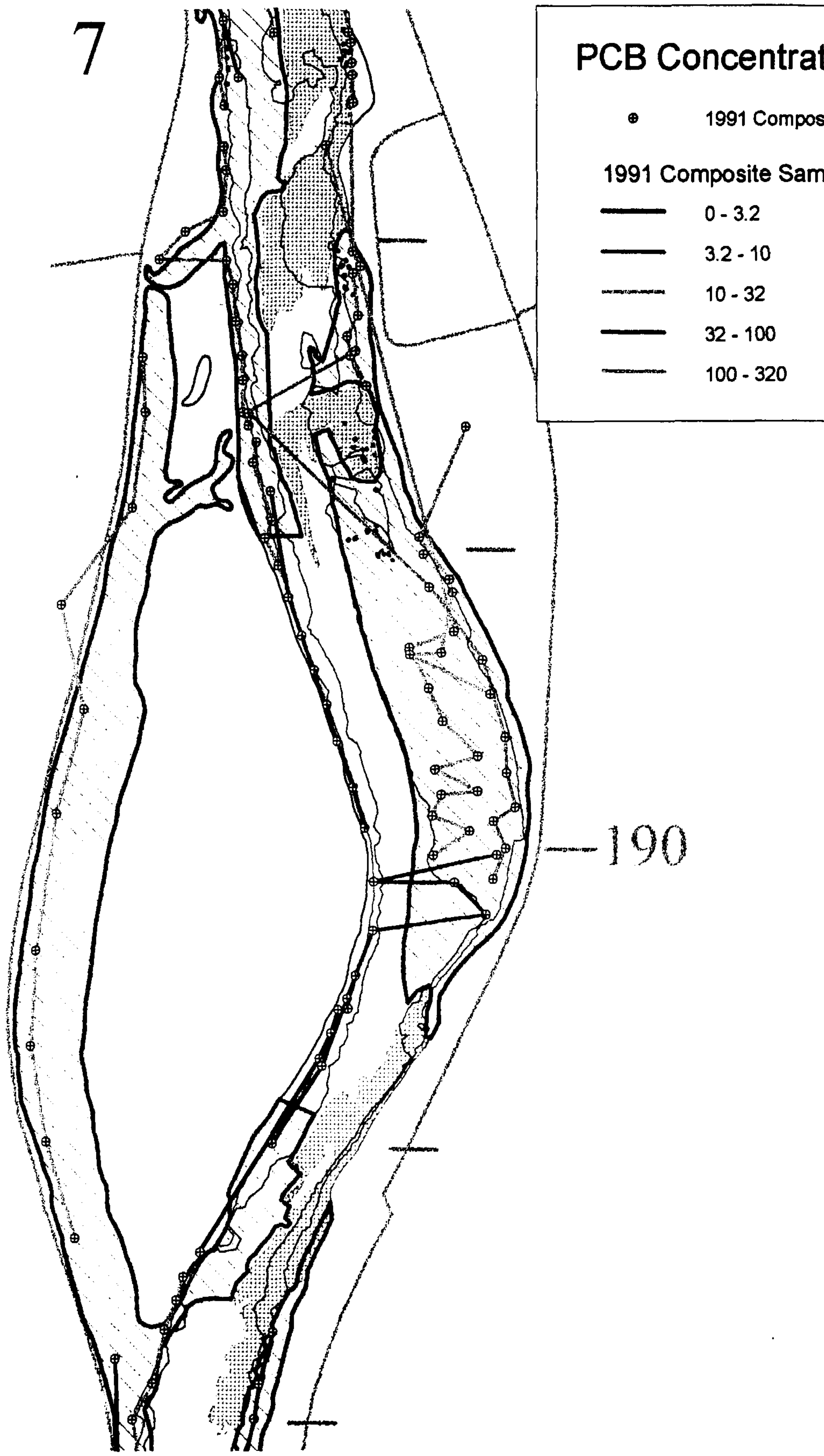
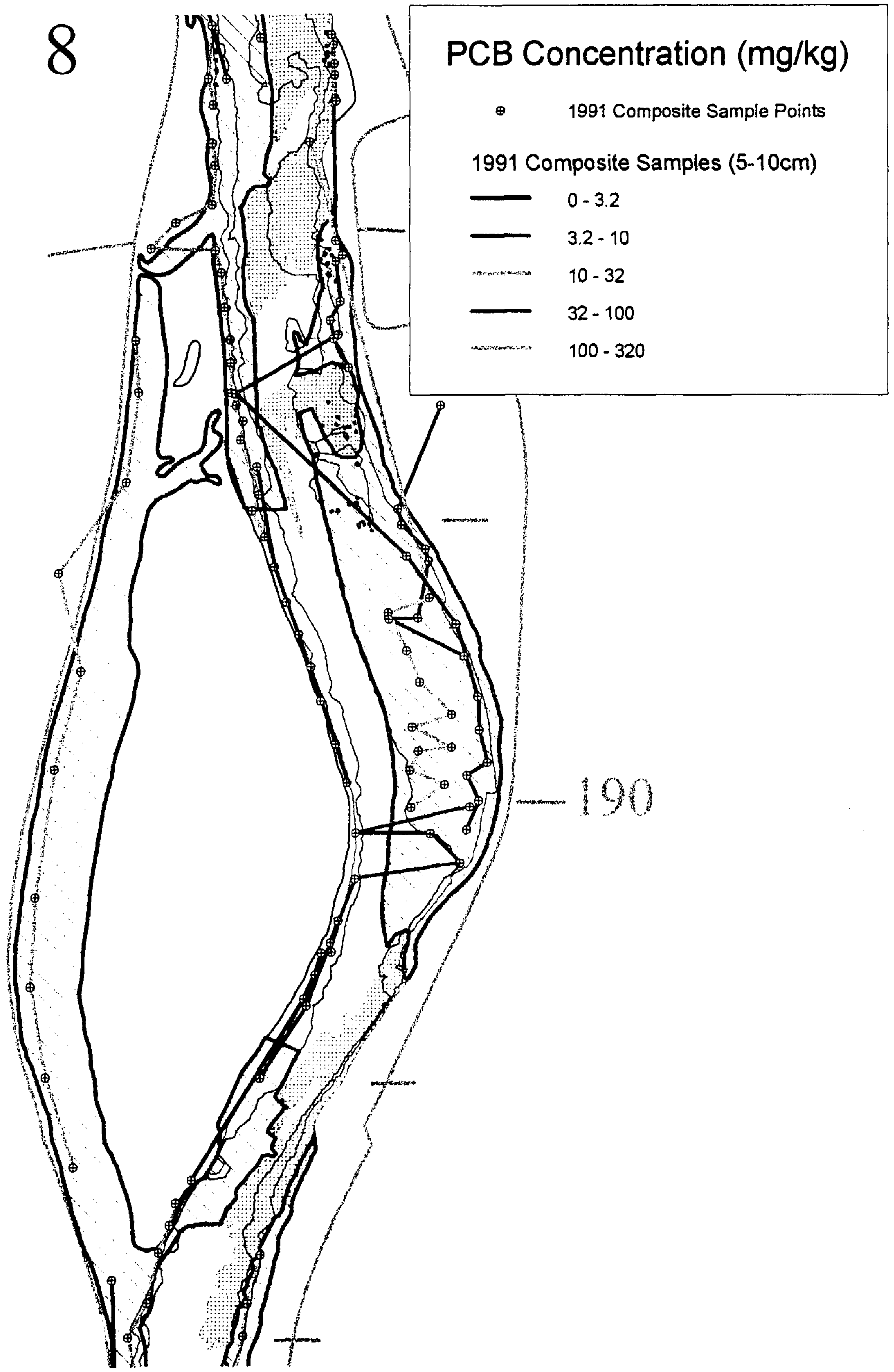
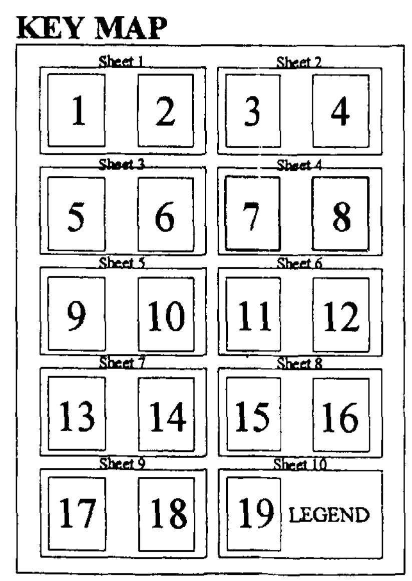
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16	Sheet 3 of 10
	Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	

401090







TAMS
TAMS Consultants, Inc.

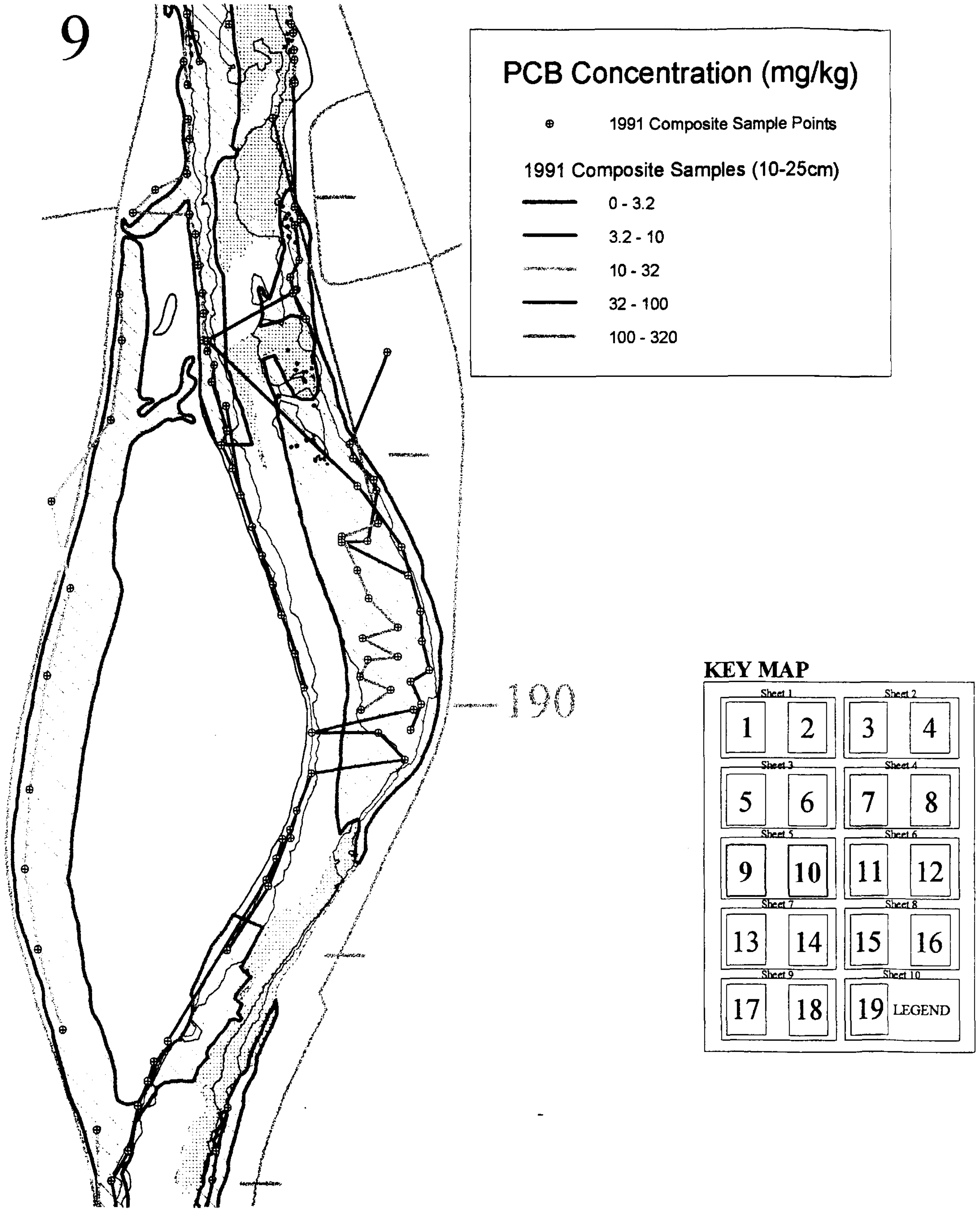
N W E S

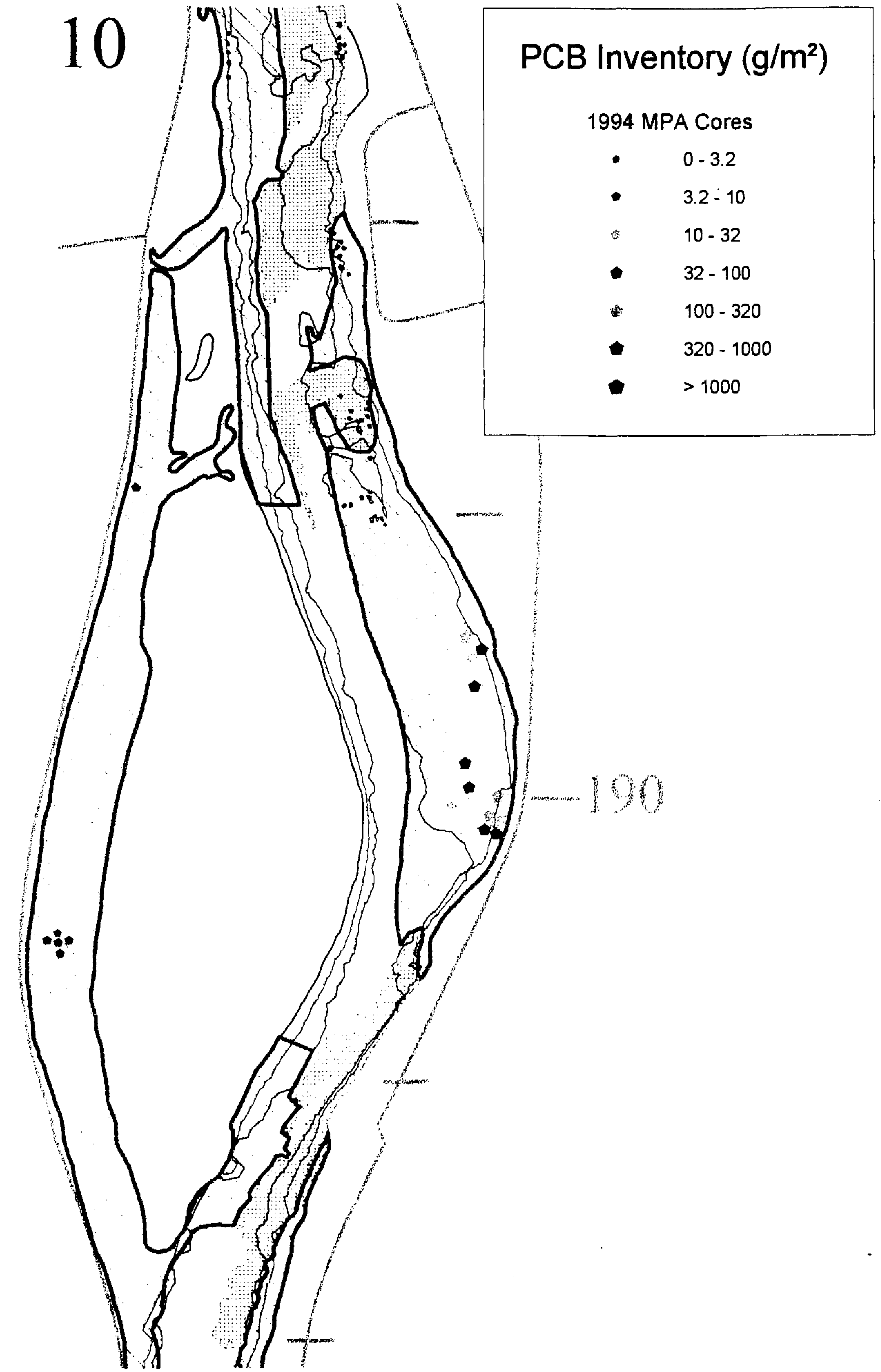
Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 4 of 10

401091





TAMS

TAMS Consultants, Inc.

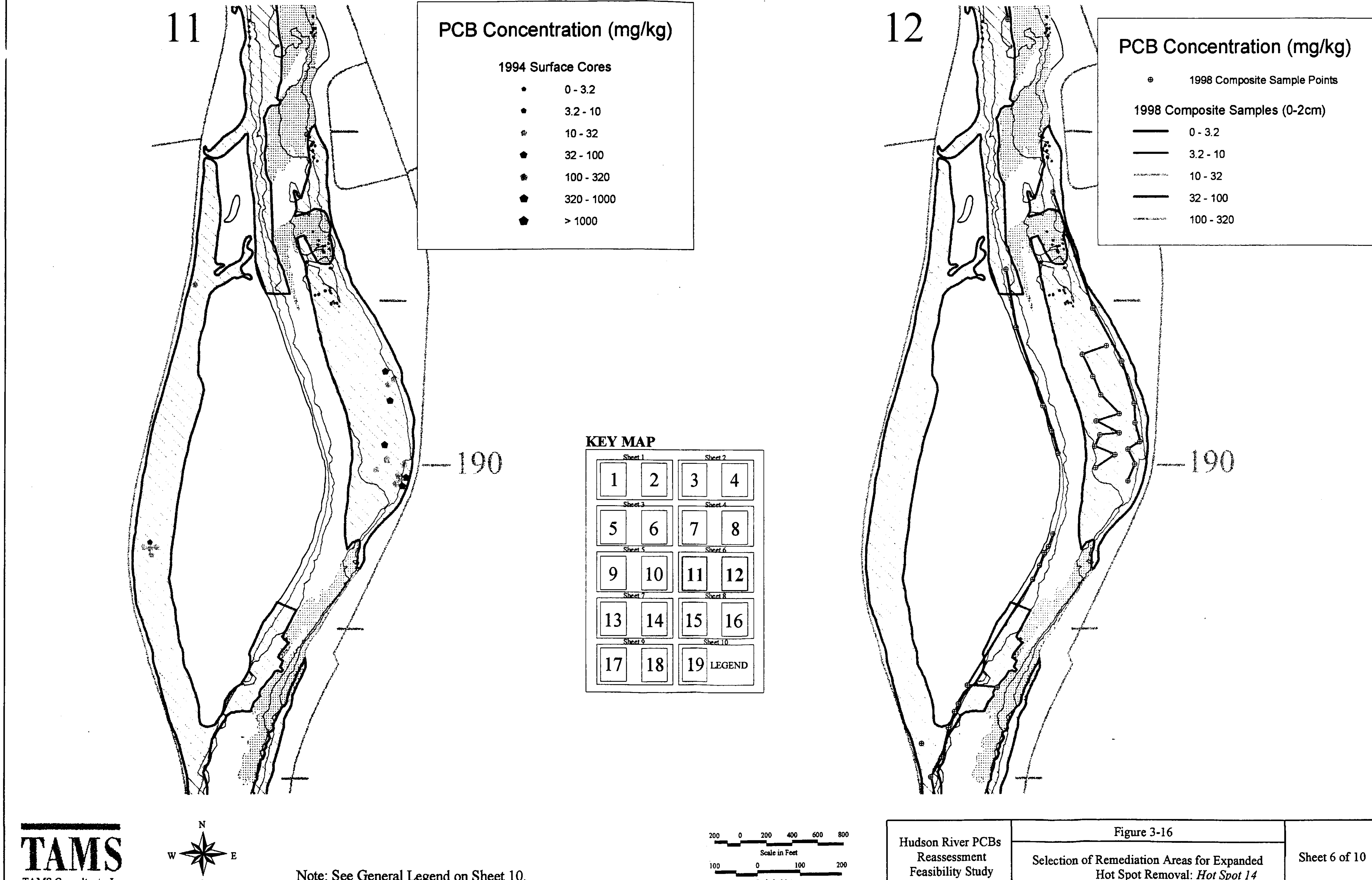
N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 5 of 10

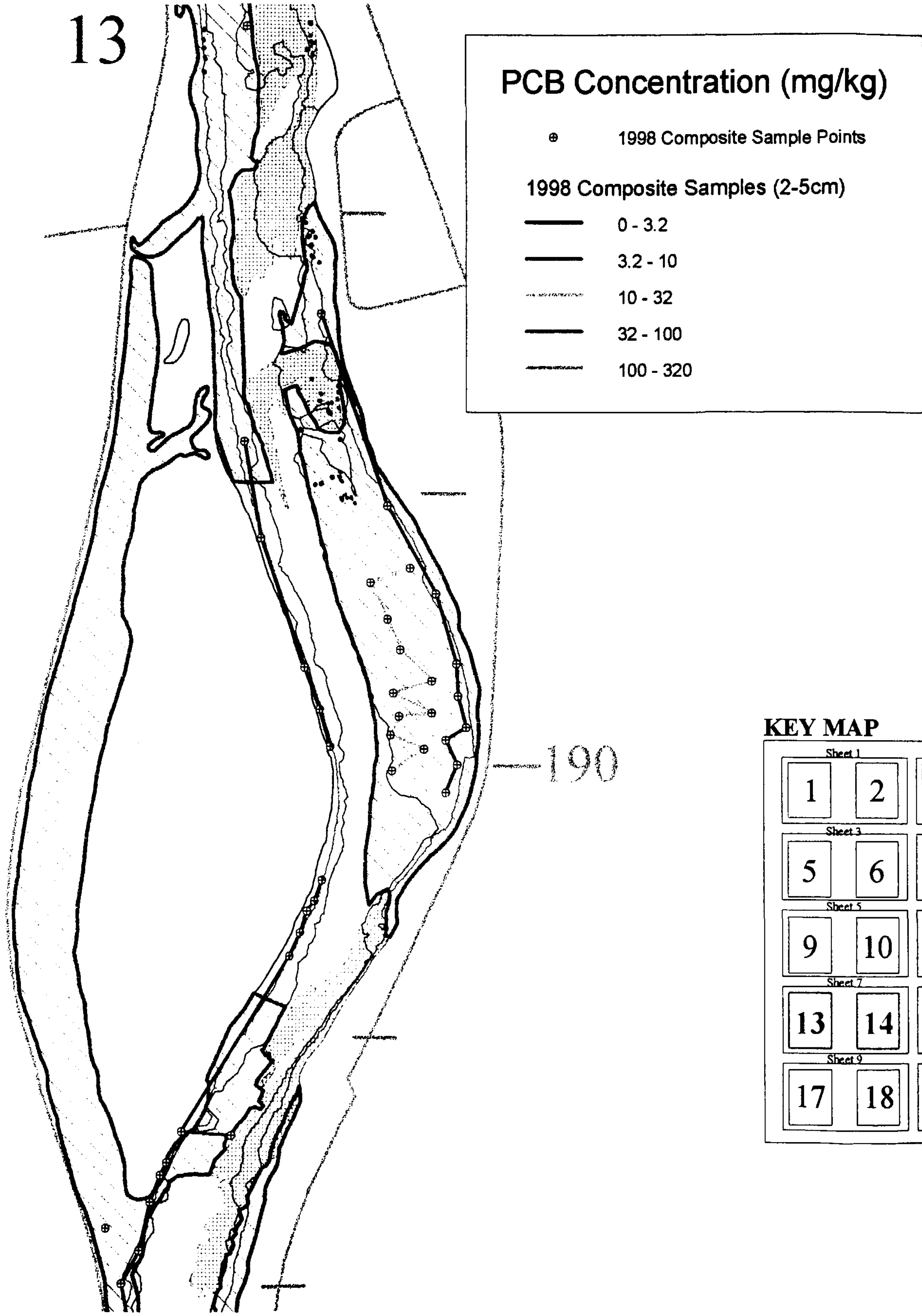
401092

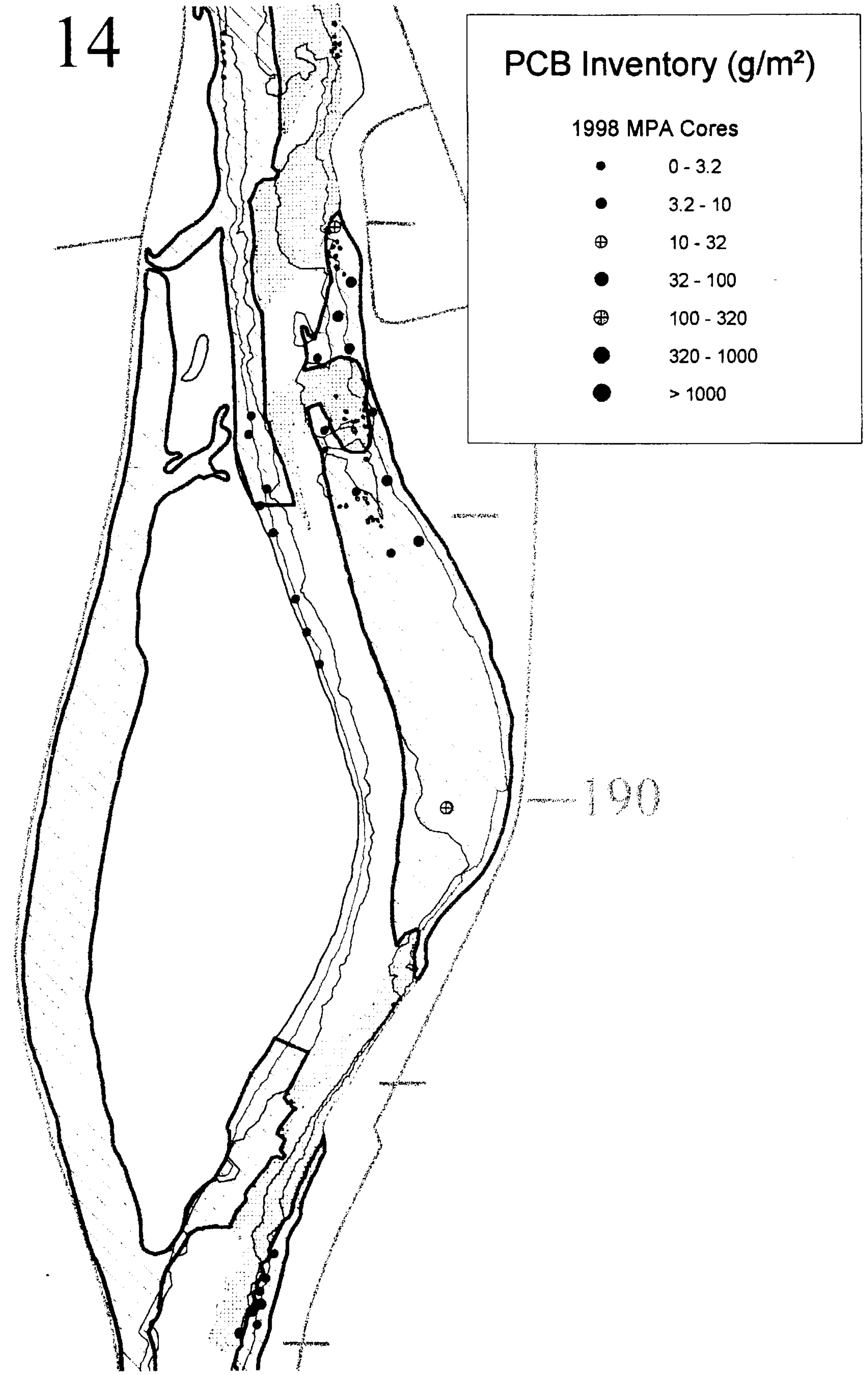


TAMS
TAMS Consultants, Inc.

Note: See General Legend on Sheet 10.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 6 of 10





TAMS

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Note: See General Legend on Sheet 10.

Scale in Feet

Scale in Meters

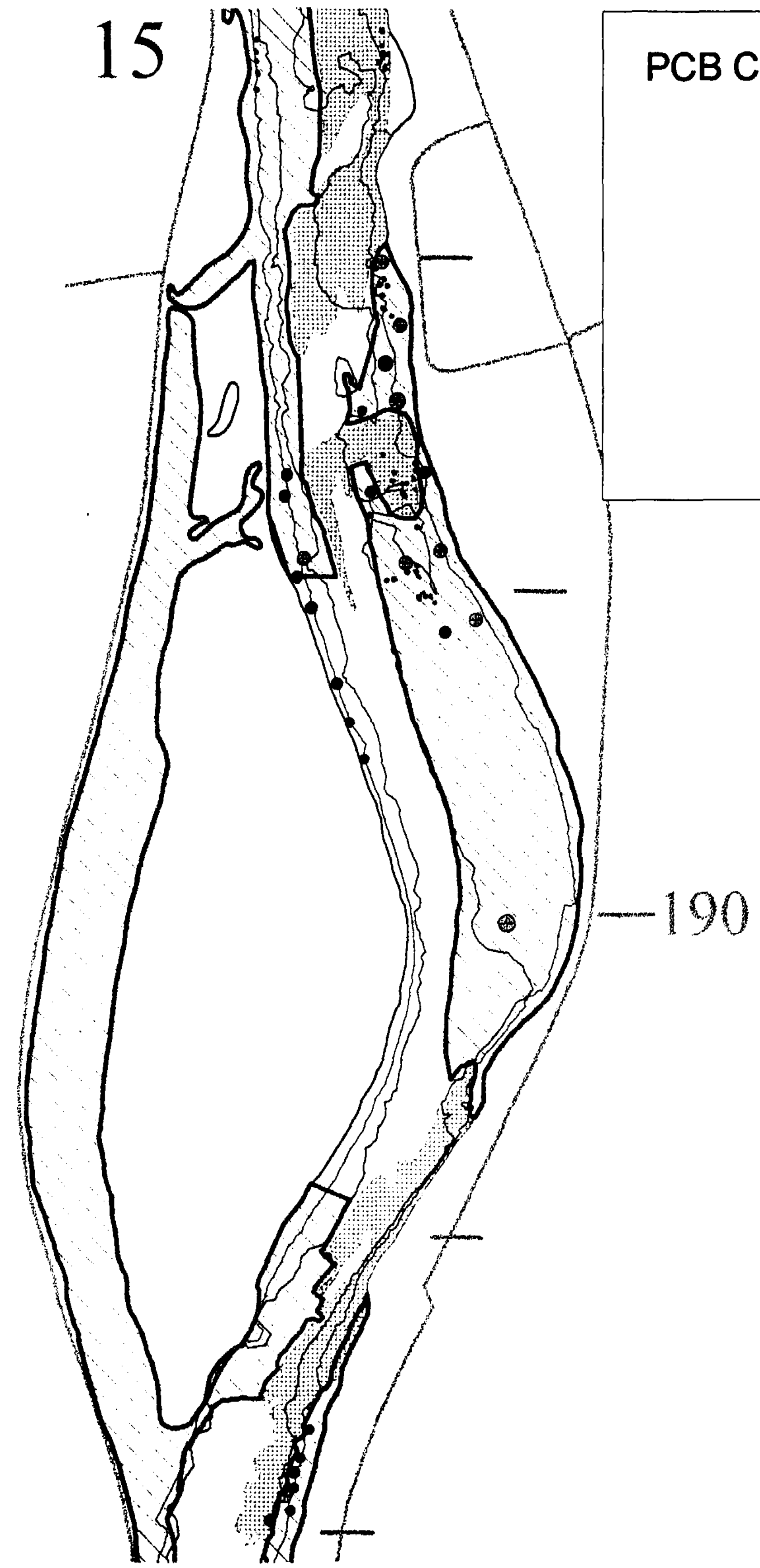
Hudson River PCBs Reassessment Feasibility Study

Figure 3-16

Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*

Sheet 7 of 10

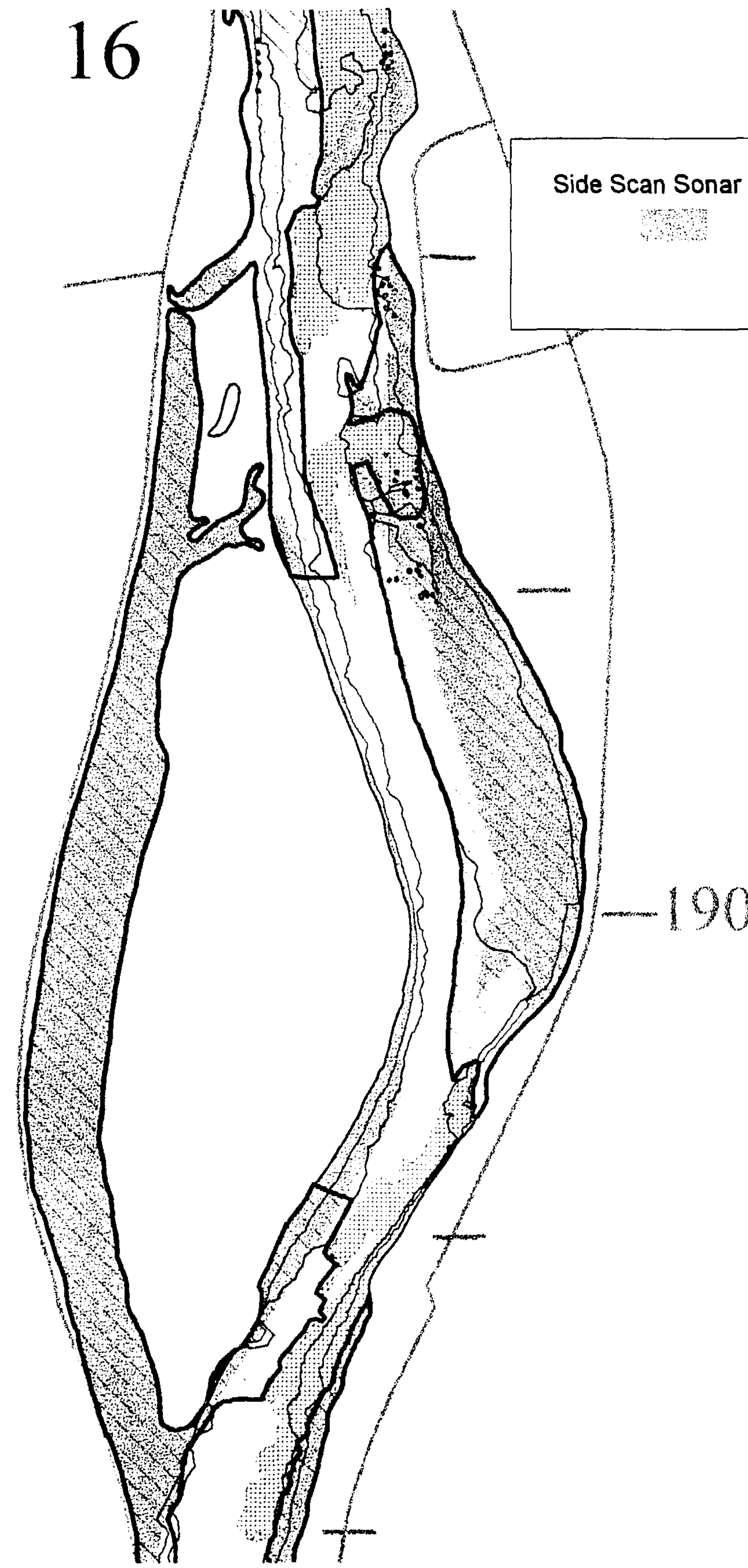
401094



PCB Concentration (mg/kg)

1998 Surface Cores

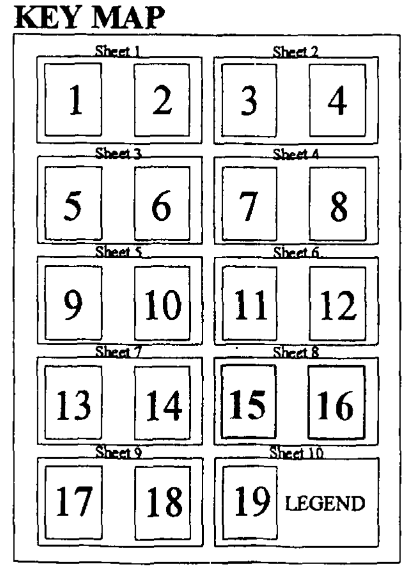
- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000



Side Scan Sonar Interpretation (C-N)

- Cohesive
- Non-cohesive

KEY MAP



TAMS

TAMS Consultants, Inc.

N W E S

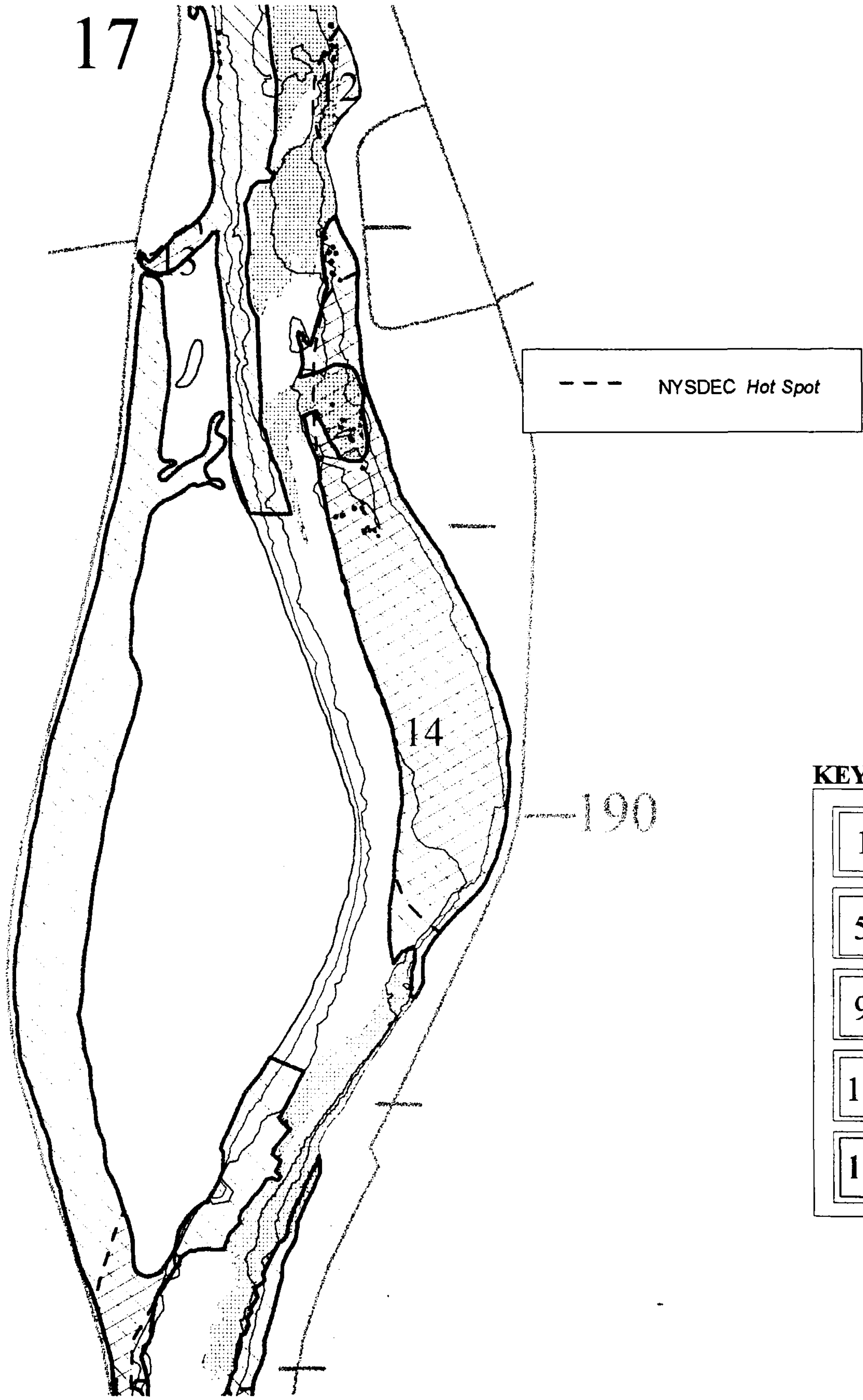
Note: See General Legend on Sheet 10.

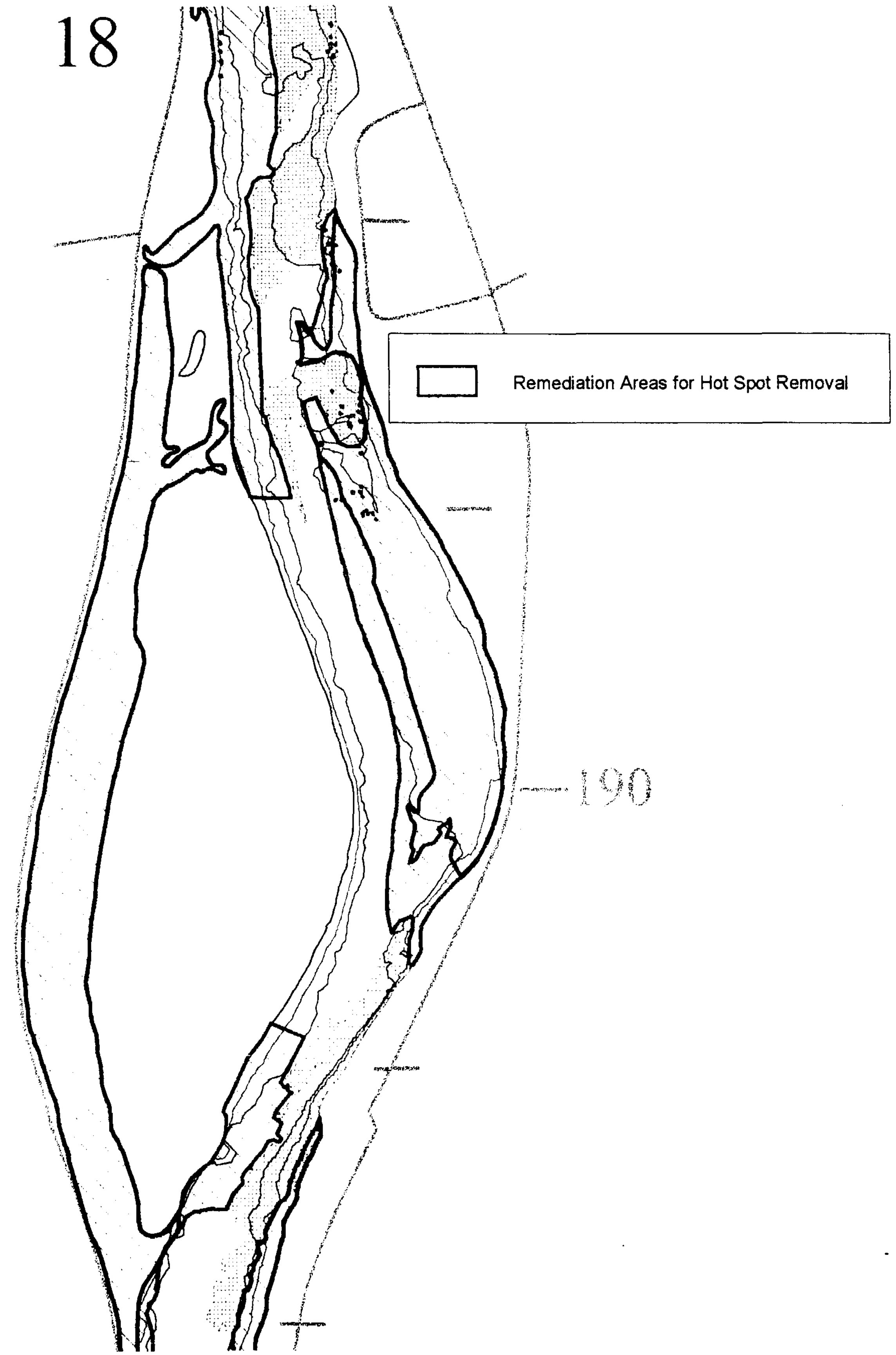
200 0 200 400 600 800
Scale in Feet

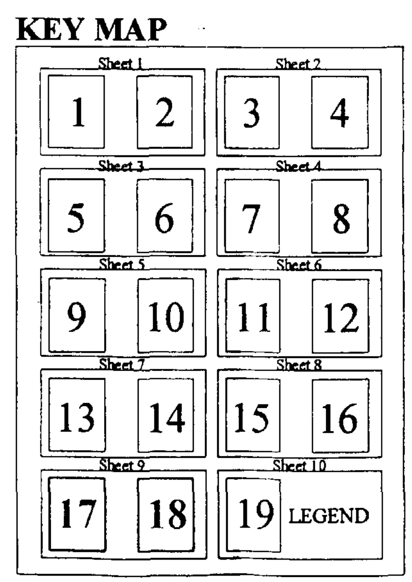
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 8 of 10

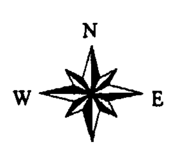
401095







TAMS
TAMS Consultants, Inc.

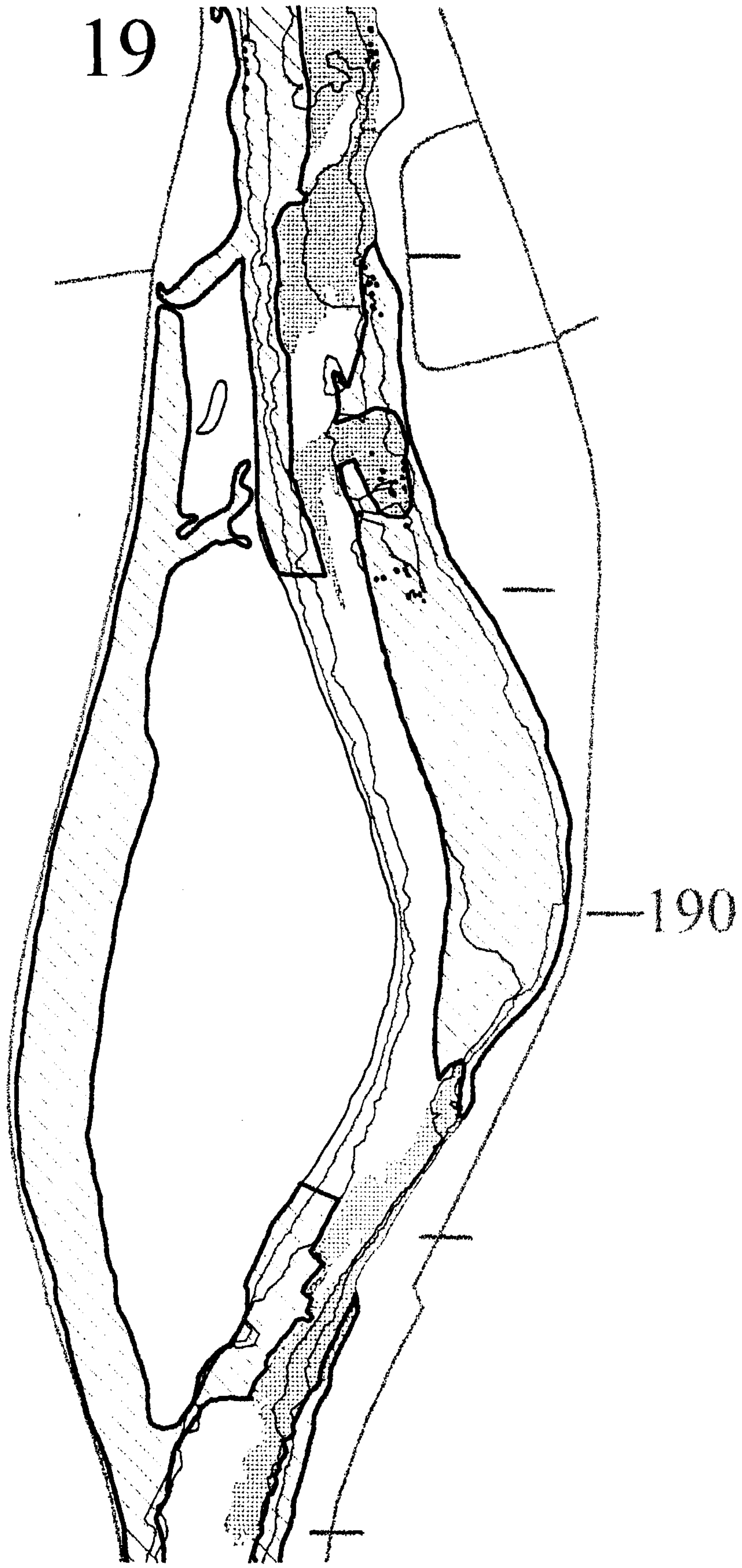


Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 9 of 10

401096



LEGEND

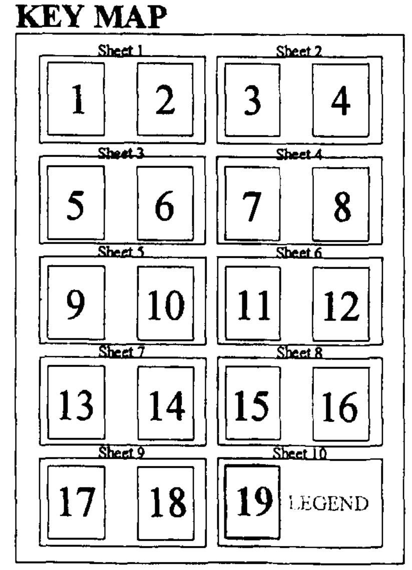
Approximate Water Depth (ft) at 3,090 cfs

- 6.5
- 12.5

Side Scan Sonar Interpretation

- Mound
- Rock
- Remediation Areas for Expanded Hot Spot Removal
- Hudson River Shoreline at 8,471 cfs
- Dam or Lock
- Road
- Rivermile Markers

KEY MAP



TAMS

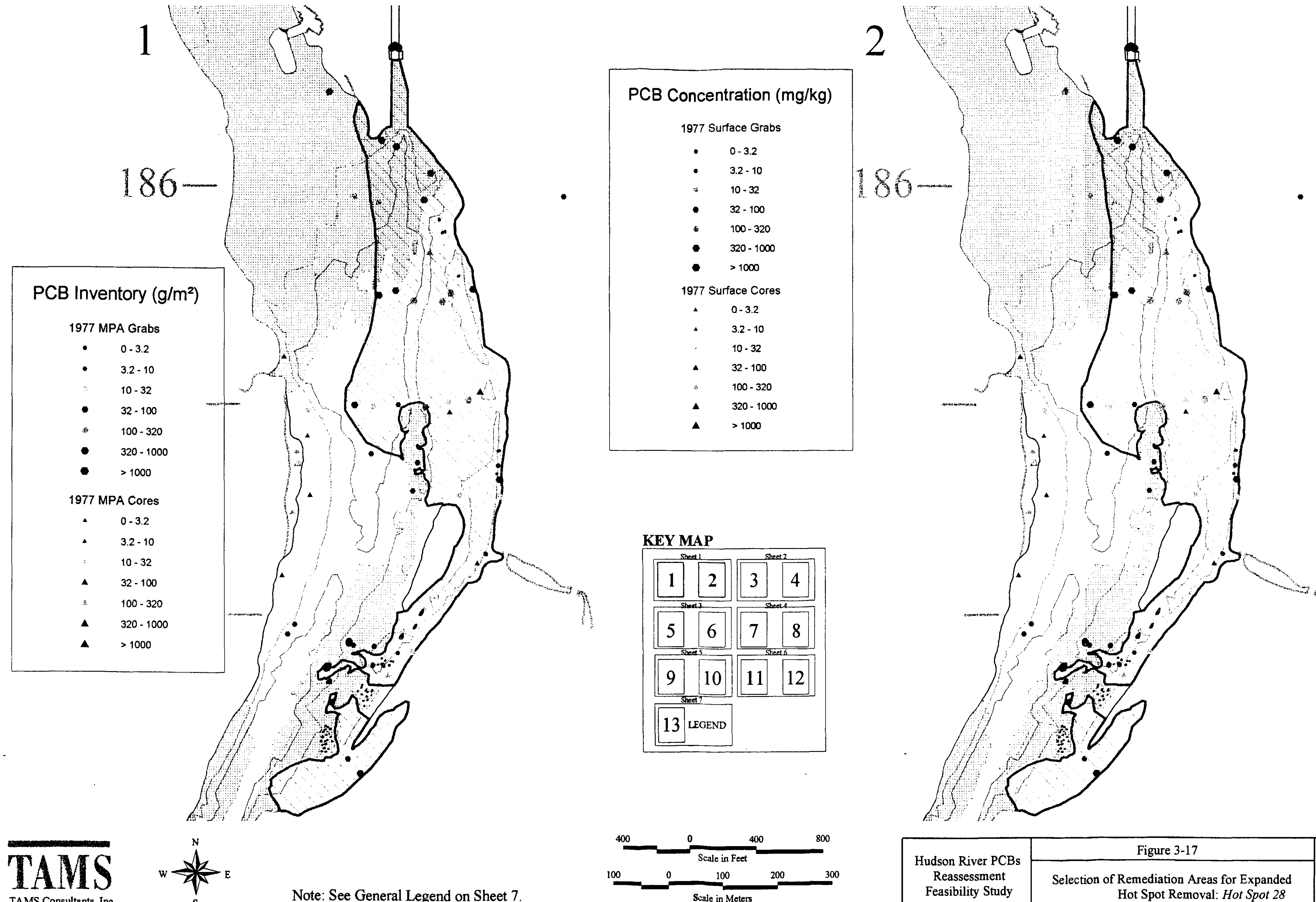
TAMS Consultants, Inc.

N W E S

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-16 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 14*	Sheet 10 of 10

401097



TAMS

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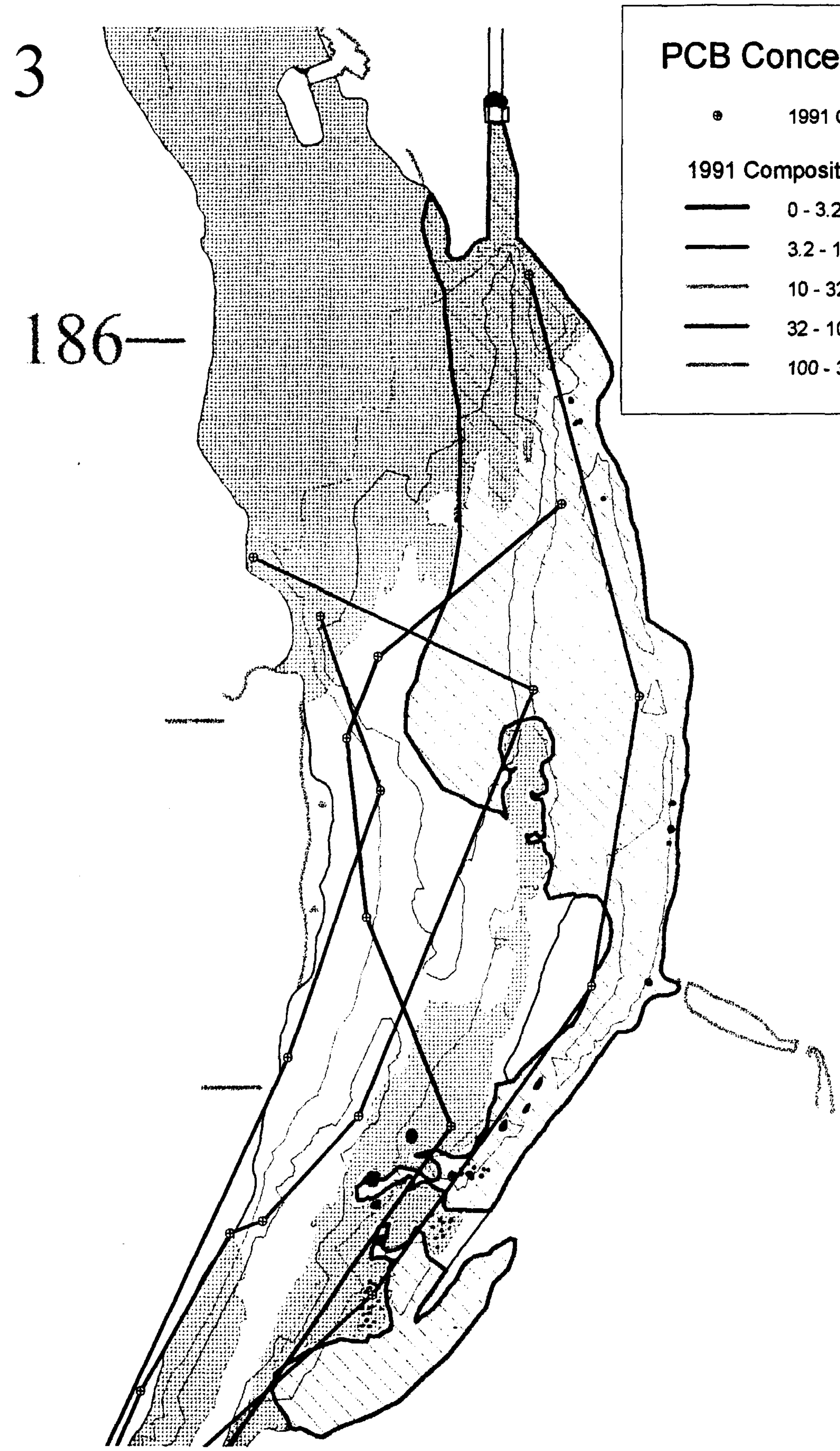
Note: See General Legend on Sheet 7.

Hudson River PCBs Reassessment Feasibility Study

Figure 3-17

Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*

Sheet 1 of 7

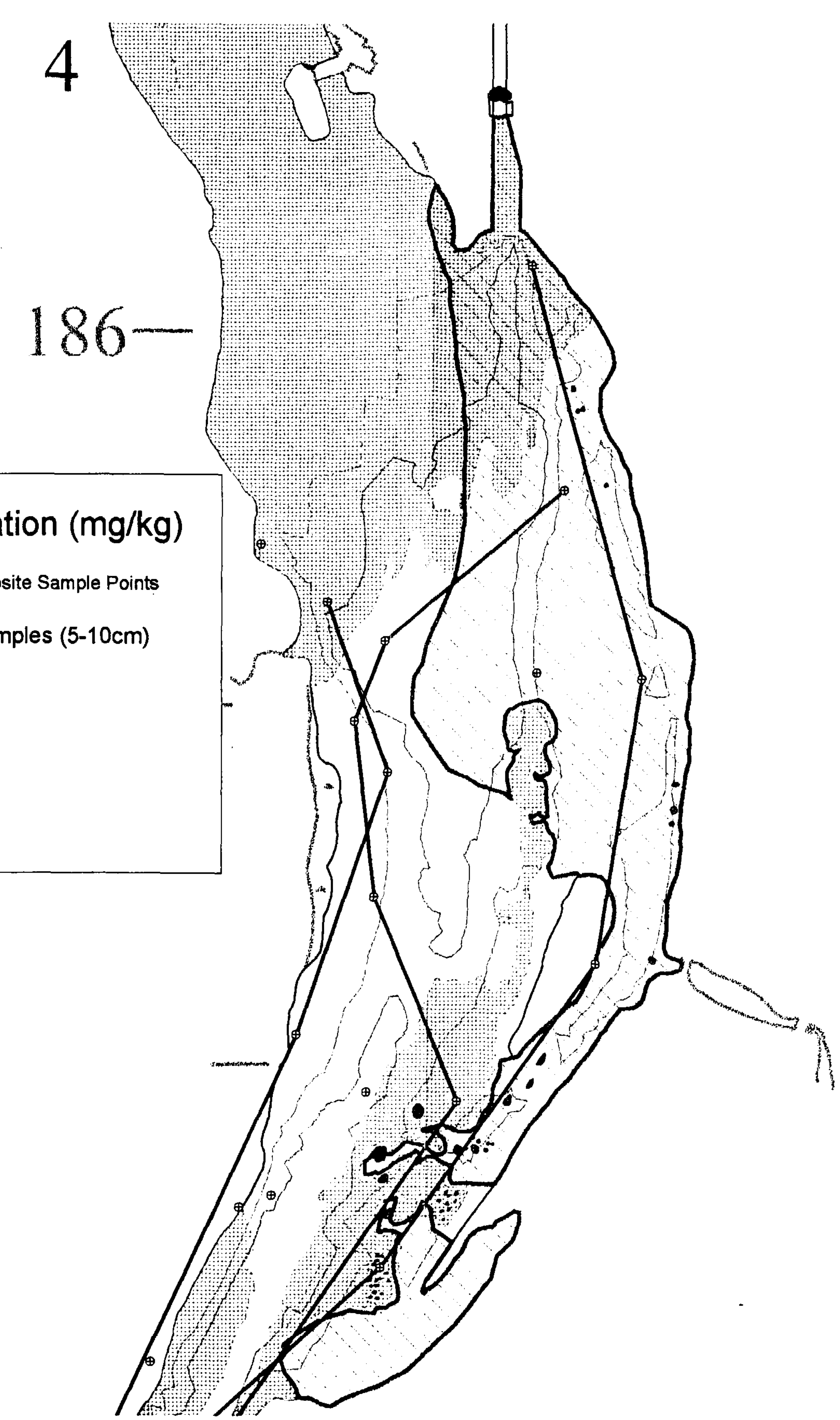


PCB Concentration (mg/kg)

⊕ 1991 Composite Sample Points

1991 Composite Samples (0-5cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320



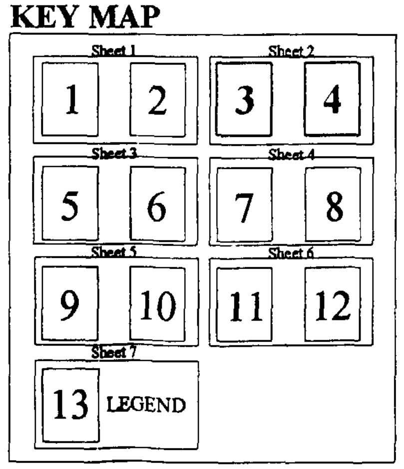
PCB Concentration (mg/kg)

⊕ 1991 Composite Sample Points

1991 Composite Samples (5-10cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320

KEY MAP



Scale in Feet: 400 0 400 800

Scale in Meters: 100 0 100 200 300

N W E S

TAMS
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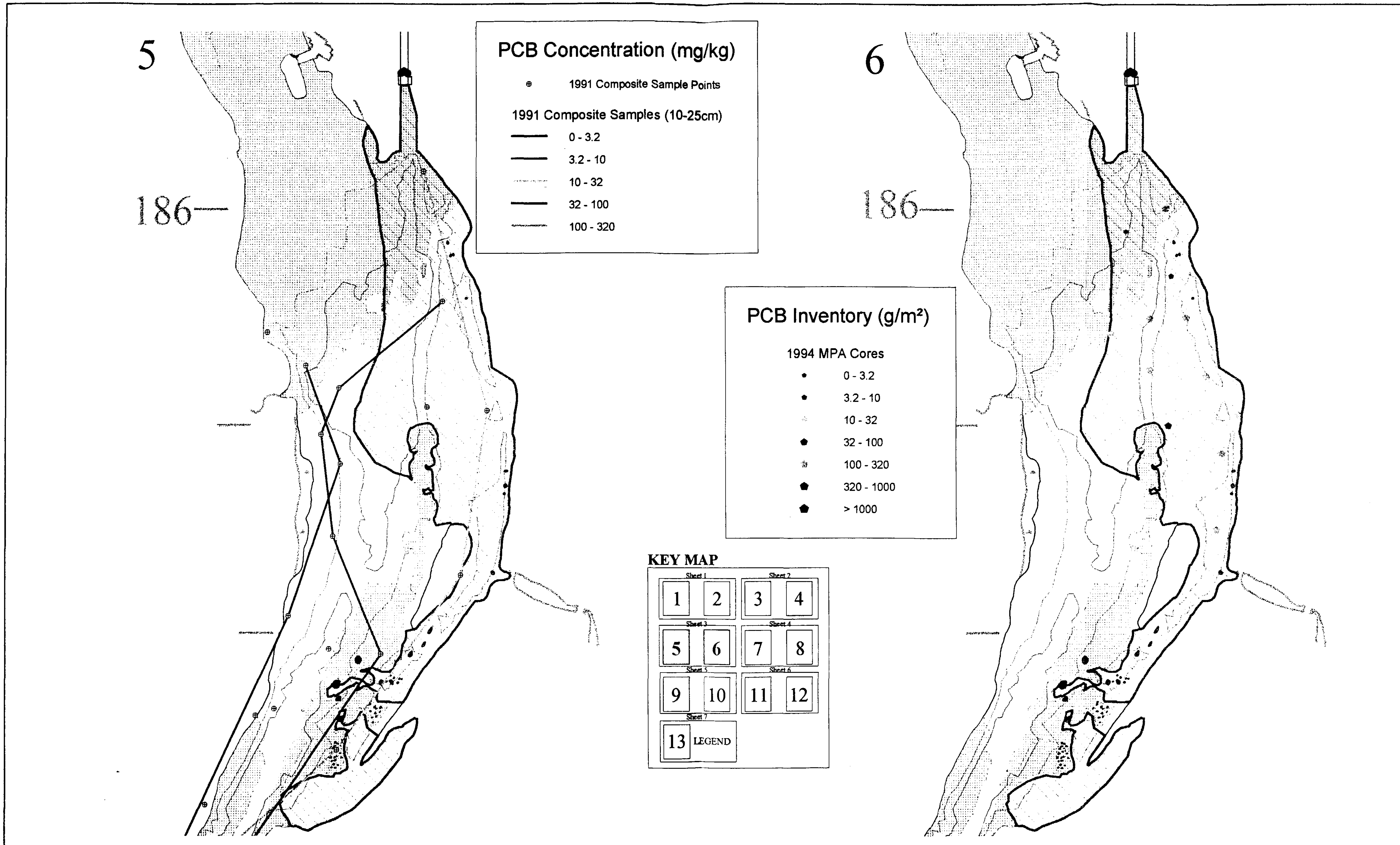
Note: See General Legend on Sheet 7.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 2 of 7

401099



TAMS

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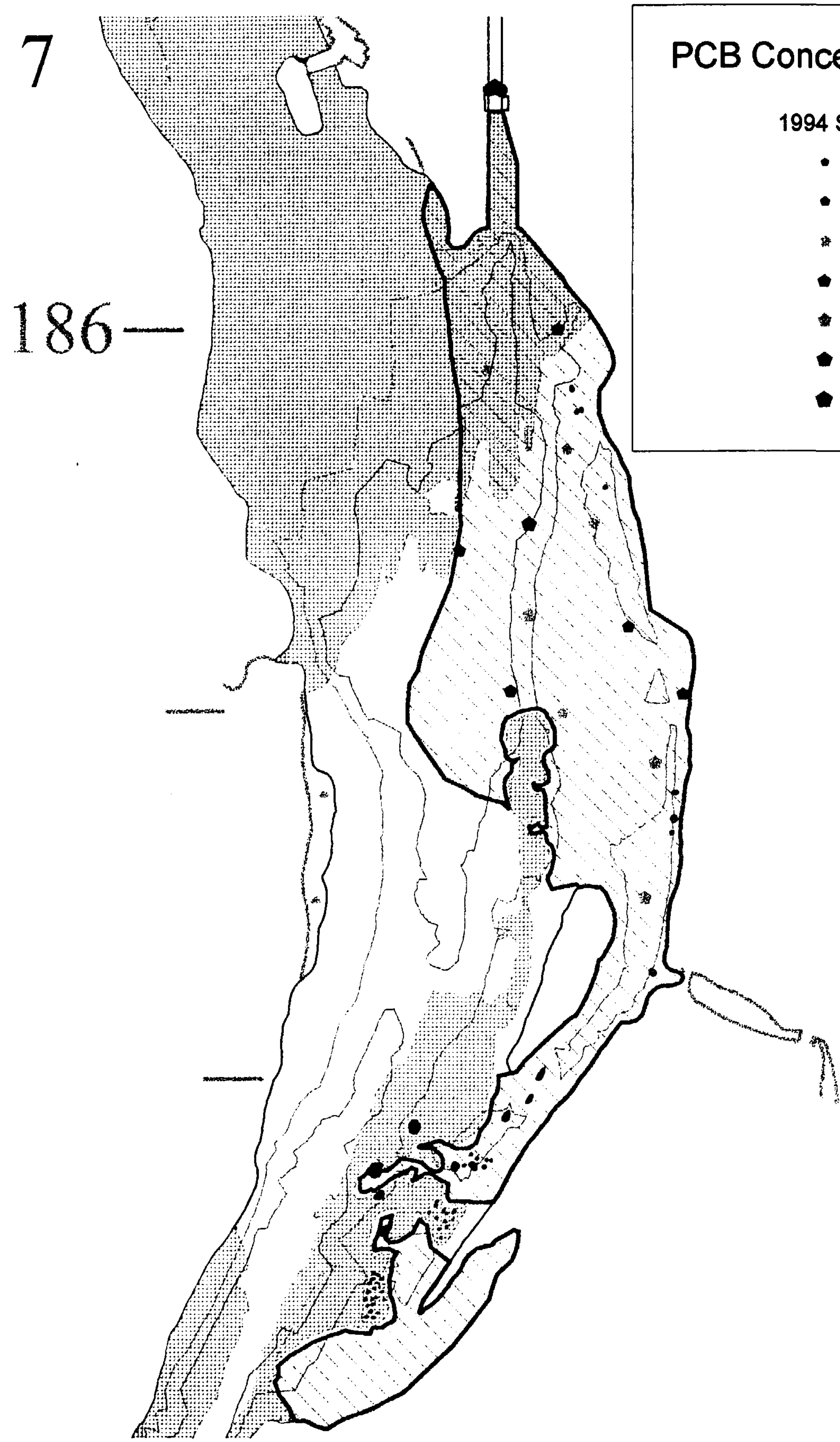
Note: See General Legend on Sheet 7.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 3 of 7

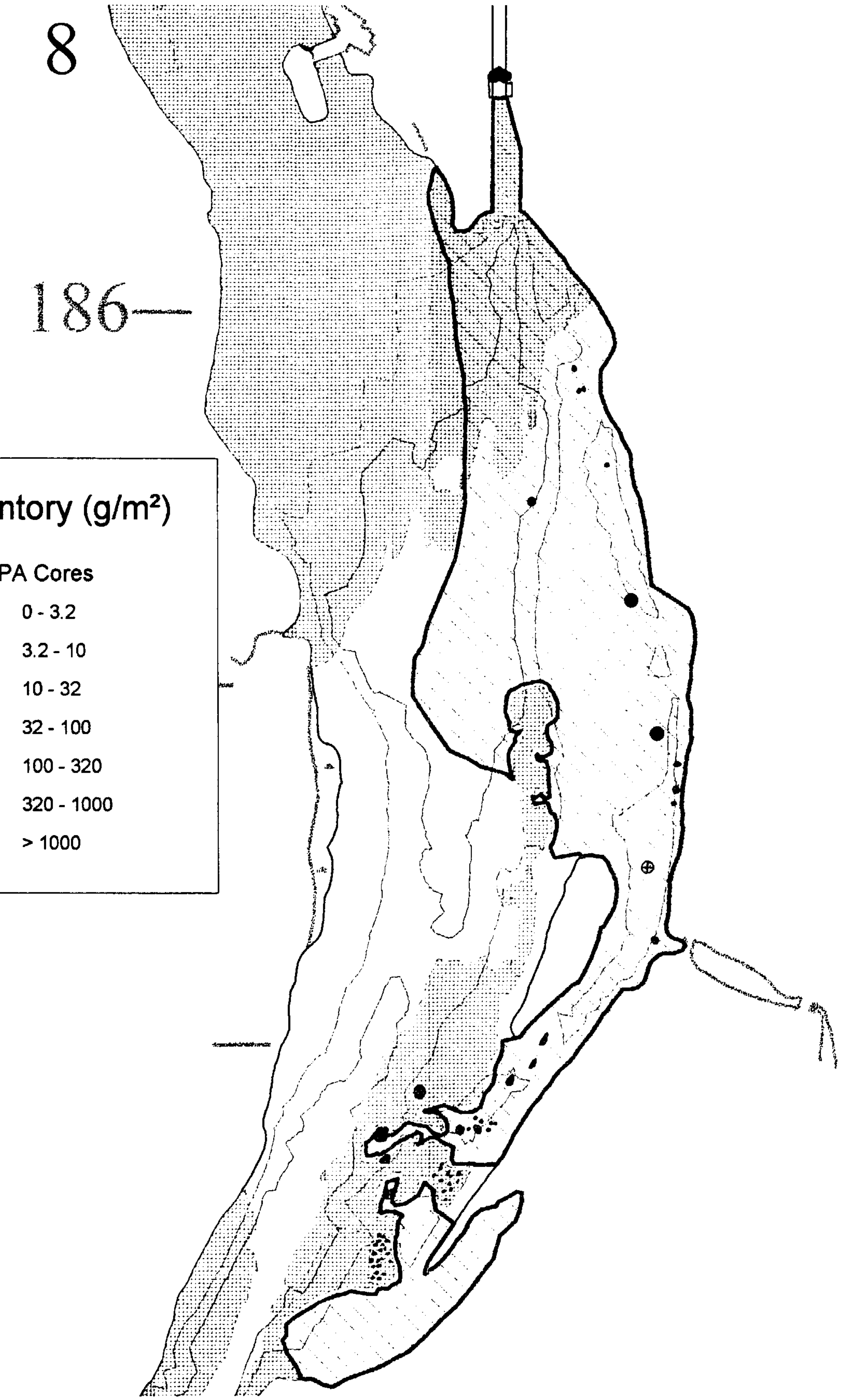
401100



PCB Concentration (mg/kg)

1994 Surface Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

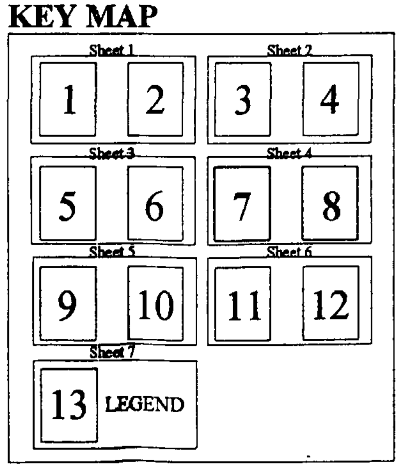


PCB Inventory (g/m²)

1998 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

KEY MAP



TAMS

TAMS Consultants, Inc.

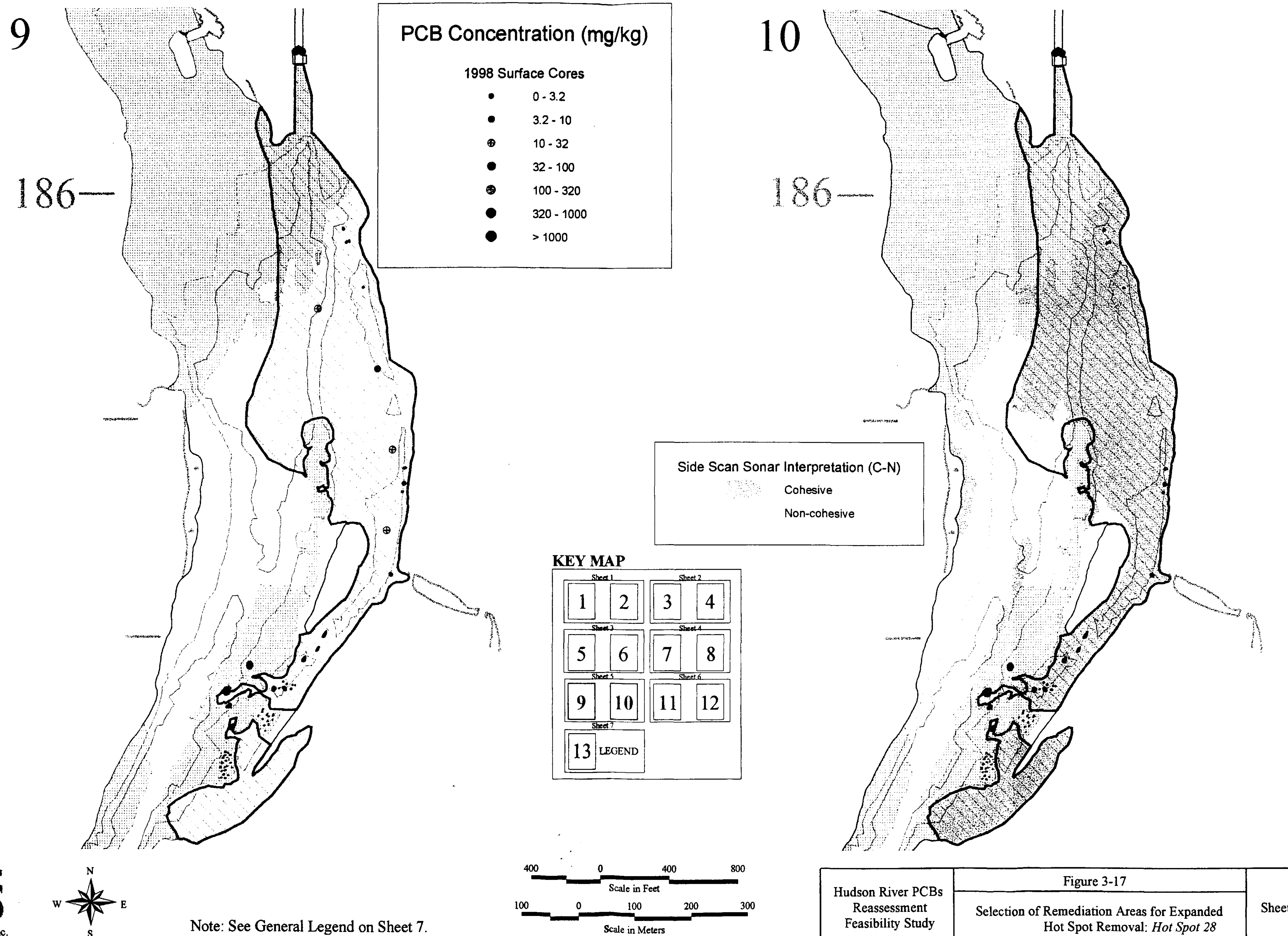
N W E S

Note: See General Legend on Sheet 7.

400 0 400 800
Scale in Feet

100 0 100 200 300
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 4 of 7



TAMS

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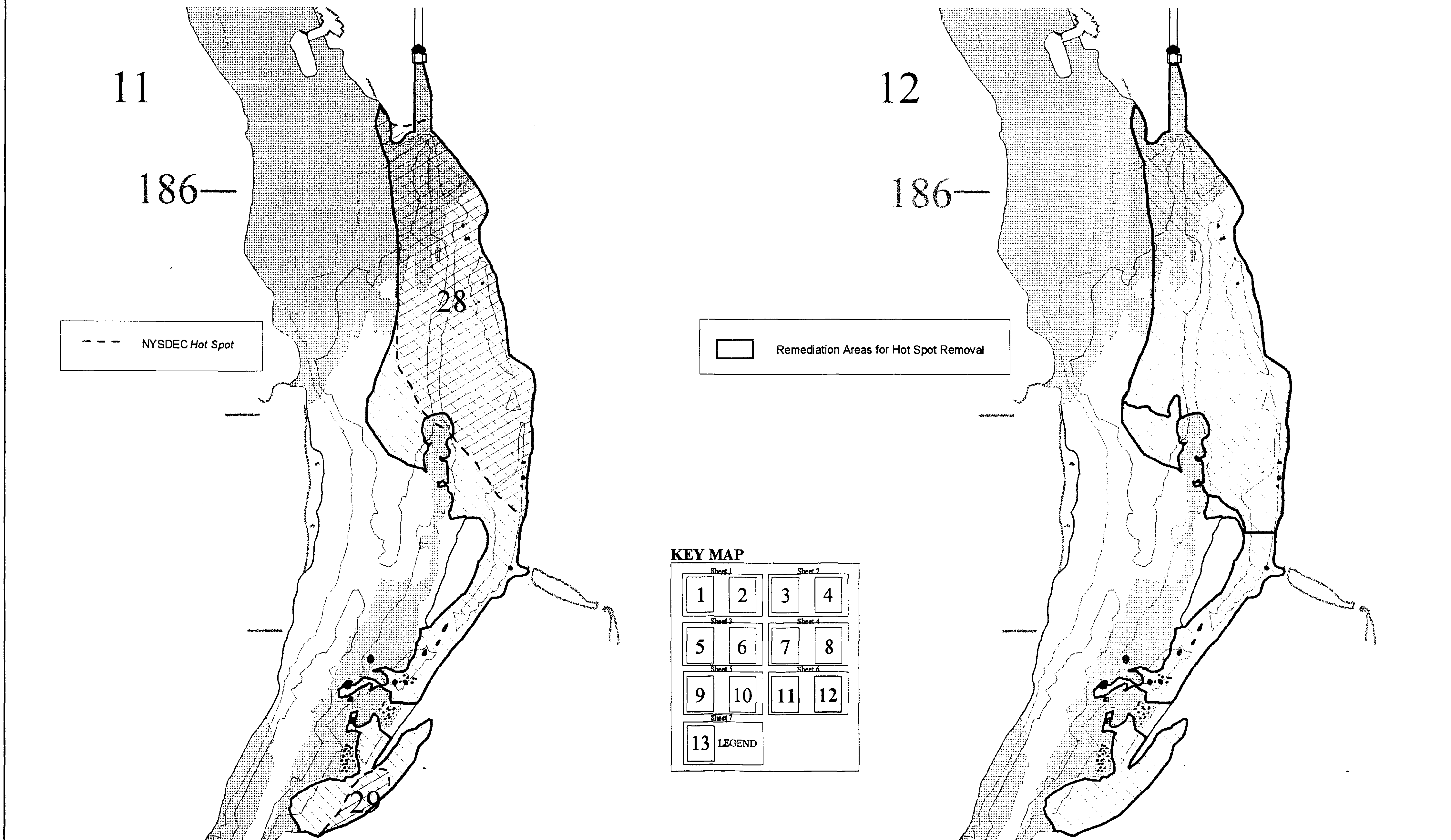
Note: See General Legend on Sheet 7.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 5 of 7

401.102



TAMS

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N W E S

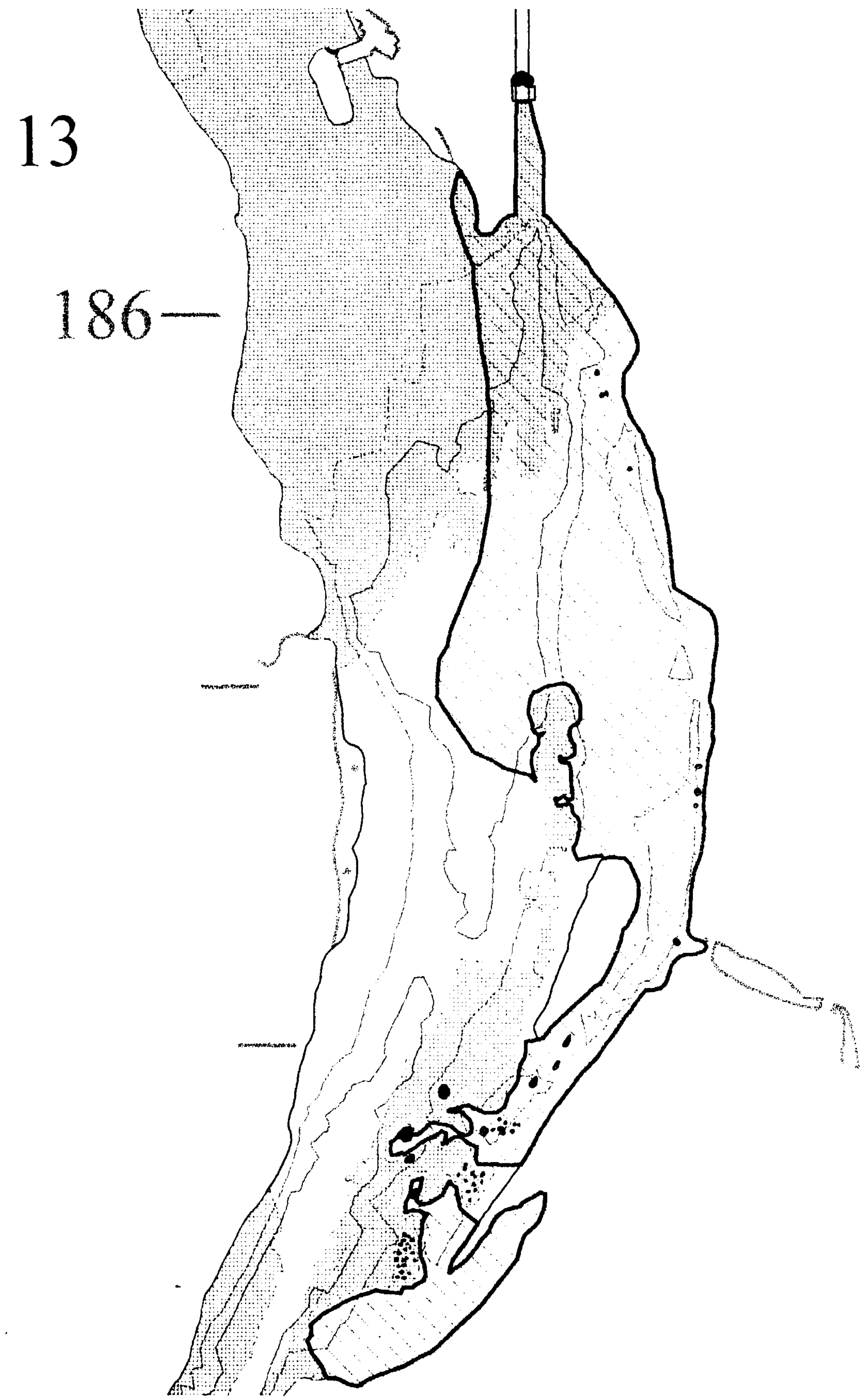
Note: See General Legend on Sheet 7.

400 0 400 800
Scale in Feet

100 0 100 200 300
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 6 of 7

401103



LEGEND

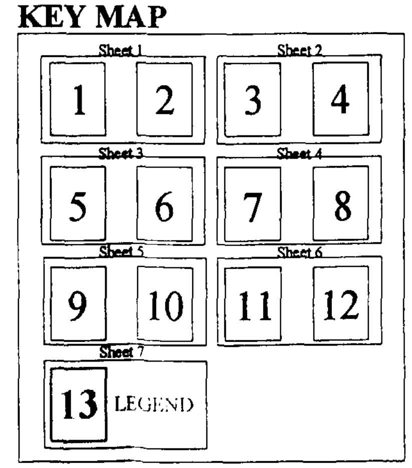
Approximate Water Depth (ft) at 3,090 cfs

- 6.5
- 12.5

Side Scan Sonar Interpretation

- Mound
- Rock
- Remediation Areas for Expanded Hot Spot Removal
- Hudson River Shoreline at 8,471 cfs
- Dam or Lock
- Road
- Rivermile Markers

KEY MAP



400 0 400 800
Scale in Feet

100 0 100 200 300
Scale in Meters

N W E S

TAMS
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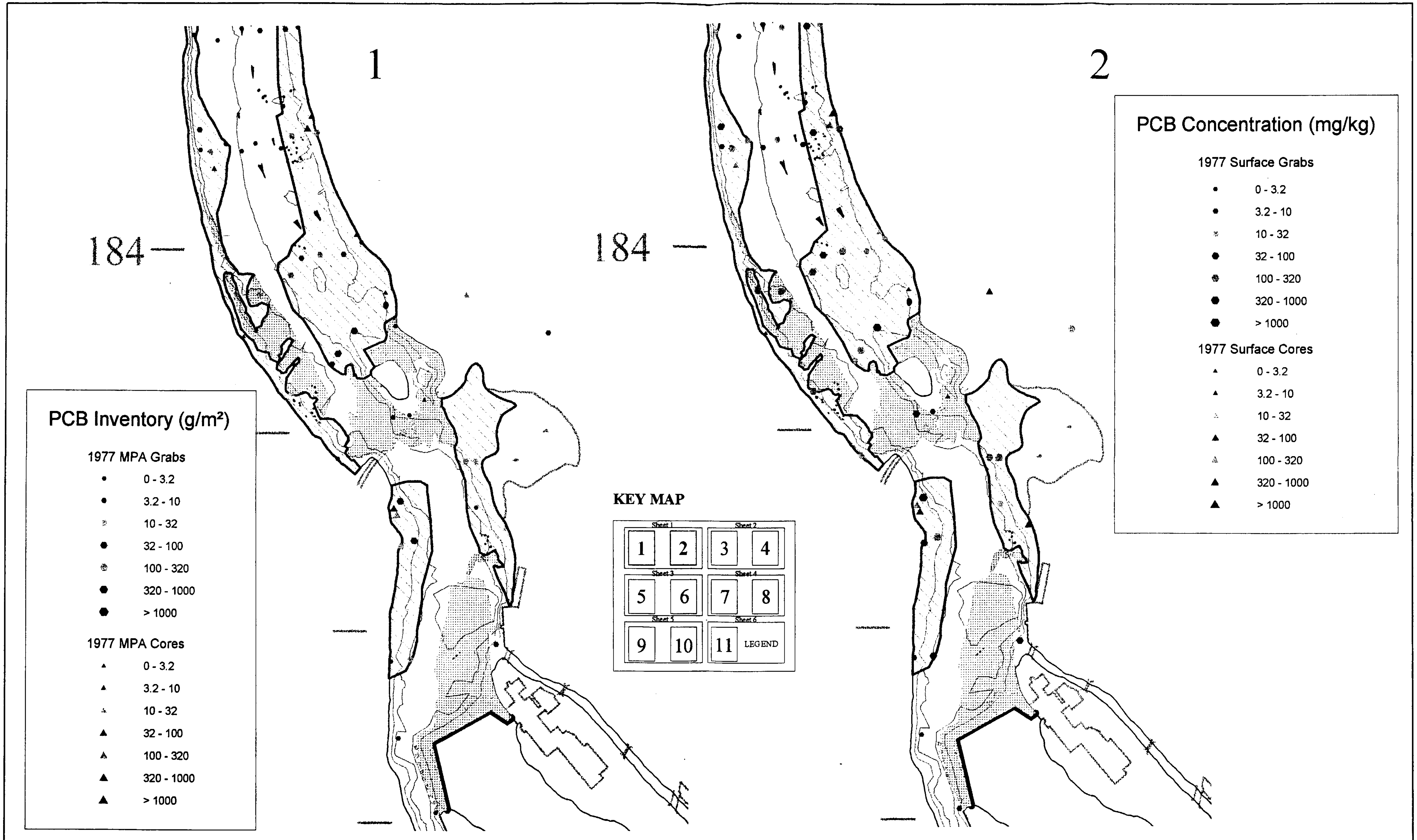
Hudson River PCBs Reassessment Feasibility Study	Figure 3-17 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 28*	Sheet 7 of 7

401104



TAMS
TAMS Consultants, Inc.

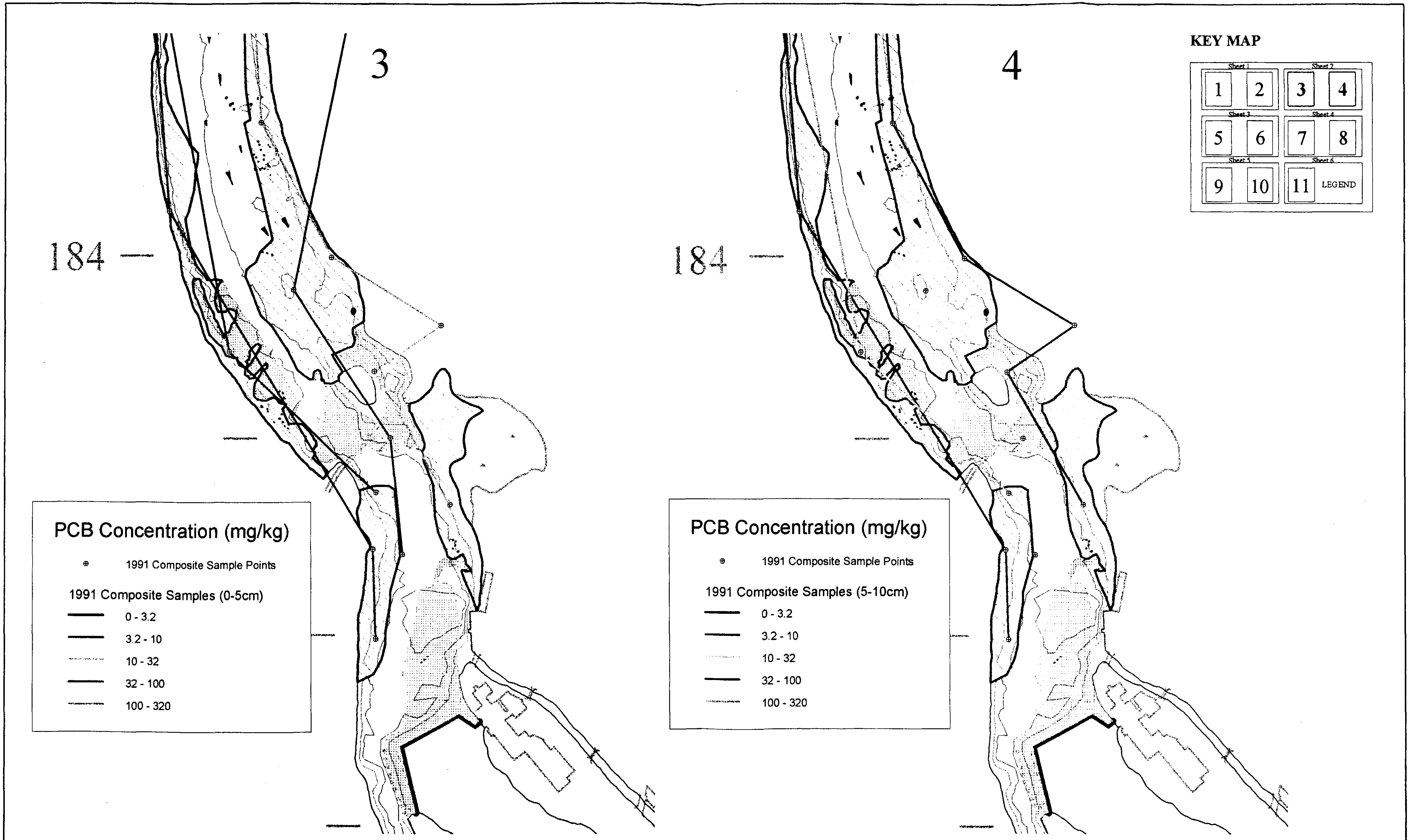
N W E S

Note: See General Legend on Sheet 6.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-18 Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25	Sheet 1 of 6

401105



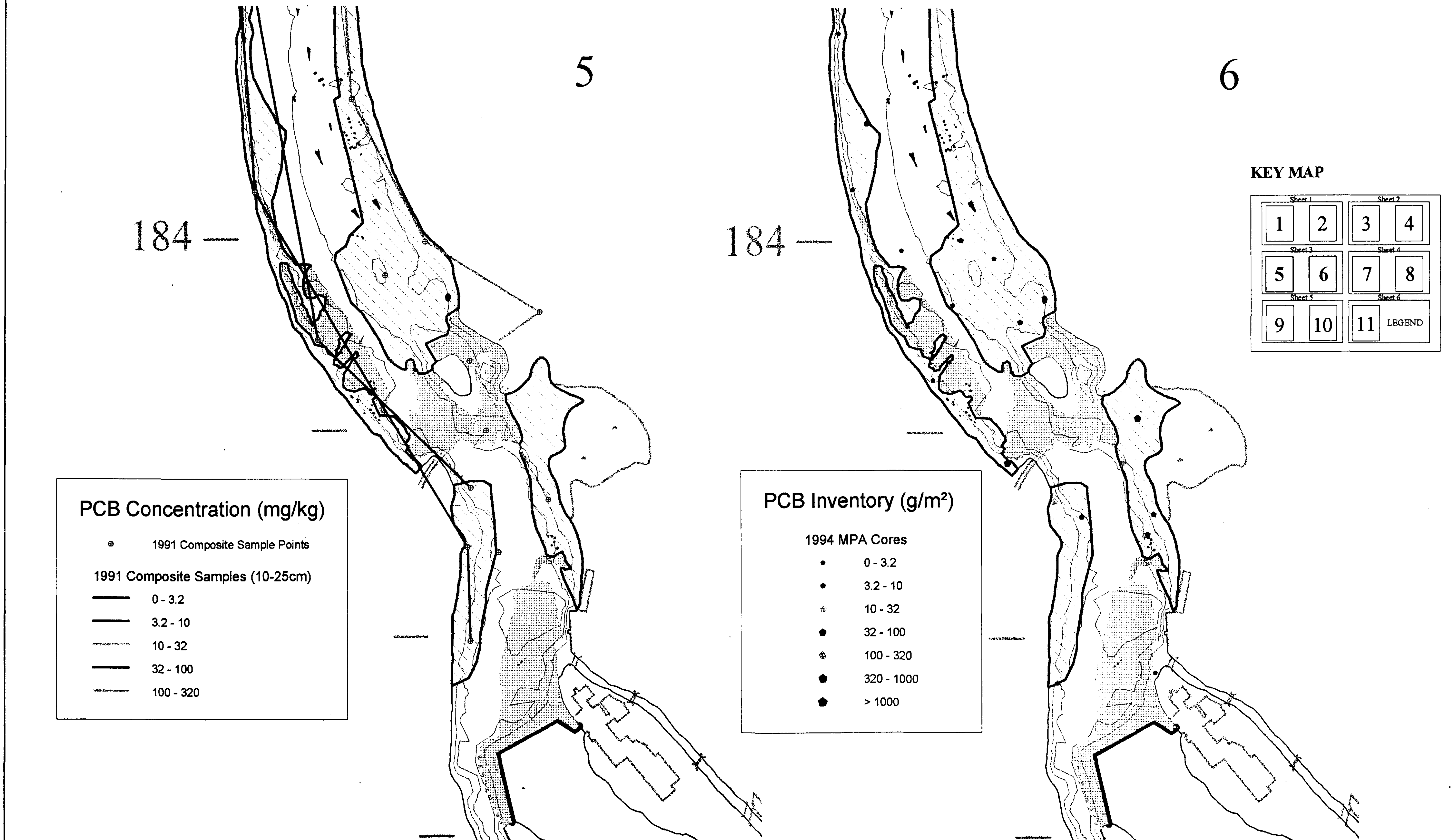
TAMS

TAMS Consultants, Inc.

Note: See General Legend on Sheet 6.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-18 Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25	Sheet 2 of 6

401106



TAMS

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N W E S

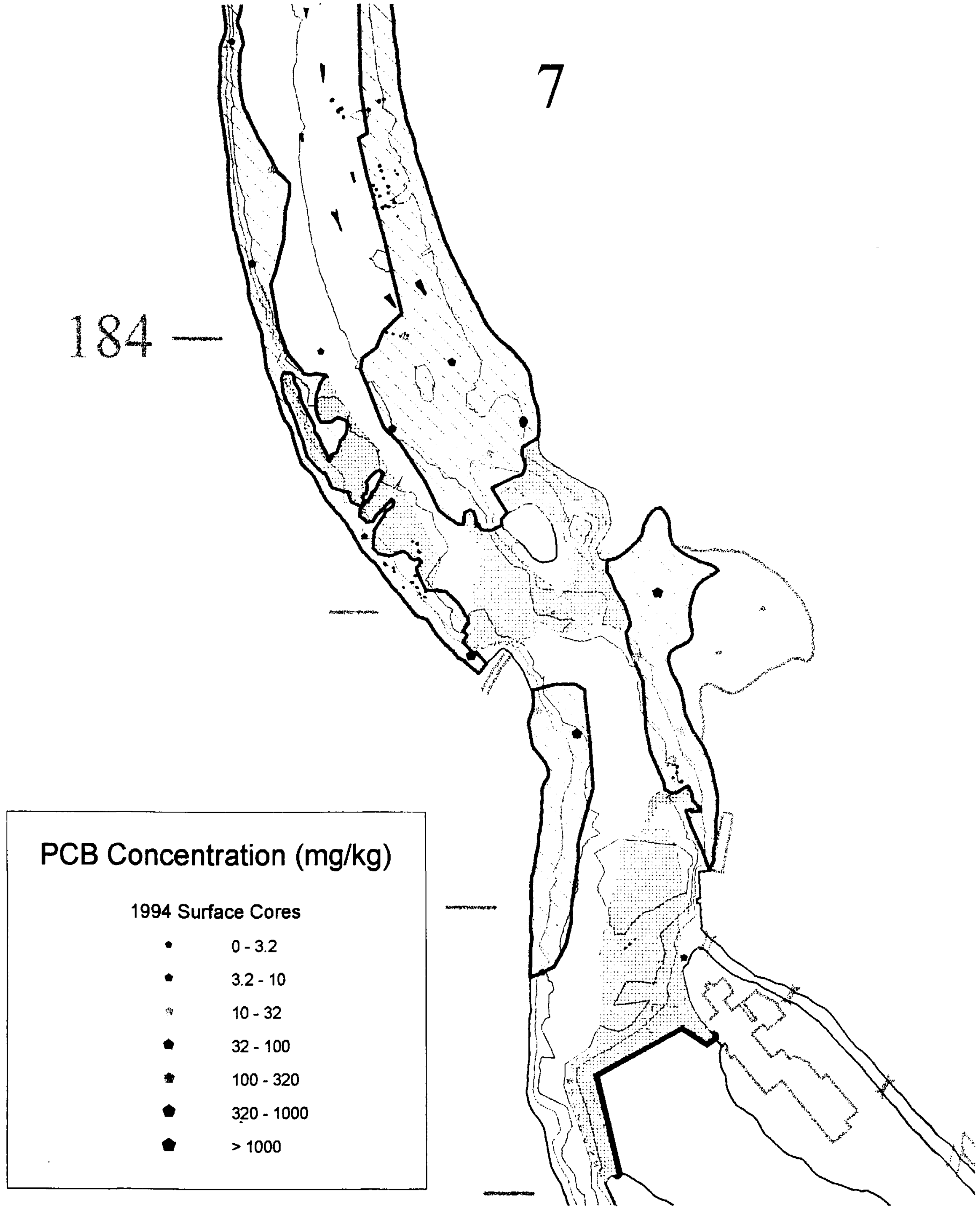
Note: See General Legend on Sheet 6.

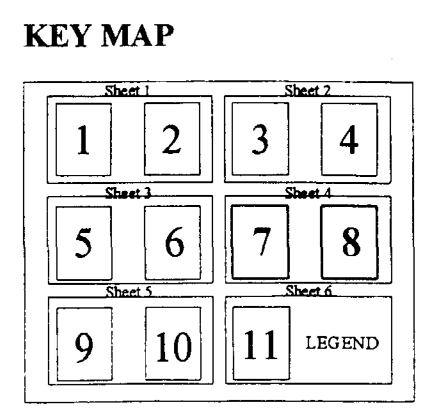
200 0 200 400 600
Scale in Feet

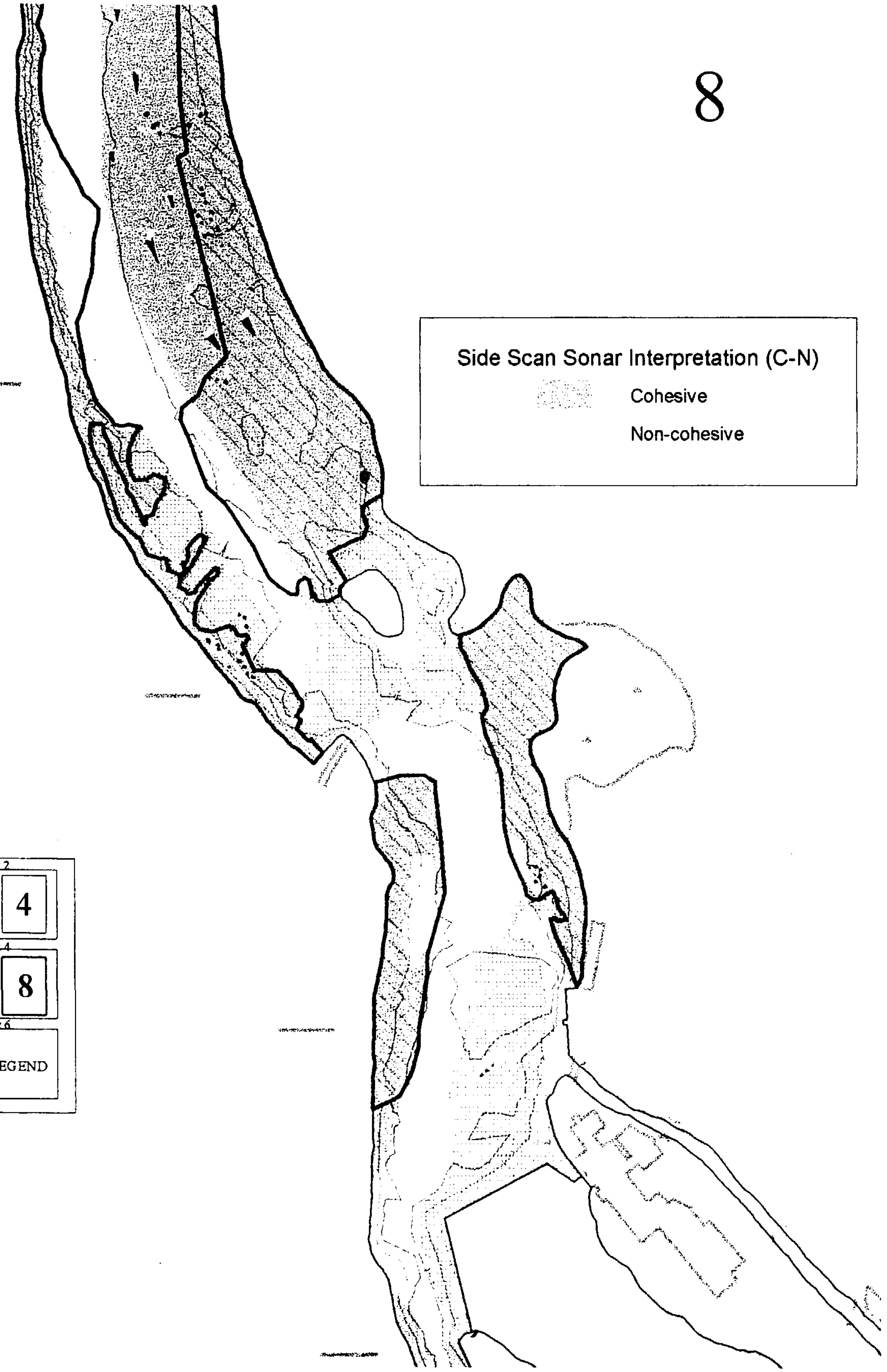
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-18 Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25	Sheet 3 of 6

401107







TAMS
TAMS Consultants, Inc.

Note: See General Legend on Sheet 6.

Scale in Feet: 200 0 200 400 600
Scale in Meters: 50 0 50 100 150 200

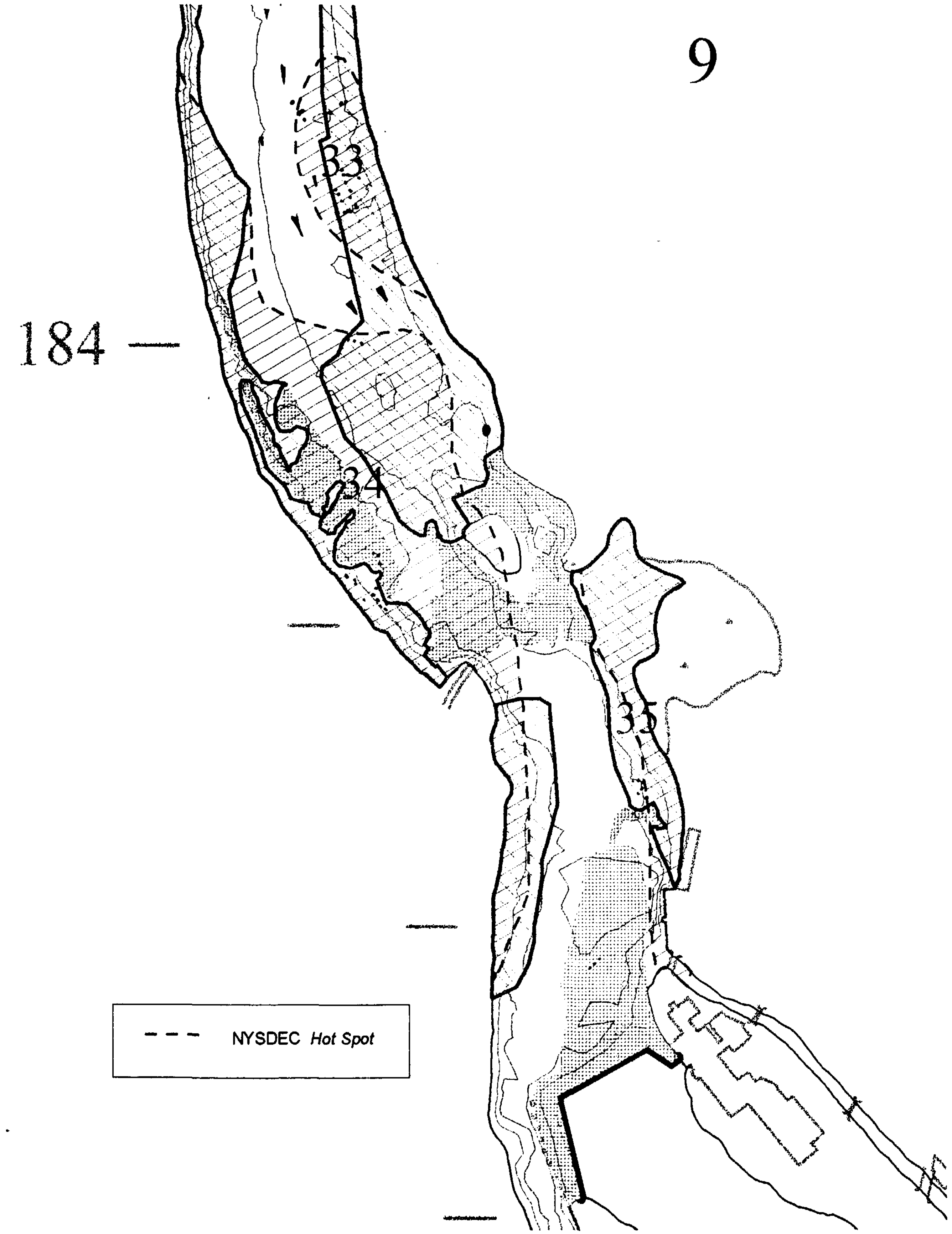
Hudson River PCBs Reassessment Feasibility Study

Figure 3-18

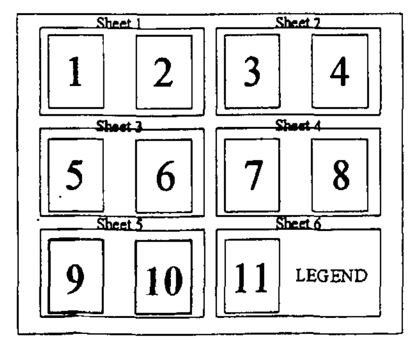
Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25

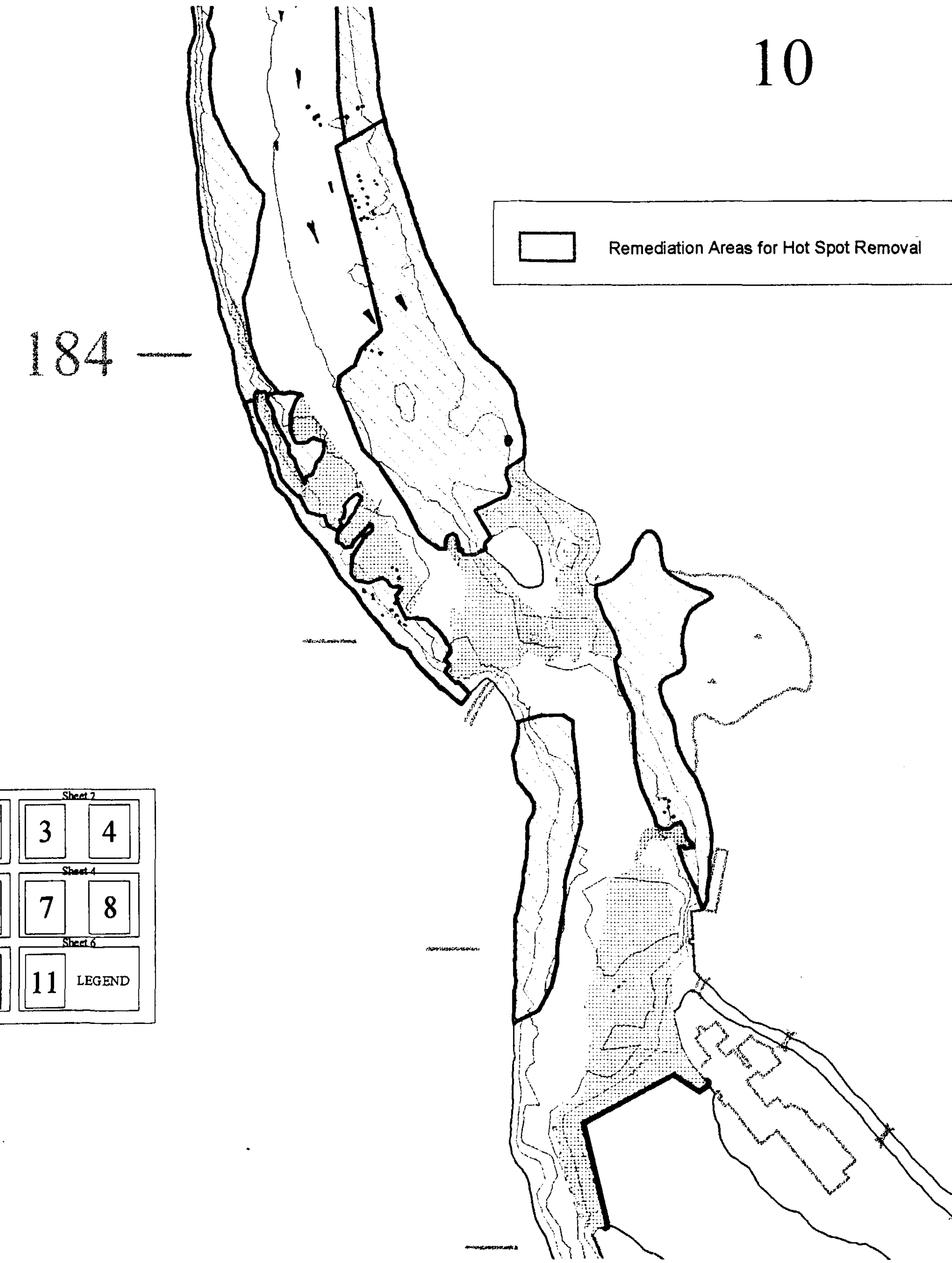
Sheet 4 of 6

401108



KEY MAP





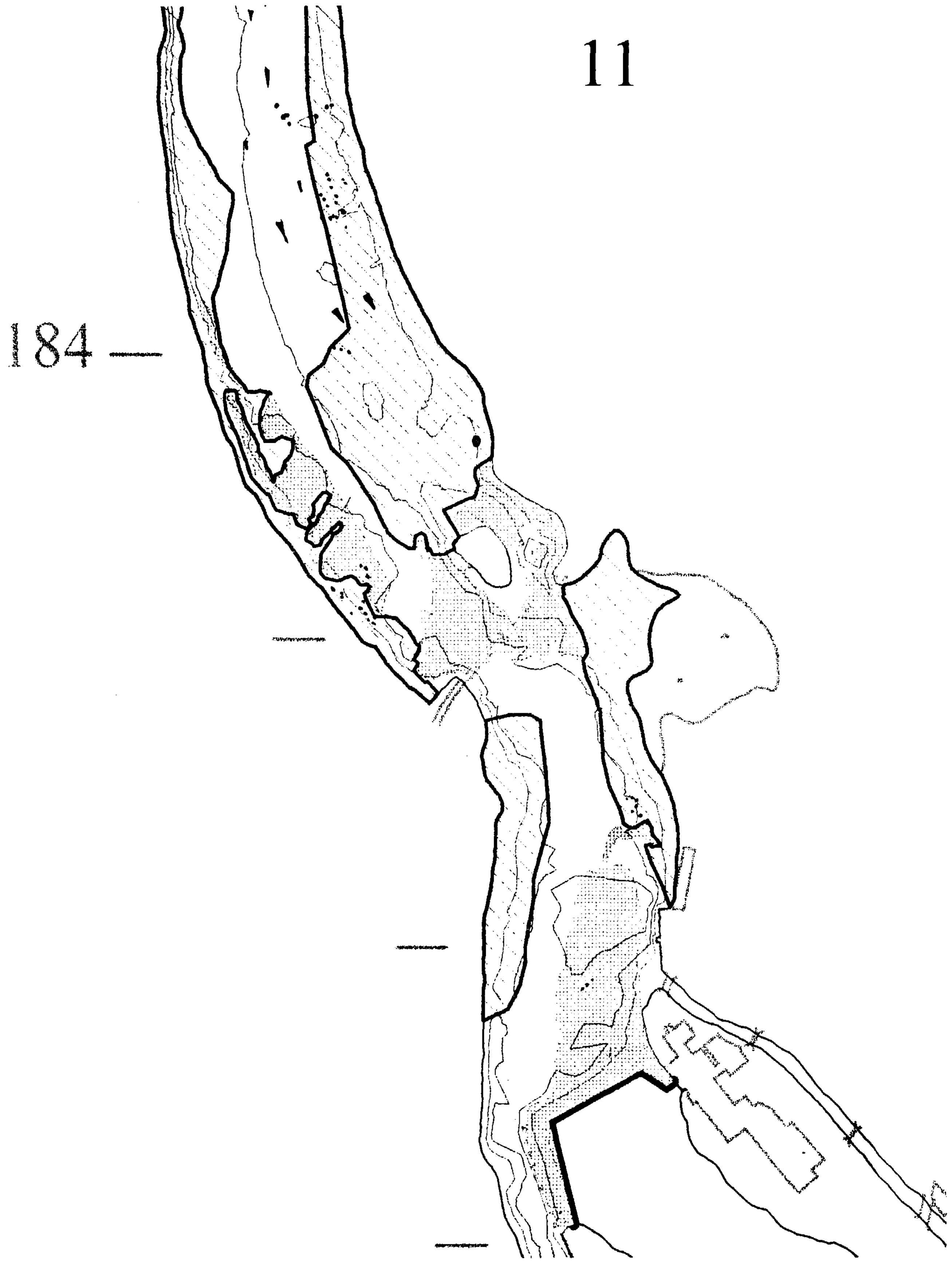
TAMS
TAMS Consultants, Inc.

N W E S

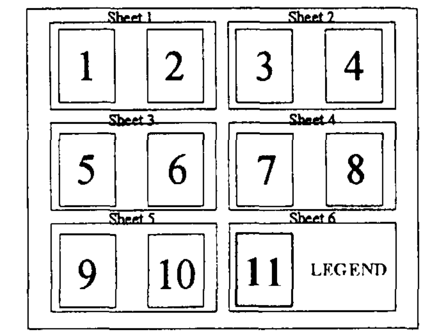
Note: See General Legend on Sheet 6.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-18 Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25	Sheet 5 of 6



KEY MAP



LEGEND

Approximate Water Depth (ft) at 3,090 cfs

- 6.5
- 12.5

Side Scan Sonar Interpretation

- Mound
- Rock
- Remediation Areas for Expanded Hot Spot Removal
- Hudson River Shoreline at 8,471 cfs
- Dam or Lock
- Road
- Rivermile Markers

N
W E
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200 0 200 400 600
Scale in Feet

50 0 50 100 150 200
Scale in Meters

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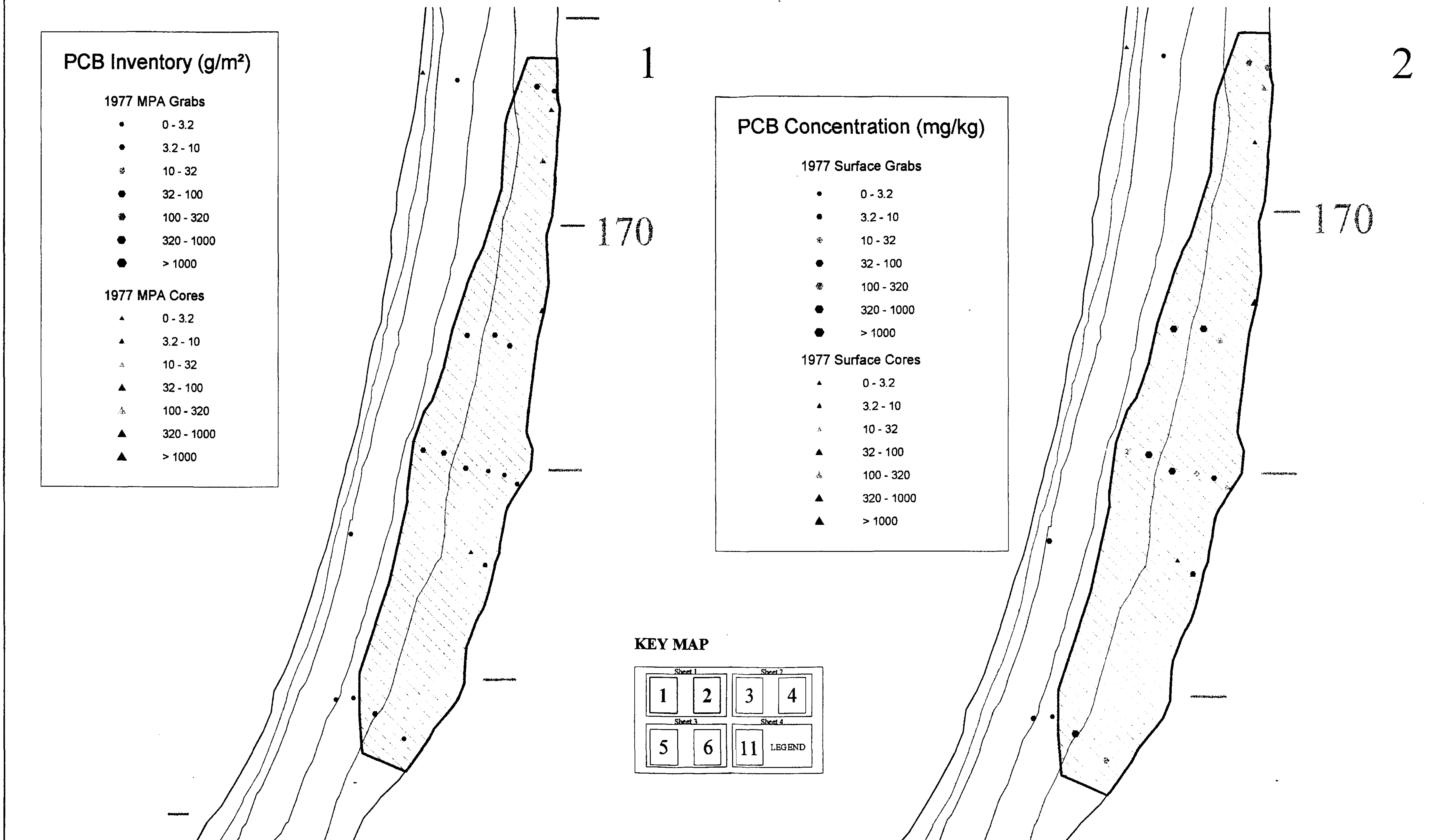
Hudson River PCBs Reassessment Feasibility Study	Figure 3-18 Selection of Remediation Areas for Expanded Hot Spot Removal: RM 183.25 - 184.25	Sheet 6 of 6

401110



TAMS
TAMS Consultants, Inc.

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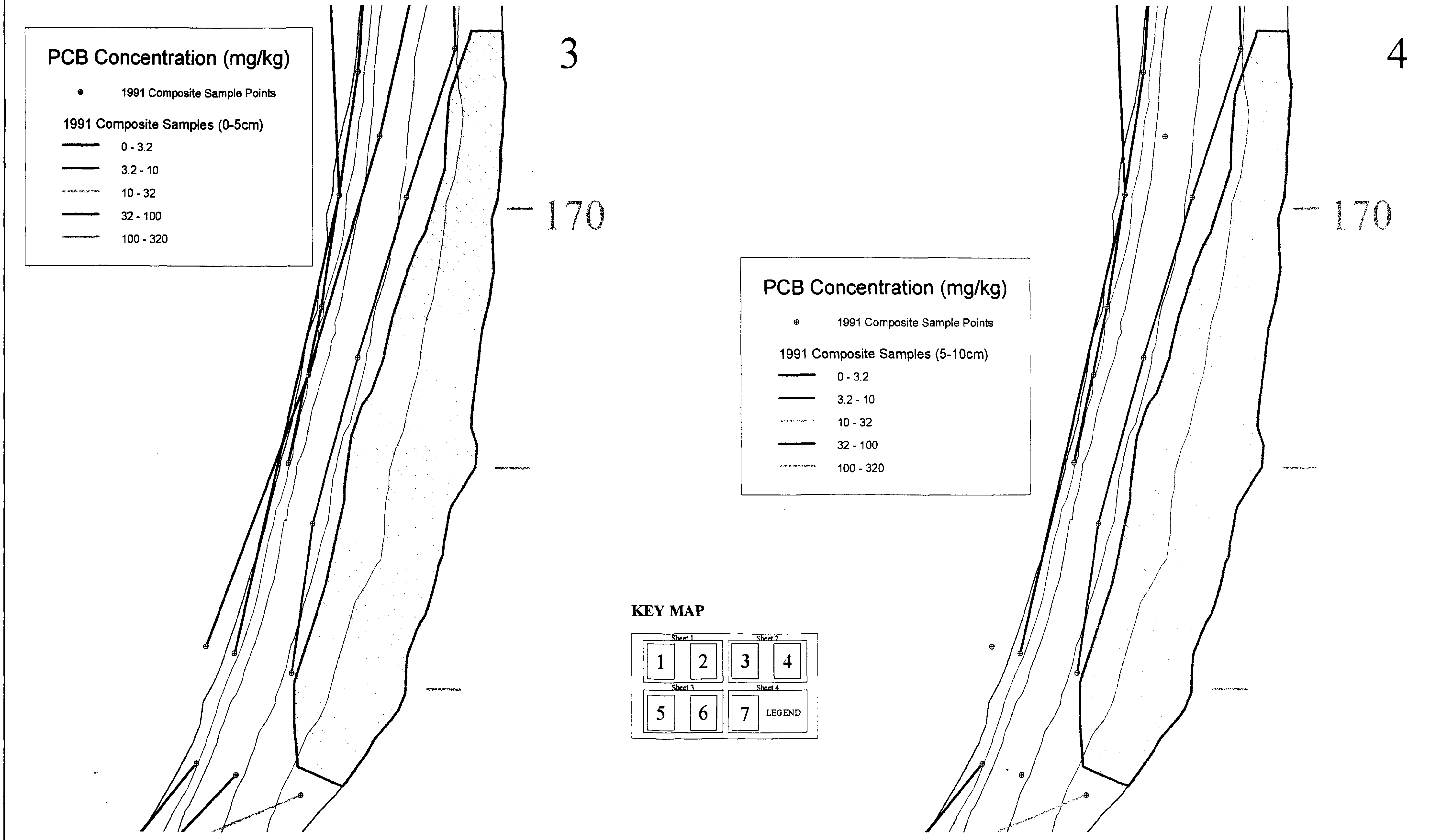
Note: See General Legend on Sheet 4.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-19 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 36*	Sheet 1 of 4

401111



TAMS

TAMS Consultants, Inc.

N W E S

Note: See General Legend on Sheet 4.

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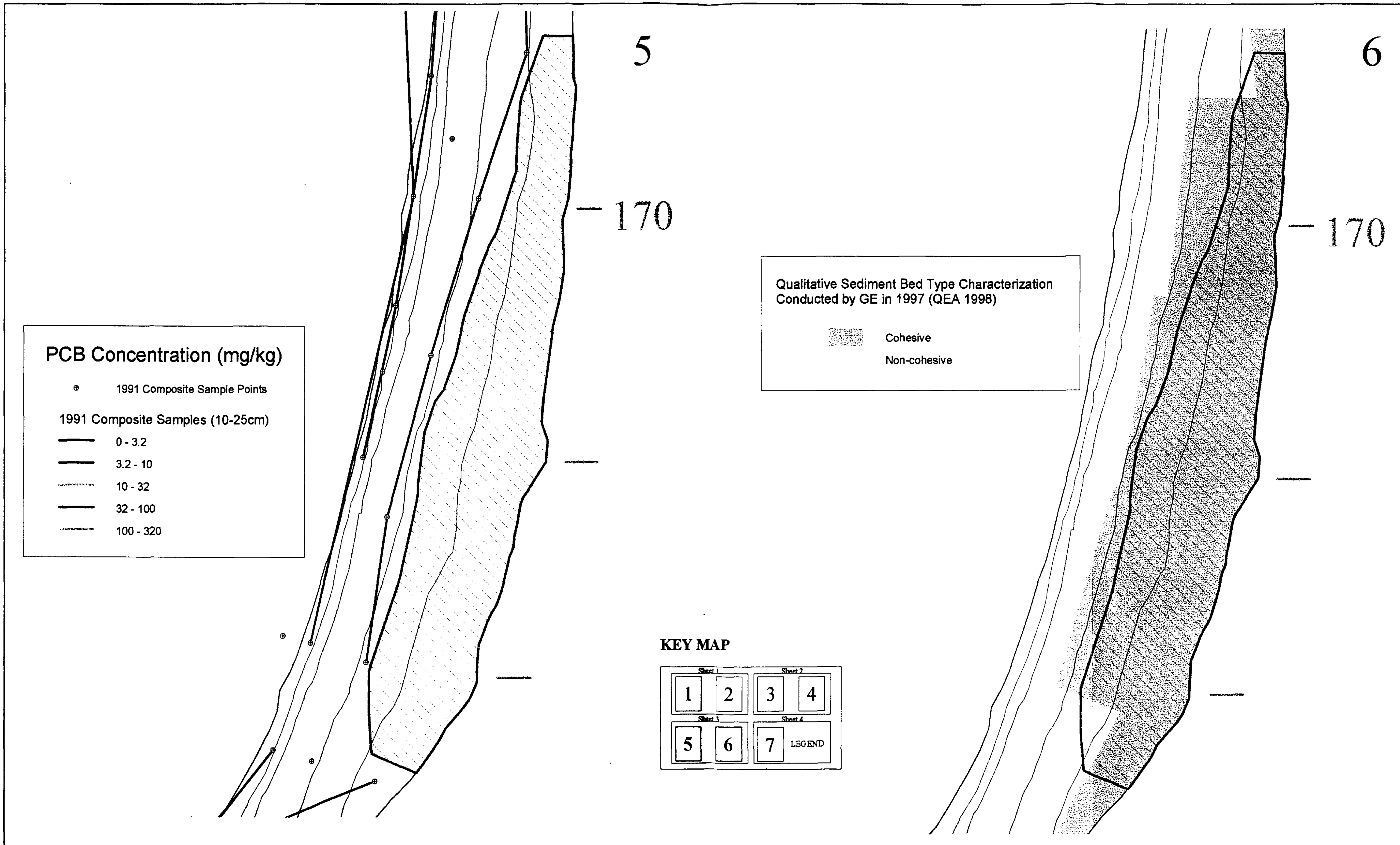
Scale in Feet

100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-19 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 36*	Sheet 2 of 4

401112



TAMS

TAMS Consultants, Inc.

N W E S

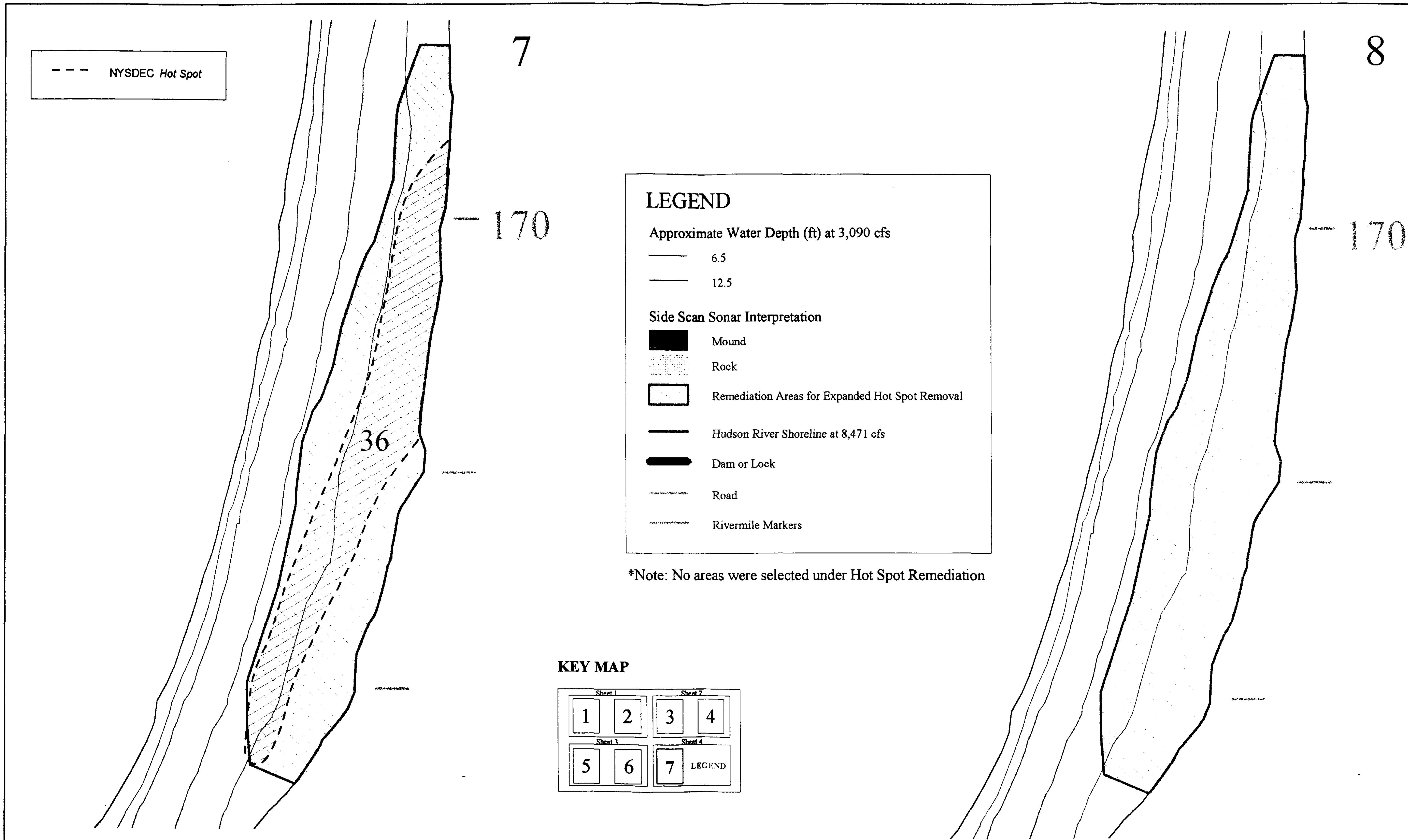
Note: See General Legend on Sheet 4.

200 0 200 400 600 800
Scale in Feet

100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-19 Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 36*	Sheet 3 of 4

401113



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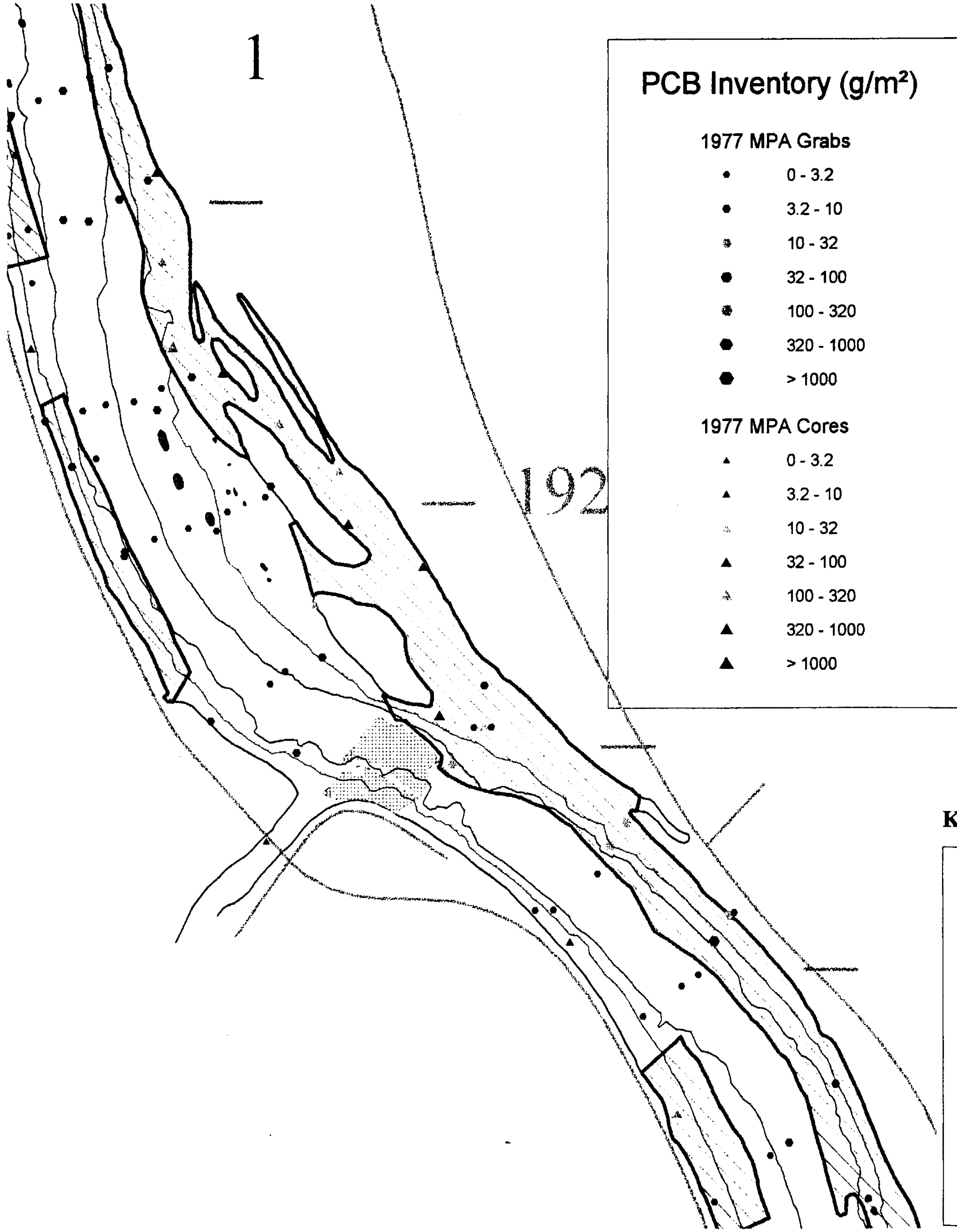
Hudson River PCBs Reassessment Feasibility Study

Figure 3-19

Selection of Remediation Areas for Expanded Hot Spot Removal: *Hot Spot 36*

Sheet 4 of 4

401114



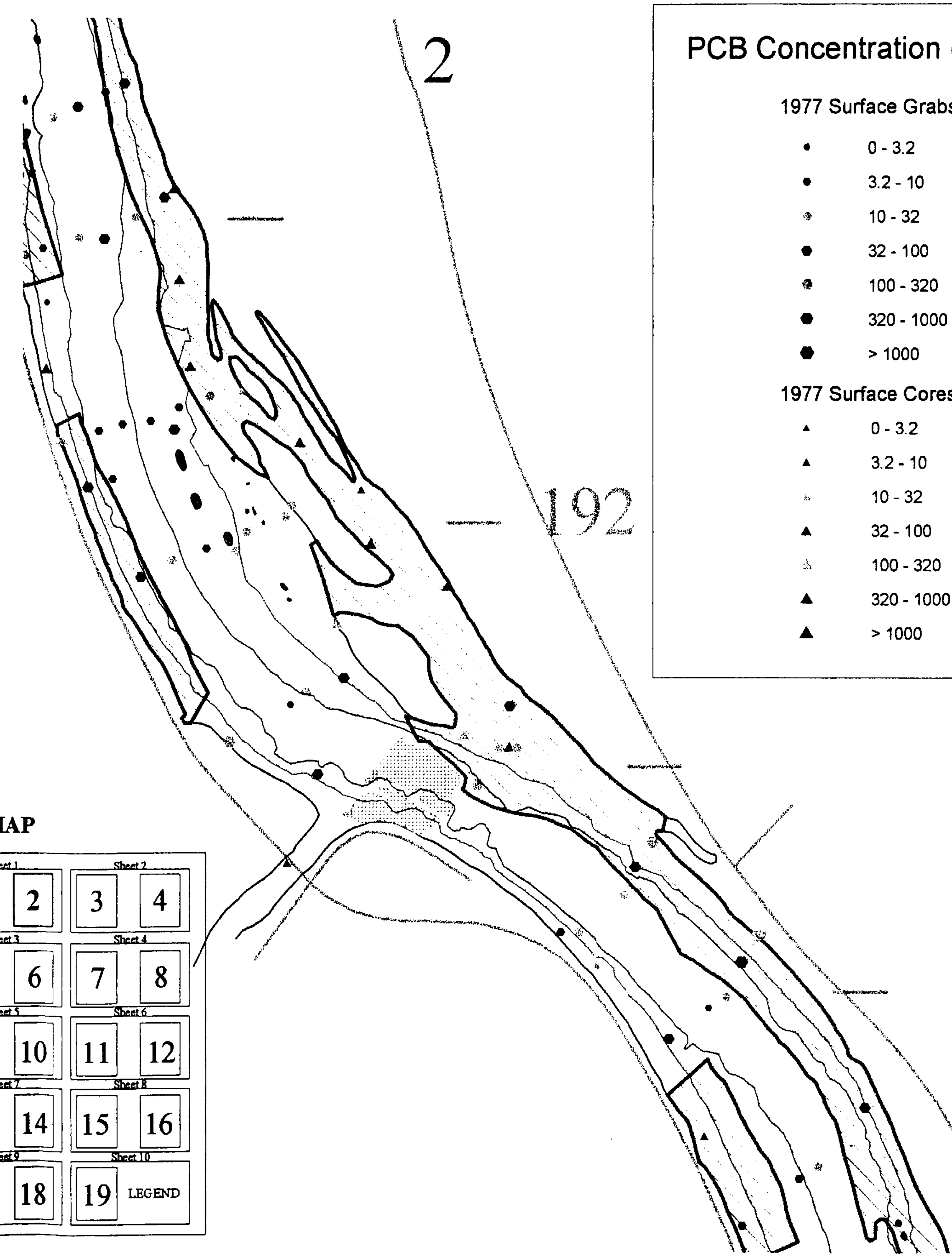
PCB Inventory (g/m²)

1977 MPA Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1977 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000



PCB Concentration (mg/kg)

1977 Surface Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1977 Surface Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

KEY MAP

Sheet 1
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Sheet 2
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Sheet 3
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Sheet 4
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Sheet 5
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Sheet 6
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Sheet 7
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Sheet 8
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Sheet 9
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Sheet 10
19
LEGEND

TAMS
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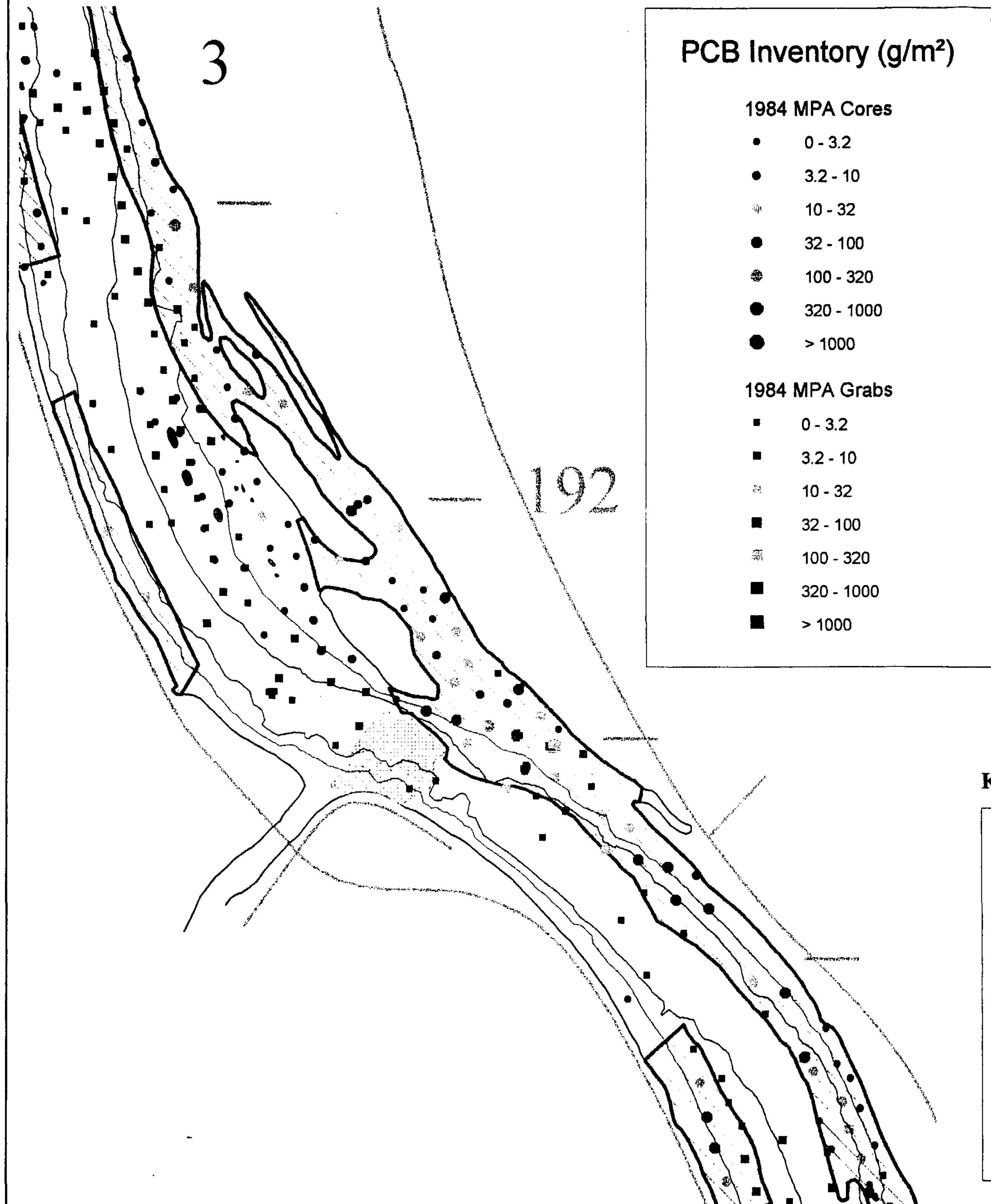
N W E S

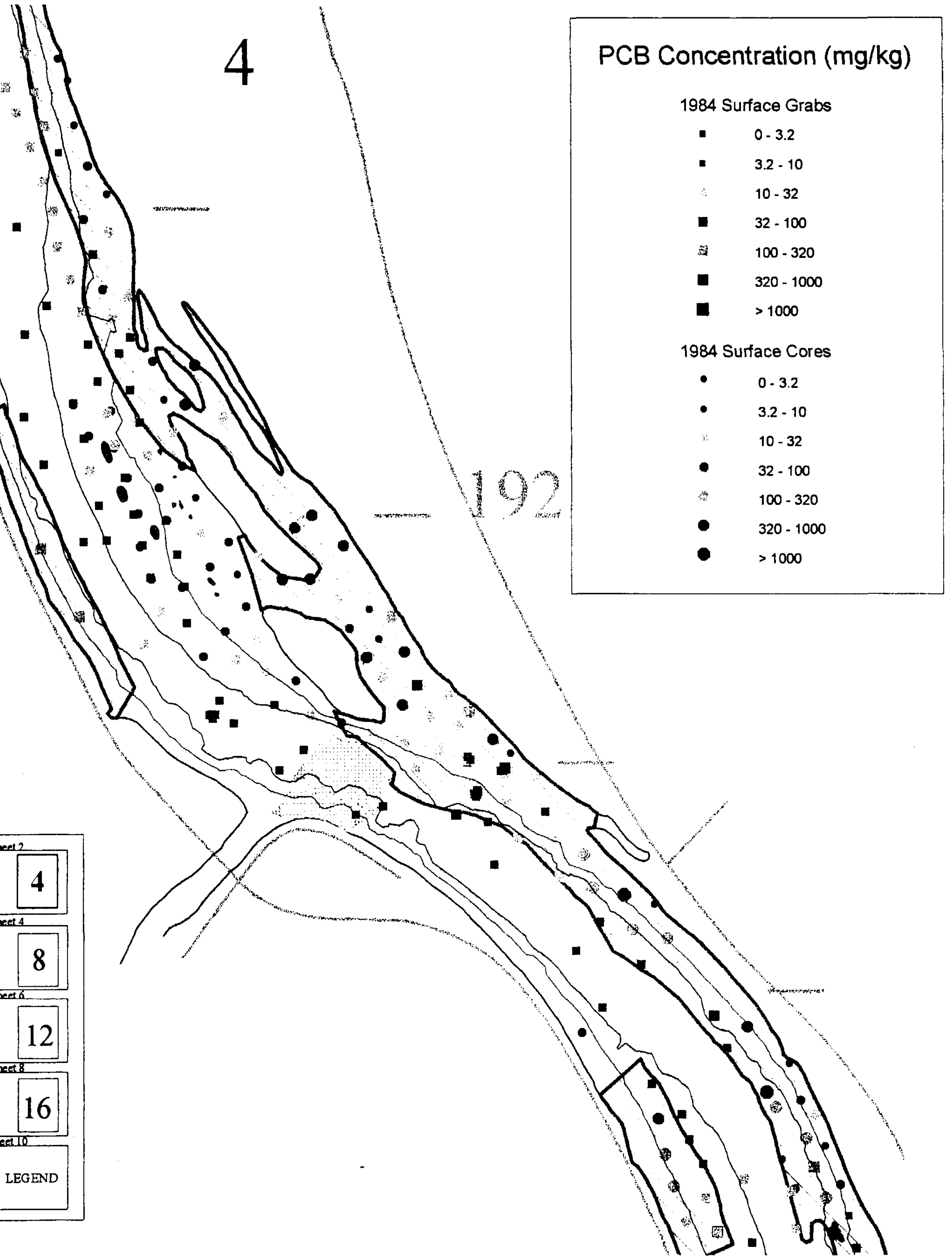
Note: See General Legend on Sheet 10.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 1 of 10

401115





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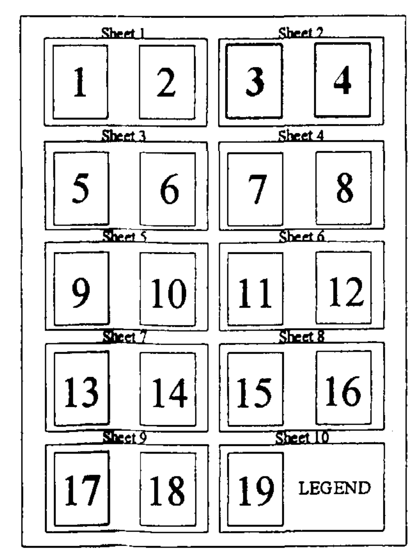

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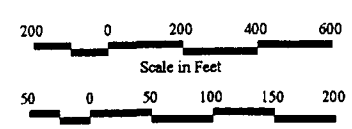
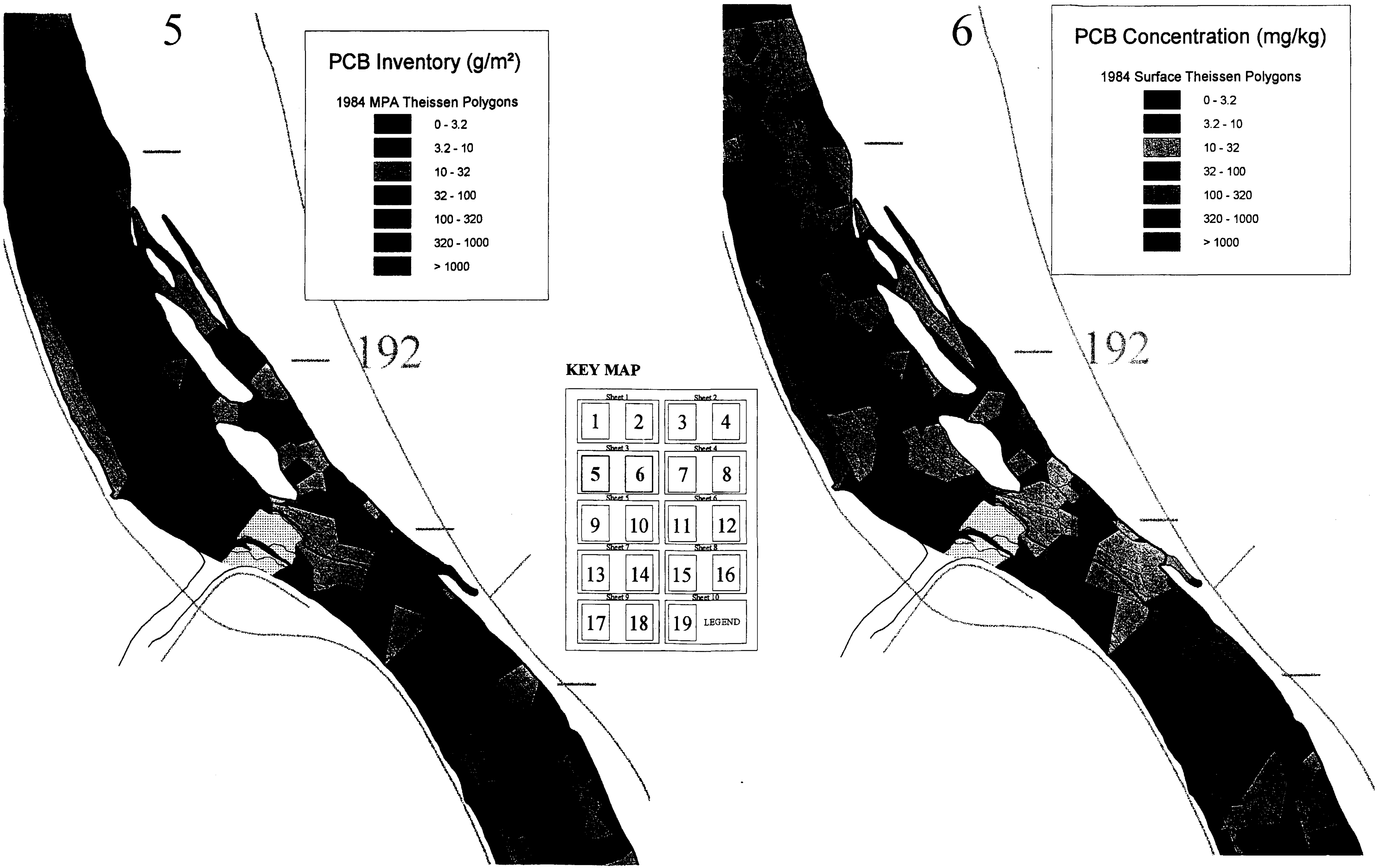
N W E S

Note: See General Legend on Sheet 10.



Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 2 of 10

401116



TAMS
TAMS Consultants, Inc.

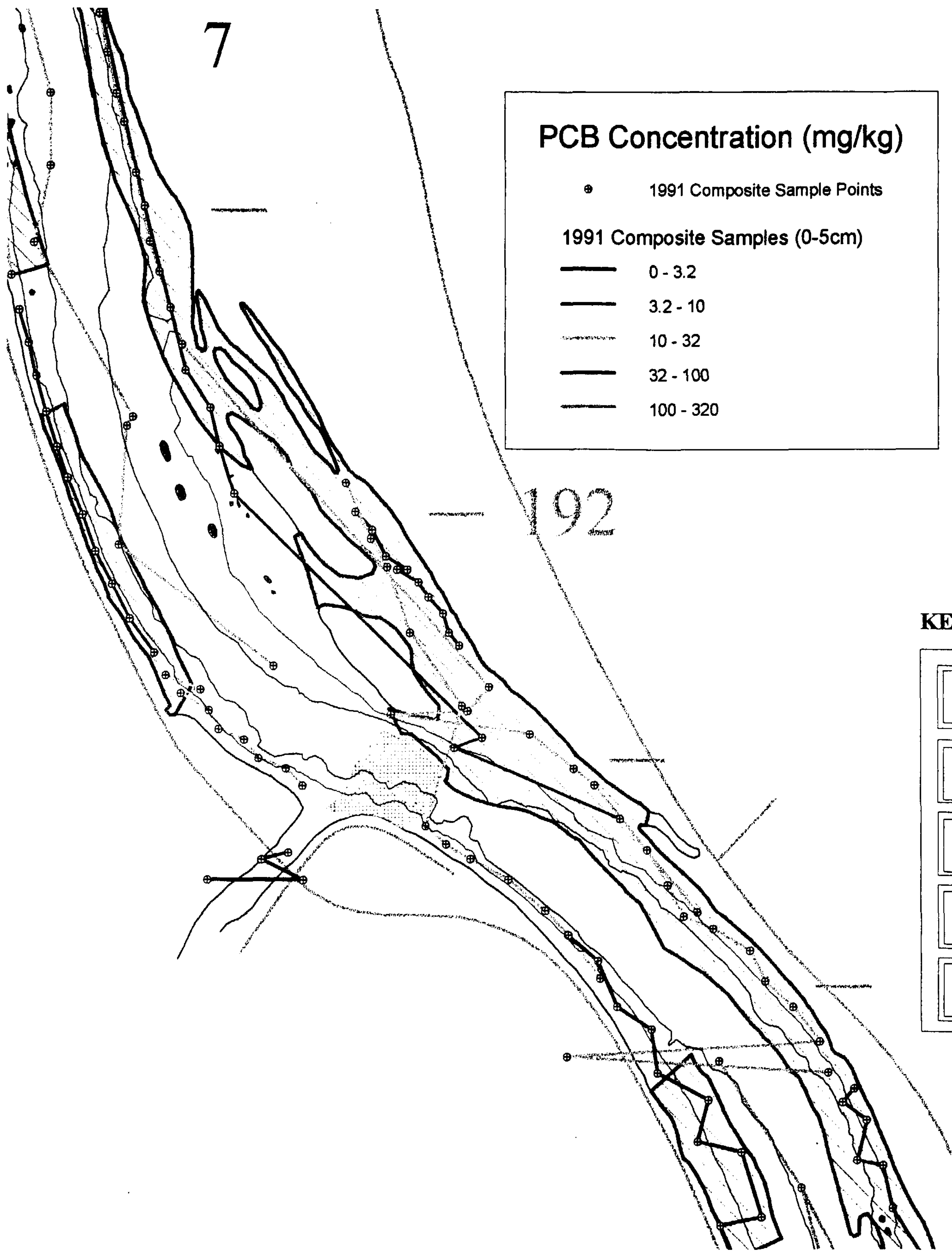
N W E S

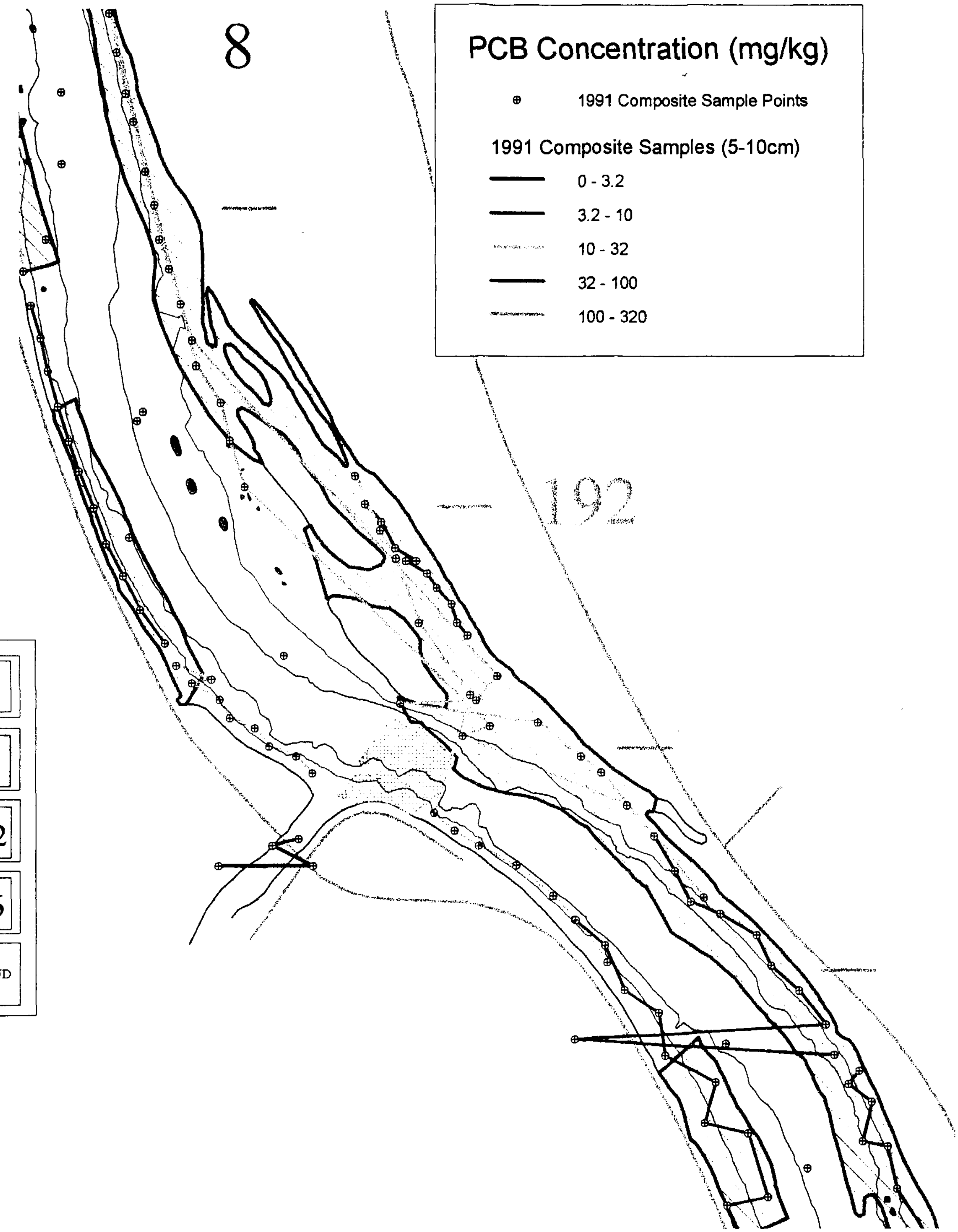
Note: See General Legend on Sheet 10.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 3 of 10

401117





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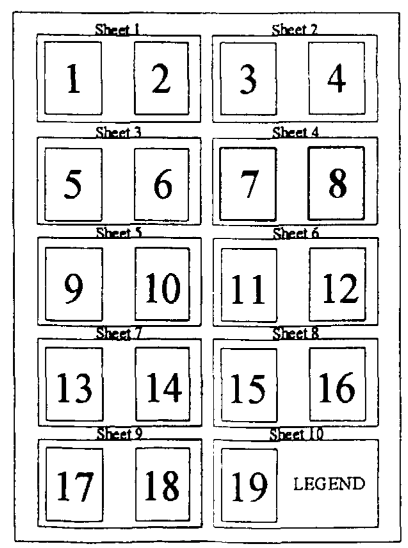

TAMS

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N W E S

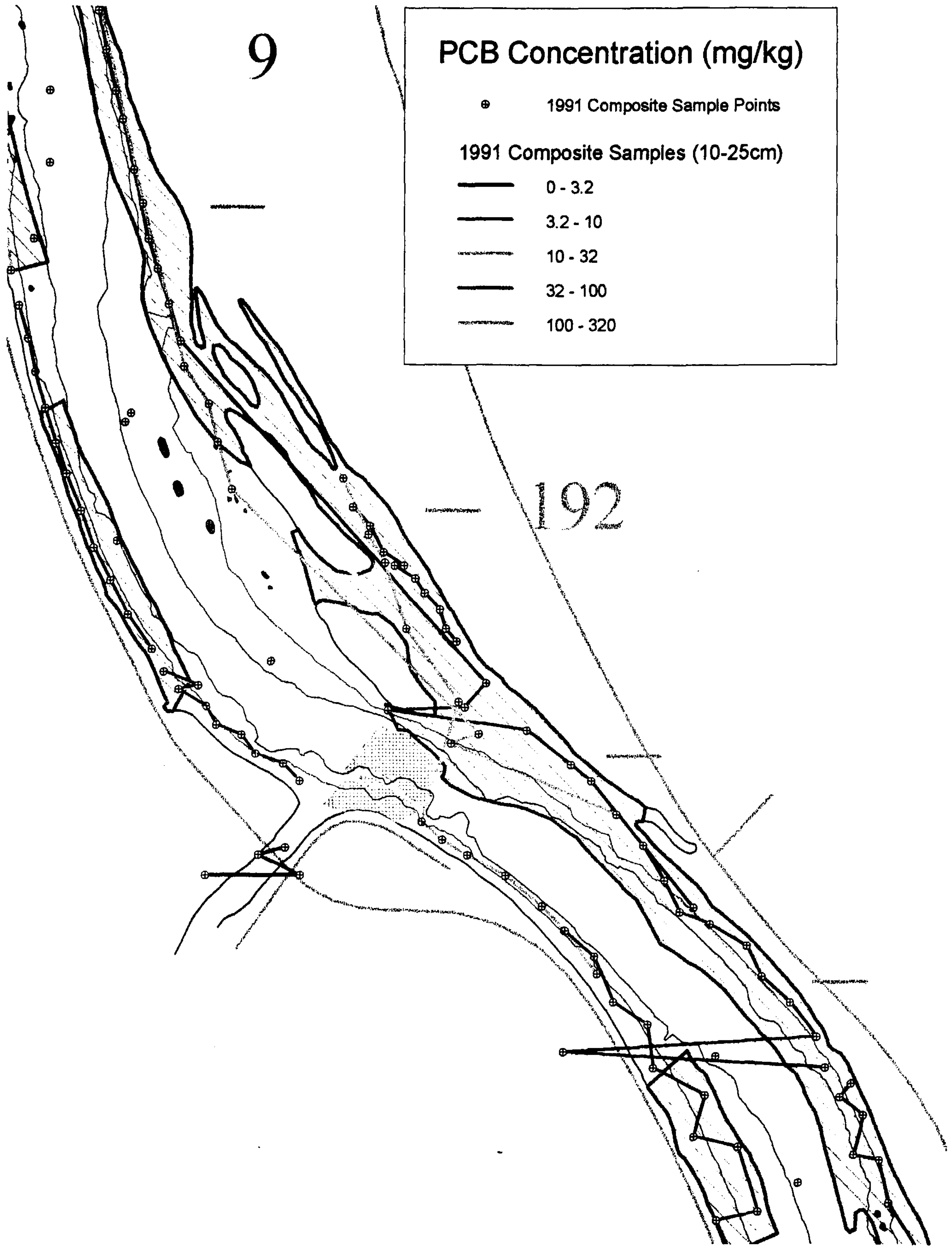
Note: See General Legend on Sheet 10.

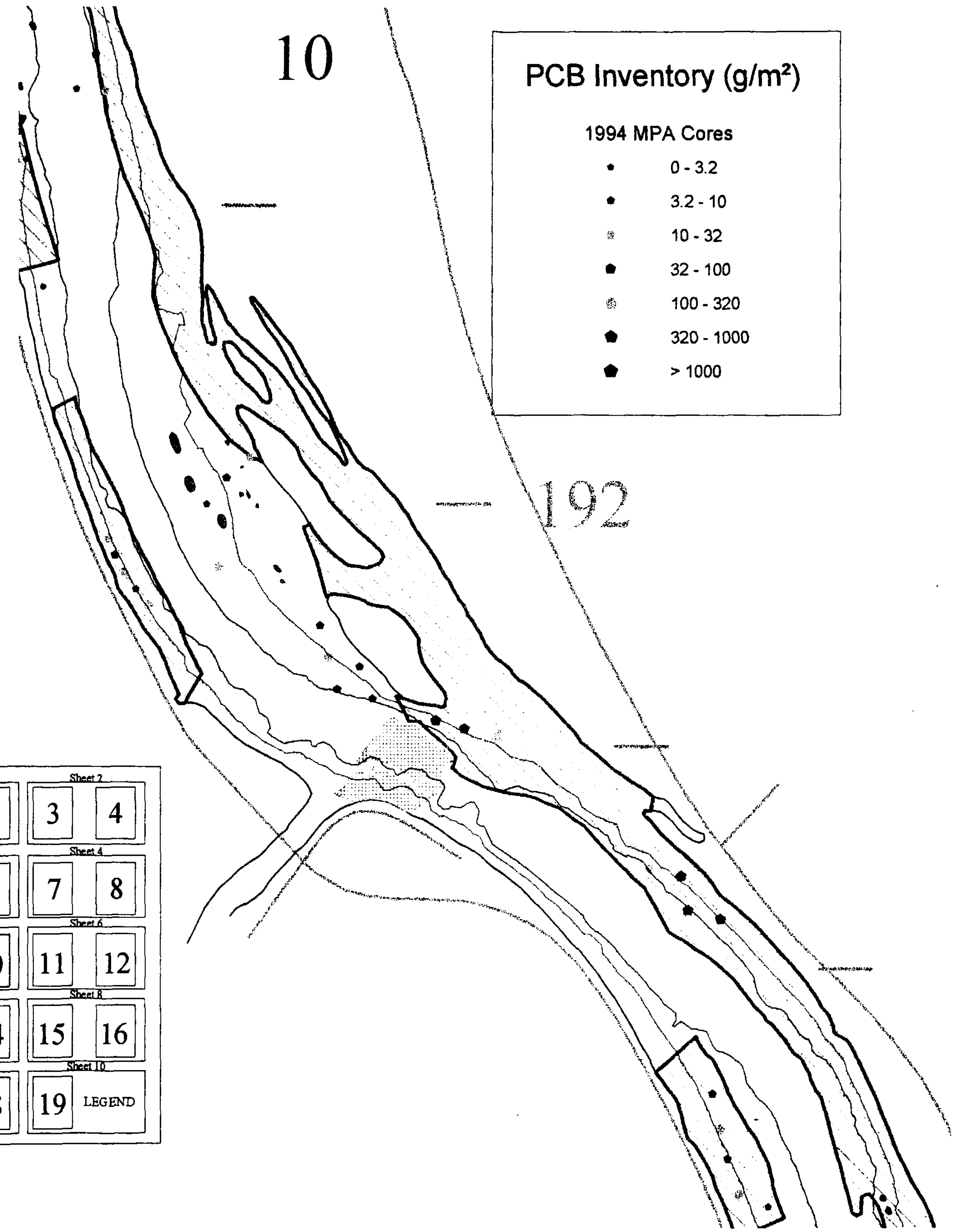
200 0 200 400 600 Scale in Feet

50 0 50 100 150 200 Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 4 of 10

401118





KEY MAP

TAMS

TAMS Consultants, Inc.

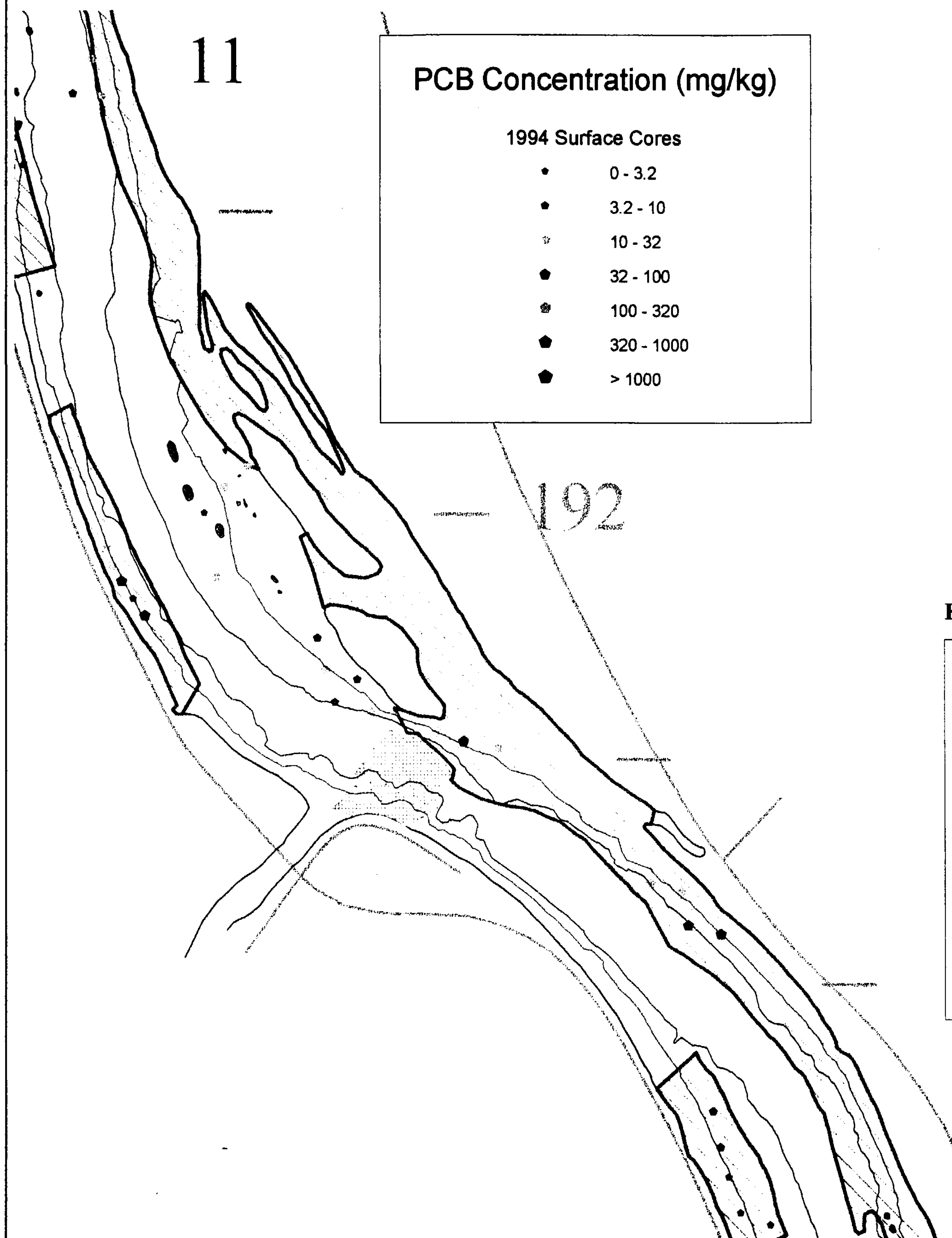
N W E S

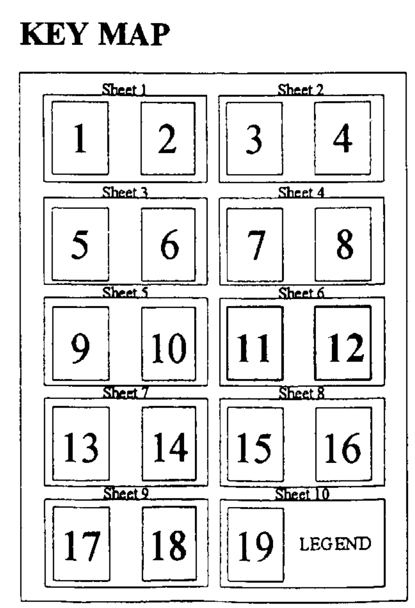
Note: See General Legend on Sheet 10.

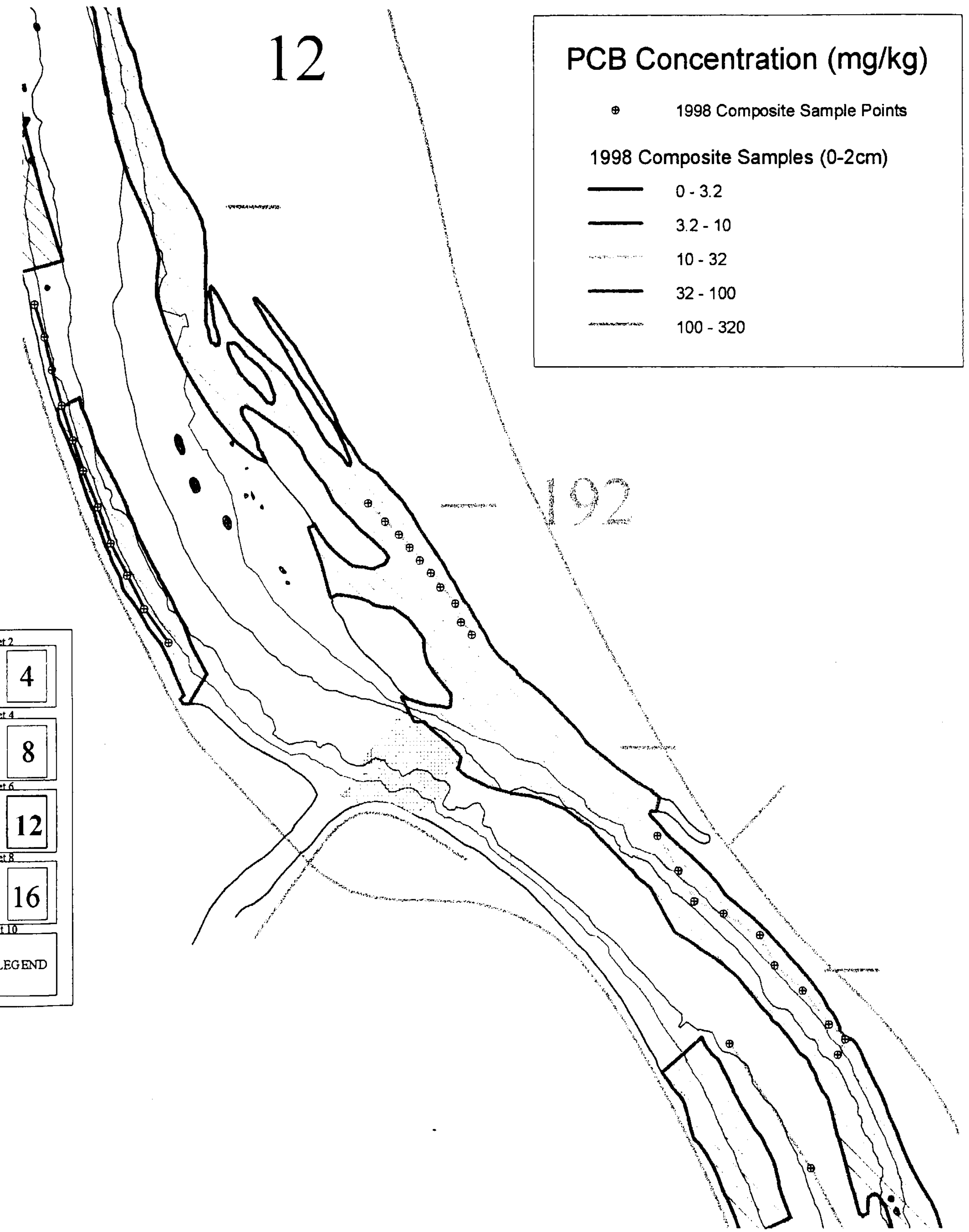
200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

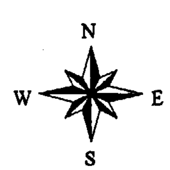
Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 5 of 10

401119



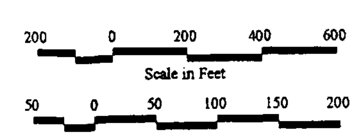






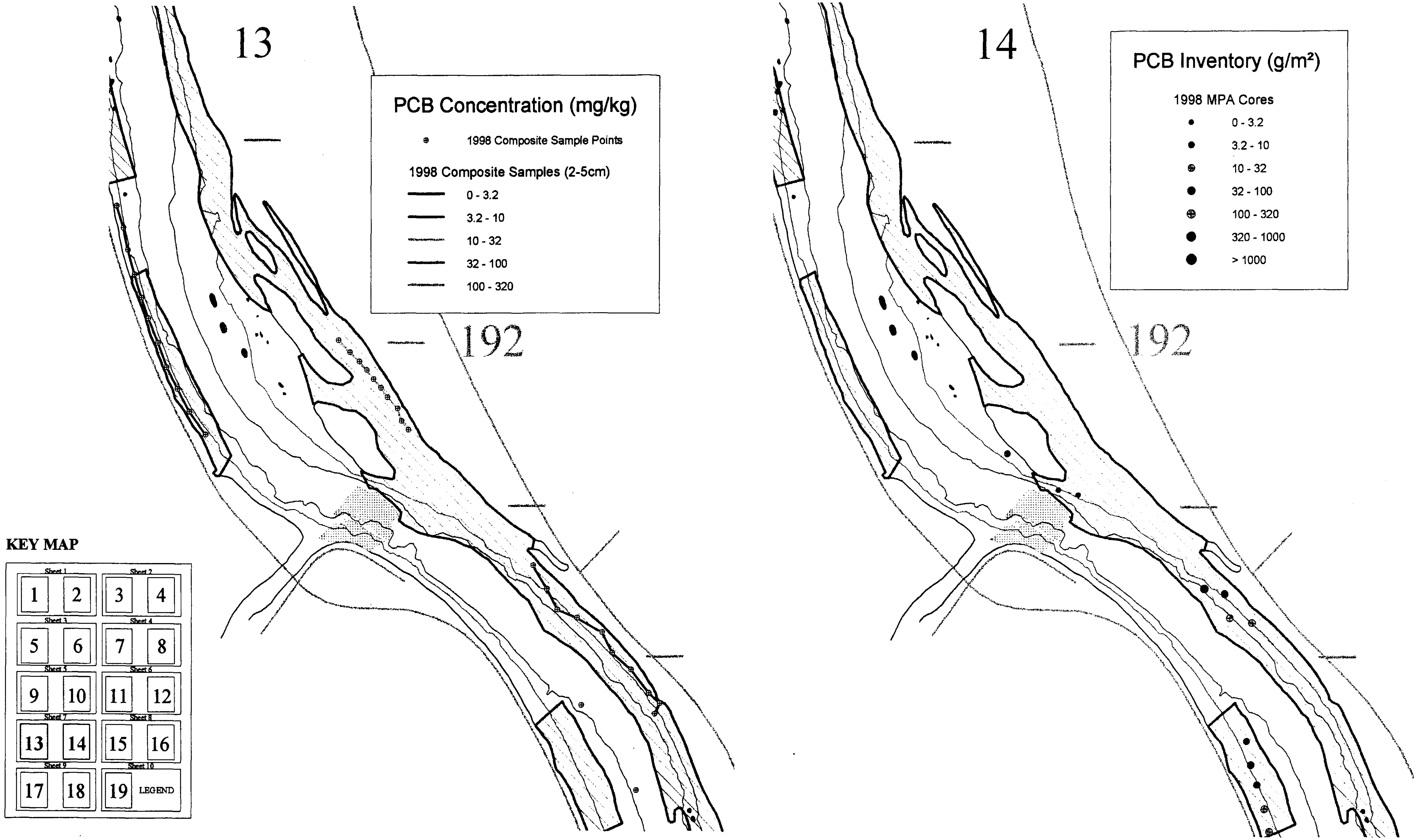
TAMS Consultants, Inc.

Note: See General Legend on Sheet 10.



Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 6 of 10

401120



TAMS
TAMS Consultants, Inc.

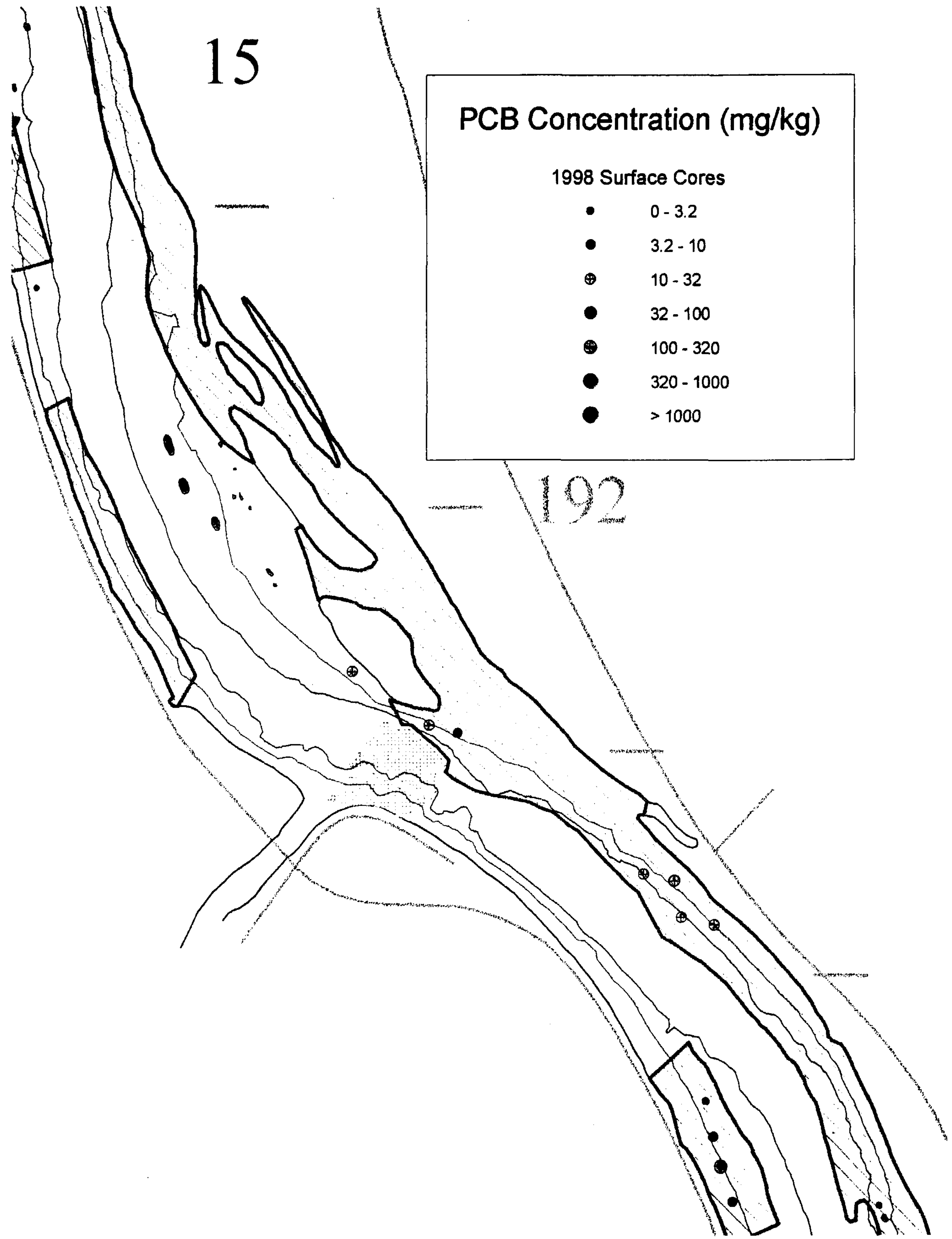
N W E S

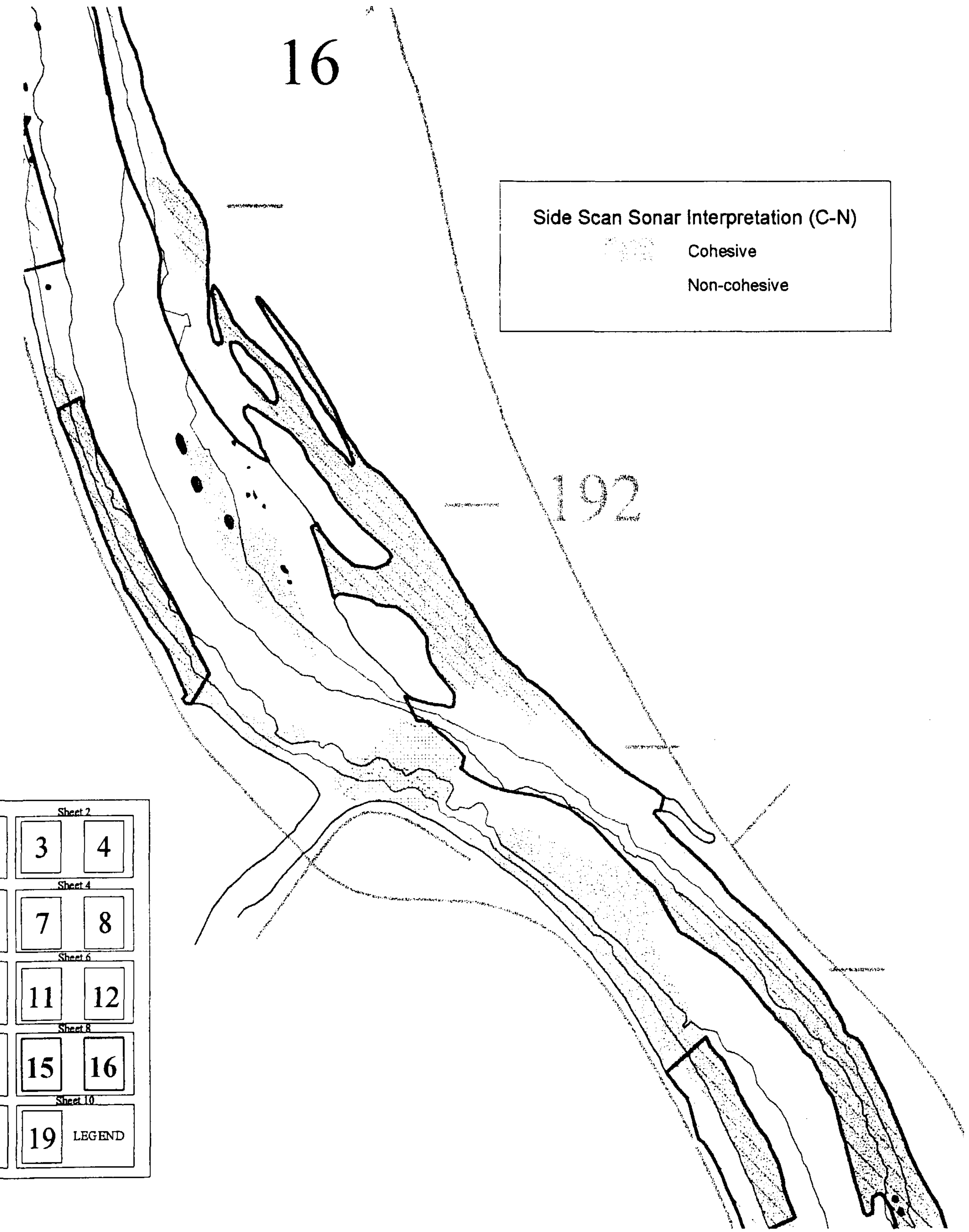
Note: See General Legend on Sheet 10.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 7 of 10

401121





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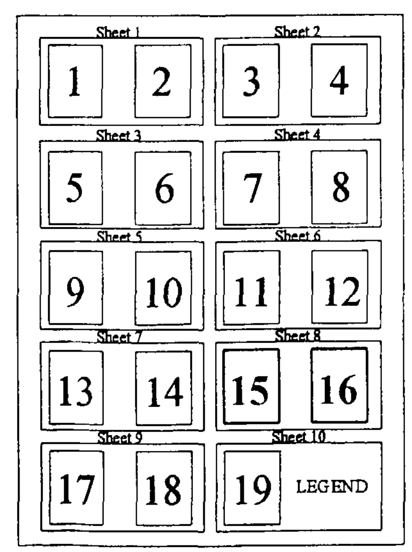


TAMS

TAMS Consultants, Inc.

N W E S

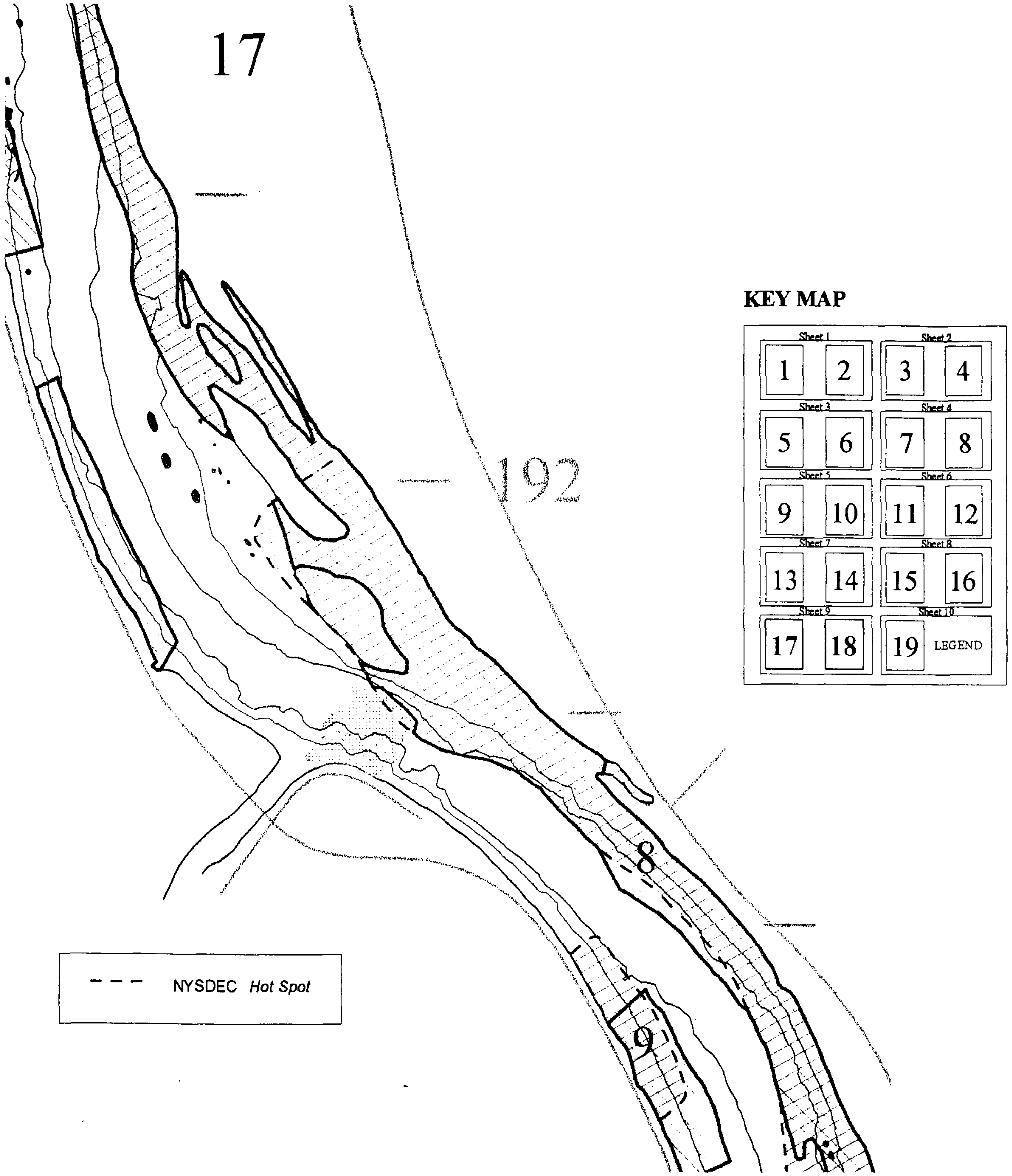
Note: See General Legend on Sheet 10.

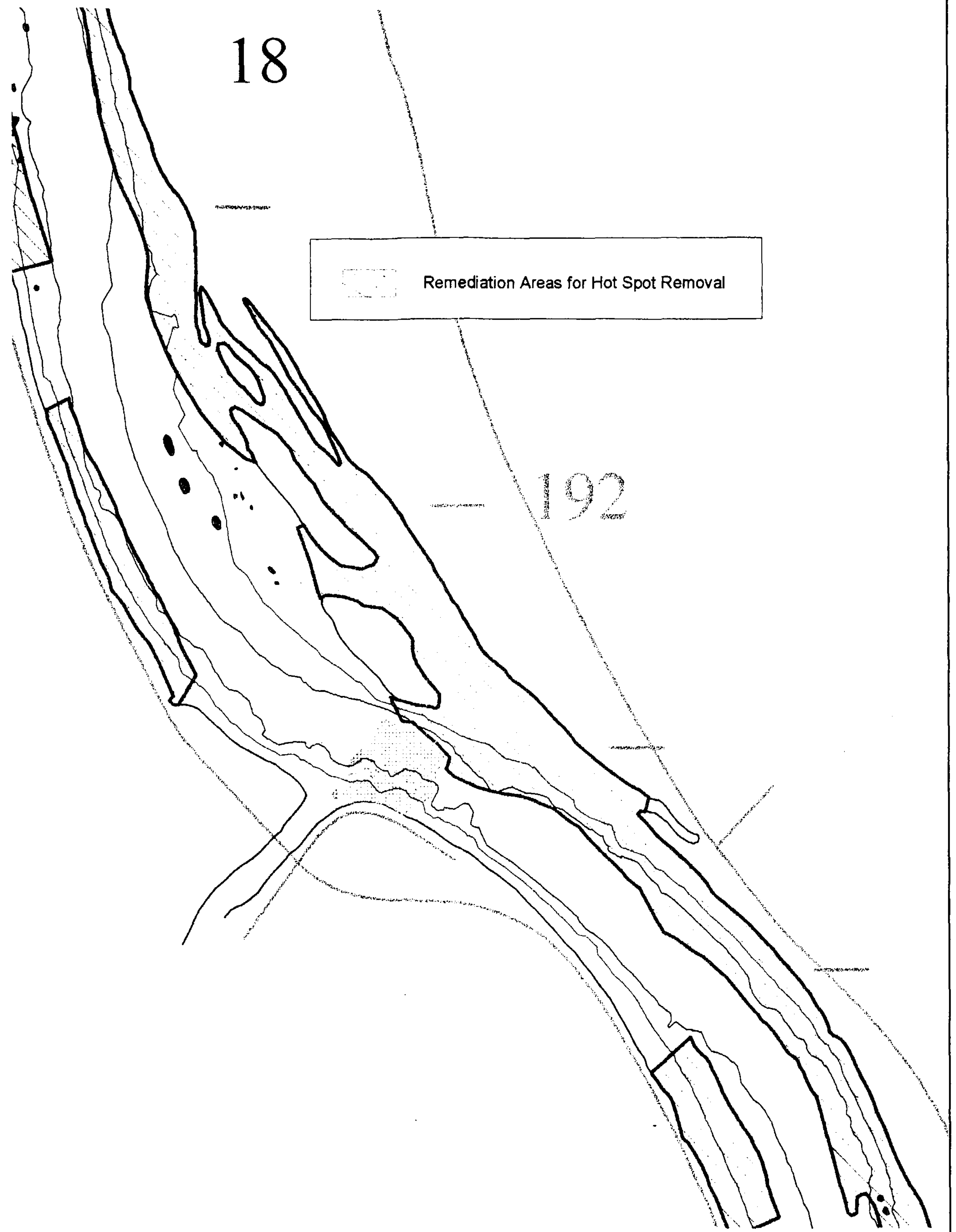
200 0 200 400 600
Scale in Feet

50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 8 of 10

401122





TAMS
TAMS Consultants, Inc.

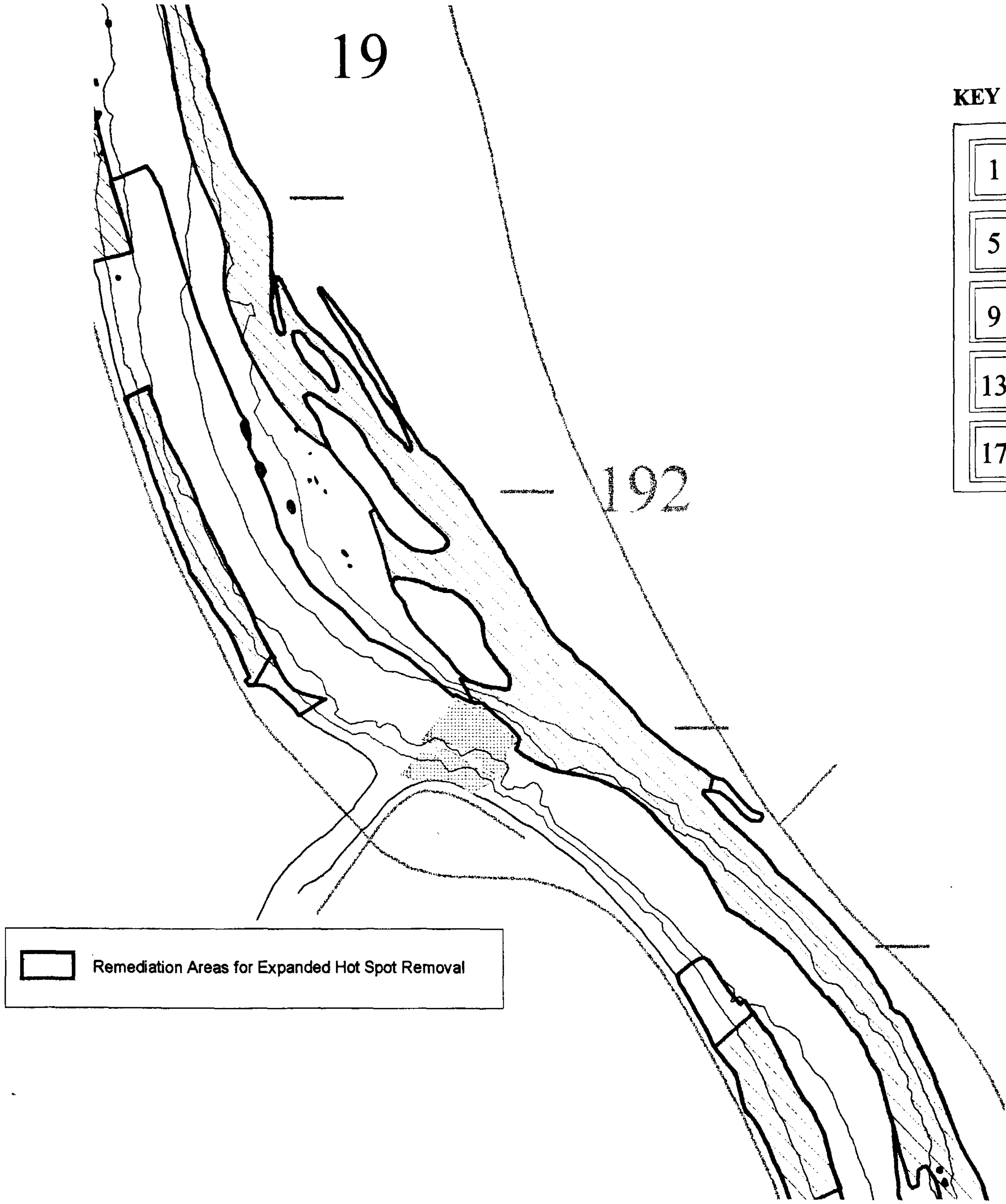
N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600
Scale in Feet
50 0 50 100 150 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 9 of 10

401123



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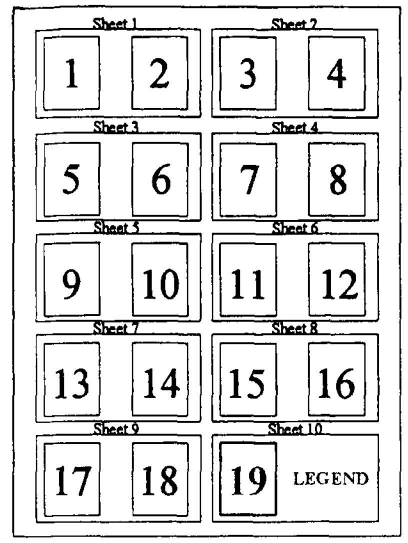

LEGEND

Approximate Water Depth (ft) at 3,090 cfs

- 6.5
- 12.5

Side Scan Sonar Interpretation

- Mound
- Rock
- Remediation Areas for Hot Spot Removal
- Hudson River Shoreline at 8,471 cfs
- Dam or Lock
- Road
- Rivermile Markers

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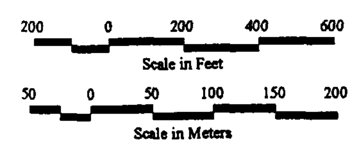
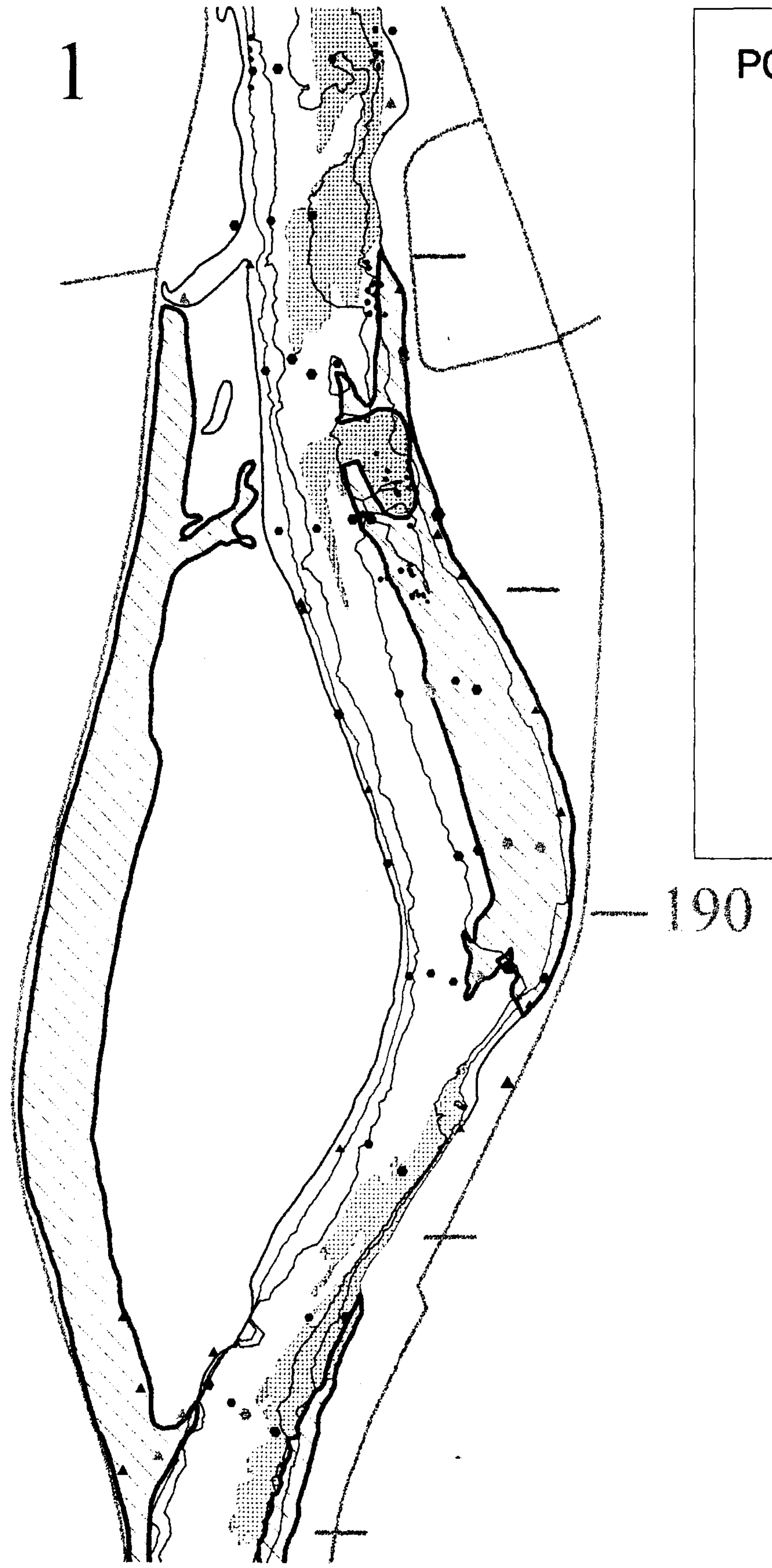


Hudson River PCBs Reassessment Feasibility Study	Figure 3-20 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 8*	Sheet 10 of 10

401124



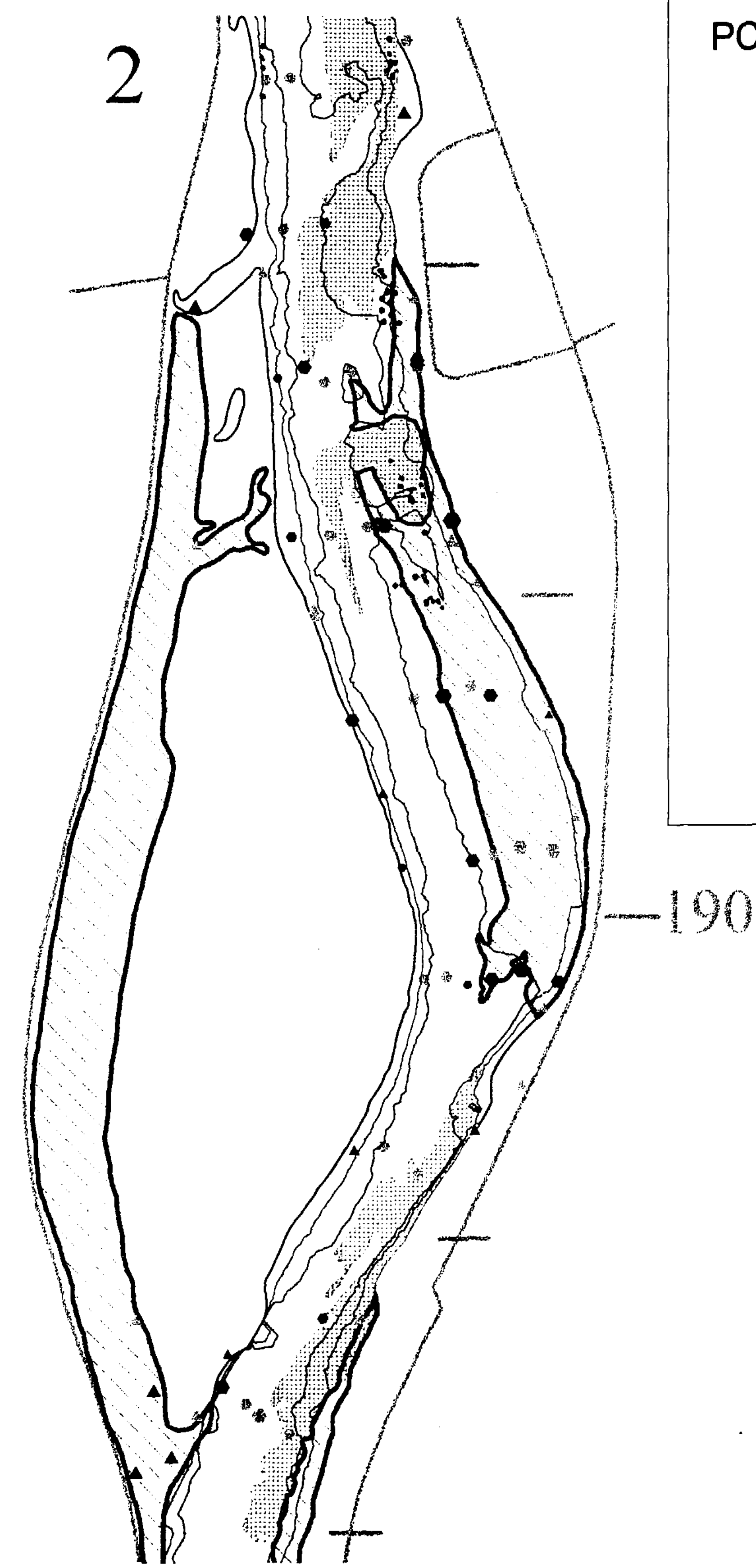
PCB Inventory (g/m²)

1977 MPA Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1977 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000



PCB Concentration (mg/kg)

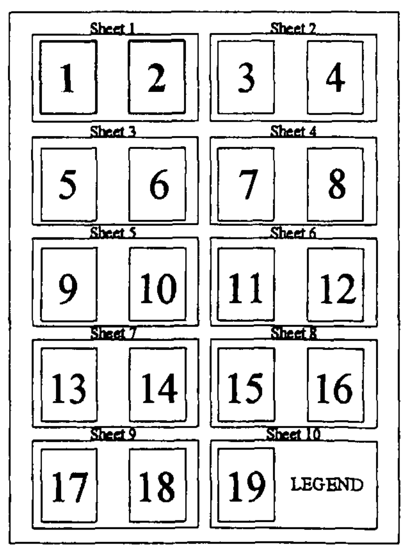
1977 Surface Grabs

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

1977 Surface Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

KEY MAP



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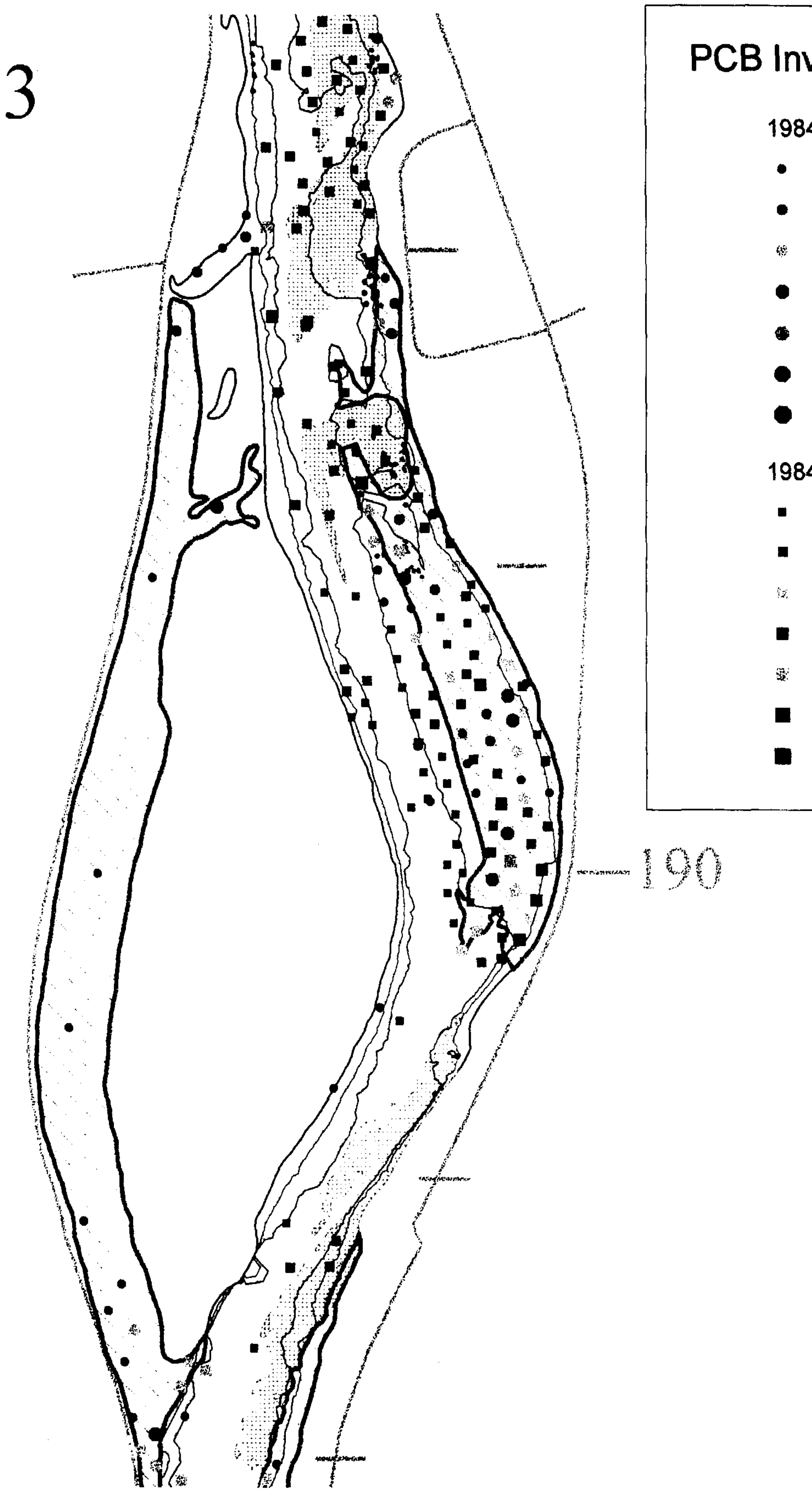
N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21	Sheet 1 of 10
	Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	

401125



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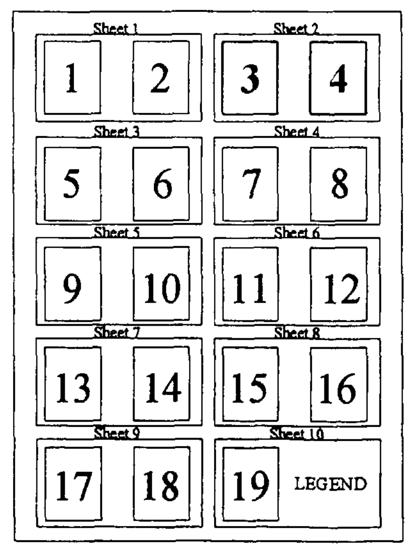

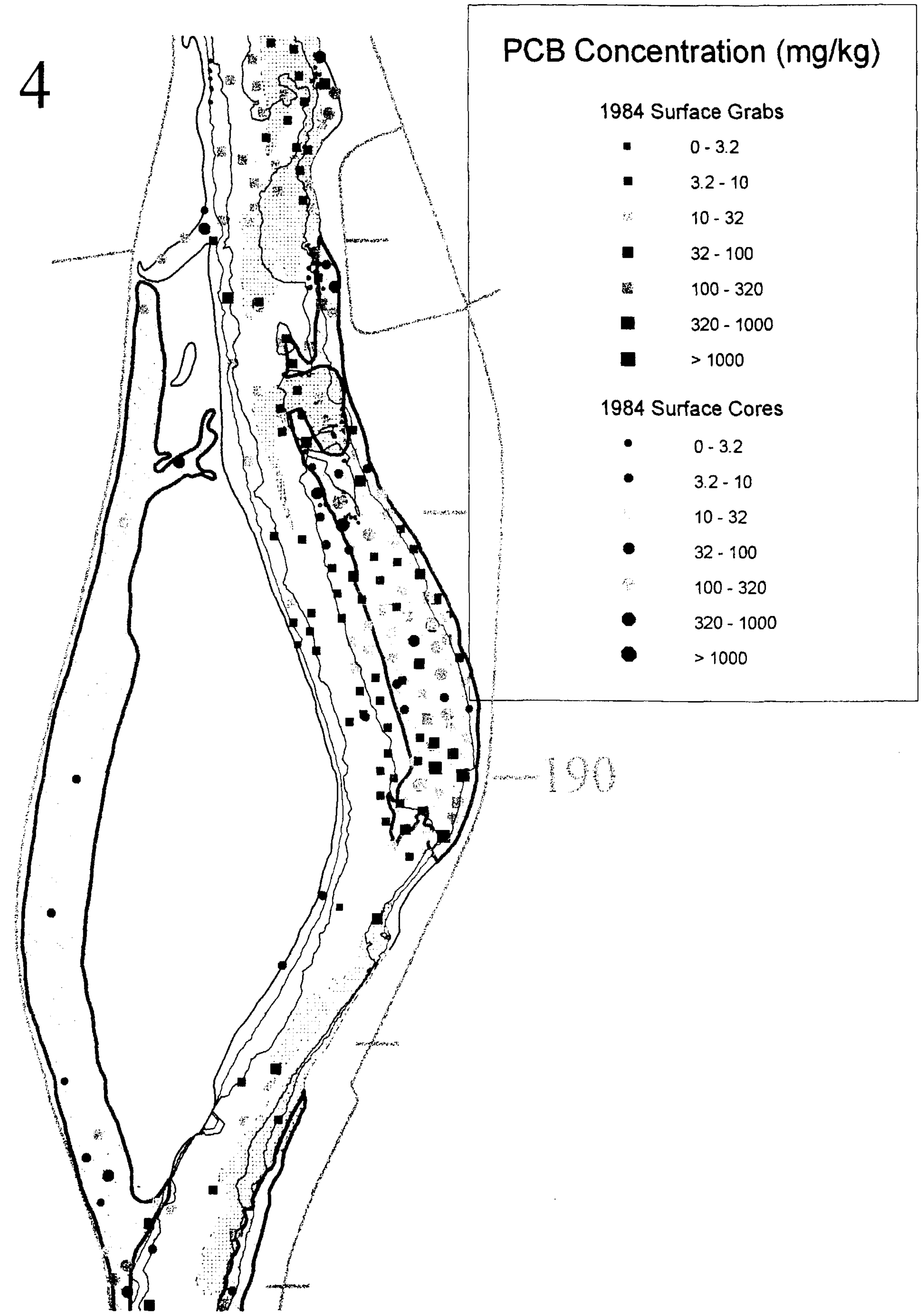

N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

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Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 2 of 10

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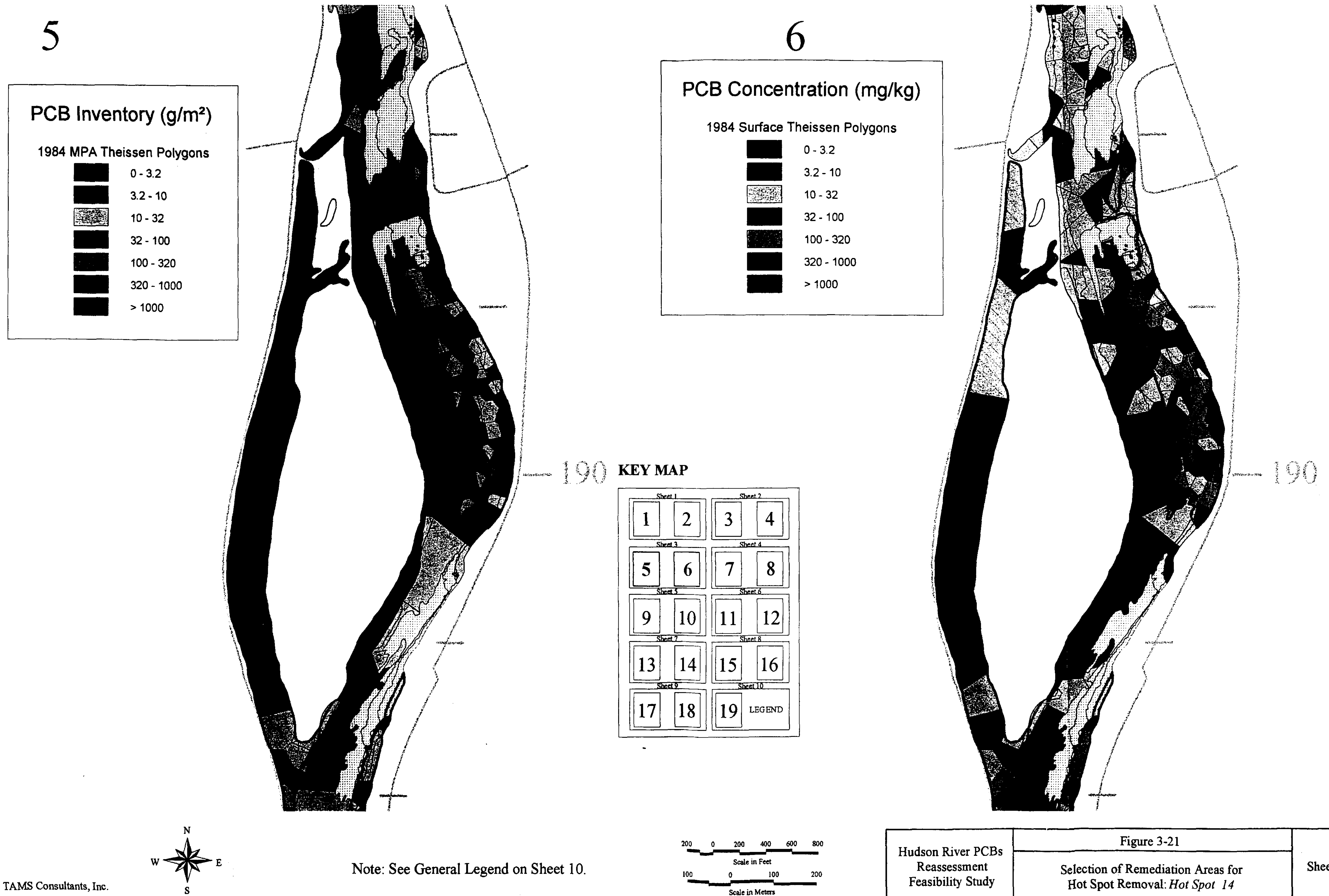

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Note: See General Legend on Sheet 10.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 3 of 10

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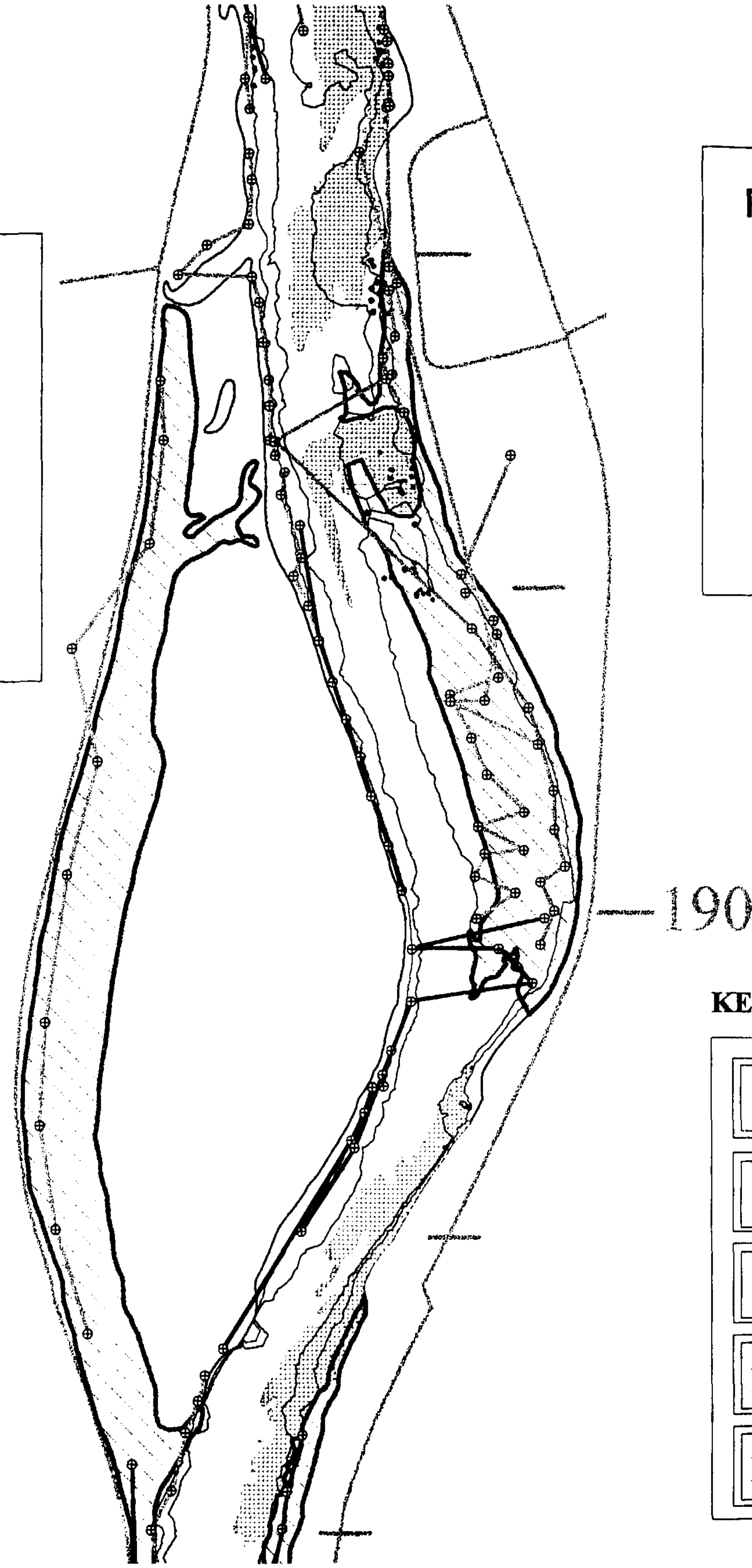
PCB Concentration (mg/kg)

⊕ 1991 Composite Sample Points

1991 Composite Samples (0-5cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320



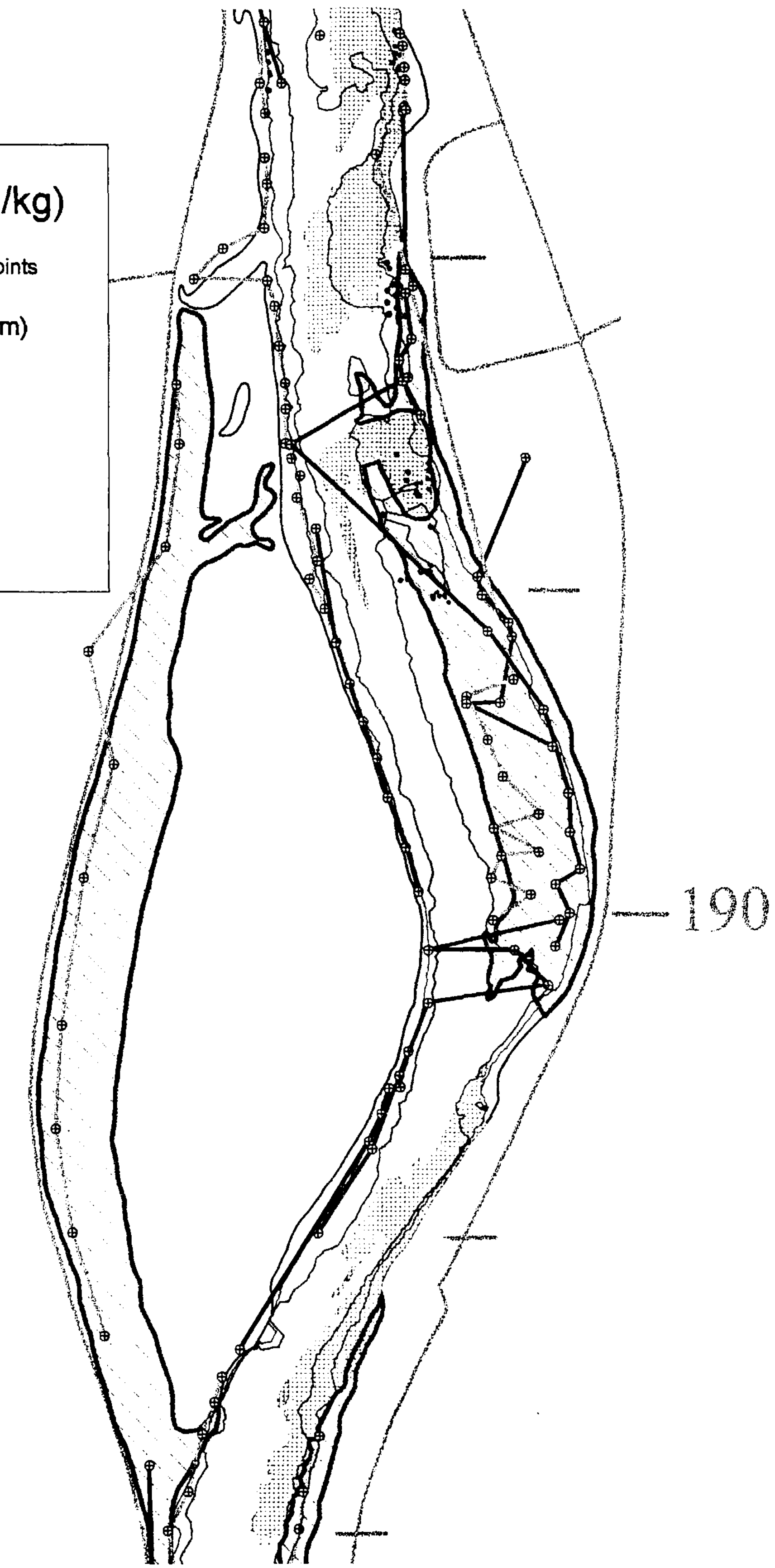
8

PCB Concentration (mg/kg)

⊕ 1991 Composite Sample Points

1991 Composite Samples (5-10cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320



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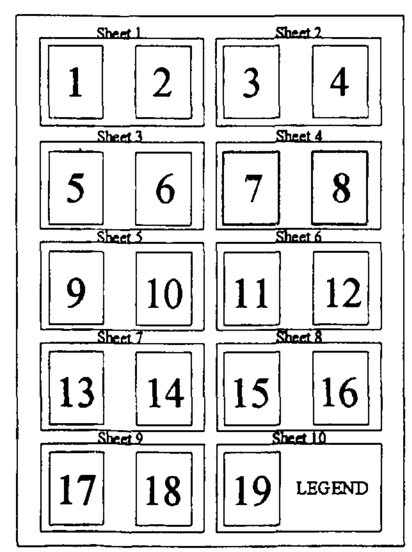

N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

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Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 4 of 10

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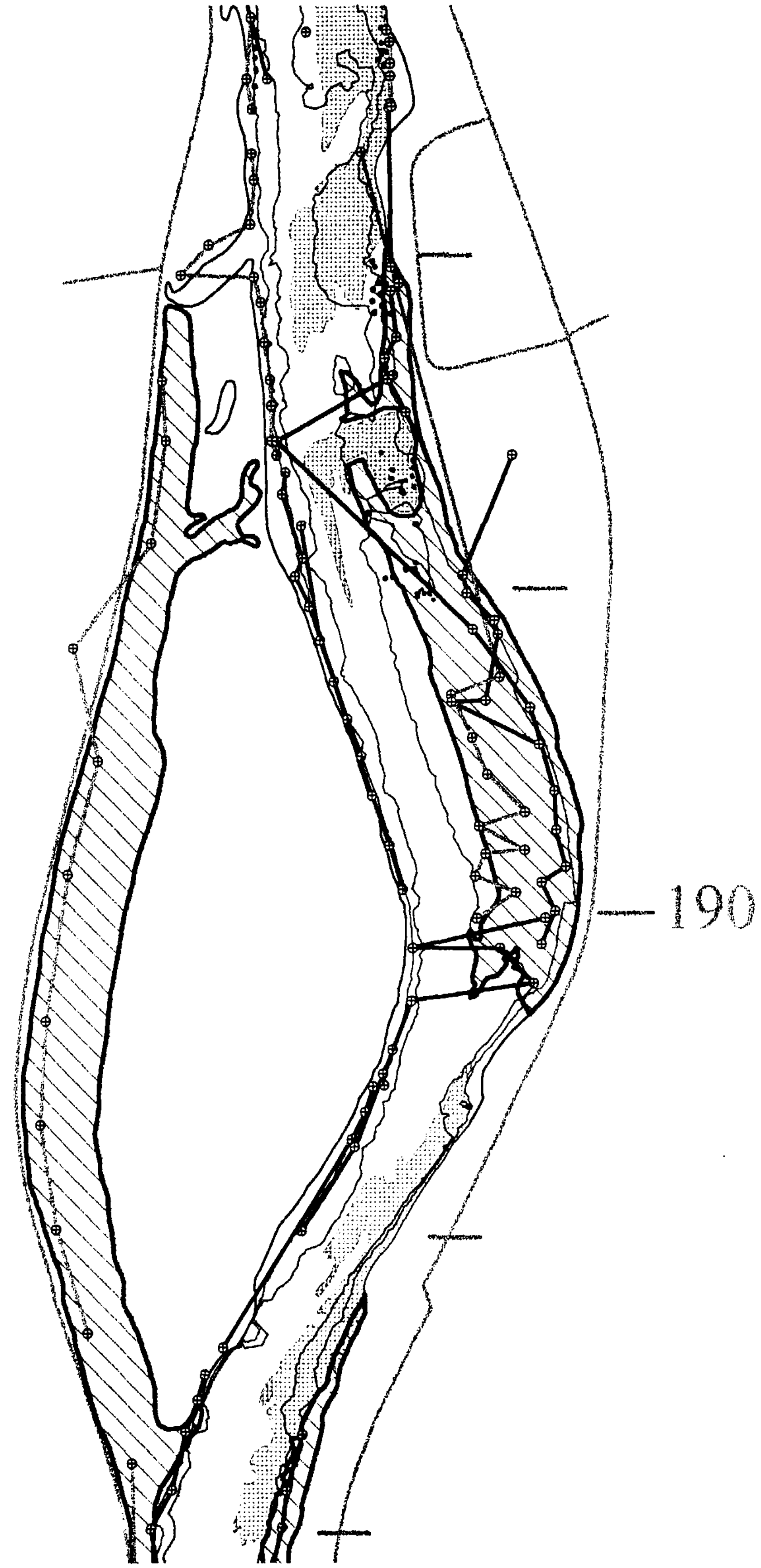

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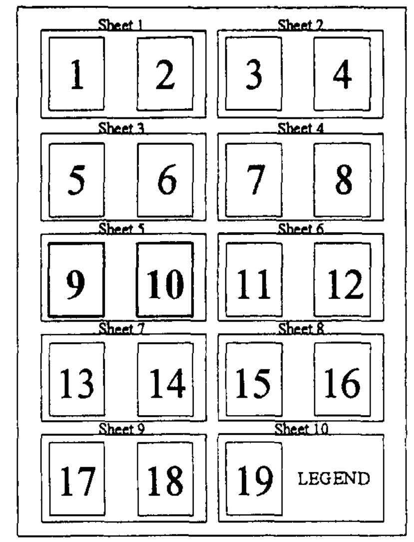

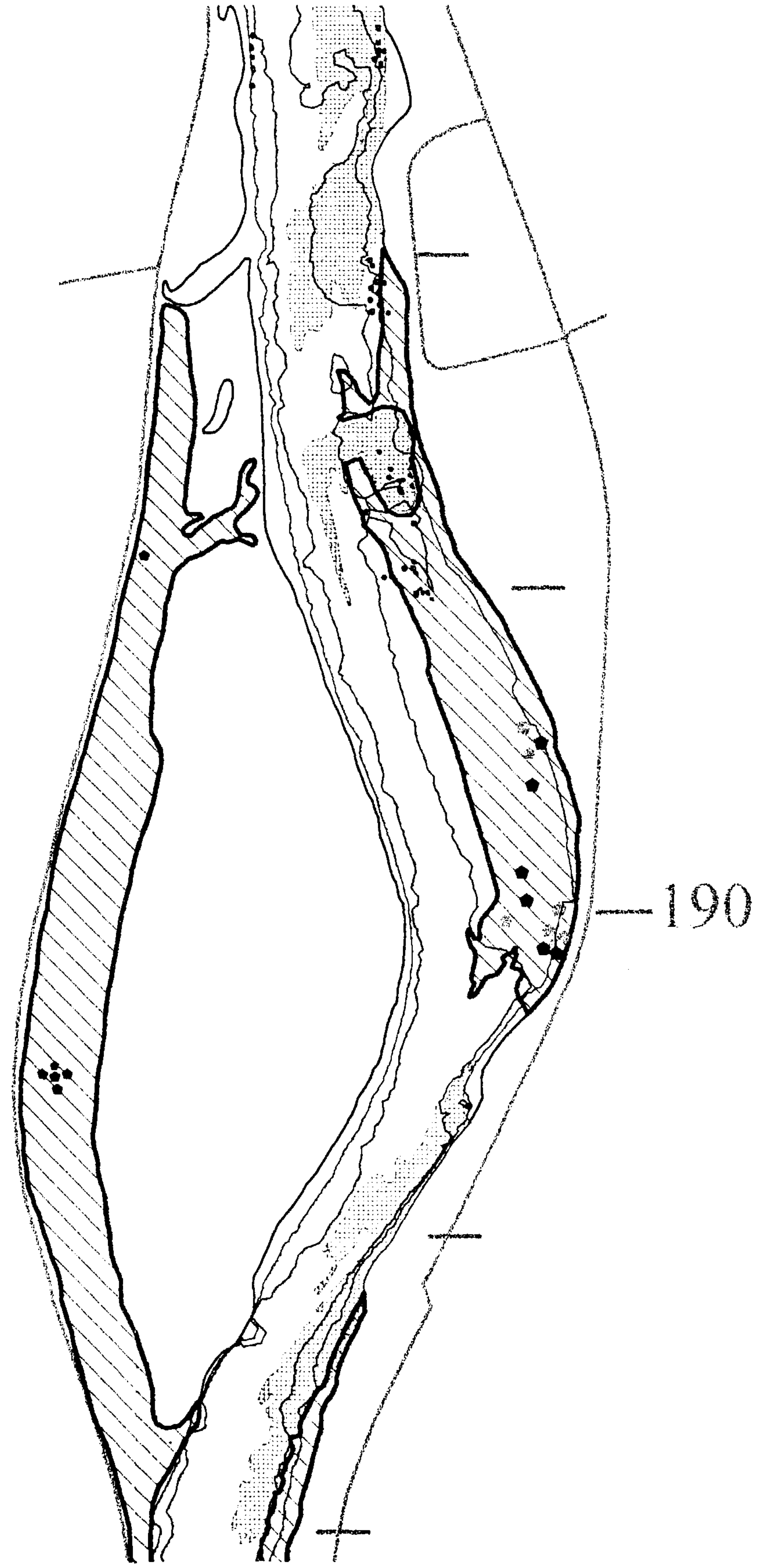

PCB Concentration (mg/kg)

⊕ 1991 Composite Sample Points

1991 Composite Samples (10-25cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320

PCB Inventory (g/m²)

1994 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000

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N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800
Scale in Feet
100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 5 of 10

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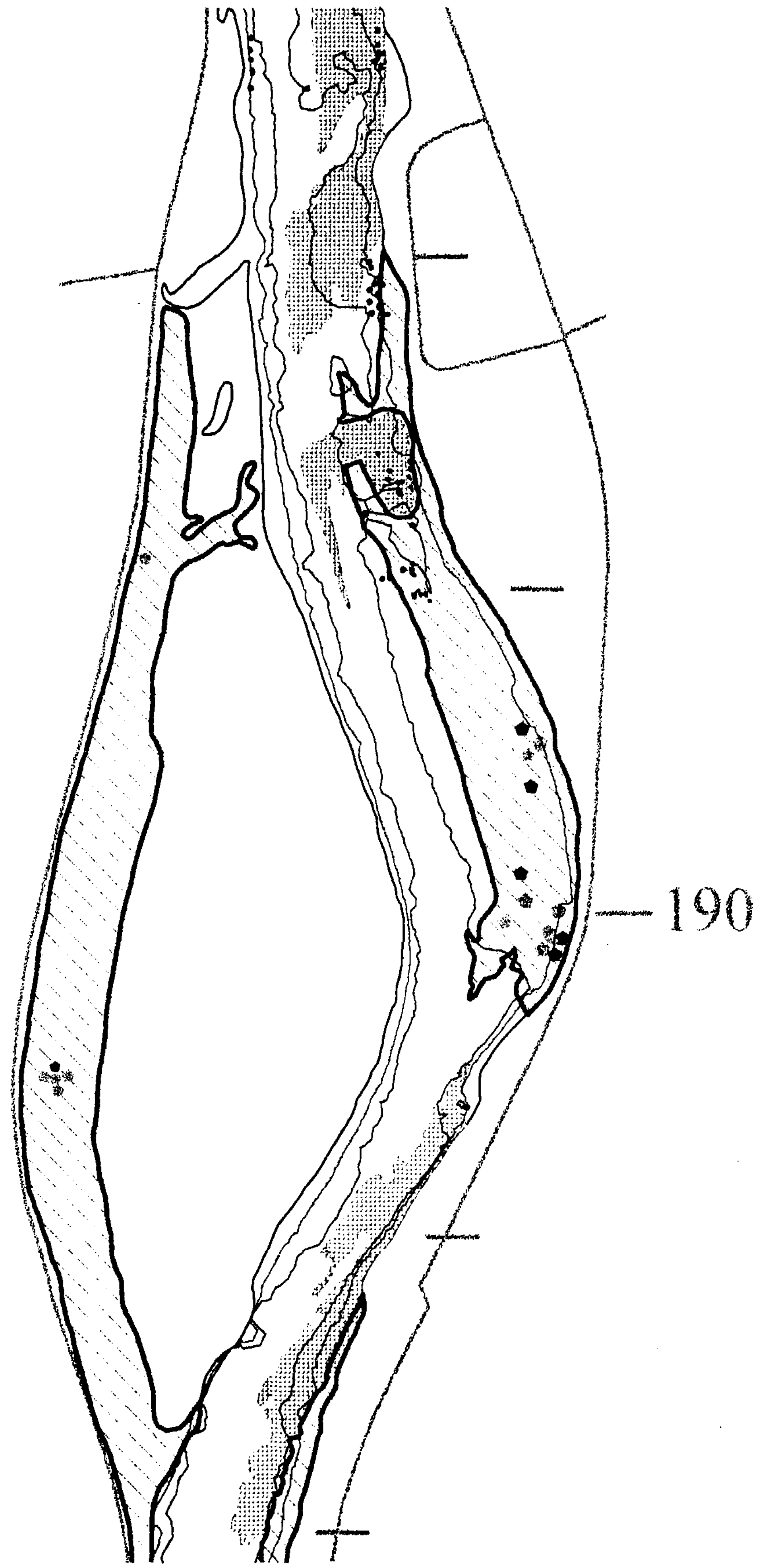
PCB Concentration (mg/kg)

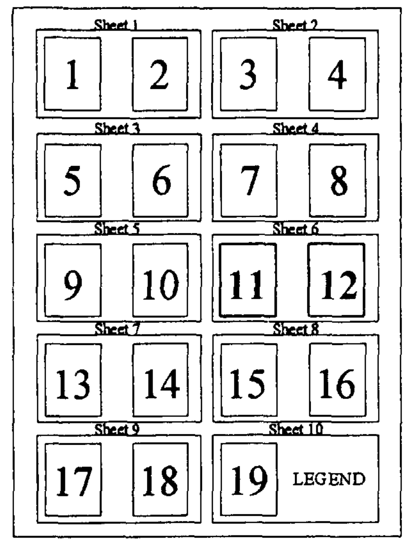
1994 Surface Cores

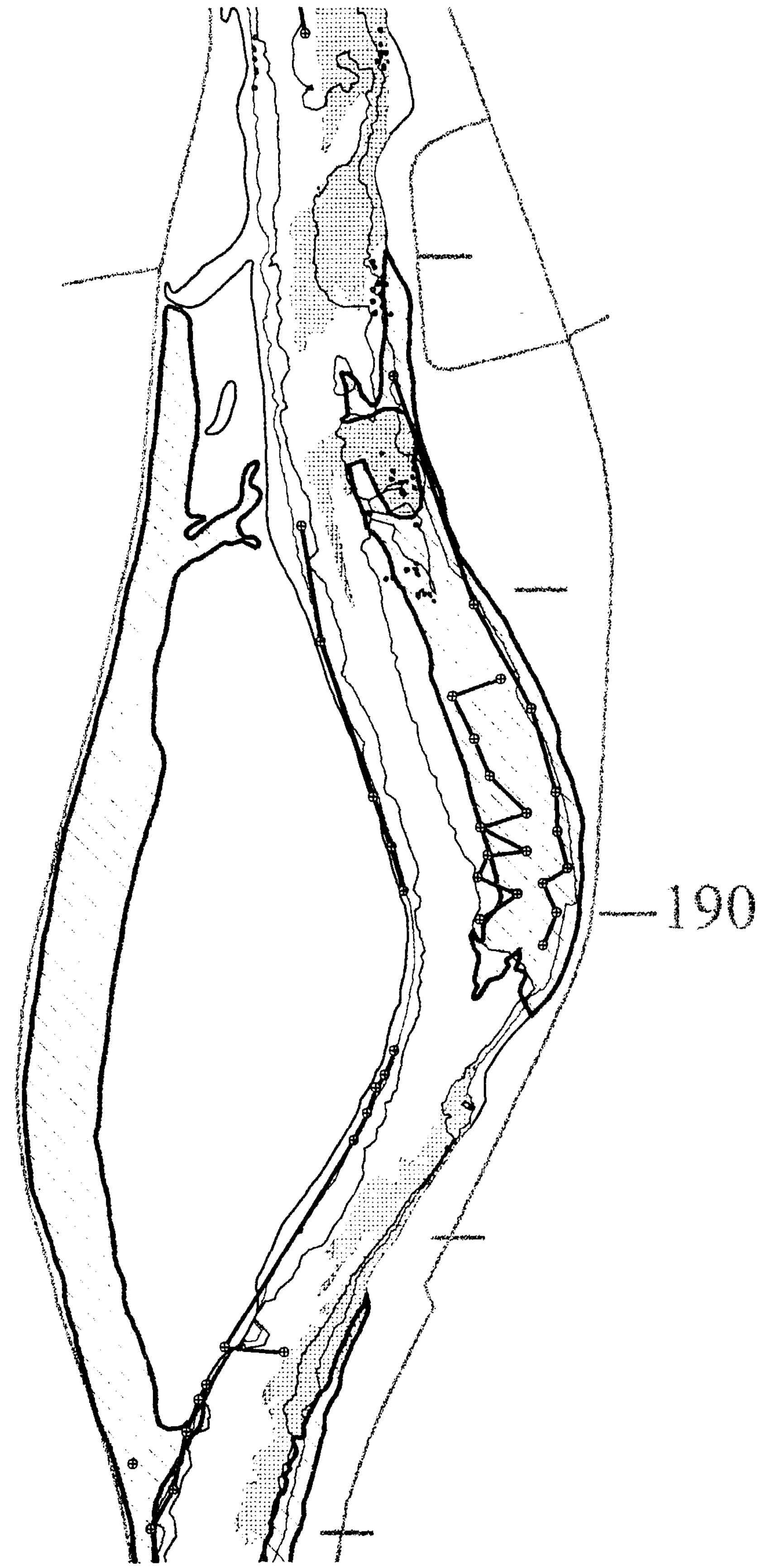
- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000



12

KEY MAP





PCB Concentration (mg/kg)

1998 Composite Sample Points

1998 Composite Samples (0-2cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320

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N W E S

Note: See General Legend on Sheet 10.

200 0 200 400 600 800 Scale in Feet

100 0 100 200 Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 6 of 10

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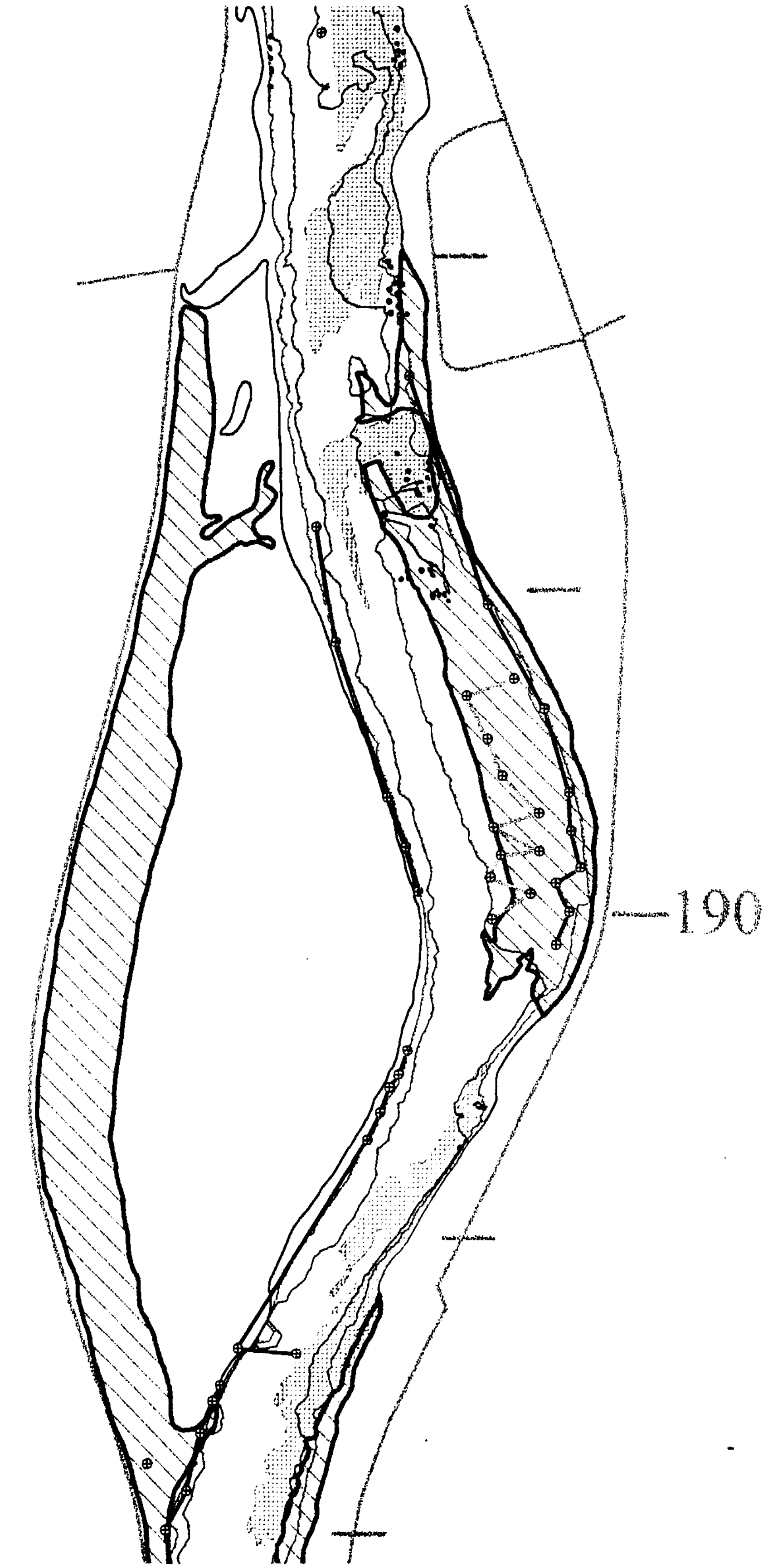
PCB Concentration (mg/kg)

⊕ 1998 Composite Sample Points

1998 Composite Samples (2-5cm)

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320

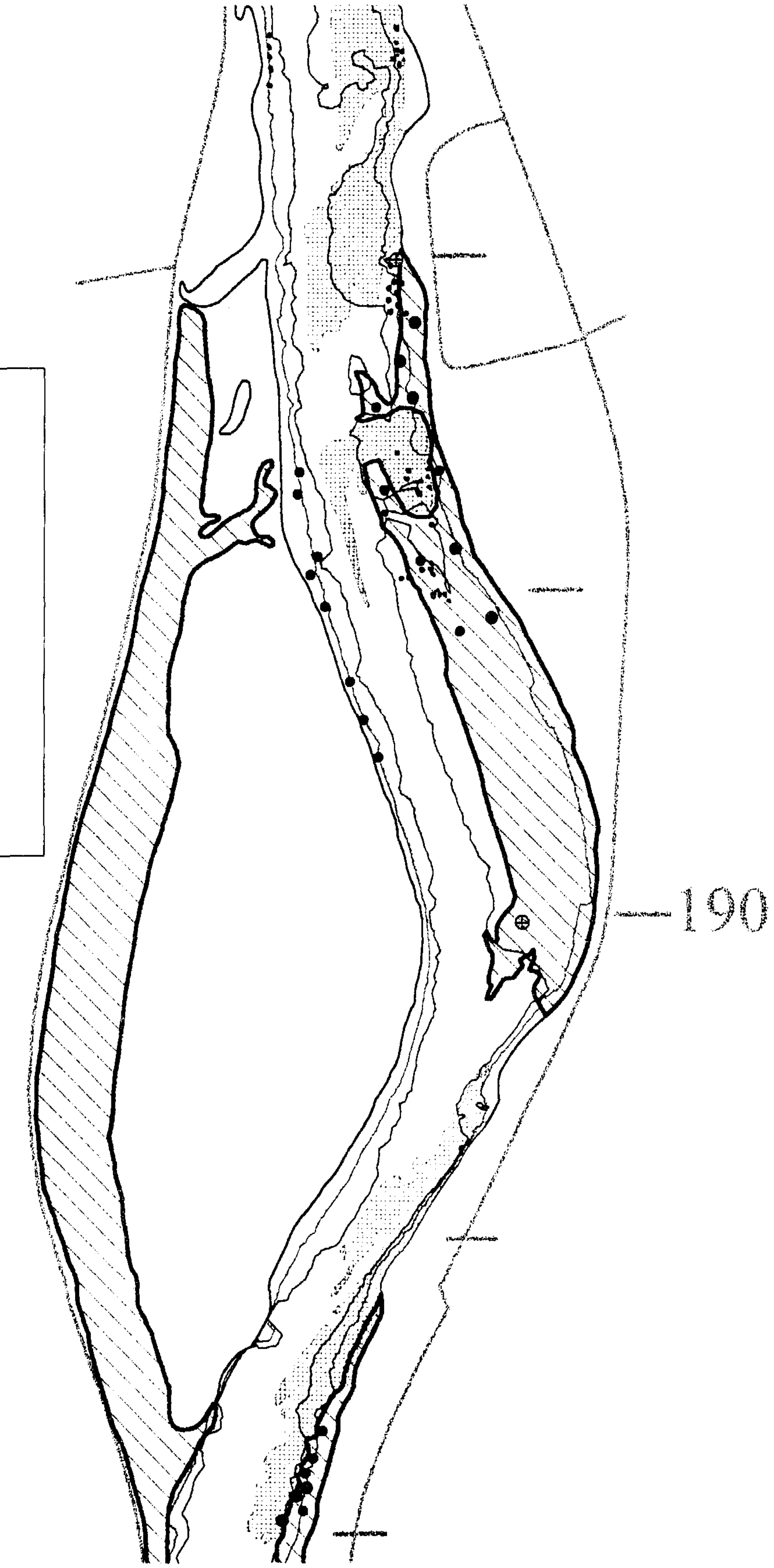


14

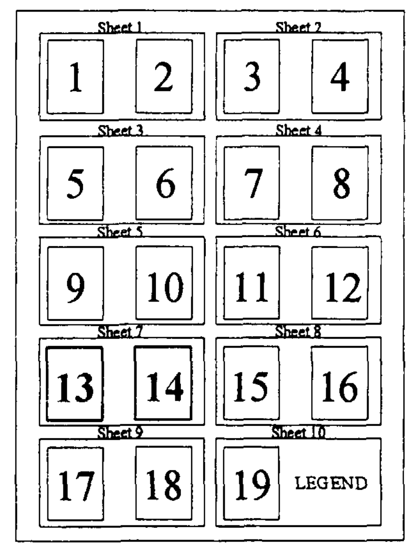
PCB Inventory (g/m²)

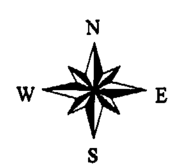
1998 MPA Cores

- 0 - 3.2
- 3.2 - 10
- 10 - 32
- 32 - 100
- 100 - 320
- 320 - 1000
- > 1000



KEY MAP





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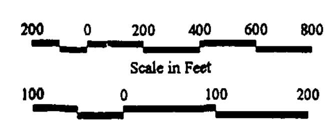
Note: See General Legend on Sheet 10.



Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 7 of 10

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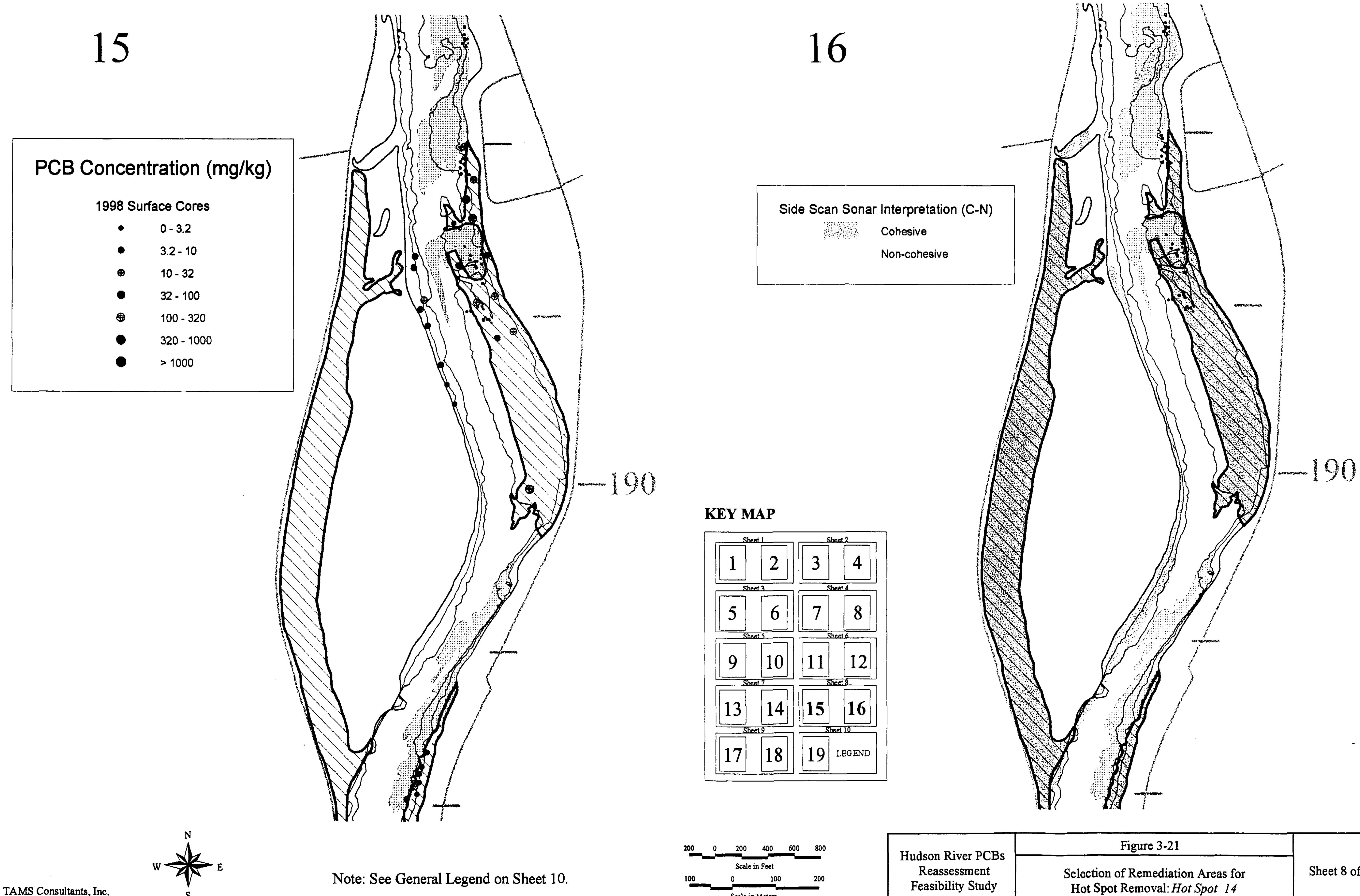

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Note: See General Legend on Sheet 10.

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 8 of 10

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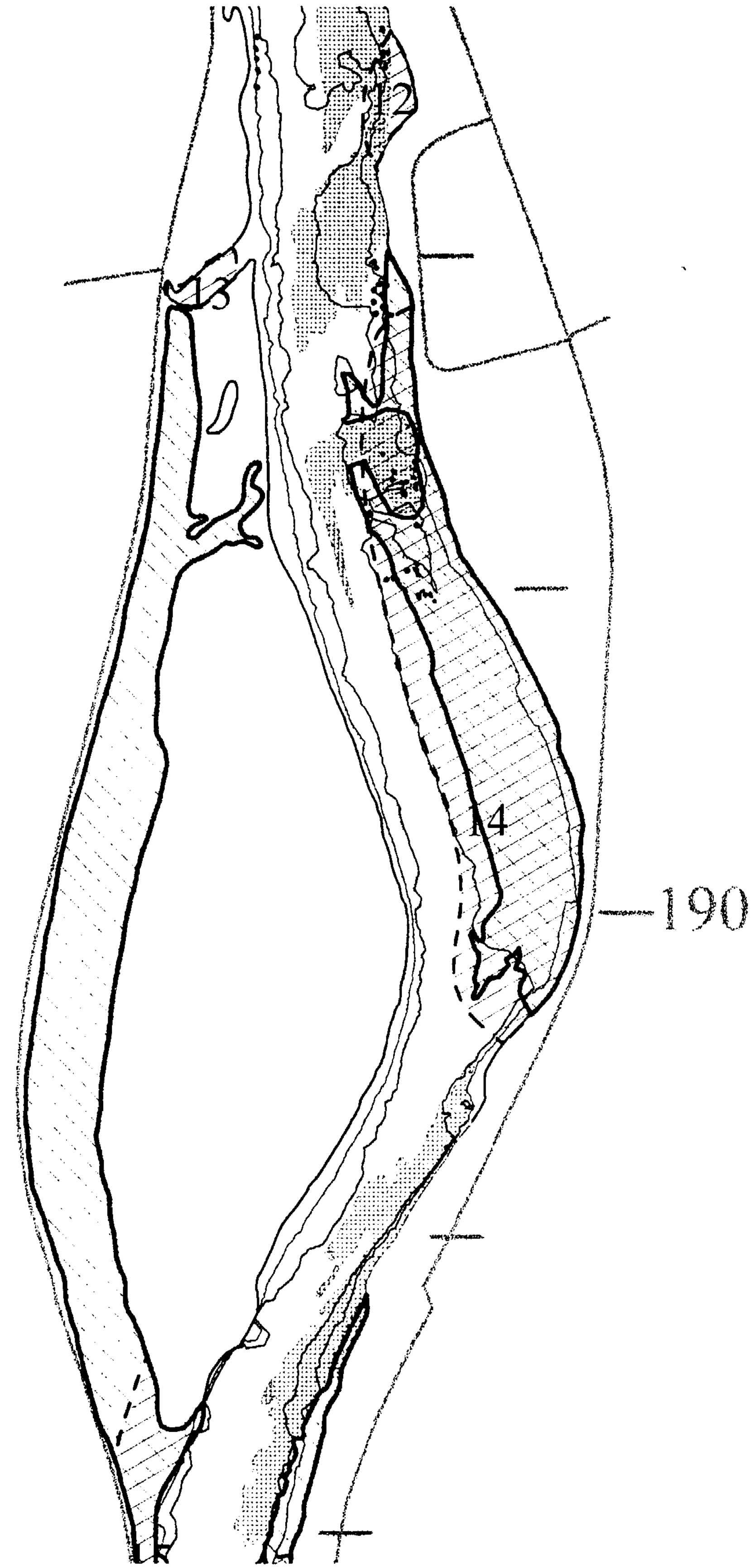
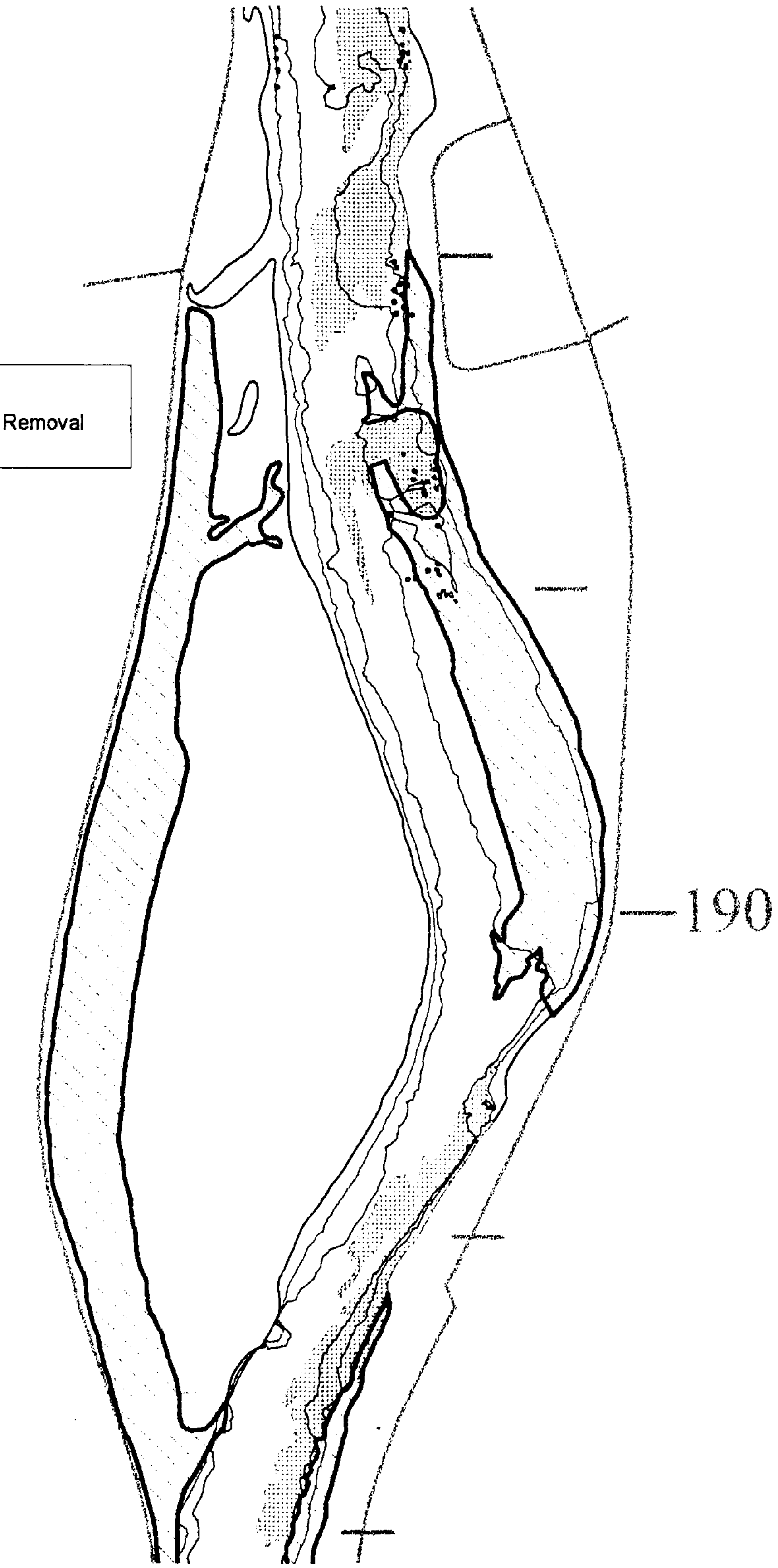


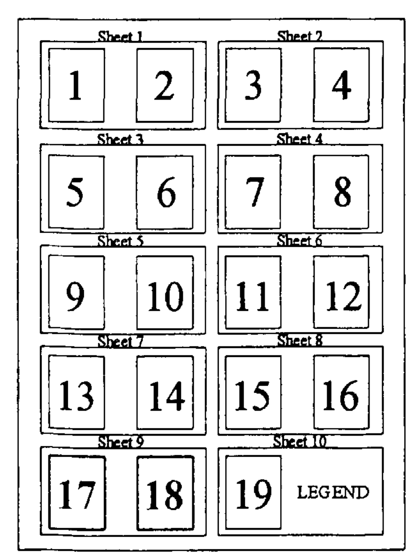
NYSDEC *Hot Spot*

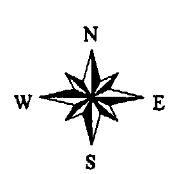
18



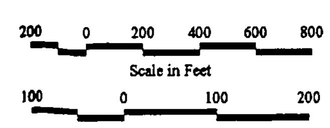
Remediation Areas for Hot Spot Removal

KEY MAP





Note: See General Legend on Sheet 10.



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Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 9 of 10

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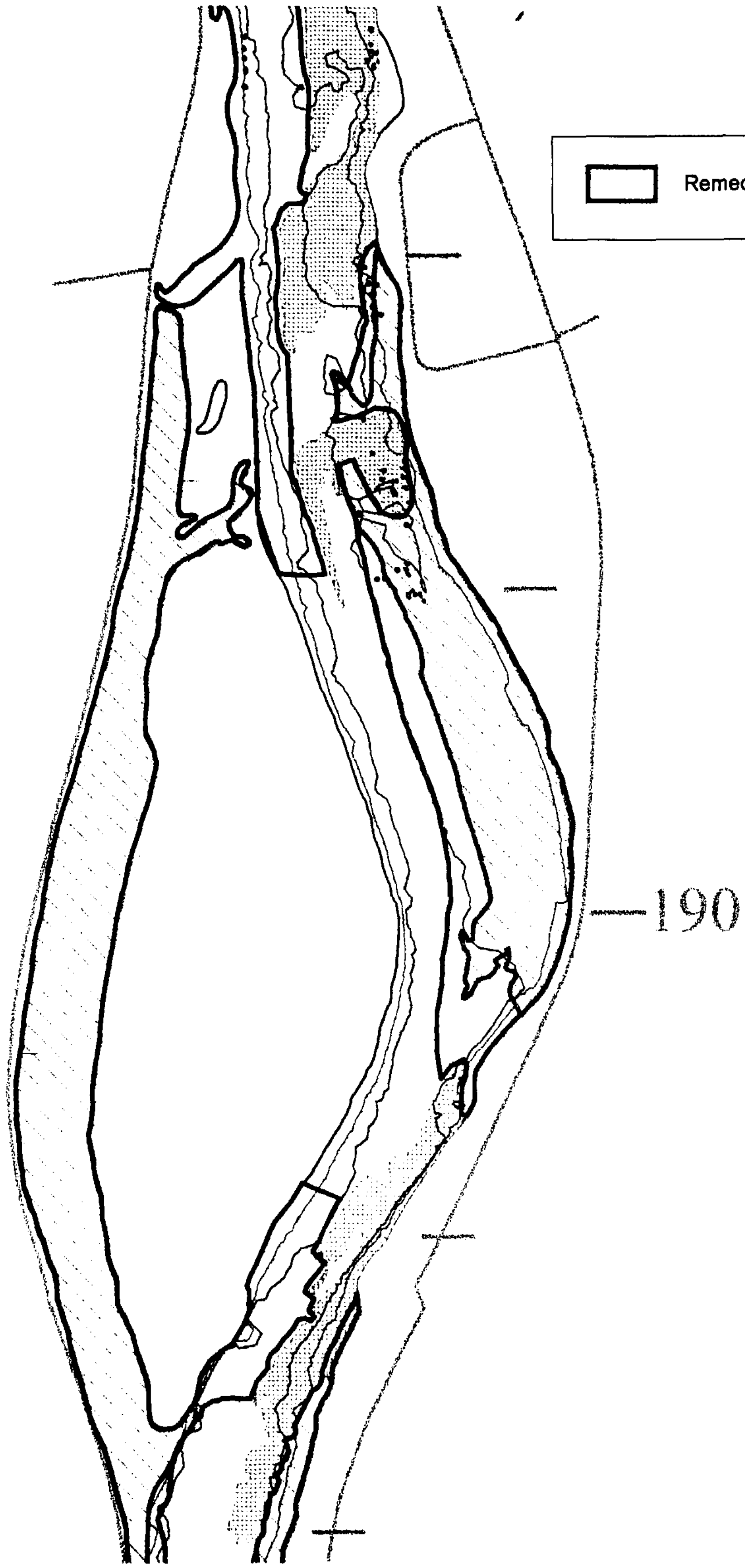


Remediation Areas for Expanded Hot Spot Removal

LEGEND

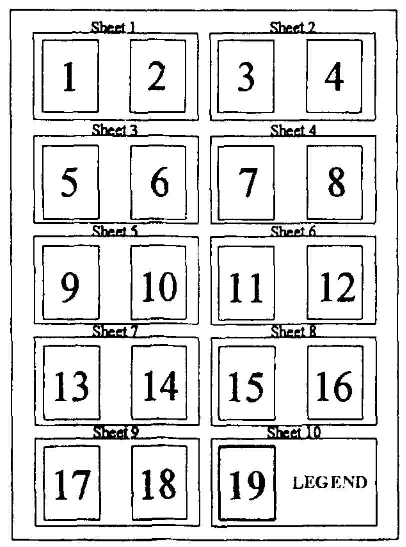
Approximate Water Depth (ft) at 3,090 cfs

- 6.5
- 12.5

Side Scan Sonar Interpretation

- Mound
- Rock
- Remediation Areas for Hot Spot Removal
- Hudson River Shoreline at 8,471 cfs
- Dam or Lock
- Road
- Rivermile Markers

KEY MAP



TAMS

TAMS Consultants, Inc.

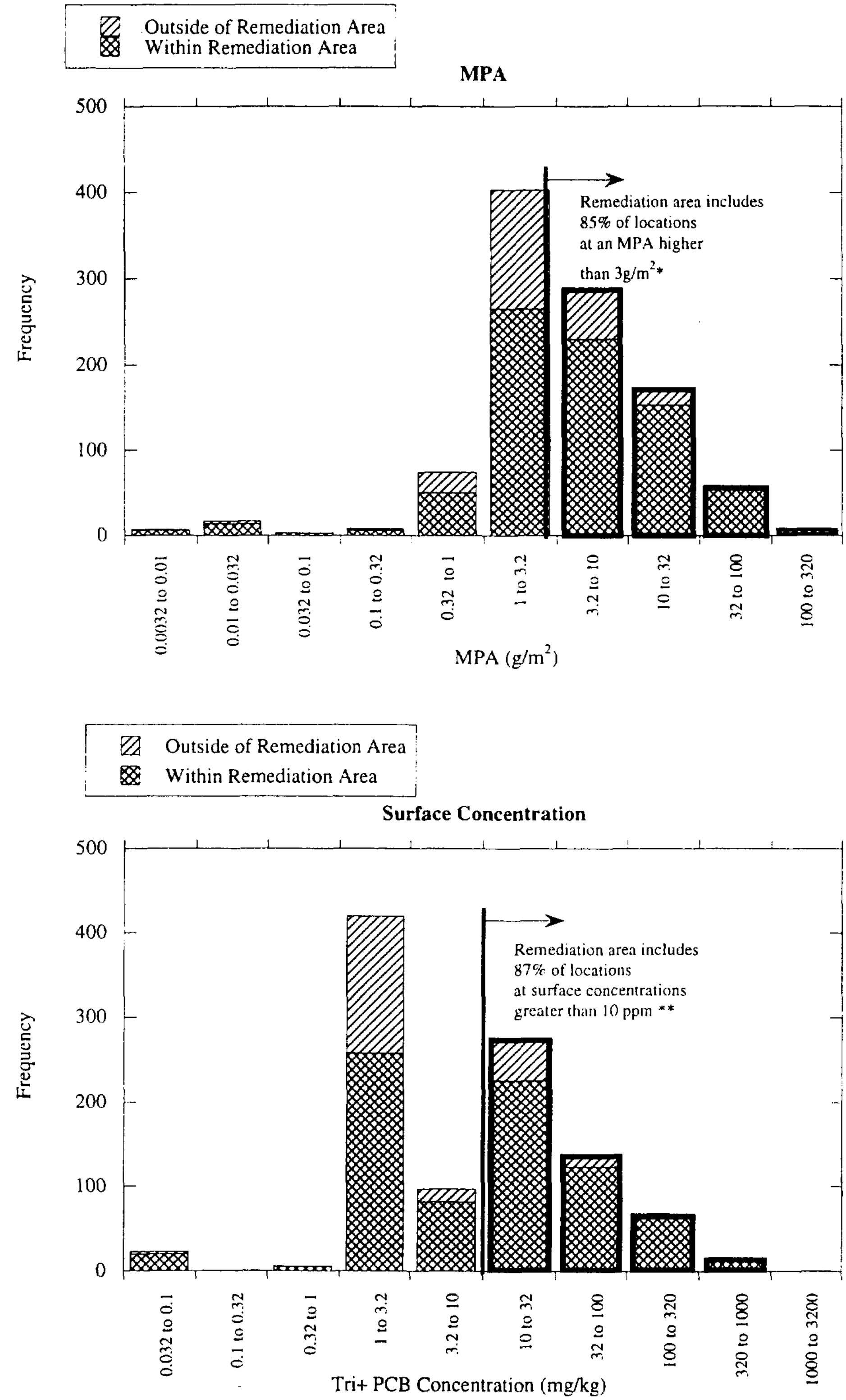
N
W E
S

200 0 200 400 600 800
Scale in Feet

100 0 100 200
Scale in Meters

Hudson River PCBs Reassessment Feasibility Study	Figure 3-21 Selection of Remediation Areas for Hot Spot Removal: *Hot Spot 14*	Sheet 10 of 10

401134

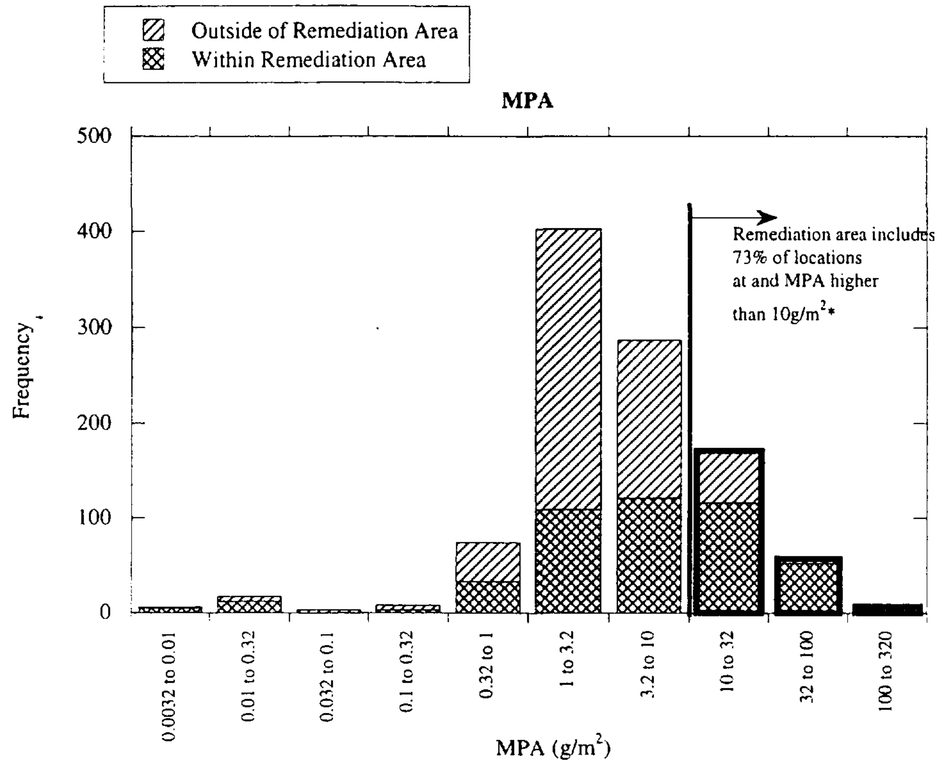


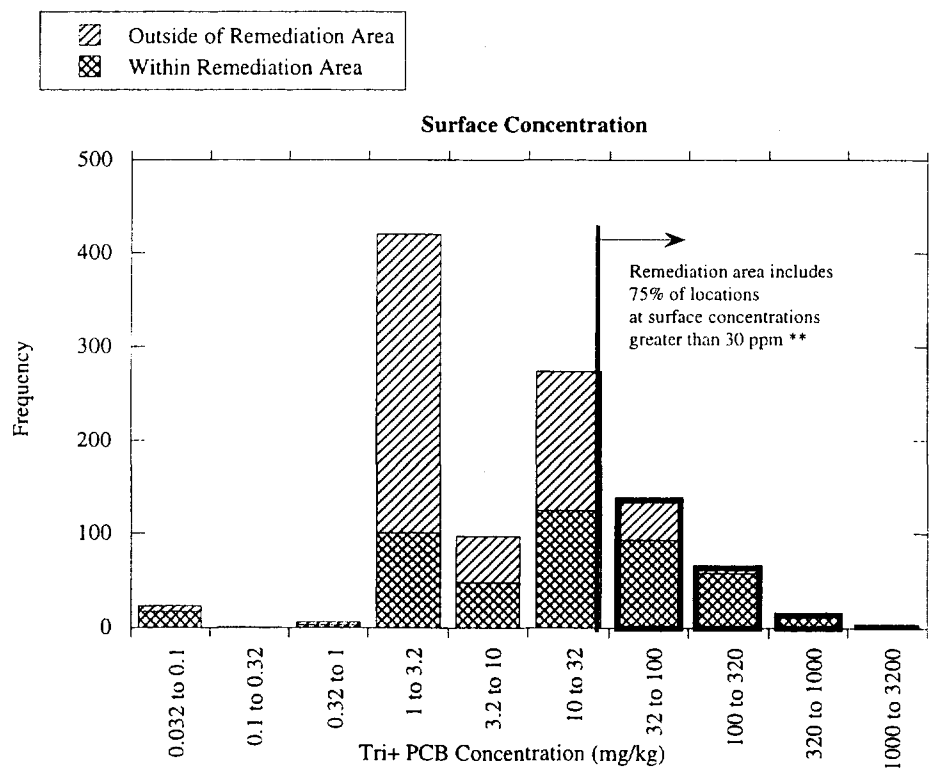
* Remediation areas include 77% of the locations at an MPA higher than 1 g/m^2

**Remediation areas include 86% of the locations at surface concentration greater than 3.3 ppm

TAMS

Figure 3-22
Assessment of the Capture Efficiency for the Expanded Hotspot Remediation Tri+ PCB Concentration and MPA Histograms for 1984 NYSDEC Data Within and Outside of Remedial Area



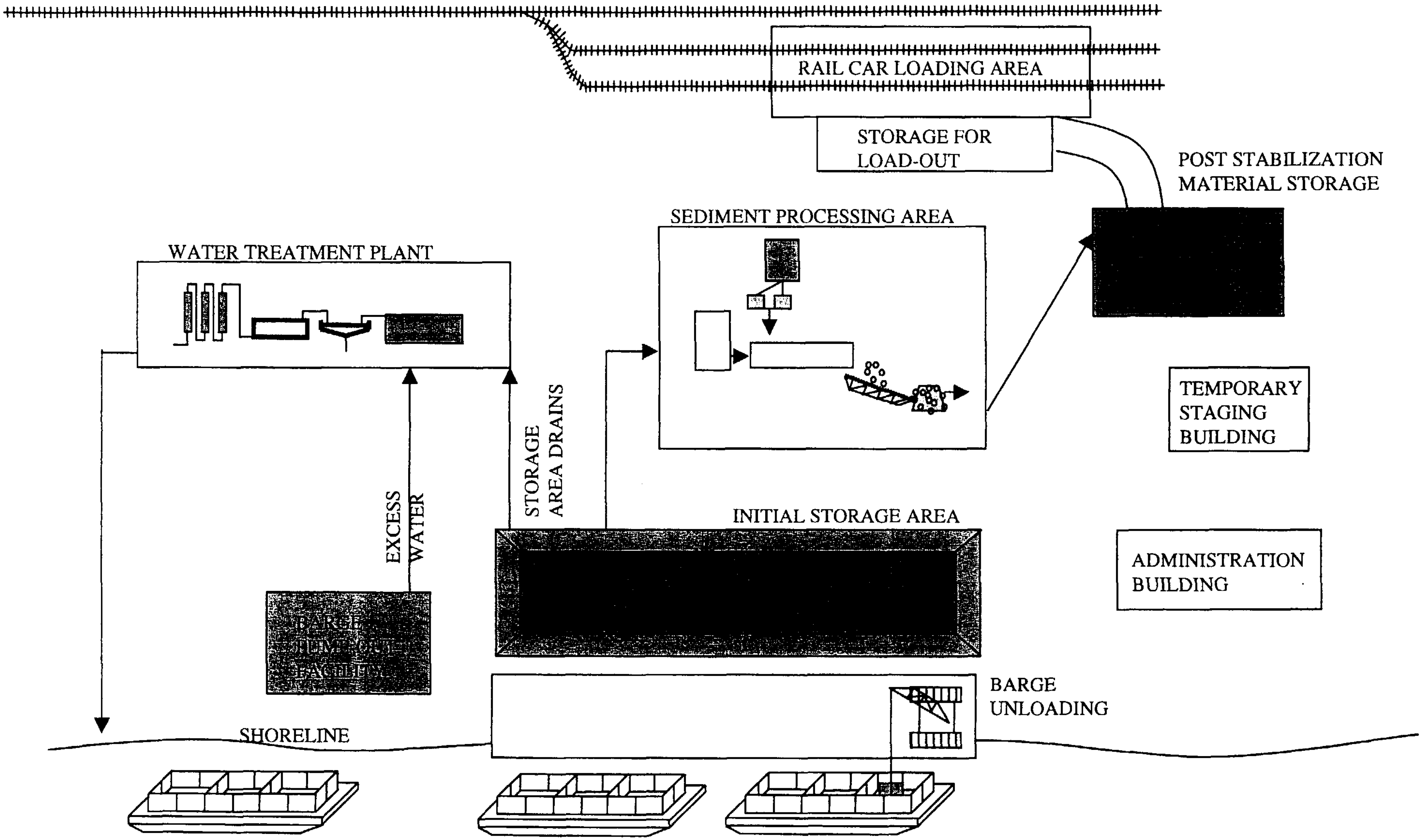


TAMS

Figure 3-23
Assessment of the Capture Efficiency for the Hotspot Remediation Tri+ PCB Concentration and MPA Histograms for 1984 NYSDEC Data Within and Outside of Remedial Area

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

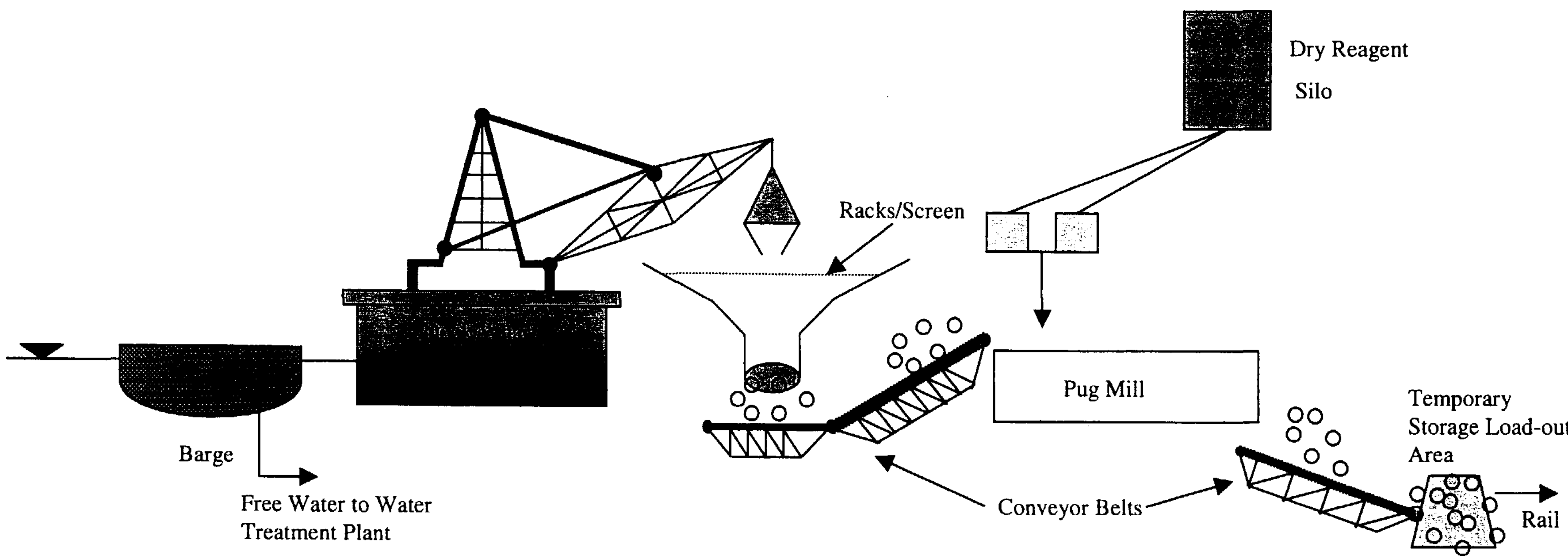
LIST OF FIGURES
CHAPTER 5



401138

Figure 5-1 Conceptual Transfer Facility Plan (Mechanical Dredging Facility)

Figure 5-2a Water Treatment and Solids Processing for Mechanical Dredging

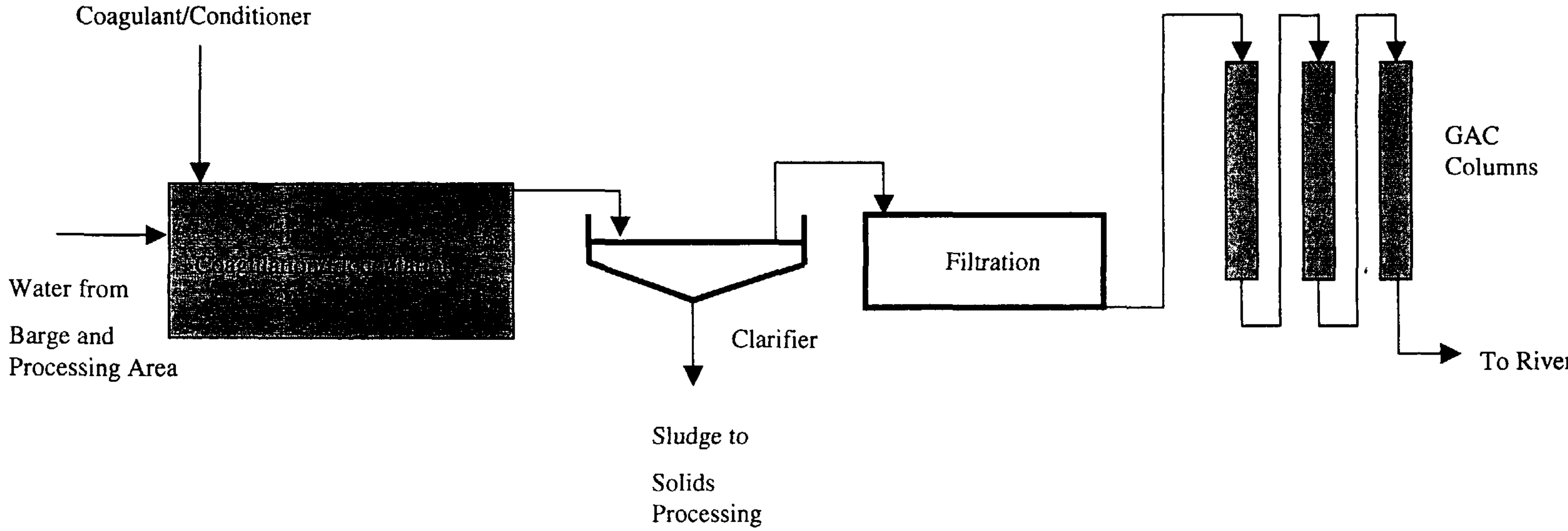


Solids Handling

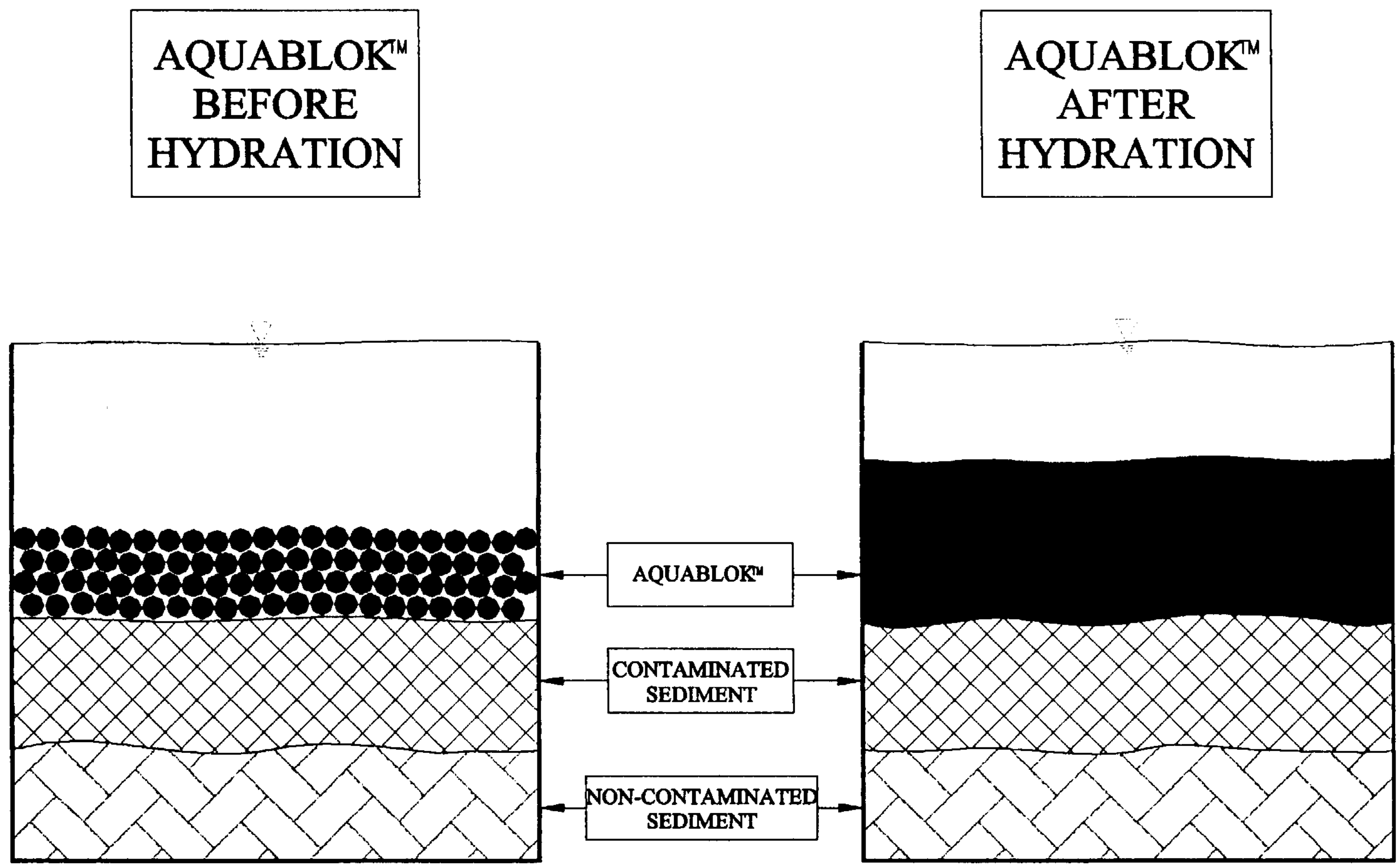
401139

TAMS

Figure 5-2b Water Treatment and Solids Processing for Mechanical Dredging



Water Treatment



NOTE: FIGURE NOT TO SCALE

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3: FEASABILITY STUDY

TYPICAL CAP DETAIL

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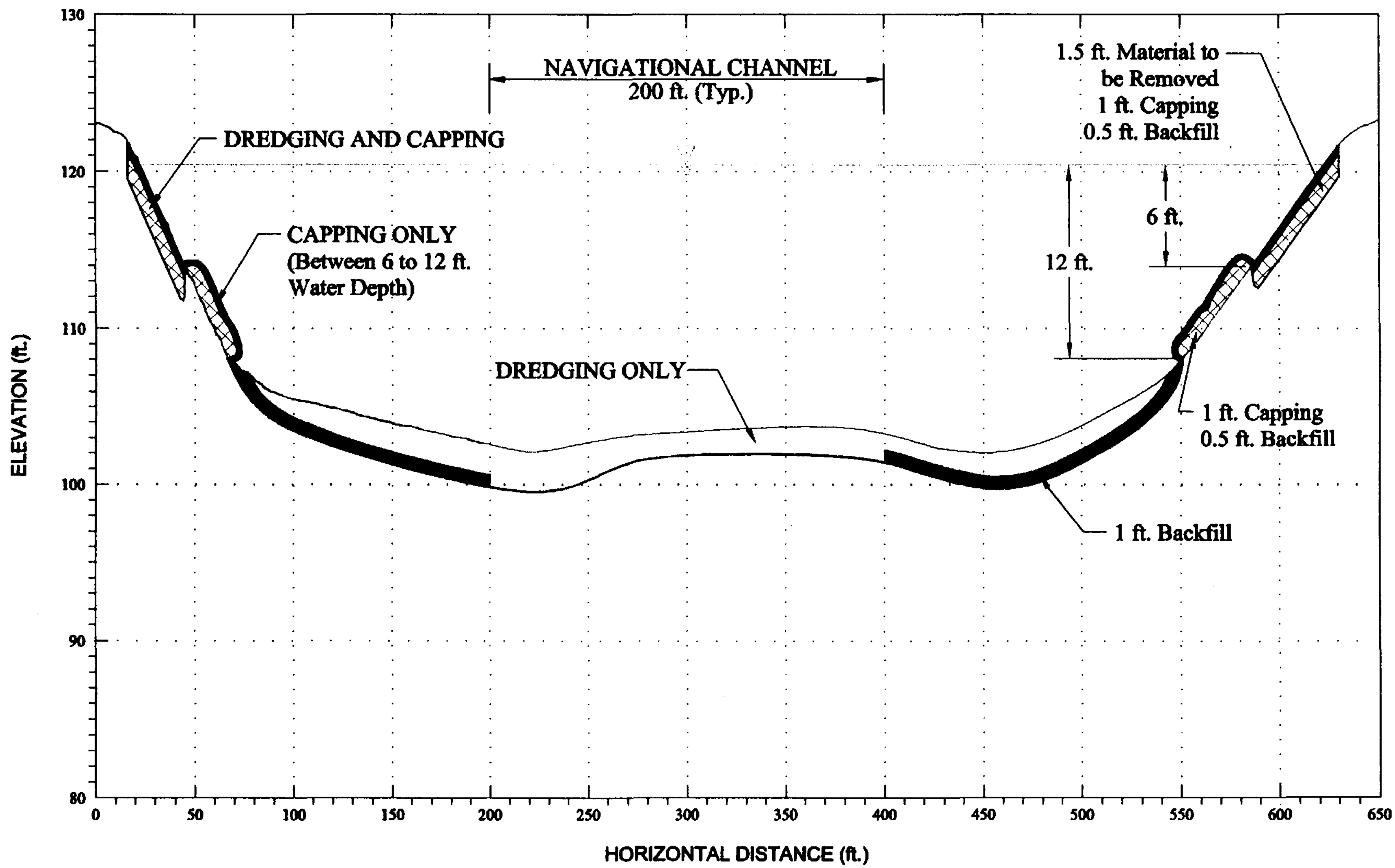
FIGURE 5-3

401141



NOTE: FIGURE NOT TO SCALE

LEGEND

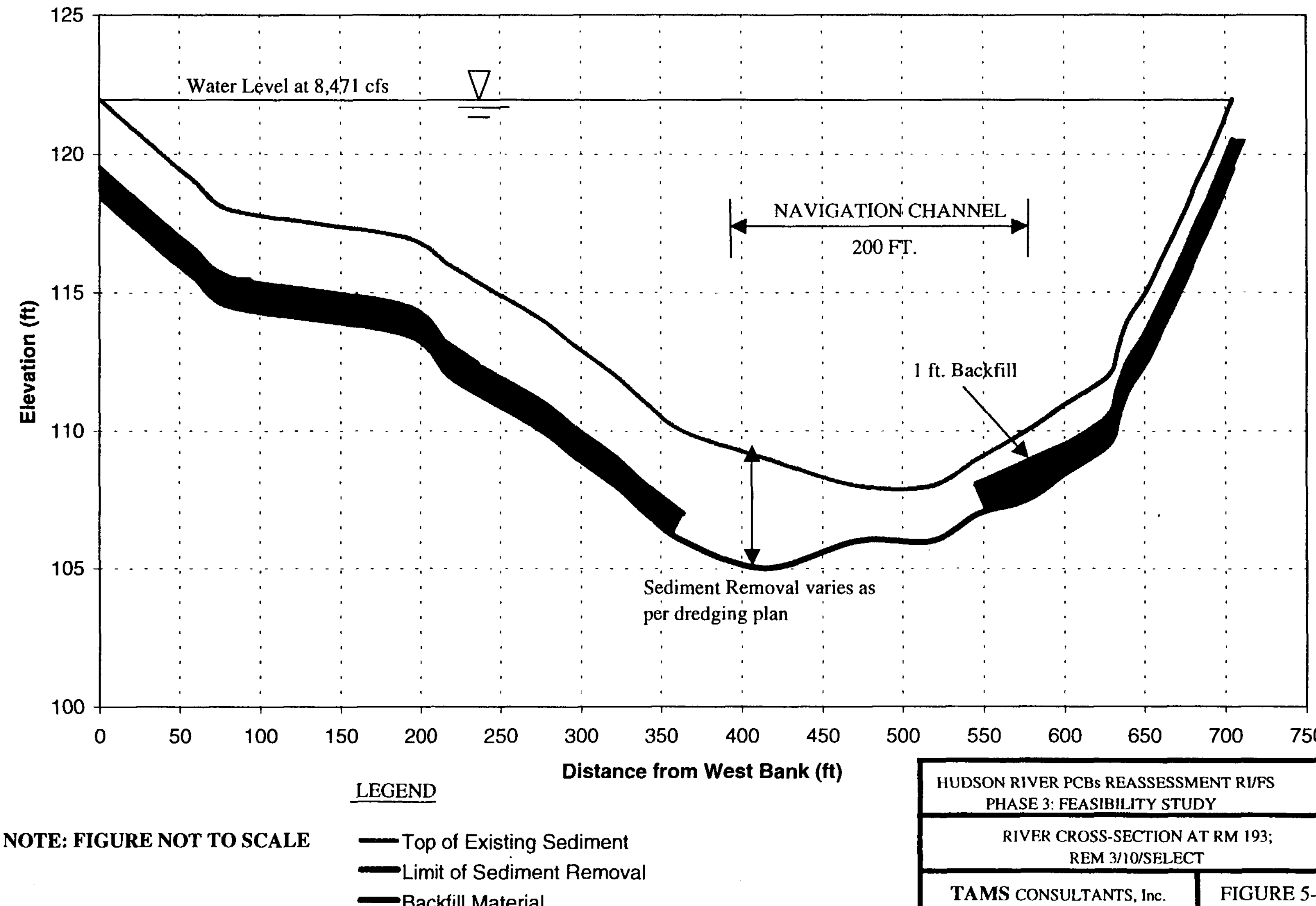
- Top of Existing Sediment
- Limit of Sediment Removal
- Backfill Material
- Capping Material

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3: FEASIBILITY STUDY

TYPICAL RIVER CROSS-SECTION
FULL-SECTION CAP ALTERNATIVE

TAMS CONSULTANTS, Inc. | FIGURE 5-4

401142



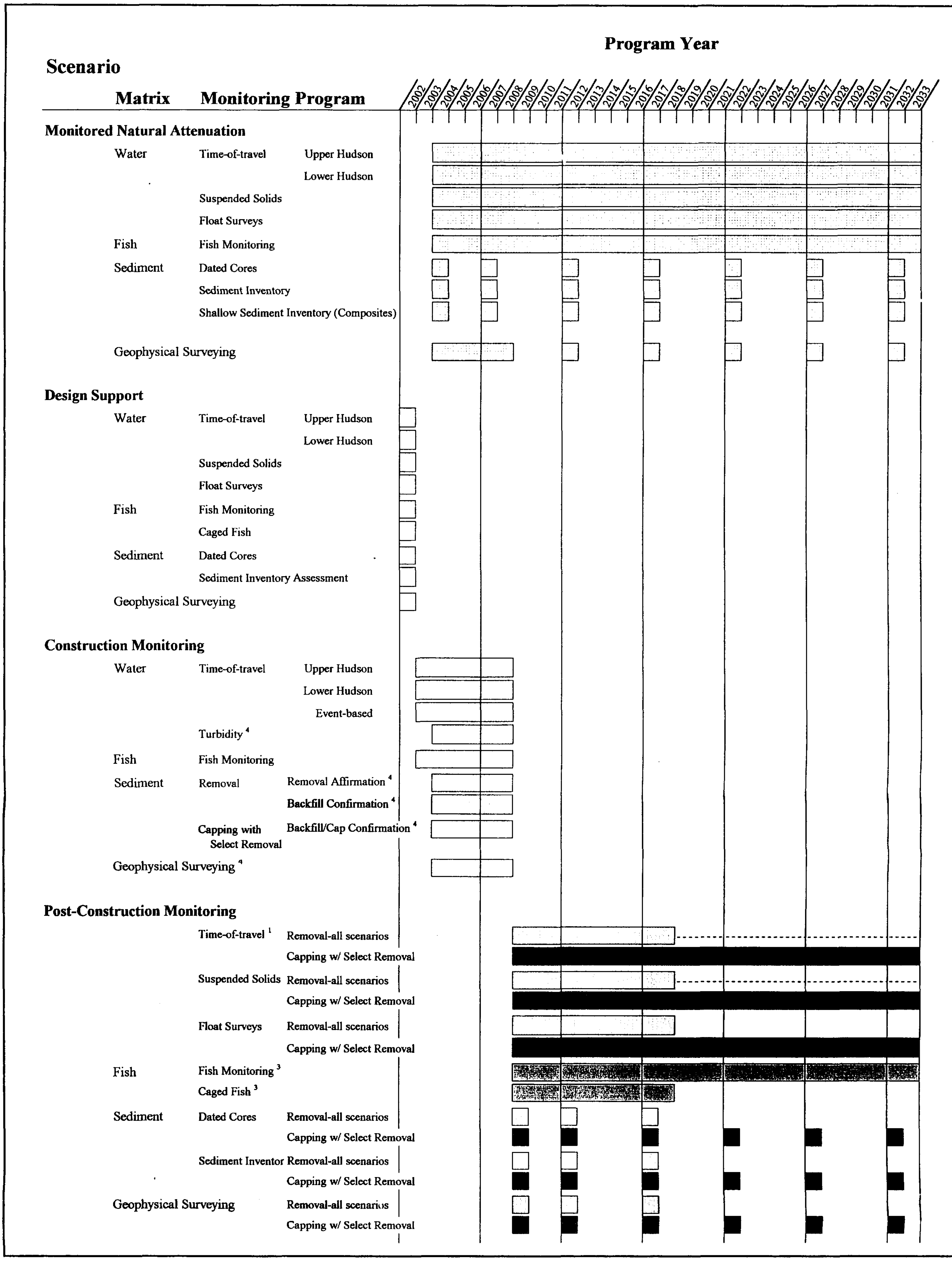
NOTE: FIGURE NOT TO SCALE

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3: FEASIBILITY STUDY

RIVER CROSS-SECTION AT RM 193;
REM 3/10/SELECT

TAMS CONSULTANTS, Inc. | FIGURE 5-5

401143



Notes

1. Includes both Upper Hudson (weekly) and Lower Hudson (monthly) surveys. For removal scenarios, period marked with dashes represents quarterly monitoring at all stations.
2. Period marked with dashes represents monthly monitoring at all stations
3. Fish monitoring program is the same for all scenarios.
4. Sediment removal to be completed in five years.

TAMS

Figure 5-6
Monitoring Program Outline

401144

HUDSON RIVER PCBs REASSESSMENT RI/FS
PHASE 3 REPORT: FEASIBILITY STUDY

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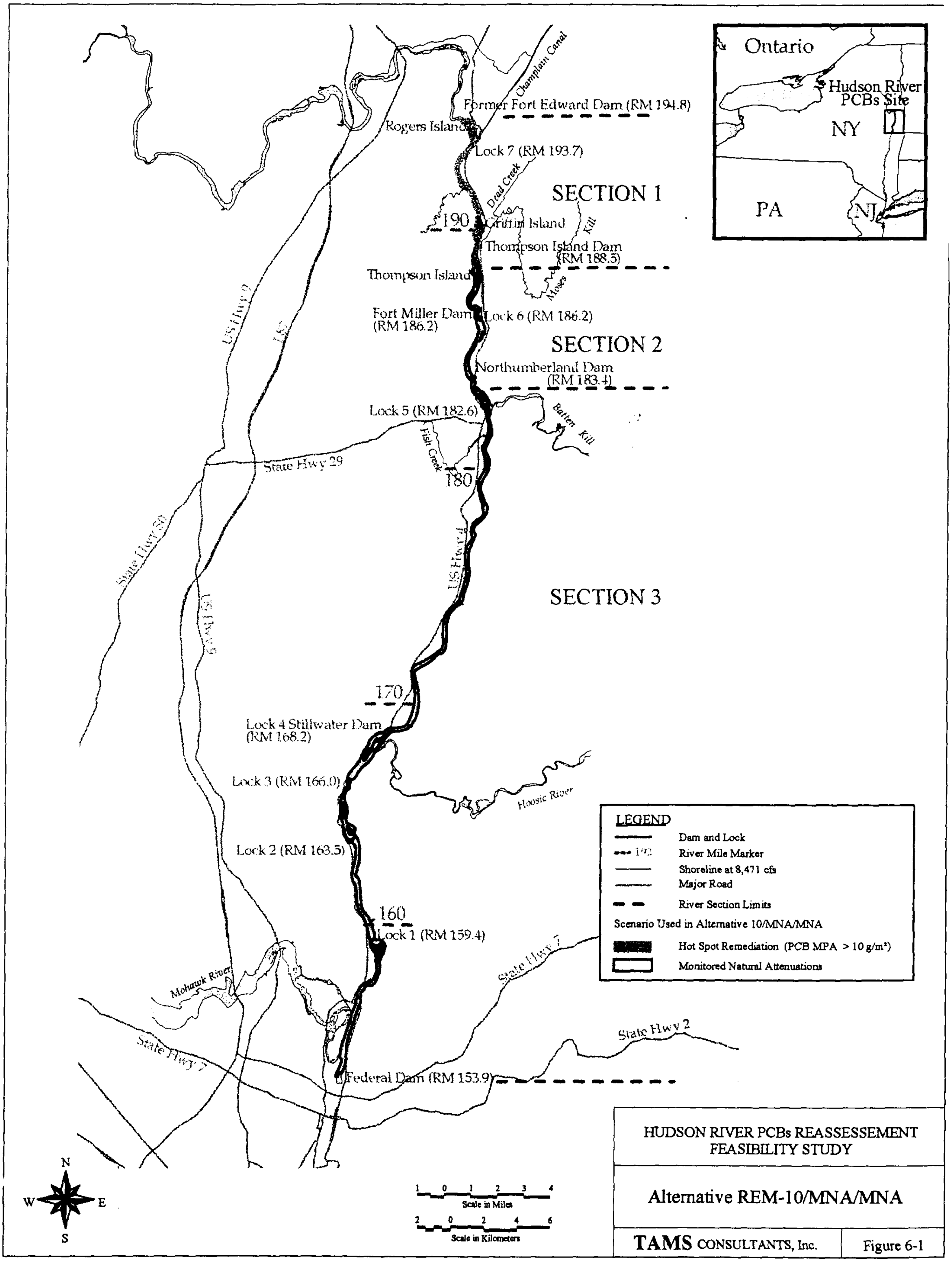
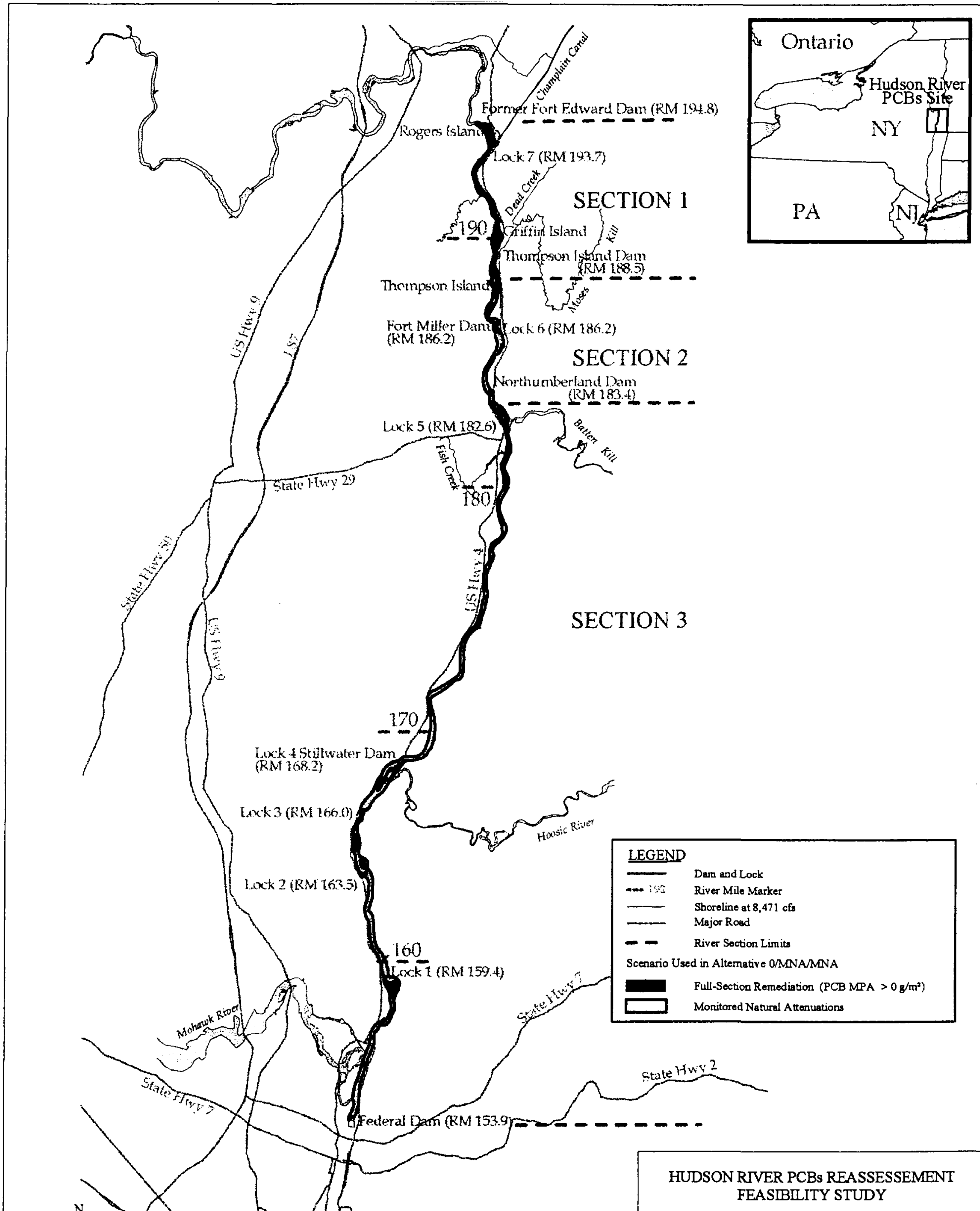


HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-10/MNA/MNA

TAMS CONSULTANTS, Inc. | Figure 6-1

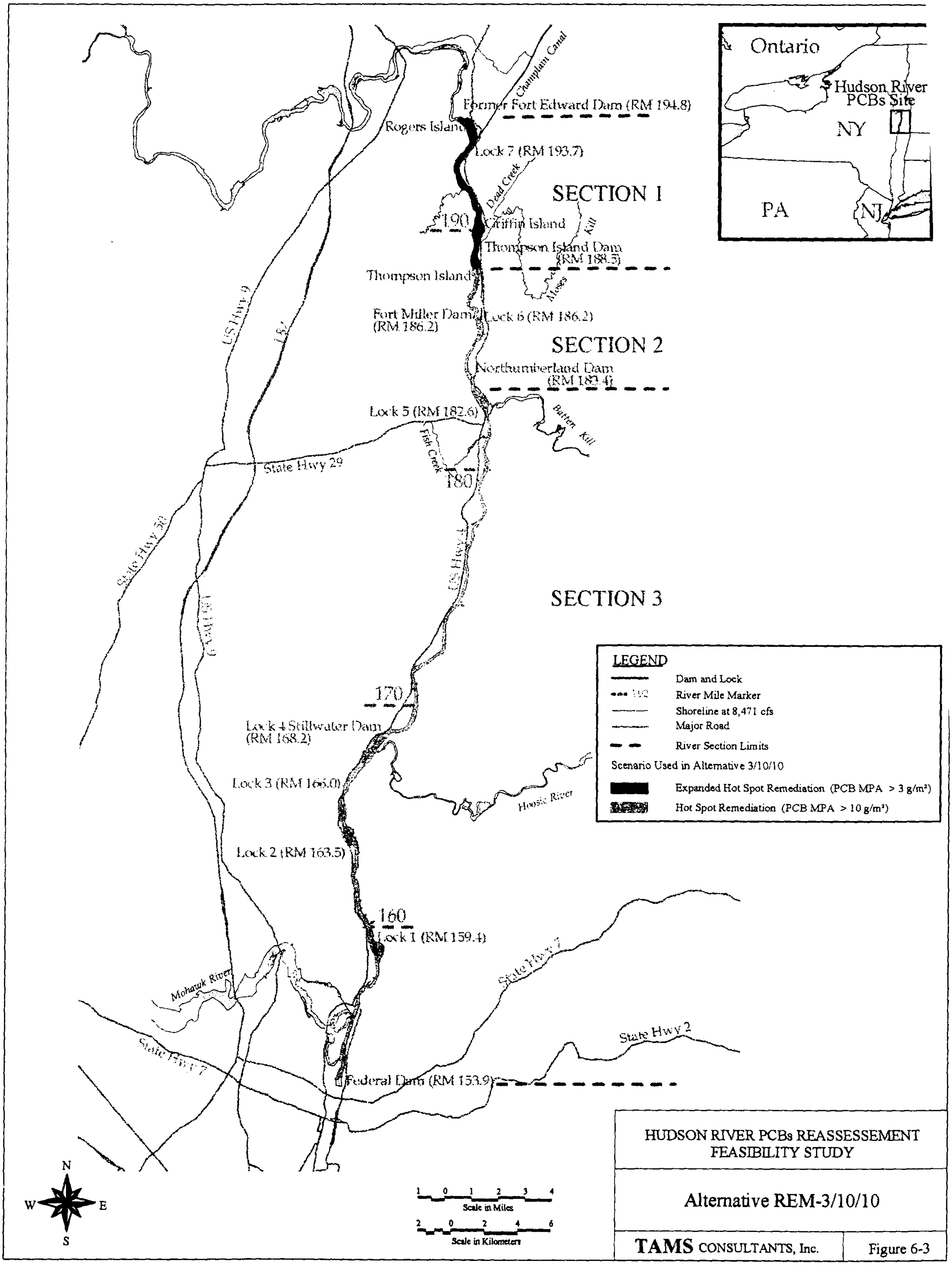
401147



HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-0/MNA/MNA

TAMS CONSULTANTS, Inc. | Figure 6-2

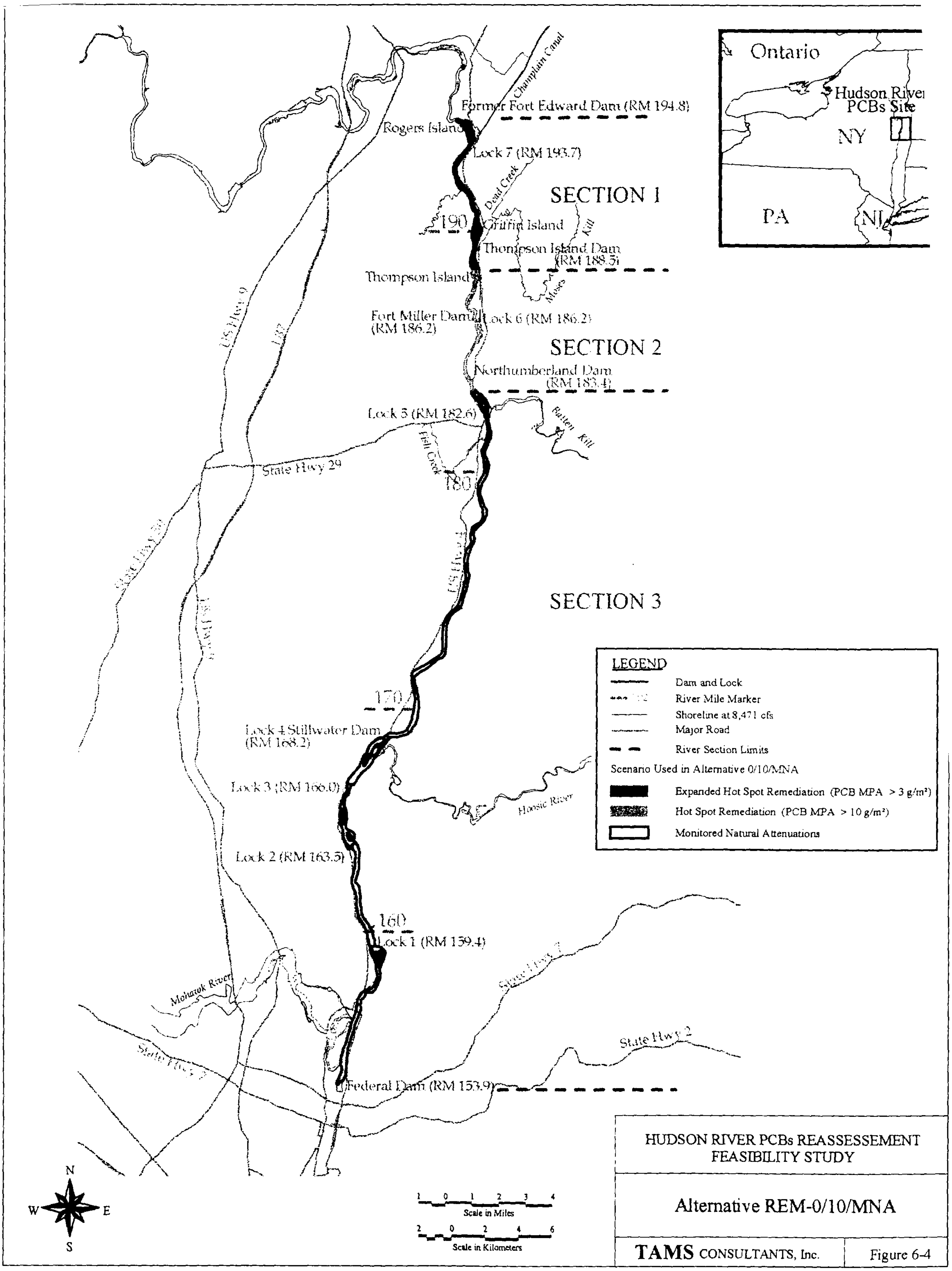


HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-3/10/10

TAMS CONSULTANTS, Inc.

Figure 6-3

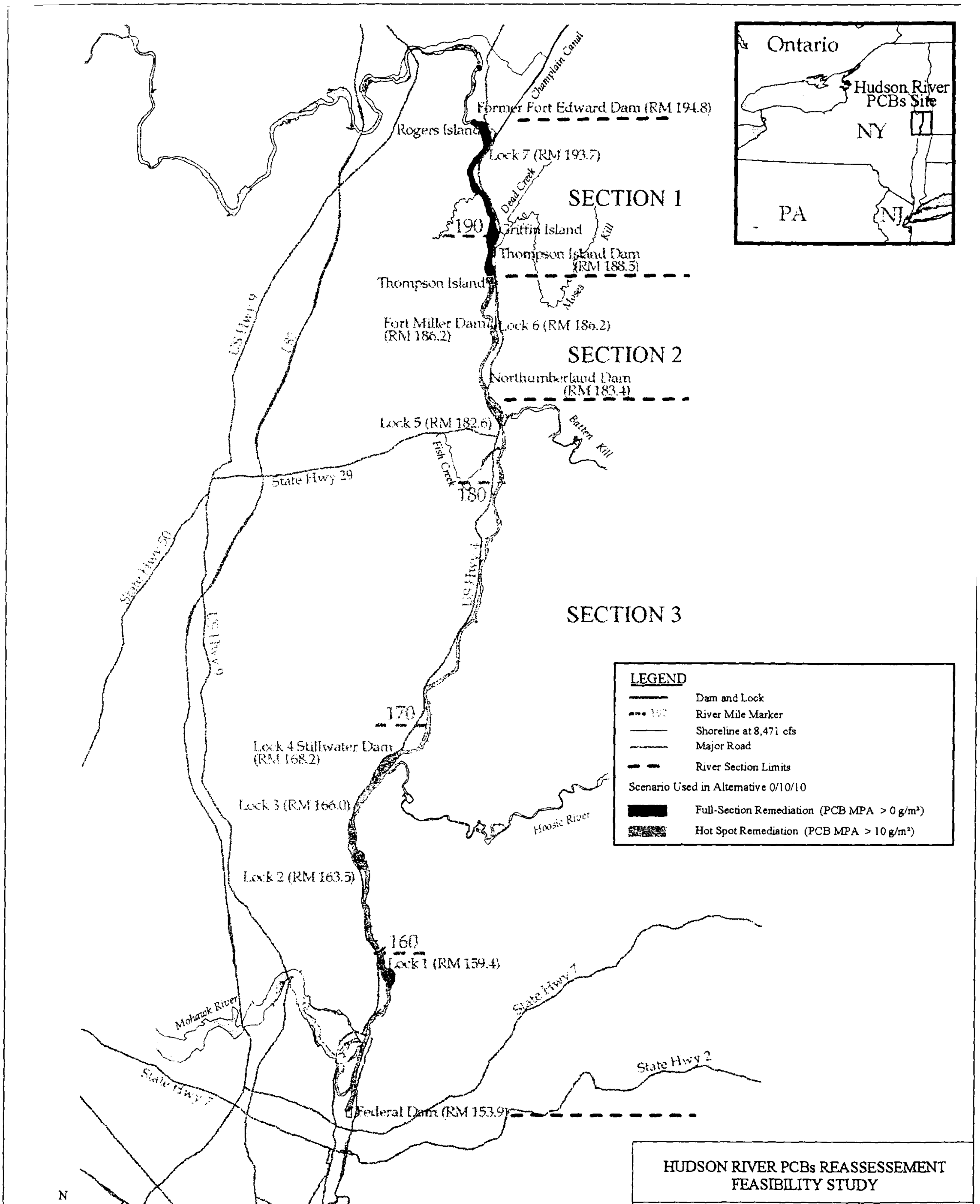


HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-0/10/MNA

TAMS CONSULTANTS, Inc. | Figure 6-4

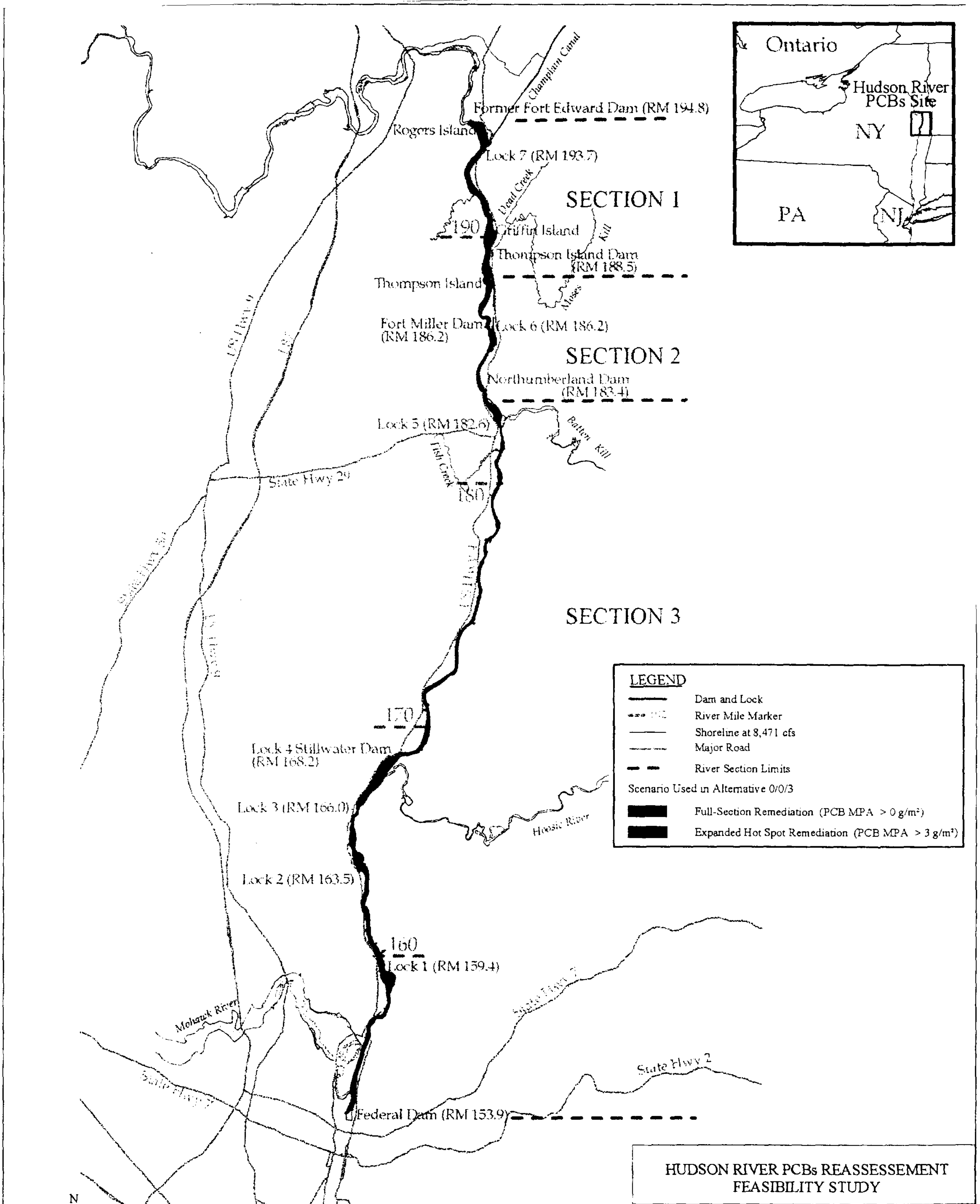
401150



HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-0/10/10

TAMS CONSULTANTS, Inc. Figure 6-5



HUDSON RIVER PCBs REASSESSEMENT FEASIBILITY STUDY

Alternative REM-0/0/3

TAMS CONSULTANTS, Inc. Figure 6-6

Figure 6-7. Comparison Between Forecasts for Thompson Island Pool Cohesive Surficial Sediments for Alternatives for Screening

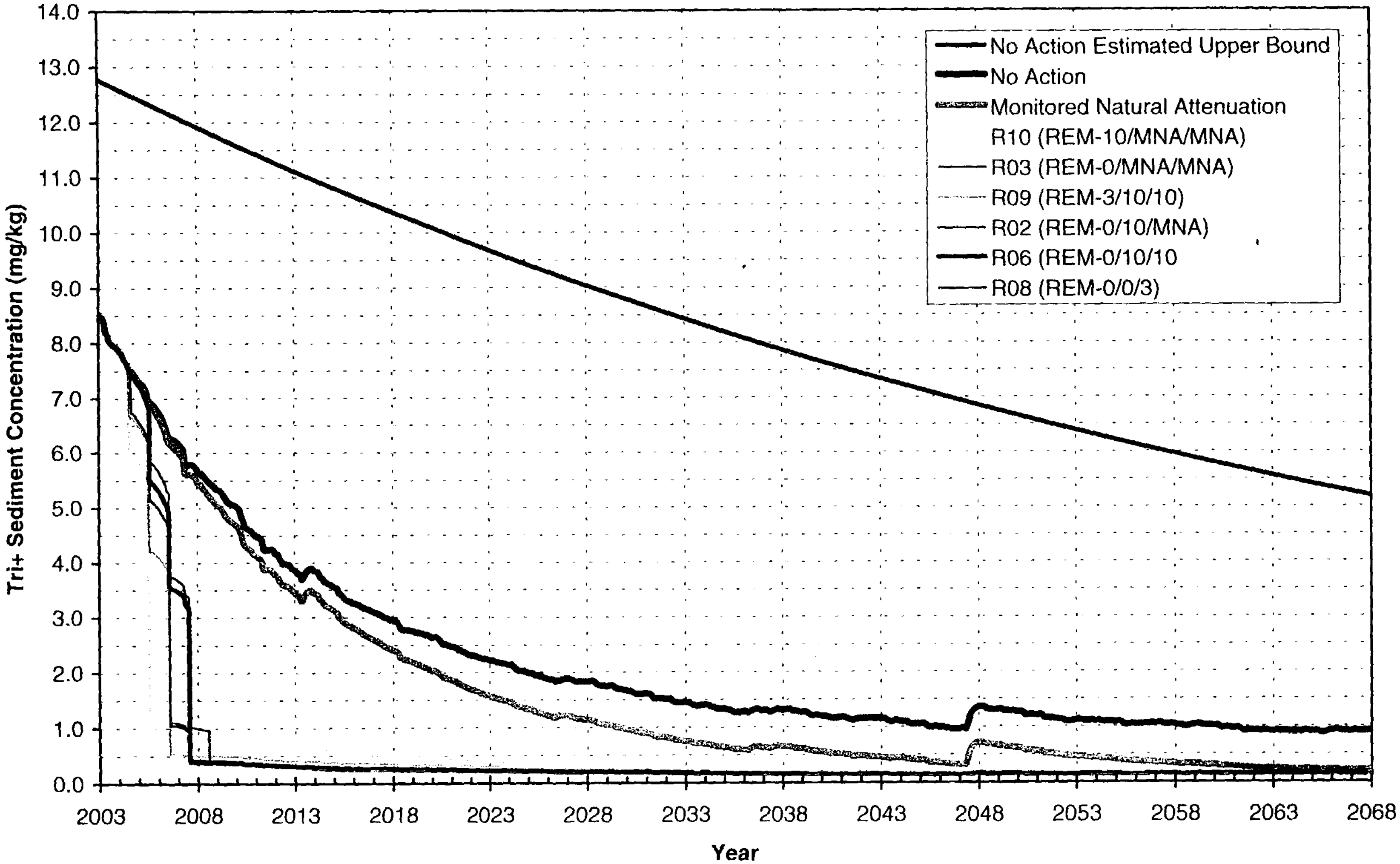


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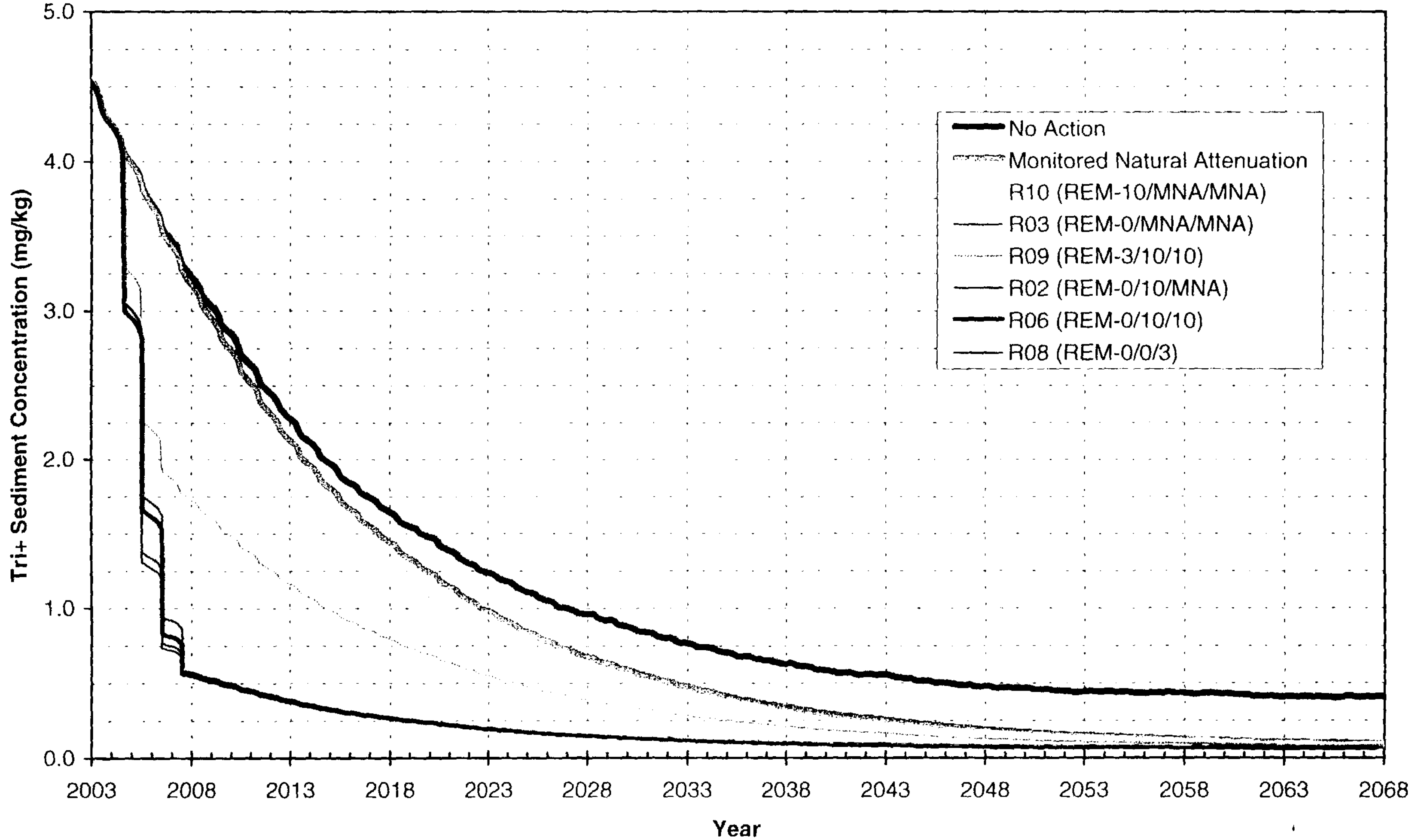
Figure 6-8. Comparison Between Forecasts for Thompson Island Pool Non-Cohesive Surficial Sediments for Alternatives for Screening



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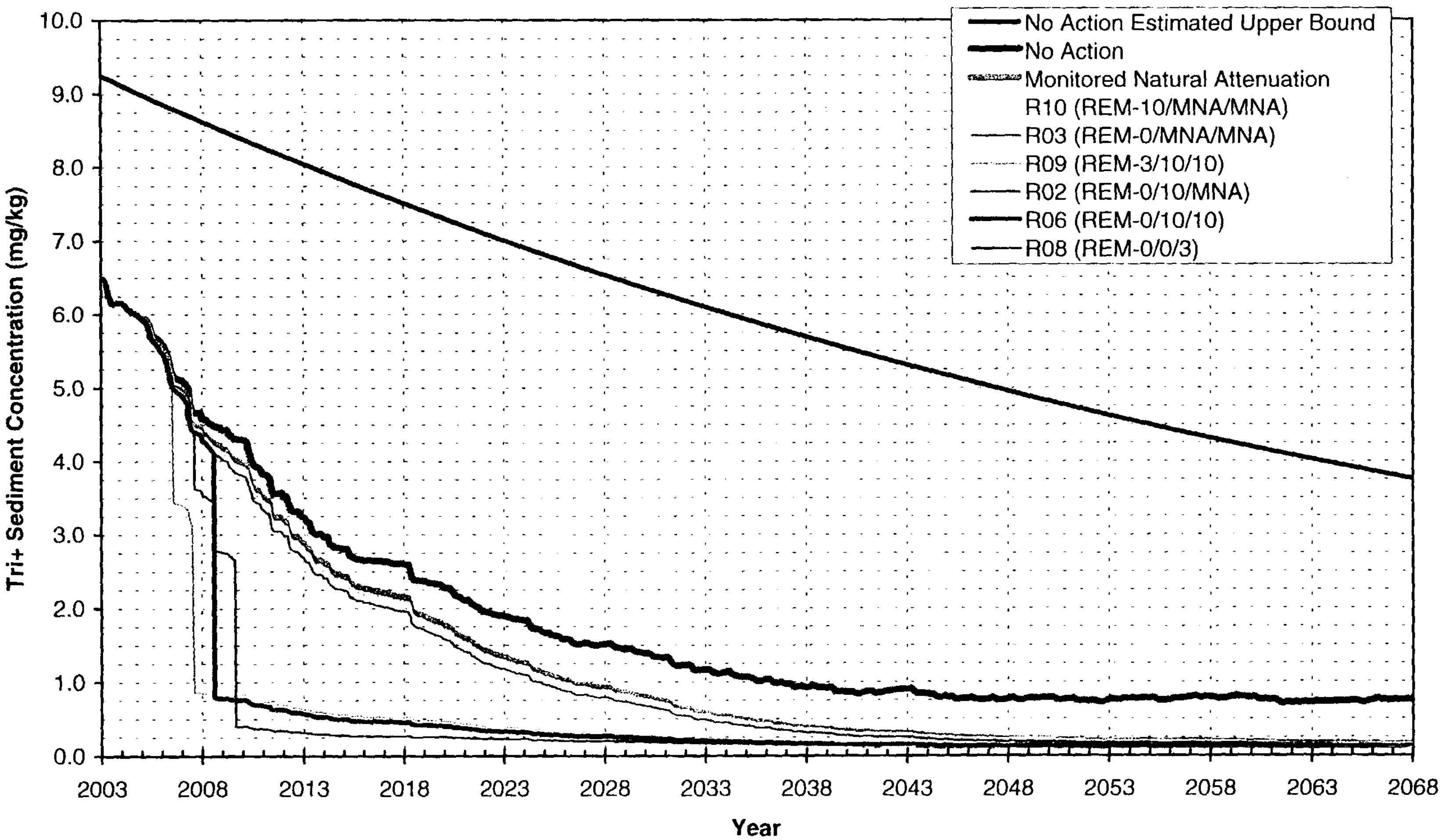

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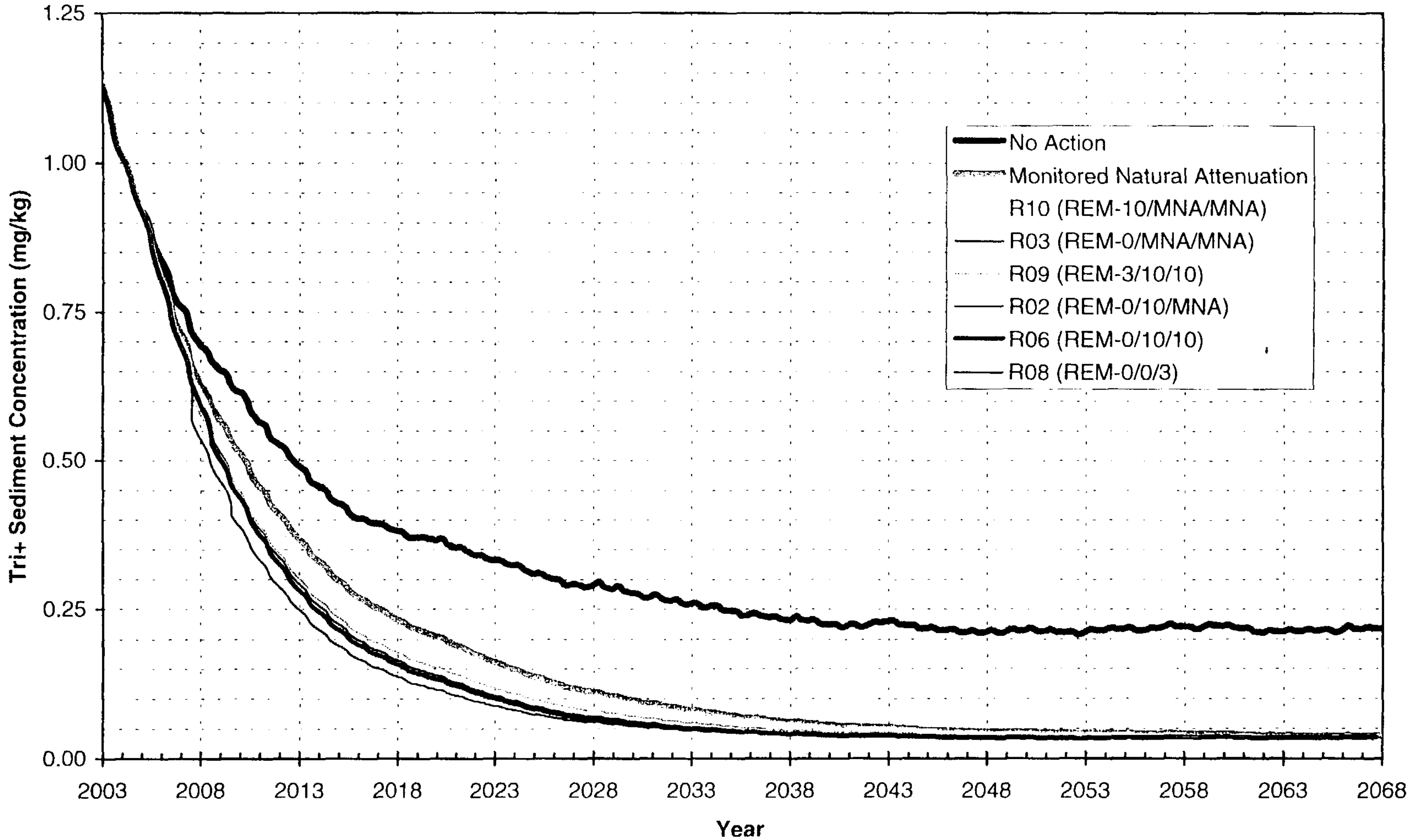

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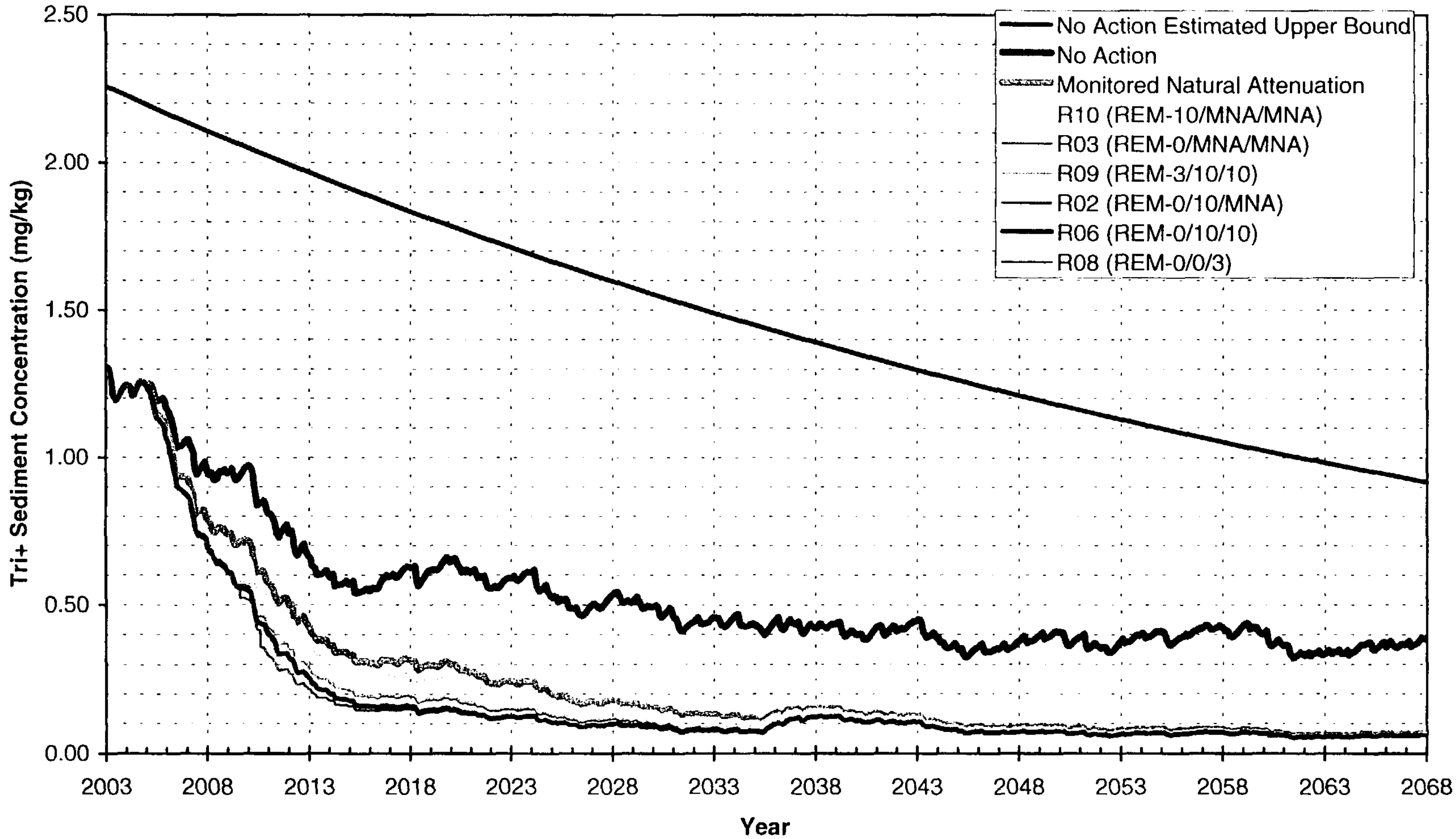

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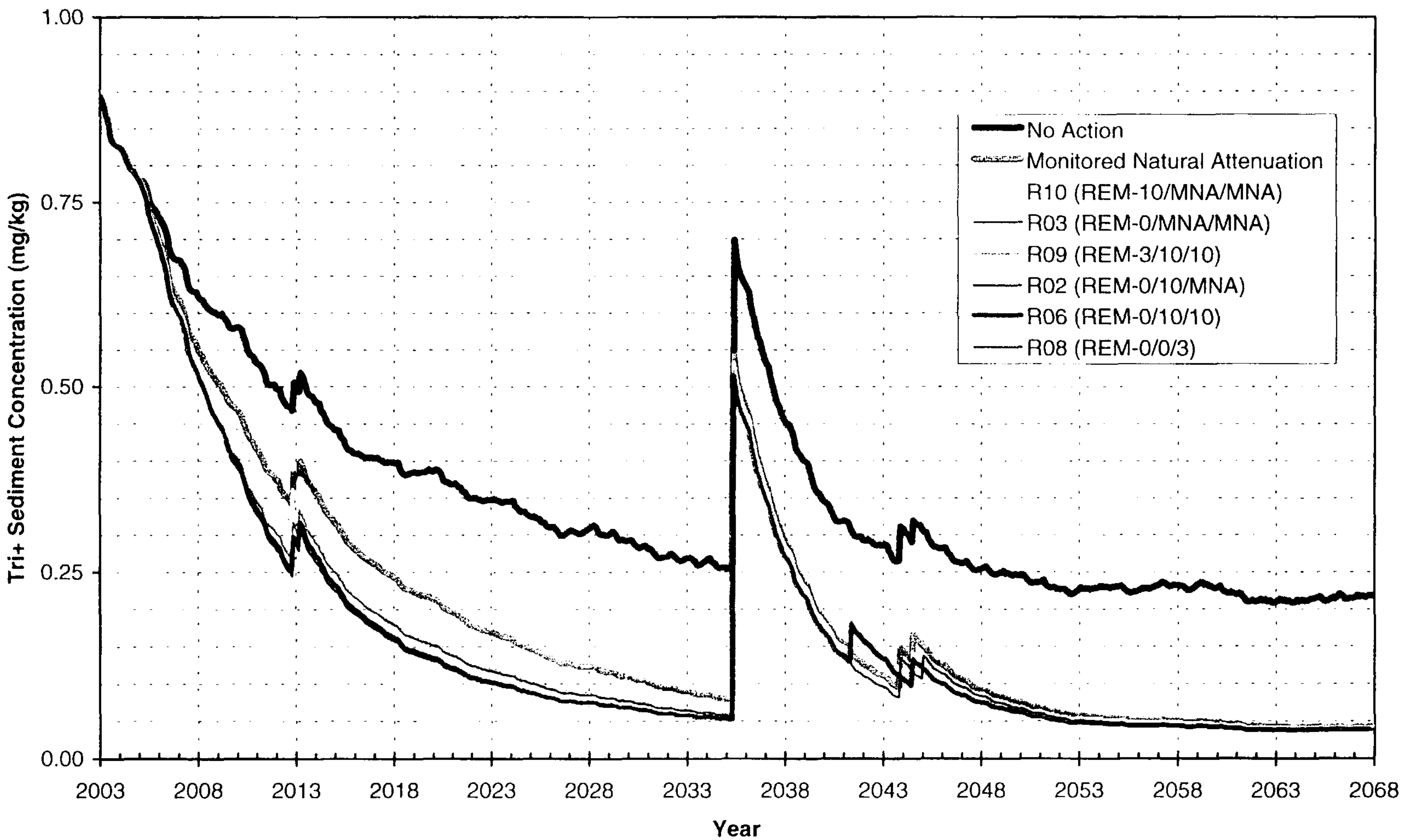

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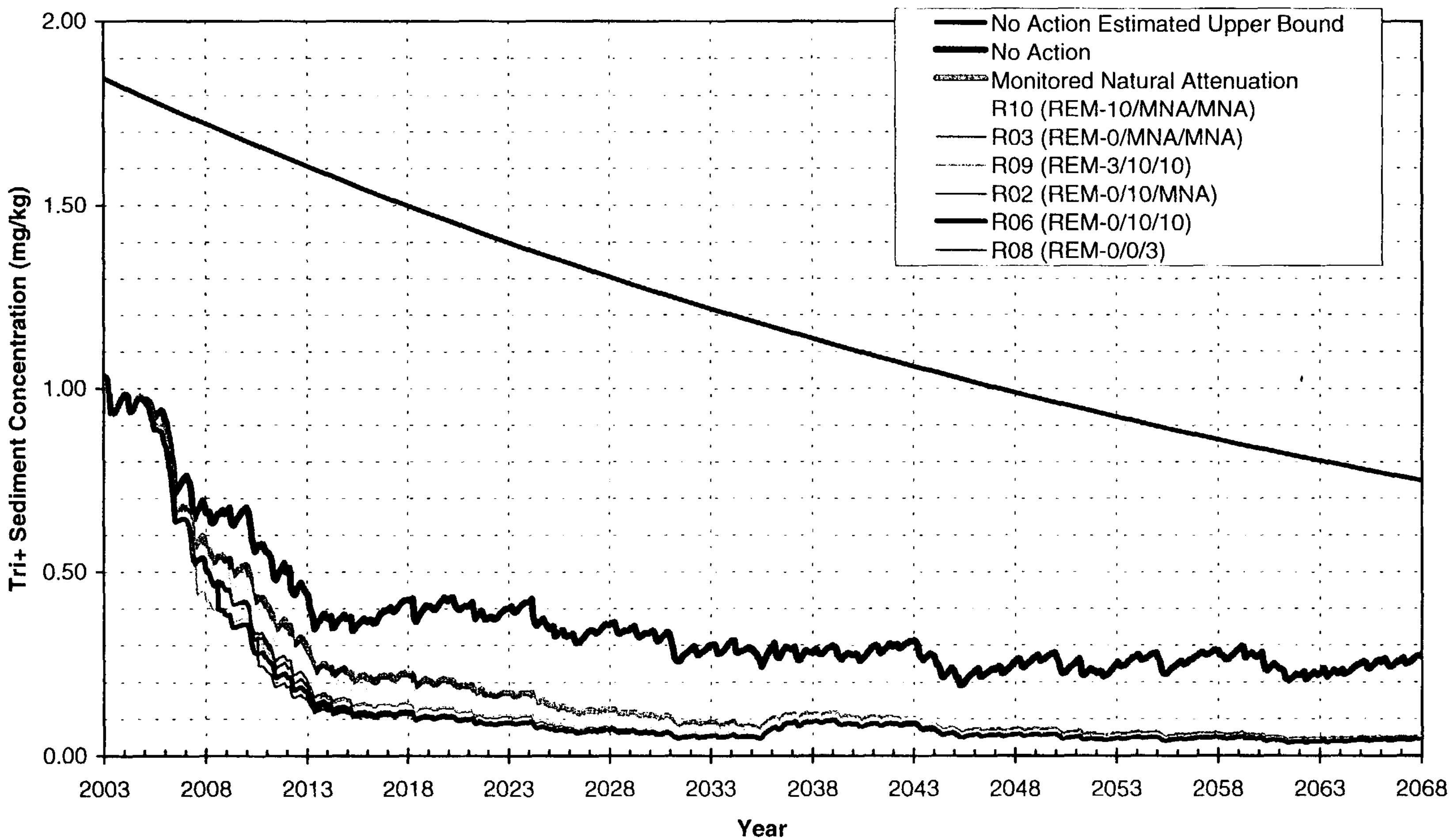

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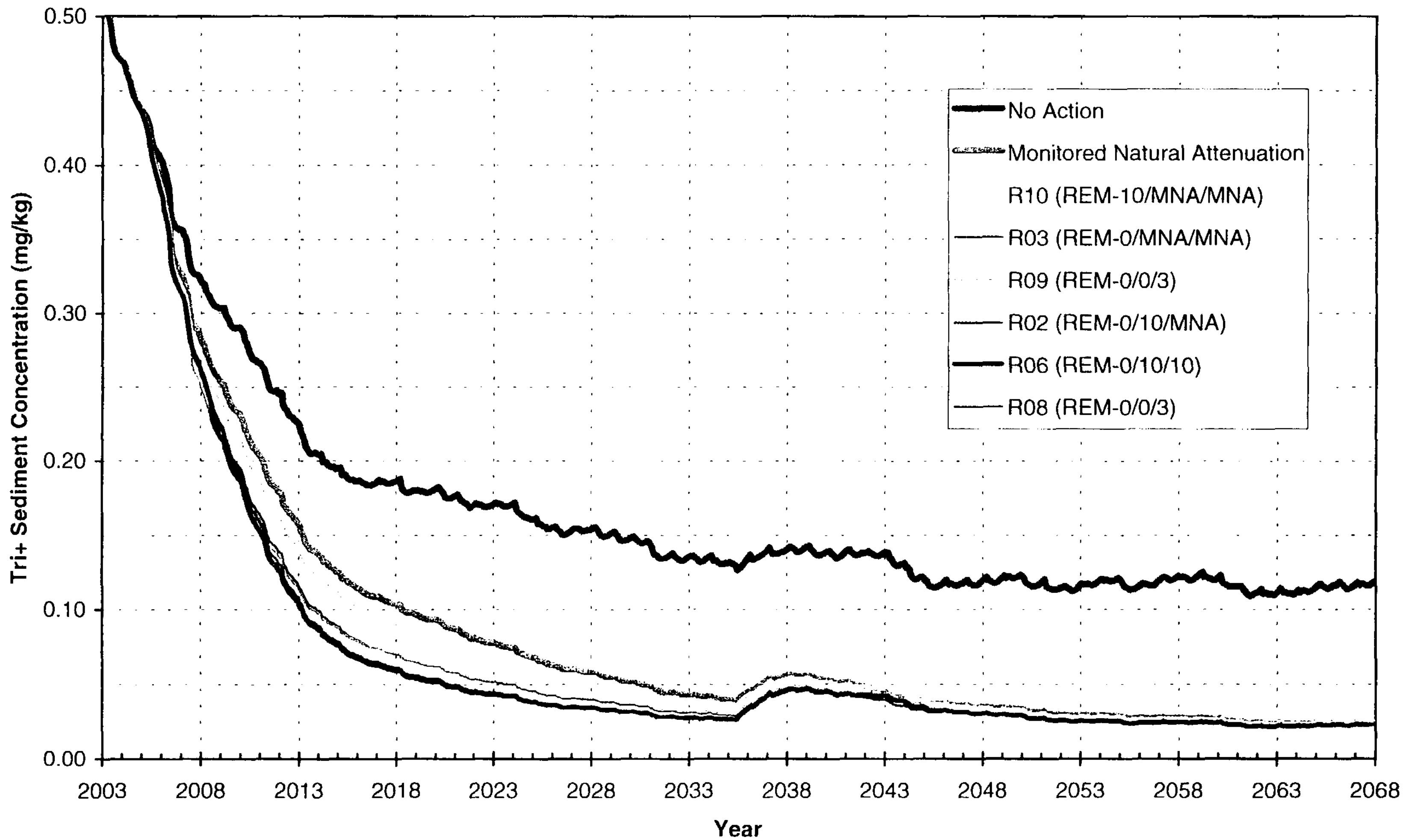

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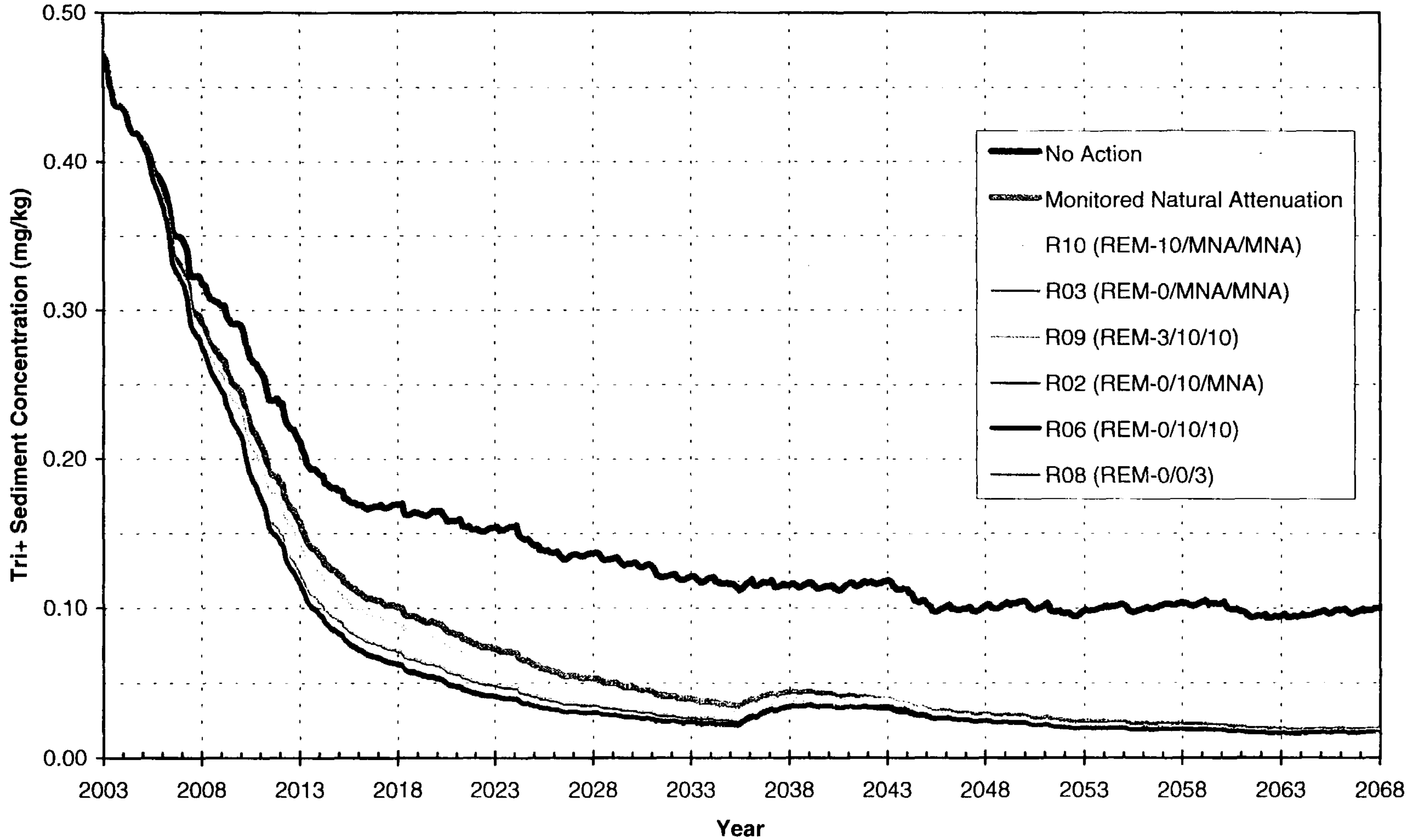

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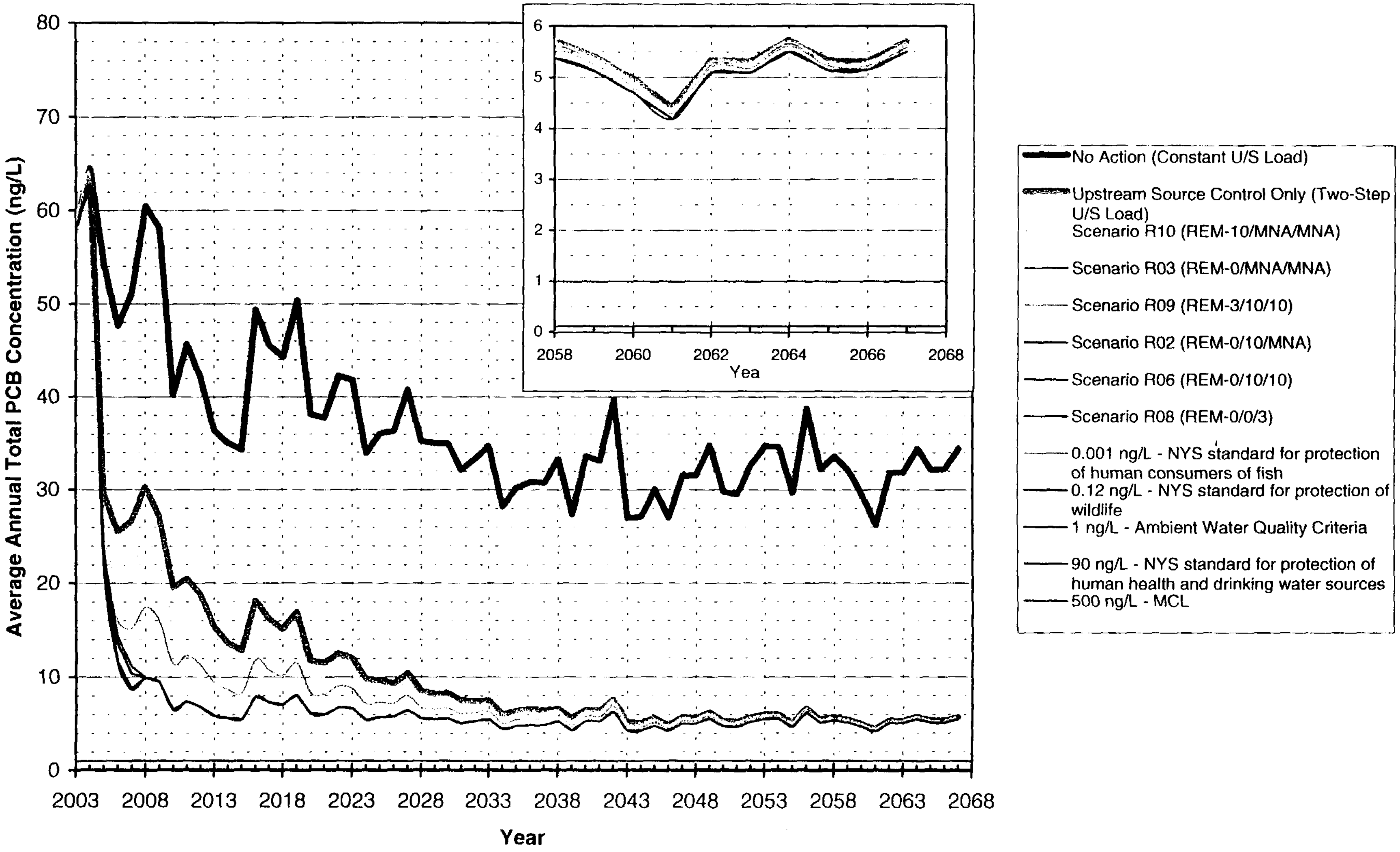

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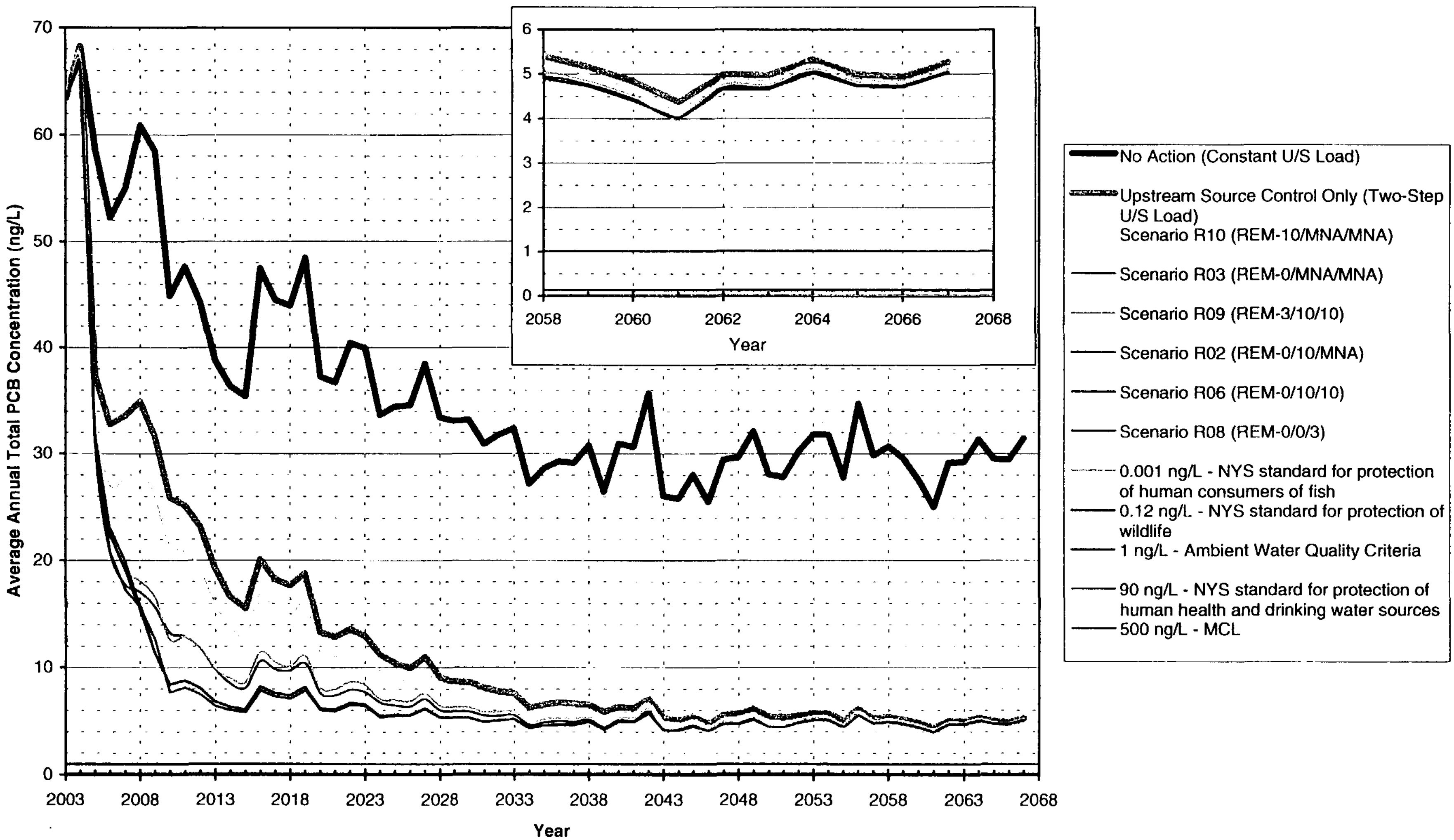

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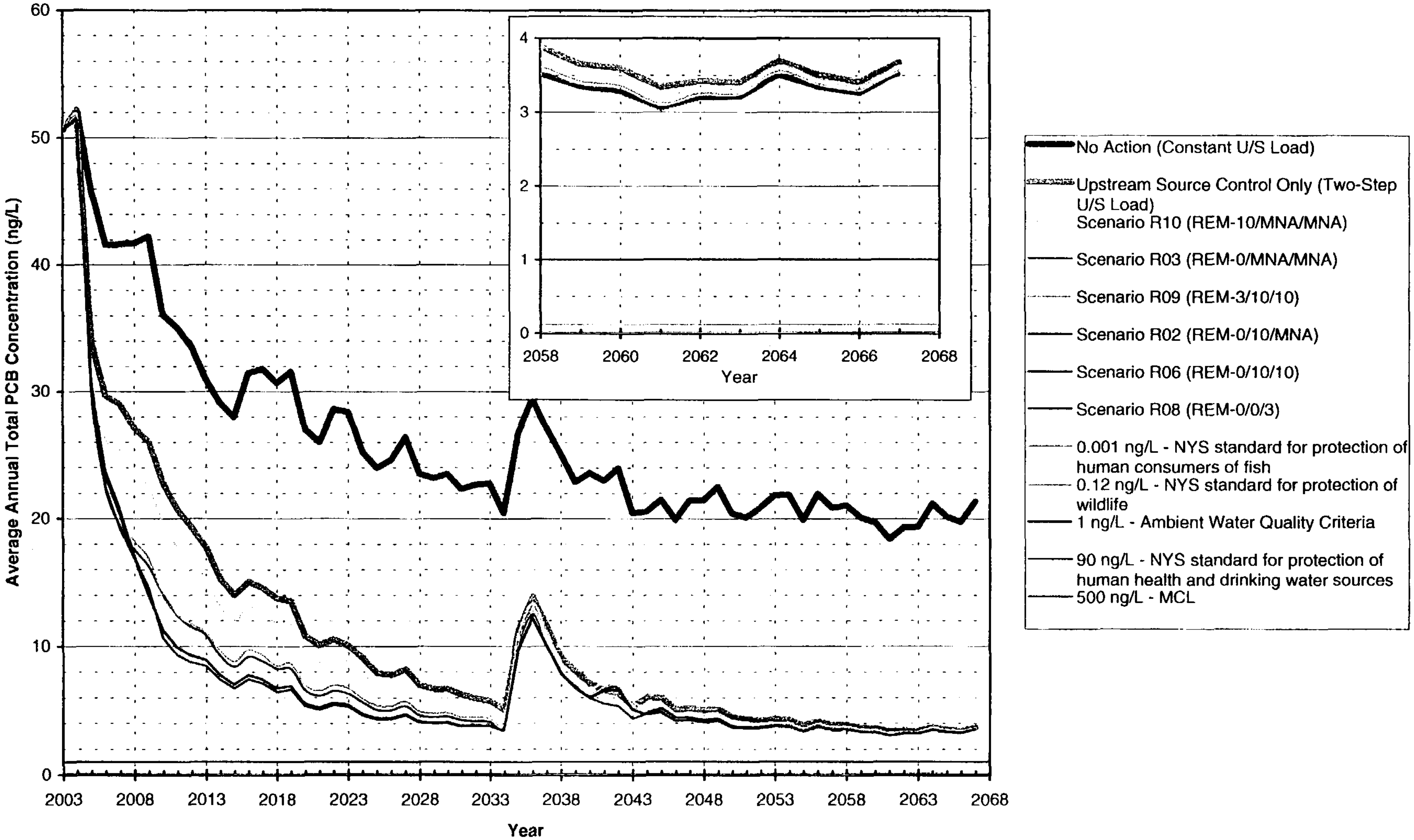

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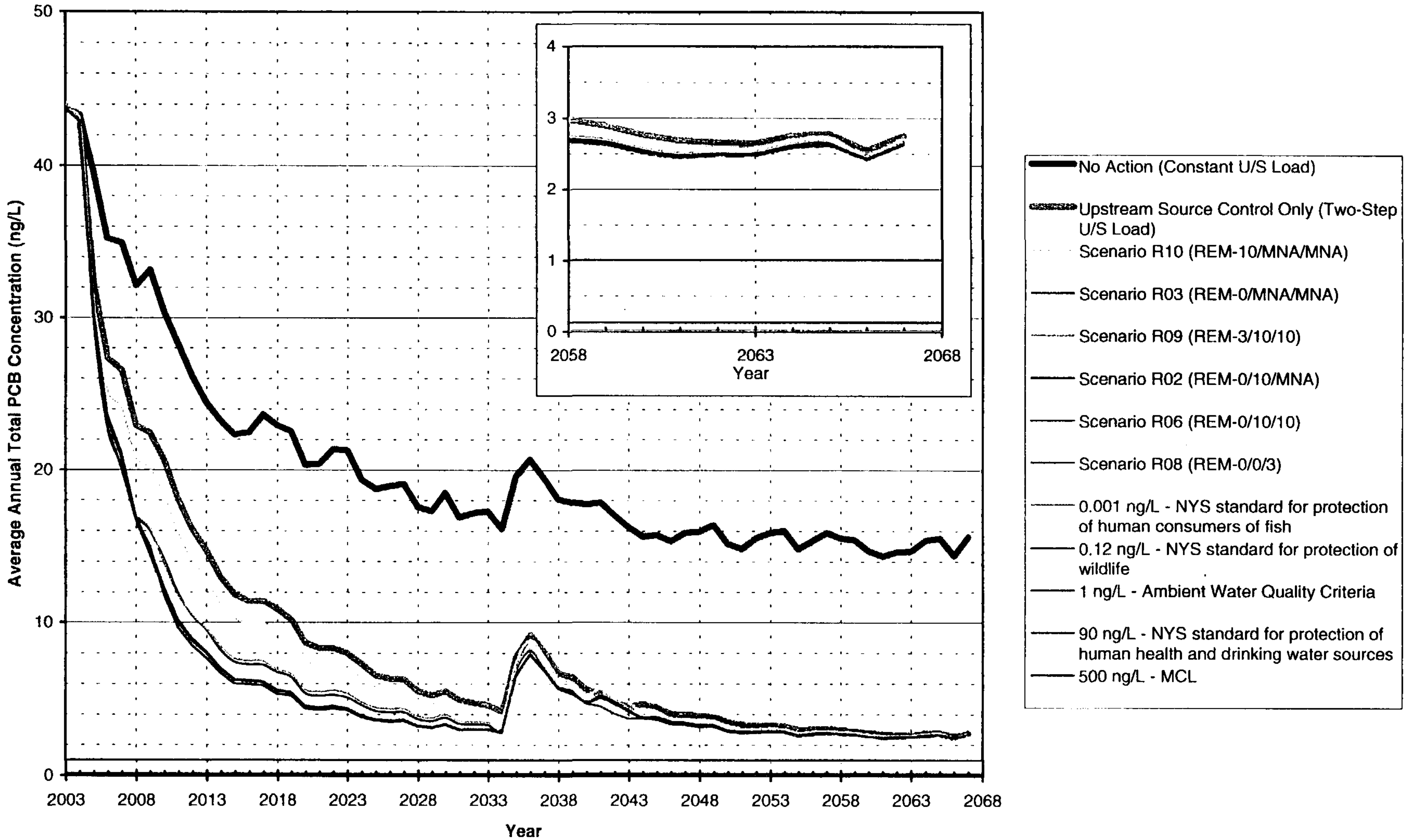

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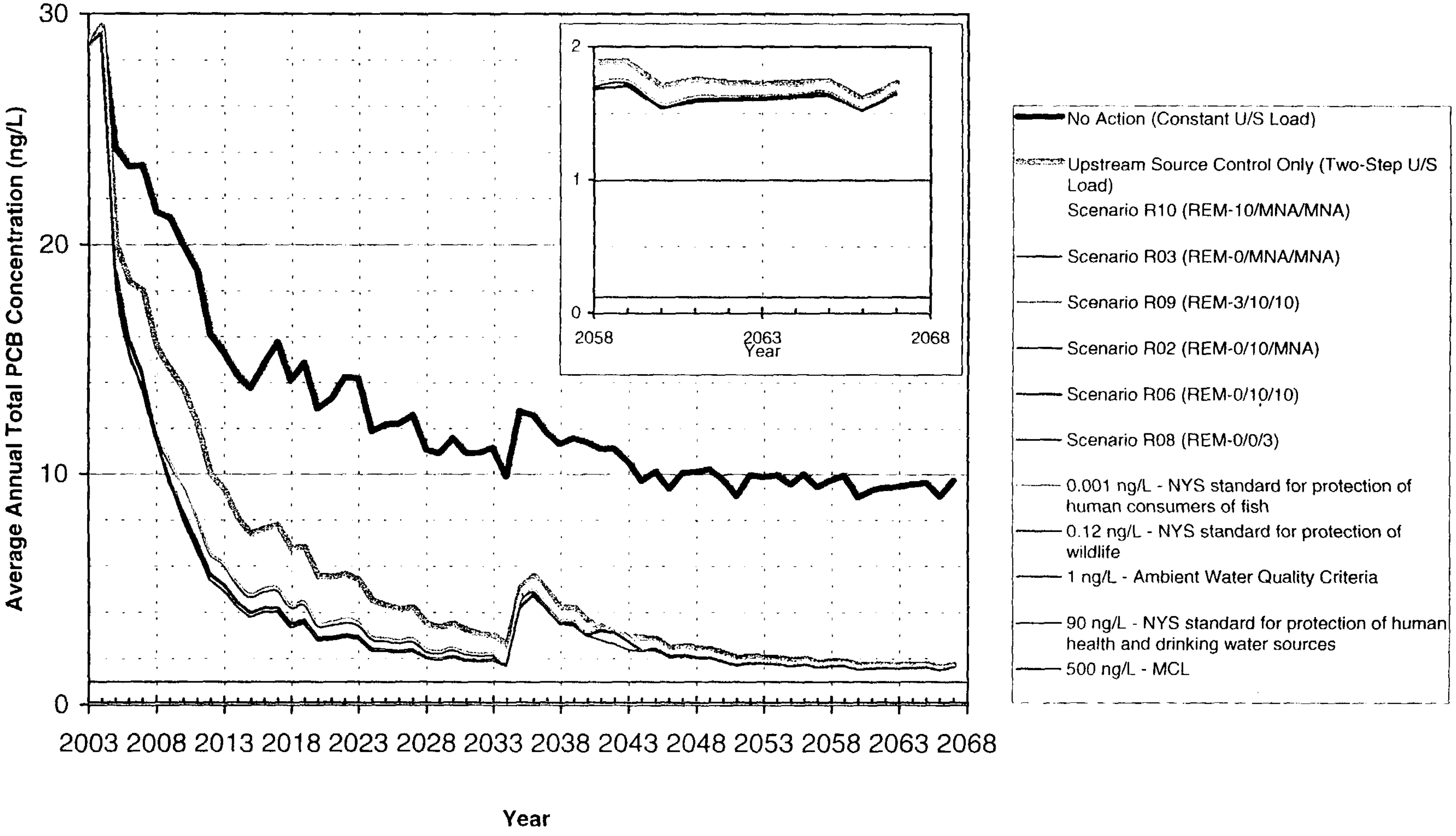

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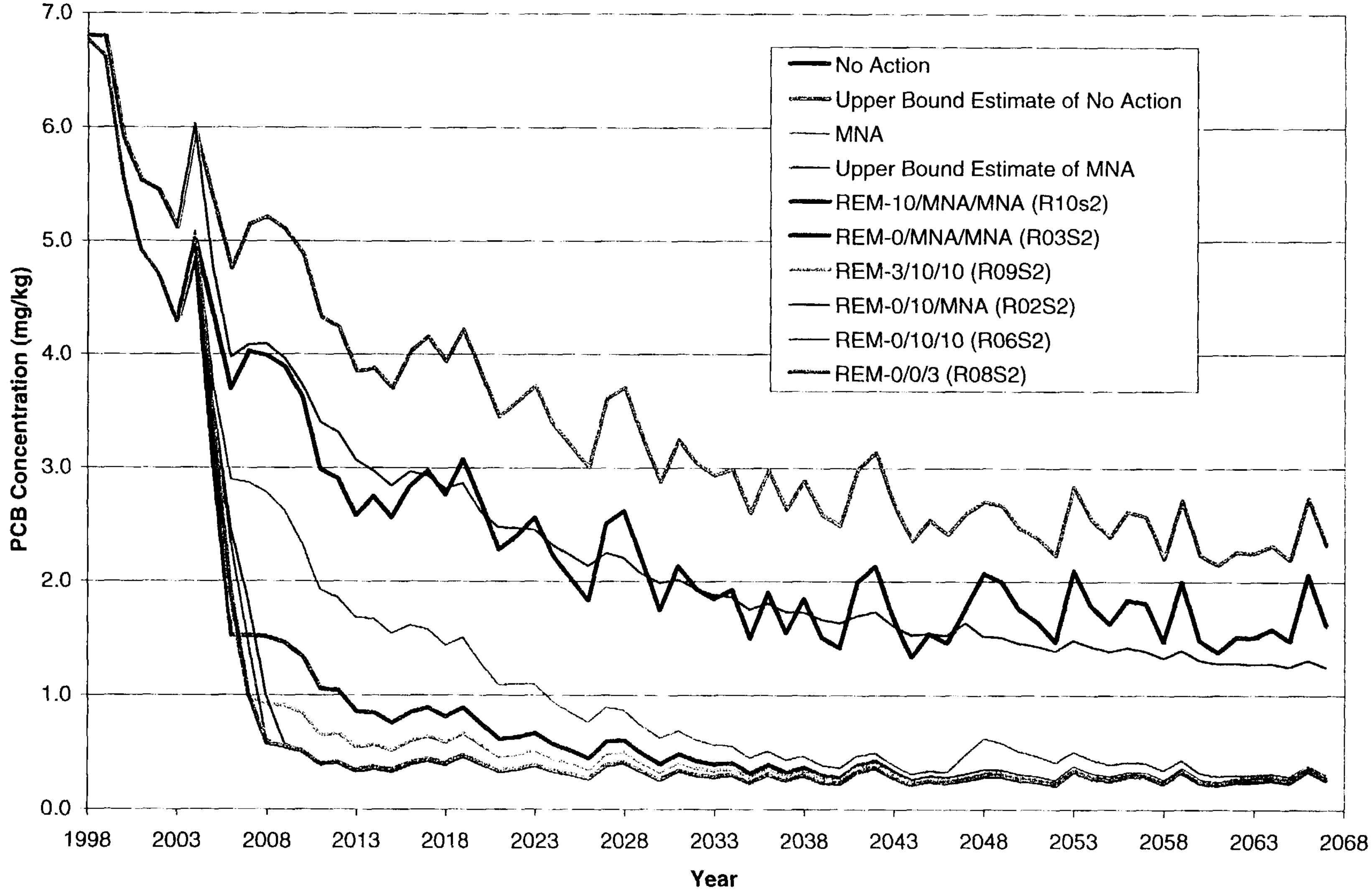

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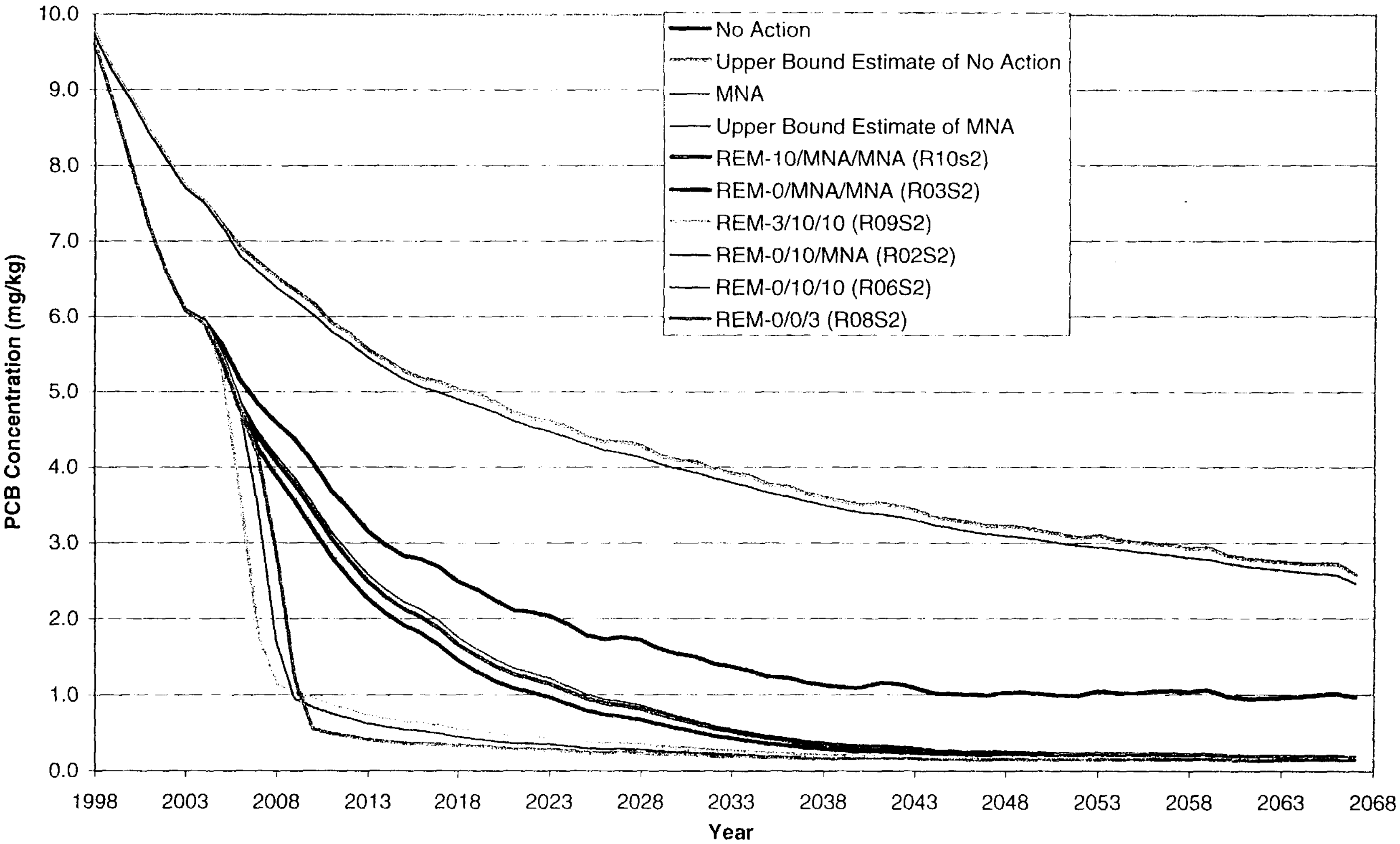

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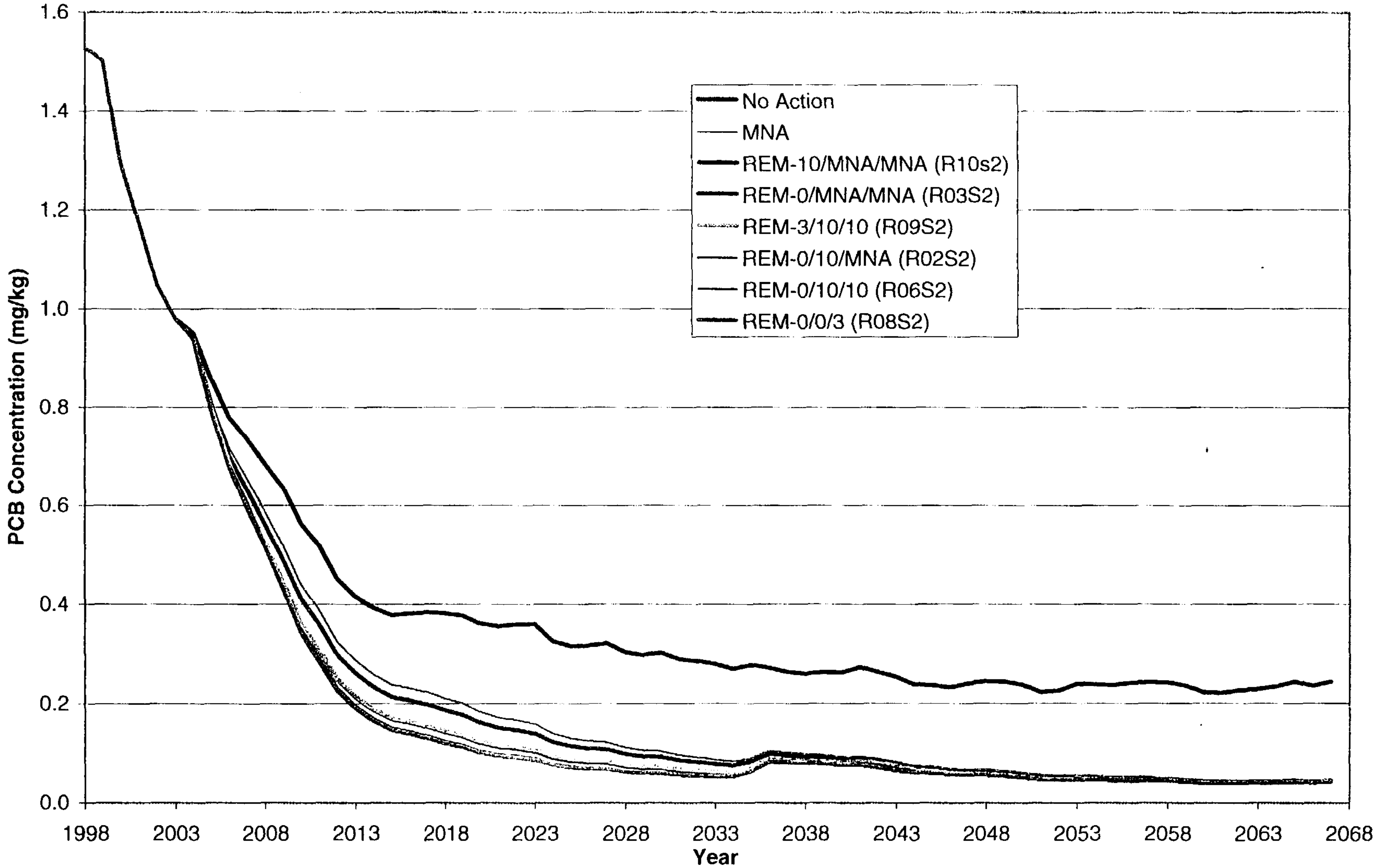

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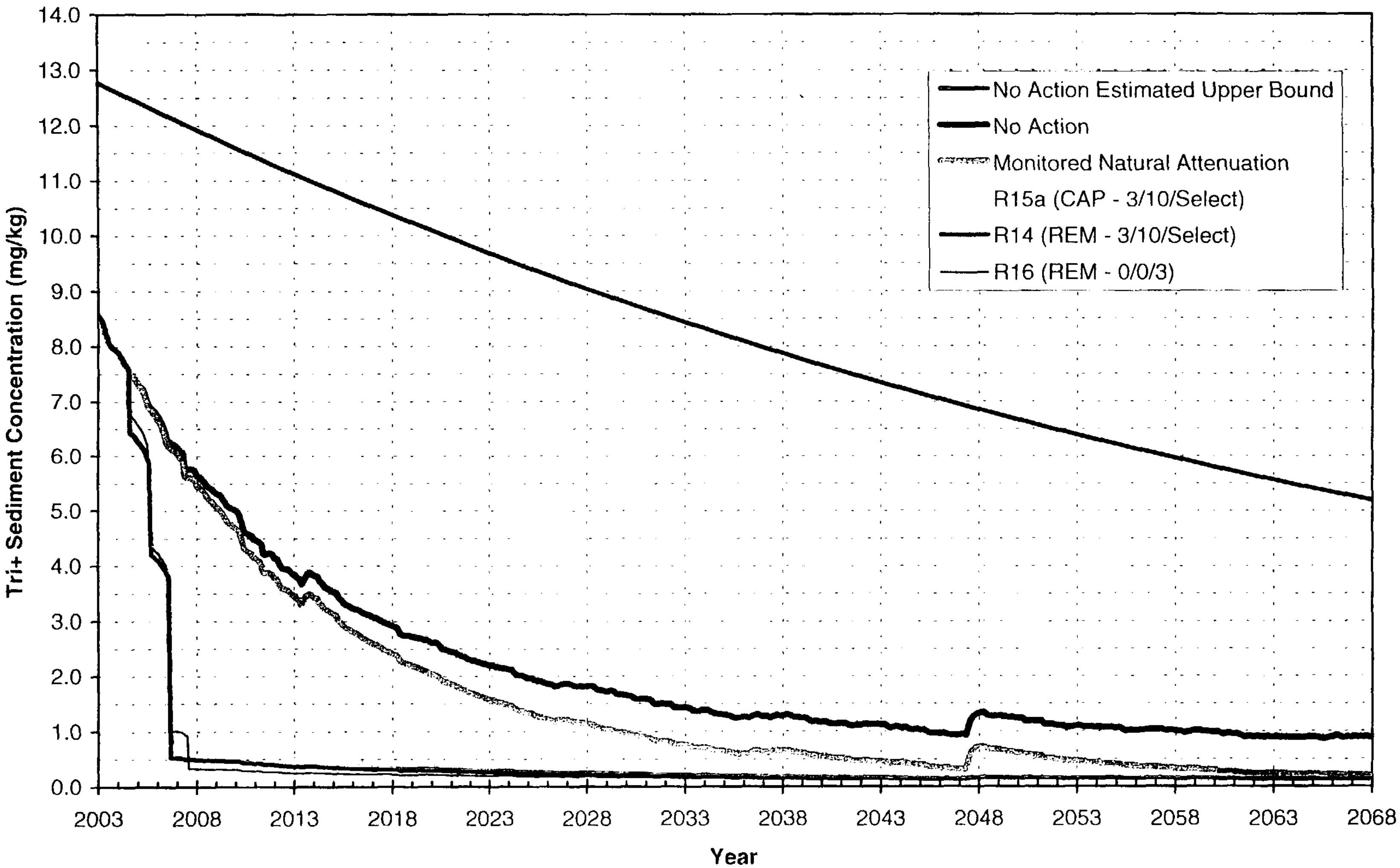

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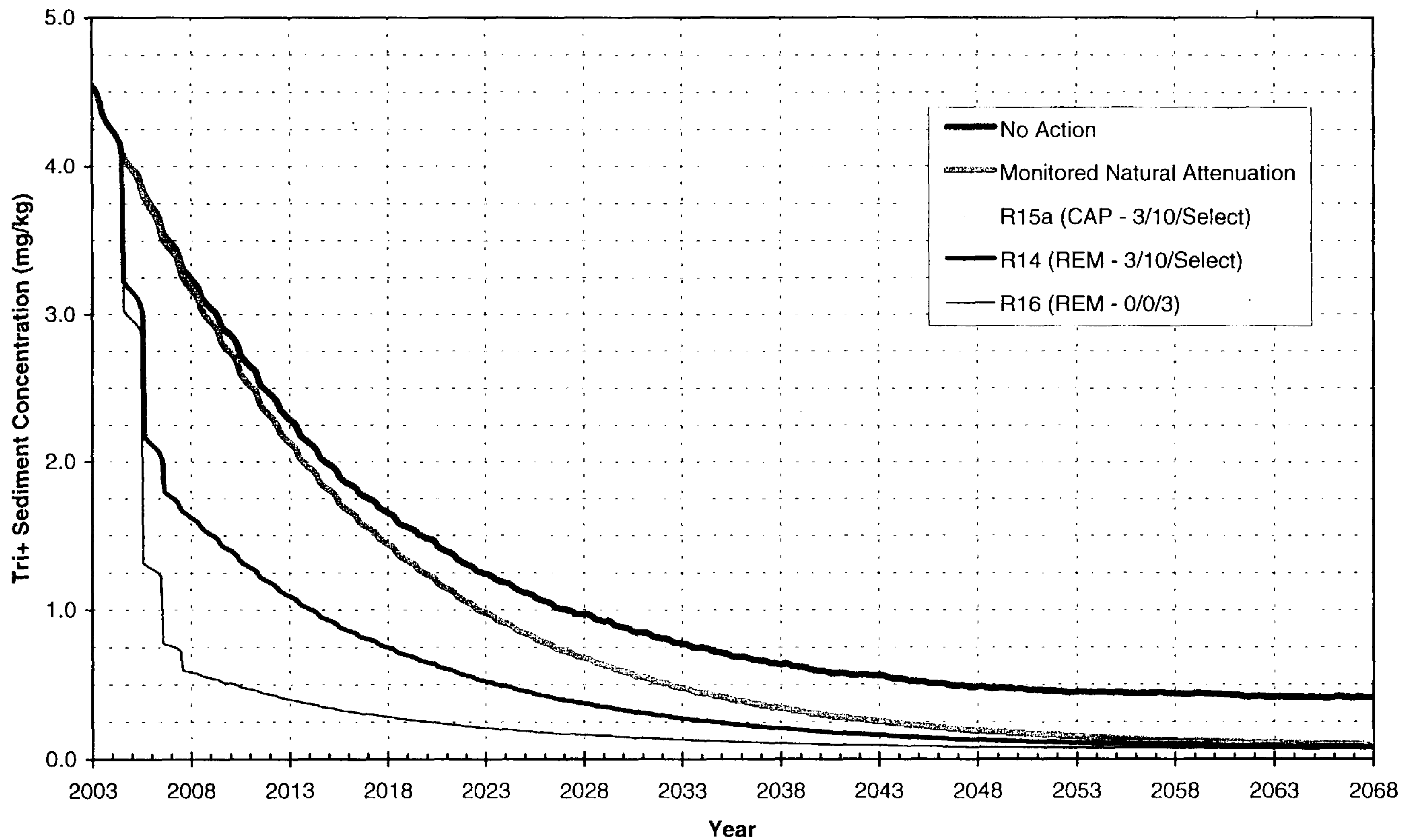

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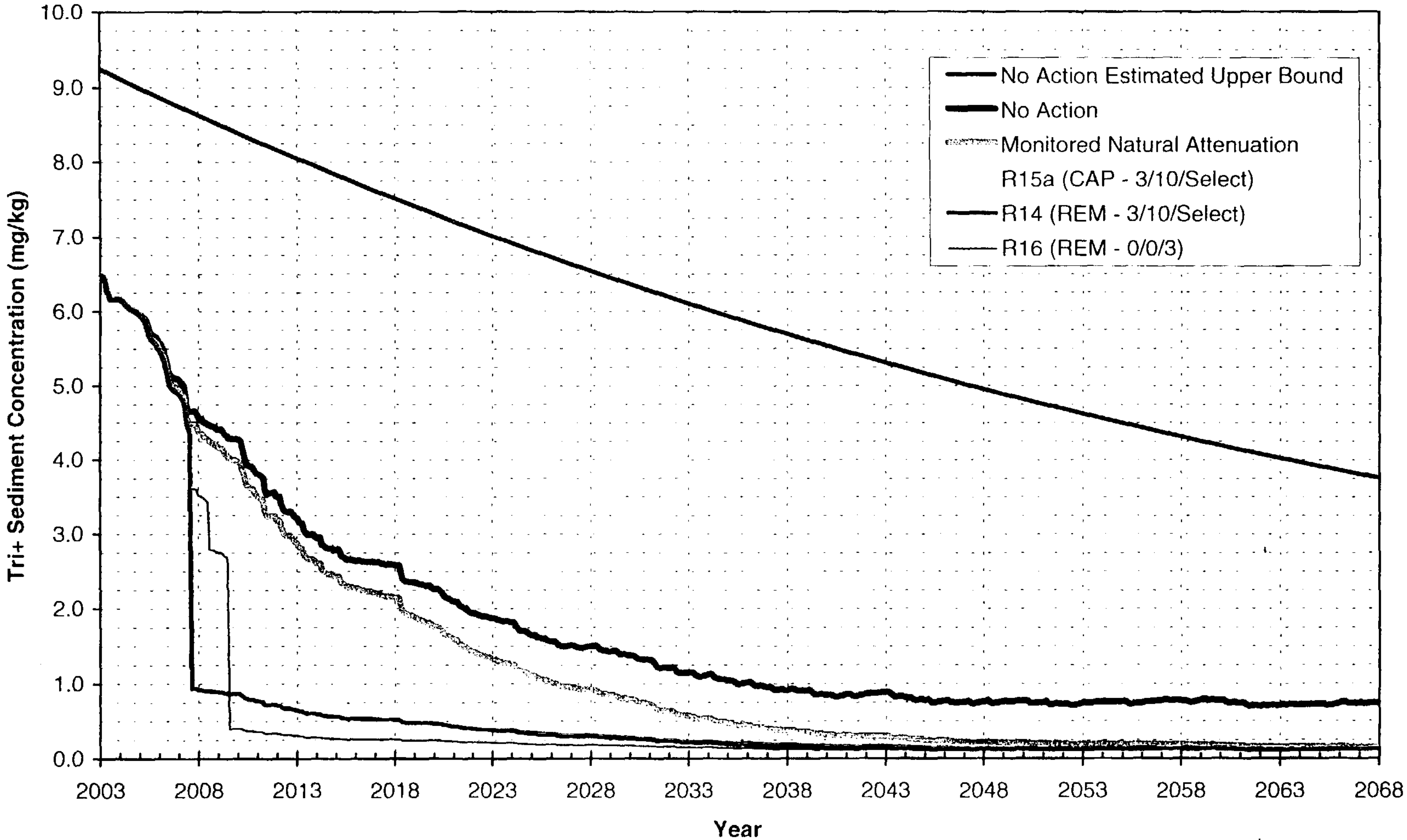

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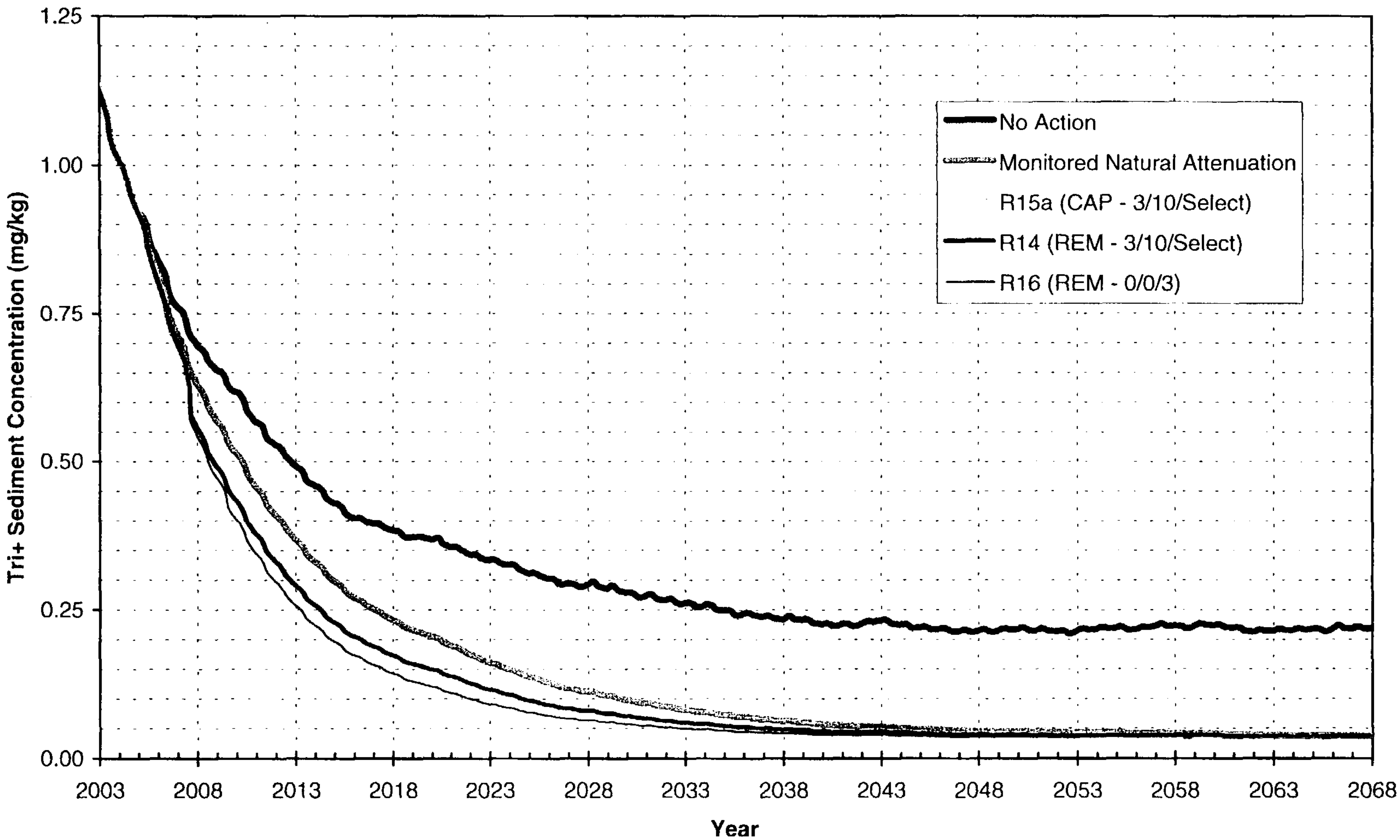

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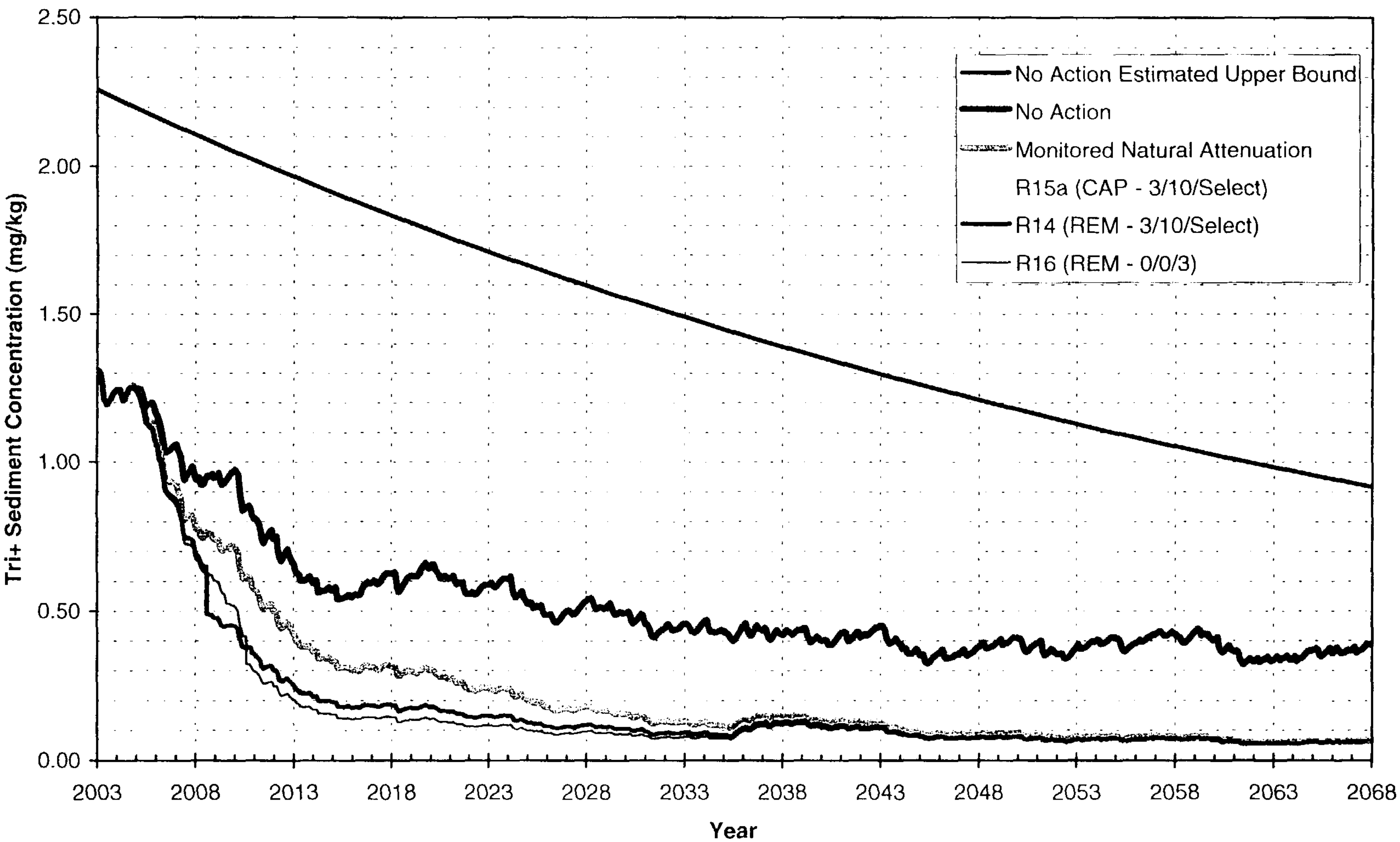

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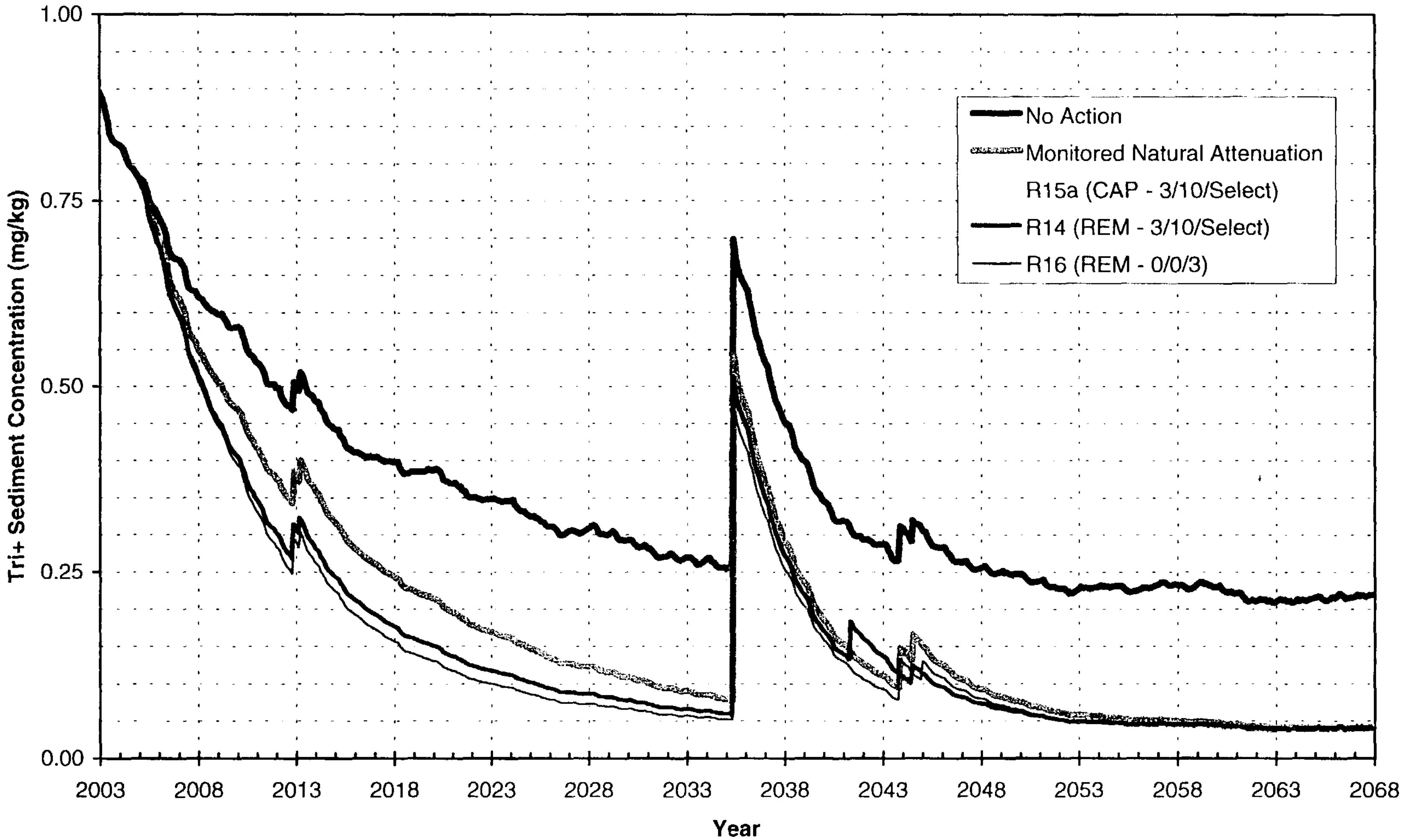

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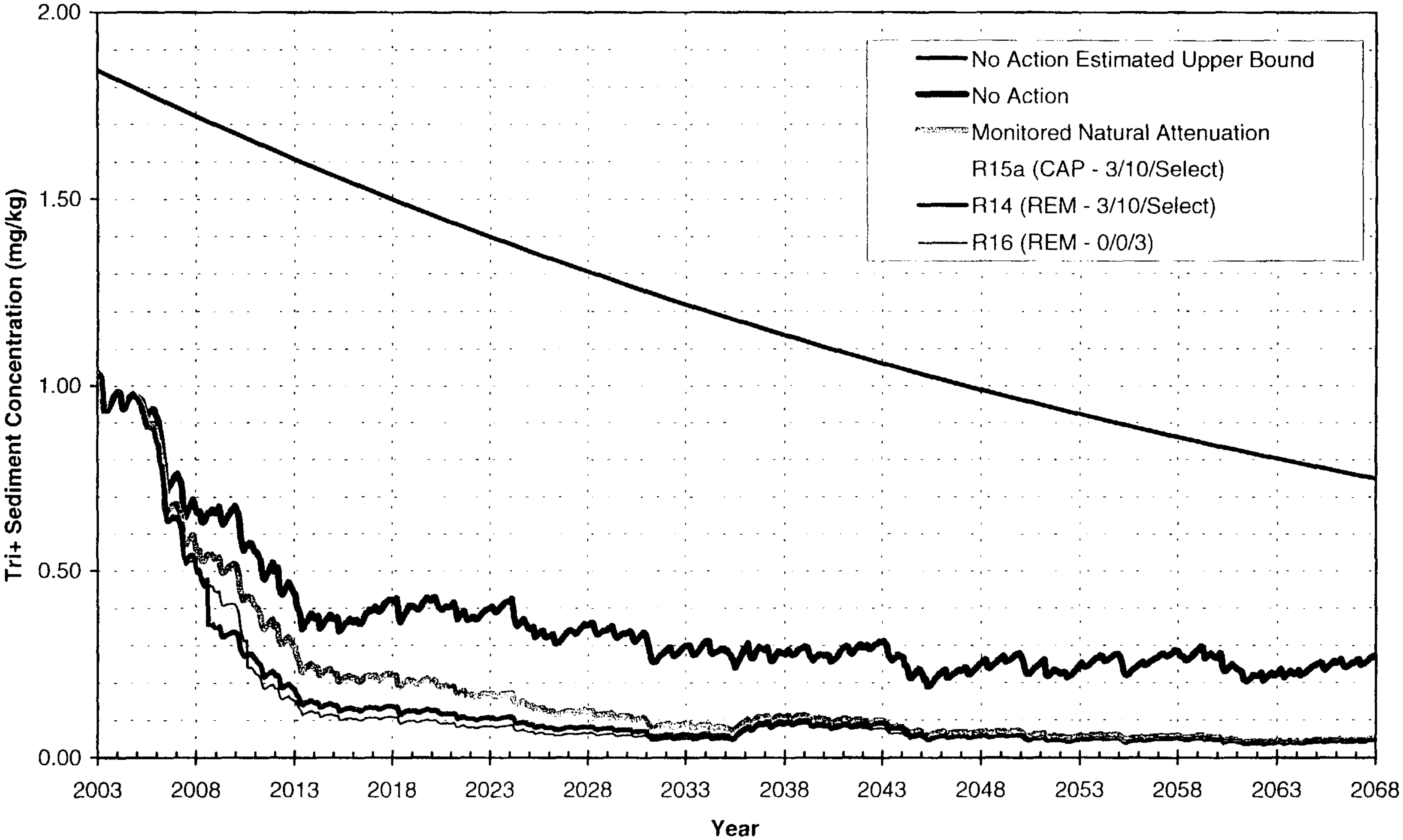

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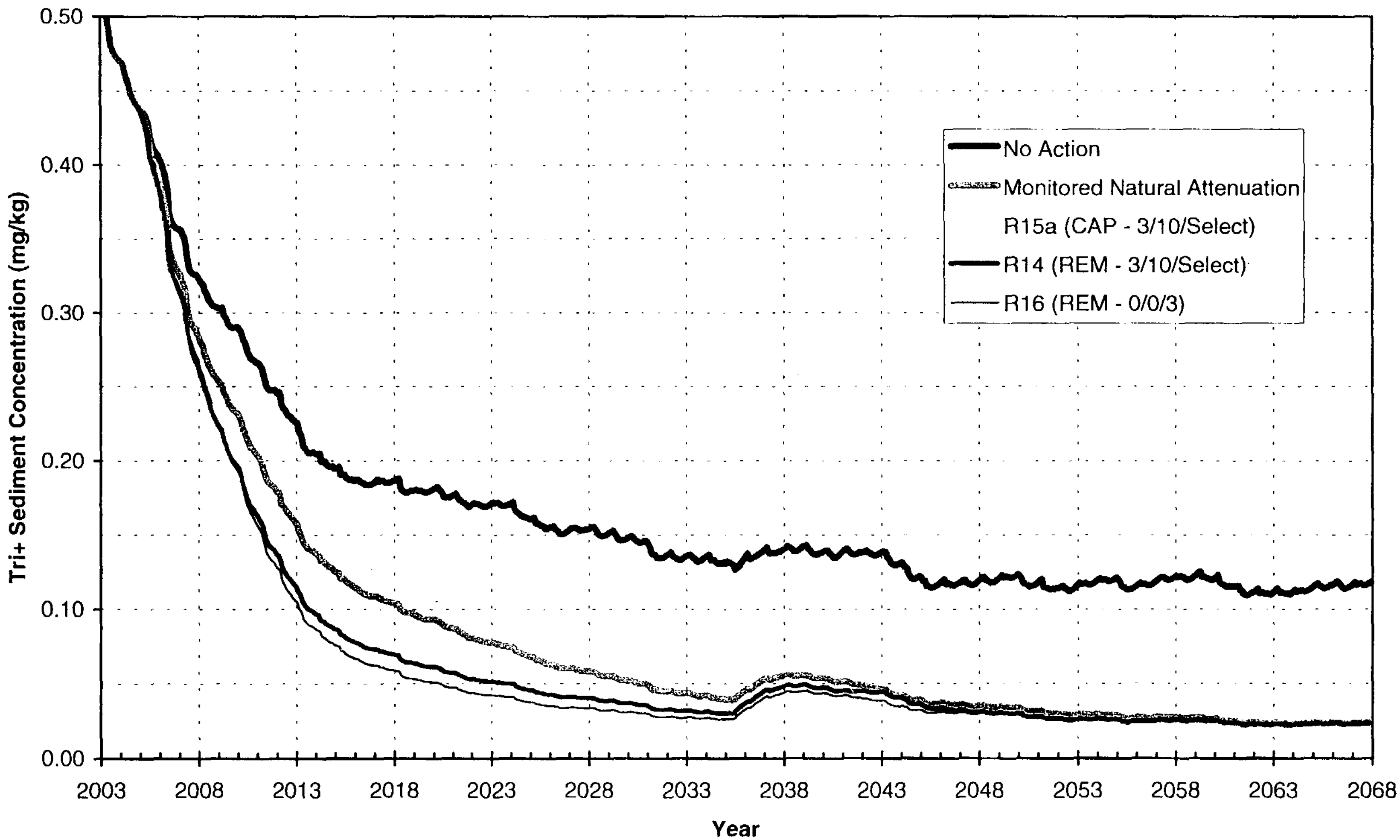

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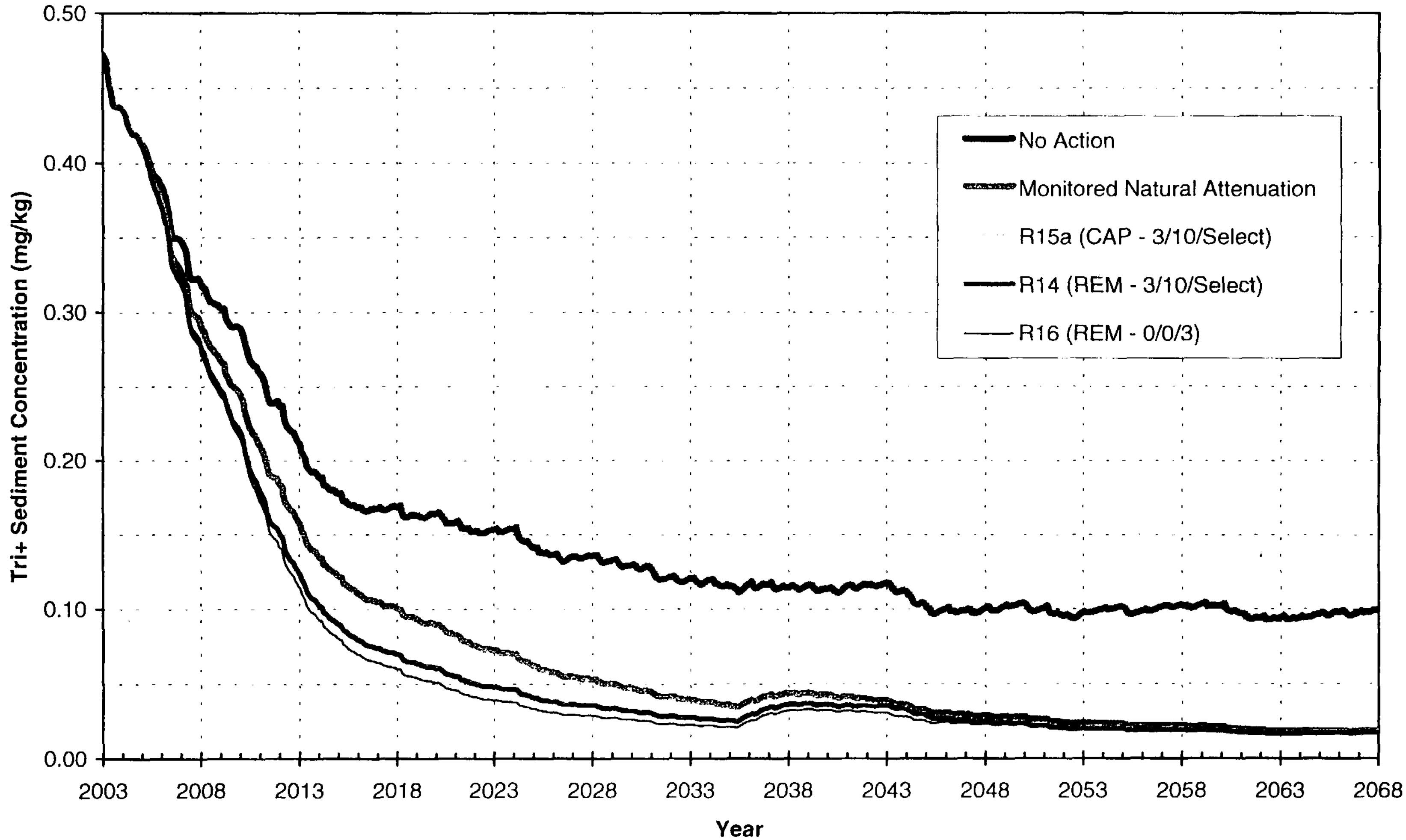

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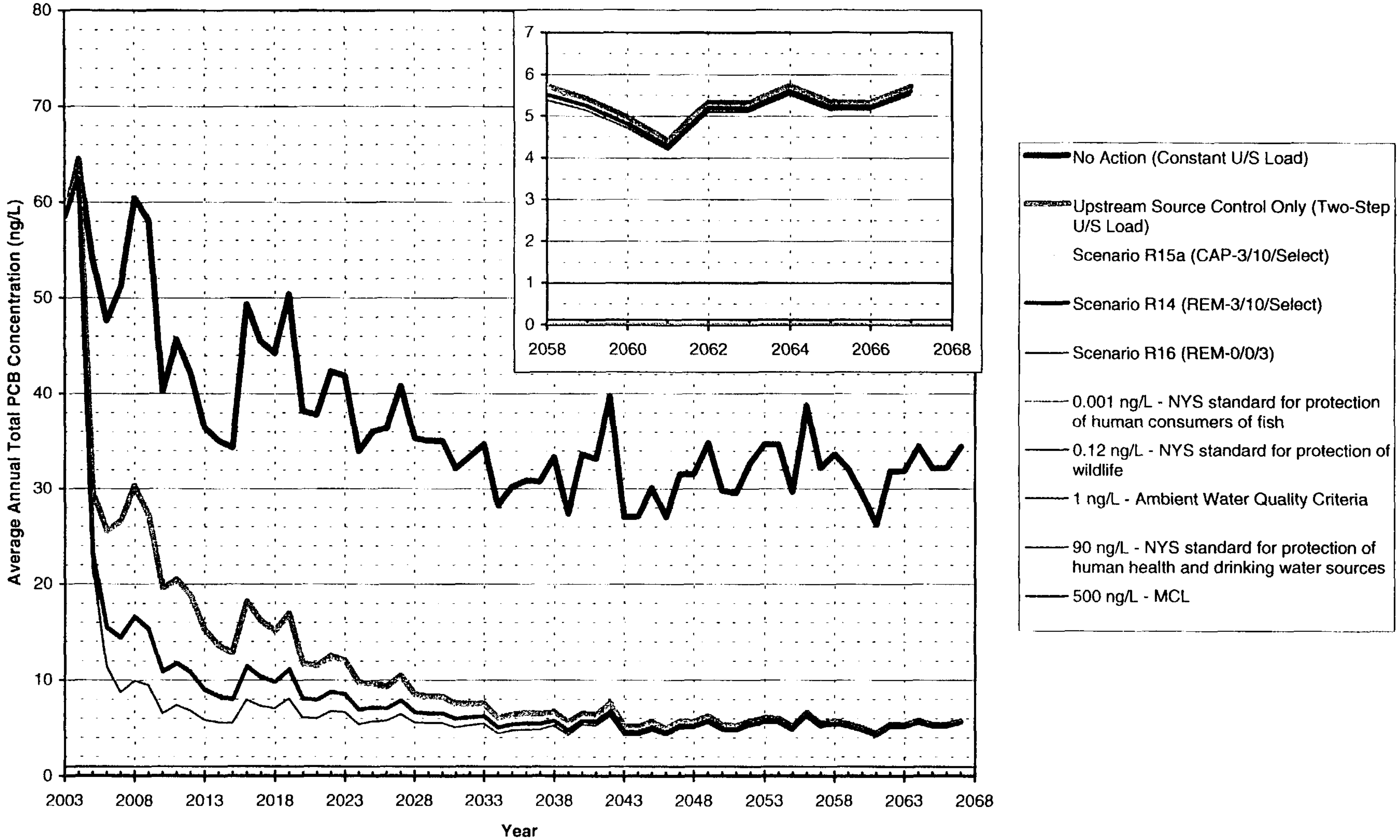

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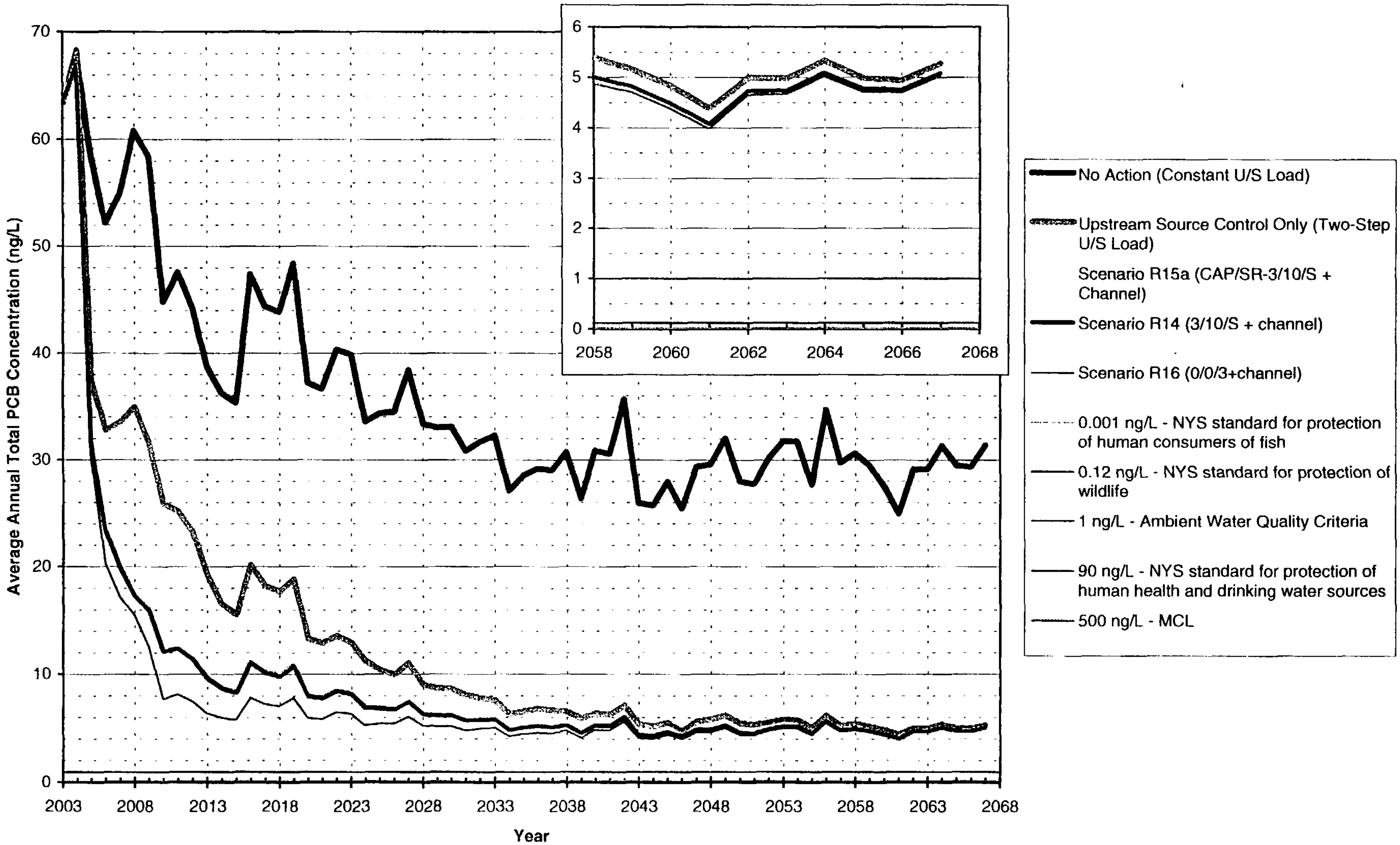

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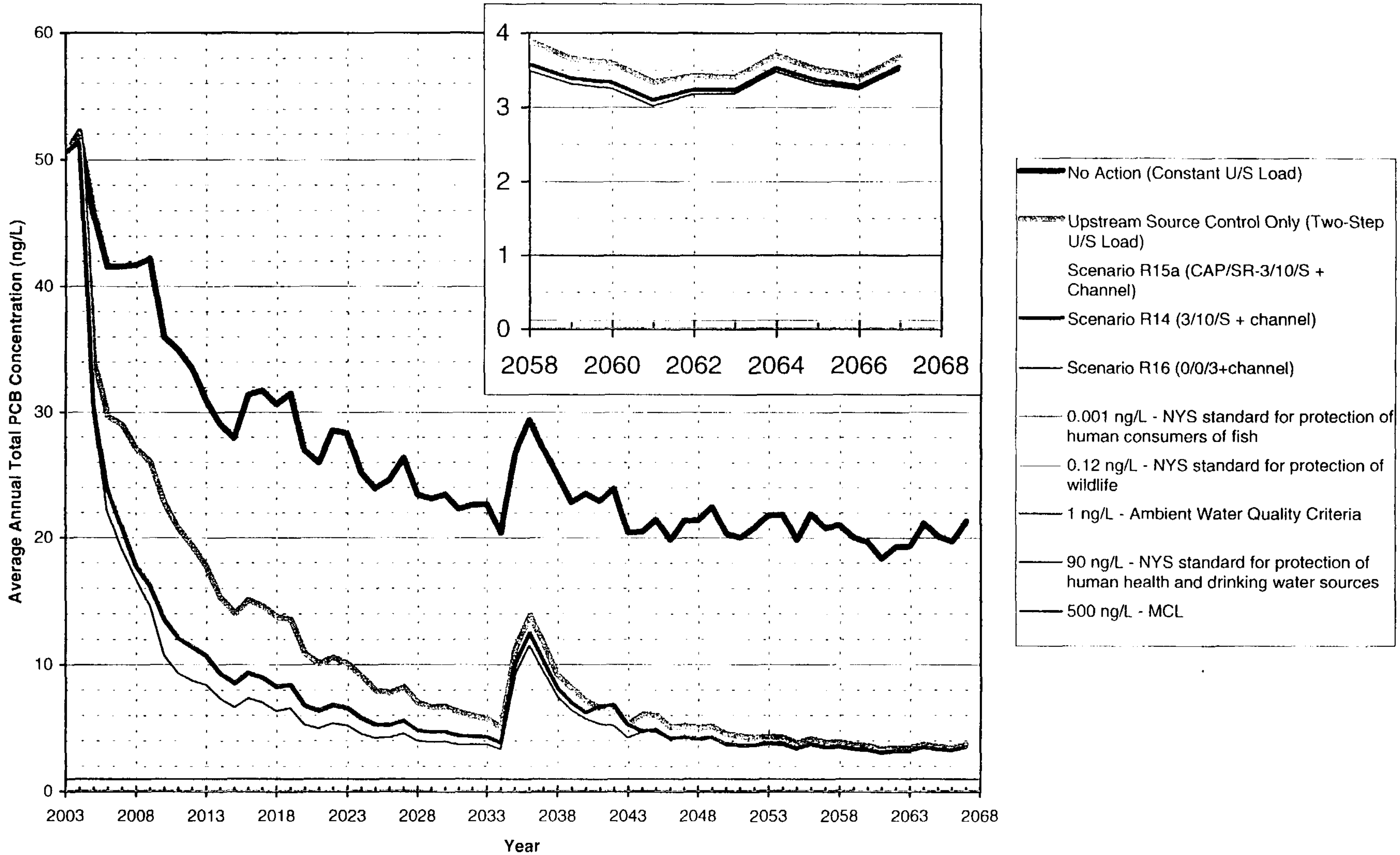

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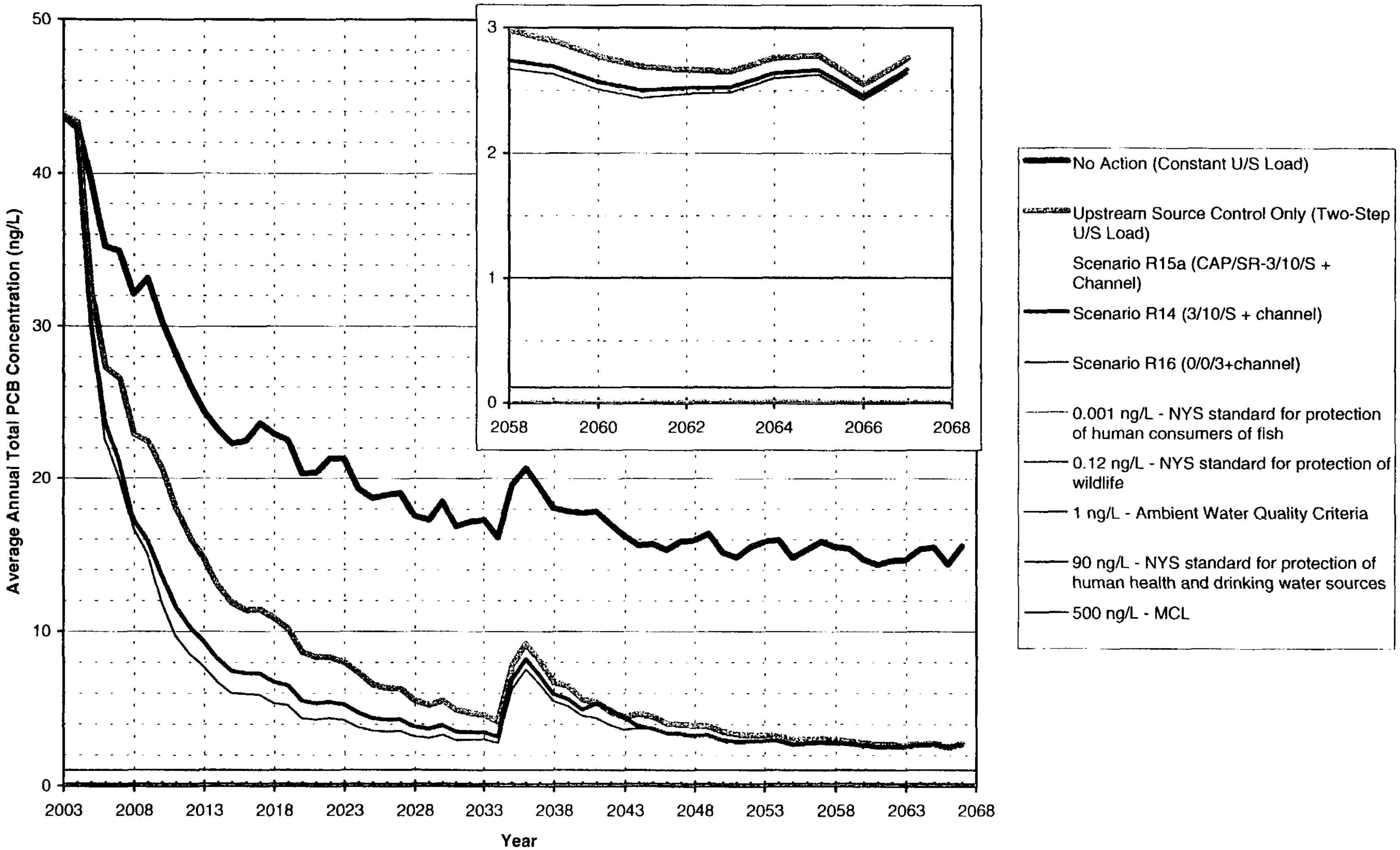

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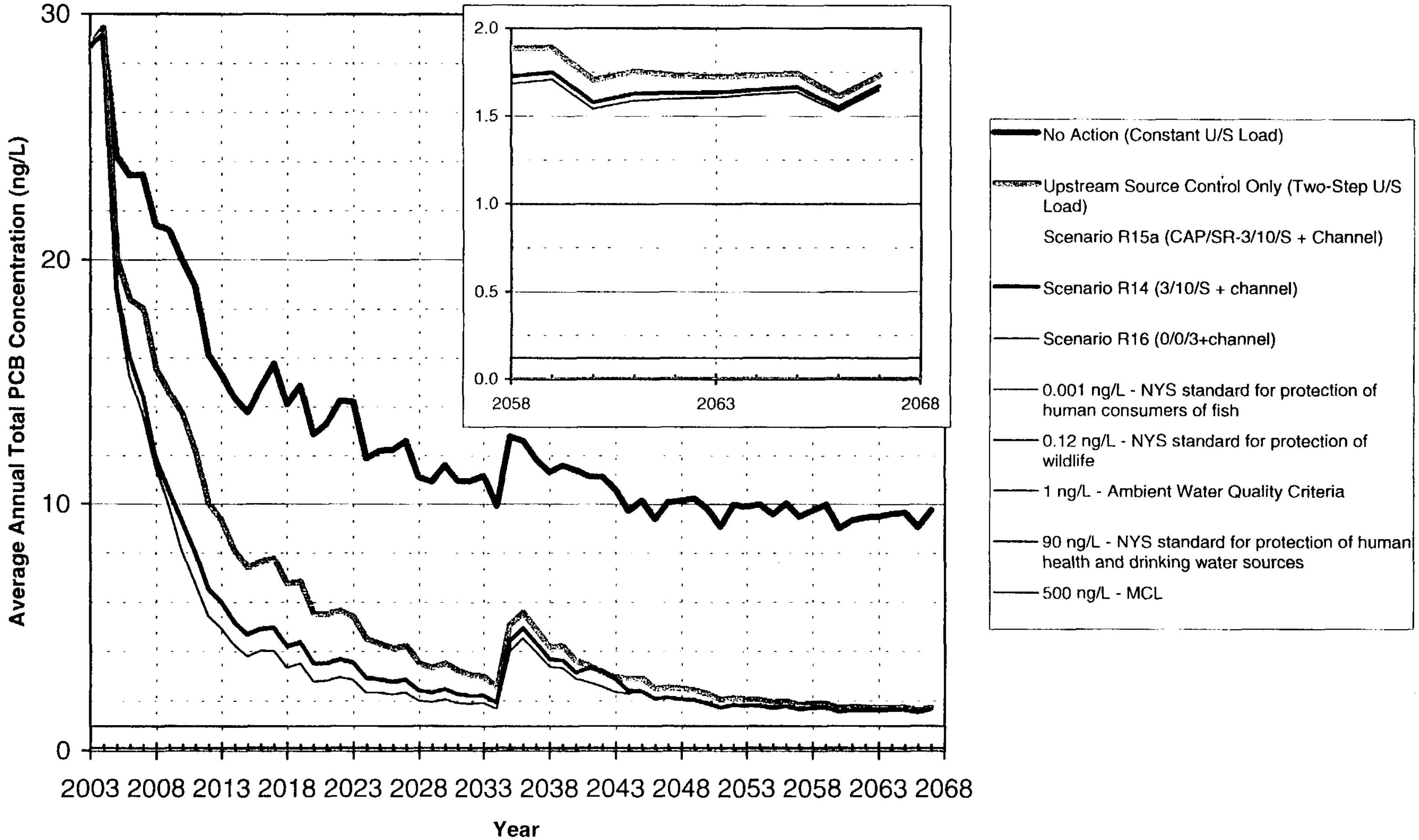

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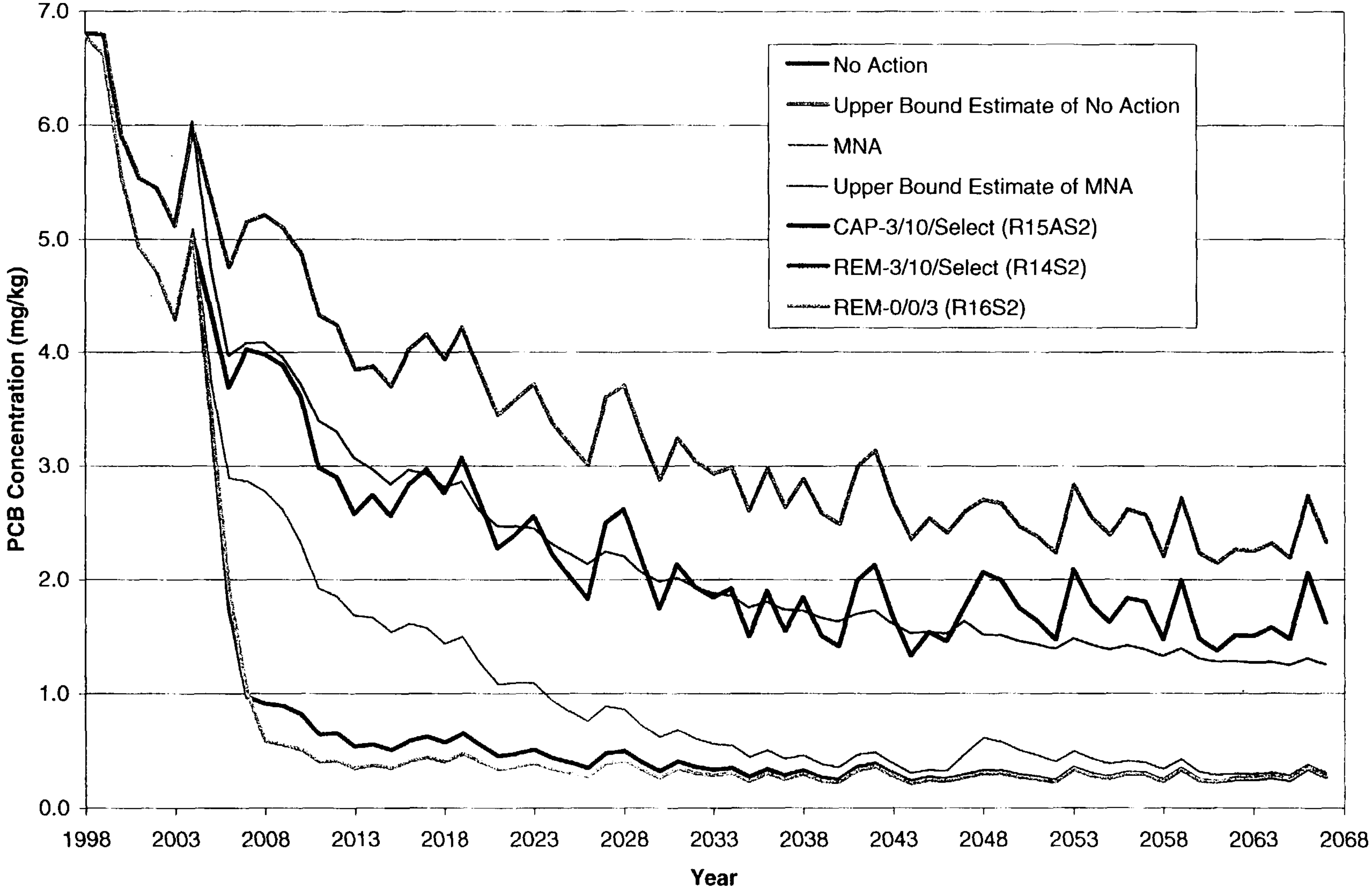

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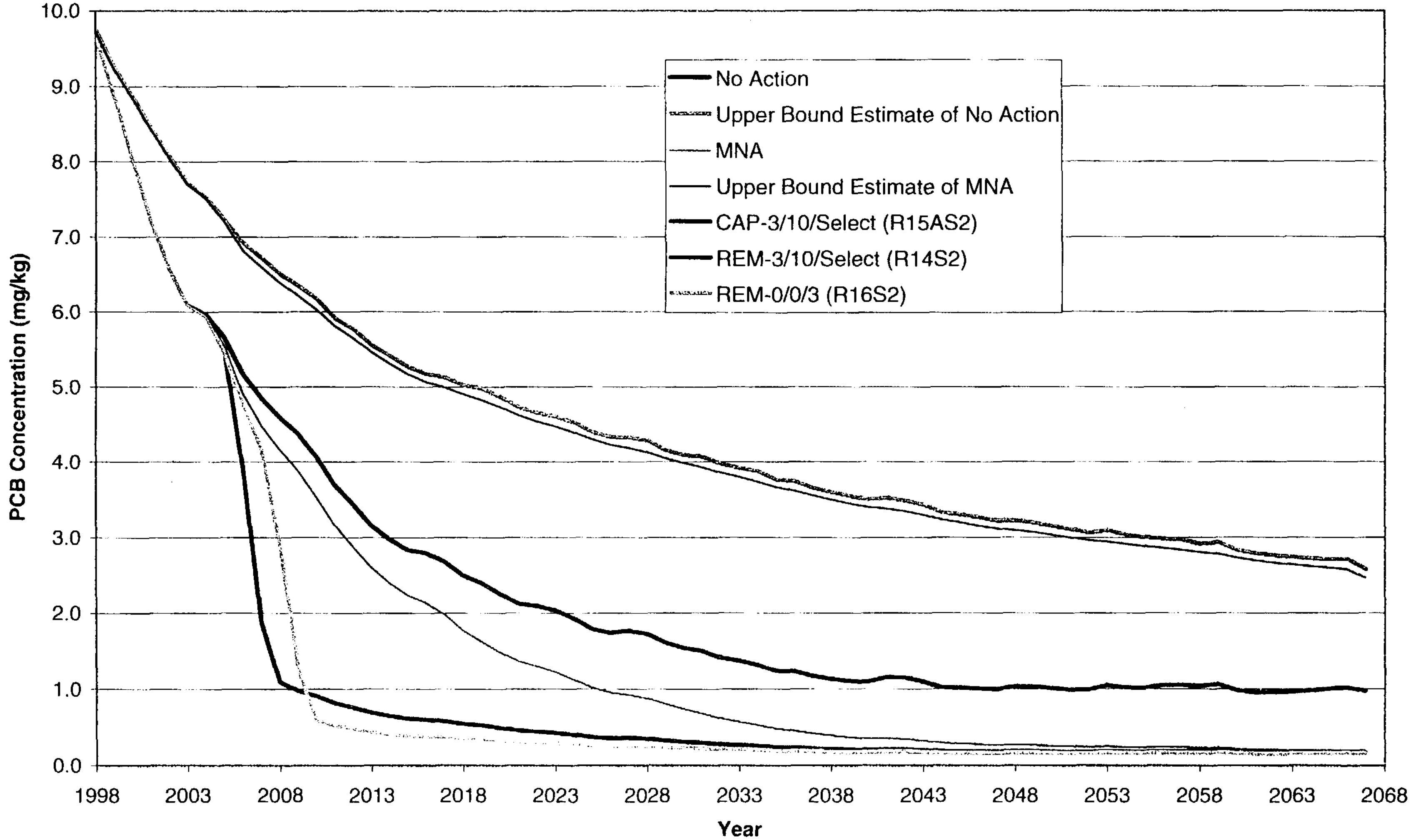

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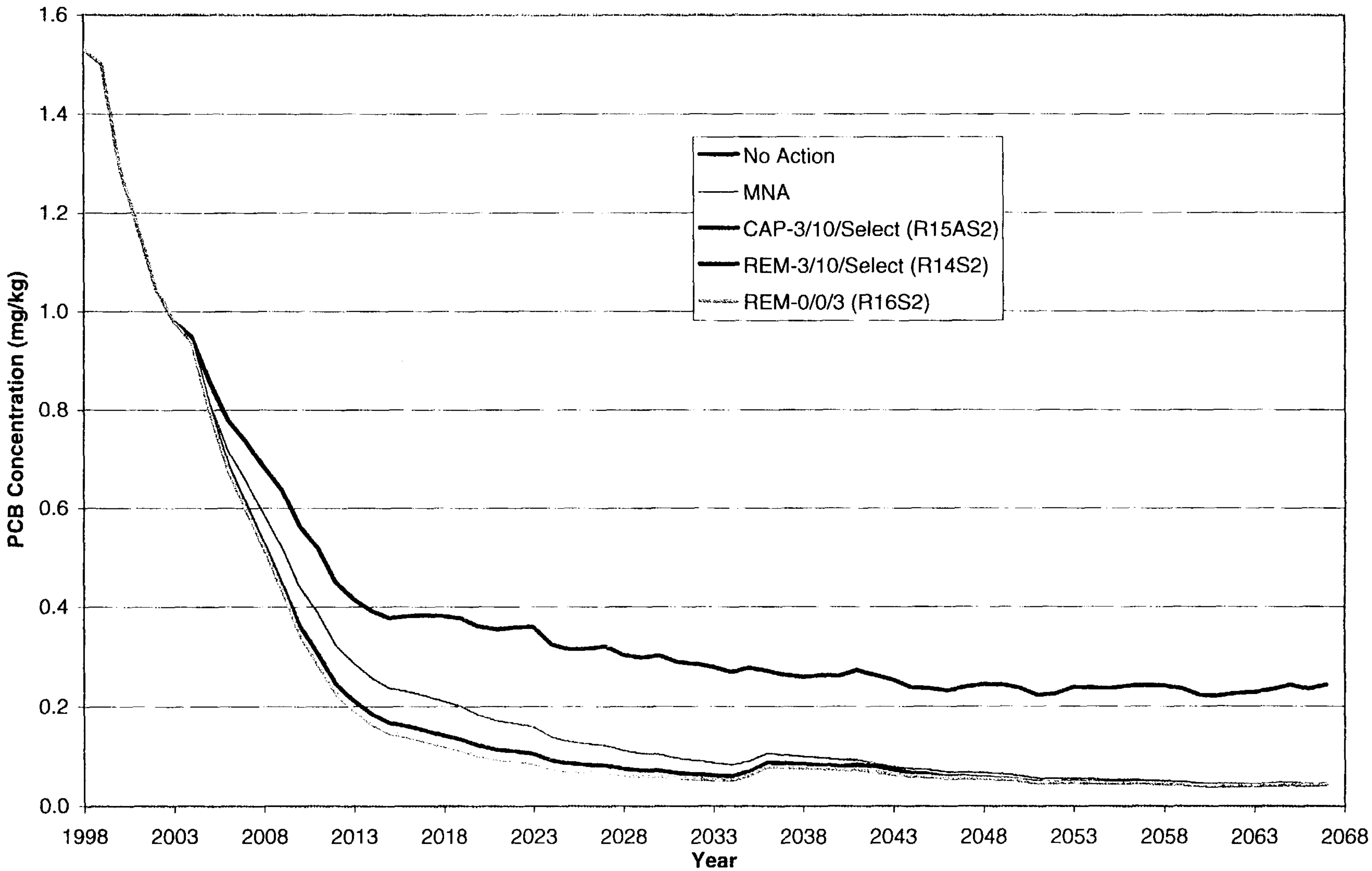

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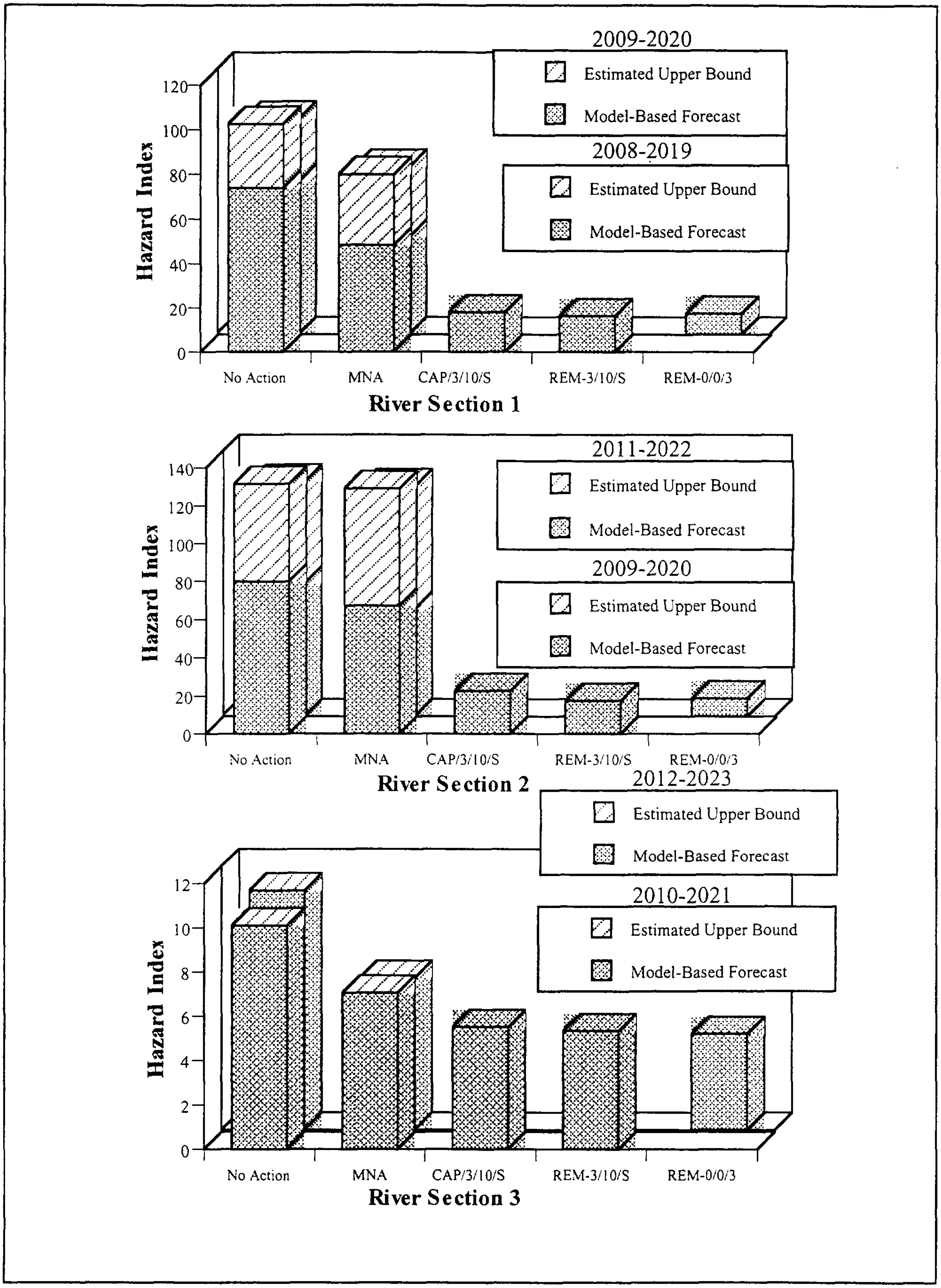

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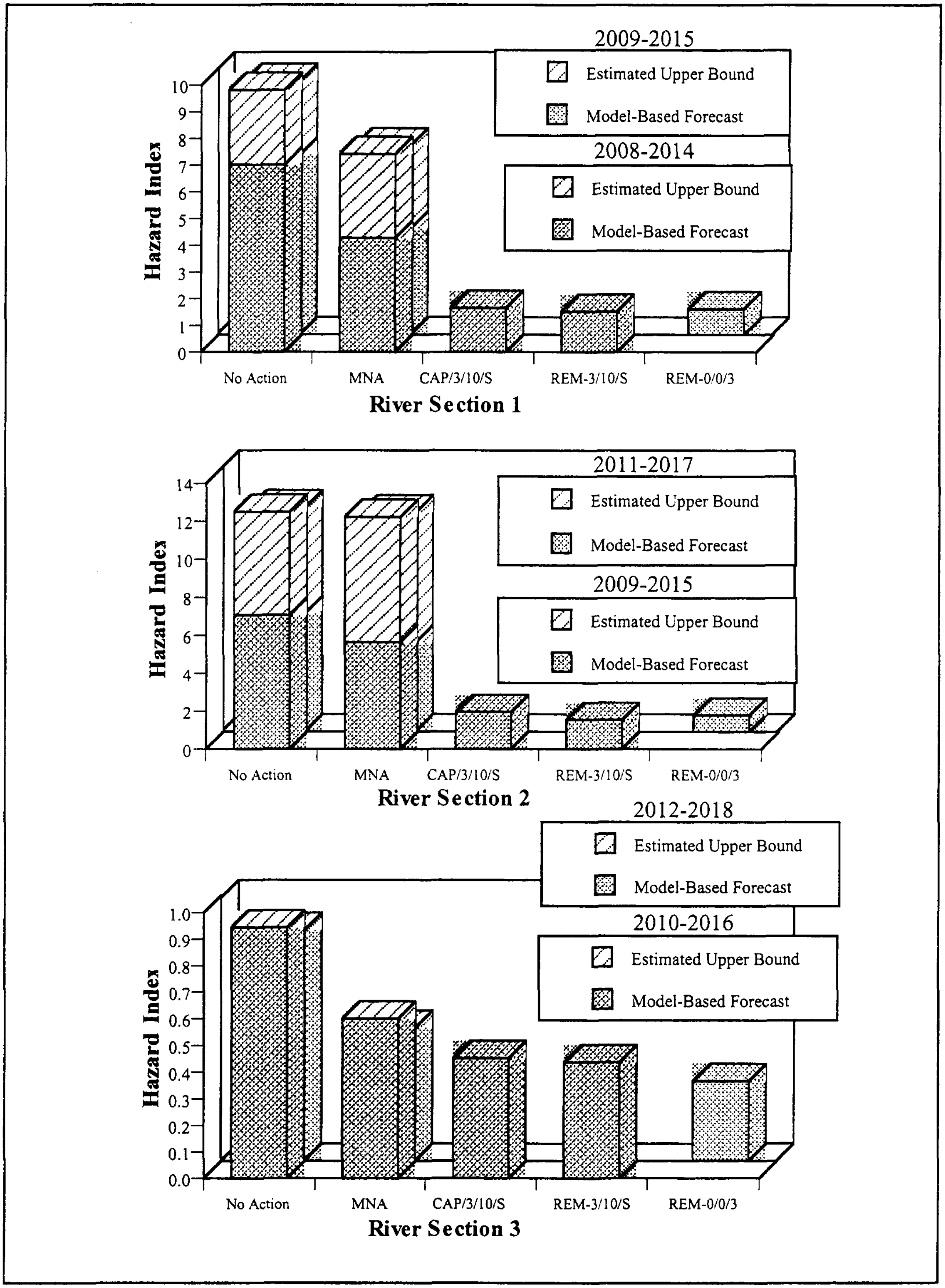

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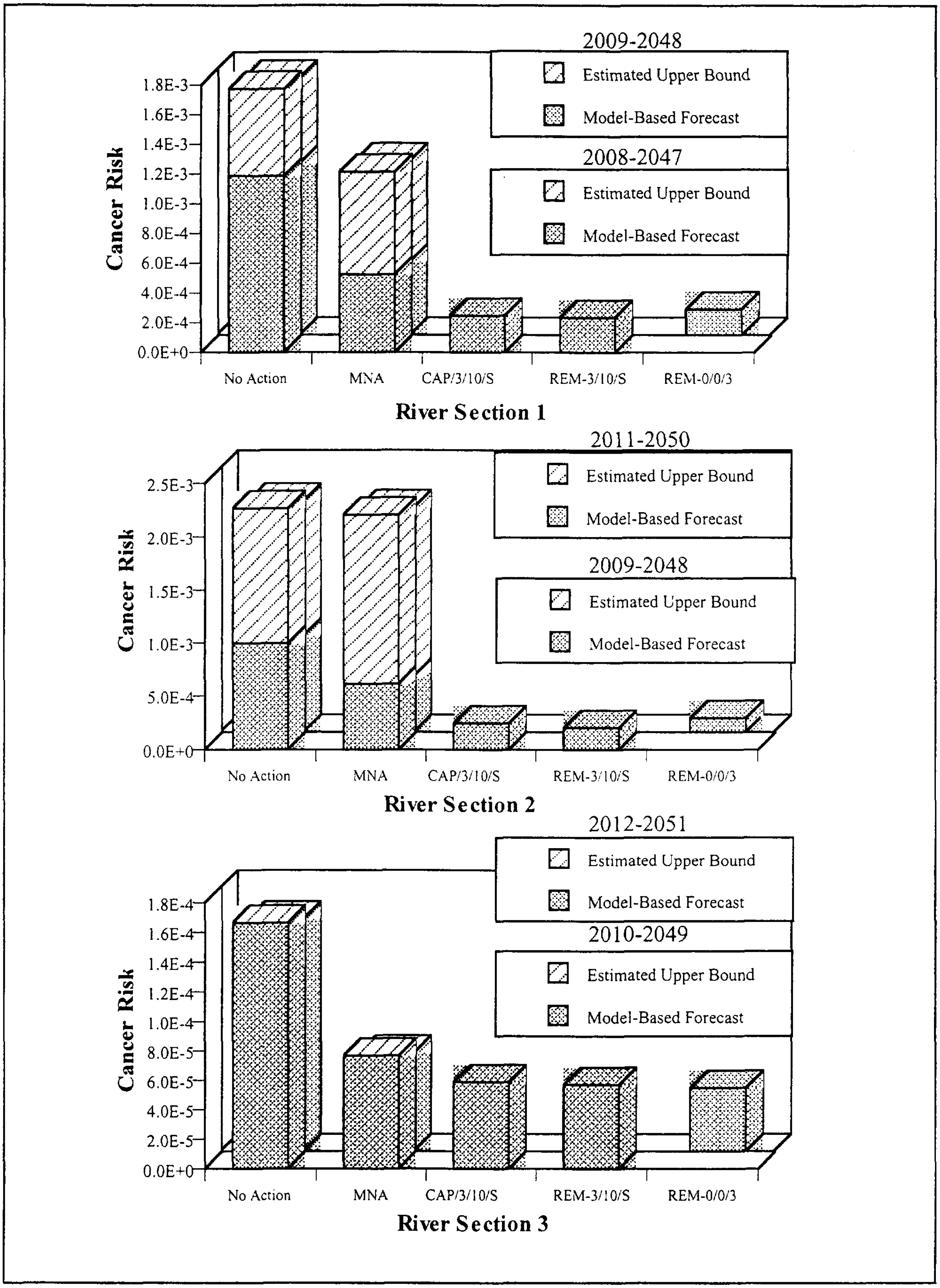

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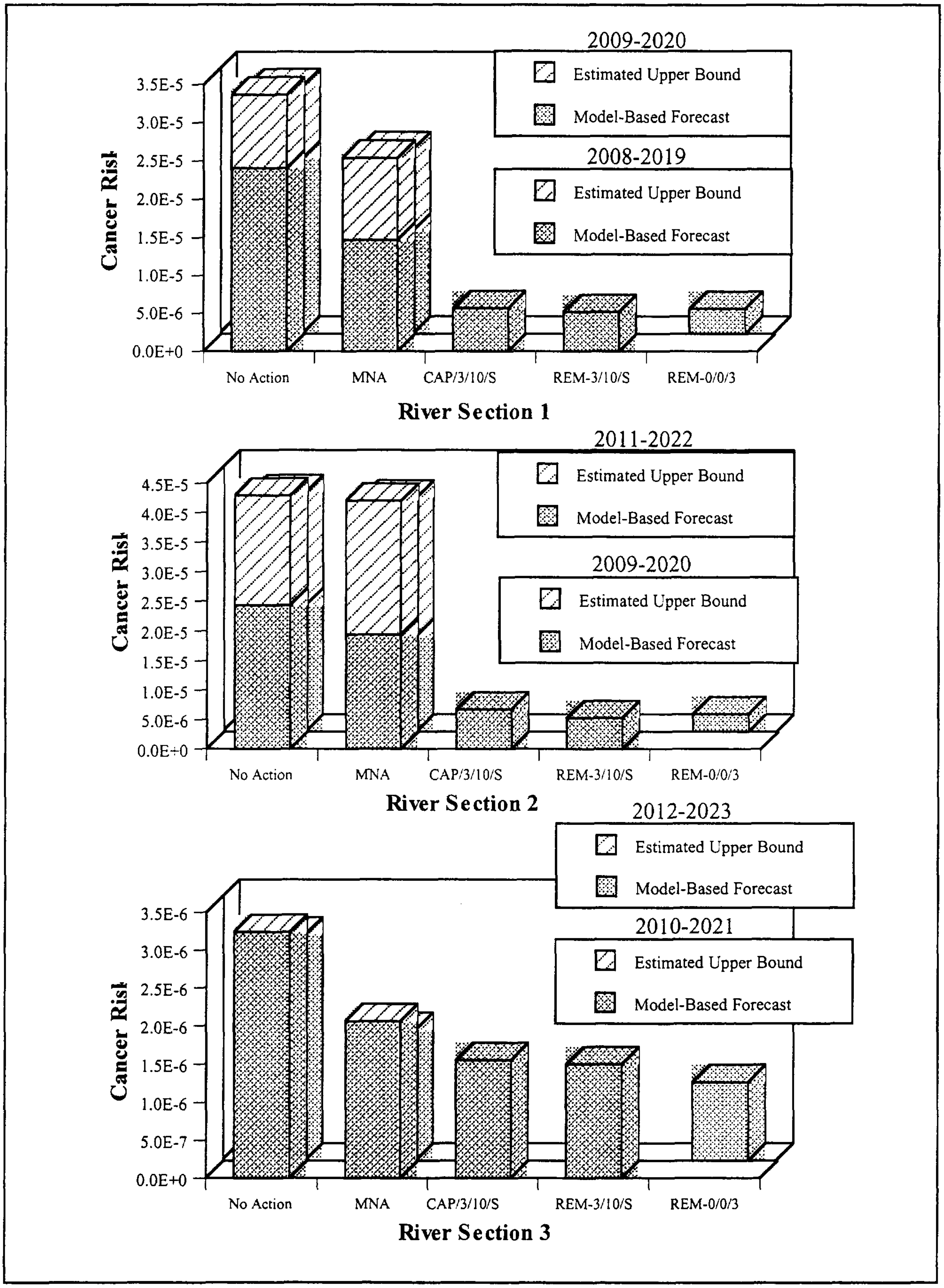

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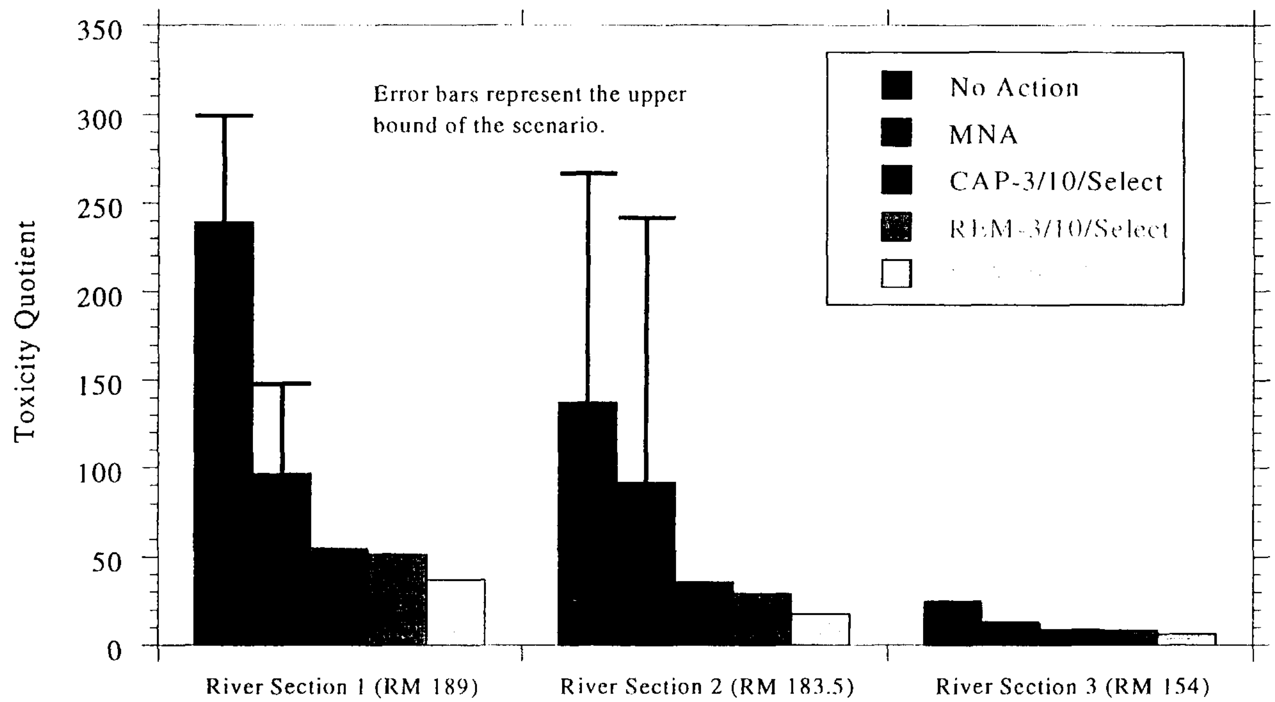

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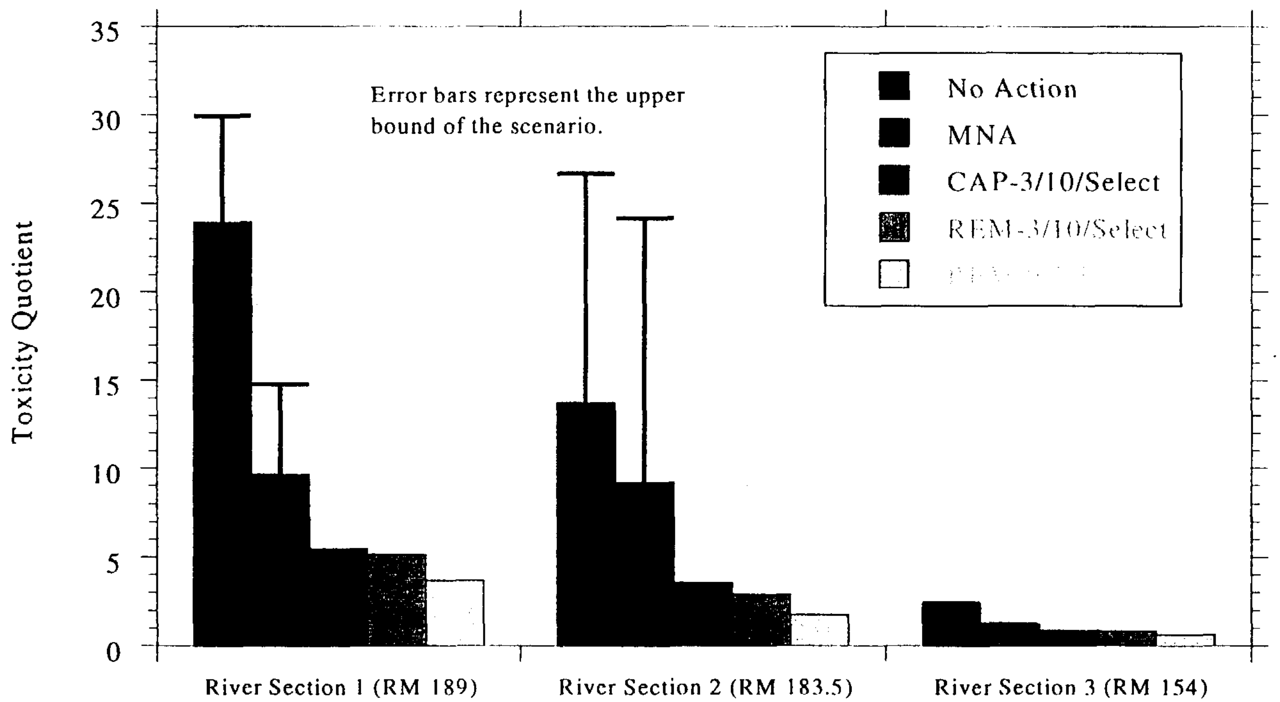

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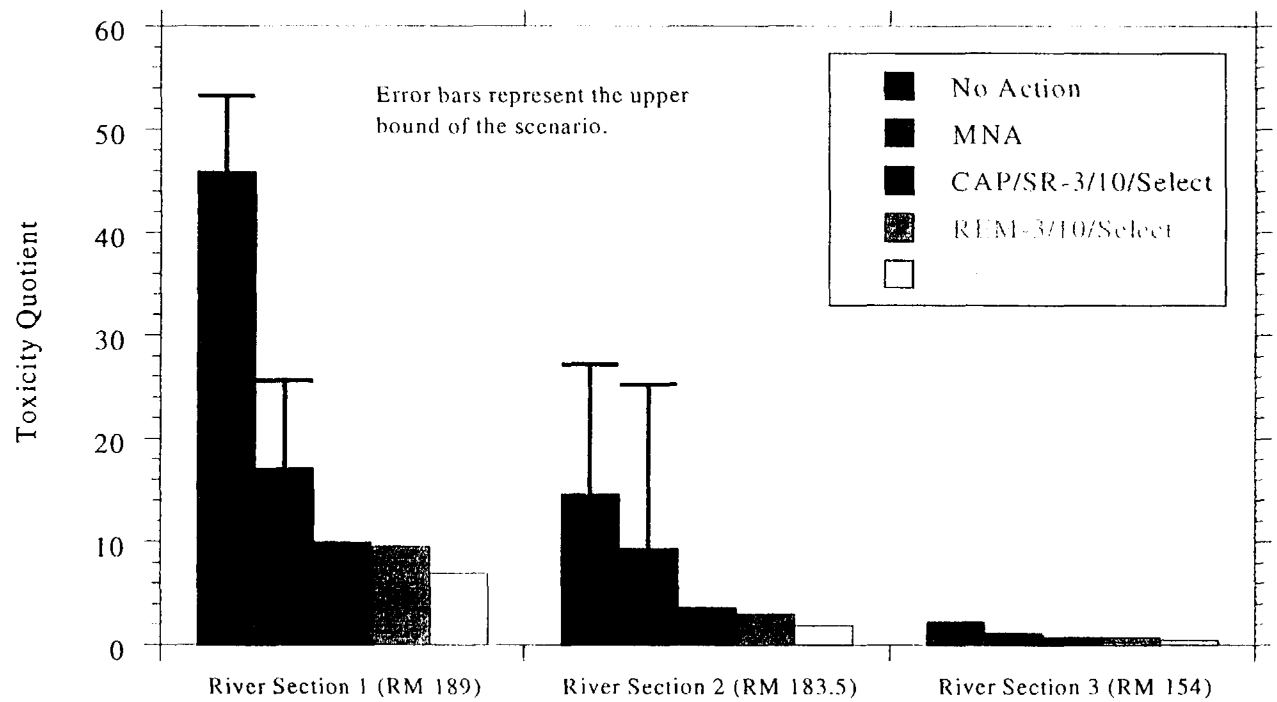

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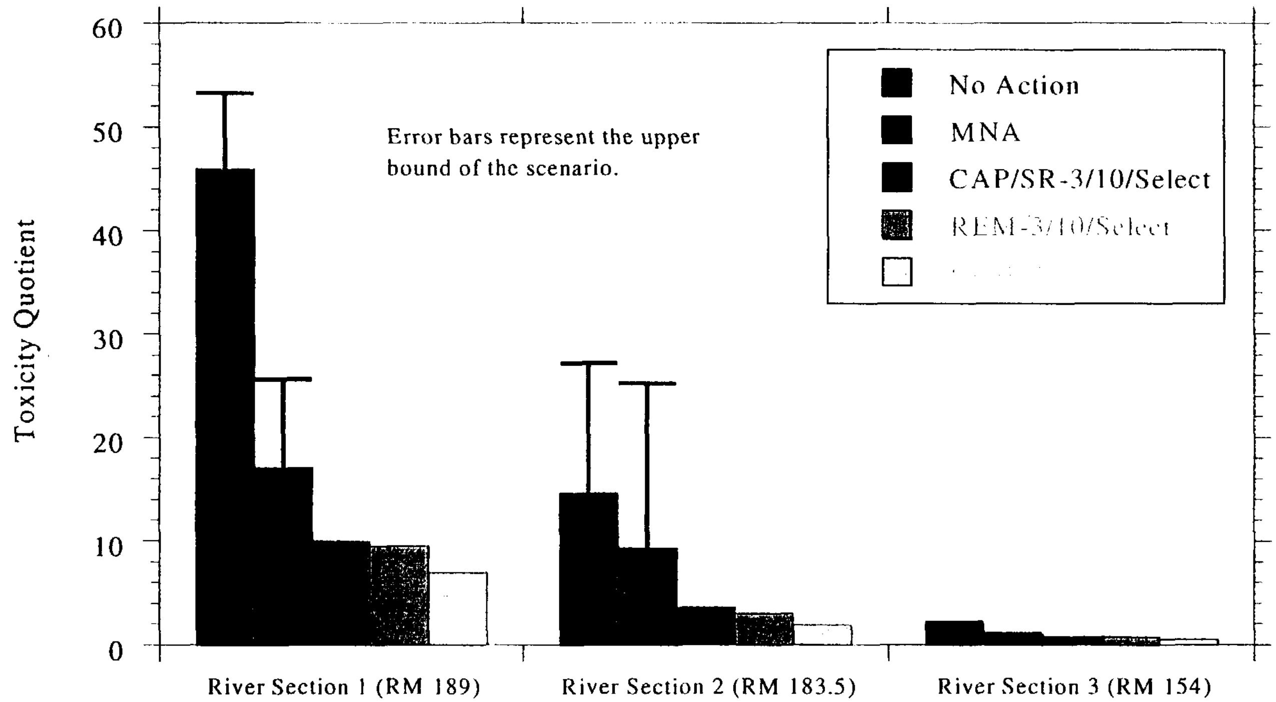

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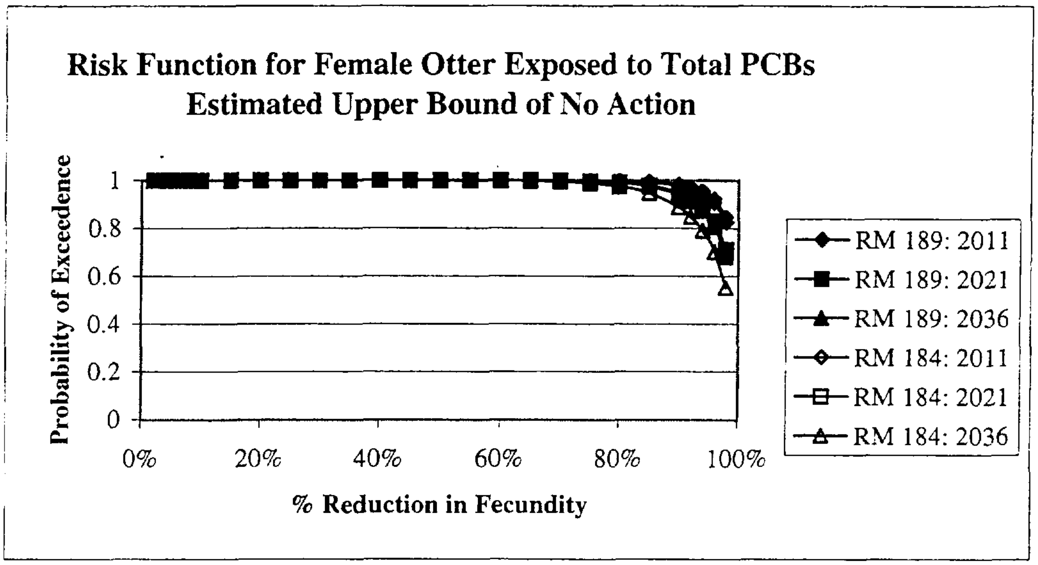

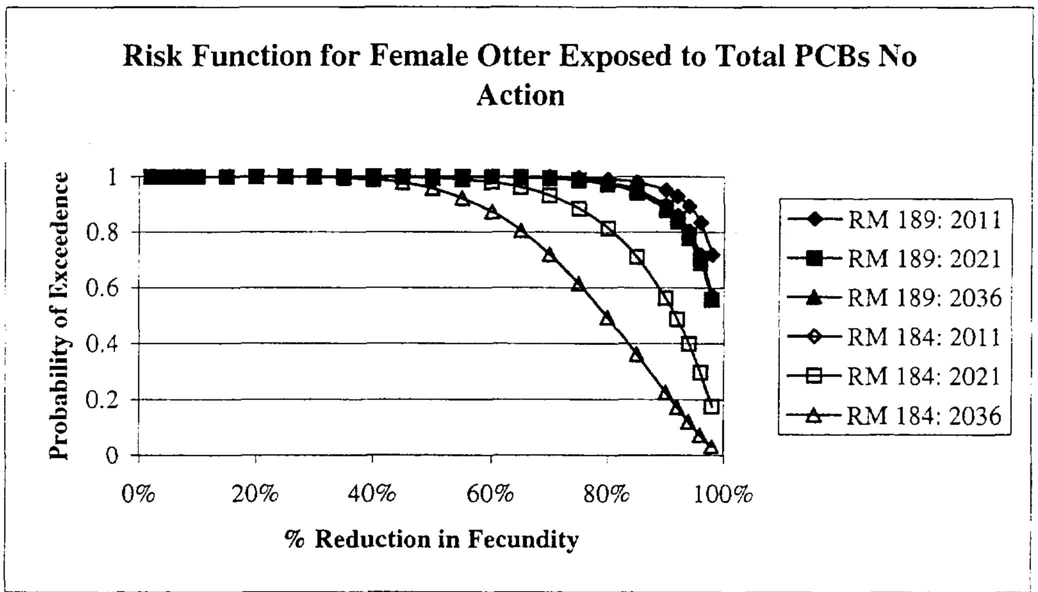

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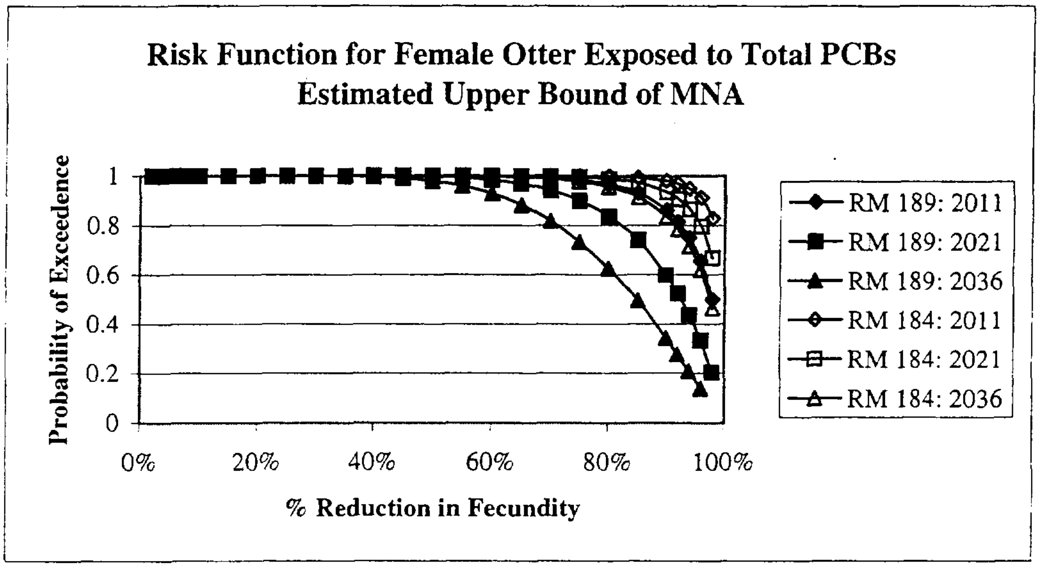

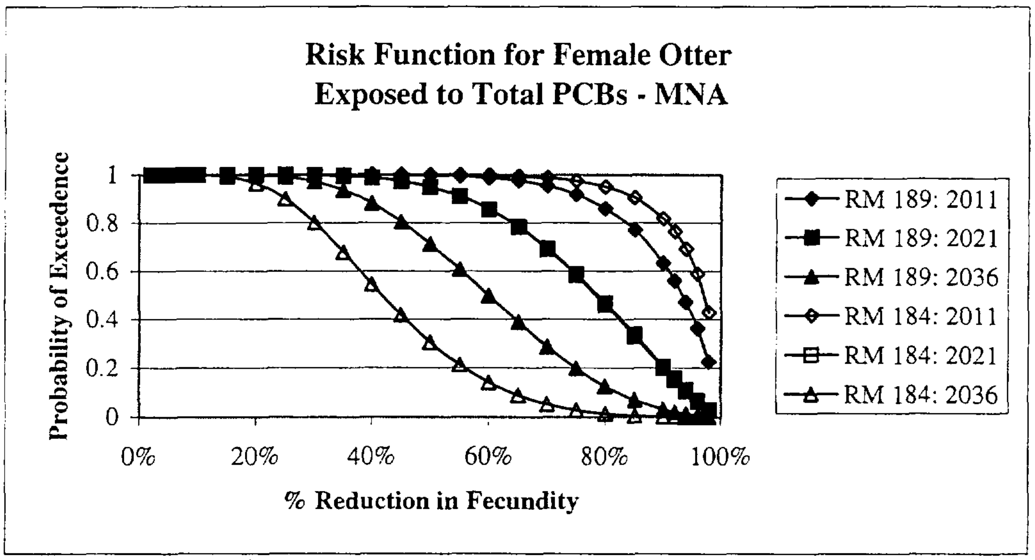

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