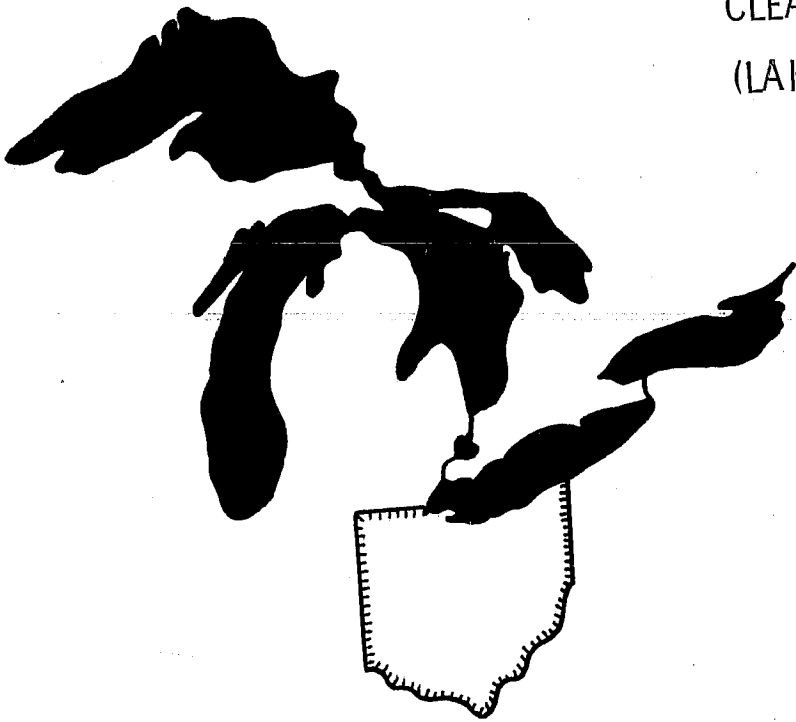


CLEAR TECHNICAL REPORT NO. 233
(LAKE ERIE TAT CONTRIBUTION NO. 8)



LAKE ERIE INTENSIVE STUDY:
MAIN LAKE AND NEARSHORE WATER
QUALITY PROBLEM AREAS

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STATE OF MICHIGAN

By use of the STORET system's standards program, data collected at tributary, connecting channel (Detroit River), water intake, intensive-nearshore and main lake sampling stations in the Michigan waters of Lake Erie were compared with International Joint Commission (IJC) Water Quality Objectives and State of Michigan Water Quality Standards (Tables 1 and 2). Of the 21 parameters retrieved, fluoride, arsenic, selenium, and un-ionized ammonia values did not exceed IJC or state limits during the two-year study period. Stations and parameters with records in excess of objectives/standards (violations) are summarized in Appendix A-1.

Total iron values exceed the 0.3 mg/l (300 µg/l) limit at all five types of surveillance sampling stations. Of all parameters compared, total iron values were the most frequent. In addition to being frequent and widespread, maximum values frequently exceed the limit by a level of magnitude. High total iron values are due, in part, to the substantial heavy industry located along the Detroit River and its tributaries. Total iron records indicate a substantial violation of the objective in Michigan waters of the lake. The frequency, extent and magnitude of total iron records along the connecting channel contributed to the designation of the Detroit River as a problem area (Great Lakes Water Quality Board 1980).

The upper limit for the hydrogen-ion concentration (pH) standard is 8.5 standard units. The upper limit for the IJC objective is 9.0. The majority of pH violations of the state standard occur in the 8.5-9.0 range. Lake Erie's natural bicarbonate substrate in the western basin produces relatively high natural pH values. These violations are considered technical in nature and require no remedial action.

A similar situation involves specific conductance values. Few stations in the Detroit River range at River Mile 3.9 have records in excess of the 308 µmhos/cm objective. However, tributary and intensive nearshore station records often exceed this limit. High tributary loads in the spring and to a lesser extent in the fall combine with shallow water in the Michigan portion of the lake to produce relatively high specific conductance in the nearshore zone. Violations of this objective are technical in nature.

Phenolic compounds were noted in concentrations exceeding the objective at one tributary monitoring station, two water intakes and at 35 of 36 stations located along the Detroit River. Heavy industry, largely steel production, effluents along the Detroit River and its tributaries are the principal source of contamination. Very few samples were collected at intensive-nearshore or main lake stations for analysis of phenolic compounds. Phenols represent a substantial violation in the connecting channel and contributed to the designation of the area as a problem area (Great Lakes Water Quality Board 1980).

Fecal coliform bacteria counts from samples collected in the connecting channel and in the nearshore zone frequently exceed the 200 organisms/100 ml standard for total body contact with the water. The sources of fecal contamination, principally the Detroit Sewage Treatment Plant, contributed to the designation of the Detroit River as a problem area (GLWQB 1980). Fecal coliform data taken over the two-year period indicate the Detroit River and nearshore waters south of Detroit (Fay and Herdendorf 1981) represent a significant problem area where use is impacted.

A number of the trace metal parameters retrieved revealed records exceeding standard. Cadmium, copper and mercury values exceeded standards at several tributary, water intake, connecting channel, nearshore and main lake stations. It is difficult at this time to assess violations of trace metal objectives/standards at intensive-nearshore and main lake stations due to standing questions about the data sets.

TABLE 1

PARAMETERS SCREENED FOR VIOLATIONS OF STATE OF MICHIGAN
WATER QUALITY STANDARDS

STORET CODE	PARAMETER	UNITS REPORTED
00300	Dissolved Oxygen	mg/l
00400	pH	Standard Units
00095	Conductivity	at 25°C μ mhos
00951	Fluoride	F, total mg/l
00940	Chloride-total	mg/l
01027	Cadmium	Cd, total μ g/l
01034	Chromium	Cr, total μ g/l
01042	Copper	Cu, total μ g/l
01045	Iron	Fe, total μ g/l
01051	Lead	Pb, total μ g/l
01067	Nickel	Ni, total μ g/l
01002	Arsenic	As, total μ g/l
71900	Mercury	Hg, total μ g/l
01147	Selenium	Se, total μ g/l
32730	Phenols	Total μ g/l
39516	PCB's	whole sample μ g/l
01092	Zinc	Zn, total μ g/l
00619	Un-ionized $\text{NH}_3\text{-NH}_3$	mg/l
31616	Fecal coliform bacteria	MFM-FCBR/100 ml
00720	Cyanide	Cn, total mg/l

TABLE 2
IJC OBJECTIVES AND MICHIGAN STANDARDS
FOR LAKE ERIE WATER QUALITY

Parameter	IJC Objective	Michigan Standards
Dissolved O ₂ (mg/l)	6.00*	6.00*
pH (std. units)	6.50-9.00**	6.70-8.50**
Dissolved solids (mg/l)	200	
Specific conductance (µmhos/cm)	308.0	
Fluoride (µg/l)	1200	50 ¹
Chloride (mg/l)		12 ²
Cadmium - total (µg/l)	0.200	100 ²
Chromium - total (µg/l)	50	
Copper - total (µg/l)	5	300 ²
Iron - total (µg/l)	300.0	30 ²
Lead - total (µg/l)	25	
Nickel - total (µg/l)	25	100 ²
Arsenic - total (µg/l)	50	50 ²
Mercury - total (µg/l)		
Mercury - dissolved (µg/l)	0.200	
Selenium - total (µg/l)	10.00	
Phenols (µg/l)	1.00	
PCB's (µg/l)	0.100 - fish, wet weight	
Zinc - total (µg/l)	30	
Ammonia - total (µg/l)	500 (NH ₃)	200 ³
Fecal Coliform (no./100 ml)		5
Cyanide (µg/l)		

¹Monthly average

²Proposed

³Total body contact

*Minimum

**Permissible range

COMMONWEALTH OF PENNSYLVANIA

A total of 42 parameters (Table 1) were retrieved by use of the STORET system's standards program for comparison with IJC objective values and Pennsylvania Department of Environment Resources (PDER) standards. Comparisons were made with observations recorded from 70 stations. Included among the total were water intake, tributary, nearshore and main lake stations. Observations exceeding objective and/or standard limits were noted for 22 of the 42 parameters retrieved. The maximum number of parameters exceeding limits at any one station was eight. A summary of violations by station and parameter is provided in Appendix A-3.

Conductivity values were among the most commonly occurring violations. Conductivity violations occurred throughout the Pennsylvania waters of Lake Erie, being recorded at all four types of stations. Inspection of summary data in Appendix A-3 reveals that the mean of all samples recorded at a station falls close to the IJC objective limit of 308 $\mu\text{mhos/cm}$. In fact, calculation of an average of station means results in a value of 340 $\mu\text{mhos/cm}$. If the latter value is taken as an indicator of the natural level in this portion of the lake, conductivity violations must be considered technical ones which require no remedial action.

Mr. K. Schoener, Bureau of Water Quality Management - PDER, indicated (personal communication) that the alkalinity standard of 20 mg/l (total as CaCO_2) was applicable to Lake Erie waters of the state. The resulting comparison resulted in a situation with every alkalinity record exceeding the standard. An average of station means produced a value of 91 mg/l (std. dev. = 5.11). This PDER standard is inappropriate for Lake Erie waters. Alkalinity records are definitely technical and are not summarized in Appendix A-3.

Dissolved oxygen values falling below the objective/standard were recorded at nearly half of the stations sampled over the two-year interval. Low dissolved oxygen records in Presque Isle Bay (Erie Harbor) contributed to the designation of this area as a problem area (Great Lakes Water Quality Board 1980). Several sources of biochemical oxygen demand resulted in dissolved oxygen violations in both winter and summer months. Low dissolved oxygen levels in the bay resulted in a massive winter kill of gizzard shad (Dorosoma cepedianum) during the winter months of 1977-1978 (Wellington 1980). Winter kills of shad are a persistent problem in Presque Isle Bay. Low dissolved oxygen levels in hypolimnetic waters resulted in violations of the IJC objective at main lake and intensive-nearshore (SUNY-Buffalo) stations. During periods of stratification, dissolved oxygen profiles were recorded at intensive-nearshore stations. The intrusion of hypolimnetic waters was indicated by the occurrence of dissolved oxygen violations being recorded for only a portion of a profile at any given station and date.

Records of fecal coliform bacteria in excess of the PDER limit of 200 organisms/ml were noted at 14 tributary and nearshore stations. Fecal

coliform violations contributed to Presque Isle Bay being designated a problem area (Great Lakes Water Quality Board 1980). An intensive beach sampling program recorded exceptionally high bacterial counts at a number of beaches at Presque Isle State Park and in Erie Harbor during the late summer months (Wellington 1980). During August, the use of selected park beaches is impacted. The completion of additional sewage treatment facilities is alleviating this problem.

The extent of total iron values in excess of the objective/standard of 0.3 mg/l cannot be fully assessed at this time due to a data entry problem with the intensive nearshore data in the STORET system. The remaining violations summarized in Appendix A-3 are principally trace metal values and a few pH values in excess of 9.0 standard units. No pattern is apparent in the occurrence of these records. As a result of the latter observation, trace metal and pH violations are considered technical in nature and require no remedial action.

TABLE 5

PARAMETERS SCREENED FOR VIOLATIONS
OF PENNSYLVANIA WATER QUALITY STANDARDS

Storet Code	Parameter	Unit of Measure
00400	pH	S.U.
00300	Dissolved Oxygen	mg/l
31503	Total Coliform	cells/100 ml
31616	Fecal Coliform	cells/100 ml
00410	Total Alkalinity	mg/l
00720	Cyanide	mg/l
00951	Fluoride	mg/l
00630	NO ₂ +NO ₃ (Total N)	mg/l
01045	Iron, Fe Total	µg/l
74010	Iron, Fe	mg/l
01147	Selenium, Total	µg/l
01145	Selenium, Dissolved	µg/l
71900	Mercury, Total	µg/l
71890	Mercury, Dissolved	µg/l
01002	Arsenic, Total	µg/l
01000	Arsenic, Dissolved	µg/l
01032	Chromium, Hexavalent	µg/l
01051	Lead, Total	µg/l
01049	Lead, Dissolved	µg/l
01055	Manganese, Total	µg/l
01056	Manganese, Dissolved	µg/l
39350	Chlordane	µg/l
39370	DDT	µg/l
39390	Endrin	µg/l
39410	Heptachlor	µg/l
39782	Lindane	µg/l
39480	Methoxychlor	µg/l
34336	Diethylphthalate	µg/l
39516	PCB's	µg/l
39400	Toxaphene	µg/l
00515	Residue - Dissolved - 105C	mg/l
00520	Residue - Volume Filter	mg/l
00525	Residue - Fix Filter	mg/l

TABLE 6

IJC OBJECTIVES AND COMMONWEALTH OF PENNSYLVANIA
STANDARDS FOR LAKE ERIE WATER QUALITY

Parameter	IJC Objective	Pennsylvania ¹
Alkalinity-total (mg/l)		20*
Ammonia (mg/l)	0.020 (NH ₃)	0.500
Arsenic (mg/l)	0.050	0.050
Fecal Coliforms (no/100 ml)		200 ²
Total Coliforms (no/100 ml)		1000 ²
Cadmium (mg/l)	0.002	0.010 (96 RLC 50)
Chromium-total (mg/l)	0.050	0.05 (hexavalent)
Copper-total (mg/l)	0.005	0.1 (96 RLC 50)
Cyanide (mg/l)		0.005 (HCN+CN ⁻)
Dissolved Oxygen (mg/l)	6.0*	6.0*
Fluoride (mg/l)	1.200	2.0
Hardness		150 (monthly mean)
Iron-total (mg/l)	0.300	0.300
Iron-dissolved (mg/l)		0.30
Lead-total (mg/l)	0.025	0.050
Manganese-total (mg/l)		1.0
Nickel-total (mg/l)	0.025	0.01 (96 RLC 50)
Nitrite+Nitrate (mg/l - nitrogen)		10.0
pH (std. units)	6.5-9.0**	6.5-9.0**
Phenolics (mg/l)	0.001	0.001
Selenium (mg/l)	0.010	0.010
Sulfate		250.0
Specific Conductance (µmhos at 25°C)		3400
Total dissolved solids (mg/l)	308	200 ³
Zinc (mg/l)	200	
Aldrin/dieldrin (µg/l)	0.030	0.001
	0.001	0.3 (mg/kg-fish, wet wt.)
	0.300 (mg/kg-fish, wet wt.)	0.060
Chlordane (µg/l)	0.060	0.003
DDT+metabolites (µg/l)	0.003	0.003
	1 µg/g - fish, wet wt.	1 µg/g - fish, wet wt.
Endrin (µg/l)	0.002	0.002
	0.3 µg/g - fish, wet wt.	0.3 µg/g - fish, wet wt.

TABLE 6 CONT.

Parameter	IJC Objective	Pennsylvania ¹
Heptachlor ($\mu\text{g}/\text{l}$)	0.001 0.300 $\mu\text{g}/\text{g}$ -fish, wet wgt.	0.001 0.300 $\mu\text{g}/\text{g}$ -fish, wet wgt.
Lindane ($\mu\text{g}/\text{l}$)	0.010 0.300 $\mu\text{g}/\text{g}$ - fish, wet wgt.	0.010 0.300 $\mu\text{g}/\text{g}$ - fish, wet wgt.
Methoxychlor ($\mu\text{g}/\text{l}$)	0.040	0.040
Toxaphene ($\mu\text{g}/\text{l}$)	0.008	0.008
Phthalic Acid Esters ($\mu\text{g}/\text{l}$)		
dibutyl-	4.0	4.0
di (2-ethyl hexyl)-	0.6	0.6
other phthalates	0.2	0.2
Polychlorinated biphenyls (PCBs)	0.001 0.1 $\mu\text{g}/\text{g}$ - fish, wet wgt.	0.001 0.1 $\mu\text{g}/\text{g}$ - fish, wet wgt.
Mercury-total (mg/l)	0.005 - fish, wet wgt.	
Mercury-dissolved (mg/l)	0.002	

¹Commonwealth of Pennsylvania Public Law 1987. Title 25. Rules and Regulations. Part I. Dept. of Environmental Resources. Article II. Water Resources. Chapter 93. Water Quality Standards.

²Geometric mean taken over not more than a thirty-day period.

³Average annual average based on representative lake-wide sampling.

*Minimum

**Permissible range

STATE OF NEW YORK

Through the facilities offered by the STORET system's standards program, a total of 22 parameters were retrieved and compared with IJC water quality objectives and New York State water quality standards (Table 4). Observations exceeding one or more objective/standard were noted at 42 sampling stations in the New York State waters of Lake Erie. Values in excess of limits were recorded at tributary, connecting channel (Niagara River), intensive-nearshore and main lake stations. Over the two-year interval, no more than eight parameters were noted with one or more violations at any one station. A summary of station and parameters in violation of objectives/standards is provided in Appendix A-4.

Low dissolved oxygen values (below 6.0 mg/l) recorded at intensive-nearshore and main lake stations were more frequently noted than violations of any other parameter. Low dissolved oxygen values were noted at 10 of 16 main lake stations and 18 of 19 intensive-nearshore stations in the Barcelona-Dunkirk-Silver Creek reach of the New York State shoreline. Low dissolved oxygen values in the nearshore are due, in part, to intrusion of hypolimnetic waters during the summer months. The latter is obvious from profile data recorded at nearshore stations; only a portion of the values recorded at a station are classified as violations on a given date.

Specific conductance values exceeding the IJC objective of 308 μ mhos/cm were recorded at tributary, connecting channel, main lake and, most frequently, at intensive-nearshore stations. Means of all samples at these stations are near or above the objective limit. Eastern basin conductivity values have been noted as higher than central and western basin values over the historical period of record (Cooper 1979). Eastern basin waters are composed of the accumulated dissolved solids moving from west to east through the lake. Those violations, therefore, must be considered technical in nature which require no remedial action.

The hydrogen-ion concentration (pH) violations summarized in Appendix A-4 are exceptions of the state upper limit (8.5) and not of the IJC objective (9.0). These values fall in the 8.5-9.0 range of the pH scale of standard units. The average of sample means (\bar{x} =8.23) approaches the New York state limit. These violations are considered technical in nature.

The remaining values exceeding objectives/standards in New York State waters of the lake are confined to the trace metal parameters. Cadmium, copper, nickel and zinc values were the most common of the trace metal violations. IJC objective limits are considerably lower than New York State standards (Table 8). As a result, the violations noted are primarily violations of objectives rather than state standards. Although not frequent at any station, violations of the IJC objective values for total nickel and total zinc are consistent throughout the New York state waters of the lake. The relatively high values recorded for the nickel and zinc parameters may reflect the nature of the bedrock substrate in the tributaries of this portion

of the lake. The trace metal violations are probably technical in nature, although the matter requires clarification.

TABLE 7

PARAMETERS SCREENED FOR VIOLATIONS
OF NEW YORK STATE WATER QUALITY STANDARDS
IN NEW YORK LAKE ERIE WATERS

Storet Code	Parameter	Units of Measure
00300	Dissolved Oxygen	mg/l
00400	pH	Standard Units
00095	Conductivity	at 25°C μ mhos
00951	Fluoride	F, total μ g/l
01027	Cadmium	Cd, total μ g/l
01034	Chromium	Cr, total μ g/l
01042	Copper	Cu, total μ g/l
01045	Iron	Fe, total μ g/l
01051	Lead	Pb, total μ g/l
01067	Nickel	Ni, total μ g/l
01002	Arsenic	As, total μ g/l
71890	Mercury	Hg, dissolved μ g/l
01147	Selenium	Se, total μ g/l
32730	Phenols	total μ g/l
39516	PCB's	whole sample μ g/l
01092	Zinc	Zn, total μ g/l
00619	Un-ionized $\text{NH}_3\text{-NH}_3$	mg/l
31501,31503,31504	Total Coliform Bacteria	cells/100 ml
31613,31615,31616	Fecal Coliform Bacteria	cells/100 ml

TABLE 8

IJC OBJECTIVES AND NEW YORK STATE STANDARDS
FOR LAKE ERIE WATER QUALITY

Parameter	IJC Objective ¹	New York State Standard ²
Fecal coliform bacteria (no/100 m)		200 ³
Total coliform bacteria (no/100 ml)		1000 ³
Dissolved oxygen (mg/l)	6.0*	6.0*
Total dissolved solids (mg/l)	200	200
Specific conductance (µmhos/cm)	308	
pH (std. units)	6.5-9.0**	6.7-8.5**
Iron, as Fe (mg/l)	0.3	0.3
Ammonia or ammonium compounds (mg/l)	0.020 (NH ₃)	2.0, at pH 8.0
	0.500 (NH ₃) - water supply	
Cyanide (mg/l-CN)		0.100
Ferrocyanide (mg/l-		0.400
Ferricyanide Fe(CN) ₆)		300.0
Cadmium total (µg/l)	0.2	200.0
Copper-total (µg/l)	5.0	300.0
Zinc-total (µg/l)	30.0	
Arsenic-total (µg/l)	50.0	
Chromium-total (µg/l)	50.0	
Lead-total (µg/l)	25.0	
Mercury-dissolved (µg/l)	0.2	
Mercury-total (µg/l)	0.5 - fish, wet wgt.	
Nickel-total (µg/l)	25	
Selenium-total (µg/l)	10	
Fluoride-total (µg/l)	1200	
Phenolic compounds (µg/l)	1.0	

¹Great Lakes Water Quality Agreement of 1978.

²Environmental Conservation Law 15-0313, 17-0301. Part 702.1
Class A - Special (International Boundary Waters).

³Geometric mean of not less than five samples taken over not more than
a 30-day period.

*Minimum

**Permissible range

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APPENDIX A-1

SUMMARY OF VIOLATIONS OF IJC OBJECTIVES
AND STATE OF MICHIGAN STANDARDS
FOR LAKE ERIE WATER QUALITY

Source: STORET System

Responsible Agency	Station No.	Parameter	IJC Objectives		Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range	
CONNECTING CHANNEL MDNR	820011	Iron	17/22	330-1300	17/22	330-1300	543.2	
		Conduct.	2/22	315-320	1/7	1.3	269.5	
		Mercury	2/6	7.0-8.0			.400	
		Copper					5.333	
		Fecal Coliforms			13/22	210-7000	997.3	
		Phenols	18/21	2.0-5.2	4/21	.0051-.0072	2.819	
		Cyanide	1/6	63			.0039	
		Zinc	16/22				28.17	
		Iron	18/21				409.1	
		Phenols			1/7	4.2	2.30	
MDNR	820014	Mercury					.8143	
		Fecal Coliforms	14/64	310-600	12/22	250-9600	1068.2	
		Iron			14/64	310-600	362.3	
		Fecal Coliforms			8/22	250-4300	539.5	
		Phenols	11/21	1.4-4.0	1/21	.007	1.446	
		Cyanide	1/6	46			.0021	
		Zinc	10/22	350-570	10/22	350-570	15.83	
		Iron	4/21	1.2-1.8			305.9	
		Phenols					.795	
		Fecal Coliforms	1/6	7.0	3/22	400-3000	298.2	
Copper					3.00			
MDNR	820016	Iron	14/64	310-600	14/64	310-600	362.3	
		Fecal Coliforms			8/22	250-4300	539.5	
		Phenols	11/21	1.4-4.0	1/21	.007	1.446	
		Cyanide	1/6	46			.0021	
		Zinc	10/22	350-570	10/22	350-570	15.83	
		Iron	4/21	1.2-1.8			305.9	
		Phenols					.795	
		Fecal Coliforms	1/6	7.0	3/22	400-3000	298.2	
		Copper					3.00	
		MDNR	820017	Iron	17/22	330-1300	17/22	330-1300
Conduct.	2/22			315-320	1/7	1.3	269.5	
Mercury	2/6			7.0-8.0			.400	
Copper							5.333	
Fecal Coliforms					13/22	210-7000	997.3	
Phenols	18/21			2.0-5.2	4/21	.0051-.0072	2.819	
Cyanide	1/6			63			.0039	
Zinc	16/22						28.17	
Iron	18/21						409.1	
Phenols					1/7	4.2	2.30	

Responsible Agency	Station No.	Parameter	IJC Objectives				Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
MDNR	820018	Iron	13/22	350-560	13/22	350-560	304.5			
		Phenols	1/21	1.8			.714			
MDNR	820026	Fecal Coliform	1/11	3.7	2/22	1110-2800	225.0			
		DO	1/11	315	1/11	3.7	8.2			
		Conduct.	11/11	410-1300	11/11	410-1300	276.8			
		Iron	9/11	1.9-6.0			830			
		Phenols					3.60			
MDNR	820028	Fecal Coliforms	5/11	400-1700	5/11	400-1700	2384.5			
		Cyanide	7/11	.0054-.0096	7/11	.0054-.0096	.0056			
		DO	1/11	4.0	1/11	4.0	8.391			
		Iron	10/11	310-1200	10/11	310-1200	548.8			
		Fecal Coliforms								
MDNR	820030	Iron	4/11	500-21000	4/11	500-21000	2451.8			
		Phenols	10/11	1.8-8.6	2/11	.005-.006	3.336			
		Cyanide	1/11	4.1	1/11	4.1	.0038			
		DO	10/11	310-880	10/11	310-880	8.545			
		Iron	10/11	1.6-6.3			495.5			
MDNR	820031	Phenols	1/11	8.582	4/11	300-15000	1780.9			
		Fecal Coliforms	6/11	330-720	1/11	.0056	.0035			
		Cyanide			1/11	4.1	8.582			
		DO			6/11	330-720	379.1			
		Iron								
		Fecal Coliforms	3/11	3700-6800	3/11	3700-6800	1553.6			

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
MDNR MDNR	820031	Phenols	10/11	1.6-5.1	1/11	3.9	2600		
	820032	D0 Conduct. Iron Phenols Fecal Coliforms Cyanide	1/11 1/11 1/11 11/11 9/11	3.9 310 350-1500 2.0-7.6	11/11	350-1500	8.245 280.5 770.0 3.709		
MDNR	820034	D0 Iron Phenols Fecal Coliforms Cyanide	1/11 9/11 10/11	4.1 380-800 2.0-6.9	4/11 8/11 1/11 9/11 3/11	500-17000 .0056-.0097 4.1 380-800 600-20000	1995.5 .0066 8.636 548.2 3.864		
		D0 Iron Phenols Fecal Coliforms Cyanide	1/11 7/11 8/11	4.2 320-600 2.0-4.8	3/11 3/11 1/11 7/11	.0052-.0063 4.2 4.2 320-600	2124.5 .0042 8.736 383.6 2.418		
MDNR	820036	D0 Iron Phenols Fecal Coliforms	1/11 7/11 8/11	4.2 320-600 2.0-4.8	3/11 6/9 9/9	300-11000 340-640	1194.5 347.8 4.144		
		D0 Iron Phenols Fecal Coliforms Cyanide	6/9 9/9	340-640 2.0-7.1	2/9 8/9	710-1200 .0052-.0098 340-570	251.1 .0064 361.1 3.272		
MDNR	820041	D0 Iron Phenols	6/9 8/9	340-570 1.7-5.0					

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
MDNR	820041	Fecal Coliforms							233.3
		Cyanide							.0045
		Iron	2/9	340-620	6/9	430-1300	6/9	430-1300	263.3
MDNR	820043	Phenols	7/9	1.9-4.0	2/7	340-620	2/7	340-620	2.167
		Fecal Coliforms							177.8
		Iron	2/9	460-530	1/9	1100	1/9	1100	273.3
		Phenols	6/9	1.2-2.6		460-530		460-530	1.522
		Fecal Coliforms							193.3
		Iron	3/9	310-640	1/9	1400	1/9	1400	280.0
		Phenols	1/9	2.0	3/9	310-640	3/9	310-640	.744
		Fecal Coliforms							110.0
		Iron	1/9	540	1/9	700	1/9	700	241.1
MDNRY	820049	Phenols	2/9	1.2-3.6	1/9	540	1/9	540	.978
		Fecal Coliforms							301.1
		Iron	2/9	310-560	1/9	2200	1/9	2200	241.1
MDNR	820051	Phenols	4/9	1.1-5.0	2/9	310-560	2/9	310-560	1.567
		Iron	2/9	470-740	2/9	470-740	2/9	470-740	285.6
MDNR	820054	Phenols	1/9	2.2	1/9	2.2	1/9	2.2	.744
		pH							8.33
		Iron	3/20	310-390	3/20	310-390	3/20	310-390	186.5
		Phenols	8/19	1.4-3.1					1.246
		pH							8.345
MDNR	820060	Iron	1/20	360	1/20	360	1/20	360	175.0

Responsible Agency	Station No.	Parameter	IJC Objectives				Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
MDNR	820060	Phenols	8/19	1.2-2.4		3/20	8.6-8.7		1.126	
	820061	pH Iron Phenols	2/20 6/19	310-410 1.4-2.2		2/20	310-410		8.295 181.0 1.016	
MDNR	820062	pH Iron Phenols	3/20 3/19	400-500 1.8-2.0		1/20 3/20	8.6 400-520		8.250 211.3 .803	
MDNR	820063	pH Iron Phenols	5/20 6/19	310-560 1.3-3.2		1/20 5/20	8.6 310-560		8.250 220.7 1.026	
USGS	04165700	Mercury	4/6	1.0-15.0		.6	.7		.333	
		Cadmium	3/6	6.0-19.0		1/6	15.0		3.5	
		Copper	4/8	310-470		4/8	310-470		7.5	
		Iron	1/7	26.0					280.0	
		Lead	3/8	.2-.5		3/8	.4-.5		11.29	
		Mercury	1/8	70.0					.4875	
		Zinc	4/9	320-670		4/9	320-670		21.50	
		Iron	9/9	1.1-4.0					353.3	
		Phenols							2.4	
MDNR	820256	Fecal	4/9			4/9	670-7100		1100	
		Coliforms	9/9			9/9	.0065-.0120		.0086	
		Cyanide	7/9	310-700		7/9	310-700		404.4	
MDNR	820258	Iron	8/9	1.3-11.0		2/9	320-900		185.6	
		Phenols				8/9	.0065-.0170		.0092	
		Fecal								
		Coliforms								
		Cyanide								

Responsible Agency	Station No.	Parameter	IJC Objectives				Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
MDNR	820261	Iron	2/9	340-750	2/9	340-750	2/9	340-750	264.1	
	820397	Phenols Iron Phenols Fecal Coliforms	3/9 5/11 6/11	1.1-2.5 340-690 1.2-3.7	3/9 5/11 6/11	1.1-2.5 340-690 1.2-3.7	3/9 5/11 6/11	340-690	1.445 313.6 1.445	
MDNR	820399	Iron Phenols Fecal Coliforms	6/11 6/11	320-640 1.1-2.2	6/11 6/11	320-640 1.1-2.2	1/11	3800 320-640	394.5 357.3 1.282	
	820413	Iron Phenols Copper Nickel Mercury	1/20 6/19 2/5 4/5	390 1.6-5.7 8.0-10.0 42-42	1/20 6/19 2/5 4/5	390 1.6-5.7 8.0-10.0 42-42	2/22 5/20 1/20	2000-2600 8.6-8.8 390	478.2 8.335 200.0 1.284 4.80 12.40 .3167 8.230 222.5 .864 .3833 291.1	
MDNR	820414	pH Iron Phenols Mercury	4/20 3/19	330-520 2.0-2.2	4/20 3/19	330-520 2.0-2.2	1/6 1/20 4/20	.60 8.6 330-520	12.40 8.230 222.5 .864	
	820416	Iron Fecal Coliforms	3/9	360-580	3/9	360-580	2/6 3/9	.20-1.0 360-580	.3833 291.1	
MDNR	820786	Phenols Iron Phenols	4/9 2/9 4/9	1.2-3.0 360-700 1.6-2.0	4/9 2/9 4/9	1.2-3.0 360-700 1.6-2.0	1/9 2/9	1100 360-700	176.7 1.322 257.8	
	820200	Iron	2/2	410-500	2/2	410-500	2/2	410-500	1.056 455.0	

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
OSU	MON M11	Nickel	2/4	.22-1.4	14/21	8.56-9.35	22.75		
		pH	7/21	9.05-9.35			8.653		
		Conduct.	13/22	310-643.6			354.0		
		Iron	4/4	530-6700	4/4	530-6700	2230.0		
		Copper	2/4	8.5-25.0			10.55		
		Zinc	3/4	73-100			69.25		
		DO	2/46	4.9-5.4	2/46	4.9-5.4			
		Conduct.	14/40	311.4-398.2	29/45	8.55-9.50			
		pH	7/45	9.03-9.50					
		Cadmium	4/9	.22-9.3					
OSU	MON M12	Iron	4/4	580-2300	4/4	580-2300	36.45		
		Chromium	1/4	58					
		Copper	2/4	68-83					
		Fecal Coliforms			1/17	250	20.8		
		Nickel	3/4	32-94			59.25		
		Zinc	4/4	32-150			76.25		
		DO	1/45	4.8	1/45	4.8	9.147		
		Conduct.	8/39	310.7-364.2	27/45	8.52-9.28	270.3		
		pH	8/45	9.02-9.28			8.569		
		Nickel	1/4	76.0			27.22		
OSU	MON M13	Iron	3/4	420-11000	3/4	420-11000	565.0		
		Copper	3/4	6.7-35.0			12.800		
		Cadmium	4/4	.22-.94			.42		
		Zinc	3/4	45-150			79.0		
		DO	1/45	5.4			9.244		
		Zinc	3/4	51-310			140.50		

Responsible Agency	Station No.	Parameter	IJC Objectives		Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range	
OSU	MON M14	pH	3/44	9.05-9.22	13/44	8.51-9.22	8.497	
		Conduct.	1/40	313.10			247.8	
		Iron	2/4	440-1000	2/4	440-1000	485.0	
		Copper	3/4	10-95	1/4	32.0	43.875	
	Lead	1/4	32.0			10.37		
	Cadmium	4/4	.22-4.5			1.885		
	Fecal Coliforms			2/17	273-287	49.1		
	Nickel	2/4	59.0-150			56.82		
	DO	1/45	5.7	1/45	5.7	9.3009		
	Copper	3/4	8.1-31			18.375		
OSU	MON M15	pH	4/46	9.01-9.07	21/46	8.56-9.07	8.446	
		Cadmium	4/4	.22-1.8			.727	
		Zinc	3/4	42-310			113.50	
		Iron	3/4	350-1000	3/4	35-1000	485.0	
	Nickel	2/4	41-93			38.27		
	DO	3/18	3.367-6.0	3/18	3.367-6.0	7.828		
	Conduct.	16/21	313.2-530.4			376.1		
	Copper	4/4	50-950			280.75		
	pH			11/20	8.57-9.0	8.498		
	OSU	MON M16						

Responsible Agency	Station No.	Parameter	IJC Objectives				Michigan Standards				Sample Mean	
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range				
OSU	MON M16	Cadmium	4/4	.22-.54							.30	
		Nickel	3/4	28-66							37.75	
		Iron	4/4	910-1700			4/4	910-1700			1302.5	
		Chromium	1/4	57.0							29.65	
		Zinc	4/4	35-200				0.0			87.50	
		DO	1/18	0.0-0.0							8.956	
		Copper	3/4	7.4-2200							587.75	
		Nickel	1/4	45-45							21.57	
		pH	9/21	9.07-9.48			14/21	8.55-9.48			8.719	
		Conduct.	14/22	335.2-475.0							353.4	
OSU	MON M17	Cadmium	4/4	.22-1.2						.66		
		Iron	4/4	750-1500			4/4	750-1500			1247.5	
		Chromium	1/4	52.0-52.0							26.34	
		Zinc	2/4	91-190							79.75	
		DO	1/17	0.0-0.0			1/17	0.0-0.0			9.694	
		Conduct.	17/22	309.2-549.1							362.1	
		pH	9/21	9.04-9.38			9/21	8.59-9.38			8.746	
		Cadmium	4/4	.22-13.0			1/4	13.0			4.15	
		Iron	4/4	600-1800			4/4	600-1800			1135.0	
		Zinc	3/4	53-190							89.50	
OSU	MON M18	Lead	1/4	33.0							10.24	
		Nickel	2/4	30-54							26.75	
		Fecal Coliforms	1/44	5.6							135.4	
		DO	2/4	74-240			1/8	980.0			9.85	
		Zinc	9/44	9.04-9.18			1/44	5.6			86.50	
		pH					29/44	8.51-9.18			8.60	
		OSU	MON M19	Cadmium	4/4	.22-.54						
				Nickel	3/4	28-66						
				Iron	4/4	910-1700			4/4	910-1700		
				Chromium	1/4	57.0						
Zinc	4/4			35-200				0.0				
DO	1/18			0.0-0.0								
Copper	3/4			7.4-2200								
Nickel	1/4			45-45								
pH	9/21			9.07-9.48			14/21	8.55-9.48				
Conduct.	14/22			335.2-475.0								

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
OSU	MON M19	Conduct.	6/39	311.3-343.9			262.1		
		Iron	3/4	410-850	3/4	410-850	465		
		Cadmium	4/4	.22-6.5			2.18		
		Copper	2/4	14-17			9.35		
		Fecal Coliforms			1/17	630.0	9.35		
		Nickel	1/4	180.0			58.6		
		DO	1/10	0.0	1/10	0.0	8.32		
		pH	1/14	9.15	4/14	8.71-9.15	8.341		
		Conduct.	6/13	310-494.8	1/12	52.0	310.6		
		Chloride					19.57		
OSU	MON M2	Chromium	1/5	66.0	1/5	18.0	4.13		
		Cadmium	5/5	.22-18.0			18.360		
		Copper	3/5	5.3-53			1595.2		
		Iron	4/5	370-3700	4/5	370-3700	22.77		
		Nickel	1/5	54.0					
		Fecal Coliforms			1/7	250.0	57.9		
		Zinc	5/5	31-130			66.40		
		pH	6/44	9.04-9.25	26/54	8.51-9.25	8.565		
		Conduct.	5/38	320.7-357.5			246.5		
		Iron	3/4	320-870	3/4	320-870	460.0		
OSU	MON M20	Cadmium	4/4	.22-6.9			2.48		
		Copper	2/4	7.8-38.0			9.20		
		Nickel	2/4	44-74			30.55		
		Lead	1/4	34.0	1/4	34.0	11.04		
		Zinc	3/4	36-330			125.75		

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Total	Violations Range	
OSU	MON M21	pH	6/44	9.04-9.21	23/24	8.54-9.21	8.495		
		Cadmium	4/4	.22-.72			.345		
		Chromium	1/4	76.0			28.76		
		Iron	3/4	310-810	3/4	310-810	522.5		
		Copper	2/4	16-21			10.20		
		Nickel	1/4	28.0			15.35		
		Zinc	3/4	56-240			108.0		
		DO	2/15	0.0-5.00	2/15	0.0-5.00	8.813		
		Conduct.	13/22	311.5-432.0			330.0		
		Nickel	2/4	27-31	16/22	8.52-9.36	16.35		
OSU	MON M22	pH	8/22	9.07-9.36			8.769		
		Cadmium	4/4	.22-.89			.535		
		Copper	2/4	8.8-50.0			15.45		
		Iron	4/4	410-940	4/4	410-940	572.5		
		Zinc	3/4	33-270			92.50		
		DO	2/16	4.0-5.0	2/16	4.0-5.0	8.875		
		Conduct.	3/20	310-320			261.4		
		pH	1/21	9.03	9/21	8.54-9.03	8.350		
		Cadmium	4/4	.22-1.90			.82		
		Iron	4/4	350-500	4/4	350-500	1685.0		
OSU	MON M3	Copper	3/4	350-5000			33.725		
		Fecal Coliforms							
		Zinc	2/4	35-99	2/10	224-460	78.0		
		DO	1/16	0.0			42.75		
		Conduct.	4/20	310-481.6	1/16	0.0	9.656		
		pH	1/20	9.24			294.3		
							8.52		

Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
OSU	MON M7	Iron	4/4	510-3200	4/4	510-3200	1335		
		Copper	3/4	16-140			48.125		
		Nickel	2/4	38-96			42.50		
		Zinc	2/4	55-74			43.75		
OSU	MON M8	pH	4/47	9.04-9.33	22/47	8.51-9.33	8.451		
		Conduct.	6/41	311-337			244.7		
		Chromium	1/4	56.0			17.76		
		Iron	3/4	310-1300	3/4	310-1300	602.5		
		Cadmium	4/4	.22-5.6			1.687		
		Copper	2/4	12-170			46.625		
		Nickel	1/4	35.0			19.25		
		Zinc	4/4	35-92			65.75		
		pH	3/46	1.08-9.23	22/46	8.53-9.23	8.448		
		Conduct.	1/40	308.6			226.6		
OSU	MON M9	Gadimium	4/4	.22-39	1/4	39.0	9.99		
		Copper	2/4	16.0-350.0	2/4	410-1200	93.10		
		Iron	2/4	410-1200			500		
		Fecal							
		Coliforms			2/19		40.2		
		Zinc	3/4	43-90			52.0		
		Nickel	2/4	39.5-90			39.0		
		Cond.	20/22	314.4-627.0	10.21	8.55-9.51	375.9		
		pH	8/21	9.04-9.51			8.828		
		Cadmium	4/4	.22-1.90			.910		
OSU	TOL M23	Iron	4/4	380-110	4/4	38-110	825		
		Copper	4/4	16.0-45.0			23.65		
		Nickel	3/4	36-40			22.37		
			2/4						

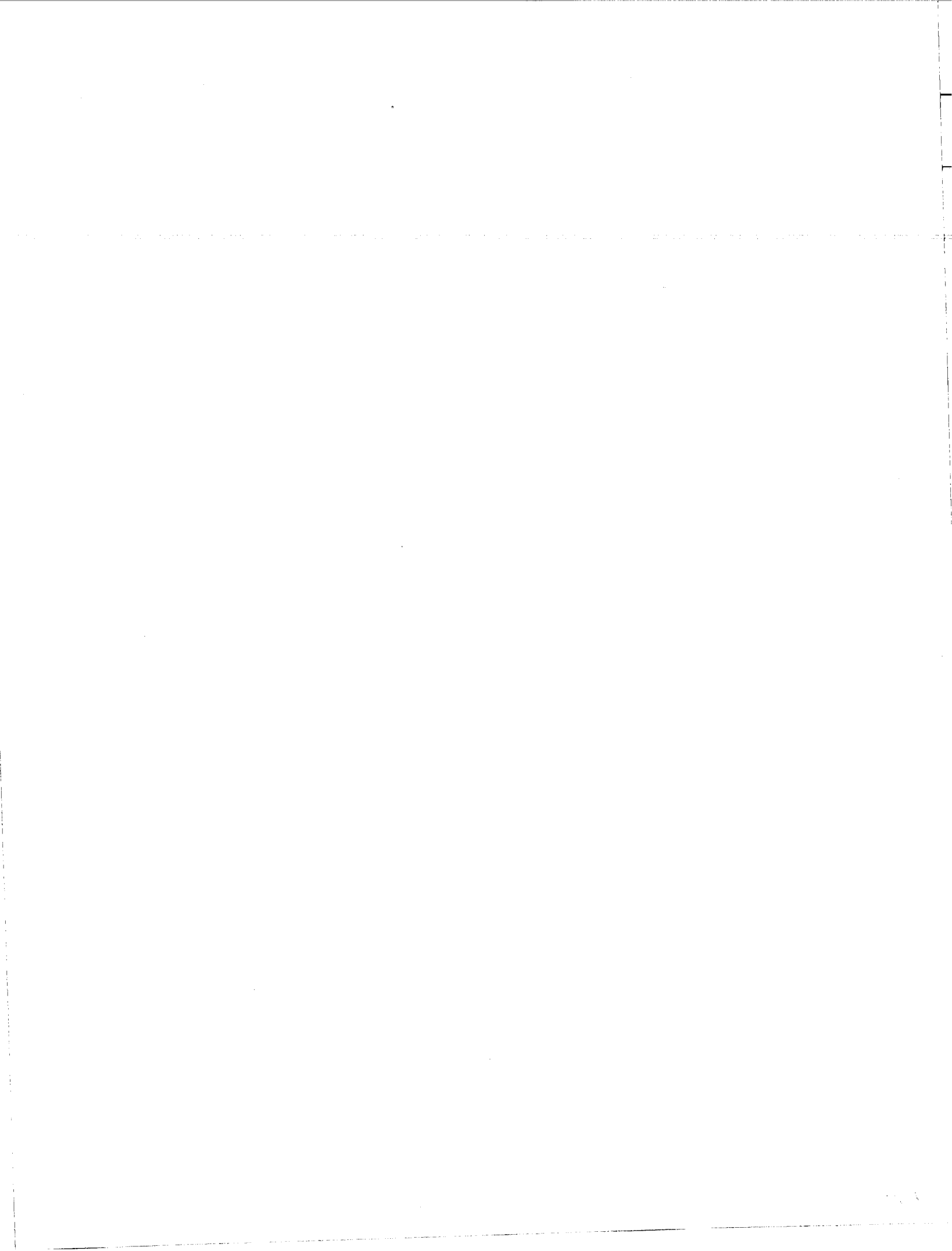
Responsible Agency	Station No.	Parameter	IJC Objectives			Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
OSU	TOL M23	Zinc	3/4	29-200			80.50		
	TOL M24	pH Conduct. Iron Cadmium Copper Fecal Coliforms	5/46 8/39 4/4 4/4 3/4	9.02-9.24 317-527 370-690 .22-8.5 8.4-130.0	32/46 4/4	8.53-9.24 370-690	8.633 288.3 502.5 2.51 40.475		
OSU	TOL M25	Zinc pH Conduct. Iron Cadmium Lead Copper Nickel Zinc	2/4 5/46 5/39 4/4 4/4 1/4 3/4 2/4 4/4	59.0-290.0 9.03-9.15 334.5-459.5 410-510 .22-.68 37.0 9.4-41.0 38-51 34-260	1/18 25/46 4/4	3300.0 8.58-9.15 410-510	200.9 96.50 8.567 268.3 457.5 2.115 11.01 21.125 24.12		
	TOL M26	pH Conduct. Iron Cadmium Lead Copper Nickel Zinc	7/22 19/22 4/4 4/4 1/4 4/4 2/4 4/4	9.13-9.40 319.8-597.0 310-1100 .22-8.10 44.0 5.5-49.0 49-91 32-310 9.1-9.24	18/22 4/4 1/4	8.51-9.40 310-1100 44.0	8.85 382.7 685 2.955 13.87 26.125 44.25 107.75 8.624		
OSU	TOL M27	Zinc pH	3/23		17/23	8.54-9.24			

Responsible Agency	Station No.	Parameter	IJC Objectives		Michigan Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
OSU	TOL M27	Cond.	23/23	39.2-147	1/14	50.1	513.4	
		Chloride	3/22	.502-.775	4/4	770-2300	30.23	
		Phos-tot	4/4	770-2300	4/4	770-2300	.253	
		Iron	4/4	.22-6.8	1/4	46.0	1492.5	
		Cadmium	1/4	46.0	1/4	46.0	1.865	
		Lead	4/4	5.3-66	2/9	230-240	14.50	
		Copper	4/4	41-83			25.275	
		Fecal	2/4	51-250			73.2	
		Coliforms	4/4				37.63	
		Nickel					125.75	
Zinc								
MAIN LAKE	L. Erie 60	pH	1/4	10.0	6/34	8.52-8.90	8.271	
		Copper	2/4	489-618	2/4	489-618	4.75	
		Iron	2/4	9.08	1/2	.100	402.7	
USEPA	L. Erie 75	Mercury	1/32	310-323	16/32	8.54-9.08	.100	
		pH	6/32	625-695	2/4	625-695	8.507	
		Conduct.	2/4	9.03	2/4	.10	282.7	
USEPA	L. Erie 84	Iron	1/37	311-400	1/2	8.52-9.03	397.7	
		Mercury	10/37	662-1110	21/37	662-1110	.10	
		pH	2/4	1.0	2/4	662-1110	8.571	
		Conduct.	2/4	6.0	2/4	.30	291.5	
		Iron	1/4		2/2		543.0	
		Cadmium				.70		
		Copper				4.75		
		Mercury				.30		

APPENDIX A-3

SUMMARY OF VIOLATIONS OF STANDARDS
AND/OR OBJECTIVES IN LAKE ERIE WATERS
OF THE COMMONWEALTH OF PENNSYLVANIA

Source: STORET System



Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
INTAKE PDER/ECDH (21 PA)	WQN0601	Cu	1/2	10			10
TRIBUTARY PDER/ECDH (21 PA)	WQN0602	Cond. Cu Fe-tot. Fec. Col. Diss. Res.	9/9 2/2 2/9	355-600 10 380-1210	2/9 4/8 7/8	380-1210 400-5300 274-442	477.9 10 290 931.9 328.9
TRIBUTARY PDER/ECDH (21 PA)	WQN0603	Cond. Cu Fe-total Fec. Col. Diss. Res.	7/7 1/2 1/7	388-1000 10 540	1/7 2/6 7/7	540 230-450 208-602	539 10 205.7 145/100 372.6
PDER/ECDH (21 PA)	WQN0604	pH	1/8	9.08			7.83

Responsible Agency	Station No.	Parameter	IJC Objectives			Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
(21 PA)	WQN0604	Cond.	5/8	315-490			327	
		Cu	2/2	10			10	
		Fe-total	2/8	480-3290	2/8	480-3290	568.7	
		Ni	1/2	30			20	
		Zn	1/2	70			50	
		Fec. Col.			2/8	2400-6000	1063.7	
		Diss. Res.			5/8	248-362	241.4	
NEARSHORE								
SUNY-Buffalo	BAR01	Cond.	13/72	312-344			318.3	
		Cd	1/8	1			--	
		Ni	3/8	42-100			34.25	
		Zn	1/7	35			5.86	
		Cond.	7/46	310-348			283.9	
SUNY	BAR02	D0	1/100	5		1/100	10.22	
		Cd	1/7	5			2.7	
		Cu	1/7	12			4.3	
		Ni	2/6	30-80			24.5	
								83.6
		Fec. Col.			1/12	760	.058	
		Hg-total			1/6	.21		
SUNY	BAR03	Cond.	5/46	310-354			289.3	
		Cu	2/7	6-11			5.143	
		Ni	1/6	80			23	

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	BAR04	Cond.	5/48	312-320			285.5
		Cd	1/8	5			--
		Cu	1/8	7			4.38
		Zn	1/7	34	1/6	.25	7.43
		Hg-total					.098
SUNY	CON 10	DO	5/308	4.5-5.6	5/308	4.5-5.6	9.24
		Cond.	1/23	312			287.6
		F	1/1	11.1	1/1	11.1	11.1
		Cu	2/8	6-11			4.75
		Ni	3/8	27-58			20.63
		Zn	1/7	281	1/20	.23	49.29
		Hg-total					.078
SUNY	CON 11	Cond.	1/46	309			282.6
		F	1/1	11.1	1/1	11.1	11.1
		Cd	3/7	1-2			--
		Cu	2/8	6-24			6.625
		Ni	2/8	42-320			52.50
		Zn	1/8	243			
SUNY	CON 12	Cond.	4/24	321-419			295.9
		Cd	1/8	2.0			--
		Cu	2/8	6-18			5.625
		Ni	3/8	28-130	1/8	26	35.38
		Se-tot	1/8	26			5.0

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	CON 12	Phenol	2/8	1.4-4.7	2.7	.2-.6	.775
		Zn Cyanide-tot.	3/8	37-148			37.5
SUNY	CON 13	Cond.	2/25	312-352	1/1	11.5	287
		F	1/1	11.5			11.5
		Cd	3/8	1.0-2.0			--
		Cu	2/8	10-19			6.63
		Ni	2/8	30-53			18.13
		Zn	3/7	111-235			72.86
SUNY	CON 14	D0	22/305	1.0-5.8			9.01
		pH	1/43	5.5			8.319
		Cond.	3/45	311-370			285.9
		F	1/1	11.1			11.1
		Cd	2/8	1			--
		Cu	2/8	6-9			4.75
		Ni	2/8	42-100			24.38
SUNY	CON 15	D0	23/310	2.2-5.8	23/310	2.2-5.8	8.88
		pH	1/41	3.0			8.2
		Cond.	2/43	310-311			283.1
		F	2/2	10.9-12			11.45
		Cd	3/8	1-2.0			--
		Ni	2/8	27-210			35.9
		Zn	1/8	56			12.63

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	CON 16	DO	5/96	2.3-2.8	5/96	2.3-2.8	9.103
		Cond.	2/21	321-876	2/2	11-12.5	315.4
		F	2/2	11-12.5			11.75
		Cd	3/8	1.0-2.0			--
		Cu	4/8	7-461			62.5
		Ni	1/8	28			11.5
		Zn	1/8	34	1/6	.42	10.9
		Hg-total					.113
		DO	25/281	2.1-5.9	25/281	2.1-5.9	8.63
		Cond.	2/48	314-316			285.4
SUNY	CON 17	F	1/1	12.4	1/1	12.4	12.4
		Cd	2/8	1.0			--
		Cu	1/8	6.0			3.875
		Ni	1/8	76			18
		Fec. Col.			1/11	600	72.7
		DO	12/137	2.2-3.9	12/137	2.2-3.9	8.92
		Cond.	4/49	312-329			287.7
		F	2/2	11.8-14.3	2/2	11.8-14.3	13.1
		Cd	3/8	1.0-7.0			--
		Cu	2/8	7.0-14.0			5.75
SUNY	CON 18	Ni	2/8	36-45			18.5
		Zn	3/8	39-122			34.0
		Fec. Col.			1/11	600	72.7

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	ERIE 01	DO	7/92	2.5-5.4	7/92	2.5-5.4	8.88
		Cond.	1/24	313	1/24	313	291
		F	1/2	11.5	1/2	11.5	5.81
		Cu	1/8	6.0	1/8	6.0	3.63
		Ni	1/7	30	1/7	30	11.1
		Zn	2/8	39-59	1/8	600	20.9
		Fec. Col.			1/5	.36	99.3
		Hg-tot.					.084
		DO	21/246	2.2-5.3	21/246	2.2-5.3	8.68
		pH	1/43	2.49	1/43	2.49	8.15
SUNY	ERIE 02	Cond.	2/43	310-316	1/2	11.5	285.6
		F	1/2	11.5	1/2	11.5	5.81
		Cd	1/8	1.0	1/8	1.0	--
		Cu	2/8	6-10	2/8	6-10	4.25
		Ni	1/8	29	1/8	29	10.9
		Zn	1/8	52	1/8	52	13.3
		Fec. Col.			1/9	600	84.4
		DO	10/118	2.5-3.5	10/118	2.5-3.5	9.53
		Cond.	5/37	315-374	5/37	315-374	296.7
		Cd	2/7	1.0-2.0	2/7	1.0-2.0	--
SUNY	ERIE 03	Ni	1/8	56	1/8	56	14.8
		Zn	1/7	58	1/7	58	10.0
		Fec. Col.			1/10	600	78.0

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	ERIE 04	D0	11/124	2.6-5.6	11/124	2.6-5.6	8.58
		Cond.	2/33	314			288
		F	1/2	11.3	1/2	11.3	5.71
		Cd	1/8	1.0			--
		Ni	1/8	28.0	1/5	.21	11.5
		Hg-tot.				.11	
SUNY	ERIE 05	D0	43/455	2.0-5.9	43/455	2.0-5.9	9.314
		Cond.	11/68	312-995			305.5
		Cd	1/7	2.0			--
		Cu	2/8	7-11			5.25
		Ni	2/8	42-240			44.13
		Zn	2/8	151-204			56.14
			2/7		1/5	.350	.106
SUNY	ERIE 06	D0	17/214	2.3-5.0	17/214		8.69
		Cond.	2/47	310-2648			1479
		F	1/2	11.4	1/2		5.76
		Cu-tot.	1/8	11.0			4.38
		Pb-tot.	1/8	29.0			18.38
		Ni-tot.	1/8	28.0			11.0
	2/8	32-72			15.88		
SUNY	ERIE 07	D0	23/202	1.8-4.2	23/202	1.8-4.2	8.30
		Cond.	2/46	312-389			290.8
		F	1/2	11.3	1/2	11.3	5.71

Responsible Agency	Station No.	Parameter	IJC Objectives			Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
SUNY	ERIE 07	Cd	2/8	1.0	3/422	4.2-4.7	9.85	
		Cu	3/8	6.0-12.0				
		Ni	1/8	140				
		Zn	3/7	32-820				
SUNY	ERIE 08	DO	3/422	4.2-4.7	2/6	.23-6.08	291.9	
		Cond.	8/71	309-498				
		Cd	2/8	1.0-2.0				
		Cu	1/8	6.0				
SUNY	ERIE 09	Ni	1/8	130	1/184	5.9	4.38	
		Hg-tot.						
		DO	1/184	5.9				
		Cond.	2/48	311-325				
SUNY	ERIE 10	Cu	1/8	9.0	11/90	.2-5.8	8.91	
		Zn	2/7	50-110				
		Hg-tot.						
		Pb-diss.						
SUNY	ERIE 10	Fe-mgl			1/5	.250	8.37	
		DO	11/90	.2-5.8				
		pH	1/28	9.1				
		Cond.	12/30	310-352				
SUNY	ERIE 10	Ni	1/4	139	1/8	325	306.2	
		PhenoIs	1/10	1.9				
SUNY	ERIE 10	Zn	1/4	33.0	4/8	.46-283	42.25	

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	ERIE 10	Fec. Col.			1/6	500	104.3
	ERIE 11	D0 pH Cond. Cd Cu Zn Fec. Col.	10/87 3/40 20/43 1/8 1/8 1/7	.2-5.9 9.05-9.1 310-363 4.0 7.0 262	10/87	.2-5.9	9.12 8.39 308.6 -- 4.25 40 113.6
SUNY	ERIE 12	D0 pH Cond. Cd Cu Ni Zn Fec. Col.	10/94 1/42 22/48 1/8 1/8 2/8 1/8	3.5-5.9 9.41 309-371 1.0 6.0 270-315 232	2/11	570-600	8.90 8.37 302.4 -- 3.88 78.75 34.25 180.9
	ERIE 13	D0 pH Cond. Cd Cu Ni Hg-tot.	8/476 2/40 9/47 1/8 1/8 3/8	5.1-5.8 9.03 310-1153 5.0 10 27-640	3/11 8/476	5.1-5.8	10.21 8.40 416.1 -- 4.88 93.63 .31

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	ERIE 14	Cond.	9/48	312-329	1/10	600	293.3
		Cu	1/8	6.0			4.13
		Fec. Col.					78.2
SUNY	ERIE 15	Cond.	11/47	309-328	3/11 1/6	210-600 .250	297.4
		Cd	1/8	1.0			--
		Cu	2/8	7-14			5.25
		Phenol	3/16	1.1-1.7			.319
		Zn	2/7	37-120			27.53
		Fec. Col. Hg-tot.					126.2 .093
SUNY	ERIE 16	D0	2/114	5.6-5.8	2/114	5.6-5.8	9.21
		Cond.	4/28	310-390			297.2
		Zn	1/3	50			17.33
SUNY	ERIE 17	D0	31/271	2.4-5.9	31/27	2.4-5.9	8.89
		Cond.	1/42	311			289.3
		F	1/2	11.3			5.71
		Cd	2/8	1-2			--
		Cu	4/8	6-19			7.25
		Ni	2/8	100-130			7.5
Zn	1/8	195	25.75				
		Hg-tot.			1/5	.22	.132

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
INTAKE							
USEPA (G050)	J4108	Res.-Diss.			20/460	205-240	185.8
NEARSHORE							
PDER/ECDH (21PA)	WQN0622	Fe-tot. Res.-Diss.	1/2	350	1/2 1/3	350 204	285 191.3
MAIN LAKE							
USEPA (GLSB)	L. Erie 16	Cr Fe-tot. Ni Zn	1/7 1/7 1/7 1/7	71 314 27 34	1/7	314	15.57 91.4 9.0 16.43
USEPA (GLSB)	L. Erie 17	D0 Cond. Cd Hg-tot.	2/59 1/60 1/9	5.2-5.3 311 1.0	2/59	5.2-5.3 .3-.6	10.04 297.2 0.467 .325
USEPA (GLSB)	L. Erie 21	Cond. Cd Hg-tot.	1/46 3/8	310 1.0-2.0	3/4	.3	298.5 .6 .275

Responsible Agency	Station No.	Parameter	IJC Objectives			Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
USEPA (GLSB)	L. Erie 22	D0	1/45	5.8	1/45	5.8	9.75	
		Cond.	1/42	310			293.7	
		Cd	1/6	1.0			.5	
		Cr	1/6	5,550			931.17	
		Cu	1/6	112			20.33	
		Fe-tot.	1/6	22,800	1/6	22,800	3,846	
USEPA (GLSB)	L. Erie 23	Ni	1/6	2,800			472.83	
		Zn	2/6	44-50			23.67	
		Cd	3/6	1.0-2.0			.867	
		Zn	1/6	42			16.83	
		D0	1/52	4.4	1/52	4.4	10.03	
		Cond.	1/50	310			294.1	
USEPA (GLSB)	L. Erie 24	Cd	2/7	1.0			.57	
		Cr	1/7	84			19.29	
		Fe-tot.	1/7	337	1/7	337	105	
		Cond.	2/71	311-312			298.2	
USEPA (GLSB)	L. Erie 63	Zn	1/9	35	1/4	.6	16.78	
		Hg-tot.					.225	
USEPA (GLSB)	L. Erie 64	D0	1/43	5.5	1/43	5.5	9.58	
		Fe	1/5	1210	1/5	1210	331	
		Zn	1/5	35			17.2	

Responsible Agency	Station No.	Parameter	IJC Objectives		Pennsylvania Standards		Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
MAIN LAKE							
CCIW	C78ER038	D0	1/31	4.86	1/31	4.86	9.178
CCIW	C78ER043	D0	3/35	4.62-5.32	3/35	4.62-5.32	9.55
CCIW	C78ER062	D0	1/36	3.96	1/36	3.96	9.61

APPENDIX A-4

SUMMARY OF VIOLATIONS OF IJC OBJECTIVES AND
NEW YORK STATE STANDARDS
FOR LAKE ERIE WATER QUALITY

Source: STORET System

Responsible Agency	Station No.	IJC Objectives				New York Standards			Sample Mean
		Parameter	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
TRIBUTARY NYDEC	01 1040	Conduct.	6/11	310-480				320.65	
		Conduct.	3/15	310-335				290.7	
CONNECTING CHANNEL NYDEC	01 L010	Conduct.	29/157	310-350				297.9	
		Conduct.	5/7	1.0-30				5.714	
USGS	04219640	Cadmium	6/7	6.00-20.00				9.714	
		Copper	2/7	26-26				13.0	
		Lead	1/7	.50				.50	
		Mercury	1/7	40.0				28.57	
INTENSIVE NEARSHORE SURVEY SUNY	BAR 05	Conduct.	6/46	309-318				288.7	
		Nickel pH	1/7	63.0		16/37	8.52-8.70	16.71 8.463	
SUNY	BAR 06	D0	1/7	2.4				9.54	
		Conduct. Copper pH Nickel Zinc	11/152 6/47	310-316 6-6		18/44	8.52-8.75	292.4 3.875 8.425 19.63 48.38	

Responsible Agency	Station No.	Parameter	IJC Objectives			New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	BAR 07	DO	42/475	2.3-5.9	42/475	2.3-5.9	9.79		
		pH	1/63	9.45	19/63	8.51-9.45	8.357		
		Cond.	19/66	309-376			302.5		
		Nickel	1/6	42			13.33		
		Zinc	1/14	37			6.14		
SUNY	BAR 08	DO	46/352	1.4-5.9	46/352	1.4-5.9	9.45		
		Cond.	5/49	310-327			288		
		Nickel	2/8	67-110			28.38		
		Zinc	1/6	35			7.50		
		pH			19/46	8.55-8.75	8.432		
SUNY	BAR 09	DO	5/122	2.4-5.2	5/122	2.4-5.2	9.759		
		Cond.	4/48	309-313			292.9		
		Cadmium	2/8	1.0-2.0			3.125		
		Copper	2/8	6.0-9.0			4.750		
		Nickel	1/8	31			13.50		
SUNY	BAR 10	pH	2/8	36.0-36.0	17/46	8.51-8.75	8.432		
		Zinc					15.50		
		DO	2/98	3.0-4.8	2/98	3.0-4.8	10.034		
		Cond.	2/24	314-314			292.1		
		Copper	1/8	6.0			4.125		
SUNY	BAR 10	Nickel	1/8	270			41.25		
		Zinc	1/7	33			5.57		
		pH			11/23	8.51-8.75	8.486		

Responsible Agency	Station No.	Parameter	IJC Objectives			New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	
SUNY	BAR 11	D0	8/127	2.7-5.2	8/127	2.7-5.2	9.653		
		Cond. Nickel	5/47	309-324	18/45	8.51-8.80	292		
		pH	3/8	30-130	4/131	2.4-2.8	33.5		
SUNY	DUN 01	D0	4/134	2.4-2.8	4/131	2.4-2.8	9.621		
		Cond. Cadmium	4/47	310-315	1/7	603	290.7		
		Copper	1/8	1.0	20/46	8.52-8.80	3.0		
		Nickel	2/8	6.0-11.0	23/489	1.9-5.9	5.125		
		Zinc	2/8	63.0-67.0	14/74	8.55-8.80	24.13		
		pH	3/7	39.0-60.3	16/45	8.52-8.80	108.29		
SUNY	DUN 02	D0	23/489	1.9-5.9	23/489	1.9-5.9	9.899		
		Cond. Copper	19/71	309-369	3/141	3.1-3.7	299.7		
		Nickel	1/8	7.0	14/74	8.55-8.80	4.375		
		pH	2/8	49.0-50.0	16/45	8.52-8.80	18.13		
SUNY	DUN 03	D0	3/141	3.1-3.7	3/141	3.1-3.7	9.593		
		Cond. Cadmium	11/47	309-323	16/45	8.52-8.80	296.9		
		Copper	1/7	5.0	2/102	3.2-3.6	3.286		
		Nickel	1/8	6.0	2/102	3.2-3.6	4.25		
SUNY	DUN 04	pH	2/8	7.0-330.0	2/102	3.2-3.6	56.25		
		D0	2/102	3.2-3.6	2/102	3.2-3.6	8.408		

Responsible Agency	Station No.	Parameter	IJC Objectives				New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range		
SUNY	DUN 04	pH Cond.	1/26	2.34	7/26	2.34-8.75	8.046			
			2/25	318-360			292.1			
SUNY	DUN 05	DO Cond. Cadmium Copper Nickel Zinc pH	6/160	2.7-5.9	6/160	2.7-5.9	10.052			
			4/46	310-312			287.8			
			1/8	1.0			3.00			
			2/8	6.0-9.0			4.875			
			1/8	27.0			13.0			
SUNY	DUN 06	DO pH Cadmium Copper Nickel Tot. Alk.	2/6	63-109	15/43	8.58-8.72	8.383			
			6/126	2.0-4.6	6/126	2.0-4.6	9.50			
			1/45	9.1	12/45	8.51-9.1	8.285			
			1/9	1.0			3.228			
SUNY	DUN 07	DO Cond. Cadmium Copper pH	4/9	6.0-11.0	2/48	76.72-79.95	19.00			
			1/9	89			87.56			
			6/115	3.0-5.4	6/115	3.0-5.4	9.619			
			2/48	313-338			290.9			
			1/9	2.0			3.0			
SUNY	DUN 08	DO Cadmium Nickel	3/9	10.0-13.5	12/46	8.52-8.75	19.78			
							8.308			
			21/255	1.6-5.2	21/255	1.6-5.2	9.285			
			6.0			4.333				
			70-454			77.56				

Responsible Agency	Station No.	Parameter	IJC Objectives			New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range		
SUNY	DUN 08	Zinc pH	1/8	32.0	13/47	8.51-8.75	6.50 8.265		
	DUN 09	DO pH Cadmium Copper Nickel Zinc	8/181 1/45 1/8 1/9 2/8 3/8	2.0-5.9 1.0 1.0 7.0 70-410 39-150	8/181 14/45	2.0-5.9 1.0-8.96	9.486 8.199 3.0 4.662 67.88 31.25		
SUNY	DUN 10	DO Conduct. Cadmium Copper Nickel Zinc	1/70 2/26 2/22 3/9 2/9 1/9	4.6 349-349 1.0-1.0 7.0-15.0 31-150 331	7/70	4.6-4.6	9.429 295.3 3.222 6.444 26.67 42.11 8.362		
	DUN 11	pH DO pH Conduct. Copper Nickel Zinc	10/175 2/45 2/52 1/9 2/9 1/9	1.80-5.70 9.11-9.11 309-311 6.0 40-71 263	10/175 15/45	1.80-5.70 8.55-9.11	9.150 8.405 289.1 4.556 22.0 33.67		
SUNY	DUN 12	DO pH	1/62 1/22	5.2 9.05	1/62 3/22	5.2 8.55-9.05	8.908 8.240		

Responsible Agency	Station No.	Parameter	IJC Objectives		New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range	
SUNY	DUN 12	Conduct. Copper Nickel	14/24 2/9 1/9	312-392 6.0-6.0 110				321.0 4.778 19.89
MAIN LAKE								
CCIW	C78ER001	D0	1/25	5.88	1/25	5.88	9.96	
CCIW	C78ER002	D0	1/25	3.29	1/25	3.29	10.086	
CCIW	C78ER003	D0	4/38	4.93-5.93	4/38	4.93	9.308	
CCIW	C78ER005	D0	1/43	5.24	1/43	5.24	9.696	
CCIW	C78ER006	D0	5/32	12-5.69	5/32	2.12-5.69	9.083	
CCIW	C78ER016	D0	1/48	5.77	1/42	5.77	10.24	
CCIW	C78ER018	D0	1/34	5.28	1/34	5.28	9.472	
CCIW	C79ER001A	D0			14/299	1.4-5.94	8.074	
USEPA	L. Erie 03	Cadmium Iron	1/6 1/6	50.4 397	1/6	397	8.733 95.7	
USEPA	L. Erie 04	Cadmium pH	1/6	.5	15/43	8.54-8.88	1.0 8.468	

Responsible Agency	Station No.	Parameter	IJC Objectives		New York Standards			Sample Mean
			Violations per Sample Total	Violations Range	Violations per Sample Total	Violations Range	Violations Range	
USEPA	L. Erie 05	D0	2/56	5.2-5.5	2/56	5.2-5.5	9.932	
		Conduct.	1/56	309			295.7	
		Cadmium pH	1/8	1.0	13/56	8.52-8.81	.475	
USEPA	L. Erie 06	D0	3/51	4.1-5.9	3/51	4.1-5.9	9.656	
		Cadmium pH	1/9	1.0	15/55	8.57-8.84	.467	
USEPA	L. Erie 07	Cadmium	4/9	1.0-50.40	14/59	8.51-8.76	6.156	
		Lead pH	1/9	36.0			9.33	
USEPA	L. Erie 08	Cadmium	3/7	1.0-1.0			.657	
		Chromium	1/7	183			33.71	
		Copper	1/7	11			3.714	
		Iron	1/7	819	1/7	819	167.4	
		Nickel pH	1/7	104	17/21	8.51-8.87	20.0	
USEPA	L. Erie 09	Conduct.	2/3	309-307			297.8	
		Chromium	1/10	218			29.10	
		Copper	1/10	12.0			2.70	
		Iron	1/10	986	1/10	986	150.0	

