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MICHIGAN DEPARTMENT OF ENVIROMENTAL QUALITY
SURFACE WATER QUALITY DIVISION
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STAFF REPORT

REFERENCE SITE SEDIMENT CHEMISTRY REPORT FOR WADABLE STREAMS 1994, 1997, AND 1998

This report is intended to provide information concerning sediment chemistry background values by ecoregion and statewide. Additional reports will be published after a suitable amount of new data has been collected.

In 1990, the Great Lakes and Environmental Assessment Section biologists, through the use of biological surveys, began to focus on certain rivers and streams considered to be minimally impacted by human activities. The purpose of this effort is to define attainable biological and habitat conditions. This effort is part of a continuing nation wide process to establish baseline data and to characterize reference site conditions in wadable streams in Michigan's five ecoregions. For the purpose of this report, a reference site is defined as a site where the biological communities present have been generally categorized as excellent.

Michigan selects and evaluates waters to establish biological criteria for a given surface water type or category of designated use. Streams that were identified as supporting high quality biological communities were selected for follow-up sampling. Part of this process involves providing ambient water (Lundgren, 1994) and sediment quality data. This is achieved through the collection of water and sediment samples and subsequent analysis for a variety of chemical parameters in order to complement biological evaluation data for each ecoregional reference site.

Glaciation in Michigan created five distinct ecoregions based on soil types, land use, land-surface form, and potential natural vegetation (Omernik and Gallant, 1988). The 1994, 1997, and 1998 sediment sampling reference sites for this report were selected from all five Michigan ecoregions. For chemical mean values reporting purposes, the information obtained was then combined with the 1991 and 1993 data presented in reference site report MI/DNR/SWQ-94/055 (Jones, 1994).

SUMMARY

1. General locations of each ecoregion and the 1994, 1997, and 1998 reference sample sites are shown in Figures 1 and 2, respectively. Specific sediment sample locations, parameters sampled for, and sample results from 1994, 1997, and 1998 are listed in Appendix A. Chemicals not detected in sediments by ecoregion are also presented in Appendix A.

2. A total of 94 reference site sediment samples have been collected throughout the state from 1991 to 1998. Forty-three of these samples were collected in the Southern Michigan Northern Indiana Till Plains (SMNITP) ecoregion; 14 were collected in the Huron/Erie Lake Plain (HELP) ecoregion; 25 were collected in the Northern Lakes and Forests (NLF) ecoregion; 4 were collected in the Eastern Corn Belt Plains (ECBP) ecoregion, and 8 were collected in the North Central Hardwood Forests (NCHF) ecoregion.

3. Table 1 lists the ecoregional mean, standard deviation, and range of mean chemical and physical values for the sampling years of 1991, 1993, 1994, 1997, and 1998.

4. Table 2 presents a list of chemicals that were not detected in sediments from any of the 1994/1997/1998 reference sites sampled.

METHODS

As was done in 1991 and 1993, the 1994, 1997, and 1998 sediment samples were collected from wadable reference sites, in depositional areas upstream of road crossings. Fifty-seven sediment samples were collected for analysis. Composites of soft sediments were obtained using a petite ponar dredge or a small stainless steel trowel. All samples collected were placed in a stainless steel bowl, mixed thoroughly with a stainless steel spoon, and spooned into 250 ml. wide mouth glass jars using a stainless steel trowel. Samples were collected in 1994, 1997, and 1998 from areas that had been previously characterized as generally having excellent biological communities present.

All of the sediment samples from the reference sites were analyzed for metals, percent solids, low level PCBs, pesticides, semi-volatile organic compounds, Kjedahl nitrogen, and total phosphorus. Additionally, some of the samples were analyzed for cyanide, mercury, phenolics, and chemical oxygen demand (COD). All samples were stored at 4°C prior to being analyzed at the MDEQ Environmental Protection Bureau Laboratory.

Mean, standard deviation, and range values for sediment chemical concentrations and physical parameters based on 1991, 1993, 1994, 1997, and 1998 sampling events, were calculated for each Michigan ecoregion. Using this information, statewide ecoregional means, standard deviations, and ranges for the various parameters were also calculated. The same information (i.e., statewide ecoregional means, etc.) was developed for chemicals that, although not detected in every sample, were detected in at least one ecoregion. To compute statewide values for samples when chemicals were not detected in some cases, one-half of the laboratory level of quantification was used to compute mean and standard deviation values, which were then rounded to two significant digits.

REFERENCES

Lundgren, R. 1994. Reference Site Monitoring Report, 1992-1993. MDEQ, Surface Water Quality Division. Report No. MI/DNR/SWQ-94/048.

Jones, R. 1994. Reference Site Sediment Chemistry Report for Wadable Streams, 1991 and 1993. MDEQ, Surface Water Quality Division. Report No. MI/DNR/SWQ-94/055.

Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest States. U.S. Environmental Research Laboratory. Report No. EPA/600/3-88/037.

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Table 1. Sediment chemistry of reference site samples collected from the five Michigan ecoregions in 1991, 1993, 1994, 1997 and 1998.

Parameter	Units	Southern Michigan Northern Indiana Till Plains Number of Samples	Mean	Standard Deviation	Range
Aluminum	mg/kg	39	2600	1600	630 - 7700
Arsenic	mg/kg	43	5.5	3.9	1.0 - 17
Barium	mg/kg	40	40	27	7.0 - 110
Beryllium	mg/kg	40	0.14	0.08	K 0.2 - 0.40
Cadmium	mg/kg	43	1.05	0.30	K 2.0 - 3.0
Calcium	mg/kg	40	34,000	40,000	2800 - 210,000
Chromium	mg/kg	43	6.7	10	K 2.0 - 65
Cobalt	mg/kg	40	3.9	2.6	K 5.0 - 11
Copper	mg/kg	43	5.7	4.3	K 2.0 - 15
Cyanide	mg/kg	6	0.22	0.20	K 0.2 - 0.56
Iron	mg/kg	40	8100	5400	2100 - 30,000
Lead	mg/kg	43	11	10	K 5.0 - 50
Lithium	mg/kg	40	3.3	2.8	K 2.0 - 12
Magnesium	mg/kg	40	6300	4800	1300 - 23,000
Manganese	mg/kg	40	370	300	45 - 1300
Mercury	mg/kg	43	nd	--	--
Nickel	mg/kg	43	5.4	4.5	K 5.0 - 20
Potassium	mg/kg	40	280	280	48 - 1200
Selenium	mg/kg	43	0.31	0.15	K 0.5 - 0.92
Silver	mg/kg	30	0.14	0.05	K 0.25 - 0.3
Sodium	mg/kg	40	110	69	45 - 270
Strontium	mg/kg	30	35	31	6.0 - 140
Titanium	mg/kg	40	80	24	24 - 140
Vanadium	mg/kg	40	7.7	3.3	3.1 - 16
Zinc	mg/kg	43	34	28	6.4 - 170
Total Solids	% TS	43	50.4	13.8	23.0 - 81.9
Total Volatile Solids	% TVS	27	6.7	4.8	K 1.0 - 17.5
Kjeldahl Nitrogen	mg/kg	36	2300	1500	220 - 5200
Total Phosphorus	mg/kg	36	380	380	81 - 2200
COD	mg/kg	6	57,000	56,000	6200 - 140,000
Phenolics	mg/kg	6	2.7	1.8	0.83 - 5.0

Parameter	Units	Huron Erie Lake Plains Number of Samples	Mean	Standard Deviation	Range
Aluminum	mg/kg	12	2900	1400	1200 - 5400
Arsenic	mg/kg	12	4.8	3.6	1.7 - 15
Barium	mg/kg	12	29	19	5.0 - 80
Beryllium	mg/kg	14	0.14	0.08	K 0.2 - 0.33
Cadmium	mg/kg	14	nd	--	--
Calcium	mg/kg	12	27,000	24,000	8600 - 79,000
Chromium	mg/kg	14	6.0	2.4	2.0 - 11
Cobalt	mg/kg	12	4.0	3.1	K 5.0 - 11
Copper	mg/kg	14	5.3	3.1	K 2.0 - 11
Cyanide	mg/kg	1	nd	--	--
Iron	mg/kg	12	7300	3300	2500 - 14,000
Lead	mg/kg	14	8.2	7.2	K 5.0 - 23
Lithium	mg/kg	12	4.8	2.6	K 2.0 - 10
Magnesium	mg/kg	12	7800	5100	2700 - 21,000
Manganese	mg/kg	12	260	190	47 - 740
Mercury	mg/kg	14	nd	--	--
Nickel	mg/kg	14	6.4	5.9	K 5.0 - 21
Potassium	mg/kg	12	390	270	140 - 1000
Selenium	mg/kg	12	nd	--	--
Silver	mg/kg	11	nd	--	--
Sodium	mg/kg	12	170	150	60 - 630
Strontium	mg/kg	11	37	26	9.0 - 96
Titanium	mg/kg	12	84	16	58 - 110
Vanadium	mg/kg	12	9.3	3.3	4.0 - 15
Zinc	mg/kg	14	29	14	16 - 69
Total Solids	% TS	14	64.5	12.0	39.1 - 80.5
Total Volatile Solids	% TVS	8	4.2	4.1	1.0 - 13.1
Kjeldahl Nitrogen	mg/kg	12	1000	1100	K 240 - 4000
Total Phosphorus	mg/kg	12	240	130	130 - 560
COD	mg/kg	1	12,000	--	--
Phenolics	mg/kg	1	1.2	--	--

K = less than
nd = not detected

Table 1 (cont)

Northern Lakes and Forests

Parameter	Units	Number of Samples	Mean	Standard Deviation	Range
Aluminum	mg/kg	19	2100	1300	450 - 6300
Arsenic	mg/kg	24	3.6	4.5	0.6 - 22
Barium	mg/kg	19	29	25	7.0 - 120
Beryllium	mg/kg	19	0.12	0.05	K 0.2 - 0.30
Cadmium	mg/kg	23	nd	--	--
Calcium	mg/kg	19	16,000	17,000	1400 - 64,000
Chromium	mg/kg	25	5.7	3.6	K 2.0 - 15
Cobalt	mg/kg	19	3.5	2.0	K 5.0 - 8.0
Copper	mg/kg	25	5.8	5.2	K 2.0 - 25
Cyanide	mg/kg	9	0.25	0.26	K 0.2 - 0.92
Iron	mg/kg	19	6500	4400	1900 - 18,000
Lead	mg/kg	25	5.6	5.4	K 5.0 - 23
Lithium	mg/kg	19	2.3	2.1	K 2.0 - 9.4
Magnesium	mg/kg	19	4500	3600	530 - 13,000
Manganese	mg/kg	19	290	260	73 - 920
Mercury	mg/kg	24	0.07	0.05	K 0.05 - 0.06
Nickel	mg/kg	25	4.0	2.9	K 5.0 - 12
Potassium	mg/kg	19	270	270	48 - 1200
Selenium	mg/kg	23	0.36	0.28	K 0.5 - 1.3
Silver	mg/kg	10	nd	--	--
Sodium	mg/kg	19	82	28	35 - 140
Strontium	mg/kg	10	27	27	7.0 - 92
Titanium	mg/kg	19	90	34	44 - 170
Vanadium	mg/kg	19	8.3	3.7	2.8 - 16
Zinc	mg/kg	25	19	11	6.5 - 51
Total Solids	% TS	25	46	18	5.8 - 73.0
Total Volatile Solids	% TVS	24	9.4	9.7	1.0 - 43.3
Kjeldahl Nitrogen	mg/kg	15	3300	3400	350 - 12,000
Total Phosphorus	mg/kg	15	340	260	110 - 1000
COD	mg/kg	7	89,000	70,000	12,000 - 200,000
Phenolics	mg/kg	5	1.1	0.58	K 0.8 - 1.9

Eastern Corn Belt Plains

Parameter	Units	Number of Samples	Mean	Standard Deviation	Range
Aluminum	mg/kg	3	2100	450	1700 - 2600
Arsenic	mg/kg	4	4.7	3.3	2.0 - 9.4
Barium	mg/kg	3	24	14	13 - 40
Beryllium	mg/kg	3	nd	--	--
Cadmium	mg/kg	4	nd	--	--
Calcium	mg/kg	4	30,000	10,000	2,1000 - 40,000
Chromium	mg/kg	4	6.5	1.4	4.7 - 8.0
Cobalt	mg/kg	4	3.9	1.6	K 5.0 - 5.5
Copper	mg/kg	4	6.7	2.9	4.5 - 11
Cyanide	mg/kg	2	nd	--	--
Iron	mg/kg	4	9200	5100	4600 - 17,000
Lead	mg/kg	4	5.1	5.3	K 5.0 - 13
Lithium	mg/kg	4	3.5	1.2	2.5 - 5.0
Magnesium	mg/kg	4	7800	1900	6200 - 10,000
Manganese	mg/kg	4	470	490	130 - 1200
Mercury	mg/kg	4	nd	--	--
Nickel	mg/kg	4	6.7	3.0	K 5.0 - 9.5
Potassium	mg/kg	4	260	120	150 - 430
Selenium	mg/kg	4	nd	--	--
Silver	mg/kg	1	nd	--	--
Sodium	mg/kg	4	93	27	65 - 120
Strontium	mg/kg	1	45	--	--
Titanium	mg/kg	3	81	34	56 - 120
Vanadium	mg/kg	3	8.0	1.0	7.0 - 9.0
Zinc	mg/kg	4	31	15	17 - 52
Total Solids	% TS	4	67.1	14.1	47.0 - 78.6
Total Volatile Solids	% TVS	3	3.8	4.0	1.0 - 8.4
Kjeldahl Nitrogen	mg/kg	3	460	89	390 - 560
Total Phosphorus	mg/kg	3	270	64	200 - 320
COD	mg/kg	2	19,000	11,000	11,000 - 27,000
Phenolics	mg/kg	2	1.1	0.37	0.8 - 1.32

Table 1 (cont).

Parameter	Units	North Central Hardwod Forests Number of Samples	Mean	Standard Deviation	Range	Statewide Values - All Ecoregions Number of Samples	Mean	Standard Deviation	Range
Aluminum	mg/kg	8	860	940	270 - 3100	81	2300	1500	270 - 7700
Arsenic	mg/kg	8	1.4	1.0	K 0.5 - 3.3	91	4.5	4.0	K 0.5 - 22
Barium	mg/kg	8	10.3	10.3	4.0 - 35	82	32	25	4.0 - 120
Beryllium	mg/kg	8	nd	--	--	84	0.13	0.07	K 0.2 - 0.33
Cadmium	mg/kg	8	nd	--	--	92	1.0	0.21	K 2.0 - 3.0
Calcium	mg/kg	8	7600	7900	1100 - 24,000	83	26,000	31,000	1100 - 210,000
Chromium	mg/kg	8	2.6	3.1	K 2.0 - 10	94	6.1	7.2	K 2.0 - 65
Cobalt	mg/kg	8	nd	--	--	83	3.7	2.4	K 5.0 - 11
Copper	mg/kg	8	2.8	4.2	K 2.0 - 13	94	5.4	4.3	K 2.0 - 25
Cyanide	mg/kg	7	nd	--	--	25	0.18	0.19	K 0.2 - 0.92
Iron	mg/kg	8	2800	2800	690 - 9300	83	7100	4900	690 - 30,000
Lead	mg/kg	8	4.9	6.9	K 5.0 - 22	94	8.4	8.6	K 5.0 - 50
Lithium	mg/kg	8	1.2	0.53	K 2.0 - 2.5	83	3.1	2.6	K 2.0 - 12
Magnesium	mg/kg	8	1900	1600	190 - 4700	83	5800	4500	190 - 23,000
Manganese	mg/kg	8	93	83	8.0 - 250	83	310	280	8.0 - 1300
Mercury	mg/kg	8	nd	--	--	93	0.05	0.04	K 0.05 - 1.3
Nickel	mg/kg	8	2.9	1.2	2.5 - 6.0	94	5.0	4.2	K 5.0 - 21
Potassium	mg/kg	8	95	105	38 - 350	83	270	260	38 - 1200
Selenium	mg/kg	8	0.47	0.62	K 0.5 - 2.0	90	0.33	0.25	K 0.5 - 2.0
Silver	mg/kg	1	nd	--	--	53	0.13	0.04	K 0.25 - 0.30
Sodium	mg/kg	8	64	18	45 - 100	83	110	80	35 - 630
Strontium	mg/kg	1	nd	--	--	53	34	29	6.0 - 140
Titanium	mg/kg	8	58	23	31 - 93	82	81	27	24 - 170
Vanadium	mg/kg	8	3.9	2.1	1.4 - 8.0	82	7.7	3.5	1.4 - 16
Zinc	mg/kg	8	13	21	K 5.0 - 64	94	27	23	K 5.0 - 170
Total Solids	% TS	8	58	20	15.0 - 75.0	94	52.7	16.6	5.8 - 81.9
Total Volatile Solids	% TVS	8	8.3	16	K 1.0 - 47.5	70	7.4	8.5	K 1.0 - 47.5
Kjeldahl Nitrogen	mg/kg	8	2200	4200	165 - 13,000	74	2200	2400	165 - 13,000
Total Phosphorus	mg/kg	8	160	230	44 - 730	74	320	300	44 - 2200
COD	mg/kg	7	24,000	25,000	4800 - 61,000	23	51,000	55,000	4800 - 200,000
Phenolics	mg/kg	7	1.6	0.89	0.62 - 3.1	21	1.7	1.2	0.62 - 5.0

Table 2. Chemicals not detected in sediment samples collected from all five ecoregions 1994, 1997 and 1998.

Parameter	No. of Samples	Detection Limits	Units
Molybdenum	57	5.0	mg/kg
Thallium	53	1.0	mg/kg
1,3-Dichlorobenzene	4	220-360	ug/kg
1,4-Dichlorobenzene	4	220-360	ug/kg
1,2-Dichlorobenzene	4	220-360	ug/kg
Hexachloroethane	55	22-290	ug/kg
1,2,4-Trichlorobenzene	55	220-2900	ug/kg
Hexachlorobutadiene	55	22-290	ug/kg
2-Chloronapthalene	55	670-8800	ug/kg
Hexachlorobenzene	55	22-290	ug/kg
g-BHC (lindane)	55	22-290	ug/kg
Pentachloronitrobenzene	55	22-290	ug/kg
Heptachlor	55	22-290	ug/kg
Aldrin	55	22-290	ug/kg
Heptachlor epoxide	55	22-290	ug/kg
g-Chlordane	55	22-290	ug/kg
a-Chlordane	55	22-290	ug/kg
4,4'-DDD	55	22-290	ug/kg
4,4'-DDT	55	22-290	ug/kg
Hexabromobenzene	55	45-590	ug/kg
Mirex	55	22-290	ug/kg
Aroclor 1242 (PCB)	55	30-360	ug/kg
*Aroclor 1016 (PCB)	55	30-360	ug/kg
*Aroclor 1221 (PCB)	55	30-360	ug/kg
*Aroclor 1232 (PCB)	55	30-360	ug/kg
*Aroclor 1248 (PCB)	55	30-360	ug/kg
*Aroclor 1262 (PCB)	55	30-360	ug/kg
*Aroclor 1268 (PCB)	55	30-360	ug/kg
BP-6 (PBB)	55	110-1500	ug/kg
*Toxaphene	55	220-2900	ug/kg

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
* = results and detection limits reported semi-quantitatively
Note: all values are on a dry weight basis unless otherwise noted

Figure 1. Ecoregions of Michigan (Omernik 1988).

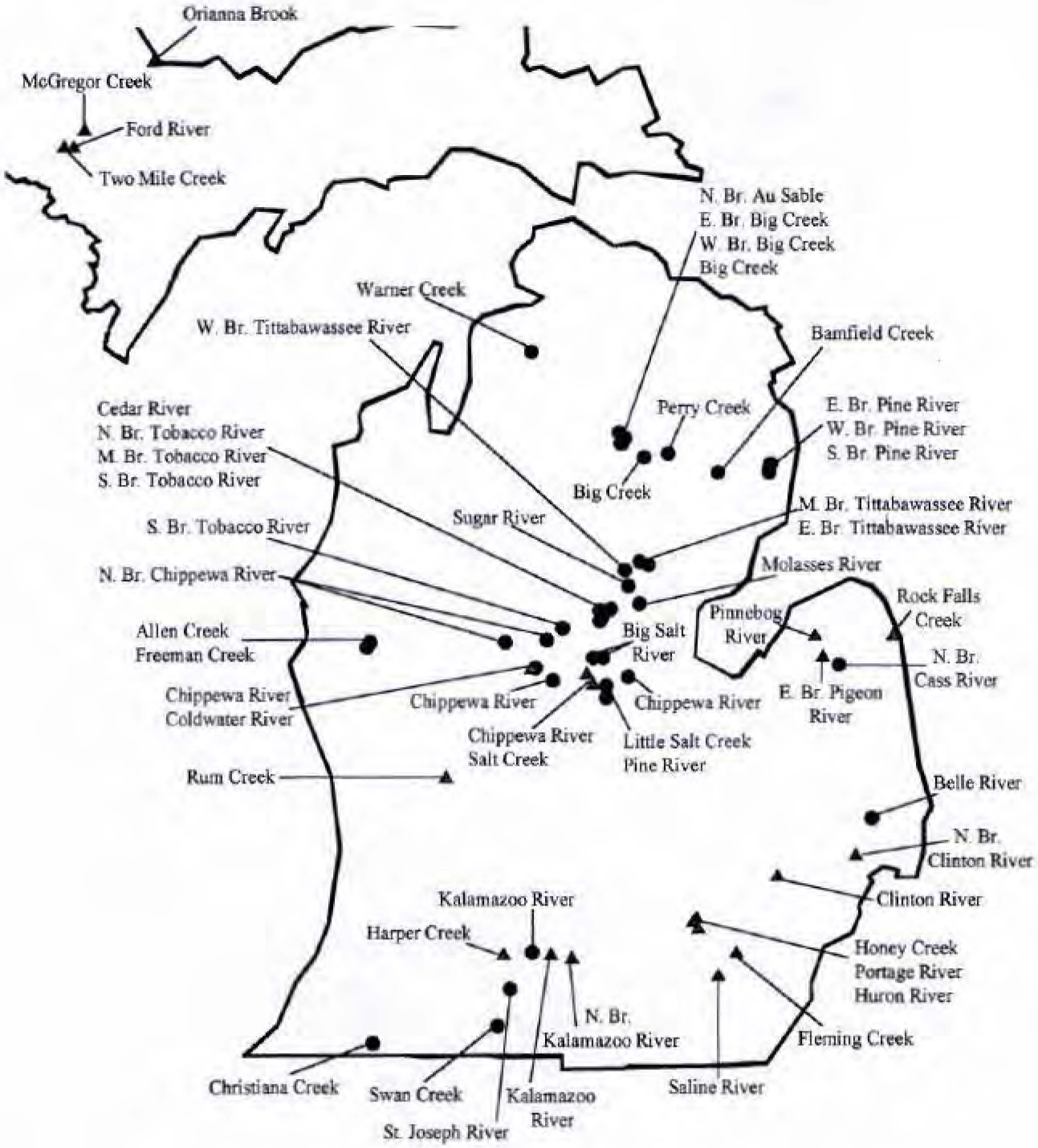

Figure 2. Michigan Sediment Reference Sites Samples in 1994, 1997 and 1998. The triangles represent sites sampled in 1994 and 1997. The circles represent sites sampled in 1998.

Appendix A

Table 1A. Sediment chemistry of the Southern Michigan Northern Indiana Till Plains ecoregion reference site samples.

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)
Swan Creek Horkey Road, Branch County	11/98	1800	8.3	48	K 0.2	K 2.0	62500	4.0	6.5	4.5
Harper Creek B Drive N., Calhoun County * Parentheses indicate duplicate analysis results	2/97	2700 (2500)	17 (16)	65 (63)	K 0.2 (K 0.2)	K 2.0 (K 2.0)	21900 (18900)	6.0 (5.0)	K 5.0 (K 5.0)	4.9 (4.5)
Kalamazoo River B Drive N., Calhoun County	2/97	2740	9.4	61	0.24	K 2.0	75000	65	K 5.0	13
Kalamazoo River d/s from Marshall WWTP, Calhoun Co.	11/98	2050	4.5	47	K 0.2	K 2.0	31400	25	6.4	15
N. Br. Kalamazoo River 29 1/2 Mile Road, Calhoun County	2/97	1450	3.3	17	K 0.2	K 2.0	34100	3.0	K 5.0	3.0
St. Joseph River 9 Mile Road, Calhoun County	11/98	3170	11	63	K 0.2	K 2.0	30500	8.0	7.0	7.5
Christiana Creek North Shore Drive, Cass County	11/98	630	17	108	K 0.2	K 2.0	213000	K 2.0	11	4.0
S. Branch Tobacco River Grant Avenue, Clare County	12/98	2500	9.3	49	K 0.2	K 2.0	29700	6.0	5.0	7.5
Cedar River Campbell Road, Gladwin County	12/98	2100	5.3	27	K 0.2	K 2.0	28700	4.0	K 5.0	3.5
M. Branch Tobacco River McCullegh Road, Gladwin County	12/98	7650	9.9	83	0.4	K 2.0	75000	14	11	13
N. Branch Tobacco River Grout Road, Gladwin County	12/98	3060	5.7	39	K 0.2	K 2.0	31700	10	5.0	5.0
S. Branch Tobacco River Grout (Townhall) Road, Gladwin County	12/98	5870	10	64	0.33	K 2.0	46600	12	9.0	15
Sugar River M-30 (Meridian Road), Gladwin County	12/98	6150	7.3	76	0.35	K 2.0	73500	11	11	11
Chippewa River Coldwater Road, Isabella County	3/97	1260	1.1	9.0	K 0.2	K 2.0	7800	2.8	K 5.0	K 2.0

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
--- = not sampled for
K = less than
DL = sample was diluted
[1] = value less than detection limits
[2] = actual value may be lower
Note: all values are on a dry weight basis unless otherwise noted

Table 1A (cont).

Waterbody	Iron (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)
Swan Creek Horkey Road, Branch County	8250	13	2.5	10500	735	8.0	150	K 0.5	0.25	110
Harper Creek B Drive N., Calhoun County * Parentheses indicate duplicate analysis results	15100 (14500)	K 5.0 (K 5.0)	3.0 (3.0)	4000 (3500)	340 (310)	K 5.0 (K 5.0)	145 (127)	K 0.5 (K 0.5)	K 0.25 (K 0.25)	130 (120)
Kalamazoo River B Drive N., Calhoun County	14800	33	3.0	4300	802	6.4	182	0.92	K 0.25	130
Kalamazoo River d/s from Marshall WWTP, Calhoun Co.	9160	50	2.5	4600	310	12	155	K 0.5	0.3	110
N. Br. Kalamazoo River 29 1/2 Mile Road, Calhoun County	5150	K 5.0	K 2.0	3400	170	K 5.0	101	K 0.5	K 0.25	110
St. Joseph River 9 Mile Road, Calhoun County	17500	18	3.5	6250	745	9.5	185	0.53	K 0.25	110
Christiana Creek North Shore Drive, Cass County	8000	21	K 2.0	6650	555	11	50.5	K 0.5	K 0.25	130
S. Branch Tobacco River Grant Avenue, Clare County	8900	17	3.5	9850	310	7.0	300	0.55	K 0.25	140
Cedar River Campbell Road, Gladwin County	5050	13	3.0	8850	420	K 5.0	270	K 0.5	K 0.25	100
M. Branch Tobacco River McCullegh Road, Gladwin County	16900	25	12	19300	835	19	1190	0.77	K 0.25	170
N. Branch Tobacco River Grout Road, Gladwin County	8150	26	5.0	11900	410	7.5	410	K 0.5	K 0.25	110
S. Branch Tobacco River Grout (Townhall) Road, Gladwin County	14100	21	9.0	17600	1100	15	905	K 0.5	0.3	150
Sugar River M-30 (Meridian Road), Gladwin County	12300	21	12	23000	300	20	1200	K 0.5	K 0.25	150
Chippewa River Coldwater Road, Isabella County	3300	K 5.0	K 2.0	3100	45	K 5.0	99.5	K 0.5	K 0.25	80

Table 1A (cont).

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)
Chippewa River Chippewa Rd., Isabella County	3/97	2330	3.1	26	K 0.2	K 2.0	22700	5.0	K 5.0	4.5
Chippewa River Meridian Road, Isabella County	12/98	1600	3.1	20	K 0.2	K 2.0	26500	4.0	K 5.0	3.0
N. Branch Chippewa River Stevenson Lake Road, Isabella County	12/98	2270	5.8	63	K 0.2	K 2.0	9850	5.0	K 5.0	3.0
Coldwater River Baseline Road, Isabella County	12/98	1300	2.5	32	K 0.2	K 2.0	51000	3.0	K 5.0	3.5
Rum Creek 10 Mile Rd. W., Kent County	3/97	1500	1.7	13	K 0.2	K 2.0	6100	4.7	K 5.0	5.0
Honey Creek Darwin Rd., Livingston County	2/97	2000	8.7	26	K 0.2	K 2.0	18900	5.0	K 5.0	3.5
Portage River Toma Rd., Livingston County	2/97	1150	1.3	10	K 0.2	K 2.0	12700	3.0	K 5.0	K 2.0
N. Br. Clinton River N 28 Mile Rd., Macomb County	2/97	5120	7.2	50	0.27	K 2.0	58000	10	K 5.0	13
N. Branch Chippewa River M-66 (30th Avenue), Mecosta County	12/98	1760	2.4	20	K 0.2	K 2.0	5350	4.0	K 5.0	K 2.0
Allen Creek Dickenson Road, Newaygo County	12/98	2780	1.2	27	K 0.2	K 2.0	2750	5.0	K 5.0	3.5
Freeman Creek Maple Island Avenue, Newaygo County	12/98	3100	2.4	33	K 0.2	K 2.0	9750	6.0	K 5.0	7.0
Clinton River Elizabeth Lake Rd., Oakland County	2/97	1570	4.4	17	K 0.2	K 2.0	26400	4.0	K 5.0	4.5
N. Branch Cass River Germania Road, Sanilac County	12/98	3700	10	45	0.2	3.0	18100	7.0	5.0	6.0
Belle River Braidwood Road, St. Clair County	12/98	3830	5.4	34	0.22	K 2.0	13700	7.0	5.0	6.0
Huron River N. Territorial Rd., Washtenaw County	2/97	3100	6.3	109	K 0.2	K 2.0	141000	7.0	K 5.0	13
Fleming Creek Geddes Road, Washtenaw County	2/97	3930	5.3	77	0.23	K 2.0	38900	7.0	K 5.0	13

Table 1A (cont).

Waterbody	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Total Solids (%TS)	Total Volatile Solids (%TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)	Aroclor 1254 (PCB) (ug/kg)	Aroclor 1260 (PCB) (ug/kg)	4,4'-DDE (ug/kg)
Swan Creek Horkey Road, Branch County	56	125	8.0	29	69.6	2.2	680	230	39	39	78
Harper Creek B Drive N., Calhoun County * Parentheses indicate duplicate analysis results	16 (15)	71 (65)	9.0 (8.0)	37 (35)	34.1 (30.5)	---	4300 (5300)	610 (1600)	K 73 (K 90)	K 73 (K 90)	K 150 (K 180)
Kalamazoo River B Drive N., Calhoun County	37	65	8.0	170	33.4	---	4700	670	K 73	K 73	K 150
Kalamazoo River d/s from Marshall WWTP, Calhoun Co.	21	70	7.5	99	37.6	10.2	860	280	K 40	K 40	K 81
N. Br. Kalamazoo River 29 1/2 Mile Road, Calhoun County	20	71	5.0	21	53.3	---	2100	240	K 43	K 43	K 85
St. Joseph River 9 Mile Road, Calhoun County	26	77	10	49	64.2	3.0	3000	480	K 58	K 58	K 120
Christiana Creek North Shore Drive, Cass County	138	24	4.0	21	50.1	3.7	1280	81	K 52	K 52	K 100
S. Branch Tobacco River Grant Avenue, Clare County	28	85	9.0	25	32.4	17.5	4700	440	K 76	K 76	K 150
Cedar River Campbell Road, Gladwin County	23	82	6.0	25	60.4	2.4	1980	330	K 39	K 39	K 78
M. Branch Tobacco River McCullegh Road, Gladwin County	58	108	16	65	33.4	13.1	3900	590	K 78	K 78	K 160
N. Branch Tobacco River Grout Road, Gladwin County	27	81	8.0	40	51.7	6.3	1970	330	K 46	K 46	K 93
S. Branch Tobacco River Grout (Townhall) Road, Gladwin County	60	94	14	48	41.8	8.4	2700	620	K 62	K 62	K 120
Sugar River M-30 (Meridian Road), Gladwin County	52	137	15	45	81.9	1.5	K 240	210	K 31	K 31	K 62
Chippewa River Coldwater Road, Isabella County	8.0	83	4.8	12	50.5	---	910	130	81	K 100	K 100

Table 1A (cont).

Waterbody	Iron (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Sodium (mg/kg)
Chippewa River Chippewa Rd., Isabella County	6150	5.5	3.5	7250	390	K 5.0	370	K 0.5	K 0.25	150
Chippewa River Meridian Road, Isabella County	4500	11	2.5	6750	250	K 5.0	171	K 0.5	K 0.25	95
N. Branch Chippewa River Stevenson Lake Road, Isabella County	6100	10	2.5	2900	1300	K 5.0	155	K 0.5	K 0.25	90
Coldwater River Baseline Road, Isabella County	3800	13	K 2.0	4100	170	K 5.0	101	K 0.5	K 0.25	100
Rum Creek 10 Mile Rd. W., Kent County	3500	K 5.0	K 2.0	2500	57	K 5.0	103	K 0.5	K 0.25	65
Honey Creek Darwin Rd., Livingston County	10900	K 5.0	2.5	5000	390	K 5.0	120	K 0.5	K 0.25	110
Portage River Toma Rd., Livingston County	2600	K 5.0	K 2.0	4700	58	K 5.0	87	K 0.5	K 0.25	75
N. Br. Clinton River N 28 Mile Rd., Macomb County	13200	12	6.9	10900	400	6.4	600	K 0.5	K 0.25	270
N. Branch Chippewa River M-66 (30th Avenue), Mecosta County	3600	K 5.0	K 2.0	2300	130	K 5.0	136	K 0.5	K 0.25	60
Allen Creek Dickenson Road, Newaygo County	4500	K 5.0	4.0	2100	72	K 5.0	290	K 0.5	K 0.25	60
Freeman Creek Maple Island Avenue, Newaygo County	6650	10	4.5	5150	586	K 5.0	330	K 0.5	K 0.25	80
Clinton River Elizabeth Lake Rd., Oakland County	4000	15	K 2.0	5300	130	K 5.0	104	K 0.5	K 0.25	95
N. Branch Cass River Germania Road, Sanilac County	7800	15	6.5	4900	210	8.5	430	K 0.5	K 0.25	90
Belle River Braidwood Road, St. Clair County	8600	11	6.0	5400	210	9.0	430	K 0.5	K 0.25	130
Huron River N. Territorial Rd., Washtenaw County	11300	30	3.5	9150	609	6.4	400	K 0.5	K 0.25	220
Fleming Creek Geddes Road, Washtenaw County	13100	6.9	4.9	5400	460	6.4	440	K 0.5	K 0.25	430

Table 1A (cont).

Waterbody	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Total Solids (%TS)	Total Volatile Solids (%TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)	Aroclor 1254 (PCB) (ug/kg)	Aroclor 1260 (PCB) (ug/kg)	4,4'-DDE (ug/kg)
Chippewa River Chippewa Rd., Isabella County	21	105	7.0	25	57.4	—	1200	330	K 48	K 48	K 96
Chippewa River Meridian Road, Isabella County	26	78	6.0	27	46.6	5.4	1840	220	K 53	K 53	K 110
N. Branch Chippewa River Stevenson Lake Road, Isabella County	12	85	6.0	37	35.3	13.9	4100	500	K 86	K 86	K 170
Coldwater River Baseline Road, Isabella County	72	72	5	29	47.6	4.9	1820	198	K 49	K 49	K 98
Rum Creek 10 Mile Rd. W., Kent County	8.0	134	5.8	11	50.6	—	2200	230	K 50	K 50	K 100
Honey Creek Darwin Rd., Livingston County	15	100	7.0	23	38.0	—	2600	430	K 40	K 40	K 80
Portage River Toma Rd., Livingston County	10	110	5.0	11	70.1	—	340 DL	130	K 35	K 35	K 70
N. Br. Clinton River N 28 Mile Rd., Macomb County	50	71	14	60	41.9	—	2500	770	K 45	K 45	K 90
N. Branch Chippewa River M-66 (30th Avenue), Mecosta County	8.0	90	5.0	33	49.5	6.1	2100	230	K 48	K 48	K 96
Allen Creek Dickenson Road, Newaygo County	6.0	94	8.0	35	46.1	7.2	2500	320	K 68	K 68	K 140
Freeman Creek Maple Island Avenue, Newaygo County	11	72	10	45	34.7	13.3	4200	490	K 61	K 61	K 120
Clinton River Elizabeth Lake Rd., Oakland County	21	100	6.0	31	58.3	—	980	150	K 38	28 [1,2]	K 75
N. Branch Cass River Germania Road, Sanilac County	24	59	10	54	57.5	5.9	1870	290	K 40	K 40	K 81
Belle River Braidwood Road, St. Clair County	23	62	11	45	65.6	3.0	900	290	K 38	K 38	K 76
Huron River N. Territorial Rd., Washtenaw County	119	90	10	50	23.0	—	5100	540	K 80	55 [1,2]	K 160
Fleming Creek Geddes Road, Washtenaw County	58	100	11	44	41.4	—	2400	520	K 50	K 50	57 [1]

Table 1B. Chemicals not detected in sediment samples collected from the Southern Michigan Northern Indiana Till Plains Ecoregion in February and March 1997, and November and December 1998.

Parameter	No. of Samples	Detection Limits	Units
Molybdenum	30	5.0	mg/kg
Mercury	30	0.05-0.25	mg/kg
Thallium	30	1.0	mg/kg
Hexachloroethane	30	60-280	ug/kg
1,2,4-Trichlorobenzene	30	600-2800	ug/kg
Hexachlorobutadiene	30	60-280	ug/kg
2-Chloronapthalene	30	1800-8400	ug/kg
Hexachlorobenzene	30	60-280	ug/kg
g-BHC (lindane)	30	60-280	ug/kg
Pentachloronitrobenzene	30	60-280	ug/kg
Heptachlor	30	60-280	ug/kg
Aldrin	30	60-280	ug/kg
Heptachlor epoxide	30	60-280	ug/kg
g-Chlordane	30	60-280	ug/kg
a-Chlordane	30	60-280	ug/kg
4,4'-DDD	30	60-280	ug/kg
4,4'-DDT	30	60-280	ug/kg
Hexabromobenzene	30	120-560	ug/kg
Mirex	30	60-280	ug/kg
Aroclor 1242 (PCB)	30	30-140	ug/kg
*Aroclor 1016 (PCB)	30	30-140	ug/kg
*Aroclor 1221 (PCB)	30	30-140	ug/kg
*Aroclor 1232 (PCB)	30	30-140	ug/kg
*Aroclor 1248 (PCB)	30	30-140	ug/kg
*Aroclor 1262 (PCB)	30	30-140	ug/kg
*Aroclor 1268 (PCB)	30	30-140	ug/kg
BP-6 (PBB)	30	300-1400	ug/kg
*Toxaphene	30	600-2800	ug/kg

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
* = results and detection limits reported semi-quantitatively
Note: all values are on a dry weight basis unless otherwise noted

Table 2A. Sediment chemistry of the Huron Erie Lake Plains ecoregion reference site samples.

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)
Molasses River Maple Point Rd., Gladwin County	12/98	2270	4.0	20	K 0.2	8550	5.0	K 5.0	2.5	5850	9.0
E. Br. Tittabawassee River Herner Rd., Gladwin County	12/98	2740	7.4	42	K 0.2	20500	6.0	5.0	5.5	8800	11
M. Br. Tittabawassee River Bensch Rd., Gladwin County	12/98	5130	15	80	0.29	75000	10	10	11	14100	23
Rock Falls Creek Schock Rd., Huron County	3/97	2020	4.0	12	K 0.2	17100	3.9	K 5.0	4.0	5350	K 5.0
Pinnebog River Eby Rd., Huron County	3/97	2920	4.1	24	K 0.2	11900	5.8	K 5.0	3.4	7160	K 5.0
Big Salt River Alamando Rd., Midland County	12/98	3300	2.3	25	K 0.2	22800	6.0	K 5.0	4.5	6050	8.5
Big Salt River Coleman Rd., Midland County	3/97	3890	3.3	32	0.2	24000	7.0	K 5.0	6.5	8950	K 5.0
Chippewa River M-20 & S. Meridian, Midland Co.	12/98	1500	2.2	5.0	K 0.2	16300	4.0	K 5.0	2.5	4700	13
Little Salt Creek MacGruder Rd., Midland County	12/98	5370	4.6	41	0.33	78500	11	11	11	12300	23
Pigeon River McAlpine Rd., Huron County	3/97	3400	3.7	29	K 0.2	26900	6.0	K 5.0	6.4	6680	K 5.0
Salt Creek Coleman Rd., Midland County	12/98	1200	1.7	19	K 0.2	18100	2.0	K 5.0	K 2.0	2500	K 5.0

mg/kg = milligrams per kilogram or parts per million

ug/kg = micrograms per kilogram or parts per billion

K = less than

--- = not sampled for

Note: all values are on a dry weight basis unless otherwise noted

Table 2A (cont).

Waterbody	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
Molasses River Maple Point Rd., Gladwin County	3.0	5150	270	K 5.0	173	110	9.0	85	9.0	29
E. Br. Tittabawassee River Herner Rd., Gladwin County	4.0	7950	370	6.5	290	110	31	74	10	69
M. Br. Tittabawassee River Bensch Rd., Gladwin County	8.5	21000	735	17	755	150	96	90	14	45
Rock Falls Creek Schock Rd., Huron County	3.5	5750	120	K 5.0	189	120	14	98	8.0	22
Pinnebog River Eby Rd., Huron County	4.4	4700	160	K 5.0	310	110	11	90	10	28
Big Salt River Alamando Rd., Midland County	5.5	7350	190	6.5	490	160	48	79	9.0	25
Big Salt River Coleman Rd., Midland County	7.0	8550	250	5.0	580	130	38	96	11	29
Chippewa River M-20 & S. Meridian, Midland Co.	2.5	6950	47	K 5.0	165	630	28	75	5.0	25
Little Salt Creek MacGruder Rd., Midland County	10	14900	430	21	985	170	61	111	15	37
Pigeon River McAlpine Rd., Huron County	5.4	6850	150	K 5.0	410	120	20	97	10	27
Salt Creek Coleman Rd., Midland County	K 2.0	2700	120	K 5.0	176	130	50	58	4.0	21

Table 2A (cont).

Waterbody	Total Solids (%TS)	Total Volatile Solids (%TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)
Molasses River Maple Point Rd., Gladwin County	63.1	3.2	890	170
E. Br. Tittabawassee River Herner Rd., Gladwin County	44.2	7.4	2600	400
M. Br. Tittabawassee River Bensch Rd., Gladwin County	39.1	13.1	4000	560
Rock Falls Creek Schock Rd., Huron County	80.5	---	K 240	170
Pinnebog River Eby Rd., Huron County	73.8	---	550	160
Big Salt River Alamando Rd., Midland County	62.4	2.5	820	260
Big Salt River Coleman Rd., Midland County	64.2	1.7	950	300
Chippewa River M-20 & S. Meridian, Midland Co.	69.4	2.6	620	132
Little Salt Creek MacGruder Rd., Midland County	74.6	2.0	340	230
Pigeon River McAlpine Rd., Huron County	72.3	---	590	210
Salt Creek Coleman Rd., Midland County	65.8	---	600	156

Table 2B. Chemicals not detected in sediment samples collected from the Huron Erie Lake Plain in March 1997 and December 1998.

Parameter	No. of Samples	Detection Limits	Units
Cadmium	11	2.0	mg/kg
Mercury	11	0.05 - 0.2	mg/kg
Molybdenum	11	5.0	mg/kg
Selenium	11	0.5	mg/kg
Silver	11	0.25	mg/kg
Thallium	11	1.0	mg/kg
Hexachloroethane	11	60-150	ug/kg
1,2,4-Trichlorobenzene	11	600-1500	ug/kg
Hexachlorobutadiene	11	60-150	ug/kg
2-Chloronapthalene	11	1800-4500	ug/kg
Hexachlorobenzene	11	60-150	ug/kg
g-BHC (lindane)	11	60-150	ug/kg
Pentachloronitrobenzene	11	60-150	ug/kg
Heptachlor	11	60-150	ug/kg
Aldrin	11	60-150	ug/kg
Heptachlor epoxide	11	60-150	ug/kg
g-Chlordane	11	60-150	ug/kg
a-Chlordane	11	60-150	ug/kg
4,4'-DDE	11	60-150	ug/kg
4,4'-DDD	11	60-150	ug/kg
4,4'-DDT	11	60-150	ug/kg
Hexabromobenzene	11	120-300	ug/kg
Mirex	11	60-150	ug/kg
Aroclor 1242 (PCB)	11	30-76	ug/kg
Aroclor 1254 (PCB)	11	30-76	ug/kg
Aroclor 1260 (PCB)	11	30-76	ug/kg
*Aroclor 1016 (PCB)	11	30-96	ug/kg
*Aroclor 1221 (PCB)	11	30-76	ug/kg
*Aroclor 1248 (PCB)	11	30-76	ug/kg
*Aroclor 1262 (PCB)	11	30-76	ug/kg
*Aroclor 1268 (PCB)	11	30-76	ug/kg
BP-6 (PBB)	11	300-760	ug/kg
*Toxaphene	11	600-1500	ug/kg

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
* = results and detection limits reported semi-quantitatively
Note: all values are reported on a dry weight basis unless otherwise noted

Table 3A. Sediment chemistry of the Northern Lakes and Forests ecoregion reference site samples.

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Cyanide (mg/kg)	Iron (mg/kg)	Lead (mg/kg)
Bamfield Creek Au Sable Road, Alcona County	12/98	1500	8.7	41	K 0.2	5250	3.0	K 5.0	K 2.0	---	7800	6.5
E. Branch Pine River Procunier Road, Alcona County	12/98	6250	1.3	45	0.3	38600	12	7.4	10	---	9210	9.9
S. Branch Pine River Cruzen Road, Alcona County	12/98	2630	3.0	29	K 0.2	16300	6.0	K 5.0	3.5	---	5850	8.0
W. Branch Pine River Cruzen Road, Alcona County	12/98	3540	3.4	34	K 0.2	34300	7.0	5.4	5.4	---	7870	9.9
N. Branch Au Sable N. Down River Road, Crawford County	12/98	2300	9.2	60	K 0.2	63500	6.0	8.0	11	---	17100	19
Big Creek N. Down River Road, Crawford County	12/98	1520	1.8	12	K 0.2	8050	4.0	K 5.0	3.0	---	3300	K 5.0
E. Branch Big Creek Griffin Road, Oscoda County	12/98	1800	3.1	12	K 0.2	11600	5.0	K 5.0	3.0	---	3800	6.9
W. Branch Big Creek Town Line Road, Oscoda County	12/98	1380	1.7	11	K 0.2	8350	4.0	K 5.0	2.5	--	3900	K 5.0
McGregor Creek 100 yds u/s of confluence with W. Br. Escanaba River, Dickinson County T-44N R-28W S-25 NE Corner	6/94	1250	0.78	13	K 0.2	1390	3.0	K 5.0	6.0	K 0.6	3700	K 5.0
Two Mile Creek Turner Truck Rd., Dickinson County T-43N R-29W S-18	5/94	1830	2.6	20	K 0.2	3370	6.0	K 5.0	3.5	K 0.3	6600	K 5.0
Ford River Turner Truck Road, Dickinson County T-43N R-29W S-16	6/94	3070	1.6	17	K 0.2	9200	9.0	K 5.0	13	0.92	7550	K 5.0
Orianna Brook City of Marquette, Marquette County	5/94	1865	3.1	40	K 0.2	2270	6.3	K 5.0	7.9	K 0.4	8320	K 5.0
Big Creek Brown Cabin Road, Oscoda County	12/98	3140	22	115	0.23	39300	15	8.0	11	---	17500	23
Perry Creek F-32 (McKinley Road), Oscoda County	12/98	2930	1.5	28	K 0.2	7950	8.0	K 5.0	4.9	---	4500	8.9

mg/kg = milligrams per kilogram or parts per million
K = less than
--- = not sampled for
Note: all values are on a dry weight basis unless otherwise noted

Table 3A (cont).

Waterbody	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Potassium (mg/kg)	Selenium (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)
Bamfield Creek Au Sable Road, Alcona County	K 2.0	1210	150	K 0.2	K 5.0	129	K 0.5	50	7.0	63	5.0
E. Branch Pine River Procunier Road, Alcona County	9.4	12900	270	K 0.05	12	1230	K 0.5	140	42	165	14
S. Branch Pine River Cruzen Road, Alcona County	3.5	5850	200	K 0.5	K 5.0	390	K 0.5	65	16	136	7.0
W. Branch Pine River Cruzen Road, Alcona County	4.9	12100	180	K 0.1	7.9	625	K 0.5	110	43	127	10
N. Branch Au Sable N. Down River Road, Crawford County	2.5	8200	600	K 0.3	10	360	1.1	120	34	65	10
Big Creek N. Down River Road, Crawford County	K 2.0	3500	130	K 0.1	K 5.0	177	K 0.5	65	7.0	90	5.0
E. Branch Big Creek Griffin Road, Oscoda County	K 2.0	4500	89	K 0.1	K 5.0	165	K 0.5	85	12	120	7.0
W. Branch Big Creek Town Line Road, Oscoda County	K 2.0	2700	150	K 0.1	K 5.0	157	K 0.5	80	8.0	115	5.0
McGregor Creek 100 yds u/s of confluence with W. Br. Escanaba River, Dickinson County T-44N R-28W S-25 NE Corner	K 2.0	530	260	K 0.05	K 5.0	69.5	K 0.5	70	---	96	7.0
Two Mile Creek Turner Truck Rd., Dickinson County T-43N R-29W S-18	K 2.0	2030	490	K 0.05	K 5.0	143	K 0.5	35	---	80	10
Ford River Turner Truck Road, Dickinson County T-43N R-29W S-16	3.0	4800	86	0.06	K 5.0	270	0.58	95	---	120	16
Orianna Brook City of Marquette, Marquette County	K 2.0	980	886	K 0.05	K 5.0	167	K 0.5	55	---	65	13
Big Creek Brown Cabin Road, Oscoda County	3.5	5800	915	K 0.3	9.5	390	1.3	130	92	69	12
Perry Creek F-32 (McKinley Road), Oscoda County	3.5	3100	72.8	K 0.1	K 5.0	350	K 0.5	70	9.0	110	8.0

Table 3A (cont).

Waterbody	Zinc (mg/kg)	Total Solids (%TS)	Total Volatile Solids (% TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)
Bamfield Creek Au Sable Road, Alcona County	17	29.4	21.4	4200	430
E. Branch Pine River Procunier Road, Alcona County	30	53.9	6.9	1760	390
S. Branch Pine River Cruzen Road, Alcona County	15	57.6	5.0	1430	260
W. Branch Pine River Cruzen Road, Alcona County	23	39.4	12.4	3400	450
N. Branch Au Sable N. Down River Road, Crawford County	46	17.8	30.1	10600	1020
Big Creek N. Down River Road, Crawford County	15	48.5	7.7	2500	220
E. Branch Big Creek Griffin Road, Oscoda County	22	43.2	9.9	3000	220
W. Branch Big Creek Town Line Road, Oscoda County	19	44.3	9.9	2400	290
McGregor Creek 100 yds u/s of confluence with W. Br. Escanaba River, Dickinson County T-44N R-28W S-25 NE Corner	9.0	31.4	8.2	---	---
Two Mile Creek Turner Truck Rd., Dickinson County T-43N R-29W S-18	15	5.8	5.8	---	---
Ford River Turner Truck Road, Dickinson County T-43N R-29W S-16	31	28.8	12.4	---	---
Orianna Brook City of Marquette, Marquette County	26	53.0	7.9	---	---
Big Creek Brown Cabin Road, Oscoda County	51	15.8	43.3	11800	850
Perry Creek F-32 (McKinley Road), Oscoda County	20	49.8	6.4	1640	190

Table 3B. Chemicals not detected in sediment samples collected from the Northern Lakes and Forest Ecoregion in May and June 1994, and December 1998.

Parameter	No. of Samples	Detection Limits	Units
Cadmium	14	2.0	mg/kg
Molybdenum	14	5.0	mg/kg
Silver	10	0.25	mg/kg
Thallium	10	1.0	mg/kg
1,3-Dichlorobenzene	4	220-360	ug/kg
1,4-Dichlorobenzene	4	220-360	ug/kg
1,2-Dichlorobenzene	4	220-360	ug/kg
Hexachloroethane	12	22-290	ug/kg
1,2,4-Trichlorobenzene	12	220-2900	ug/kg
Hexachlorobutadiene	12	22-290	ug/kg
2-Chloronapthalene	12	670-8800	ug/kg
Hexachlorobenzene	12	22-290	ug/kg
g-BHC (lindane)	12	22-290	ug/kg
Pentachloronitrobenzene	12	22-290	ug/kg
Heptachlor	12	22-290	ug/kg
Aldrin	12	22-290	ug/kg
Heptachlor epoxide	12	22-290	ug/kg
g-Chlordane	12	22-290	ug/kg
a-Chlordane	12	22-290	ug/kg
4,4'-DDE	12	22-290	ug/kg
4,4'-DDD	12	22-290	ug/kg
4,4'-DDT	12	22-290	ug/kg
Hexabromobenzene	12	45-590	ug/kg
Mirex	12	22-290	ug/kg
Aroclor 1242 (PCB)	12	45-360	ug/kg
Aroclor 1254 (PCB)	12	45-360	ug/kg
Aroclor 1260 (PCB)	12	45-360	ug/kg
*Aroclor 1016 (PCB)	12	45-360	ug/kg
*Aroclor 1221 (PCB)	12	45-360	ug/kg
*Aroclor 1248 (PCB)	12	45-360	ug/kg
*Aroclor 1262 (PCB)	12	45-360	ug/kg
*Aroclor 1268 (PCB)	12	45-360	ug/kg
BP-6 (PBB)	12	110-180	ug/kg
*Toxaphene	12	220-360	ug/kg

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
* = results and det. Limits reported semi-quantitatively
Note: all values are on a dry weight basis unless otherwise noted
Note: Pesticide/PCB results for Orianna Brook and Two Mile Creek were not used due to unacceptably high levels of detection

Table 4A. Sediment chemistry of the Eastern Corn Belt Plains Ecoregion reference site samples.

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)
Saline River Curtiss Park d/s of M-12, Washtenaw Co.	2/97	2020	2.7	19	37700	7.0	5.4	7030	13	2.5	8250	200

Table 5A. Sediment chemistry of the North Central Hardwood Forests Ecoregion reference site samples.

Waterbody	Date Collected	Aluminum (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)
Warner Creek Barber Road, Charlevoix Co.	12/98	3130	1.8	35	23900	10	13	9250	22	2.5	2800	250

mg/kg = milligrams per kilogram or parts per million

--- = not sampled for

K = less than

DL = sample was diluted

Note: all values are on a dry weight basis unless otherwise noted

Table 4A (cont).

Waterbody	Nickel (mg/kg)	Potassium (mg/kg)	Selenium (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Total Solids (%TS)	Total Volatile Solids (%TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)
Saline River Curtiss Park d/s of M-12, Washtenaw Co.	K 5.0	198	K 0.5	120	45	120	8.0	28	78.6	---	430 DL	320

Table 5A (cont).

Waterbody	Nickel (mg/kg)	Potassium (mg/kg)	Selenium (mg/kg)	Sodium (mg/kg)	Strontium (mg/kg)	Titanium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Total Solids (%TS)	Total Volatile Solids (%TVS)	Kjeldahl Nitrogen (mg/kg)	Total Phosphorus (mg/kg)
Warner Creek Barber Road, Charlevoix County	6.0	350	2.0	100	38	61	8.0	64	15.0	47.5	12600	730

Table 4B and 5B. Chemicals not detected in sediment samples collected from the Eastern Corn Belt Plains Ecoregion in February 1997, and from the North Central Hardwood Forests Ecoregion in December 1998.

Parameter	No. of Samples	Detection Limits	Units
Beryllium	2	0.2	mg/kg
Cadmium	2	2.0	mg/kg
Cobalt	2	5.0	mg/kg
Mercury	2	0.05 - 0.3	mg/kg
Molybdenum	2	5.0	mg/kg
Silver	2	0.25	mg/kg
Thallium	2	1.0	mg/kg
Hexachloroethane	2	60-290	ug/kg
1,2,4-Trichlorobenzene	2	600-2900	ug/kg
Hexachlorobutadiene	2	60-290	ug/kg
2-Chloronapthalene	2	1800-8800	ug/kg
Hexachlorobenzene	2	60-290	ug/kg
g-BHC (lindane)	2	60-290	ug/kg
Pentachloronitrobenzene	2	60-290	ug/kg
Heptachlor	2	60-290	ug/kg
Aldrin	2	60-290	ug/kg
Heptachlor epoxide	2	60-290	ug/kg
g-Chlordane	2	60-290	ug/kg
a-Chlordane	2	60-290	ug/kg
4,4'-DDE	2	60-290	ug/kg
4,4'-DDD	2	60-290	ug/kg
4,4'-DDT	2	60-290	ug/kg
Hexabromobenzene	2	120-590	ug/kg
Mirex	2	60-290	ug/kg
Aroclor 1242 (PCB)	2	30-150	ug/kg
Aroclor 1254 (PCB)	2	30-150	ug/kg
Aroclor 1260 (PCB)	2	30-150	ug/kg
*Aroclor 1016 (PCB)	2	30-150	ug/kg
*Aroclor 1221 (PCB)	2	30-150	ug/kg
*Aroclor 1232 (PCB)	2	30-150	ug/kg
*Aroclor 1248 (PCB)	2	30-150	ug/kg
*Aroclor 1262 (PCB)	2	30-150	ug/kg
*Aroclor 1268 (PCB)	2	30-150	ug/kg
BP-6 (PBB)	2	300-1500	ug/kg
*Toxaphene	2	600-2900	ug/kg

mg/kg = milligrams per kilogram or parts per million
ug/kg = micrograms per kilogram or parts per billion
* = results and detection limits reported semi-quantitatively
Note: all values are on a dry weight basis unless otherwise noted

Table 6A. Locations of reference site sediment samples taken in 1994, 1997 and 1998.

Station Name	Street Location	County	Ecoregion	Town	Range	Section	Longitude	Latitude
Bamfield Creek	Au Sable Road	Alcona	NLF	25N	05E	11	83 47' 31"	44 34' 17"
W. Branch Pine River	Cruzen Road	Alcona	NLF	25N	08E	04	83 27' 46"	44 35' 35"
S. Branch Pine River	Cruzen Road	Alcona	NLF	25N	08E	09	83 27' 46"	44 34' 26"
E. Branch Pine River	Procunier Road	Alcona	NLF	26N	08E	27	83 27' 17"	44 36' 44"
Swan Creek	Horkey Road	Branch	SMNITP	06S	08W	35	85 12' 08"	41 54' 08"
Kalamazoo River	B Drive North	Calhoun	SMNITP	02S	05W	26	84 51' 19"	42 15' 41"
Kalamazoo River	d/s from Marshall WWTP	Calhoun	SMNITP	02S	06W	26	84 58' 27"	42 15' 47"
Harper Creek	B Drive North	Calhoun	SMNITP	02S	07W	31	85 09' 36"	42 15' 40"
N. Br. Kalamazoo River	29 1/2 Mile Road	Calhoun	SMNITP	03S	04W	01	84 43' 37"	42 14' 46"
St. Joseph River	9 Mile Road	Calhoun	SMNITP	04S	07W	34	85 07' 08"	42 04' 51"
Christiana Creek	North Shore Drive	Cass	SMNITP	07S	15W	36	85 59' 60"	41 49' 18"
Warner Creek	Barber Road	Charlevoix	NCHF	32N	06W	25	84 59' 18"	45 08' 45"
S. Branch Tobacco River	Grant Avenue	Clare	SMNITP	17N	04W	28	84 47' 18"	43 49' 47"
N. Branch Au Sable	N. Down River Road	Crawford	NLF	27N	01W	22	84 25' 12"	44 42' 59"
Big Creek	N. Down River Road	Crawford	NLF	27N	01W	23	84 24' 32"	44 42' 56"
E. Branch Big Creek	Griffin Road	Crawford	NLF	27N	01W	13	84 22' 48"	49 44' 20"
W. Branch Big Creek	Town Line Road	Crawford	NLF	28N	01W	34	84 25' 28"	44 46' 08"
Two Mile Creek	Turner Truck Road	Dickenson	NLF	43N	29W	18	87 58' 28"	46 07' 37"
Ford River	Turner Truck Road	Dickenson	NLF	43N	29W	16	87 57' 41"	46 07' 34"
McGregor Creek	100 yds u/s of confluence with W. Br. Escanaba	Dickenson	NLF	44N	28W	25	87 51' 37"	46 12' 17"
M. Branch Tobacco River	McCullegh Road	Gladwin	SMNITP	17N	02W	03	84 31' 31"	43 53' 20"
S. Branch Tobacco River	Grout Road (Townhall)	Gladwin	SMNITP	17N	02W	16	84 32' 44"	43 52' 01"
Cedar River	Campbell Road (River Rd.)	Gladwin	SMNITP	18N	01W	30	84 28' 30"	43 55' 46"
Molasses River	Maple Point Road	Gladwin	HELP	18N	02E	19	84 17' 16"	43 56' 54"
N. Branch Tobacco River	Grout Road	Gladwin	SMNITP	18N	02W	28	84 32' 42"	43 55' 00"
Sugar River	M-30 (Meridian Road)	Gladwin	SMNITP	19N	01W	13	84 22' 02"	44 02' 03"
W. Branch Tittabawassee	Fitzwater Road	Gladwin	HELP	20N	01W	23	84 23' 14"	44 06' 15"
M. Branch Tittabawassee River	Bensch Road	Gladwin	HELP	20N	02E	07	84 17' 19"	44 08' 45"
E. Branch Tittabawassee River	Herner Road	Gladwin	HELP	20N	02E	15	84 13' 40"	44 07' 44"
E. Br. Pigeon River	McAlpine Road (Gagetown)	Huron	SMNITP	15N	11E	30	83 06' 44"	43 42' 17"

Table 6A (cont).

Station Name	Street Location	County	Ecoregion	Town	Range	Section	Longitude	Latitude
Pinnebog River	Eby Road	Huron	HELP	16N	11E	15	83 09' 55"	43 48' 41"
Rock Falls Creek	Schock Road	Huron	HELP	16N	15E	23	82 39' 47"	43 48' 42"
Chippewa River	Chippewa Road	Isabella	SMNITP	14N	03W	11	84 37' 42"	43 37' 26"
Chippewa River	Meridian Road	Isabella	SMNITP	14N	05W	24	84 50' 54"	43 34' 38"
Coldwater River	Baseline Road	Isabella	SMNITP	15N	05W	31	84 57' 22"	43 38' 23"
Chippewa River	Coldwater Road	Isabella	SMNITP	15N	06W	35	84 59' 16"	43 39' 07"
N. Branch Chippewa River	Stevenson Lake Road	Isabella	SMNITP	16N	05W	14	84 52' 28"	43 46' 13"
Rum Creek	10 Mile Road	Kent	SMNITP	09N	10W	32	85 31' 50"	43 07' 04"
Honey Creek	Darwin Road	Livingston	SMNITP	01N	04E	25	83 55' 30"	42 26' 33"
Portage River	Toma Road	Livingston	SMNITP	01N	04E	35	83 56' 42"	42 25' 28"
N. Br. Clinton River	N. 28 Mile Road	Macomb	SMNITP	04N	13E	22	82 54' 24"	42 44' 45"
Orianna Brook	City of Marquette	Marquette	NLF	48N	25W	27	87 24' 47"	46 31' 38"
N. Branch Chippewa River	M-66 (30th Avenue)	Mecosta	SMNITP	16N	07W	28	85 08' 52"	43 45' 43"
Little Salt Creek	MacGruder Road	Midland	HELP	13N	02W	02	84 30' 30"	43 33' 10"
Pine River	MacGruder Road	Midland	HELP	13N	02W	26	84 30' 31"	43 29' 34"
Chippewa River	M-20 & South Meridian	Midland	HELP	14N	01W	24	84 22' 09"	43 35' 39"
Salt Creek	Coleman Road	Midland	HELP	14N	02W	29	84 35' 17"	43 34' 22"
Big Salt River	Alamando Road	Midland	HELP	15N	02W	15	84 31' 39"	43 41' 32"
Big Salt River	Coleman Road	Midland	HELP	15N	02W	18	84 35' 16"	43 41' 23"
Freeman Creek	Maple Island Avenue	Newaygo	SMNITP	16N	14W	31	86 02' 20"	43 44' 27"
Allen Creek	Dickenson Road	Newaygo	SMNITP	16N	14W	19	86 01' 06"	43 45' 48"
Clinton River	Elizabeth Lake Road	Oakland	SMNITP	03N	09E	21	83 24' 10"	42 38' 42"
Big Creek	Brown Cabin Road	Oscoda	NLF	26N	01E	13	84 15' 32"	44 39' 08"
Perry Creek	F-32 (McKinley Road)	Oscoda	NLF	26N	03E	09	84 04' 59"	44 39' 29"
N. Branch Cass River	Germania Road	Sanilac	SMNITP	14N	12E	12	83 01' 04"	43 39' 35"
Belle River	Braidwood Road	St. Clair	SMNITP	06N	14E	28	82 48' 02"	42 54' 58"
Huron River	N. Territorial Road	Washtenaw	SMNITP	01S	04E	13	83 54' 39"	42 23' 13"
Fleming River	Geddes Road	Washtenaw	SMNITP	02S	06E	25	83 40' 02"	42 16' 27"
Saline River	Curtis Park, d/s of M-12	Washtenaw	ECBP	04S	05E	01	83 47' 07"	42 09' 43"