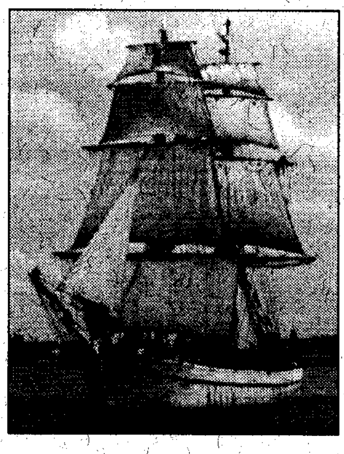
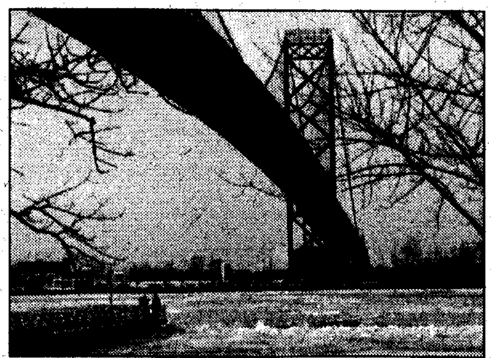
1996 Detroit River Remedial Action Plan Report





1996 Detroit River Remedial Action Plan Report

"Clean-up of the Detroit River depends on an involved citizenry in both the United States and Canada. Only with public interests and action, can we expect governments and industry to commit the resources necessary for clean-up. A river free of toxic chemicals with fish and wildlife habitat restored are goals worth working for. We hope this binational plan helps to move us quickly toward these goals".

Mike Walsh, Chairperson,
Binational Public Advisory Council

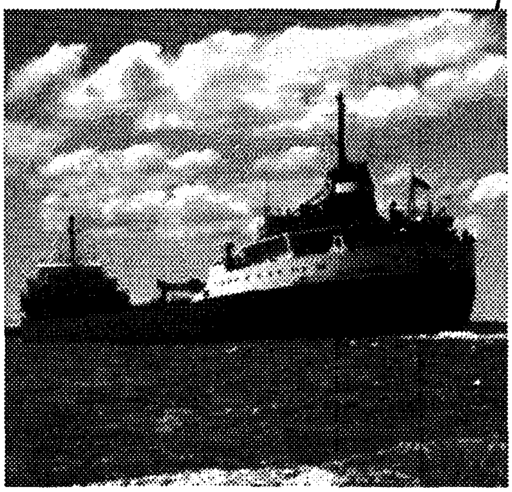


Table of Contents

List of Tables

List of Figures

List of Acronyms

307	Sites Sites of environmental contamination under Michigan Public Act 307 of 1982, now Part 201 of PA 451 of 1994
Act 245	Michigan Public Act 245 of 1929, now Part 31 of PA 451 of 1994
ACV	Aquatic Chronic Value
ACP	Agricultural Conservation Program
AOC	Area of Concern
AQD	Air Quality Division
BAT	Best Available Technology
BCT	Best Conventional Treatment
BHC	Benzene Hexachloride
BIP	Beach Improvement Program
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BPAC	Binational Public Advisory Council
BPJ	Best Professional Judgment
BPT	Best Practicable Treatment
CAS	Chemical Abstract Service Number
Cd	Cadmium
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COA	Canada/Ontario Agreement
COE	U.S. Army Corps of Engineers
CRV	Cancer Risk Value
CSO	Combined Sewer Overflow
Cu	Copper
CWA	Clean Water Act
CWIP	Clean Water Incentives Program
DDD	A breakdown product of the pesticide DDT
DDE	A breakdown product of the pesticide DDT
DDT	Dichlorodiphenyltrichloroethane
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DWF	Dry Weather Flow
DWSD	Detroit Water and Sewage Department
EC	Environment Canada
EMAP	U.S. EPA Environmental Monitoring and Assessment Program
EMS	Enforcement Management System

EPA	United States Environmental Protection Agency
ERCA	Essex Region Conservation Authority
ERD	Environmental Response Division
FAV	Final Acute Value
FC	Fecal Coliform Bacteria
FDA	U.S. Food and Drug Administration
FY	Fiscal Year
GEM	Groundwater Education in Michigan
GIS	Geographic Information System
GLISP	Great Lakes International Surveillance Plan
GLCF	Great Lakes Cleanup Fund
GLPF	Great Lakes Protection Fund
GLWQA	Great Lakes Water Quality Agreement
HCB	Hexachlorobenzene
Hg	Mercury
I/I	Infiltration and Inflow
IJC	International Joint Commission
IPP	Industrial Pretreatment Program
LaMP	Lakewide Management Plan
LC50	Lethal concentration to 50% of a population
LRPCP	Little River Pollution Control Plant
LWMD	Land and Water Management Division
MAP	Municipal Assistance Program
MCL	Maximum Contaminant Level
MDA	Michigan Department of Agriculture
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDPH	Michigan Department of Public Health
MERA	Michigan Environmental Response Act
MGD	Million Gallons per Day
mg/l	Milligrams per liter
MIRIS	Michigan Resources Inventory System
MISA	Municipal/Industrial Strategy for Abatement
MOEE	Ontario Ministry of the Environment and Energy
MOU	Memorandum of Understanding
MSU	Michigan State University
MT	Metric Tons

NBS	National Biological Survey
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng/l	Nanograms per liter
NH_3	Ammonia
NIP	National Information Program
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPS	Nonpoint Source
NWI	National Wetlands Inventory
O & M	Opperation and Maintenance
OCWA	Ontario Clean Water Agency
OMAF	Ontario Ministry of Municipal Affairs
OMNR	Ontario Ministry of Natural Resources
PAH	Polynuclear Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyls
PCP	Pollution Control Plan
PEAS	Pollution Emergency Alerting System
PERM	Program for Effective Residuals Management
pH	Hydrogen Ion Concentration
POTW	Publicly Owned Treatment Works
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per trillion
PRP	Potentially Responsible Party
RAP	Remedial Action Plan
RC&D	Resource Conservation and Development
RCRA	Resource Conservation and Recovery Act
RIF	Recreational Improvement Fund
RI/FS	Remedial Investigation/Feasibility Study
SEMCOG	Southeast Michigan Council of Governments
SPCC	Spill Prevention Control and Countermeasure
SRF	State Revolving Funds
SS	Suspended Solids
SWQD	Surface Water Quality Division
TCDD	Tetrachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran

TCDF	Tetrachlorodibenzofuran
TLSC	Terrestrial Life Cycle Safe Concentration
TSCA	Toxic Substances Control Agreement
TWG	Technical Workgroup
ug/l	Microgram per liter
UGLCCS	Upper Great Lakes Connecting Channels Study
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOC	Volatile Organic Chemical
WET	Whole Effluent Toxicity
WMD	Waste Management Division
Windsor PCP	Windsor Riverfront Pollution Control Planning Study
WSU	Wayne State University
WWPCP	West Windsor Polution Control Plant
WWTP	Wastewater Treatment Plant
Zn	Zinc

Conversion Formulas

Measures & Units

mg/L	=	milligrams per litre	=	part per million (ppm)
ug/L	=	microgram per litre	=	part per billion (ppb)
ng/L	=	nanogram per litre	=	part per trillion (ppt)
pg/L	=	picograms per litre	=	part per quadrillion (ppq)
ug/g	=	microgram per gram	=	part per million (ppm)
mg/kg	=	milligram per kilogram	=	part per million (ppm)
ug/kg	=	microgram per kilogram	=	part per billion (ppt)
ng/kg	=	nanogram per kilogram	=	part per trillion (ppt)

Metric Conversion Table

English		Metric
Length		
1 inch	=	2.54 centimeters
.039 inch	=	1 centimeter (10 millimeters)
1 foot (12 inches)	=	30.5 centimeters
1 yard (3 feet)	=	0.91 meters
1.09 yards	=	1 meter (100 centimeters)
Area		
1 square inch	=	6.45 square centimeters
0.15 square inch	=	1 square centimeter
1 square foot (144 square inches)	=	929 square centimeters
1 square yard (9 square feet)	=	0.84 meters
1.20 square yards	=	1 square meter (10,000 square centimeters)
1 acre (4,840 square yards)	=	0.40 hectares
2.47 acres	=	1 hectare (10,000 square meters)
Volume		
1 acre-foot (43,560 cubic feet)	=	1,233.6 cubic meters
Weight		
1 English ton (2,000 pounds)	=	0.91 metric ton
1.10 English tons	=	1 metric ton (1,000 kilograms)
Flow Rate		
1 cubic foot/second	=	28.32 liters/second
0.035 cubic foot/second	=	1 litre/second
1 cubic foot/minute	=	28.32 liters/minute
0.035 cubic foot/minute	=	1 litre/minute
1 gallon/minute	=	3.785 liters/minute
0.264 gallons/minute	=	1 liter/minute

Amount	Multiples and Submultiples	Prefixes	Symbols
1 000 000 000 000 000 000	10^{18}	exa	E
1 000 000 000 000 000	10^{15}	peta	P
1 000 000 000 000	10^{12}	ters	T
1 000 000 000	10^{9}	giga	G
1 000 000	10^{6}	mega	M
1 000	10^{3}	kilo	k
1 00	10^{2}	hecto	h
1 0	10	deka	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	p
0.000 000 001	10^{-9}	nano	n
0. 000 000 000 001	10^{-12}	pico	p
0. 000 000 000 000 001	10^{-15}	femto	f
0.000 000 000 000 000 001	10^{-18}	alto	a

Temperatures-Centigrade to Fahrenheit

Temperature in degrees centigrade is expressed in the left column and in the top row; the corresponding temperature in degrees fahrenheit is in the body of table.

Temp.°C.	0	1	2	3	4	5	6	7	8	9
0	32.0	33.8	35.6	37.4	39.2	41.0	42.8	44.6	46.4	48.2
10	50.0	51.8	53.6	55.4	57.2	59.0	60.8	62.6	64.4	66.2
20	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2
30	86.0	87.8	89.6	91.4	93.2	95.0				

For intermediate temperatures or those exceeding the range of the tables, the following formulas may be used:

$$F = 1.8 \times C = 32, \qquad C = \frac{F - 32}{1.8}$$

Temperatures-Fahrenheit to centigrade

Temperature in degrees fahrenheit is expressed in the left column and in the top row; the corresponding temperature in degrees centigrade is in the body of table.

Temp.°F.	0	1	2	3	4	5	6	7	8	9
30	-1.1	-0.6	0.0	0.6	1.1	1.7	2.2	2.8	3.3	3.9
40	4.4	5.0	5.6	6.1	6.7	7.7	7.8	8.3	8.9	9.4
50	10.0	10.6	11.1	11.7	12.2	12.8	13.3	13.9	14.4	15.0
60	15.6	16.1	16.7	17.2	17.8	18.3	18.9	19.4	20.0	20.6
70	21.1	21.7	22.2	22.8	23.3	23.9	24.4	25.0	25.6	26.1
80	26.7	27.2	27.8	28.3	28.9	29.4	30.0	30.6	31.1	31.7
90	32.2	32.8	33.3	33.9	34.4	35.0	35.6	36.1	36.7	37.2

Web Site Reference

Argonne National Laboratory
A database of research opportunities in pollution prevention and environmental technologies. WWW:"http://www.anl.gov/LabDB/anlprogcap.html" or "http://www.anl.gov". Call 708-252-5575 for further information.

Center for Green Design and Manufacturing
Sponsored by the University of California, Berkeley, this site includes abstracts of current publications and research projects on green design used in industrial engineering. WWW: "http://euler.berkeley.edu/green/cgdm.html".

EcoGopher
Sponsored by the University of Virginia, this is a virtual library of environmental information from universities worldwide. Gopher: "ecosys.drdr.virginia.edu". Select: The Library.

Environmental Protection Agency
Main access to the EPA's on-line resources, including regulations, standards and information locators. WWW: "http://www.epa.gov". Gopher: "gopher.epa.gov". FTP: "ftp.epa.gov".

Environmental Protection Agency Online Library System
Databases of EPA documents and services. Telnet: "epaibm.rtpnc.epa.gov". Select: Public Access Applications Menu EPA National Online Library System.

Enviro$sense
EPA-sponsored, free, environmental information system with a wide variety of databases on technical environmental information. Text can be searched from anywhere on the site. This source also includes extensive information on solvent alternatives. WWW: "http://wastenot.inel.gov/envirosense". BBS: 703-908-2092. For help, call the hotline at 703-908-2007 or call the system managers: Louis Paley, 202-260-4640 for BBS, or Myles Morse 202-260-3161 for WWW.

Global Recycling Network
A commercial service that lists recyclable materials worldwide - a global materials exchange. This site is relatively new, but has great potential as a commercial marketplace. WWW: "http://grn.com/grn/ora.html".

Industry ONLINE
A commercial bulletin board service serving the plastic, chemical, tooling, packaging and recycling markets. System offers postings for scrap plastics, used machinery, manufacturers' catalogs and order entry, forums, resin library, open bid section and many other features. WWW: "http://www.IndustryONLINE.com/IOL". FTP: "198.110233.250" and get file MHT_150.EXE, or call 1-800-628-8666 for assistance.

MSDS Central
On-line database of Material Safety Data Sheets available from the Chemical Manufacturers Association (CMA). For access information call CMA at 1-800-388-6737.

NORTEL Habitat (Northern Telecom)
This is an on-line platform for a wide range of corporate environmental issues, including international environmental standards. WWW: "http://www.nortel.com.80/english/environ/habitat.html".

Technology Transfer Network
Another EPA on-line service with 18 bulletin boards created and managed by the EPA's Office of Air Quality Planning and Standards. This service provides information on air quality that ranges from Clean Air Act updates to new control technologies, including access to free engineering assistance. Modem: call 919-541-5742. Telnet: "ttnbbs.rtpnc.epa.gov". For more information or assistance call the help desk at 919-541-5384.

Glossary

Acute Toxicity: Mortality that is produced within a short period of time, usually 24 to 96 hours.

Algae: Simple, rootless plants found in natural waters that grow in relative proportion to the amount of nutrients available. Sudden growth spurts, or blooms, can adversely affect water quality.

Area of Concern: A geographic area within the Great Lakes basin designated by the U.S. and Canadian governments where the environmental quality has been degraded, and the area's ability to support aquatic life has been diminished, or beneficial uses of the water have been impaired.

Benthic: Occurring at the bottom of a body of water.

Benthos: Bottom dwelling organisms.

Bioaccumulation: The accumulation and concentration of certain persistent chemicals in a food chain. By means of this process, extremely small quantities of certain persistent chemicals in water are known to concentrate along a food chain. Concentrations of these chemicals are magnified at the top of the food chain (e.g., fish in an aquatic ecosystem).

Biochemical Oxygen Demand (BOD): The decrease in oxygen content in milligrams per liter of a sample of water kept in the dark at a certain temperature over a specified period of time. This consumption of oxygen is brought about by the bacterial breakdown of organic matter. As a rule, BOD is measured after 5 days (BOD5), at which time 68% of the final value has usually been reached.

Caddisfly: A small moth-like fly whose immature forms live in freshwater. Immature caddisflies can be found in nearly all types of unpolluted aquatic habitats. Caddisflies are among those organisms that water pollution biologists refer to as clean-water-associated.

Chlorides: A form of chlorine that is produced when salt is dissolved in water. Chlorides in high concentrations produce a brackish taste in water.

Chlorophyll: A green pigment of plants. In the presence of sunlight, it converts carbon dioxide and water into carbohydrates.

Chronic Toxicity: Toxicity marked by a long duration, that produces an adverse effect on organisms. The end result can be death but the usual effects are sublethal.

Clean Water Act: The common name for the U.S. Federal Water Pollution Control Act of 1977. Enacted to "restore and maintain the chemical, physical, and biological integrity of the nations waters."

Combined Sewer Overflow: A discharge of a mixture of raw sewage and surface runoff directly to a body of water. In dry weather, combined sewers carry only sanitary sewage to a treatment plant. However, during wet weather these sewers carry storm water as well. If the flow is excessive, the sewage/storm water combination overflows directly into the receiving waters.

Concentration: Expression of the weight of a substance per unit volume of water, sediment or body material (example – milligrams per liter).

Connecting Channels: A stream or river connecting two larger bodies of water. The connecting channels of the Great Lakes include the St. Marys, St. Clair, Detroit, Niagara and St. Lawrence rivers, and Lake St. Clair.

DDT (dichlorodiphenyltrichloroethane): A highly toxic, chlorinated hydrocarbon insecticide. DDT is now banned from use, but residual amounts remain in the aquatic environment from its long history of use and environmental persistence.

Dieldrin: A highly toxic persistent insecticide.

Effluent: As used in this report, effluent refers to the wastewater discharged from point sources into the aquatic environment.

Eutrophic: A state of lake or stream productivity characterized by high nutrient levels, heavy plant growth, and low oxygen levels.

Eutrophication: A sequence of changes that gradually enrich natural waters with plant nutrients. This is the natural "aging" process of a lake which can be accelerated by human activities.

Fecal Coliform: Species of bacteria that are present in the digestive tracts of humans and other warm-blooded animals. These are not disease producers, but great numbers of these bacteria indicate unsanitary conditions where disease-causing organisms may also be present.

Limiting Nutrient: The nutrient most critical to growth. This nutrient will limit the amount of productivity within a lake or stream.

Loading: A unit describing the total mass of a substance carried at a given point in a river during a unit time (example-kilograms per day).

Macroinvertebrates: Invertebrate animals large enough to be seen by the unaided eye, which live at least part of their life cycles within or upon available substrates in a body of water or water transport system.

Mayfly: Insects with fragile bodies and slender tails that can be quite abundant in ponds and streams. The immature form of this insect can be found in nearly all types of unpolluted aquatic habitats. Mayflies are among those organisms that water pollution biologists refer to as clean-water-associated.

Mesotrophic: A state of lake productivity characterized by moderate levels of nutrients, moderate growth and intermediate levels of oxygen.

Milligrams per liter (mg/l): The most common unit of concentration used in water quality, equal to one milligram of a substance in a liter of water. If sixty pounds of salt were dissolved in a block of water 100 feet wide, 100 feet long, and 100 feet deep, the concentration would be approximately 1 mg/l.

Nitrates or nitrate nitrogen: The final product of the biological breakdown of organic nitrogen compounds. The form of nitrogen most readily usable by plants.

Nonpoint Source: Discharge that does not enter the watercourse at a fixed point, such as surface runoff from precipitation or atmospheric deposition.

NPDES (National Pollutant Discharge Elimination System) Permits: Permits issued by the Michigan Department of Environmental Quality which authorize the discharge of wastewater. They stipulate the quality of the discharge and set time limits for compliance.

Nutrients: Any of a group of elements necessary for growth. Although over 15 elements have been identified as necessary for the growth of aquatic plants, phosphorus is usually the limiting nutrient in Michigan surface waters.

Oligotrophic: A state of lake productivity characterized by clear water, low nutrient levels and high oxygen levels.

Parameter: A measurable quantity whose value varies with place and time.

Phosphorus: An element that can affect water quality. In one of its forms, it can be used by algae in a stream or lake as a nutrient.

Point Source: A discharge of wastewater from a fixed point such as a municipal or industrial plant effluent pipe.

Pollution-tolerant: Able to withstand polluted conditions.

PCBs (Polychlorinated Biphenyls): A class of toxic organic compounds containing one or more atoms of chlorine. These are resistant to high temperatures and do not break down in the environment. They are also widely distributed in the environment and food chains.

Species Diversity: An ecological measurement which combines the number of species present in a community (species richness) with the relative abundance of the species.

Total Phosphorus: A measure of the total amount of inorganic and organic phosphorus in natural waters.

Toxic Material: A substance or compound that is poisonous.

Turbidity: A cloudy condition in water due to the suspension of silt or finely divided organic matter.

Water Quality Standard: A water quality standard is a level of water quality that must be met to ensure that a stream or lake can be used for its designated uses (i.e., swimming, fishing, water supply).

Watershed: Land areas that drain into a common lake or stream.

1 RAP Strategies

"If RAPs did not exist we would have to invent them! Focus is everything when it comes to undertaking ambitious projects, and RAPs provide that focus in meeting significant environmental challenges such as we find on the Detroit River. The RAP Process focuses the energies of multiple stakeholders on important issues and, thus, provides invaluable help in moving the agenda forward."

Tracy Mehan
Director, Office of the Great Lakes
Michigan Department of Environmental Quality

Work Plan

The work plan for the Detroit River Remedial Action Plan (RAP) and its development are detailed in Appendix 1.1. This work plan was developed to produce a complete Stage 2 report as outlined in Annex 2 of the Great Lakes Water Quality Agreement (GLWQA) of 1978 as amended in 1987. This plan was accepted by all involved parties in the fall of 1992 .

The original work plan allowed almost two years for the development of the Stage 2 report and a one year review period. The RAP Co-Coordinators proposed, in the Spring of 1994, a revised schedule (Appendix 1.2) that extended slightly the time for development of the document while reducing the review period prior to forwarding the document to the International Joint Commission (IJC) and holding formal public comment sessions. This revised schedule was endorsed by the BPAC (April 27, 1994 meeting) and the RAP Team (March 30, 1994 meeting) with the understanding that the document would meet Stage 2 and COA steering committee requirements.

RAP Process

The revised schedule for the Detroit River RAP was based in part on Michigan's streamlined approach for RAP development; however, this revision affected only the review of the document. Under the new Michigan strategy less emphasis is placed on producing documents while stressing the implementation of remedial actions. The Michigan streamlined approach calls for biennial reports to be submitted to the IJC detailing progress and achievements in the RAP process. Each report contains the appropriate elements from all three stages of RAP development as outlined in Annex 2 of the GLWQA. It is felt that this approach more accurately reflects remedial efforts in complex systems such as the Detroit River Area of Concern. Details of the Michigan Streamlined approach and its development are included as Appendix 1.3. The Michigan approach parallels recent changes made by the other Great Lakes states to their RAP processes.

In Canada, the development of a complete Stage 2 is done in two steps. The first step involves the development of a "Recommended Plan"which represents an agreed upon plan of what needs to be done along with a proposed implementation framework. As a second step an "Implementation Annex" is developed which includes commitments from all implementors and a timetable for implementation. The Implementation Annex is then added to the existing Recommended Plan, thereby completing Stage 2. The complete Stage 2 is then formally transmitted to the International Joint Commission by Canada's Minister of External Affairs.

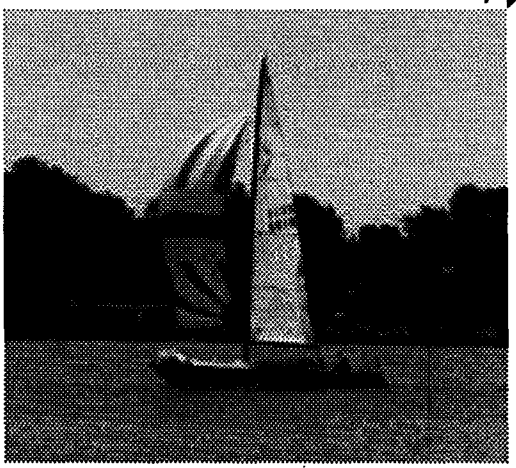
In an effort to accommodate the differing approaches to RAP development in the binational RAPs a meeting was held in December 1994 involving representatives from the U.S. Environmental Protection Agency (US EPA), Environment Canada, Michigan Department of Natural Resources (MDNR), and Ontario Ministry of Environment and Energy (MOEE) to discuss the connecting channel RAPs common to Michigan and Ontario. A small group from this meeting was requested to discuss and resolve specific issues concerning the Detroit River RAP process. The small group met on January 18, 1995 and reached consensus on the content and context of the RAP document as well as on a list of specific activities, deliverables and a timeline. It is the intention that this iteration of the Detroit River RAP will fulfill the requirements of a Michigan Biennial Report and an Ontario Recommended Plan. It is the intent of MOEE that the next Biennial Report will fulfill the requirements for an Ontario Implementation Strategy.

Each of the four Technical Work Groups was charged with identifying a time line, the cost and funding source, and a party responsible for the implementation of each of their recommendations. This was not possible in all cases. Further, commitments for implementing the recommendations have not yet been pursued. This will be a focus of the next biennial report.

2 Executive Summary

"We at the local level–more than any other level of government, are responsible for the health, safety and welfare of our citizens. This mandate, includes the protection of our water, air and land resources for their recognized beneficial uses established by our citizens. Local governments which have chosen to protect and preserve their natural resources and pursue sustainable development, provide their citizens with areas in which to reside and work and clean natural areas in which to recreate, resulting in an enhanced quality of life for the people of our communities."

Michael D. Hurst
Mayor, City of Windsor



Annex 2 of the Great Lakes Water Quality Agreement (GLWQA) of 1978, as amended by protocol in 1987, details the principles and requirements of Remedial Action Plans (RAPs) which must be prepared for each of the 42 Areas of Concern (AOC) within the Great Lakes Basin. AOCs are those areas where the beneficial uses of the water body have been impaired due to anthropogenic causes. RAPs are essentially site clean up plans which are developed through a partnership of federal, state, provincial, and local agencies, technical experts, special interest groups and the local citizens.

The Detroit River has been designated as an AOC. Since the Detroit River serves as the boundary between the United States and Canada, the RAP process is carried out through binational cooperation. A Stage 1 document which described the environmental problems of the area was submitted to the International Joint Commission in 1991. The current document reports on progress in the AOC since the Stage 1 was completed.

Description of the Detroit River Area of Concern

The Detroit River is part of the international boundary between the United States and Canada. The Detroit River is a 32 mile long channel linking Lake St. Clair and the upper Great Lakes to Lake Erie (Map 1, General Location Map of the Detroit River AOC). The 807 square mile Detroit River Area of Concern (AOC) includes: the areas which drain directly to the river and the drainage area of its tributaries in Michigan and Ontario (700 square miles); and an additional City of Detroit sewershed area of 107 square miles (Map 2, Detroit River AOC). Approximately 75 percent of the total land area of the watershed is in Michigan (607.7 square miles).

Within the Detroit River AOC, there are five Michigan tributaries and three Ontario tributaries. Combined, these tributaries account for less than 5% of the flow into the Detroit River. The Rouge River (Michigan) is the largest tributary, draining an area of approximately 467 square miles or more than half of the drainage basin. However, the Rouge River is an Area of Concern with its own RAP in development and so is considered a point source for the purposes of the Detroit River RAP.

Land use in the Detroit River AOC differs significantly in Michigan and Ontario. Almost 10% of Michigan's land use is commercial or industrial, compared to 2% in Ontario. Thirty percent of the Michigan portion of the AOC (approximately 180 square miles) is undeveloped or used for agricultural purposes, compared to 90% in the Ontario portion of the AOC (also approximately 180 square miles). The population within the Detroit River drainage basin is approximately four million people, with approximately 87 percent of the total living in the U.S. mostly centered around the City of Detroit.

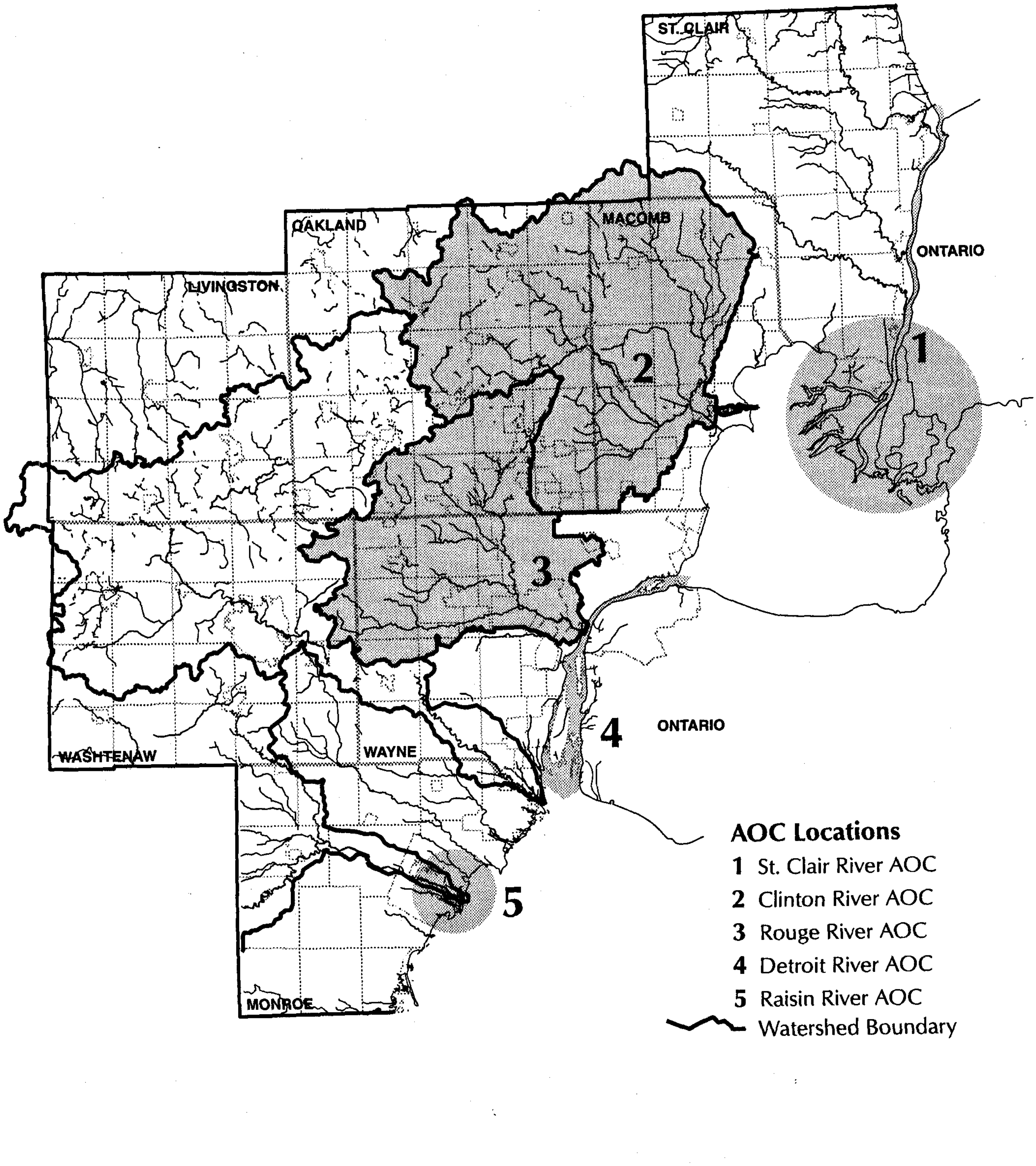
The Detroit River is used extensively for diverse activities and needs including commercial navigation, industrial and municipal drinking water supply, recreational activities, and as a receiving water for treated industrial and municipal wastewater. While agriculture is a major activity in the watershed, agricultural use of the Detroit River is minimal.

The Detroit River RAP Stage 1 Report (MDNR 1991) contains a detailed description of the Area of Concern. Updates of the Stage 1 description information are contained in chapter 5 and the appendices of this report.

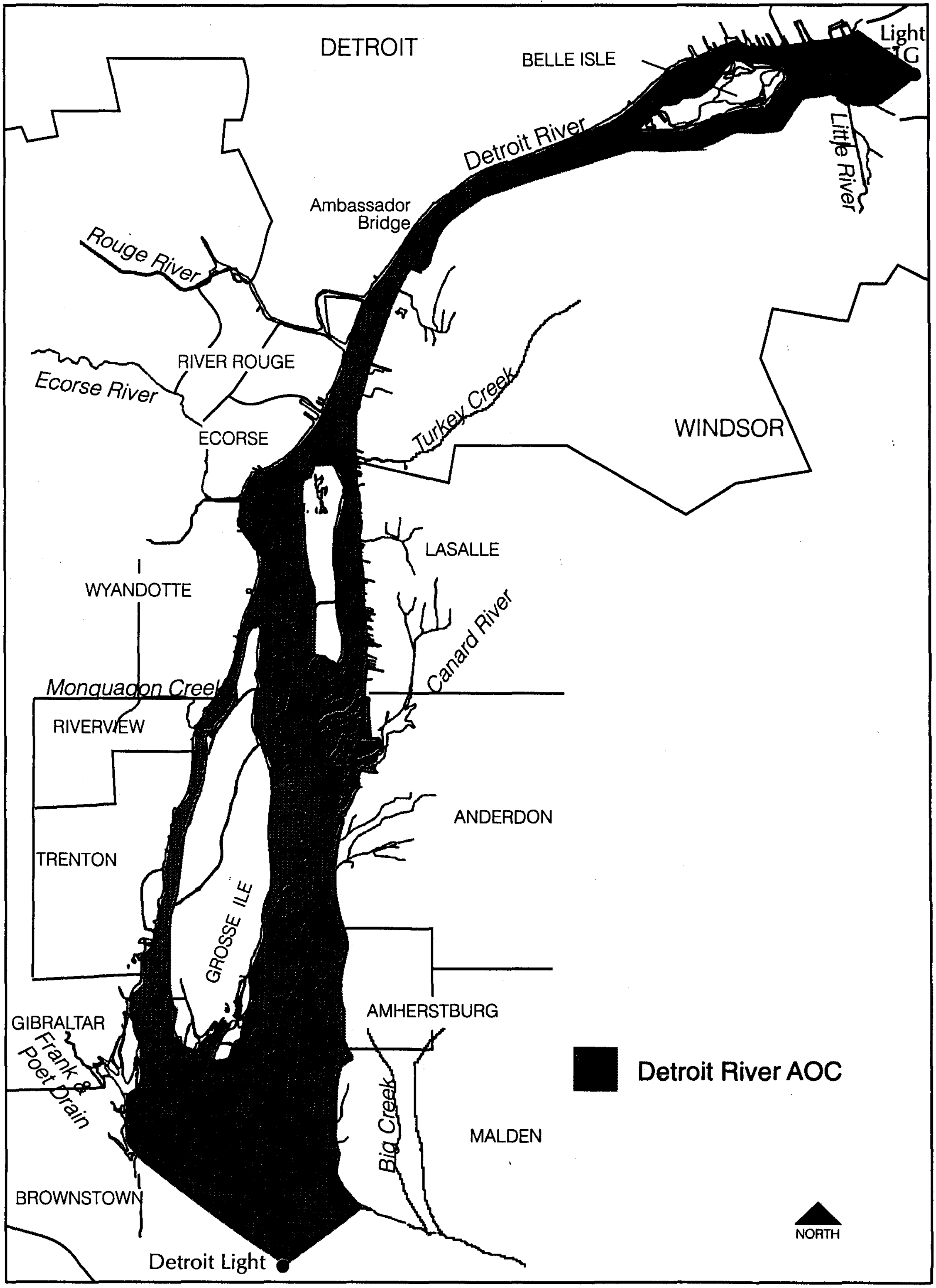
Overview of Area of Concern Issues

The Detroit River Stage 1 RAP outlined the AOC issues for the Detroit River. These issues included: contaminated sediments; point sources (both municipal and industrial discharges); non-point sources (stormwater runoff and air deposition); and combined sewer overflows (CSOs). Habitat issues, including the loss of habitat and potential impacts of existing water and sediment quality on biota are also of concern in this AOC. In addition to the Impaired Beneficial Uses, the Stage 1 Report notes additional environmental concerns including: the introduction of exotic species, changes in fish community structure, and reductions in wildlife populations (primarily due to the loss of habitat).

Map 1
General AOC Location Map



Map 2
Detroit River Area of Concern



The Upper Great Lakes Connecting Channels Study (UGLCCS) and Stage One Report identified upstream inputs as contributing the largest proportion of many contaminants when compared to the classes of inputs within the AOC (Michigan and Ontario - Point Sources, CSOs, stormwater, and tributaries). This is due to the large volume of water that enters the Detroit River from the upper Great Lakes via Lake St. Clair (Hartig and Law 1994). In recognition of this situation Detroit River General Water Use Goal 3 states in part that while some impaired beneficial uses will require a basin wide effort for remediation, local efforts should not be delayed and will enhance the basin wide approach (page 13).

Parameters identified in UGLCCS as having large upstream sources include: suspended solids, zinc, nickel, mercury, copper, HCB, chloride, phosphorus, PCBs, and silica (UGLCCS 1988, Volume II, Fig. IX-21). Stage 1 identifies the following parameters as having large upstream inputs: PCBs, suspended solids, nickel, zinc, cyanide, copper, phosphorus, iron, HCB, and OST (Detroit River RAP Stage 1 Report, page 480, and Figure 8-18, page 471). The Detroit River AOC is still a significant contributor of most of these parameters. Parameters that were identified in the Stage 1 as having a higher proportion of input from within the Area of Concern included: mercury (Michigan CSOs), phenols (Michigan point sources), and chlorides (Ontario point sources).

Remedial Action Plan Process

In 1987, the United States and Canadian governments signed a Protocol amending the Great Lakes Water Quality Agreement (GLWQA). Annex 2 of the GLWQA requires the development and implementation of Remedial Action Plans (RAPs). These RAPs are to serve as an important step toward the virtual elimination of persistent toxic substances and toward restoring and maintaining the chemical, physical and biological integrity of the Great Lakes Basin ecosystem. Eight elements and three stages of RAP development are outlined in the GLWQA. The International Joint Commission (IJC) is charged with reviewing and commenting on each RAP at the completion of each stage.

The first stage includes: 1) a definition and detailed description of the environmental problem in the AOC, including a definition of the beneficial uses that are impaired, the degree of impairment and the geographical extent of the impairment; and 2) a definition of the causes of the use impairment, including a description of all known sources of pollutants involved and an evaluation of other possible sources.

The second stage includes: 1) an evaluation of remedial measures in place (RAP Stage 1 and TWG reports); 2) an evaluation of alternative additional measures to restore beneficial uses (Priority Recommendations); 3) a selection of additional remedial measures to restore beneficial uses and a schedule of their implementation (Secondary Recommendations); 4) an identification of the persons or agencies responsible for implementation of remedial measures (TWG Reports and Priority Recommendations); 5) a process for evaluating remedial measure implementation and effectiveness (RAP Management Structure); and 6) a description of surveillance and monitoring processes to track the effectiveness of remedial measures and the eventual confirmation of the restoration of uses (RAP Management Structure).

The third stage is submitted when monitoring indicates that identified beneficial uses have been restored. The monitoring process is continued to insure that beneficial uses remain unimpaired.

Detroit River RAP Process

The Detroit River RAP is a binational effort with both Americans and Canadians working together to clean up the river. The Michigan Department of Environmental Quality (MDEQ) has been designated as the lead agency in the development of the Detroit River RAP through a "letter of intent" signed by the Governor of Michigan and the Premier of Ontario. A Stage 1 RAP for the Detroit River was completed in June 1991.

The federal, state, and provincial agencies have agreed to report to the public and the IJC through a series of Biennial Reports. Each Biennial Report will detail the plans, progress, and environmental assessments of the preceding two years. This report is the first of the Biennial Reports since the completion of the Stage 1 document and will also fulfill the requirements of a Canadian Recommended Plan. The Ontario RAP Coordinator will garner input to insure that the next Biennial Report will fulfill the requirements of a Canadian Implementation Annex and the Michigan RAP Coordinator will likewise insure that Michigan's requirements are met.

The Detroit River RAP Biennial Report was developed cooperatively by members of the Binational Public Advisory Council (BPAC), the RAP Team, interested citizens, and other technical experts. Four Technical Work Groups (TWGs) were formed to address the major Detroit River RAP issues (Habitat, Contaminated Sediments, Combined Sewer Overflows, and Point and Nonpoint Sources). The final report and recommendations of each TWG have been incorporated as portions of this Report (Chapters 7 - 10). The work plan for the Detroit River RAP and it's development are detailed in chapter 1 of this report and it's appendices.

The BPAC consists of representatives of special interest groups and the general public. There are currently 25 members from Michigan and 25 members from Ontario. It is the responsibility of the BPAC to provide diverse public input to the Detroit River RAP process, and to disseminate RAP information back to their representative groups. The BPAC also advises the RAP Team on RAP development and issues. Chapter 6 of this report details information on the Detroit River BPAC and public involvement and education efforts of the Detroit River RAP process.

The RAP Team consists of representatives from the federal, state, and provincial agencies impacted by or impacting RAP activities. There are also four BPAC representatives on the RAP Team. The RAP Team is responsible for insuring the development and content of the RAP documents and process.

Membership on Technical Work Groups, or TWGs, is open to RAP Team and BPAC members, other agency representatives, technical experts, and the general public. TWG meetings were generally held during the day at alternating sites in the United States and Canada.

Detroit River Technical Work Group Summary

Habitat Technical Work Group

The Habitat TWG gathered information concerning the following beneficial use impairments/water use goals; Restrictions on fish and wildlife consumption, Tainting of fish and wildlife flavor, Degradation of fish and wildlife populations, Bird or animal deformities or reproductive problems, and Loss of fish and wildlife habitat (numbers 1, 2, 3, 5, and 14 respectively). The TWG recommended changing the status of "Tainting of fish flavors " (2) to "impaired" to reflect the results of an MDNR/MDPH study. This study indicated a low level of "off flavor" in walleye collected in the Trenton Channel of the Detroit River. The TWG also recommended changing the status of "Degradation of wildlife populations" (3) and "Bird or animal deformities or reproductive problems" (5) from "not impaired" to "unknown" to reflect incomplete or inconclusive information. The status of fish populations in the Detroit River remain as in Stage 1, "not impaired" but are an environmental concern. While changes in the population structure have been noted and some local populations may be impacted by the loss of habitat, the fishery remains strong and fully supports current management plans.

The Habitat TWG developed 25 recommendations to address beneficial use impairment/water use goal 14, the loss of fish and wildlife habitat, through two objectives:

- Preserve and protect existing habitat, and
- Restore and enhance habitat

The implementation of these actions should also increase fish and wildlife populations through the increase of available habitat.

Based on the draft OMNR document "Survey of Candidate Sites on the St. Clair and Detroit Rivers for Potential Habitat Rehabilitation and Enhancement" and professional judgement, the Habitat TWG selected 19 sites for habitat restoration and enhancement (Figure 4 Chapter 7). The TWG also developed the elements of a habitat biomonitoring plan (Table11 Chapter 7) for the Detroit River from their perspective. Prior to implementation this plan will be integrated with similar proposals from the other TWGs.

Contaminated Sediments Technical Work Group

The Contaminated Sediments TWG addressed two specific impaired beneficial uses; degradation of benthos (6), and restrictions on dredging (7). The TWG developed general objects and specific sediment quality objectives (Table 13 Chapter 8) which if achieved would meet the Water Use Goals for these two impairments. The TWG reviewed sediment data, reported on recent findings and ongoing work (both site assessment and modeling), and developed criteria to prioritize a list of "hotspots" which were identified through past sediment surveys. A final list of six priority sites or zones was determined based on mercury concentrations. Mercury was chosen due to it's bioaccumulativeness and the pathway to humans through fish consumption. The TWG proposed these six hotspots for immediate action by the respective agencies. Due to the complexity of the Detroit River sediments, the variation between sites, and the dynamic nature of sediment remedial technologies the TWG could not endorse specific remedial activities or assign cost to individual sites. Current technologies and costs are discussed in the TWG report.

Point Source/Nonpoint Source Technical Work Group

The Point Source/Nonpoint Source TWG focused on the six parameters that had been shown to have exceeded water quality standards/objectives at some time in the past (Water Use Goal 1a. and 1b.). These six parameters are; copper, cadmium, zinc, lead, mercury, and PCBs. The TWG also noted the impact of these six parameters on other beneficial use impairments including; Restrictions on fish consumption (1), Degradation of benthos (6), and Restrictions on dredging (7).

Based on the mass balance studies reported in the Upper Great Lakes Connecting Channels Study (UGLCCS), the loading estimates reported in UGLCCS and the Stage 1 Detroit River RAP, and past and ongoing efforts to control traditional point sources; the TWG focused it's attention on source control activities rather than additional end of the pipe treatment. While there is room for improvement in some facilities, in general, gains from additional treatment would be more costly and less productive than a similar level of effort directed towards source control. Source control also supports the philosophy of zero discharge and will lead to the goal of virtual elimination.

The TWG developed four general and seven parameter specific recommendations for point source dischargers in the Detroit River watershed. Fifteen recommendations for point source regulatory programs were also developed.

The TWG identified seven categories of nonpoint sources; soil erosion, urban stormwater, rural stormwater, air deposition, spills, remediation sites/landfills, and household hazardous waste. An eighth category, on site sewage disposal systems, was proposed by the Essex Region Conservation Authority (ERCA) and accepted by the TWG. For nonpoint sources the parameters of concern were not treated individually, rather treatment mechanisms which would be expected to reduce the loadings of all six of the parameters of concern to some degree were recommended. Loading reduction estimates from the implementation of these recommendations were for the most part not possible.

Combined Sewer Overflow Technical Work Group

The Combined Sewer Overflow TWG focused on the same six parameters of concern as the PS/NPS TWG. The CSO TWG developed CSO specific objectives for water use goals/beneficial use impairments 1, 6, 7, 10, and 11 (Restrictions on fish consumption, Degradation of benthos, Restrictions on dredging, Beach closings, and degradation of aesthetics respectively). The TWG also developed objectives for the exceedences of water quality standards/objectives (water use goals 1a, and 1b). The CSO TWG reviewed the current strategies designed to solve CSO problems, described and assessed the adequacies of the current CSO control activities and strategies, and described recommended remedial options that they believed should be used to address the Detroit River CSOs.

The CSO TWG placed their recommendations into the following four categories: Strategy and Policy, Programmatic, Education, and Characterization. The Strategy and Policy recommendations address recommended modifications, changes, or improvements to the existing MI Strategy and proposed Ontario Policy relating to how CSOs are managed (ten specific recommendations). Programmatic recommendations refer to modifications, changes, or improvements to specific programs or practices that can reduce or eliminate the volume and/or pollutant loadings of CSO discharges (seven specific recommendations). The Education recommendations address the need to disseminate information to municipalities, industries, and the general public concerning environmentally sound practices (two specific recommendations). Lastly, the Characterization recommendations identify the needed monitoring and surveillance necessary to characterize CSO discharges (two specific recommendations).

Beneficial Use Impairments/Water Use Goals

The GLWQA defines beneficial use impairments as "a change in the chemical, physical or biological integrity of the Great Lakes System sufficient to cause" a loss in a use(s) of the water. The Agreement defines 14 possible impairments to beneficial uses which may occur in an AOC. Table 2 contains a listing of the 14 impairments to beneficial uses listed in the GLWQA as well as the status of those impairments as listed in the Stage 1 document and the current status.

The Detroit River RAP has used water use goals to guide the development of this Biennial RAP Report (i.e. select remedial actions) and its implementation. The goals are statements of what the condition of the Detroit River should be after implementation of the remedial activities. The goals include a primary goal, three general goals and eighteen specific goals (Appendix 2.1). The primary and general goals are presented below. There is a specific water use goal based on each of the 14 impairments to beneficial uses listed in the GLWQA as well as four specific goals for ambient water quality. The specific goals, the corresponding beneficial use impairment, and associated monitoring programs are presented in Table 1 (Water Use Goals/Monitoring Programs for the Detroit River RAP). The Water Use Goals were jointly developed by the BPAC and RAP Team and subsequently endorsed by both in 1992.

Primary Water Use Goal

To restore and maintain the integrity of the Detroit River ecosystem to a standard that will provide a safe, clean and self-sustaining natural environment such that (1) self-reproducing, diverse biological communities are restored and maintained, and (2) the presence of contaminants does not limit the use or appreciation of fish, wildlife or waters of the river.

General Water Use Goals

1. The implementation of the RAP shall restore impaired beneficial uses in the Detroit River AOC. In addition, water quality shall be restored and maintained to meet the Objectives of the GLWQA, Michigan's Water Quality Standards and designated uses, and the Ontario Provincial Water Quality Objectives.
2. In the long term, it is the goal of the RAP to virtually eliminate the input of persistent toxic substances, through a control philosophy of zero discharge.
3. The implementation of the RAP shall restore impaired beneficial uses in the Detroit River AOC. Remedial actions, including the development of new initiatives and stronger enforcement of existing legislation, are needed to address point and non-point source discharges into all media that directly or indirectly impact the Detroit River. Possible impacts on other areas of the ecosystem (positive or negative) will be considered in the evaluation of remedial options. In addition, all aspects of the RAP should be integrated with the Lakewide Management Plans as developed by U.S. and Canadian federal governments. The RAP identifies some environmental problems for which complete remediation is only possible through a Great Lakes Basin approach (e.g., the control of zebra mussels and elimination of all fish consumption advisories). Local remediation efforts will enhance a basin-wide approach, and the RAP recognizes that local efforts should not be delayed.

Table 1
Water use goals/monitoring programs for the Detroit River RAP

GLWQA Beneficial Use Impairment	*Specific Water Use Goal*	*Existing Monitoring Program*
1. Restrictions on fish and wildlife consumption.	Levels of contaminants such as PCBs and mercury in fish tissue shall be less than MDPH and OMNR/MOEE action levels.	MDEQ Native Fish Trend Monitoring Program MDEQ and MOEE/OMNR Fish Contaminant Monitoring Programs
2. Tainting of fish and wildlife flavor.	No tainting	MDEQ/MDPH Fish Flavor Tests
3. Degradation of fish and wildlife populations.	To maintain a healthy, diverse and self-sustaining fish and wildlife community.	MDNR Fisheries, Wildlife Programs
4. Fish tumors and other deformities.	Liver and oral/dermal tumor incidence rates shall be no greater than rates at unimpacted control sites. Survey data shall confirm the absence of neoplastic or preneoplastic liver tumors.	Situational based studies
5. Bird or animal deformities or reproductive problems.	Deformities and reproductive problems shall be no greater than rates at unimpacted sites.	MDEQ Wildlife Division (Peregrine Project)
6. Degradation of benthos.	Establish and maintain benthic communities such that populations are diverse and appropriate for the physical characteristics of the area and include pollution tolerant organisms.	MOEE Sediment Benthic Analysis, MDEQ Trenton Channel Project ACOE Predredging tests
7. Restrictions on dredging activities.	Concentrations of pollutants in sediments shall be below levels that restrict dredging activities.	MOEE Sediment Benthic Analysis, MDEQ Trenton Channels Project
8. Eutrophication or undesirable aglae.	Nutrients from the river shall not impair uses downstream (nutrient loadings shall be consistent with the GLWQA).	MDEQ-SWQD Ambient Water Quality Monitoring
9. Restrictions on drinking water consumption, or taste or odor problems.	There shall be no taste or odor problems.	MDPH and MOEE Drinking Water programs
10. Beach closings.	All areas of the AOC shall be safe for total body contact activities. Bacteria levels shall meet MOEE/MDEQ criteria. There shall be no beach closings in the AOC or impacted areas in Lake Erie due to AOC contamination.	MDPH and local health units
11. Degradation of aesthetics.	Elimination of the discharges from CSOs and spills from point sources and nonpoint sources (into any media) such that debris and presistent objectionable deposits are not found in the river or along the shoreline. There shall be no visible oil sheens on the river from any discharge.	MDEQ-SWQD Permits MDNR/MDEQ Pollution Emergency Alert System (PEAS)
12. Added costs to agriculture or industry.	There shall be no added costs to agriculture or industry for water improvement.	None identified
13. Degradation of phytoplankton and zooplankton.	Assessment of nearshore populations of zooplankton shall indicate communities similar to those found in unimpacted control sites.	Situational-based studies
14. Loss of fish and wildlife habitat.	Wetlands shall be maintained at zero loss in the AOC, and no net loss of the productive capacity of fish habitats.	USACOE-MDEQ L&WMD (Permits), ERCA-OMNR wetlands management programs
15. Exceedances of ambient water quality standards/objectives.	Ambient water quality will not exceed current water quality standards/objectives.	MDEQ-SWQD ambient water monitoring

Revisions to Beneficial Use Impairments Since Stage 1 Report

The Detroit River RAP Stage 1 Report, completed in June 1991 identified eight beneficial use impairments in the Detroit River AOC (Table 2). In March 1992, the IJC reviewers presented their review and comments on the Stage 1 Report. Some of the IJC reviewers disagreed with the status listed for three of the beneficial use impairments. These were:

- Degradation of fish and wildlife populations. Five of the ten reviewers felt that the available data did not support a "no impairment" conclusion for either fish or wildlife populations.
- Bird or animal deformities or reproductive problems. One of the ten reviewers felt that studies supported an "impairment" conclusion, a second reviewer felt more studies were required to make a determination.
- Degradation of phytoplankton and zooplankton populations. One reviewer noted that bioassays in Trenton Channel suggest an "impairment" status.

For two other beneficial use impairments, some reviewers felt that the information base was lacking to be able to identify the beneficial use status. These were: Tainting of fish and wildlife flavor (2); and Added cost to agriculture or industry (12).

The Detroit River RAP Team responded to the IJC comments in January, 1992. In regards to degradation of plankton populations the RAP Team stated:

> "The bioassays referred to are not specifically identified, however the bioassays discussed in the RAP were laboratory tests using sediment elutriate or interstitial water (note: this is the water between the sediment particles). These assays are not designed to portray actual field conditions and are inappropriately interpreted as documentation of degraded phytoplankton or zooplankton populations."

Table 2
Beneficial use impairment status in the Detroit River Area of Concern

GLWQA Criterion	*Beneficial Use Impairment*	*Status of Impairment Stage One*	*Current Status of Impairment*
1	Restrictions on fish and wildlife consumption	Impaired (fish)	Impaired (fish)
2	Tainting of fish and wildlife flavor	Not Impaired	Impaired (fish)
3	Degradation of fish and wildlife populations	Not Impaired	Not Impaired (fish) Unknown (wildlife)
4	Fish tumors or other deformities	Impaired	Impaired
5	Bird or animal deformities or reproductive problems	Not Impaired	Unknown
6	Degradation of benthos	Impaired	Impaired
7	Restriction on dredging activities	Impaired	Impaired
8	Eutrophication or undesirable algae	Not Impaired	Not Impaired
9	Restrictions on drinking water consumption, or taste and odor problems	Impaired (taste and odor)	Impaired (taste and odor)
10	Beach closings	Impaired	Impaired
11	Degradation of aesthetics	Impaired	Impaired
12	Added costs to industry or agriculture	Not Impaired	Not Impaired
13	Degradation of phytoplankton and zooplankton populations	Not Impaired	Not Impaired
14	Loss of fish and wildlife habitat	Impaired	Impaired
15	Exceedance of water quality standards/objectives	Impaired	Impaired

Based on data collected and reviewed by the Technical Working Groups since 1991 and the Detroit River RAP Teams response to review comments, the status of three beneficial use impairments have been revised. They are:

- Tainting of fish and wildlife flavor (2). Changed from "not impaired" to "impaired" for fish.
- Degradation of fish and wildlife populations (3). Changed from "not impaired" to "unknown" for wildlife, fish populations status remains "not impaired".
- Bird or animal deformities or reproductive problems (5). Changed from "not impaired" to "unknown".

Changes in the status of "wildlife populations" and "bird deformities" were made in the recognition of the lack of data to support listing as either "impaired" or "not impaired". "Tainting of fish and wildlife flavor" was changed to reflect results from MDNR/MDPH studies (detailed in Chapter 5).

Achievability of Restoring Impaired Beneficial Uses

It is important for the Detroit River RAP to address sources of beneficial use impairments within the Detroit River AOC. This is acknowledged in the third general water use goal for the Detroit River which states in part "Local remediation efforts will enhance a basin-wide approach, and the RAP recognizes that local efforts should not be delayed." Like other connecting channels in the Great Lakes Basin, a large volume of water flows through the Detroit River AOC which originates outside the AOC watershed. Water flowing into the Detroit River from Lake St. Clair is a source of pollution to the AOC and therefore contributes to the beneficial use impairments. In some cases (e.g., fish consumption advisories), this input alone would cause the beneficial use impairment - remediating local sources of pollution will not fully restore the beneficial use. In other cases (e.g., tainting of fish flavor), remediating local sources of pollution will fully restore beneficial uses.

Based on current data, Table 3 (Achievability of Restoring Impaired Beneficial Uses) indicates the achievability of restoring beneficial use impairments. A 'high' ranking implies that complete restoration will be very difficult. A 'medium' or 'low' ranking indicates that restoration may be more easily attained. This ranking of achievability is based on factors such as the extent of the impairment, sources of pollution, resources required for remediation, and the effectiveness of recommendations.

Table 3
Achievability of restoring impaired beneficial uses

	GLWQA Beneficial Use Impairment	*Degree of Difficulty*[1]
1.	Restrictions on fish and wildlife consumption.	High (fish consumption)
2.	Tainting of fish and wildlife flavor.	High (fish flavor)
3.	Degradation of fish and wildlife populations.	Not Impaired-fish/Unknown-wildlife
4.	Fish tumors and other deformities.	High
5.	Bird or animal deformities or reproductive problems.	Beneficial use status unknown.
6.	Degradation of benthos.	Medium
7.	Restrictions on dredging activities.	Medium
8.	Eutrophication or undesirable algae.	Beneficial use not impaired.
9.	Restrictions on drinking water consumption, or taste and odor problems.	Low (taste and odor)
10.	Beach closings.	Medium
11.	Degradation of aesthetics.	Low
12.	Added costs to agriculture or industry.	Beneficial use not impaired.
13.	Degradation of phytoplankton and zooplankton.	Beneficial use not impaired.
14.	Loss of fish and wildlife habitat.	Low
15.	Exceedance of water quality standard/objectives.	Low

[1] Most difficult = High; Least difficult = Low

Priority Recommendations

Each of the four TWGs assessed the available data and information pertaining to their individual area of focus and developed recommendations for actions needed to achieve the water use goals and restore the impaired beneficial uses in the Detroit River Area of Concern. The full reports of each of the TWGs are included as chapters 7 - 10 of this report. Each of these reports contains not only the priority recommendations reported below, but also additional secondary recommendations, supporting background material, and data summaries and interpretations. While we have made the following Summary Table (Table 4) as complete and as accurate as possible, the individual TWG reports should be read for a full understanding of each priority recommendation and their relationship to the secondary recommendations.

Development of the Recommendations

Several of the environmental issues were common to two or more of the TWGs. There were occasional joint meetings and some individuals were active on more than one TWG. In these ways data and information were shared between the TWGs. The TWGs however, worked independently to address their specific focus. Because of this several of the recommendations are very similar. It should not be surprising that two of the TWGs would develop similar approaches to solving the overlapping issues. There was no attempt to edit out these overlaps as they are important to the integrity of the individual TWG reports.

The Habitat TWG developed 25 recommendations to address beneficial use impairment 14, the loss of fish and wildlife habitat, through two objectives:

- Preserve and protect existing habitat, and
- Restore and enhance habitat

The implementation of these actions should also increase fish and wildlife populations through increased available habitat. The current status of wildlife populations is "unknown" and fish populations are not impaired. Some TWG members disagree with this status. However, intense research has not identified any populations which can be considered impaired due to causes within the AOC and the fishery is fulfilling all fishery plans and goals.

The Contaminated Sediments TWG addressed two specific impaired beneficial uses; degradation of benthos, and restrictions on dredging. The TWG developed general objectives and specific sediment quality objectives to meet the Water Use Goals. Recommendations for additional sediment work and a list of priority sites for action were produced by the TWG.

The Point Source/Nonpoint Source TWG focused on the six parameters that had been shown to have exceeded water quality standards/objectives at some time in the past. These six parameters are; copper, cadmium, zinc, lead, mercury, and PCBs. The TWG also noted the impact of these parameters on the impaired beneficial uses in the Detroit River AOC. The TWG proposed seven parameter specific and 15 regulatory program recommendations for point sources as well as recommendations for eight categories of nonpoint source pollution.

The Combined Sewer Overflow TWG also examined the six parameters shown to have exceeded water quality standards/objectives. The TWG developed CSO specific objectives for; restrictions on fish consumption and dredging activities, degradation of the benthos and aesthetics, beach closings, and exceedences of water quality standards/objectives. The TWG developed 21 recommendations in four categories.

Table 4
Priority recommendation summary table
(Based on TWG Report Information)

Priority Recommendation (shortened version)	*Beneficial Use Impairments Addressed** 1	6	7	10	11	14	*Proposed Lead*	*Proposed Partners*	*Cost*	*Status*	*Tracking*
(90) Meet water quality standards and use criteria for toxicity due to CSO's.	✔	✔	✔	✔	✔		Municipal governments with CSOs	MDEQ, MOEE, USEPA	High	Recommendation has been treated as a goal for CSOs	MDEQ/MOEE
(88) Complete implementation of short term CSO controls by 2000.	✔	✔	✔	✔	✔		Municipal governments with CSOs	MDEQ, MOEE, USEPA	Medium	Mostly accomplished in US. Ontario proposed CSO policy under discussion	MDEQ/MOEE
(89) Development of long term plans by 1997 and implementation of controls by 2035.	✔	✔	✔	✔	✔		Municipal governments with CSOs	MDEQ, MOEE, USEPA	High	Planning and implementation underway	MDEQ/MOEE
(87) Identify CSOs with greatest impact and implement remedial programs.	✔	✔	✔	✔	✔		Municipal governments with CSOs	EPA, USGS, MDEQ, MOEE,	Medium	Some monitoring has begun for US side	MMTF
(91) Provide adequate disinfection of CSOs.				✔			Municipal governments with CSOs	MDEQ, MOEE, USEPA, local health departments	Medium	Some improvement recently	MDEQ/MOEE
(92) Remove settleable solids and control all floatable sanitary waste.			✔		✔		Municipal governments with CSOs	MDEQ, MOEE, USEPA	Medium	Some improvements	MDEQ/MOEE
(86) Implement pollution prevention programs, particularly contaminants of concern to municipal sewers.	✔	✔	✔				Municipal governments with CSOs, SEMCOG	Industry; BPAC; businesses MDEQ, MOEE, USEPA	Medium	Some programs exist, in need of coordination and dollars	PPTF
(34) Institute rigorous industrial pretreatment and source elimination programs.	✔	✔	✔				Municipal governments with WWTPs	Industry, MDEQ, MOEE, USEPA	Low	Hg/PCB program underway at DWSD	PPTF
(82) Develop an education program for homeowners and commercial properties for waste reduction.	✔	✔	✔				MDEQ, EPA, SEMI, MOEE, EWSWA	BPAC, industry	Low	Program should cover SE Michigan, not just the AOC.	MDEQ
(94) Voluntary public and industrial pollution prevention initiatives to prevent spills to the collection system.	✔	✔	✔				Industry, Municipal governments;	BPAC/NGOs, SEMCOG	Low	There are voluntary public and industrial pollution prevention initiatives under way	MDEQ

Priority Recommendation (shortened version)	Beneficial Use Impairments Addressed* 1	6	7	10	11	14	Proposed Lead	Proposed Partners	Cost	Status	Tracking
(95) Assure proper implementation of the Industrial Pretreatment Program (US) and Municipal Sewer Use Bylaws (Ontario).	✔	✔	✔				Wayne County, Detroit, Trenton, Windsor, LaSalle, Amherstburg	MDEQ, MOEE, federal governments	NA	Industrial Pretreatment (US) and Municipal Sewer Use Bylaw (Ont.)	PPTF
(99) Region-wide recycling and disposal programs for household hazardous waste.	✔	✔	✔				EWSWA, local governments, SEMCOG, SEMI	MDEQ EPA, Ontario, industries	Medium	Several programs in place, needs coordination	PPTF
(100, 39, and 41) Implement a source control program for mercury and PCBs.	✔	✔	✔				DWSD, WPWD	POTWs, industry, MDEQ, MOEE, RPO	Medium	Ongoing	MMTF
(68) Develop a program to identify and remove illegal connections to the stormwater system.	✔	✔	✔	✔			All municipalities with separated systems	MDEQ, MOEE,		Ongoing	MDEQ/MOEE
(31) Establish a Monitoring/ Modeling group for the overall RAP.	*Indirectly all*						USEPA, EC	BPAC, Industry MDEQ, MOEE,	NA	Monitoring and Modeling Task Force being established	MDEQ/MOEE
(37 and 40)Evaluate nonpoint and nontraditional point sources to quantify and qualify source loadings of mercury and PCBs.	✔	✔	✔				DWSD, WPWD	RPO, MDEQ, USEPA	High	In progress	MMTF
(33) River monitoring to determine local impacts and total loading to the river.	*Indirectly all*						MDEQ/MOEE	Industry, municipalities, USEPA, USGS	NA	Mass Balance Modeling Program being developed	MMTF
(70) Monitoring to confirm stormwater loadings.	*Indirectly 1,6, 7,10*						ERCA, Municipal governments	MDEQ, OMOEE, EPA, USGS	Medium	Some monitoring programs in progress	MMTF
(1) Develop a Habitat Inventory for the AOC.	*Indirectly 14*						SEMCOG/ERCA	Habitat TWG	$100 K	Wetlands complete in Canada	MDNR/MOEE
(3) Develop a G.I.S. for the AOC.	*Indirectly all*						ERCA/SEMCOG	RAP Team/BPAC	$100 K	Portions are complete	MMTF
(22) A hydraulic study of the Detroit River.	*Indirectly 14*						Environment Canada	Several detailed in proposal	$200 K	Some components underway	MMTF

Priority Recommendation (shortened version)	Beneficial Use Impairments Addressed* 1	6	7	10	11	14	Proposed Lead	Proposed Partners	Cost	Status	Tracking
(19) Public education program, involving a network of angler, environmental and conservation groups and schools.	Indirectly all						ERCA/friends of the Detroit River	MDNR, MDEQ, MOEE, NGOs, School Boards,	$100 K	Little River Enhancement Group example of public education program	BPAC
(18) Education program to train (professionals) in permitting requirements, violations, and enhancement/protection.						✔	ERCA/MDEQ/OMNR	SEMCOG	N/A	OMNR establishing an education program for its staff.	BPAC
(23) Begin remedial actions on the list of proposed habitat candidate sites.						✔	Site specific	Site specific	Site specific	Some sites underway/ completed	Habitat TWG
(29) Remedial action on a list of "hot spots" based on mercury levels.	✔	✔					Site specific	Site specific	Site specific	Further assessment underway, treatment technologies are being investigated	C-sed TWG
(2) Develop a Habitat Management Plan for the AOC.						✔	ERCA/SEMCOG	Habitat TWG, municipalities	$50 K	There is no Habitat Management Plan.	MDNR/MOEE
(12) More efficient use of staff through coordination.	Indirectly all						Government agencies	None	$0, this will save money	Many examples of cooperative agreements and coordinated efforts	BPAC
(16) Improve communication between local government and developers with MDEQ and OMNR.						✔	MDEQ/OMNR, ERCA	Municipal governments, developers	Low	Ongoing in Michigan through CQI	BPAC
(17) Local agencies review of plans and ordinances/bylaws to incorporate environmental aspects.	Indirectly 14						ERCA/SEMCOG	Municipal governments, MDEQ/MDNR/OMNR		Ontario Planning Act requires municipalities to incorporate ecosystem planning principles	BPAC
(60, 61, 62) Implement the ERCA Private Sewage Disposal Proposal.							ERCA	None	$250 K	Proposal submitted for funding	RAP Team
(64, 65, 66, 67) Implement ERCA Agricultural Soil Erosion Control Proposal							ERCA	None	$1.1 Mil	Proposal submitted for funding	RAP Team

Acronyms
PPTF=Pollution Prevention Task Force
BPAC=Binational Public Advisory Committee
MMTF=Modeling and Monitoring Task Force
N/A=Not Applicable, no additional costs

* Beneficial Uses 3, 5, 8, 12 and 13 are not impaired. The cause(s) of impairment of beneficial uses 2, 4 and 9 have not been determined. However, the implementation of RAP recommendations may have a positive impact on these beneficial uses.

Detroit River RAP Implementation

The GLWQA requires each Remedial Action Plan to include (among other components):

- a process for evaluating remedial measure implementation and effectiveness; and
- a description of surveillance and monitoring processes to track the effectiveness of remedial measures and the eventual confirmation of the restoration of use.

The purpose of this section is to identify and describe the needs of both the RAP Management and the Surveillance and Monitoring Program of the Detroit River RAP. RAP Management will be responsible for the continued development of remedial measures, and the evaluation of remedial measure implementation and effectiveness. The Surveillance and Monitoring Program will provide the information necessary to be able to track the effectiveness of remedial measures and the eventual confirmation of the restoration of the beneficial uses.

This section is divided into two parts: first, RAP Management and second, Monitoring and Surveillance Program. The first part identifies the components of the Detroit River RAP and their working and reporting relationships. The second part identifies and describes the individual monitoring programs that comprise the Detroit River RAP Monitoring and Surveillance Program. The Detroit River Remedial Action Plan is an iterative planning and implementing process which will report to the public every two years. The recommended remedial actions reflect the state of environmental knowledge, remedial technology and commitments at any one point in time. The strength of the Remedial Action Plan program is its ability to revise these recommendations so that the Plan, over time continues to reflect new or changing environmental knowledge, remedial technology or commitments. The purpose of the Monitoring and Surveillance and RAP Management components of the Plan is to enable the Detroit River RAP to be an effective blueprint for restoring and protecting beneficial uses. To be effective, the RAP process must go well beyond the series of reports which are snapshots in time.

RAP Management Structure

Within the Detroit River RAP, the focus of activity is shifting from defining environmental problems to identifying, implementing and tracking the effectiveness of remedial recommendations and actions. In order to accommodate this changing focus, the present Detroit River RAP organization will need to be modified.

In its problem definition phase (Stage 1 of the Remedial Action Plan process), the Detroit River RAP was composed of; the RAP Team (state, provincial, and federal agency representatives), the Binational Public Advisory Council (interested public from Michigan and Ontario), and the Technical Advisory Committee. To expedite the process of identifying remedial recommendations that would restore and protect impaired beneficial uses (Stage 2 of the Remedial Action Plan process as outlined in the GLWQA), four Technical Working Groups (TWGs) were created. These groups consisted of RAP Team and BPAC representatives, technical experts and members of the general public. The four Technical Working Groups have completed the task of identifying recommendations and the RAP Team and BPAC have prioritized the TWG recommendations.

The Detroit River RAP Coordinators and the Technical Writer jointly developed much of the following structure during revisions to the draft RAP document in the spring of 1995. Since that time there have been considerable changes affecting all levels of government in both nations. These changes and their effects continue to impact RAP programs and RAP implementation at the federal, state, provincial, and local level. While the specific details of the following structure may no longer be applicable, it has been retained for discussion purposes. A final structure for the continuation of RAP efforts on the Detroit River is under development through consultations between the Detroit River BPAC, the sponsoring agencies, and potential implementors.

To continue the Remedial Action Plan process, including the implementation and tracking of recommendations, it is proposed that the basic structure and components of Detroit River RAP be retained, though their roles and terms of reference will need to be revised.

For tracking purposes, the recommendations have been divided into four broad categories:

- programmatic,
- monitoring and modeling,
- pollution prevention, and
- outreach and education.

Programmatic recommendations are those that require action by or change in an agency or a change in legislation. Monitoring and modeling recommendations will generate the information necessary to determine RAP implementation progress - "How well is the RAP doing?" - as well as determine the need for additional recommendations. Pollution prevention recommendations are directed towards controlling pollution at its source, in effect stopping the pollution before it is generated (virtual elimination). Pollution prevention is one of the principles of the GLWQA. Outreach and education recommendations work towards eliminating future problems by changing current customs, attitudes and habits through the dissemination of information of environmentally sound practices to municipalities, industries, and the general public.

RAP Organization Components

Detroit River RAP Management Team

The RAP Management Team should be responsible for the overall development and direction the Detroit River RAP. This involves activities such as: ensuring good communication among RAP participants; releasing RAP reports and updates; responding to emerging issues; securing funding; etc. Previously these were the duties of the RAP Team. For this phase of the RAP process, the mandate would expand to include two critically important additional roles. These are:

- Track and report on the implementation of **Programmatic recommendations**, recommendations that require action by or change in an agency, or a change in legislation.
- Provide a **synthesis and integration service** to the Detroit River RAP. The RAP Team would be responsible for ensuring that information from a variety of sources (within and outside the RAP process) was integrated and synthesized into a comprehensive and ecosystem reporting structure.

With the responsibility for tracking and reporting the implementation of the recommendations divided among different components within the Detroit River RAP, there is a need for a strong coordinating body, like the RAP Management Team.

Within this integration and synthesis role, the RAP Management Team would be responsible for ensuring the secondary recommendations were reviewed periodically and if appropriate, raised to the priority class of recommendation for implementation.

Detroit River BPAC

The BPAC has participated in the development of the Water Use Goals, the TWGs, and the development of the draft Biennial Report. The BPAC would continue its role as a mechanism for providing informed and continuous public participation. The BPAC's advisory role on all aspects of the development and implementation of the RAP would continue. For this next phase of the RAP process, the BPAC's mandate should expand to include two additional roles. They are:

- Serve as a focus for planning and implementing public outreach activities; and
- Track, evaluate and report on the implementation of Education and Outreach recommendations.

Technical Working Groups (TWG)

The Contaminated Sediment; Point Source, Non Point Source; and Habitat TWGs could continue to collect and report new information relating to the description of the environmental problem, status of impaired beneficial uses and definition of the causes of the use impairments.

The Combined Sewer Overflows TWG members felt they had fulfilled their charge and have disbanded. The TWGs outstanding issues (primarily monitoring, tracking, and evaluating) could be addressed by the Monitoring and Modeling Task Force suggested by the PS/NPS and Habitat TWGs and the RAP Management Team. Status reports on CSO issues will occasionally be made to the RAP participants by former TWG members.

The Point Source, Non Point Source TWG should continue but change its focus to include; expansion of the list of parameters of concern, source effects on sediment and biota quality, and a higher focus on non-point source issues should be considered. The PS/NPS TWG members also felt they had a strong role to play on the Monitoring/Modeling Task Force.

The Habitat and Contaminated Sediment TWGs also plan to continue in their current roles of collecting data and evaluating environmental conditions.

It will be the role of the individual TWGs to ensure the RAP data base remains current and that it is reported to the groups with tracking responsibilities. Since the CSO TWG has disbanded, its updating function could be completed by the Monitoring and Modeling Task Force.

Monitoring and Modeling Task Force

It was the recommendation of the Point Source, Non Point Source and Habitat TWGs that a Monitoring and Modeling Task Force be created. TWG members felt that both the monitoring and modeling tasks were too broad for any one TWG to successfully undertake and that significant overlap existed in the needs of the individual TWGs. The Task Force's proposed mandate is to track and report on the implementation of Monitoring and Modeling recommendations and the evaluation of monitoring and modeling proposals and needs for the Detroit River RAP. Membership would include representatives from both the former RAP Team and BPAC. Technical experts would be invited to participate as appropriate.

Pollution Prevention Task Force

A Pollution Prevention Task Force should be created to track and report on the implementation of the pollution prevention recommendations. Membership would include representatives from both the former RAP Team and BPAC. Technical experts would be invited to participate as appropriate.

Monitoring and Surveillance

The Monitoring and Surveillance Program will provide information necessary for evaluating recommendation (remedial measures) implementation and effectiveness. This is not a "formal" program, rather data from existing and proposed monitoring programs will be collected and evaluated to determine recommendation implementation and effectiveness. The components of the surveillance and monitoring program are outlined in this Chapter. Table 1 links monitoring programs to water use goals.

Detroit River RAP Surveillance and Monitoring Program

Upon the advice of the TWGs, a Monitoring/Modeling Task Force should be established. All TWGs would be represented on the Task Force. While the Terms of Reference have not been finalized, it is envisioned that the Task Force would assume overall responsibility for evaluation of monitoring and modeling for the Detroit River RAP. Previously the individual TWGs made recommendations for monitoring and carried out modeling for their own specific needs. Creating a Task Force would increase consistency and efficiency while also eliminating redundancies in both data collection and modeling activities.

The Monitoring/Modeling Task Force would be responsible for over seeing the surveillance and monitoring program. The Task Force would be responsible for reporting information to the RAP Management Team. The RAP Management Team would review reports from the Task Force and distribute them as appropriate. The Biennial Report format is the suggested mechanism for integrating and synthesizing the information from the different monitoring programs into a comprehensive statement.

Components of the program, as developed by the TWGs are briefly outlined below. Please refer to the individual TWG reports for a detailed description of each program.

Habitat Biomonitoring Plan
The Habitat Biomonitoring Plan provides the elements needed to evaluate the fate of and monitor the effects of biological contaminants and stressors in biota representing different trophic levels. It includes specific taxa, related beneficial use impairments, metrics to be obtained, criteria for measurement, and indicates the availability of existing data sets.

Contaminated Sediment Monitoring and Surveillance Plan
The Contaminated Sediment Plan is a binational, multi-staged, tiered strategy for assessing the status of sediment quality in the Detroit River. The main stages of the plan involve AOC assessment, AOC trend analysis, Hotspot/Sensitive Area evaluation, and remedial action monitoring. The main tier components of the Plan include benthic community, sediment chemistry, and sediment toxicity and bioaccumulation testing.

Point Source/Non Point Source Detroit River Monitoring Program
The Point Source, Non Point Source Program focuses on two scales of monitoring, the local scale (where the impacts of individual outfalls are determined) and the river scale (where the impact of the entire AOC is determined in terms of total loading). While the methods of sampling will be somewhat different for these two scales, it is possible there will be some overlap.

CSO Monitoring Program
Similar to the Point/Nonpoint Source monitoring Program the CSO Monitoring Program also considers both local impacts and total loading from CSOs to the Detroit River. In addition, the CSO influents would also require monitoring (this would include both sanitary and storm sewers).

Other Programs
There are also a number of existing on going monitoring programs by both government and nongovernment organizations. While these are not RAP programs, they generate information that supports RAP activities or will be useful in assessing the effectiveness of Detroit River RAP recommendations. These programs are detailed in the individual TWG reports.

Prioritization of Recommendations

"Public consultation and involvement must be central to the Remedial Action Plan. To protect our environment, we must eliminate the discharge of persistent toxic substances into the Detroit River. Financial commitment from both government agencies is essential to carry out remedial action that will eliminate the impaired beneficial uses in our area. An informed and active public will stimulate action."

Dr. Lynda Corkum
Department of Biological Sciences
University of Windsor

RECOMMENDATIONS

Recommendations are the actions that when implemented, will restore and protect water uses in an AOC. The recommendations represent the community consensus as to what is required to do the job. With respect to recommendations or remedial measures, the GLWQA requires each plan to include:

- an evaluation of remedial measures in place;
- an evaluation of alternative additional measures to restore beneficial uses;
- a selection of additional remedial measures to restore beneficial uses and a schedule for their implementation; and
- an identification of the persons or agencies responsible for implementation of remedial measures.

The Detroit River RAP Team and BPAC have classified each of the 104 TWG recommendations into a two tier system. Tier one is the priority recommendations and tier two includes all remaining recommendations (secondary recommendations). The priority recommendations will be the focus for implementation in the short term, the secondary recommendations have a longer implementation horizon. It should be noted that all recommendations are "priority" recommendations, and that none will be discarded.

The Detroit River RAP process for developing recommendations involved the public, agency staff, and technical advisors. The development process consisted of three components. They were:

1. **TWG Development of Recommendations.** Four Technical Working Groups (TWGs) were established and charged with a number of tasks, including identifying recommendations that would address the known pollutants or stressors and their sources within the focus area. Each of the TWGs was to report back to the BPAC and RAP Team with their recommendations.
2. **Compilation of Recommendations in Biennial Report.** The RAP Coordinators and TWG chairs compiled the TWG reports into a comprehensive document, the Draft Biennial Report. In addition to the individual TWG reports, the Draft Biennial Report also contained "linkage" chapters that synthesized the TWG recommendations into a comprehensive listing of all Detroit River RAP recommendations.
3. **Selection of Priority Recommendations.** An ad hoc committee of the Detroit River RAP Team established a draft priority recommendation list from the full list of recommendations. The draft priority recommendation list, as well as the secondary recommendation list (those not on the priority list) were presented to the full RAP Team and BPAC for review and comment at a June 1995 Workshop. Workshop participants used this draft list to finalize priority recommendations for the Detroit River RAP.

TWGs Development of Recommendations

Four Technical Working Groups (TWGs) were established in 1992 - **Combined Sewer Overflows (CSO) TWG; Contaminated Sediments TWG; Habitat TWG; and Point Source/Nonpoint Source TWG** - to develop objectives that would achieve the water use goals and restore impaired beneficial uses. The TWGs correspond to the environmental issues identified in Stage 1 of the Detroit River RAP. TWG membership included representatives from the RAP Team, BPAC and technical experts.

The TWGs worked independently to address their individual focus topics. However, many issues involved or impacted more than one TWG. Therefore, information was shared between TWGs, and joint meetings were occasionally held. Additionally, several people were members of more than one TWG. The work of each of the TWGs is briefly described below. The linkage between each TWGs recommendations and the impaired beneficial uses are presented in Table 5. For more detail please refer to the individual chapters (chapters 7 through 10) covering each of the TWGs in the Biennial Report.

The **Habitat TWG** (recommendations 1 - 25) collected data on the following beneficial use impairments: Restrictions on fish and wildlife consumption; Tainting of fish and wildlife flavor; Degradation of fish and wildlife populations; and Loss of fish and wildlife habitat. The Habitat TWG developed recommendations to address the Loss of fish and wildlife habitat. To restore this beneficial use, two objectives were identified: Preserve and protect existing habitat; and, Restore and enhance habitat in the Detroit River ecosystem. To these ends, the TWG: one, evaluated potential sites in the river where the technical experts felt habitat could be restored or enhanced, drafting proposals, reviewing suggested plans, and discussing potential funding sources for conducting that work; and two, critically assessed the ability of existing legislation to preserve and protect existing habitat (including shorelines and wetlands). Increasing habitat would also have a positive effect on fish and wildlife populations.

In July 1995, the Habitat TWG prioritized the habitat recommendations. The Habitat TWG list parallelled the BPAC-RAP Team list of priority recommendations very closely.

The **Contaminated Sediments (CSeds) TWG** (recommendations 26 - 30) developed recommendations to address the following beneficial use impairments and their associated water use goals: Degradation of benthos; and Restriction on dredging. As well, the TWG has identified specific sediment parameter objectives and has recommended specific actions to be implemented by government agencies. Due to the evolving nature of remedial options and the complexity of the Detroit River sediments, specific remedial actions and associated costs could not be developed.

The **Point Source/Non-Point Source TWG** (recommendations 31 - 83) focused on the six parameters identified in Stage One - cadmium, copper, lead, zinc, mercury and PCB - as having exceeded water quality standards or objectives in the water column at some point in the past. Modeling of these parameters was undertaken by MOEE using Stage 1 data. However, the TWG did not undertake an evaluation of the model or its output as it related to specific sources. The TWG questioned the adequacy of the currently available data. Consequently, the TWG's first recommendation was the formation of a Monitoring and Modeling group to oversee the collection of data and the evaluation of available models and model output for the Detroit River RAP. The recommendations of the PS/NPS TWG focus on polution prevention, education, and source control as means to reduce the inputs of the parameters of concern to the Detroit River.

The **Combined Sewer Overflows (CSO) TWG** (recommendations 84 - 104) developed recommendations to address the following beneficial use impairments and their associated water use goals: Restrictions on fish and wildlife consumption; Degradation of benthos; Restriction on dredging; Beach closings; and Degradation of aesthetics. The TWG reviewed current strategies designed to solve the CSO problem, assess the adequacy of current CSO control activities and strategies, and recommended remedial options.

Table 5
Linkage of Recommendations to the Impaired Beneficial Use/Water Use Goals of the Detroit River Area of Concern.

	Recommendations for Impaired Beneficial Use - Water Use Goal										
Technical Work Group	1	2	3	4	6	7	9	10	11	14	WQ
Habitat			IND							YES	
C. Sediments	IND				YES	YES				IND	
PS/NPS	YES				YES	YES		YES		IND	YES
CSO	YES				YES	YES		YES	YES	IND	YES

IND = Recommendations may indirectly effect this impaired use.
WQ = Ambient Water Quality
Note: Beneficial Uses 3, 5, 8, 12 and 13 are not impaired. The cause(s) of impairment of beneficial uses 2, 4 and 9 have not been determined. However, the implementation of RAP recommendations may have a positive impact on these beneficial uses.

Selection of Priority Recommendations

Several reviewers of the Detroit River Draft Biennial Report suggested that the recommendations from the TWGs be prioritized, as a means for focusing remedial action. The RAP Team concurred and established an ad hoc committee to produce a first cut or draft list of priority recommendations. Both the RAP Team and BPAC were represented on the committee.

To provide guidance and focus to their discussion, the committee developed the following criteria to select priority recommendations:

- linkage and relationships to other recommendations;
- ability to address beneficial use impairments or environmental impacts;
- need for more information before developing recommendations; and
- availability of resources.

A draft list of priority recommendations was developed from these criteria. This priority list considered only the recommendations previously developed by the TWGs and contained in the draft Biennial Report. The draft list was discussed at a joint BPAC/RAP Team Workshop in June 1995. There was consensus that the draft list prioritized the recommendations contained in the TWG reports. Additional new recommendations were put forward at that workshop, for consideration by the TWGs and the RAP Team. These new recommendations had not been reviewed by RAP participants.

Following the June 1995 Workshop, the Habitat TWG and the Point Source/Nonpoint Source TWG met to review and add detail to their priority recommendations. The list of priority recommendations produced by the Habitat TWG members closely paralleled the list developed at the workshop.

The priority recommendations are summarized in Table 4 of the Executive Summary chapter and are listed in full detail in the following section. The table summarizes information contained in the TWG report and indicates beneficial use impairments addressed, proposed lead and partners, cost, status, and tracking responsibilities as currently determined. New information will be incorporated as it becomes available. Under the Ontario RAP development process much of this detail is developed as part of the implementation annex.

In this section, priority recommendations are listed by Technical Working Group (TWG). Within each TWG, the recommendations are divided into four categories (i.e., Programmatic, Outreach and Education, Pollution Prevention, and Monitoring and Modeling). Each recommendation is discussed under the following headings: rationale; benificial use(s) addressed; proposed lead; proposed partners; tracking responsibility, proposed time line; proposed funding sources; and status. In all cases, additional detailed information concerning current policies, programs, strategies and remediation activities as well as source information (updated since the Stage 1 Report) for each priority recommendation is available in the Technical Working Group (TWG) Reports.

Secondary recommendations are also listed in this chapter, following the priority recommendations. The TWG reports contain full details for each of the secondary recommendations. As was noted in Chapter 2, the Detroit River RAP Management Team is responsible for ensuring the secondary recommendations are reviewed periodically and if appropriate, raised to the priority class of recommendation for implementation.

Habitat Priority Recommendations

Programmatic Priority Recommendations

Recommendation 2: Develop a Habitat Management Plan for the Detroit River RAP.

Rationale: A Habitat Management Plan would clearly document strategies and their rationale for the protection, restoration and enhancement of fish and wildlife habitat in the Detroit River AOC. It would pro-actively provide information to municipalities and developers that could be incorporated into planning documents. In addition, the plan could delineate areas suitable for public access development and environmental appreciation and education that would foster a better understanding of the relationship between humans and their environment.

Beneficial Uses Addressed:	14
Proposed Lead:	SEMCOG, ERCA
Proposed Partners:	Habitat TWG, municipalities
Tracking Responsibility:	MDNR, MOEE
Proposed Timeline:	Immediate and continuing
Proposed Funding Sources/Amount:	GLCUF - GLPF/$50,000

Status: The OMNR and ERCA have completed a wetlands inventory and evaluation of wetlands within the Canadian portion of the AOC. A complete habitat inventory will be needed to complete the plan.

Recommendation 12: Make more efficient use of existing staff by coordinating environmental protection activities with other agencies.

Rationale: The purpose of this recommendation is to ensure that government agencies continue to find innovative ways of coordinating their environmental protection activities to restore and protect habitat.

Beneficial Uses Addressed:	Indirectly all
Proposed Lead:	Government agencies
Proposed Partners:	None
Tracking Responsibility:	Detroit River BPAC
Proposed Timeline:	Ongoing
Proposed Funding Sources/$$:	None required, this should save money.

Status: Permit and plan review agencies have already made tremendous strides in cooperative agreements and coordination of efforts to become more efficient. Discussions are proceeding between OMNR and Conservation Authorities at the provincial level to advance this initiative further.

Recommendation 23: Begin remedial actions on the list of proposed habitat candidate sites.

Rationale: The National Biological Survey (NBS) has estimated that over 90% of wetlands present in the river in 1873 were destroyed as the shoreline was modified and developed. In the face of these huge losses the Habitat TWG felt that restoration activities should begin immediately.

Beneficial Uses Addressed:	14
Proposed Lead:	Site Specific
Proposed Partners:	Site Specific
Tracking Responsibility:	Habitat TWG
Proposed Timeline:	Site Specific, ASAP
Proposed Funding Sources/$$:	Site Specific

Status: Work has begun at several of the sites, funding is being sought for others.

Outreach and Education Priority Recommendations

RECOMMENDATION 18: ESTABLISH AN EDUCATION PROGRAM TO TRAIN LOCAL PLANNING AND ZONING OFFICIALS, REAL ESTATE AGENTS, CONSULTANTS, DEVELOPERS, MUNICIPAL BUILDING OFFICIALS, AND CONSERVATION OFFICERS IN IDENTIFYING PERMITTING REQUIREMENTS, WETLAND VIOLATIONS, AND HABITAT ENHANCEMENT/PROTECTION OPPORTUNITIES.

Rationale: This training initiative should improve the efficiency in protecting habitat in the Detroit River AOC.

Beneficial Uses Addressed:	14
Proposed Lead:	ERCA/MDEQ/OMNR
Proposed Partners:	SEMCOG
Tracking Responsibility:	Detroit River BPAC
Proposed Timeline:	Long Term
Proposed Funding Sources:	Existing budgets

Status: OMNR is currently developing a province-wide aquatic habitat training initiative for OMNR field staff involved in the implementation and enforcement of habitat protection legislation and planning mechanisms.

RECOMMENDATION 19: DEVELOP A PUBLIC EDUCATION PROGRAM, INVOLVING A NETWORK OF ANGLER, ENVIRONMENTAL AND CONSERVATION GROUPS AND SCHOOLS TO PARTICIPATE IN ENVIRONMENTAL AWARENESS ACTIVITIES.

Rationale: This recommendation was developed in order to include students and interested public in a water quality education program. The implementation of such a program would assist the public in changing habits in order to protect the environment. Also, it would help mold today's students into environmentally sensitive adults.

Beneficial Uses Addressed:	Indirectly all
Proposed Lead:	ERCA, Friends of the Detroit River
Proposed Partners:	MDNR, MDEQ, MOEE, non-government org, school boards.
Tracking Responsibility:	Detroit River BPAC
Proposed Timeline:	Short Term
Proposed Funding Sources/$$:	$100,000

Status: The Little River Enhancement Group, organized in the Windsor School District, is a good example of a public education program. The first river cleanup in the spring of 1991 involved clearing garbage and debris from the stream. Six clean ups of the Little River set the stage for further work like planting trees (10,000 so far) and building hiking trails.

RECOMMENDATION 16: IMPROVE COMMUNICATION BETWEEN LOCAL GOVERNMENT AND DEVELOPERS WITH MDEQ AND OMNR.

Rationale: Citizens often initiate work on private property without obtaining the proper required permits from MDNR. In addition, developers, real estate agents, etc. often state that it is very difficult to know when an MDNR permit is required for various activities.

Beneficial Uses Addressed:	14
Proposed Lead:	MDEQ, OMNR, and ERCA
Proposed Partners:	Municipal Governments, developers
Tracking Responsibility:	Detroit River BPAC
Proposed Timeline:	Ongoing
Proposed Funding Sources/$$:	Current budgets/Low $$ required

Status: Improved communication is a goal for Michigan's state government where Continuous Quality Improvement (CQI) has been implemented.

Recommendation 17: Encourage local agencies to review existing plans and local zoning ordinances/ by-laws to incorporate environmental aspects and be aware of existing environmental legislation over all program areas.

Rationale: If the developer or local government would confer with OMNR and ERCA to discuss the concept, a better project design (from an ecological perspective) which meets both provincial requirements and the needs of the developer/local government can be developed from the start.

Beneficial Uses Addressed:	14
Proposed Lead:	ERCA, SEMCOG
Proposed Partners:	Municipal Governments, MDEQ, MDNR, OMNR
Tracking Responsibility:	Detroit River BPAC
Proposed Timeline:	Ongoing
Proposed Funding Sources/$$:	None Required

Status: Recent revisions to the Ontario Planning Act will make it compulsory for local municipalities to revise planning documents and incorporate ecosystem planning principles into all planning and development exercises. However, this planning can only be effective in protecting habitat if OMNR and ERCA are able to provide timely and accurate data and comments.

Monitoring and Modeling Priority Recommendations

Recommendation 1: Develop a Habitat Inventory for the Detroit River AOC.

Rationale: A habitat inventory is needed to obtain baseline information on existing wetland habitat, wildlife and fishery resources. A habitat inventory would give MDEQ/OMNR the information needed to pro-actively give developers and municipalities some guidance regarding habitat sensitivity and appropriate land zoning and permitted uses.

Beneficial Uses Addressed:	14
Proposed Lead:	ERCA, SEMCOG
Proposed Partners:	Habitat TWG
Tracking Responsibility:	MDNR/MOEE
Proposed Timeline:	Ongoing (will not completed in the next two years)
Proposed Funding Sources/$$:	Several sources, estimated total for St.Clair - Detroit River Corridor $100,000

Status: The OMNR and ERCA have completed a wetlands inventory and evaluation of wetlands within the Canadian portion of the Detroit River AOC.

Recommendation 3: Develop a GIS System for the entire St. Clair/Detroit River system to identify various habitat types and alert consultants, developers, state, provincial and federal regulators to critical or protected areas.

Rationale: This recommendation proposes a regional wetland/habitat GIS to include the entire St. Clair/Detroit River system in order to evaluate impacts and address habitat protection on the regional basis.

Beneficial Uses Addressed:	Indirectly all
Proposed Lead:	ERCA/SEMCOG
Proposed Partners:	RAP Team, BPAC
Tracking Responsibility:	Monitoring and Modeling Task Force
Proposed Timeline:	Ongoing
Proposed Funding Sources/$$:	Estimated at $100,000 over current funding

Status: SEMCOG maintains a GIS system for the Southeast Michigan area as do several other entities. The US ACOE recently developed a sediment based GIS with plans to expand the system to include biological factors.

Recommendation 22: Complete a hydraulic study of the Detroit River focusing on cumulative impacts.

Rationale: Cumulative hydraulic impacts have been documented in the Niagara River. Since most of the proposed aquatic habitat improvement projects include infilling, hydraulic studies may be required for each project. An overall study would be more cost effective and would delineate candidate areas.

Beneficial Uses Addressed:	Indirectly 14
Proposed Lead:	Environment Canada
Proposed Partners:	Several, see proposal
Tracking Responsibility:	Monitoring and Modeling Task Force
Proposed Timeline:	Many components underway on the US side.
Proposed Funding Sources/$$:	Total estimate: $200,000 ($100,000 each side) GLCUF -$70,000

Status: Many components of the total study have been initiated by USGS, NOAA, and US ACOE.

C.Sed Priority Recommendations

Programmatic Priority Recommendations

(29) Recommendation Remedial action on a list of "hot spots" based on mercury levels.

Rationale: Mercury was used for prioritization because of its bioaccumulativeness and the pathway to humans via fish consumption. Remedial actions will remove these areas as sources of contamination.

Beneficial Uses Addressed:	1,6
Proposed Lead:	Site Specific
Proposed Partners:	Site Specific
Tracking Responsibility:	C-Sed TWG
Proposed Timeline:	Ongoing, Long Term
Proposed Funding Sources:	Site Specific, Overall High

Status: Further site assessment (to better detail areal extent) is scheduled, and treatment technologies are being evaluated.

Point Source/Non Point Source Priority Recommendations

Programmatic Priority Recommendations

Recommendation 31: Establish a Monitoring and Modeling Group to oversee the collection of data and the evaluation of available models and model output for the Detroit River RAP.

Rationale: Considering the scope of the monitoring and modeling tasks in the Detroit River AOC, TWG members felt these activities should be carried out for the RAP as a whole rather than for each TWG individually. This should greatly enhance consistency and efficiency of monitoring and modeling activities for the Detroit River RAP.

Beneficial Uses Addressed:	Indirectly all
Proposed Lead:	EC, USEPA
Proposed Partners:	BPAC, Industry, MDEQ, MOEE
Tracking Responsibility:	MDNR, MOEE
Proposed Timeline:	Immediately
Proposed Funding Sources/$$:	RAP Program/ $50,000

Status: A Monitoring and Modeling Task Force is in the process of being established. It will be composed of representatives from the Detroit River RAP Team and BPAC.

Outreach and Education Priority Recommendations

Recommendation 82: Develop an education program at the local level for homeowners and commercial properties that targets waste reduction. Concepts that should be stressed are; recycling, identification of less harmful alternatives, and proper disposal of waste products.

Rationale: Educating home and commercial property owners about recycling, identification of less harmful alternatives, and proper disposal of waste products will help to keep hazardous materials out of the waste stream and ultimately the water.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	EWSWA, MDEQ, MOEE, SEMI, USEPA
Proposed Partners:	BPAC, industry
Tracking Responsibility:	MDEQ
Proposed Timeline:	Short Term
Proposed Funding Sources/$$:	Existing program in Michigan additional funding and coordination through SEMI and local sponsors.

Status: The greatest benefits to the Detroit River AOC would be realized if the program covered not only the Detroit River AOC but encompassed the entire Southeast Michigan area. The program then would not only reduce inputs from the AOC but also upstream inputs to the AOC.

Pollution Prevention Priority Recommendations

Recommendation 34: Institute rigorous industrial pretreatment and source elimination programs to reduce the parameters of concern to the lowest practical level.

Rationale: The best alternative for load reductions is to stop the parameters of concern from entering the waste stream in the first place. Source elimination programs should be developed by all dischargers to identify where the parameters of concern are used in their processes and how that substances' use can be eliminated, reduced or recycled.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	Municipal Governments with WWTPs
Proposed Partners:	Industry, MDEQ, MOEE, USEPA
Tracking Responsibility:	PPTF
Proposed Timeline:	Ongoing
Proposed Funding Sources:	Existing programs

Status: The mercury and PCB program at DWSD is an example of this type of program underway.

Recommendation 68: Develop an illegal connections elimination program to identify and remove illegal connections to the stormwater system.

Rationale: Illegal connections contribute waste water directly to the stormwater system. Similar programs in other areas have been very successful at reducing wet weather contamination of the environment.

Beneficial Uses Addressed:	1,6,7,10
Proposed Lead:	All communities with separated systems
Proposed Partners:	MDEQ, MOEE
Tracking Responsibility:	MDEQ, MOEE
Proposed Timeline:	Ongoing
Proposed Funding Sources:	Sewer fees

Status: On going program, some areas have been completed.

Monitoring and Modeling Priority Recommendations

RECOMMENDATION 33: SET UP A RIVER MONITORING PROGRAM WHICH WILL DETERMINE THE LOCAL IMPACTS OF DISCHARGES AS WELL AS THE TOTAL LOADING TO THE RIVER.

Rationale: The monitoring program must be able to provide an ongoing assessment of environmental conditions to determine if the rehabilitation goals and objectives are being achieved and once established, that theses conditions are being maintained. The second purpose of this monitoring is to suggest corrective actions in the event that objectives are not being met.

Beneficial Uses Addressed:	Indirectly all
Proposed Lead:	MDEQ/MOEE
Proposed Partners:	Industry, municipalities, USEPA, USGS
Tracking Responsibility:	Monitoring and Modeling Task Force
Proposed Timeline:	Immediately
Proposed Funding Sources/$$:	Implementation cost will be medium

Status: A 'Mass Balance' program is being developed by OMNR. A Monitoring and Modeling Task Force is in the process of being established. The Task Force will have the responsibility for designing and implementing the Detroit River RAP Monitoring and Modeling Program.

RECOMMENDATION 37: A QUANTITATIVE EVALUATION OF NON-TRADITIONAL SOURCES OF PCBS IS NECESSARY TO ACCURATELY QUALIFY AND QUANTIFY SOURCE LOADINGS FOR THE EXPRESSED PURPOSE OF CONTROL AND ELIMINATION.

RECOMMENDATION 40: A QUANTITATIVE EVALUATION OF NONPOINT AND NONTRADITIONAL POINT SOURCES OF MERCURY IS NECESSARY TO ACCURATELY QUANTIFY AND QUALIFY SOURCE LOADINGS OF MERCURY FOR THE PURPOSE OF CONTROL AND ELIMINATION.

Rationale: The RAP Team and BPAC identified specific goals for the six toxicants found to have had caused an exceedence of water quality standards or objectives in the water column at some time in the past (see water use goals). PCB and mercury are chronic toxicity concerns, while the other parameters are acute toxicity concerns. PCBs and mercury can also be more closely linked to human health concerns through fish consumption, and most traditional sources have been controlled.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	DWSD, WPWD
Proposed Partners:	MDEQ, RPO, USEPA
Tracking Responsibility:	Monitoring and Modeling Task Force
Proposed Timeline:	Ongoing (will not be completed in the next two years)
Proposed Funding Sources:	Ongoing program

Status: Please see CSO TWG report (Chapter 10).

RECOMMENDATION 70: SITE SPECIFIC STORMWATER MONITORING IS NEEDED TO CONFIRM OR ADJUST THE LOADINGS SO THAT DECISIONS CAN BE BASED ON SOUND DATA. THE MONITORING SHOULD ALSO EVALUATE CONTROL MEASURES AS THEY ARE INSTALLED.

Rationale: The loadings contributed by stormwater which are listed in the Stage 1 RAP are based on average urban stormwater quality and predicted runoff.

Beneficial Uses Addressed:	Indirectly 1,6,7,10
Proposed Lead:	ERCA, Municipal governments
Proposed Partners:	Federal Governments, MDEQ, MOEE
Tracking Responsibility:	Monitoring and Modeling Task Force
Proposed Timeline:	Ongoing (will not be completed in the next two years).
Proposed Funding Sources/$$:	Cost - medium

Status: In Michigan stormwater permits will be issued to construction sites and industrial sites. Some stormwater monitoring is being carried out by DWSD and the USGS.

Combined Sewer Overflows Priority Recommendations

The CSO TWG identified a generic list of potential grant and loan sources for both Ontario and Michigan. Michigan funding sources included the State Revolving Fund and the Great Lakes Protection Fund. The list also identified the EPA publication Watershed Protection as a catalog of federal programs oriented to water quality and ecosystem management in the United States. Ontario funding sources included the Municipal Assistance Program; the National Information Program, Beaches Program; and the Great Lakes Cleanup Fund. For more information, please refer to Table CSO.5, in the CSO TWG Report (chapter 10).

Programmatic Priority Recommendations

Recommendation 88: Complete implementation of short term CSO controls by no later than 2000. Short term CSO controls are actions or measures that (1) can reduce CSO discharges and their effects on receiving water quality, (2) do not require significant engineering studies or major construction, and (3) can be implemented in a relatively short time.

Rationale: The CSO TWG chose 'no later than 2000' for complete implementation of CSO controls. This refers to those controls which can be accomplished without lengthy planning efforts or major capital expenditures.

Beneficial Uses Addressed:	1,6,7,10,11
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	MDEQ, MOEE, USEPA
Tracking Responsibility:	MDEQ, MOEE
Proposed Timeline:	Ongoing, completed by 2000
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: Mostly accomplished for the US, remaining communities are subject to ongoing enforcement actions. As proposed in the Ontario CSO Control Policy, municipalities with combined sewer system shall complete the Pollution Control and Prevention Plans (PPCP) within three years of the Ontario CSO policy promulgation.

Recommendation 89: Complete development of long term plans by 1997 and implementation of final long term CSO controls no later than 2035.

Rationale: The CSO TWG chose "no later than 2035" for complete implementation of final long term CSO controls. The phrase "no later than" was chosen specifically to promote commencement of interim and long term controls as soon as possible and to the extent possible, but to recognize that in some instances completion of CSO control could likely take many years. Given the complexity of the sewer system, the CSO TWG felt that 40 years for completion of all CSO controls was not unreasonable, as long as reasonable and measurable progress can be demonstrated starting immediately.

Beneficial Uses Addressed:	1,6,7,10,11
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	MDEQ, MOEE, USEPA
Tracking Responsibility:	MDEQ, MOEE
Proposed Timeline:	Long Term (to year 2035)
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: Both planning and implementation are underway.

Recommendation 91: Provide adequate disinfection of CSOs for protection of human health.

Rationale: Combined sewer overflows pose significant public health concerns. CSO effluent resembles dilute sewage and has higher pollutant concentrations than sewage treatment plant effluent and urban runoff with the exception of total nitrogen. Average concentrations of total and fecal coliform in CSO are typically at least several orders of magnitude higher than disinfected sewage treatment plant effluent.

Beneficial Uses Addressed:	10
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	County/City health departments, MDEQ, MOEE, USEPA
Tracking Responsibility:	MDEQ, MOEE
Proposed Timeline:	Ongoing (to the year 2035)
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: The protection of human health is important to all involved. While improvements have been made in recent years, more needs to be done.

Recommendation 92: Remove settleable solids and control all floatable sanitary waste from CSO discharges to ensure that downstream deposition and discharge of identifiable objects of human origin is minimized.

Rationale: This is one of the "nine minimum controls" of EPA.

Beneficial Uses Addressed:	7,11
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	MDEQ, MOEE, USEPA
Tracking Responsibility:	MDEQ, MOEE
Proposed Timeline:	Long Term (to the year 2035)
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: Presently settleable solids are not completely removed nor is there complete control of floatable sanitary waste from CSO discharges. There has been some improvements in recent years, however, much remains to be done.

Pollution Prevention Priority Recommendations

Recommendation 86: Implement pollution prevention programs, particularly with respect to reduction or elimination of discharge of the contaminants of concern to municipal sewers.

Rationale: The best alternative for reducing or eliminating the discharge of the contaminants of concern to municipal sewers is to stop them from entering the sewer system in the first place. This can be achieved through either removing the contaminants from the waste stream before discharge to the municipal sewer system or eliminating them from the production process.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	Municipalities with CSOs , SEMCOG
Proposed Partners:	Industries, businesses, citizens, MDEQ, MOEE, USEPA
Tracking Responsibility:	MDEQ
Proposed Timeline:	On-going
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: Michigan is currently in the process of implementing the Industrial Pretreatment Program. Through its MISA program, Ontario has finalized legally enforceable discharge limits for all nine industrial sectors and is expected to release draft regulations for the municipal sector soon.

RECOMMENDATION 94: PROMOTE VOLUNTARY PUBLIC AND INDUSTRIAL POLLUTION PREVENTION INITIATIVES PARTICULARLY WITH RESPECT TO PREVENTION OF SPILLS TO THE COLLECTION SYSTEM.

Rationale: The best alternative for reducing or eliminating the discharge of the contaminants of concern to municipal sewers is to stop them from entering the sewer system in the first place. This can be achieved through either removing the contaminants from the waste stream before discharge to the municipal sewer system or eliminating them from the production process.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	Industry, municipal governments
Proposed Partners:	BPAC/NGOs, SEMCOG
Tracking Responsibility:	MDEQ
Proposed Timeline:	Short Term/Ongoing
Proposed Funding Sources:	Private and/or public sources.

Status: Several programs are underway. Instances are detailed in the TWG reports.

RECOMMENDATION 95: ASSURE PROPER IMPLEMENTATION OF THE INDUSTRIAL PRETREATMENT PROGRAM (U.S.) AND MUNICIPAL SEWER USE BYLAWS (ONTARIO) AS THEY RELATE TO TOXICANT DISCHARGES TO MUNICIPAL SEWER SYSTEMS.

Rationale: Such programs can have a dramatic effect on WWTP influent (see description in PS/NPS TWG Report - Chapter 9).

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	Wayne County, City of Detroit, City of Trenton, City of Windsor, Town of Amherstburg, Town of LaSalle
Proposed Partners:	State, Provincial and Federal governments
Tracking Responsibility:	Pollution Prevention Task Force
Proposed Timeline:	Ongoing
Proposed Funding Sources:	Municipalities

Status: Implementation of the Industrial Pretreatment Program (U.S.) and Municipal Sewer Use Bylaws (Ontario) as they relate to toxicant discharges to municipal sewer systems is proceeding.

RECOMMENDATION 99: DEVELOP AND IMPLEMENT REGION-WIDE RECYCLING AND DISPOSAL PROGRAMS FOR HOUSEHOLD HAZARDOUS WASTE.

Rationale: Region-wide recycling and disposal programs for household hazardous waste are effective pollution prevention programs that will help to remove household hazardous wastes from the municipal sewer system.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	EWSWA, local governments, SEMCOG, SEMI
Proposed Partners:	State, Provincial, and Federal governments, industries
Tracking Responsibility:	Pollution Prevention Task Force
Proposed Timeline:	Ongoing
Proposed Funding Sources:	Private and/or public sources

Status: Although there are several such programs already underway, region wide coordination would enhance the impact on the environment substantially.

RECOMMENDATION 100: DEVELOP AND IMPLEMENT A SOURCE CONTROL PROGRAM FOR MERCURY AND PCBS.

RECOMMENDATION 39: A MINIMIZATION PLAN FOR PCBS IN THE DETROIT WASTE WATER SYSTEM WILL BE DEVELOPED AND IMPLEMENTED.

RECOMMENDATION 41: A MINIMIZATION PLAN FOR MERCURY IN THE DETROIT WASTE WATER SYSTEM WILL BE DEVELOPED AND IMPLEMENTED.

Rationale: The NPDES permit for the Detroit WWTP contains limits for mecury and PCB which are below the level of detection. Monitoring has indicated concentrations of both are sometimes above the detection levels.

Beneficial Uses Addressed:	1,6,7
Proposed Lead:	DWSD
Proposed Partners:	Municipalities
Tracking Responsibility:	Pollution Prevention Task Force
Proposed Timeline:	Ongoing (to the year 2004)
Proposed Funding Sources:	Sewer revenues, grants, fees (from identified sources)

Status: On going.

Monitoring and Modeling Priority Recommendations

RECOMMENDATION 87: IDENTIFY THE CSOS WITH GREATEST IMPACT ON THE DETROIT RIVER (LOADINGS OF CONTAMINANTS OF CONCERN OR ADVERSELY AFFECTING BENEFICIAL USES) AND DEVELOP AND IMPLEMENT APPROPRIATE REMEDIAL PROGRAMS TO CONTROL THOSE CSOS AS DESCRIBED IN RECOMMENDATION 89.

Rationale: Identifying and remediating the CSOs with the greatest impact on the Detroit River will achieve the greatest reduction in loadings of contaminants such as PCBs, cadmium, and mercury, and so promote the restoration of impaired beneficial uses.

Beneficial Uses Addressed:	1,6,7,10,11
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	EPA, USGS, MDEQ, MOEE
Tracking Responsibility:	MMTF
Proposed Timeline:	Identify and plan 1997, Control no later than 2005
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: The monitoring of some CSOs has begun.

RECOMMENDATION 90: MEET THE MICHIGAN WATER QUALITY STANDARDS AND ONTARIO WATER USE CRITERIA FOR TOXICITY DUE TO CSOS.

Rationale: Within the context of this Biennial Report, this recommendation has been treated as a goal statement. The other CSO priority recommendations are the mechanisms that will be used to achieve this goal.

Beneficial Uses Addressed:	1, 6, 7, 10, 11
Proposed Lead:	Municipalities with CSOs
Proposed Partners:	MDEQ, MOEE , USEPA
Tracking Responsibility:	MDEQ, MOEE through Ambient Water Quality Monitoring
Proposed Timeline:	Ongoing (to the year 2035)
Proposed Funding Sources:	Local sewer use charges, local taxes, local bonding, bonding through a county agency/the State Revolving Fund, stormwater utilities and federal, state and provincial grant assistance

Status: All CSO recommendations are designed to support this goal.

SECONDARY RECOMMENDATIONS

Following is a list of secondary recommendations by Technical Working Groups. Within each TWG, the recommendations have been broken into Programmatic, Outreach and Education, Pollution Prevention, and Monitoring and Modeling categories. Preceding each recommendation is it's identifying number and an indication of implementation time frame: O = On going S = Short term (will be done within the next two years), L = Long term (will not start or be completed in the next two years) O/L = Ongoing but will not be completed during the next two years). Please refer to the appropriate TWG Report for more information on each of the secondary recommendations. Where possiblle each TWG developed the implentation information for each recommendation.

Habitat TWG Secondary Recommendations

Programmatic

4 L The TWG supports the use of settlements and judgement awards to restore and protect habitat in the Detroit River AOC.

5 L Federal funding could be made available to support specific activities required by the Great Lakes Fish and Wildlife Restoration Act in the Detroit River AOC.

6 O Require MDNR and local government review of all county stream improvement projects.

7 L The Migratory Birds Convention Act should be amended to include protection of nesting habitat throughout the year.

8 L Amend the Planning Act so that it will function more effectively in protecting fish and wildlife habitat and encourage more widespread proactive municipal planning on an ecosystem basis.

9 L Develop specific provincial legislation (e.g. a "Wetlands Protection Act") with associated policy and adequate penalties to protect wetland areas and function. A legislative equivalent to the Fisheries Act is needed to protect all wetlands and their functions (even those that are not provincially significant).

10 L The Conservation Authorities Act needs to be amended to give direct authority to Conservation Authorities for the preservation and protection of wetlands, fish habitat and other environmentally significant areas. Also, the penalty provisions (fines) for violations, including the forcing of rehabilitation, should be substantially increased and strengthened to act as a greater deterrent.

11 O Increase staffing levels in Michigan and Ontario regulatory agencies which have jurisdiction in the Detroit River AOC.

13 O Encourage the coordination of permits.

15 O Encourage the development of a common wetland evaluation system for use in both Michigan and Ontario.

21 L Reinstate the applicability of the Ontario Conservation Land Tax Rebate to Conservation Authority lands in order to protect these holdings located within the various AOCs.

Outreach and Education

14 S Develop and distribute public guidance documents in Ontario promoting an ecosystem approach to land development and provide direction on permit and planning application requirements.

20 O Encourage participation in existing federal, state and provincial incentive programs for habitat protection and rehabilitation activities.

Contaminated Sediments TWG Secondary Recommendations

Programmatic

26 O Encourage the continuation of the Contaiminated Sedements Technical Work Group.

Monitoring and Modeling

27 O/L The TWG supported an increased level of sediment monitoring.

28 O/L The TWG supported an increased level of monitoring of sources in support of sediment modeling.

30 O/L The TWG recommended a higher level of support for modeling activities.

Point/Non Point Source TWG Secondary Recommendations

Programmatic

42 O Maintain good communication, in both directions, from the National level to the facility level. facilities need regulatory requirements to be fully explained and help with technical issues. More, well trained regulatory field staff are needed to interact with a greater number of dischargers more frequently.

43 L Streamline the regulatory process. Use computer data bases and electronic transfers of monitoring data to make data more accessible and easier to use. Eliminate unnecessary or redundant paper work.

45 O MDEQ and MOEE should provide more information to dischargers on their programs and treatment technology. Industrial dischargers were particularly interested in receiving detailed administrative information for permit applications or proposed future regulations. Municipal dischargers were interested in technical assistance with treatment system operation as well as administrative information.

46 O Regulatory staff need to be better trained in order to (1) Understand the technical issues of various wastewater treatment systems and (2) Be able to help dischargers with clear, consistent advice on administrative procedures or technology transfer.

47 O Maintain good communication between all parties involved, Federal, State/Provincial, City/County and the facility. All are players in the process of improving water quality and information must be shared with everyone involved.

48 L Allow permit and monitoring data to be submitted by the discharger electronically.

49 S Review paper work and monitoring requirements and be sure they are relevant and necessary.

50 O Review permits and certificates every 5 years. Make any appropriate changes.

51 O Increase the number of field staff in regulatory programs and clearly prioritize their workload. This recommendation was one of the most often recommended by both regulatory agencies and dischargers.

52 O Do multi-media inspections at least once per year with staff from all applicable regulatory programs.

53 L Change legislation to allow local governments to levy significant fines for programs which fall under their jurisdiction. This is particularly necessary with pretreatment programs.

55 O Additional funding mechanisms should be identified.

56 O Streamline penalty collection mechanisms.

57 O A clearly defined strategy for enforcing compliance in local IPP programs should be developed.

58 O Control documents and discharge permits should consider both concentration and loading limitations of pollutants and included when applicable.

63 O Create a strong Soil Erosion Control program to reduce the amount of erosion and sedimentation. Construction sites should be considered a priority in such a program.

69 O Develop a strong stormwater regulatory program. A strong program would set requirements for the quality and quantity of runoff from urban or urbanizing areas, construction sites, large developed areas and industrial sites.

72 O The regulatory agencies should act as a clearinghouse for current information on control measures.

76 L Larger fines for spills from industrial facilities.

77 O Quicker, more efficient methods of enforcement.

79 O Continue to catalog all existing and abandoned landfills and remediation sites or any other identified groundwater contamination problems.

80 S Include remediation sites in stormwater regulations which are developed.

81 O Identify zones of local impact where possible.

Outreach and Education

75 S Begin an intensive education effort aimed at pleasure craft and marina owners on how to avoid discharges of pollutants to the river.

Pollution Prevention

38 L A program for the elimination of PCBs in electrical transformers and capacitors should be actively pursed.

44 L New, long term planning programs are needed. A pollution prevention program needs to be established or continued as necessary to help keep substances out of the waste stream to begin with. New funding mechanisms are needed. Stronger authority to local governments to levy fines for programs under their direct jurisdiction is necessary.

54 O Institute a toxic chemical source elimination or reduction program.

78 O Pollution Incident Prevention Plans (PIPPs) should be developed by any industrial or commercial facilities which store or use materials which, if lost to the environment could directly or indirectly reach the Detroit River.

83 L Institute deposits or disposal fees on items which are composed of significant portions of the parameters of concern and are often improperly disposed of such as tires and batteries.

Monitoring and Modeling

32 O Continue data acquisition and evaluation on all point source dischargers for the parameters of concern at acceptable frequency and detection level to accurately define the total loading from each individual point source as well as the total load.

35 O Further investigative work should be conducted on the Rouge and Ecorse Rivers to determine the sources of cadmium loadings in these tributaries to the Detroit River.

36 O/L Further investigative work should be conducted on the Rouge and Ecorse Rivers to determine where the high loadings of copper are originating.

59 O In order to properly implement the stormwater program and obtain sound data on which to make decisions about stormwater discharges from industrial sites, monitoring should initially occur at a frequency determined to provide statistically accurate representation of the stormwater. This data should then be used to make specific, long term monitoring recommendations.

71 L Methods should be evaluated to reduce the quantity of stormwater into the collection system of developed areas through retention and detention. To be practical and cost efficient the time frame for implementing such a plan could be 15 to 40 years.

73 O/L Expand data acquisition to accurately define total loadings from tributaries to the Detroit River specifically including sampling to reflect strom events.

74 L The work group proposed a joint Canadian/U.S. study of air deposition.

Combined Sewer Overflow TWG Secondary Recommendations

Programmatic

84 O Implement MI CSO permitting strategy through effective NPDES permit application and enforcement.

85 S Adopt and implement the proposed Ontario Policy for CSO Control.

93 O Provide preferential treatment for separate sanitary flow and regulated combined sewer flows.

Outreach and Education

101 S Municipalities within the area of concern should disseminate information to indirect dischargers encouraging waste reduction practices.

102 S Educate public with regard to appropriate disposal of household hazardous waste.

Pollution Prevention

96 L The Industrial Pretreatment Program and Municipal Sewer Use By-law should be expanded to require indirect industrial dischargers that are tributary to CSOs to minimize their discharges during wet weather, where feasible.

97 L The Industrial Pretreatment Program and Municipal Sewer Use By-law should be expanded to require indirect dischargers to develop and implement Pollution Prevention Plan.

98 O Adopt best management practices as facilities including "good housekeeping" to prevent stormwater runoff from collecting pollutants and depositing them in a combined sewer.

Monitoring and Modeling

103 O Continue to gather data to quantify and qualify pollutant levels (particularly for toxics) in CSOs and pollutant loadings from CSOs to the Detroit River.

104 O Complete the development of regional hydraulic models to demonstrate appropriate CSO controls.

4 Environmental Justice

"The Detroit River is one of the most vital natural resources in our region. Since the inception of our community here, the river has been central to our economic livelihood and commerce, our recreation, and our vision of aesthetic beauty. Just as the development of the City of Detroit began with its waterfront, so too will the Detroit River play an essential role in the continued development and rejuvenation of our city. If we are to preserve our way of life, our city and ultimately our planet, it is imperative that we find efficient and cost-effective ways to clean up environmental contamination and to use our precious resources, including our water, in environmentally sound ways, for ourselves, and for the generations that come after us."

Dennis Archer
Mayor, City of Detroit

Background

Social and economic changes in North American society since the 1960s have led to demographic shifts. For example, in the Detroit area there has been significant movement away from a heavy manufacturing and industrial base toward a base of light manufacturing , technology, and information. Coupled with this shift has been a reduction of the population of the City of Detroit by almost 50% since the 1950s. Throughout North America it is now common to find urban centers with large proportions of their populations made up of minorities and the economically disadvantaged. Currently approximately 75% of Detroit's population is African-American.

There are growing concerns about the potential exposure to environmental pollution and the associated effect on the health of urban dwellers. Increased exposure to certain pollutants may result from living in proximity to industrial activities, waste management facilities, and contaminated sites. These types of sites all tend to be concentrated in older urban areas. Such areas may also attract speculative activities which seek low cost locations and perceived lax regulation or enforcement of environmental law. Some perceive that under these conditions urban residents may be disproportionally exposed to higher pollutant levels thereby experiencing a lower quality of life, as well as being at higher risk for certain health problems such as respiratory diseases.

These issues and concerns have alternately been termed *environmental equity, environmental equality, environmental racism,* and **environmental justice.**

Environmental Justice & the Detroit River RAP

The concepts of environmental justice were first discussed in relation to the Detroit River Remedial Action Plan (RAP) process during the July 14, 1994 meeting of the Detroit River Binational Public Advisory Council (BPAC) held in Amherstburg, Ontario. Environmental justice issues have been discussed at each of the BPAC meetings held since that time. During the March 9, 1995 meeting the Detroit River BPAC overwhelmingly endorsed the concept that the recommendations in the Detroit River RAP be implemented in a manner which considers environmental justice concerns throughout the Area of Concern. The BPAC also felt that a chapter discussing environmental justice as it applies to the Detroit River RAP process should be prepared by "staff", with input from BPAC members, for inclusion in the current biennial report.

The Detroit River RAP Team also supported the BPAC initiative to integrate environmental justice concerns and the Detroit River RAP process. Individuals from the RAP Team have reviewed and commented on several draft environmental justice reports as well as supplying information and background material to the report writers.

Although the suggested environmental justice efforts received overwhelming binational support from both the Detroit River BPAC and RAP Team, concerns were initially expressed over the applicability of environmental justice to the Canadian portion of the Area of Concern (AOC). These concerns were attributed to the perception that environmental justice had begun, and continues, as primarily a United States based movement. Research by Environment Canada (EC), Health Canada (HC), and the Ontario Ministry of Environment and Energy (MOEE) quickly identified several examples of provincial and federal policy and law which incorporate the principals of environmental justice. Although the terminology may be somewhat different, the interest in environmental justice is strong in the governments of both the United States and Canada.

Recommendations for Environmental Justice

While environmental justice has been discussed by the BPAC since July 1994, two issues need to be resolved in order to address the environmental justice concerns through the Detroit River RAP process.

- Minorities and the economically disadvantaged are under-represented on BPAC
- The environmental justice movement consists of many diverse groups and opinions

The participation of local environmental justice experts with the Detroit River RAP could address both of these concerns. Individuals should be selected to represent the wide range of groups and opinions which make up the environmental justice movement. This would insure appropriate input to the RAP on these issues as well as establishing linkages to the previously under-represented groups.

A. Recommendations in the 1996 Detroit River Remedial Action Plan Report should be implemented in a manner which considers environmental justice concerns through out the Area of Concern.

   Status: It is the intent of the Detroit River RAP community that this will be done, in part through Recommendation "C" below.

B. A chapter discussing environmental justice as it applies to the Detroit River RAP process should be prepared by staff with input from the BPAC for inclusion in the 1996 Detroit River RAP Report.

   Status: This has been done. However, future iterations of the Detroit River RAP should also contain chapters detailing environmental justice efforts as they pertain to the Detroit River RAP process.

C. The participation of local environmental justice experts will be garnered for the Detroit River RAP.

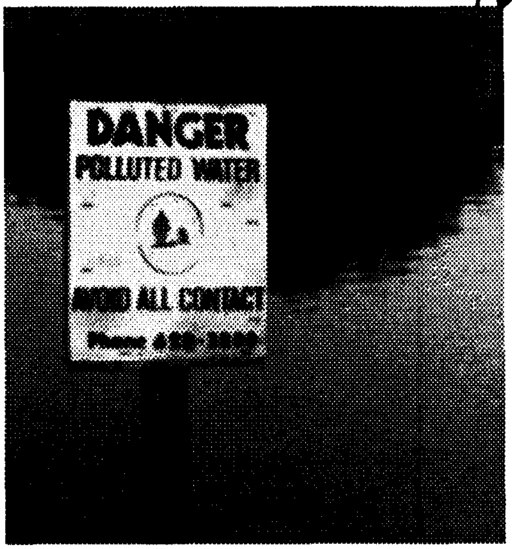
   Status: Environmental justice is currently a priority focus area of the USEPA. MDEQ and USEPA have both offered help in recruiting local experts for participation with the Detroit River RAP process.

5

Stage 1 RAP Update

"The real strength of the Detroit River RAP is that stakeholders truly concerned about the health of the river can come together with the surrounding communities and plot a course of action. The iterative nature of the Detroit River RAP allows the participants to make course corrections as we work together to achieve a common vision for the Detroit River. The RAP Update charts our progress and provides direction for future efforts as we navigate through the RAP process."

Susan Benzie
Michigan Department of Environmental Quality



"The first step to achieving any solution is identifying the problem and the task to be met. The Stage 1 document made that important step and provided a starting point for the Detroit River RAP process. It is essential that people, being the most fundamental resource of the RAP, be constantly involved throughout the process to ensure that the document continually reflects current realities. The RAP Update takes the next step towards the future by solving the problems of the past."

Dan Gaudenzi
MOEE Sarnia District Office

Regulatory Programs

Many of the programs and regulations relevant to habitat in the Detroit River AOC were outlined in the Stage 1 Detroit River RAP. Appendix 5.1 outlines new or additional programs and regulations and updates the information from the Stage 1 RAP pertaining to environmental legislation and guidence. As in the Stage 1 RAP, this discussion is intended to outline the major aspects of important regulatory programs that effect the Detroit River AOC, particularly from the habitat point of view. The chapter is organized by jurisdiction to point out the regulatory tools that each has to work with at this time. It is not the intent to compare or contrast programs, but rather to present information which forms the basis of many decisions affecting the AOC. Analysis of current programs and regulations is contained in the individual Technical Work Group Reports (Chapter 7 - 10). Regulatory and programmatic recommendations are also discussed in each of these reports.

The State of Michigan recently completed efforts to "codify, revise, consolidate, and classify" it's existing environmental and natural resource laws. The Natural Resources and Environmental Protection Act, or Public Act 451 of 1994, is the result of these efforts. Appendix 5.1 contains a conversion chart for locating Michigan environmental and natural resource legislation that is now contained within Act 451.

Description of the Area

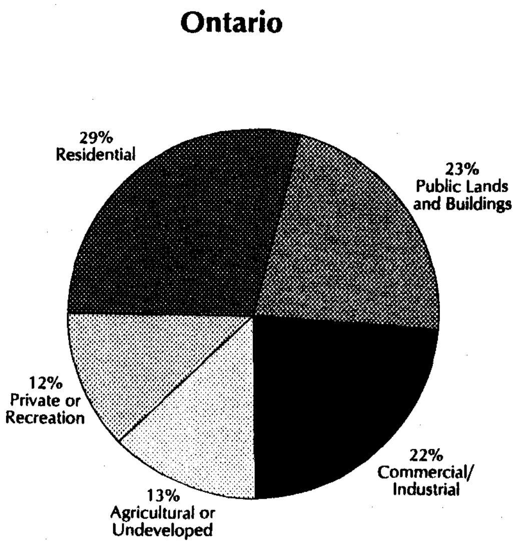
Michigan

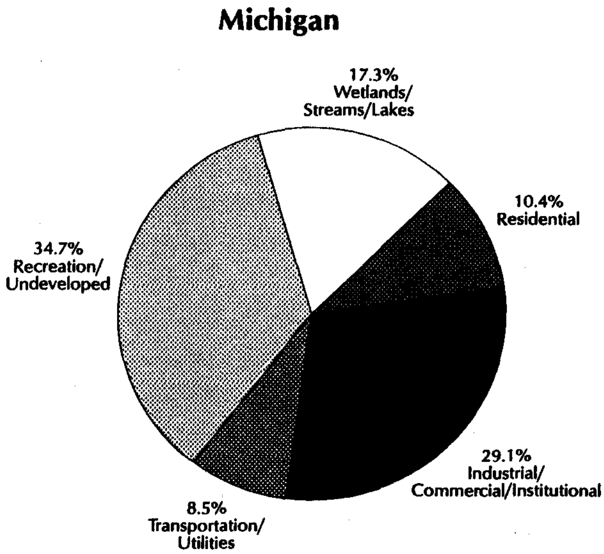
The land use along the Michigan side of the Detroit River has changed slightly over the last ten years. Industrial and commercial uses have decreased from the 19.0 miles listed in the Stage One to 17.0 miles currently. This has lead to slight increases in residential and recreational uses (Figure 3).

Ontario

Residential is the predominant land use along the Ontario shoreline accounting for 15.48 km. As in Michigan, commercial and industrial uses have decreased from the values listed in the Stage One. Recreational uses have also declined. It is likely that these uses were converted to public/municipal uses (Figure 3).

Figure 3
Shoreline Land Use in the Detroit River AOC





Appendix 5.2 contains additional information on land use along the shorelines, and the islands of the Detroit River. This appendix also contains update information on the parks and open spaces within the AOC.

Description of the Aquatic Ecosystem

Water Quality

Ambient water quality conditions at head and mouth of the Detroit River have been monitored by the MDNR since 1971. Monitoring was designed to calculate loadings, document water quality, and determine water quality trends over time. Details of this effort are found in the report "Ambient Water Monitoring in Michigan: Concentration and Loading Trends in the Detroit River and Great Lakes Tributaries" (MDNR, 1993). The parameters examined were; total phosphorus, suspended solids, chloride, total lead, total copper, and total zinc. Annual mean concentration and loading rates for all parameters, except suspended solids, have decreased at the downstream transect since monitoring began (Appendix 5.3). There has been no detectable trend for suspended solids.

Tributaries

Loads from the Rouge River were estimated for the years 1992 and 1993 for cadmium, copper, lead, and zinc. No estimates were possible for mercury (all results below detection) or PCBs (parameter not analyzed). The estimation with censored data was made easier by the fact that a constant detection limit was used for each metal. This allowed an estimate of a "replacement value" for each observation reported as "less than detection". The same bias correction and flow adjustment equations typically used for phosphorus were then applied. Some trouble with cadmium was experienced (because there were less than 25% of the values above the detection value), but a conservative estimate was obtained. Load estimates are summarized in table 1 (below) and are contained in full in the appendices of chapter 9 (Point Source/Nonpoint Source).

Contaminated Sediments Update to the Stage 1 RAP

The purpose of this section is to update information on Detroit River sediments and associated studies conducted between the Stage 1 and the current RAP. To conduct an update, identification, compilation, review, and analysis of the new information is required. The initial step was to compile all sediment-related studies cited in the Stage 1 RAP. The compilation indicated that approximately 50 reports and publications were cited. Section 8.2 of the Bibliography presents a compilation of sediment-related studies on the Detroit River which were not cited in the Stage 1 document. This is approximately 75 reports and publications.

Sediment study citations from Stage 1 range into the early 1990's. However, the information summarized in Stage 1 primarily encompasses documentation available through 1988; only limited results are presented through the early 1990's. Because of this factor, this update focuses on a time period of approximately 6 years and focuses on reports and publications which have become available since the completion of Stage 1. Citations provided in Section 8.2 of the Bibliography also include some older documents which were not cited in Stage 1 for completeness of Detroit River documentation. It is estimated that the Stage 2 update represents approximately 90% of the documentation from 1988 to the present.

Between 1984-1988 one of the most intensive studies ever conducted on the Detroit River occurred during the Upper Great Lakes Connecting Channels Study (UGLCCS). These studies were conducted by a large number of governmental and academic groups from the U.S. and Canada. Development of the Stage 1 RAP partially coincided with UGLCCS and available UGLCCS data were used in the formulation of Stage 1. A number of the reports cited in Stage 1 were preliminary or were from working documents provided by UGLCCS Technical Work Groups; in many cases, personnel were involved with both undertakings. A great deal of the UGLCCS reports and data used in Stage 1 were preliminary or interim, but decidedly, most of the UGLCCS data as used in Stage 1 were final or ultimately became finalized. Therefore, a considerable number of interim reports cited in Stage 1 are presented as final reports in this update. Additional findings also became available after Stage 1 completion and are included in Section 8.2 of the Bibliography; these reports and publications were usually further syntheses of subset of data from reports or interpretation of several data sets. Also included in Section 8.2 of the Bibliography are reports and publications which were not related to UGLCCS.

The primary intent of this update is to present, review, and discuss the more recent data collected from the Detroit River and any unique information that has become available since Stage 1. Emphasis is placed on major topic areas, e.g., heavy metals, organic contaminants, sediment toxicity, benthic communities, etc. and any unique information which had not been previously discussed. Although a great many questions exist, this review will address some of the overall questions on Detroit River status, for example: Were data assessed adequately in the Stage 1 RAP? Has our overall system-wide perception of Detroit River sediments changed? Have there been qualitative/quantitative system-wide improvements or degradation? Have sediments and associated conditions changed over the past 6 years on a local basis? Have there been certain sediment aspects which have not been previously discussed? What are the data gaps? What additional studies are needed or should be conducted in the future?

Contaminants

Heavy Metals/Trace Elements

One of the most recent system-wide studies of heavy metals/trace elements in sediments was conducted in 1991 by the MOEE (Farara and Burt, 1993). A sizable number of heavy metals exceeded their respective lowest effect levels (LEL) and a number also exceeded severe effect levels (SEL). Only a very small number of stations in both Canadian and U.S. waters did not exceed LEL values for one or more heavy metals/trace elements. In most cases, the stations sampled had multiple LEL exceedances. In Canadian waters, cadmium, copper, and nickel had the greatest number of LEL exceedances; chromium, copper, mercury, and lead exhibited SEL exceedances. Maximum heavy metal concentrations (ppm D.W.) observed in sediments from Canadian waters are as follows: arsenic (9.7), cadmium (2.80), chromium (140), copper (220), lead (710), mercury (2.20), nickel (46), and zinc (380). In U.S. waters, LELs were frequently exceeded by most metals. Severe effect levels values for most metals were exceeded at least once; the SEL for copper was exceeded most frequently. Maximum heavy metal concentrations (ppm D.W.) observed in sediments from U.S. waters are as follows: arsenic (27.3), cadmium (28.67), chromium (260), copper (530), lead (1100), mercury (11.70), nickel (130), and zinc (970).

Sediment analyses were conducted on samples collected from the Detroit River navigation channel in 1991 for evaluation regarding maintenance dredging (USACOE, 1991). A sizable number of the samples exhibited metal concentrations which would be considered nonpolluted. However, in some cases arsenic, chromium, copper, lead, mercury, nickel, and zinc exhibited concentrations considered moderately polluted and exceeded LELs; a very limited number of the values exceeded SELs. Maximum concentrations (ppm D.W.) are as follows: arsenic (12.3), cadmium (8.9), chromium (96), copper (82), lead (99.4), mercury (2.1), nickel (70), and zinc (420).

In the past several years, a series of sediment cores have been collected in the lower Detroit River to examine the vertical contamination of sediments. These studies have been centered in the Trenton Channel and are as follows: 1) short sediment cores (to approximately 25 cm) from the entire Trenton Channel on both the west and east nearshore zones (Rossmann et al., 1978), 2) long sediment cores (to approximately 2m) from the Black Lagoon in the central, U.S. nearshore zone of the Trenton Channel (Mich. Dept. Nat. Res., 1988), and 3) long sediment cores (to approximately 3m) primarily from the western nearshore zone of the Trenton Channel (Mich. Dept. Nat. Res., 1994). Several general observations can be made from the results of these studies. In many cases, heavy metal concentrations in sediment cores are generally greatest in the western nearshore zone, compared to the eastern shoreline (Grosse Ile side). In most cases, contaminant concentrations in surface intervals are moderately to heavily polluted and exceed both USEPA and MOEE (LEL and SEL) sediment guidelines; select surface sediments primarily near Grosse Ile, exhibit concentrations which were not considered moderately or grossly polluted. These results generally agree with results of surficial sediment surveys collected using the Ponar technique. Of particular note is that many sediment cores exhibit concentrations with depth that are equal to or greater than those observed at core surfaces. In many cases, USEPA and MOEE heavily polluted and SEL guidelines, respectively, for metals are exceeded with depth. These cases may be observed in intervals which are to a depth of 3 m from the surface. In some cases, subsurface maxima exhibit concentrations that are 2 or more times greater than those at the surface. Even though the Detroit River is a high energy system with complex sediment dynamics, greater heavy metal concentrations with depth appear to guardedly reflect the general contamination history of the system. A survey of heavy metal concentrations in sediments of 10 Detroit River tributaries was conducted (Pranckeviscius, undated). Fifteen samples were collected and the Huron River and Mouillee Creek were treated as Detroit River tributaries in this survey. Survey results indicated that heavy metal concentrations for most metals were consistently high in sediments from many of the tributaries and that heavily polluted sediment quality and SEL guidelines were exceeded in many tributaries for one or more metals. Heavily polluted guidelines, LELs, and SELs for most metals were usually exceeded in at least eight of the samples, and many times, were exceeded in thirteen of the samples. Guidelines for barium, chromium, copper, lead, and zinc were exceeded most often. Conners Creek, Rouge River, Monguagon Creek, and Ecorse River were consistently noted with highest concentrations and the greatest number of exceedances. Maximum concentrations (ppm D.W.) for selected heavy metals are as follows: arsenic (54), cadmium (47), chromium (330), copper (300), lead (1000), mercury (1.5), nickel (190), and zinc (1800). Greatest heavy metal concentrations were consistently observed in Detroit River tributary sediment samples compared to those from Lake St. Clair, St. Clair River, and St. Mary's River tributaries.

Organically-complexed tin, tri-n-butyltin, was observed in sediments of the Detroit River ranging from 1.72 x 10-8 to 1.59 x 10-7 mol Sn/kg D.W.; other organotin compounds were also observed in sediments as well as in water samples (Maguire et al., 1985). Detroit River concentrations were lower than the concentration (6.1 x 10-7) observed in Rouge River sediment.

Alkyllead compounds were examined in several environmental media of the Detroit River including water, surface microlayer, fish, and sediments (Chau et al., 1985). Various media exhibited different alkyllead species. Total, acid-extractable lead was presented for sediments. Although, direct measurements were not presented, it was suggested that tetraalkyllead would be relatively high in sediments, compared to other media, due to its' chemical nature and the absorbent capacity of sediments.

Organic Contaminants

The most recent system-wide study of organic contaminants was conducted in 1991 by the MOEE (Farara and Burt, 1993). No samples exceeded SELs throughout the system. A considerable number of samples exceeded the LEL and for both U.S. and Canadians waters, PAHs exhibited the greatest number of exceedances. In Canadian waters, only one station exceeded total PCB and one station exceeded the total DDT lowest effect level. Maximum concentrations (ppm D.W.) in sediments from Canadian waters are as follows: total PAH (86.50), total PCB (0.075), and total DDT (0.012). In U.S. waters, most stations exceeded LEL values for total PAHs and a sizable number of stations exceeded LEL values for total PCB, total DDT, and DDT components. Maximum concentrations (ppm D.W.) in sediments from U.S. waters are as follows: total PAH (351.85), total PCB (3.0), and total DDT (1.205).

Sediment analyses were conducted on samples collected from the Detroit River navigation channel in 1991 for evaluation regarding maintenance dredging (USACOE, 1991). All samples showed organic contaminants to be lower than the limit of detection, excepting analyses for PCB aroclors. The greatest total PCB concentration (aroclor sum) observed was 2.2 ppm D.W. and most were less than 1.0 ppm; different aroclor mixtures were observed at different locations. In samples where PCB aroclors were detected, LEL guidelines were exceeded. Furlong et al. (1988) reported polychlorinated naphthalenes and polychlorinated terphenyls in a study of the Trenton Channel. Greatest concentrations observed were in the central area of the western nearshore zone of the channel.

Alkylphenols were found in sediments of the Trenton Channel (Carter and Hites, 1992a). Of the 7 alkylphenols, 2,4-di-tert-pentylphenol (24DP) was the most prevalent and exhibited highest concentrations (430 mg/kg D.W.) in Monguagon Creek, a small tributary to the Trenton Channel. Concentrations decreased considerably toward the mouth of the Detroit River. Carter and Hites (1992b) also detected 24DP in sediments throughout Lake Erie at considerably lower concentrations. The alkylphenols were also shown to accumulate in carp from the Trenton Channel (Shiraishi et al., 1989).

A survey of organic contaminant concentrations in sediments of 10 Detroit River tributaries was conducted (Pranckeviscius, undated). Fifteen sediment samples were collected and the Huron River and Mouillee Creek were included as Detroit River tributaries in this survey. Survey results indicated that organic contaminants were consistently high in sediments from most of the tributaries. DDT and metabolites, pesticides, benzenes, and PAHs were found in all tributaries and volatile organic compounds, phthalate esters, and PCBs were observed in sediments from the majority of tributary sediments. LEL guidelines were exceeded in many cases, although SEL guidelines were not. Conners Creek, Rouge River, Monguagon Creek, and Ecorse River were consistently noted with highest concentrations and Mouillee Creek and the Huron River generally exhibited the relatively lowest concentrations.

Platford et al. (1985) examined concentrations of hydrocarbons and chlorinated hydrocarbons in several phases in the Detroit River: surface microlayer, subsurface water, suspended solids, sediments, sediment pore water and air. Concentration ranges of PCBs, PAHs, chlorobenzenes, HCB, and other organic contaminants in sediments were presented. A major finding of the study as related to sediments, indicated that sediments are the largest reservoir of halogenated compounds for all phases when the relative mass of contaminants is considered on a phase-by-phase basis. Sediments had an enormous adsorption capacity and, for example, over 99% of the chlorobenzenes and PCB isomers resided in sediments.

A series of sediment cores have been taken in the lower Detroit River to examine the vertical contamination of sediments and were described above. The general observations made for heavy metals are similar to those for organic contaminants. General observations include organic contaminant concentrations are generally greatest in the western nearshore zone, contaminant concentrations in surface intervals are moderately polluted with concentrations near Grosse Ile being relatively lower, and concentrations with depth are equal to or greater than those observed at core surfaces, potentially reflecting the history of contamination in the river.

Conventional Parameters/Nutrients
Total Kjeldahl nitrogen (TKN), total phosphorus, and total organic carbon frequently exceeded LEL levels throughout the system (Beak Consultants Limited, 1993). In U.S. waters, total phosphorus exceeded SEL values at 5 stations.

A survey of nutrient concentrations in sediments of 10 Detroit River tributaries was conducted (Pranckeviscius, undated). Survey results indicated that nutrients/conventional parameters were high in sediments from some of the tributaries. Oil and grease, total volatile solids, and cyanide concentrations were high in 12 or more of the samples. Total Kjeldahl nitrogen and total phosphorus were high in approximately one-half of the tributary sediment samples. Conners Creek, Monguagon Creek, and an unnamed tributary, south of Sturgeon Bar, were typically cited as those with the greatest concentrations. Typically, LEL guidelines were exceeded.

Sediment Toxicity
Sediment toxicity testing was conducted using fathead minnows, Hyalella (amphipod), Lumbriculus (aquatic earthworm), and Ceriodaphnia (Ankley et al., 1991). Samples were obtained from the Trenton Channel and exhibited a range from no to great toxicity. General concurrence was observed for the different types of test organisms in determining whether sediments were toxic and the degree of toxicity. The most toxic stations appeared to be in the central portion of the western U.S. nearshore

zone. Sediment toxicity of the Trenton Channel appeared to be within the range, and similar to, toxicities observed for sediments from other waterways in the Great Lakes basin.

Microtox, Daphnia magna, Chironomus tentans, and Hexagenia limbata were used as test organisms in toxicity tests to examine the sensitivities of the different organisms to 3 methods for diluting/mixing sediments (Giesy et al., 1990). Based on lethality, Hexagenia was the most sensitive organism to Detroit River sediments. Lethality of D. magna to sediment porewater and the Hexagenia in whole sediment testing exhibited the best agreement.

Rosiu et al. (1989) reported vertical toxicity of sediments in short sediment cores from the Trenton Channel using chironomid growth as the endpoint. Toxicity testing in this study was conducted on cores with complementary heavy metal and organic contaminant analyses cited as Rossmann et al. (1987). Two primary patterns were observed: 1) greatest toxicity at the surface with underlying sediment exhibiting little or no toxicity and 2) greatest toxicity at a subsurface interval with less toxicity above and below the maximum. In selected cases, severe to moderate toxicity was observed for each interval of the 25-cm cores.

Sediment toxicity was conducted in the western nearshore zone of the Trenton Channel to assess the effects of dredging and construction of the Elizabeth Park Marina (Besser and Giesy, 1994). Tests indicated that conditions in and near the marina were similar to those in the Trenton Channel. Generally no toxicity was observed in porewater tests using Daphnia magna and Microtox. However, amphipods and chironomid larvae exhibited similar toxic effects in the channel and marina.

Genotoxicity

A method for determining cyto- and genotoxicity of sediment extracts was demonstrated using sediments from the Trenton Channel, Turkey Island, and Channel Ecart-St. Clair River (Ali et al., 1993). Bullhead cell lines were exposed to the sediment extracts and indicated that Trenton Channel extracts were consistently more cyto- and genotoxic than extracts from the other two sites. The results of the tests also appear to correspond to contaminant concentrations measured in sediments from the sites.

DNA adducts tests were conducted on Detroit River fish species using a P-32-postlabeling technique (Dunn et al., 1987; Maccubbin et al., 1990). DNA was isolated from fish livers and subjected to analysis and examined for adducts. Brown bullheads and walleye from the Detroit River exhibited DNA adducts. Compared to fish from the Buffalo River, Detroit River fish had DNA adduct levels both lower and greater than Buffalo River fish, dependent on the species examined. In all cases, DNA-adduct levels were greater than those in control specimens.

Bioaccumulation

Field and laboratory studies of organic contaminants and their effects on American wildcelery growth and reproduction were conducted using Detroit River and St. Clair River plants (Lovett Doust et al., 1994). Overall plant performance was shown to be affected by contaminant concentrations and American wildcelery was proposed as a biomonitor for organic contaminants. Field-collected plants were found to accumulate HCB, OCS, PCBs, p,p'-DDE, and other organic contaminants. Concentration differences were observed to vary with site, contaminant, tissue type, and season. The influence of contaminant concentrations in sediments was cited. In a comparison of field and laboratory data, plants from the Detroit River exhibited lower contaminant concentrations and greater production of ramets, leaves, and total biomass, compared to those from the St. Clair River.

Mac et al. (1990) demonstrated that fathead minnows and earthworms accumulated total PCBs from Detroit River sediments. Similar concentrations were obtained from sediment exposures in laboratory flow-through systems and in field uptake studies. Concentrations observed from both exposure types were significantly greater than, and approximately an order of magnitude greater than, pre-exposure concentrations.

Heavy metal concentrations were measured in drifting aquatic plants collected from the Detroit River (Manny et al., 1991). The primary species found in the drifting vegetation was American wildcelery, the bulk of the macrophytes appeared to be live, and greatest drift appeared during May. Plants contained relatively greatest concentrations of zinc, nickel, and copper. Relative to total contaminant export to Lake Erie via the Detroit River, contaminants in drifting plants appear to be negligible.

Alkylphenols were shown to accumulate in carp from the Trenton Channel (Shiraishi et al., 1989). Greatest concentrations were observed in carp from the mid-portion of the Trenton Channel with greatly reduced concentrations in fish from northern and southern sectors of the channel. Concentrations observed corresponded to those found in sediments.

Bioassays were conducted in which Hexagenia nymphs were subjected to short-term (a standard 21 days bioassay using half-grown nymphs) or lifetime (244 days using newly hatched nymphs) exposures of bulk sediment from a highly contaminated location (Trenton Channel) Ciborowski et al. 1992a). The contaminated sediment was diluted with specific quantities of contaminated free formulated sediment to obtain a serial dilution protocol Nymphs exposed for 21 days survived in all treatment mixtures. When nymphs were exposed to sediment treatments for 244 days, some nymphs survived in dilutions containing up to 50% contaminated sediment. However, nymphs grew and emerged into adults only in those treatments with 25% or less Trenton Channel sediment suggesting that the Trenton Channel sediment was about four times too toxic for Hexagenia to complete their life cycle.

Night-flying caddisflies and mayflies have been collected using light traps in the Connecting Channels of the Great Lakes and compared with reference sites within and outside the basin (Ciborowski and Corkum 1988, Kovats and Ciborowski 1989, Kovats and Ciborowski 1993). The high body burdens of PCB congeners found in winged insects in the Detroit River samples reflected the industrial loadings near Detroit.

Modeling

Meteorological Effects on Sediments

A frequency analysis of flow in the Trenton Channel indicated that flow is very stable and has a very low probability of deviating from the mean flow by more than +/- 10% (Bedford, 1988). Due to flow stability, any sediment entrainment observed primarily results from wind events which exceed critical sediment shear stresses; other factors may be influential on a temporal basis. Entrainment events are most frequent (approximately 30%) during the fall with lower frequencies during spring, summer, and winter (Koltun and Bedford, 1990). Wind waves (resulting in sediment entrainment) can be directed into the southern portion of the Detroit River by S, SE, and E winds from Lake Erie. For the Trenton Channel, primarily north and south winds are the most influential. However, for most portions of the Trenton Channel, north winds generally appear to mediate sediment entrainment as they typically occur at greater intensities and durations than south winds.

Erosion, Resuspension, Transport, and Deposition of Sediments

Erosion, resuspension and transport of sediments in the Trenton Channel were primarily influenced by wind waves and secondarily by flow (Ziegler et al., 1988). As previously discussed, wind waves generated by north winds were the most influential. The fetch required to produce significant entrainment can be drastically reduced by winds changing to off-axis winds by only a few directional degrees. It appeared that the large depositional zone at the confluence with Lake Erie contributes much more resuspended sediments to the water column during an event than other areas in the Channel. Depositional sites and depositional rates were determined for several sites in the Trenton Channel. Most sites exhibited greatest deposition during the winter, when flow is lowest and temporal ice cover is present; however, some of the deposited material would be resuspended during spring runoff and slightly higher flows.

Sediment/Water Relationships

Water quality modeling conducted in the Trenton Channel showed that large, east-west physico-chemical gradients existed in the Trenton Channel (Di Toro et al., 1988). Little or no lateral, advective mixing was observed and appears to correspond to the east-west gradient observed in Trenton Channel sediments. Typically, contaminant discharges from the western nearshore zone are deposited to sediments in this ribbon and are then subject to dynamic sediment-water interactions.

Field and laboratory investigations of sediment resuspension and metals partitioning were conducted for the Detroit River (Theis et al., 1989; DePinto et al., 1989). Using a shaker device for resuspending sediments, several conclusions could be drawn. Sediment type and properties governed metals adsorption and desorption. The total resuspended sediment (suspended solids) in the overlying water correlated with shear stress intensity generated in the shaker device. Similarly, increased total metal concentrations in overlying water correlated with increased shear stress and resuspension. Dissolved metal concentrations in overlying water increased during simulated resuspension only when pH was less than 7.5. It appeared that the influence of pH during resuspension events governed concentrations of dissolved metal concentrations.

The toxicity of sediments was examined relative to water quality criteria (Di Toro et al., 1988). The objective was to determine if water quality criteria would be exceeded upon sediment resuspension. Resuspended sediments did not exceed one toxic unit and was considered not to exceed criteria with a return period of three years. Although this major conclusion was forwarded at this time, enhanced understanding of resuspension coefficients and amounts of resuspended material may influence the outcome of these calculations. Subsequently, water quality criteria may have been exceeded, via resuspended sediments, if calculations were revisited.

Assessment of Historical Change

A large number of factors point to a longterm improvement in the overall Detroit River environment during approximately the past 20 years. Many of the improvements are observable, unmistakable, and documented; other improvements, however, may be somewhat anecdotal or incidental observations at this time and may require additional scientific definition and confirmation in the future. Different compartments of the system respond at differing rates and magnitude. Decreases in total system loadings of anthropogenic substances over the period suggests that other remedial actions potentially can be taken for further improvements. As a repository for contaminants, sediments appear to be responding slower than other environmental components of the system. In the past, sediment remediation would not have been considered feasible, due to continued loadings, unless some extremely high risk area was identified. However, longterm improvements in the Detroit River system has now brought sediments to the fore as having potential for remedial action. Loadings have been reduced to the point that sediment action is feasible, although sustainable, longterm improvements will have to be examined relative to present loading information and the dynamic processes which influence sediments.

During the past 20-25 years some improvements in sediment quality and sediment-associated factors have been observed. In some cases, decreases in sediment concentrations of heavy metals and organic contaminants have been observed. Vertical contamination of sediments generally exhibit decreases toward the surface, however, this must be a guarded interpretation due to the high energy nature of this system and cores may not necessarily reflect accurate contaminant loading histories. In some cases, general improvements in overall benthic macroinvertebrate communities have been observed, where a greater number of pollution sensitive taxa have increased and the densities of caddisflies and mayflies have increased. Parallel with these improvements it appears that undesirable, pollution insensitive species have declined, specifically, densities of the oligochaete Tubifex. In this longterm picture, other factors have pointed to some general improvements in sediments and associated factors; however, it must be noted that degradation has also been observed. The general conclusion that can be drawn for the longterm record is that improvements were observed for different sediment-related issues until the early to mid-1980's and appear to be temporal compared to data obtained during the past decade. It should also be noted that it is very difficult to assess longterm records of sediments because they are spatially heterogeneous and temporally variable (although are usually less variable than water and biota) and are subject to a large number of dynamic processes which mediate sediment observations. Ideally, sediments should be assessed every five years or less for comparative purposes and trend examination. This procedure is consistent with the RAP sediment monitoring plan and with the elevated importance of sediments, relative to system remediation at this time. However, it is very difficult to assess all factors synoptically in this time frame and the 5 to 10-year period used in this comparison is guardedly satisfactory.

The Stage 1 RAP appears to have adequately presented sediment data for the information available at that time. A considerable amount of data was used, recent data was provided, data provided spanned many topic areas, data presentation techniques appeared to be appropriate, and overall interpretation and conclusions appeared to be appropriate. Only a limited number of reports have been identified through this update that were available and not cited during preparation of the Stage 1 RAP. Since completion of the Stage 1 Detroit River RAP, a number of studies have been formalized in peer-reviewed journal articles or reports and a number of new studies have been conducted. This recent information base is used to examine the present status and short-term record of sediments and other issues. During the past 5-10 years, sediments in the Detroit River on a system-wide basis have been shown to: still possess areas of heavy contamination by heavy metals, organic contaminants, and conventional parameters, continue to yield new contaminants which have not been previously observed, be severely toxic to a wide array of test organisms, exhibit a degraded benthic community which is generally dominated by pollution insensitive species, induce moderate to severe cyto- and genotoxic responses in fish, contain contaminants which are bioaccumulative in fish, earthworms, insects, and aquatic plants, exhibit a decline in American wild celery buds, and contain introduced species of plants and animals. In general, it appears that the present status of Detroit River sediments is generally moderately to severely contaminated and that major improvements have not occurred in the above factors during the past 5-10 years; with qualifications dependent on specific contaminants, locations, and issues.

Generally, sediments over large expanses of the Detroit River exceed sediment quality guidelines for one or more heavy metal/trace elements and organic contaminants. Conversely, sediments over a sizable area of the Detroit River do not exceed guidelines. In many sectors of the Detroit River, sediment- dwelling macroinvertebrate communities contain undesirable species and are considered degraded; although some areas of the river possess fairly healthy benthic communities. As well sediment toxicity testing has shown that sediments exhibit varying magnitudes of toxicity to a wide variety of species using several test endpoints; sediments exhibiting little or no toxicity have also been observed. As a general assessment, certain areas of the Detroit River exhibit degraded conditions when sediment is considered and in general, improvements have been observed through the early to mid-1980's, but in many cases, improvements have not been distinctly observed during the past decade.

Several improvements, however, have sustained through the past decade and should be noted. Continued decreases in heavy metal concentrations were observed at the mouth of the Ecorse River; at the mouth of the Rouge River improvements were evident from 1970 to 1980, but 1991 data exhibit different trends for different metals (level, increases, decreases). A notable improvement observed is the significant, system-wide decrease in organic contaminants (total PCB, DDT, hexachlorobenzene, and chlordane). In the past, certain areas of the river have been completely dominated by the oligochaete, T. tubifex, and it appears that this species continues to decline in importance.

It appears that the long- and short-term record of Detroit River sediments, on a system-wide basis, exhibits signals of improvement, no change, and degradation. One concludes therefore that signals are mixed on a system-wide basis. For example, in a system-wide comparison of maximum heavy metal concentrations in sediments between those reported in the Stage 1 RAP and those reported in this update, many concentrations are lower and substantially so in the most recent dataset. However, several maximum concentrations reported in this update are considerably greater than those reported in the mid-1980's and on a station-by-station basis many increases have been observed. These mixed signals can also be observed on a local basis. Concentrations of heavy metals in sediments from river mouths of the Rouge and Ecorse Rivers, over a 20-year period are presented in Tables 6 and 7, respectively. Rouge River data exhibit concentration increases in most metals between 1970 and 1980 with some decreases to 1991, but primarily no change in most concentrations for the most recent period. In contrast, data from the Ecorse River exhibit distinct decreases from 1970 to 1980, with modest decreases or no change in most concentrations to 1991. The temporal and spatial heterogeneity of sediments is also shown in these datasets.

Table 6
Comparison of 1970, 1980 and 1991
heavy metal concentrations for the mouth of the Rouge River

SAMPLE DATE	CONCENTRATIONS IN ug/g DRY WEIGHT CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC	MERCURY
1970	<30	26	41	54	38	118	1.12
1980	14	140	190	180	40	550	0.53
1991	7.1	110	210	180	38	740	0.02

Source: 1970 and 1980 data from Thornley and Hamdy (1984); 1991 data adapted from Farara and Burt (1993).

Table 7
Comparisons of 1970, 1980 and 1991
heavy metal concentrations for the mouth of the Ecorse River

SAMPLE DATE	STATION	CONCENTRATIONS IN ug/g DRY WEIGHT CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC	MERCURY
1970	34	<30	540	290	300	230	1300	1.2
1980	34	3	120	99	140	87	530	0.18
1991	34	1.1	66	72	94	37	280	0.22
	75	1.4	81	100	90	42	350	11.7

Source: 1970 and 1980 data from Thornley and Hamdy (1984); 1991 data adapted from Farara and Burt (1993).

Data from a station in the central, western nearshore zone of the Trenton Channel are presented in Table 8, as an example of a local, short-term record. These data show little or no distinct changes in a short-term sense. Additionally, this site has been consistently shown to be severely toxic over the time period. This recent record demonstrates that a combination of sources, including sediments themselves, may preclude sustainable sediment remediation. These data, as well as those from the Elizabeth Park marina study, indicate that contaminant concentrations in sediments, in deposited sediments, and in sediments subject to dynamic processes may not be sufficiently clean to prevent recontamination of sites that could be considered for remediation. Additionally, Detroit River sediments may have been so heavily polluted in the past that and when combined with various contaminant sources, sustained, unmistakable improvement has been slow. This factor is in contrast with the recent improvements noted for the St. Clair River and Lake Erie sediments. Because of the mixed signals, it may be that Detroit River sediments are responding slower but may be near a threshold and when this threshold is crossed, improvements may become more demonstrable and distinct.

Table 8
Contaminant concentrations at Black Lagoon, Western,
Nearshore zone of the Trenton Channel, Detroit River (mg/kg)

	1986 PONAR	1987 CORE MEAN OF UPPER 25 cm	1988 CORE UPPER 60 cm	1993 CORE UPPER 30 cm	1993 CORE UPPER 60 cm	1994 CORE UPPER 30 cm
Cadmium	12.72	30.76	21.20	14	12	16
Chromium	86.89	230	248	102	191	121
Copper	117.9	138	140	99	226	110
Mercury	1.02	NA	0.5	1.4	5.6	1.2
Nickel	109.7	84.6	NA	49	100	56
Lead	255.9	385.8	381	193	574	218
Zinc	2023	5730	1660	6060	1340	3320

Source: 1970 and 1980 data from Thornley and Hamdy (1984); 1991 data adapted from Farara and Burt (1993).

The recent system-wide study of Detroit River sediments and other studies have re-enforced our perception of Detroit River sediments in some instances, and have somewhat changed our perception in other cases. The study indicated that the U.S. portion of the River remains relatively more impacted than the Canadian portion; thus a considerable east-west difference which has been known for a considerable amount of time. The U.S.-Canadian differences can many times be observed in a systematic and quantifiable fashion. Similarly, the sediments on the western nearshore zone from the Rouge River to the confluence with Lake Erie, including the Trenton Channel, remain some of the most severely contaminated and toxic sediments in the river. Generally, the upper portion of the river is also less contaminated and less impacted than the lower portion. Several changes of our perception have also occurred and reflect degrees of change or degradation. Sediments in the upper portion of the river in the western nearshore zone (U.S.) waters, appeared to be more contaminated (particularly mercury concentrations) than appeared from the Stage 1 RAP. Similarly, it appears that a greater area of sediments in Canadian waters have deteriorated to moderately impacted. Lastly, a zone of sediment in the lower, eastern nearshore zone (Canadian waters) is more heavily contaminated than believed from the Stage 1 RAP.

Based on historical conditions, present status, and present perception of Detroit River sediments, how do we proceed in striving for greater improvements and sediment remediation? Probably a first assessment would include remediation of any sediment deposits which are high risk or imminent threats to human health. These sites would have to have a high priority in a Great Lakes or regional ranking. Potentially a site that had, for example, 100 ppm total PCB or 50 ppm mercury, would probably qualify as a high risk site and would require timely remediation. Although sources would be at least preliminarily examined and considered, remediation in a case such as this, would more than likely, disregard any consideration of recontamination by point or nonpoint sources, including sediment resuspension and deposition from upstream sites. Sustainable, longterm remediation may not occur but would probably reduce risks compared to the present condition. Although some sites in the Detroit River are heavily polluted, they are not of the type (nor are they close to high risk considerations) which would receive immediate remediation.

Given that the above scenario is probably not now considered as a factor in remediation of Detroit River sediments, the relationship of all anthropogenic loads and sediments must be recognized and quantified as a starting point and factors such as sustainable, longterm remediation and upstream remediation must be considered. Loads may originate from point and nonpoint sources and is confounded by the sediments themselves which are a nonpoint source. Contaminated sediments may be redistributed under certain hydrologic and meteorologic conditions. In the most desirable and simplest scenario, remediation would occur using the upstream extent method. This method would allow sustainable longterm remediation and recovery and must be considered due to the cost of remedial activities. In this scenario, the starting point would be at the confluence of the Detroit River and Lake St. Clair. When contaminant loads from the Lake St. Clair-St. Clair River complex have been reduced to the point where recontamination of a remediated area will not occur, this method will be desirable. Remediation would proceed in a downstream fashion from this point, ensuring that loads have been eliminated or reduced to the point where sediment recontamination will not occur. Similarly, recontamination by sediments is eliminated in this procedure which would then ensure sustainable recovery and cost-effective actions.

A primary finding of the recent studies of the Detroit River indicates that the upper reach of the Detroit River has been further contaminated than previously observed. Therefore, this procedure would, at the present time, suggest that sustainable remediation may be at risk and may not be cost effective. The importance of point and nonpoint source loads (including upstream sediments) to the Detroit River and watershed become extremely obvious in this case and the loading information being compiled during the Stage 2 RAP are intimately linked and critical to moving forward with sediment remediation. The source or sources of the increased concentrations must be identified and corrective actions taken. If loads from the St. Clair complex or from other sources in the upstream reach cannot be verified to be sufficiently reduced for the Detroit River upstream remediation procedure, several other strategies can be taken to prepare for the event that at some time in the future, it will be amenable to this procedure. The upstream extent method should be applied to tributaries, point, and nonpoint sources in the watershed; this procedure must ultimately be used and can be simultaneous with other actions. If loads can be sufficiently reduced from these sources, the upstream method would be able to become more likely for the main trunk of the Detroit River.

In preparation for sediment remediation or if a decision has been made for remedial actions on sediment at a specific site, several factors can be recommended. Undoubtedly the spatial extent of the area must be determined. Similarly, the vertical nature of the area must be assessed. Basically, a three-dimensional picture of the material to be remediated must be realized. The factor of vertical contamination must be known to determine the maximum depth and the volume of the material to be remediated; this will also prevent exposing layers which have greater or similar deleterious effects compared to the surficial material. The nature of the material must be determined for evaluation relative to restrictions on disposal or whether other advanced technologies are required. These operations, in combination with benthic invertebrate surveys and toxicity tests, will provide baseline information for future use. After remediation procedures, analyses and toxicity testing should be conducted to determine if the desired remediation has been obtained. For outyears, contaminant analyses, toxicity testing, and benthic community structure should be monitored (e.g., 2, 5, 7, and 10 years) to ensure that a longterm, sustainable recovery is taking place. These and similar procedures have been outlined in several IJC documents.

Benthic Organisms

A system-wide study of benthic macroinvertebrates indicated that 176 taxa were observed from sediment collections in 1991 (Farara and Burt, 1993). A total of 5 phyla, 8 classes, and 12 families were observed. The most commonly encountered species was the amphipod, Gammarus fasciatus, with roundworms, oligochaetes, flatworms, nemerteans, and pea clams representing other commonly-occurring groups. Oligochaetes, chironomids, gastropods, and pelecypods were represented by sizable numbers of species. Zebra mussels were observed at 77% of the stations sampled; the quagga mussel was not observed. Based on analyses of benthic community structure, moderately large portions of the system exhibit severely impacted benthic communities. The majority of the severely impacted zones primarily along the lower U.S. shoreline. Large expanses of the system also exhibit moderately impacted benthic communities, specifically in the upper U.S. portion of the river, mid-river on the eastern side of Grosse Ile, and the lower river. Non-impacted sites generally occur at sediment stations in Canadian waters (and generally in the upper portion of the river), representing less than 25% of the system.

Mayfly nymph production was examined in the four upper connecting channels and Lake St. Clair in relation to contaminants measured in sediments (Edsall et al., 1991). Lowest relative production was observed in the Detroit River compared to the other sites. Mean production values (mg m2 D.W.) were as follows: St. Mary's River (2,648), St. Clair River (693), Lake St. Clair (9,231) and Detroit River (652). Production appeared to be related to the levels of oil and grease and heavy metals observed in sediments at individual sites over the entire study area. In a related study, Schloesser et al. (1991) demonstrated that the occurrence of mayfly nymphs was negatively related to oil in sediments. For the four upper connecting channels, the Detroit River exhibited the lowest, mean mayfly nymph densities at 94 m^2, compared to 279, 224, and 117 m^2 for Lake St. Clair, the St. Mary's River, and the St. Clair River, respectively. Mean nymph densities at stations with oil were 61 m^2 and without oil were 224 m^2.

Benthic macroinvertebrate analyses were conducted in the nearshore zone of the Trenton Channel in relation to construction of the Elizabeth Park Marina (Besser and Giesy, 1994). Benthic community structure was similar throughout the study area, both in the Trenton Channel and in the marina. In most cases, benthic communities were dominated by oligochaetes (greater than 90%). Oligochaete absolute densities were somewhat lower in the marina than in the Trenton Channel; however, sufficient time since marina construction may not have elapsed to establish densities to their fullest abundance capacity.

Reynoldson and Zarull (1989) demonstrated a phased, integrated strategy for sediment assessment using biological, chemical, and physical data from the Detroit River. Results of cluster analyses showed various degrees of severe sediment degradation at the Rouge River and southward along the Trenton Channel. Generally, most sediments in areas outside of this zone were less impacted or of higher quality. Good agreement between high contaminant concentrations, undesirable benthic species, and high relative proportions of silt were observed at the degraded sites.

An examination of abundance and distribution patterns of caddisflies (Tricoptera) in the Detroit River was conducted in the mid-1980's (Davis et al., 1991). Although low densities and low species richness was observed in many areas, community structure had generally improved over a 12-15 year period.

Nicholls and Hopkins (1993) have indicated that zebra mussels (Dreissena polymorpha) in Lake Erie have had a greater impact, on all major groups of phytoplankton, than phosphorous control over the period 1970 to 1985. The pathway for planktonic primary production has therefore been affected and the associated impact to higher trophic levels can not yet be estimated.

Nalepa et al. (1993) completed studies on the nutritional requirements of Dreissena in Lake St Clair and concluded that populations in the southern portion of the lake will stabilize or start to decline.

Quagga mussels (Dreissena bugensis) were discovered in the St. Lawrance Seaway, Lake Ontario, Lake Erie, and Lake Huron in 1991. Quagga mussels can live on muddy or sandy substrates, are more tolerant of lower water temperatures, and can live in deeper waters than the related zebra mussels. The impacts of quagga mussels on the ecosystem are not currently known.

Holland (1993) confirmed the work of Nicholls and Hopkins (1993) when she reported that the total number of planktonic diatoms had decreased by 6% since 1984-86 and by 92% since 1961-65. Secchi disc readings were also reported as being 100% higher than in 1984-86. Once again the conclusion that food web impacts would be expected.

Aquatic Plants

Wild celery (Vallisneria americana) is not only a valuable food for migrating waterfowl, especially diving ducks like canvasback and scaup, but also the most frequently found submersed, macrophytic plant in the river. Unfortunately, scientific studies showed that occurrence of wild celery among all macrophytes in the river in fall decreased from 78% in 1954 to 58% in 1978. Of the sites examined, some exhibited no change whereas others exhibited decreases. Overall there was a decrease of 72% in the production of buds from 1950 to 1985. This decrease in wild celery in the river has reduced the amount of food available to migrating ducks and the number of canvasback ducks, redhead ducks, and scaup using Detroit River migration routes (Schloesser and Manny 1990).

In 1985, macrophytic plants drifting in the Detroit River were collected from May to October to estimate quantities of heavy metals being transported to Lake Erie by the plants. A total of 151 metric tonnes of plants containing 2,796 kilograms of cadmium, chromium, cobalt, copper, mercury, nickel, and zinc entered Lake Erie during that time. The enrichment of each metal was surprisingly high (range: 4000 x to 161000 x) in plants, relative to their concentration in the water of the river. Detroit River macrophytes are thus a source of contaminated food for animals in the river and Lake Erie (Manny et al. 1991).

Schloesser and Manny (1984) recorded Eurasian millfoil in the Detroit River system as the fourth most common submersed macrophyte in the system. It was first recorded in 1974 and appeared to be an important submersed macrophyte in the system by 1978. It did not appear to be fluctuating in abundance or causing major nuisances during this time period, suggesting that the population is fairly stable.

WETLANDS

Examination of historic maps of the Detroit River by the National Biological Survey revealed that shorelines of the river were once gradually sloping and covered with vast, continuous beds of emergent and submersed aquatic vegetation. Due to shoreline development for residential and industrial uses, more than 90% of that vegetated habitat was replaced with bulkheads and deep, fast moving water since 1873. Now only about 1,382 hectares (3,415 acres) of wetland habitat in the river, mostly on islands, sustains a surprising assortment of desirable, resident and migratory, fish and wildlife (Manny et al. 1988). For these reasons, restoration of wetlands and other wildlife habitat in the Detroit River was identified in this plan as a high priority.

Provincially Significant Wetlands

The Stage 1 document identifies four major wetlands on the Ontario portion of the Detroit River AOC that were designated as class 1-3 based on the provincial evaluation and classification system: Canard River Complex (Class 1 - 580 hectares), Detroit River Complex (Class 2 - 575 hectares), Turkey Creek Marsh (Class 3 - 32 hectares), and Fighting Island Marsh (Class 3 - 113 hectares).

At the time that the Stage 1 document was prepared, only Class 1 and 2 wetlands were considered to be provincially significant. The inclusion of Class 3 wetlands in the provincially significant category brings the total area of wetlands protected by provincial policy to 1,136 hectares.

Purple Loosestrife

Purple Loosestrife (Lythrum salicaria) poses a significant threat to the natural composition of Great Lakes wetlands. This resilient plant is now drastically altering the plant communities of wetlands by rapidly replacing natural emergent plant species.

Biological control holds the most promise for a long term solution for protecting wetlands from purple loosestrife. Two European insects (Galerucella calmariensis and G. pusilla) which are specific herbivores on loosetrife have been released in Michigan and Ontario. Fifteen other states and six Canadian provinces have made similar releases.

FISH

The tables and figures pertaining to and referenced in this section as well as additional information are contained in appendix 5.4.

DFO Liver Enzymes and Hormone Levels Study

Over the past two summers a limited number of fish have been examined to determine the potential of using the Trenton Channel site for future work. Research has been aimed at the examination of why fish loss the ability to control their reproductive hormones when exposed to pulp mill effluent. The reproductive dysfunction is seen with a number of chemicals which induce liver detoxification enzymes (MFOs or ERODs), including PAHs and PCBs, as well as pulp mill effluent. Both PAHs and PCBs have been associated with some loss of reproductive function in some published studies. The long term objective of this study is to determine whether diverse classes of organic chemicals impact reproduction in fish via a common physiological mechanism.

Interpretation of the Trenton Channel samples is limited, but, it can be concluded that some areas of the Trenton Channel have high concentrations of chemicals capable of inducing liver detoxification enzymes in fish. It can also be concluded that wild fish in the Trenton Channel are showing induction of these enzymes. Although the full significance (biologically) of this induction is unknown it is concluded that this area is worthy of more detailed study.

MDNR Fish Contaminant Monitoring Program

Michigan initiated a native fish trend monitoring effort in 1990 to establish a database to identify temporal trends and spacial differences in contaminant levels in native fish. Select fish species are periodically sampled at 27 locations throughout the State. Carp and walleye were sampled from the Detroit River in 1990, 1992, 1993, and 1994 as part of this effort. Because this is a new effort, insufficient data are available to evaluate temporal trends and spatial differences. Additionally, since whole fish are used in this effort, the results can not be directly compared to past sampling analyzing edible portions. Data from the analysis of fish collected in 1993 and 1994 are available in draft form. Results from 1990 and 1992 are presented in appendix 5.3. Some general highlights of the results thus far include:

- Heptachlor, mirex, aldrin, lindane, terphenyl, and PBB were not found in any of the fish sampled
- Mercury, dieldrin, hexachlorobenzene, total PCB, total chlorodane, total DDT, and heptachlor epoxide were found at most monitoring locations, suggesting that these chemicals are ubiquitous in the aquatic environment.
- The Kalamazoo and Detroit Rivers had the highest levels of PCB with mean concentrations in carp of 13.2 and 3.75 mg/kg respectively.

MOEE Sport Fish Contaminant Monitoring Program

Boblo Island - Walleye have been the most consistently sampled fish and they were the only species sampled in 1993. Mercury levels in walleye were higher than in previous years (Appendix 5.4). As a result of these higher levels, and because larger fish were sampled for the first time, there will be a consumption advisory on walleye over 55 cm in the 1995 "Guide to Eating Ontario Sport Fish". The mercury levels reached a maximum of 0.77 ppm which is over the 0.50 ppm unrestricted consumption guideline, but still relatively low for this size category as compared to most locations sampled in Ontario.

Carp sampled in 1990 had elevated levels of PCB which resulted in a consumption advisory being issued. Smaller sizes of channel catfish sampled indicate that PCB levels in larger channel catfish could approach or exceed the 2.0 ppm guideline.

Fighting Island - Walleye, white bass, and fresh water drum were sampled in 1993 at this location. Similar to Boblo Island larger walleye were sampled and mercury levels have increased. This new information will be added to the consumption advisory in the 1995 guide. Mercury levels also increased in the largest size of white bass, which will result in a consumption restriction being advised. Mercury levels in fresh water drum declined, and they will now be unrestricted to 45 cm. The "no consumption advised" category will be replaced with a lower consumption restriction.

Carp sampled in 1990 showed results and concerns similar to those of Boblo Island. Carp were also tested for dioxins/furans and were below the 15 ppt guideline.

Suns et. al (1993) reports that since biomonitors integrate spacial and temporal trends in water quality, contaminant accumulations found in biota provide a good basis for assessing environmental change. Spottail shiners were collected in 1990 from Peche Island, Fighting Island, and Amherstburg in the AOC. Young of the year spottail shiners had trace levels of PCBs at the Peche Island collection site (Appendix 5.3). In samples from Fighting Island, Amherstburg and Big Creek in Lake Erie the levels were at or slightly below the IJC Guidelines for aquatic life of 100 ng/g. Of the 10 sites collected above Lake Erie, four had high levels and two of those four sites were Fighting Island and Amherstburg. Five sites had "no detectable amounts", and the site at Peche Island had trace amounts. These levels show a significant decrease ($p= <0.05$) over time when compared to contaminant levels in the late 70's and early 80's. But based on this data the Detroit River is still implicated in PCB enrichment of the western basin of Lake Erie.

Fish Flavor Impairment Studies

The Michigan Department of Natural Resources (MDNR) has conducted two fish flavor impairment studies on walleye taken from the Detroit River. These tests were done in response to concerns raised by the Detroit River Binational Public Advisory Council (BPAC) as they participated in a process to identify impaired uses (as defined by the Great Lakes Water Quality Agreement of 1978, as amended.) The Fisheries Division of the MDNR did not have documented reports of fish tainting in the Detoit River as is usually the situation where significant fish tainting occurs. In an attempt to assist in the determination of the impairment status of this beneficial use of the river, a preliminary fish flavor impairment study was conducted on walleye from the Trenton Channel of the Detroit River in 1992 (Waggoner, 1993.)

Flavor impairment studies are conducted by the Michigan Department of Public Heatlh (MDPH) using ASTM standard methods and a panel of volunteers to taste fish. The purpose of these studies are to determine if fish from a specific lake or stream have an impaired flavor when compared to fish of the same species from sources that are known to be uncontaminated. If a flavor problem is confirmed, the MDNR and MDPH may carry out further laboratory testing and investigations to identify possible sources and types of contamination.

In the preliminary study conducted in 1992, four of the six Trenton Channel walleye evaluated were found to taste impaired at the 95 % confidence level of significance, and three walleye tasted impaired at the 99% confidence level as compared to control walleye purchased from a seafood market. A follow-up study was designed to evaluate whether the flavor of walleye from select locations in the Detroit River, Lake St. Clair and Lake Erie was impaired compared to a local control population; and define the extent of any fish flavor impairment problems (Wood, 1994.)

In the 1993 study, five walleye were collected from Lake Huron, two from Lake Erie, five from the Detroit River Trenton Channel, and five from the Detroit River east of Grosse Ile. The Detroit River and Lake Erie fish were collected by anglers from the Downriver Walleye Association and MDNR staff. The report identifies several factors which limit the conclusions which can be drawn from the study, including the small sample size from Lakes Erie and St. Clair, fish movement, variation in the age of the fish samples, the use of sample portions which included the lateral line and variation in the results for the fish sampled by the two taste panels. However, the report concludes that in spite of these problems, the results of the study were consistent with findings from the 1992 study and a small percentage of the walleye in the Trenton Channel may exhibit flavor impairment.

In addition an informal survey of 1,224 anglers was conducted at the 1993 Detroit Boat Show to obtain information on potential fish taste or odor problems in the Detroit River and several additional southeastern Michigan water bodies. Of the 408 Detroit River anglers which responded, 9.3% (38) had noticed unusual taste or odor in fish they caught from several locations including the Trenton Channel. The dominant species identified as flavor impaired in the Detroit River were walleye along with white bass, steelhead (rainbow trout), perch, rock bass, salmon, catfish and crappie.

Round and Tubenose Gobies

Round and tubenose gobies (Neogobius melanostomus and Proterorhinus marmoratus respectively) were transported to the St. Clair River system between 1986 and 1988 in ballast water by freighters from the Black Sea in Europe. Both species are becoming more common in the St. Clair River and Lake St. Clair. The round goby grows slightly larger and is a voracious feeder, eating many items including aquatic insect larvae, and zebra mussels. The impact of exotic fish on the St. Clair system has not been determined. Round gobies have been found in the Detroit River.

Wildlife

CWS research conducted on turtle eggs collected in 1981 and 1984 (Struger et al 1993), and in 1988 and 1991 (Bishop 1993) at 6 study sites from Georgian Bay to the St Lawrence indicated the widespread and geographically variable organochlorine contamination, associated not only with pelagic ecosystems, but also with wetlands associated with AOC's. Highest values for p,p'-DDE, hexachlorobenzene dieldrin and mirex were at Hamilton Harbour, while highest levels of chlorobenzene and PCB were located at Lake St. Clair and near Cornwall in 1984. Geographic variation in eggs was similar to those found in Spottail shiners and Herring gulls collected from the pelagic area of the Lake. Both of these reports suggested that it might be necessary to examine reptiles and other biota in the Great Lakes food web to determine contaminants profiles.

The Detroit River is an important resource for a wide variety of wildlife. Migratory birds focus on it (and associated habitats) as a outer corridor that connects larger bodies of water on their North/south migrations. Locally, breeding bird and mammal populations have a greater dependence on its habi-

habitats for their existence. Although much of the upper reach has been developed, the lower reach still has an adequate habitat base (in structure) to support wildlife needs.

Migratory waterfowl have historically used the lower Detroit River/Lake Erie confluence as a major nesting/feeding place. Its vast wild celery beds provided an important food source. The MDNR has flown aerial surveys of the Detroit River. Twenty different species have been identified at various times (Appendix 5.4).

Peregrine falcons

Peregrine falcons have been using the Detroit River as a migratory route for many years. The downtown Detroit area, with its many tall buildings provides good hunting vantage points to spot the many prey species that reside in Detroit or migrate through the area. The peregrine was not known to have nested in the Detroit area historically. With the increased use of pesticides in the 1950's, there were no known successful nestings east of the Mississippi River in the 1960's.

In 1986, Michigan joined other midwestern states in a program to reintroduce falcons into their historical range by means of hacking peregrine chicks obtained from breeders. Nesting structures were constructed on the roof tops of tall buildings. Peregrine chicks were fed remotely so as not to condition them to people. This continued until they fledged and were able to feed on their own. In 1987, five peregrine chicks were hacked off the top of the Guardian Building which overlooks the Detroit River in downtown Detroit. It was anticipated that any peregrines using Detroit would also use Windsor as they hunted over the Detroit River. Observations from this release confirmed this as falcons are often sighted in Canada – making this truly a binational release.

In 1988, six additional young were hacked, however, the release program was aborted when a two year old male (hacked in 1986, Grand Rapids, Michigan) became aggressive towards the young. Since that time Detroit has always had peregrines throughout the nesting season. From 1987 to 1994, fifteen different peregrines have been observed (eleven of which were positively identified from their leg bands.)

In 1992, a two-year-old falcon (Sudbury, Ontario - 1990 release) attempted to nest on the ledges of the Book Building. A subsequent rain caused the three eggs to become infertile. The MDNR quickly placed a nesting structure on the ledge and replaced the eggs. The Raptor Center in Minnesota arranged for two chicks to be placed under the falcon and the infertile eggs removed. These chicks successfully fledged.

In 1993, the same falcon successfully raised and fledged a total of five chicks. At the same time, in 1994, two other peregrine falcon pairs were using the Detroit area. One pair successfully hatched young on the Detroit Edison Connors Creek plant, adjacent to the Detroit River. The young died of weather related conditions. Another pair stayed close to the New Center area (3 1/2 miles inland from the river) but didn't attempt to nest.

Downtown Detroit is going to be a focus point for nesting peregrine falcons. Although 88% of their prey could be considered inland species, the 12% – from the river – does constitute an important food base. From 1989 to 1994, 56 different prey species (1220 individuals) have been identified (J. Yerkey, 1995). Twelve percent of the prey were water oriented birds, ring bill gulls the most important of these (n=95).

Problem Definition

Fish and Wildlife Populations

Degradation of fish and wildlife populations was identified as an environmental concern in the Stage 1 RAP. Fish populations and the fish community structure were noted in the Stage One to have shifted significantly towards benthivores over the last 100 years. Some fish populations in the Detroit River may be impacted through competition with exotic species or through the loss of habitat (wetland and littoral areas specifically). However, the fishery is meeting all management goals and an extensive literature review failed to identify any degradation of fish populations due to conditions within the

AOC. Rather several populations are impaired on a basin wide scale. The status of fish populations therefore remains "not impaired" and will remain an environmental concern.

The wildlife carrying capacity of the AOC is much reduced from pre-colonial conditions due to development of the watershed and the resultant loss of habitat. A thorough habitat inventory, assessment, and development of management plans are required for the AOC (see recommendations 1 and 2). To reflect the lack of the base knowledge and a management plan the status has been changed to "unknown".

Tainting of Fish or Wildlife Flavor

Fish flavor impairment studies on the Detroit River carried out by the MDNR and MDPH indicate the possibility of a low incidence of flavor impaired walleye in the Trenton Channel area of the Detroit River. Fish flavor should therefore be considered impaired.

Bird or Animal Deformities or Reproductive Problems

The Stage One listed the status of this impairment to benificial uses as "not impaired". Eagles on the Canadian shoreline have experience reproductive failures in some years. The cause of these failures has not been determined. Therefore the status has been changed to "unknown".

Pollutant Inputs to the Detroit River

CSO Load Estimates

Due to the Industrial Pretreatment Program (IPP), the general decline of industrial activity in the area, the conscientious efforts of industries to reduce discharges through pollution prevention, and other factors, the CSO TWG members concluded that the "current" (1992) concentrations of toxic substances from CSOs is substantially less than the 1978 concentrations. Estimates were based on the ratio of 1983 Influent Concentration to 1992 Influent Concentration. This ratio then was applied to the 1978 CSO toxicant concentration to achieve a "current" estimate of toxicant concentrations (Calculated Concentration). If data from 1978 through 1992 were available, it is expected that a larger correction factor would apply. Hence the use of the 1992/1983 ratio should provide a conservative estimate of the reduction in pollutant concentrations since 1978.

A similar analysis was used to calculate "current loadings" to the Detroit River from the Detroit Water and Sewerage Department (DWSD) CSOs. The 1978 CSO concentration data were converted to "current" by use of an influent concentration ratio. The most current model results for Total Annual CSO flow to the Detroit River was used to convert these concentrations into loading (1992 Annual Average Loading to Detroit River.

Table 29 (Chapter 10) lists the average concentration of the critical contaminants in municipal wastewater for the City of Windsor in 1992. Also listed are average concentrations of wet weather samples collected from interceptor/overflow chambers in 1993. The 1970 concentrations of some of these parameters in the influent to West Windsor Pollution Control Plant (WWPCP) are also listed showing the significant reduction in metals concentrations in sanitary sewage which have been achieved principally as a result of the City's aggressive industrial waste control program (Sewer Use Bylaw).

The total treated sewage discharged by the Little River Pollution control Plant (LRPCP) and the WWPCP and the volume bypassed during 1992 are also listed in Table 29. The Windsor Riverfront PCP Study modeling of the interceptor sewer system estimates that 17,832,000 m3 of combined sewer overflow and storm relief sewage would be discharged to the Detroit River in a typical rainfall year. Using the average effluent concentrations, for treated flows, influent concentrations for bypass flows, and average wet weather concentrations in overflow chambers, estimated loadings to the Detroit River of these parameters were calculated.

Point Source Load Estimates

The PS/NPS TWG spent considerable time discussing methods to estimate point and nonpoint source loadings of the six parameters of concern in the Detroit River AOC. Methods for the treatment of values listed as "less than detection" were particularly contentious. In the end a method similar to that used on the Niagara River was used. The TWG supported this method with the knowledge that the resulting estimates would be higher than those generated by methods previously used and that the estimates could not therefore, be directly compared to previous load estimates. Support for this method was further based on the understanding that the resulting estimates would not be used for enforcement or permitting activities. Rather the point source estimates would be used in comparison to loading estimates from other sources using similar methodologies.

Complete estimates for 1992 and 1993, a cumulative gross discharge estimation table, and a description of the protocol used in the development of the estimates are located in Appendix 9.1 of the report PS/NPS TWG Report (Chapter 9).

Table 9
Estimated Loadings for the Detroit River — 1992

Sources	Parameters — Kg/day					
	Cadmium	Copper	Mercury	Lead	Zinc	PCB
Point Source	12.5364	63.5618	0.7291	68.7768	371.9330	0.5426
Rouge at mouth	0.5	13.4	N/E	9.1	44.1	N/E
CSO–DWSD	4.099	5.953	2.893	13.222	33.274	0.016
CSO –Windsor	0.027	1.096	0.006	0.822	3.562	0.003

N/E = No Estimate
CSO estimates are the annual loads divided by 365.

Table 10
Estimated Loadings for the Detroit River — 1993

Sources	Parameters — Kg/day					
	Cadmium	Copper	Mercury	Lead	Zinc	PCB
Point Source	11.8352	67.1429	0.7857	66.0277	402.2840	0.6214
Rouge at mouth	0.4	14.0	N/E	69.9	67.0	N/E

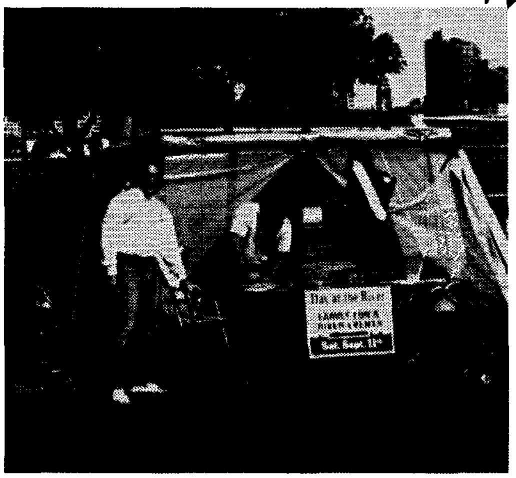
N/E = No Estimate
No estimates were made for the CSOs for 1993

6

Public Involvement and Education

"A successful RAP is one that regards community involvement as a value, and as a consequence, has strong community participation in the decisions that will achieve the goals of the RAP. Community supported remediation programs and hands-on activities directly involving school groups can work wonders in creating and sustaining interest in the RAP for the Detroit River."

Mary Ginnebaugh



The Detroit River RAP Stage 2 public involvement process was a diverse program which employed a number of mechanisms to include the public in the planning process, disseminate information, and increase public awareness of the water quality and environmental issues of the Detroit River. These mechanisms included: 1) Binational Public Advisory Council (BPAC) meetings, which provided a forum for BPAC members and the general public to comment on the plan and related issues; 2) Technical Workgroup (TWG) meetings, which facilitated the cooperative efforts of BPAC members, the public and technical experts in the RAP process; 3) a Newsletter, which presented the Water Use Goals and encouraged public comment; 4) Day at the River, which increased public awareness of the Detroit River water quality issues; and 5) presentations at schools and other events by members of BPAC, RAP Team and other RAP participants.

The Detroit River BPAC supported Michigan's new RAP strategy in recognition of the need to streamline the development process, include more diverse groups of people in the planning process, and create partnerships with other government agencies and local citizen groups. The Stage 2 RAP workplan was developed with these benefits in mind and included a schedule to develop and approve the Stage 2 RAP Report within a 2 year period. Four technical work groups (TWGs) were formed in September 1992 to develop reports on the technical portions of the following major topics of: 1) habitat, 2) contaminated sediments, 3) combined sewer overflows, and 4) point source/nonpoint sources (PS/NPS). The TWGs were a major opportunity for public involvement in Stage 2. Participants on the TWGs included members of the RAP Team, BPAC, the public and technical experts.

Binational Public Advisory Council (BPAC)

The Detroit River BPAC was formed in December 1987 for the purpose of involving the stakeholders in the RAP process. The purpose of the BPAC is to advise the RAP Team on the development and implementation of the RAP. The RAP Team is a committee of government representatives charged with developing the plan. The BPAC also has representation on the RAP Team.

The BPAC played a more active role in the Stage 2 RAP process than in Stage 1. From development and approval of the RAP Water Use Goals in April 1992, to participation on the TWGs, BPAC members made important contributions to the development of the Stage 2 RAP Report. The BPAC developed a RAP review process for Stage 2 which concentrated on concepts and issues rather than a chapter by chapter review.

Expansion of BPAC Membership

It was recognized at the beginning of Stage 2 that the planning process would involve decision making on technical issues such as evaluating various remedial options or assessing the results of monitoring programs. To meet these new challenges, the BPAC was expanded and restructured to include more technically qualified members. An intensive membership search was implemented with mailings to governmental, industrial, and academic and technical representatives. In the filling of vacancies the need was emphasized for more minority and ethnic representation on the BPAC. This continues to be an important guideline when filling BPAC vacancies. The BPAC was increased to 50 members, 25 from Michigan and 25 from Ontario from the following interest groups:

Michigan

- Citizens
- Industry
- Municipal
- Other Government
- Academic/Technical

Ontario

- Conservation and Environment
- Business and Industry
- Municipal
- Labour
- Community Groups
- Health
- Recreation

Role of BPAC and Technical Experts in the Technical Workgroups (TWGs)

The TWGs were formed to develop the technical portions of the RAP. Participation was categorized by the level of involvement.

Core member:	A participant who provided regular input and direction to the development of the TWG report.
Technical expert:	An expert who provided occasional technical input in a particular area.
Interested party:	An individual who followed the progress of the TWG, but does not participate on a regular basis.

The TWGs maintained an open operating process which included accounting for all opinions and striving for consensus on issues. Dissenting views on issues are noted in the reports.

BPAC

The BPAC membership approved the TWG process and revised its schedule to meet quarterly. A quarterly meeting schedule was chosen to provide adequate time for the TWGs to make progress on their reports between BPAC meetings. The BPAC members, as representatives of the public were encouraged to participate on the TWGs to: 1) increase BPAC support of the document, 2) engage the assistance of technically able BPAC members in the development of the RAP, and 3) serve as public advocates in the planning process. Monthly schedules were mailed out to keep the BPAC appraised of TWG meeting dates. Quarterly TWG progress reports were given at BPAC meetings usually by a BPAC member.

Technical Experts

Agency staff with technical expertise from the RAP Team, Technical Advisory Committee, and other pertinent agencies, provided the necessary expertise to develop the majority of the TWG reports. These individuals, comprising the core of the TWGs provided the necessary "know-how" to: 1) evaluate new data to update Stage 1, 2) review and assess in-place remedial and regulatory measures, 3) develop surveillance and monitoring plans, and 4) develop and evaluate preferential remedial options and programmatic recommendations. Special technical experts were brought into the TWG process on a temporary basis to address issues in which the core members had no expertise. For example, the Contaminated Sediments TWG received the assistance of Dr. Robert Schwartz, Wayne State University, to address the issue of socioeconomic benefits of the Detroit River RAP.

The technical experts responsible for developing the TWG reports came from a wide range of governmental agencies, organizations and businesses including:

- BASF Corporation;
- Canadian Coast Guard;
- Canadian Department of Fisheries and Oceans;
- City of Windsor Department of Public Works;
- Canadian Salt Company, Ltd.;
- Canadian Wildlife Service;
- Detroit Water and Sewerage Department;
- Environment Canada;
- Essex Region Conservation Authority;
- General Chemical Canada, Ltd.;
- Great Lakes Division, National Steel Corporation;
- Hiram Walker and Sons, Ltd.;
- International Joint Commission;
- Michigan Department of Environmental Quality;
- Michigan Department of Natural Resources;

- National Biological Service;
- Ontario Ministry of Environment and Energy;
- Ontario Ministry of Natural Resources;
- Southeast Michigan Council of Governments;
- Trenton Wastewater Treatment Plant;
- University of Windsor, Great Lakes Institute;
- U.S. Army Corps of Engineers;
- U.S. Environmental Protection Agency;
- U.S. Fish and Wildlife Service;
- U.S. Geological Survey;
- Wayne County Department of the Environment;
- Wayne County Department of Health;
- Wayne County Port Authority; and
- Wayne State University.

BPAC meetings—dates and topics

For a list of BPAC meetings and major meeting topics which occurred during Stage 2, refer to Appendix 6.3.

Outreach Efforts

Public outreach provides an opportunity for RAP participants to connect with the public and increase their awareness of the river and the efforts being taken through the development of the RAP to restore its impaired beneficial uses. During the development of the Stage 2 RAP Report, BPAC and RAP Team members participated in various outreach activities, made presentations at a number of schools, and at other events (Appendix 6.1).

Day at the River

"Day at the River" was a joint Michigan and Ontario binational public outreach event which was held on September 11, 1993. The purpose of Day at the River was to increase public awareness of the river's water quality problems, highlight associated water and land uses and promote recreational opportunities along the river. This was accomplished through the coordination of river-based activities including the following: tours of municipal wastewater treatment plants, Great Lakes vessels, habitat areas and historical waterfront structures.

Central sites were used to focus public attention on "Day at the River". Participating organizations highlighted their activities through displays and information booths related to the RAP, water quality issues or other river uses. Hart Plaza served as the central site for Day at the River on the U.S. side, while Little River Pollution Control Plant, Dieppe Park and Holiday Beach were used on the Canadian side. "Day at the River" was a successful outreach event with several thousand people in attendance, primarily on the Canadian side.

The Second Annual "Day at the River" was held in Windsor and was successful in attracting some 1000 people. Activities included displays, a concert and tours of the Windsor Water Pollution Control Plant.

Newsletters

A newsletter was distributed in spring 1992, reporting on aspects of the Stage 2 RAP Process and conveying the Water Use Goals to the public. Approximately 2,500 copies of the newsletter was distributed to the general and interested public through the mail and at conferences and workshops.

Public Meetings

A public meeting was held at the Riverview Municipal Offices for the Stage 1 RAP on February 21, 1991. Public meetings are held at milestones during the development of the RAP. The purpose of the meetings are to update interested citizens on the progress of developing the RAP and to receive public comment on the product.

Stage 2 Workshops

Workshops were held on March 1, 2 and April 6, 1994 to assess the preferred recommendations and remedial options which were developed and evaluated by the TWGs. The goals of the workshop were to: 1) discuss and seek consensus on the recommendations and remedial options , and 2) identify and record opposing view points on recommendations for which consensus could not be reached. Approximately 55 people participated in the March 1 and 2 workshops which were held at the Grosse Pointe War Memorial and the University of Windsor CAW Student Centre, respectively. Twelve persons participated in the April 6 supplementary workshop which was held at SEMCOG. Participants included members of the BPAC and TWGs and interested parties.

7 Habitat TWG Report

"Wetland habitat is the nursery of our wildlife and is among the most productive and valuable components of our environment, but unfortunately is also the fastest disappearing resource we have. In 1800 wetlands were a very common feature of the landscape; today only fragmented remnants remain. It is time that our wetlands were treated as an endangered space. If the Detroit River RAP recommendations are adopted they could set the scene for changing, even reversing this trend effectively protecting what remains and restoring at least some of our lost biodiversity."

Dan Lebedyk
Staff Biologist
Essex Region Conservation Authority

Impaired Beneficial Uses Relating to Habitat

The Stage 1 RAP identifies "Loss of fish and wildlife habitat" as an impaired use in the Detroit River Area of Concern (AOC) as a result of the significant physical loss of wetlands and other habitats which has occurred through agricultural conversion, urban development, and industrial growth. Habitat loss or impairment due to poor water quality was not documented in the Stage 1 remedial Action Plan (RAP), however further evaluation of the issue was recommended. Habitat loss due to contaminated sediments has been documented and is detailed in the contaminated sediments chapter of this document (chapter 8).

The related beneficial use, "Degradation of fish and wildlife populations," was identified as an "Environmental Concern" in the Stage 1 RAP. It was noted that the fish community structure has changed significantly toward benthivores over the past 100 years. However, an extensive literature review found no instances of impaired fish populations due to factors from within the AOC. Rather, some populations are impaired through out the Great Lakes basin due to basin wide factors. These populations will require basin wide efforts for recovery.

The wildlife carrying capacity of the AOC is much reduced from pre-colonial conditions due to development resulting in the change or loss of habitat. The Stage 1 RAP notes that improved or increased wetland habitat would result in enhanced fish and wildlife populations and would have a positive impact on the health of the river. However, the current status of wildlife populations is listed as "unknown" due to an incomplete data base, lack of wildlife management plans, and wildlife inventories.

Water Use Goals and Objectives

The Stage 2 Water Use Goals were developed by the RAP Team and Binational Public Advisory Council (BPAC) to provide direction for the planning and implementation of the RAP. The Water Use Goals advocate an ecosystem perspective in the process of remediating impaired uses. In addition, Specific Goals were identified for each beneficial use:

IJC Listed Impaired Beneficial Uses:	**Water Use Goals**
3. Degradation of fish and Wildlife populations	To maintain a healthy, diverse and self sustaining fish and wildlife community
14. Loss of Fish and Wildlife Habitat	Wetlands shall be maintained at zero loss in the AOC, and no net loss of the productive capacity of fish habitats. Remediation, amelioration, and restoration of wetlands shall be conducted wherever feasible. Management plans for fish and wildlife should be developed, subsequently evaluated to determine if the current level of habitat supports the management plans' goals. Additional evaluation is necessary to determine the effects of water and sediment quality on biota.

In response to this direction provided by the RAP Team and the BPAC, the Habitat Technical Work Group (TWG) established the following objectives:

1. Preserve and protect existing habitat; and
2. Restore and enhance habitat.

In addition to remediating fish and wildlife habitat, additional studies are needed to evaluate the potential impacts of existing water and sediment quality on biota. The TWG supports research efforts and has reviewed many proposals for additional work. For example, the on going Trenton Channel study jointly undertaken by the MDEQ and the US EPA and the MOEE extensive sediment and benthos study in 1991 (Beak 1993). Several other research proposals have been discussed and supported by the TWG, such as the use of macrophytes and adult mayflies as biomonitors of the aquatic ecosystem. These research proposals are listed in the Habitat Biomonitoring Section of this report. The TWG supports the concept of additional research, however it is recognized that efforts can be undertaken concurrently to protect existing habitat, and restore habitat.

The Habitat TWG reviewed the historic biological uses of the river and compared them to today's usage. While it would be most desirable to restore all of the Detroit River habitat, it would be logistically impossible to do so to pre-colonial conditions. Therefore, the Habitat TWG proceeded to address the two objectives by 1) critically assessing the ability of existing legislation to preserve and protect existing habitat (including shorelines and wetlands, dredging activities, and development requirements), and 2) evaluating potential sites in the river where the technical experts felt habitat could be restored and enhanced, drafting proposals, reviewing suggested plans, and discussing potential funding sources for conducting that work.

The Habitat TWG discussed the definition of "habitat". In 1991, the International Joint Commission (IJC) defined habitat as "specific locations where physical, chemical, and biological factors provide life support conditions for a given species". This definition includes water as part of the habitat for aquatic species. The TWG agreed that the focus of the work group was to increase the quality and quantity of habitat for desirable plants and animals including adequate water and sediment quality.

The TWG also supported the importance of employing an ecosystem perspective. The Great Lakes basin ecosystem is the interacting components of air, land, water and living organisms, including humans, within the drainage basin (GLWQA 1987). The ecosystem approach entails the citizens of the United States and Canada recognizing that they must consider the effects of their actions on the environment and work together to restore and protect its health. Every part of the ecosystem - the air and land, the lakes, rivers and streams, plant life, wildlife and humans — depends on others for its health. Specific interrelationships in habitat remediation are:

- Habitat improvement for fish and wildlife should be compatible and mutually beneficial;
- Improvement projects should not endanger existing habitat;
- Habitat improvement should occur only in areas where sediment and water quality are acceptable in order to avoid creating "attractive nuisances" — such as attracting wildlife to contaminated areas;
- Habitat improvement should occur only where pollution sources have been controlled;
- Consideration must be given to existing navigation routes (dredged areas), aircraft flight concerns, and potential hydrological impacts.

The Habitat Technical Work Group

The Habitat TWG first met in November, 1992. The TWG includes representatives from the RAP Team and the BPAC, and technical experts (Appendix 6.2, Habitat Technical Work Group). The group met 14 times, often at locations in the AOC where field trips to potential or significant habitat areas could be included in the meeting agenda. Specific meeting dates, locations, and discussion topics are included in Appendix 6.3. Technical Work Group meetings often included presentations by various agency representatives to discuss and evaluate the effectiveness of regulatory programs specific to habitat protection and enhancement.

Objective #1: Preserve and Protect Existing Habitat

The first objective established by the Habitat TWG to address relevant water use goals is to preserve and protect existing habitat. Recommended actions required to achieve this objective were developed by critically evaluating relevant state, provincial and federal legislation, programs and procedures (eg. identifying program or data gaps and inefficient or inadequate program delivery). Twenty-two programmatic recommendations were developed for strengthening legislation, improving the regulatory protection process to prevent more habitat losses, implementing habitat protection education programs, and encouraging the use by landowners of existing habitat incentive programs. These recommendations were then further evaluated with regard to cost, logistics, time lines and other factors related to implementation.

The Habitat TWG also reviewed the IJC *Listing/Delisting Guidelines For Great Lakes Areas of Concern* (January, 1991) in an effort to specify what measurements could be used to "delist" the Detroit River AOC with respect to the beneficial use "Loss of Fish and Wildlife Habitat." The delisting guideline specifies that this use is restored "when the amount and quality of physical, chemical and biological habitat required to meet fish and wildlife management goals has been achieved and protected." This guideline supports the need for a management plan for fish and wildlife in the AOC. Several observations were made by the TWG:

- There is no existing wildlife management plan for the AOC.
- Draft fish community goals and objectives for Lake St. Clair and connecting waters have been developed jointly by MDNR and OMNR (under the Great Lakes Fishery Commission). These have not been finalized yet.
- In order to develop a management plan, an inventory of existing fish and wildlife habitat (quality and quantity) is necessary. An inventory and management plan would provide a "road map" of where we are and where we want to go for habitat protection, that is essential for government organizations in their regulatory and planning activities, for developers' real estate interests, and for recreational and environmental groups.
- An inventory and management plan for the Detroit River AOC should be a part of an inventory and management plan for the St. Clair River, Lake St. Clair and Detroit River system, since these areas are intrinsically related with respect to fish and wildlife habitat.
- A management plan would identify the quantitative, specific objectives and indicators needed to measure improvements in the AOC and confirm restoration of this impaired beneficial use.

These two recommendations, **1) To develop a habitat inventory**, and **2) To develop a fish and wildlife management plan**, represent the most fundamental needs for meeting the objective to preserve and protect existing habitat. Other recommendations to meet this objective can be summarized as follows:

- Develop a GIS to provide information on the habitat inventory and management plan, protected areas and areas of environmental concern to government agencies, planners, developers and consultants;
- Strengthen specific legislation and establish needed legislation;
- Improve and strengthen the permitting process (related to land use and development);
- Improve communication between state, provincial and federal agencies and with the public with respect to habitat needs and legislation;
- Establish education programs for local agencies, developers, land use planners with respect to habitat needs and existing legislation;
- Develop a public education program to promote environmental awareness; and
- Increase public awareness and use of incentive programs for habitat preservation and development.

Habitat Inventory, Management Plan and GIS

Recommendation 1: Develop a Habitat Inventory for the Detroit River AOC.

A habitat inventory is needed to obtain baseline information on existing wetland habitat, and wildlife and fishery resources. Once obtained, the inventory can be used to:

a. compare existing data with historical data in order to evaluate loss and restoration potential;
b. coordinate with other contaminant issues (sites of sediment contamination and prioritization of remediation sites);
c. assist in prioritizing sites of habitat rehabilitation by identifying the restored value, i.e., cost/benefits;
d. provide a relative comparison to the future for measuring the effectiveness of restoration efforts;
e. provide baseline data or priority sites regarding the regulatory permitting process, (i.e., dredge and fill, this should expedite processing applications);
f. provide the baseline data needed for a habitat management plan for the AOC; and
g. potentially reveal patterns of accumulated impact from similar small scale activities.

A habitat inventory would give MDNR/OMNR the information needed to pro-actively give developers and municipalities some guidance regarding habitat sensitivity and appropriate land zoning and permitted uses. The inventory should be detailed enough to describe the wetland habitats and regional habitats, including littoral, deepwater, soils, plants and benthic community. A wildlife/fisheries inventory should describe uses in the AOC with special attention to species that are endangered/threatened (State/Federal) or that will be used in future bio-monitoring.

The OMNR and the ERCA have completed a wetlands inventory and evaluation of wetlands within the Canadian portion of the Detroit River AOC. The OMNR "Survey of Candidate Sites on the St. Clair and Detroit Rivers for Potential Habitat Rehabilitation/Enhancement," identifies and evaluates potential wetland/habitat areas within the Canadian portion of the Detroit River AOC. In addition, the document provides recommended actions for rehabilitating or enhancing the sites.

A document prepared by OMNR entitled "Guidelines for Collecting Baseline Aquatic Habitat Data in the Great Lakes Areas of Concern" is available. These guidelines are designed to standardize AOC habitat status reports and to facilitate the monitoring of progress toward achieving beneficial use of habitat.

Implementation 1:

Multi-disciplinary teams consisting of aquatic biologists, fisheries biologists, ecologists, botanists and geologists are needed to evaluate both the quality (i.e., Official plans, master plans, zoning ordinances and bylaws), and quantity of remaining habitat areas in Michigan and Ontario. In addition, the Michigan shoreline needs to be surveyed with respect to areas of potential habitat development. Consistent criteria for the Habitat Inventory are needed for both sides of the river. (See Recommendation 14, Common wetland evaluation system).

Recommendation 2: Develop a Habitat Management Plan for the Detroit River AOC.

At this time there exists no comprehensive legal planning mechanism in Michigan that encompasses the numerous political jurisdictions and interests which occupy the Detroit River AOC. This element has played a profound role in the continued piecemeal deterioration of the river's habitat areas. This has been further exacerbated by a distinct lack of attention to the habitat losses by state agencies with the authority to institute rehabilitation plans. A Habitat Management Plan would clearly document strategies and their rationale for the protection, restoration and enhancement of fish and wildlife habitat in the Detroit River AOC. It would pro-actively provide information to municipalities and developers that could be incorporated into planning documents such as official plans, master plans, zoning ordinances/by-laws and development proposals. In addition, the plan could delineate areas suitable for public access development and environmental appreciation and education (e.g. habitat restoration demonstration sites) that would foster a better understanding of the relationship between humans and their environment in the AOC.

Under the current system, permits for development and shoreline construction are reviewed on a case by case basis. This approach, in Michigan, does not provide for integrated management of resources on a regional basis; or for the consideration of cumulative impacts to the ecosystem resulting from a specific project. Permit applications by MDEQ are given the most intensive scrutiny when a denial is likely or expected to be challenged. Contested decisions of the MDEQ place a significant additional demand on the limited human resources already committed to the application process. In Ontario, this review is by agencies such as OMNR, ERCA and MOEE. However, other agencies may be involved, e.g. Canadian Department of Fisheries and Oceans (DFO) for fisheries habitat compensation agreement, the Coast Guard for Navigable Water Convention Act permits, single craft harbors, and the Harbour Commissions. Through a cooperative arrangement between OMNR and ERCA, this approach does provide some integrated management of resources on a regional basis. Also considered, are the future impacts of a project on the ecosystem, though only on a cursory basis. A Habitat Management Plan could be developed by MDNR/OMNR and ERCA to provide guidance needed by permit writers to better protect existing habitat. It would identify key habitat areas in the region from an ecosystem perspective and consider future ecological impacts resulting from individual projects on the whole system. The intent is not to promote development but to provide better information.

Existing Michigan legislation should be modified to provide a mechanism to address unique areas, i.e., protection for key habitat areas in the region as identified in the inventory and management plan (example: downriver wetland areas). Current legislation is applicable on a state-wide basis. It does not provide special consideration for habitat areas unique to a region like southeast Michigan.

Further, complicating this process is the consideration of riparian rights and property rights, which often severely complicates issues involving habitat protection in Michigan. A clear definition of the relationship of these rights as they relate to habitat protection/rehabilitation is necessary to effectively plan and manage.

RECOMMENDATION 3: DEVELOP A GIS SYSTEM FOR THE ENTIRE ST. CLAIR-DETROIT RIVER CORRIDOR TO IDENTIFY VARIOUS HABITAT TYPES AND ALERT CONSULTANTS, DEVELOPERS, STATE, PROVINCIAL AND FEDERAL REGULATORS TO CRITICAL OR PROTECTED AREAS.

This recommendation proposes a regional wetland/habitat GIS to include the entire St. Clair-Detroit River system in order to evaluate impacts and address habitat protection on a regional or AOC basis. Several GIS initiatives are underway, compatibility between systems will be an important issue.

SEMCOG, is currently digitizing the 1979 U.S. National Wetland Inventory (NWI) maps of Wayne County for MDNR. While the NW maps are somewhat dated, especially in the urban areas, they are still considered to be fairly accurate and are widely used. Further, NW maps are based on USGS 7 1/2 minute quadrangle maps, which make effective base maps.

The development of an AOC wetland/habitat GIS is quite feasible. However, all relevant current wetland/habitat data, which is available in digital form, must be identified before an estimate for the cost of the project can be developed. The main challenge would be the identification of a stable funding source for acquisition of additional data required for the project. Because of the regional nature of the AOC, and of wetlands in general, the expertise of ERCA and SEMCOG in the realm of GIS development and maintenance would be very beneficial.

The ERCA and the OMNR have recently completed wetland mapping for the Town of LaSalle. The mapping has been scanned into their GIS database in order to identify and protect lots which contain wetlands. The GIS will also identify adjacent lands which are within 120 meters of the wetland boundary. Under new Provincial Wetland Policy Statement Guidelines, an environmental impact statement (EIS) must be prepared for any development which occurs inside this 120 meter "adjacent land area."

IMPLEMENTATION 3:

Several GIS systems include portions of this area. Coordination, compatibility, and "ownership" are all issue that will need to be addressed.

Assessment and Evaluation of Existing Programs, Recommendations, and Implementation

RECOMMENDATION 4: THE TWG SUPPORTS THE USE OF SETTLEMENT AND JUDGEMENT AWARDS TO RESTORE AND PROTECT HABITAT IN THE DETROIT RIVER AOC.

United States — Critical Evaluation of Existing Legislation

Section 404 of the Federal Clean Water Act (U.S.).

The FWS biologists that work the permitting process in the Detroit River basin feel that they do not know enough about the remaining, fragmented habitat left in the Detroit river basin to make an evaluation of the effectiveness of the Section 404 Program. EPA Region V staff concur with this assessment. The Program needs a complete, current inventory of existing wetland habitat, wildlife and fishery resources (See recommendation #1). By some work group members estimates, 95% of the original habitat is already lost or severely impacted. The 5% remaining is dispersed and fragmented throughout the entire basin and is impaired partly because of this disjunctiveness. This makes dealing with the individual Section 404 permit actions as they cross the desk of these biologists very difficult, with cumulative impacts hard to discern. Only the large, controversial, or contaminated-sediment-disturbing projects are generally able to receive much attention, while the relatively small, but still probably important, remnants of habitat are being piecemealed away through cumulative impacts, including an inadequate permitting process staffed by few biologists with state wide and Great Lakes basin wide responsibilities.

Great Lakes Fish and Wildlife Restoration Act of 1990

The Great Lakes Fish and Wildlife Restoration Act of 1990 (16 U.S.C. 941-941g) was enacted to: 1) carry out a comprehensive study of the status, and the assessment, management, and restoration needs of the fishery resources of the Great Lakes Basin; 2) develop proposals to implement recommendation resulting from the study; and 3) provide assistance to the Great Lakes Fishery Commission, States, Native Americans, and other interested entities to encourage cooperative conservation, restoration, and management of the fish and wildlife resources and their habitats of the Great Lakes Basin.

The U.S. FWS biologists that work the Detroit River basin feel that although the FWS supports the request in the President's budget for a $700,000 appropriation, the FWS can not complete all the activities requested by the Act with the present and historical funding levels (maximum of $1 million/year since 1992, $0 appropriated in 1991, even though authorized for $10 million/year since and including 1991). Specifically, the FWS could not complete a Great Lakes-wide fisheries restoration study due in October, 1994 due to this shortfall. A proposed request of $4 million to work towards these activities was contained in the Fish and Wildlife Foundation Needs Assessment.

RECOMMENDATION 5: DIRECT FEDERAL FUNDING TO SUPPORT SPECIFIC ACTIVITIES REQUIRED BY THE GREAT LAKES FISH AND WILDLIFE RESTORATION ACT IN THE DETROIT RIVER AOC.

Endangered Species Act of 1973

The Endangered Species Act of 1973 (as amended, 16 U.S.C. 1531-1543) implemented the Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere. The Act provides for the conservation of threatened and endangered species of fish, wildlife and plants by Federal action and by encouraging the establishment of State programs.

The FWS biologists that have worked the Detroit River basin feel that the Service has relatively few federally listed species in the Detroit River Basin. However, all levels of government and non-governmental organizations have helped form partnerships to benefit those listed species that have needed the Endangered Species Act. Being listed as an endangered species helped save the remainder of the Belle Isle population of the Northern Riffleshell Mussel (Epioblasma torulosa rangiana) from encrustation by the invading zebra mussel (see section 3.1.2). When its habitat is secure, the Riffleshell could be returned to Detroit River waters near Belle Isle. Presence of several candidate species have resulted in habitat protection gains through project reviews and subsequent modifications over recent years.

MICHIGAN (STATE AND MUNICIPAL)— CRITICAL EVALUATION OF EXISTING LEGISLATION

PA451 Part 303 (Goemaere-Anderson Wetland Protection Act P.A. 203)

Michigan's Goemaere-Anderson Wetland Protection Act, passed in 1979, establishes regulations to preserve, manage, and protect wetland resources in the light of extensive historic losses and ongoing impacts due to human use and development. The Act requires permits for such activities as filling, dredging, construction, or draining and restricts wetland use and impacts. Under the established framework, which mirrors federal law, the MDNR may not issue a permit authorizing a loss of wetlands unless certain stringent tests are met. The proposed project must be found to be in the public interest; the project must not unacceptably disrupt the state's aquatic resources; and significantly, the impacts to wetlands must be unavoidable. One of the stated purposes of the act is to protect habitat for wildlife, waterfowl, fish, and rare, threatened and endangered species. The Act requires MDNR to develop an inventory of all wetlands in the state. The Act provides for criminal and civil penalties for violations.

The Wetland Protection Act applies to all wetlands in Michigan except for non-contiguous wetlands less that 5 acres in size, unless the MDNR determines that the particular wetland is essential to the preservation of the natural resources of the state. A non-contiguous wetland is defined as a wetland with no surface or groundwater connection with other waters of the state. While the Act is protective of Michigan's wetlands, greater protection of wetlands less than 5 acres can be accomplished through local wetland protection ordinances. The Habitat TWG encourages local communities to adopt ordinances that identify these less than 5 acre wetlands and protect them against further loss.

Although the Wetland Protection Act provides comprehensive protection of wetlands, most normal agricultural and silvicultural activities are exempted from permit requirements. Degradation of existing wetlands may result from farming practices, including minor drainage and cropping. Some forestry practices, such as harvesting, are exempted from permit requirements, and may result in damage to forested wetlands.

Under the current wetland permit system, the State of Michigan is typically allowed only 90 days to review a permit application and issue a decision. An informed decision on a permit application for a specific site (especially a negative decision) usually requires consideration and documentation of seasonal data, i.e. seasonal use by wildlife and fish, water quality and quantity data, etc. Obviously, a 90 day review period does not allow for seasonal data to be collected. As a result, either the decision on the permit is made without the benefit of all the necessary information, or the issuance of the permit is delayed until the necessary data are collected. A delay can result in litigation, and force a poor decision. This situation benefits no one.

The state wide wetland inventory required under the Goemaere-Anderson Wetlands Protection Act has not yet been completed. As a result, MDNR has lost some cases in court where the judge has ruled in favor of the defendant because the MDNR has no official inventory to prove the area has been identified as a wetland and therefore is protected under the Act. (See Recommendations #1 and #3.)

PA451 Part 301 (Inland Lakes and Streams Act P.A.346)
The Inland Lakes and Streams Act provides regulatory authority over construction activities below the Ordinary High Water Mark of inland lakes and streams. Criminal and civil penalty provisions exist for violation of the statute. The Inland Lakes and Streams Act is often used in combination with the Wetland Protection Act to regulate activities in wetlands. Road building, stream crossings, and building of bridges are regulated by the Inland Lakes and Streams Act.

Act 346 is generally well accepted by the public and proven in the courts. Significant changes in the statute or administrative rules are not suggested at this time. Land and Water Management Division is presently preparing a state-wide Policy and Procedures Manual, which will provide permit review staff with stronger direction and support on habitat management issues, such as dredging, seawall construction and stream crossing methods.

The Division has recently prepared and is implementing a Compliance and Enforcement Manual. Along with recent amendments to Act 346 and related statutes, the Division's enforcement program should be significantly improved.

Michigan Drain Code (P.A. 40)
Many streams in southeast Michigan are defined as drains and therefore regulated under the jurisdiction of the County Drain Commissioner, pursuant to the Michigan Drain Code, PA 40 of 1956. Modifications to the streams, such as blocking, channelizing and redirecting, are done as "improvement and maintenance" tasks under the Act. Although these modifications may benefit the drainage patterns in a local area, they may have major environmental impacts on the stream ecology and hydrology of downstream areas. A review by MDNR and the local government would ensure that stream modifications are consistent with all environmental laws and with a Habitat Management Plan (See recommendation #2). Improved communication between the County Drain Commission Office and state and local government is needed to address this issue (See recommendation #11– improved communication).

PA451 Part 91 (Soil Erosion and Sedimentation Control Act P.A. 347)
Soil erosion from construction sites is regulated through the Soil Erosion and Sedimentation Control Act, 1972 PA 347. The Act requires permits for all earth changing activities within 500 feet of a lake or stream, or that are likely to disturb an acre or more of land area. The program is administered by the MDNR through local designated enforcement agencies.

The local designated enforcement agencies issue permits and conduct compliance and enforcement. Methods of enforcement include minimal fines and cease and desist orders. The MDNR approves and audits the local programs.

Soil erosion and sedimentation is a major problem in southeast Michigan surface waterways. Runoff carrying sediment from construction sites fill in waterways disrupting flow patterns and destroying fish and wildlife habitat including food sources and water quality.

Often counties and local governments which are charged with enforcing the Soil Erosion and Sedimentation Control Act either do not view environmental protection as a high priority or do not have the necessary funds to operate an adequately staffed inspection program. Thus, assistance through education of local community staff, developers, and consultants would be a necessary step to strengthen the efficiency of the Act (see recommendation #16– Education for planners, etc).

RECOMMENDATION 6: REQUIRE MDNR AND LOCAL GOVERNMENT REVIEW OF ALL COUNTY STREAM IMPROVEMENT PROJECTS IN THE DETROIT RIVER WATERSHED.
The main challenge to the implementation of this recommendation is to secure cooperation of County Drain Commissioners in providing reviewing opportunities for MDNR and local communities.

Canada — Critical Evaluation of Existing Legislation

The Fisheries Act requires that all development proposals or undertakings are planned and implemented so that free movement of fish is maintained, no disturbance to habitat occurs and no pollution or siltation results. Exceptions are accommodated and mitigation or compensation measures accepted only upon the approval of the federal Minister of Fisheries and Oceans. Sections of this Act applicable to habitat are administered jointly by OMNR and DFO with the day to day enforcement of the Act handled by OMNR. A summary of estimated charges for violations of this Act (for Fiscal Year 93-94) was provided by the Canadian Department of Fisheries and Oceans:

Charges Laid Sec 35/36	155
Charges still pending	111
Total Fines	$11,005
Rehabilitation Orders	$160,000

Of the Rehabilitation Orders, there were four convictions. Additionally, there were several pleas of guilty to provincial violations (pursuant to the Lands Act, and Fisheries Act charges were withdrawn). Seventy-five thousand dollars from one conviction went into a trust account for impact studies. As well, one individual was ordered to perform manual tasks.

On the surface, the Fisheries Act is a strong piece of legislation. The definition of fish habitat under the Act is broad and penalties are severe enough to act as a stern deterrent. However, the Act is reactive in application. If habitat is damaged, the Act applies both with penalties and possible orders to correct damage, but only if OMNR is aware that the impacts have taken place and can prove them in court.

The Migratory Birds Convention Act prohibits the disturbance of nests or eggs of migratory birds. In its current form, it provides protection only when a nest is actively used. For example, a person could not cut down the trees in which great blue herons were nesting during the breeding season, but could cut them down in winter with impunity.

The Boundary Waters Treaty Act has been cited recently in review of habitat restoration projects. The Issues Division of Environment Canada's Environmental Services Branch, based at CCIW in Burlington Ontario, citing this Act and the recommendations of the IJC Great Lakes Water Levels Reference Study (1986), has indicated that in-filling of the connecting channels within the Great Lakes will no longer be allowed. This policy appears to be in contradiction to other programs currently in progress and clarification on this issue, by way of a policy statement is expected shortly. It has been proposed by the Water Issues Division that all of the parties in the St. Clair and Detroit Rivers hold a joint meeting and assess the potential impacts of future development along the corridor. These parties would include: IJC, Environment Canada, DFO, Transport Canada, COE, NBS and FWS, OMNR, MOEE, MDNR, ERCA, St Clair Region Conservation Authority and SEMCOG.

Given that the Fisheries Act is largely a reactive piece of legislation, there is a need to ensure that fish habitat management concerns are given regard at the preliminary steps in the planning process, not at the end. Logically this should achieve a better result with less expense to all involved. The most effective way to do this would be to amend policy statements and procedures associated with the Planning Act (Ontario) rather than to revise or amend the Fisheries Act.

Recommendation 7: Provide more effective protection to migratory birds and their habitat. The Migratory Birds Convention Act should be amended to include protection of nesting habitat throughout the year.

Implementation 7:

The main challenge to timely amendment to the Migratory Birds Convention Act is to generate sufficient political support at the Federal level to promote the necessary legislative action. The BPAC and RAP Team, provincial agencies, and NGOs need to lead the effort in encouraging the appropriate federal Minister to introduce legislative changes in parliament. In a political climate that favors more protection to the natural environment, a time-line of 2-3 years to realize legislative changes is realistic.

ONTARIO (PROVINCIAL AND MUNICIPAL) — CRITICAL REVIEW OF EXISTING LEGISLATION

The most significant planning mechanism protecting wetlands, shorelines and other types of fish and wildlife habitat is the Planning Act. The OMNR and ERCA use opportunities in the planning process defined under the Planning Act (e.g. official plans of municipalities, zoning by-laws, subdivision plans, etc.) to ensure that land development is consistent with their mandates for the conservation, protection and management of natural resources.

Under Section 3 of the Planning Act, provincial policy statements may be legally issued and municipalities must be consistent with these policy statements in preparing their Official Plan and in all land use decisions. In June 1992, a Wetlands Policy Statement under Section 3 of the Planning Act went into effect in an effort to protect "provincially significant wetlands". Until very recently, there were major deficiencies in the Planning Act with respect to procedures, its function and its intent when considering the protection of the natural environment. Specific examples include:

- The Wetlands Policy Statement (in its current form) provides only indirect protection to lower class wetlands (class 4 to 7) that are not provincially significant. Loss of these wetlands would contribute cumulatively to the overall loss of habitat in the Detroit River AOC.
- A legislative equivalent to the Fisheries Act (Canada) does not exist to provide absolute protection of wetlands. Penalties for wetland destruction are generally small and not a deterrent.
- Municipal controls under the Planning Act are only as effective as municipal intent to enforce their implementation. This intent may not be strong - particularly in difficult economic times.
- The Planning Act in its current form cannot prohibit landowners from altering the shape of their land prior to going through the planning process (eg. a farmer filling in a wetland on his property or a land developer clearing and grading a site prior to submitting a draft plan of subdivision).
- A clear provincial policy statement on fisheries does not presently exist under Section 3 of the Planning Act. In the absence of provincial policy direction, federal statutes such as the Fisheries Act are often regarded by municipalities and the Ontario Municipal Board (OMB) as being outside the land use planning process set out in the Planning Act.

  The Planning Act is presently under provincial review because of concerns that on one hand, development approvals are taking too long; and on the other hand, environmental values are not receiving adequate consideration. The Sewell Commission on Planning and Development Reform in Ontario has reviewed the Planning Act and published a document entitled "New Planning for Ontario" which addresses specific recommendations and associated policy statements to, among other things, focus on protecting the natural environment. Some of the general recommendations for natural environment protection include:

- Provincial policies would require that significant natural features be protected from any development. Development may proceed in other sensitive areas only if it is determined there are no adverse effects.
- Municipalities must assess the environmental impacts of options and alternatives when preparing plans.
- Municipalities must map or describe environmental resources, regularly monitor environmental (and other) indicators, and plan on a watershed basis.
- Municipalities should be able to control site alterations, including clearing of vegetation and placing or removal of fill.
- Municipal infrastructure should be subject to a Class Environmental Review process under the Planning Act.

The Conservation Authorities Act provides the legal basis for Conservation Authorities and defines their role. Under the Conservation Authorities Act, Fill, Construction and Alteration to Waterways/ Shorelands Regulations may be enacted. Where these regulations are in place, permits are required to undertake any works within the regulated area. These regulations can assist in controlling dredging, filling and drainage of wetland areas, along watercourses, and along shorelines.

Within the Conservation Authorities Act, clarification is needed for the definitions of "pollution" and "conservation of lands". These terms are not defined within the legislation and because of this vagueness, they are not enforceable. The Act should clearly give direct mandate to Conservation Authorities for the preservation and protection of wetlands, fish habitat and other environmentally significant areas. Also, the penalty provisions (fines) for violations are generally small and do not function as an effective deterrent.

RECOMMENDATION 8: AMEND THE PLANNING ACT SO THAT IT WILL FUNCTION MORE EFFECTIVELY IN PROTECTING FISH AND WILDLIFE HABITAT AND ENCOURAGE MORE WIDESPREAD PROACTIVE MUNICIPAL PLANNING ON AN ECOSYSTEM BASIS.

On May 18, 1994 Provincial Cabinet initiated planning reform by approving the "Comprehensive Set of Policy Statements" under Section 3 of the Planning Act. Actual amendments to the Planning Act are expected to take effect on March 1, 1995. In June 1995, the new provincial government introduced Bill 20 to recind these amendments to the Planning Act. The new Act and policies are expected to be released in the summer of 1996.

IMPLEMENTATION 8:

On May 19, 1994, Provincial Cabinet dealt with reform of the Planning Act and approved the "Comprehensive Set of Policy Statements" under Section 3 of the Planning Act. The changes will take effect January 1, 1995.

There are three principles in this reform:

1. Municipalities are getting more control of the process (which means OMNR and ERCA will need to be more proactive and more involved at the front end of the planning process);
2. Habitat will be better protected through the comprehensive policy statements; and
3. The planning process will be streamlined by amendments to the Act. The time frame for comments and input are to be shortened considerably and regulatory agencies can only become a party to an issue if it provides comments at the front end of the planning process. This will put an onus on OMNR and ERCA to provide timely and well informed input early in the planning process.

The Comprehensive Policy Statements cover a wide range of topics including housing, agriculture, economic and community development, and infrastructure issues. A common theme to all of these is the requirement to give due regard to environmental sustainability, regardless of the activity or interest in question.

The Policy Statement on Natural Heritage , Environmental Protection, and Hazard Policies addresses most of the program gaps and deficiencies mentioned previously. There are three goals in this policy statement:

1. To protect the quality and integrity of ecosystems, and to encourage restoration or remediation where quality and integrity have been diminished;
2. To ensure that wetlands have been identified and adequately protected through the land use planning process and to achieve no loss of provincially significant wetlands; and
3. To affirm the current flood plain policy and introduce the Great Lakes Shoreline Policy as new policy. A major point is that "development" will not be permitted in significant ravine, valley, river, and stream corridors, and development will be permitted only if there is no net loss to fish habitat and there are no negative impacts on significant natural corridors, woodlands and wildlife habitat.

It should be noted that the above revisions to the Planning Reforms address virtually all of the concerns raised above, with one exception. Wetlands that are not provincially significant (classes 4 - 7 by the provincial evaluation system) are still not protected.

RECOMMENDATION 9: DEVELOP SPECIFIC PROVINCIAL LEGISLATION (E.G. A "WETLANDS PROTECTION ACT") WITH ASSOCIATED POLICY AND ADEQUATE PENALTIES TO PROTECT WETLAND AREA AND FUNCTION.

A legislative equivalent to the Fisheries Act is needed to protect all wetlands and their functions (even those that are not provincially significant). The Detroit River AOC has lost so much in the past that we cannot afford to lose any more.

RECOMMENDATION 10: THE CONSERVATION AUTHORITIES ACT NEEDS TO BE AMENDED TO GIVE DIRECT MANDATE TO CONSERVATION AUTHORITIES FOR THE PRESERVATION AND PROTECTION OF WETLANDS, FISH HABITAT AND OTHER ENVIRONMENTALLY SIGNIFICANT AREAS. ALSO, THE PENALTY PROVISIONS (FINES) FOR VIOLATIONS, INCLUDING THE FORCING OF REHABILITATION, SHOULD BE SUBSTANTIALLY INCREASED AND STRENGTHENED TO ACT AS A GREATER DETERRENT.

IMPLEMENTATION 9 &10:

The main challenge to implementing the Conservation Authorities Act and developing a new "Wetlands Protection Act" is the development of sufficient political support to promote the necessary legislative changes. The BPAC, RAP Team, Association of Conservation Authorities of Ontario (ACAO), and ERCA need to lead the effort in encouraging the Province of Ontario, and the Minister of Natural Resources to carry out these recommendations in order to create an effective and efficient regulatory process for environmental protection. A time-line of 2 to 3 years to implement legislative changes is realistic.

Permitting and Approvals Process

CRITICAL EVALUATION OF EXISTING PROCESS

Michigan

Michigan is justifiably proud of its "one stop shopping" program for land and water related permits. With few exceptions, a landowner may apply to the MDNR for all appropriate state and federal permits through a single application. The joint state/federal permit application is reviewed through a consolidated/coordinated process which notifies and involves all affected agencies, interested groups, and riparian landowners. A timely decision is then made which reflects the concerns of all parties, within the constraints and confines of the appropriate statutes. This minimizes the conflicts and redundancy in cases were several permits are required for a single project.

Ontario

As noted previously, the OMNR and ERCA use opportunities in the planning process defined under the Planning Act to ensure land development is consistent with their mandates for conservation, protection, and management of natural resources. In addition, both agencies review work permit applications (eg. Public Lands Act, Lakes and Rivers Improvement Act, permits under the authority of the Conservation Authorities Act) for activities that could affect habitat (eg. dredge, fill, channelization, and other shoreland restructuring proposals).

Many municipalities still operate with planning documents and by-laws which were developed years ago, prior to many of today's environmental concerns. As a result, many project proposals are currently not brought to OMNR or ERCA until after they are substantially developed and have gained support at the local level. If OMNR or ERCA have fundamental problems with the proposal, it is difficult to deny the permit or planning approval at this point when the proposal has significant support and momentum at the local level. Often all the reviewing agencies can do is require modifications to the proposal to make it minimally acceptable.

In addition, staff availability and workload problems, created by the large volume of material that require input and review, lead to delays in planning approval. Consequently, reviews are rushed, increasing the risk of habitat loss. This also applies to enforcement – conservation officer availability and the long periods of time it takes to investigate and prosecute.

Recent reforms to the Planning Act will require municipalities to have more regard for the natural environment when developing planning documents and administering development proposals, but will also have even more serious workload implications to OMNR and ERCA than at present. These agencies must be able to provide timely and accurate resource information, mapping and comments early in the planning process.

Planning Act amendments will give municipalities much more authority to regulate development. The time frame for input from reviewing agencies will be shortened dramatically, with a one-time opportunity to comment at the front end of the planning process. If that entry point is missed because of lack of data or workload, then OMNR and ERCA will have lost their opportunity to be a party to that issue as it proceeds through the planning process.

These changes will require OMNR and ERCA to become even more efficient and to respond quickly and effectively to planning issues as they first arise. There will be a requirement to provide quality resource information (including accurate mapping) and to predict high workload areas and set priorities on a daily basis.

Recommendation 11: Increase staffing levels in Michigan and Ontario regulatory agencies which have jurisdiction in the Detroit River AOC.

The benefits of increased staffing would be:

- The new staff would generate new information about threatened habitat (increased number of field inspections, surveys and evaluations);
- reduced staff turn-overs and improved regulatory memory;
- more effective and consistent enforcement of existing habitat protection legislation;
- timely completion of a Michigan wetland, fish and wildlife inventory;
- timely data collection upon which permit decisions are based;
- timely completion of permit reviews and issuance;
- and improved coordination with local communities in the review of local development projects.

The main challenge to the implementation of this recommendation is the lack of a stable funding source in both the Michigan and Ontario governments.

Recommendation 12: Make more efficient use of existing staff by coordinating environmental protection activities in the Detroit River AOC with other agencies.

The coordination between the ERCA and OMNR serves as an example of this coordination. Conservation Authorities such as ERCA, work in partnership with OMNR to protect wetlands and shoreline habitat. Conservation Authorities are the key agencies responsible for the development of shoreline and watershed management plans in consultation with municipalities and other provincial agencies. These plans can be made proactive from a wetlands protection perspective with the incorporation of features which encourage wetland protection and enhancement. Under the Conservation Authorities Act, Authorities can enact Fill, Construction, and Alteration of Waterways Regulations. Since permits are required to undertake any work within regulated areas, these regulations can assist in controlling dredging, filling, and draining of specific wetland areas, especially lower class wetlands that are not protected by the Wetland Policy Statement. ERCA is active in both evaluation of wetlands and use of plan input and review to protect wetlands. While OMNR has the lead responsibility in these matters, OMNR staff are presently working with ERCA to take advantage of their mutual interests and shared capabilities to establish an efficient and effective division of responsibility on a local basis.

The OMNR is currently developing a province-wide aquatic habitat training initiative which should improve staff efficiency in protecting fish habitat. This initiative is intended for OMNR field staff (biologists, planners, technicians, conservation officers, etc.) involved in the implementation and enforcement of habitat protection legislation and planning mechanisms, but it is recommended that in the Detroit River AOC, training be extended to appropriate staff of ERCA and local municipalities (e.g. planners, engineers and regulation/bylaw enforcement officers).

Another example would be coordinating various monitoring efforts between the different agencies, such as Canadian Wildlife Service (CWS) MOEE, OMNR, ERCA, MDNR, NBS and the FWS. MDNR conducts semi-annual fly-overs to observe wildlife populations on the U.S. side of the Detroit River. This effort could be coordinated with CWS to collect data for both sides of the Detroit River in a single survey.

Implementation 12:

Agencies responsible for permits and plan review have already made tremendous strides in cooperative agreements and coordination of efforts to become more efficient. Discussions are proceeding between OMNR and Conservation Authorities at the provincial level to advance this initiative further.

Recommendation 13: Increase Permit Coordination and the Availability of Information on Permit Requirement

Citizens often initiate work on private property without obtaining the proper required permits from MDNR. In addition, developers, real estate agents, etc. often state that it is very difficult to know when an MDNR permit is required for various activities. Permit coordination services related to Michigan resource management and environmental protection regulations can be obtained through two state offices:

Business Ombudsman. In 1983, the Office of the Business Ombudsman was established in the Governor's office to "act within government as an advocate and problem solver for Michigan's businesses." This office is committed to smoothing out the interactions between business and State government, as well as responding to specific issues. Toll free hotline: 1-800-323-2727.

MDEQ Permit Coordination Services. The MDEQ has a department-wide permit coordinator, and each Division provides coordination services. The Permit Coordinator is the central contact point for coordinating Department responses to proposed developments and projects which require more than one permit. The emphasis of this service is to initiate work early in the planning stages of a proposed development to ensure that all environmental requirements are identified and the appropriate permits are pursued. Each permit issuing division provides specific information regarding permits and the permitting process. In an effort to provide better permit coordination, MDEQ has prepared a list of key questions which help identify what departmental permits, licenses, or approvals of a permit-like nature may be needed (Permit Coordination Information, Form PR 1011). The objective of submitting this form with the permit application is to expedite permit review and help reduce the possibility that a delay may occur due to the untimely discovery of additional permitting requirements later in the process. (Reference: Michigan Permit Requirements for Natural Resource Development, October 1990, MDNR.)

ERCA is testing a similar permit coordination service on the Ontario side of the AOC. While the OMNR has the lead responsibility in habitat protection in Ontario, a partnership between OMNR and ERCA has created a " one window shopping" service for providing such information to landowners as:

- the various permits required for the development; and
- environmental requirements/restrictions, from applicable provincial or federal statutes.

ERCA is not only the issuing agency for permits utilizing guidelines established by ERCA/OMNR, but also assists landowners through the regulatory processes on other permits not singularly issued through the ERCA office.

Implementation 13:

The Environmental Assistance Division of MDEQ has been established in answer to a serious need for an effective program to assist Michigan industries, commercial establishments, municipalities, and the public in understanding and complying with the vast and complex environmental regulations administered by the MDEQ. The new division has the following five principal areas of focus:

- Outreach: Education, information, community development, training, and friendly access to environmental programs.
- Technical Assistance: Facilitate problem resolution, foster communication among the Department's environmental programs, develop clear, plain English technical information on all environmental program areas, provide facility operator training, and provide compliance assistance and self audit training.
- Pollution Prevention: Help business and municipalities identify effective and economical ways of reducing waste at the source, thereby avoiding costly waste treatment and disposal. The toxic release inventory/community right to know program will be a part of this effort.
- Permit Coordination Function: Work with new and expanding industries to facilitate and coordinate necessary environmental permitting.
- Financial Assistance: Oversee the State Revolving Fund which provides low interest loans for municipal waste water treatment plants.

Recommendation 14: Develop and distribute public guidance documents in the Detroit River AOC promoting an ecosystem approach to land development and provide direction on permit and planning application requirements.

With reduced staffing levels in Ontario regulatory agencies, less assistance is available for consultants and citizens in completing the various permit and planning applications. Guidance documents written jointly by local OMNR, MOEE, and ERCA staff and distributed primarily by "one window" permitting agencies such as ERCA, would provide general assistance to the public concerning the completion of the various permit applications. These documents would be produced primarily to assist landowners understanding of the requirements for permits obtained for activities such as dredging, filling and alteration of shorelines, wetlands and tributaries.

On a larger scale, there is a need to produce documents which inform municipalities and the development community of the rationale behind and components of provincial guidelines and standards that protect habitat from impacts related to major residential, commercial and industrial development activities.

Implementation 14:

Regarding development and distribution of guidance documents, the major challenge to implementation will be the identification of a funding source to develop and print the documents.

ERCA would be an appropriate agency to implement the development and distribution of guidance documents for environmental land-use planning. This could be funded through the ERCA budget consisting of 50% provincial grant and 50% from other sources, still to be identified. An estimated cost would be $10,000 and could be implemented within a time frame of 12 months.

SEMCOG has recently completed a document to assist local southeast Michigan communities – "Land Use Tools and Techniques: A Handbook for Local Communities." The handbook includes a detailed section on existing tools for environmental protection – including draft ordinance language. A similar document can be prepared by ERCA if a funding source is identified.

A manual for the implementation of the Provincial Wetlands Policy Statement and a fish habitat protection guidelines manual for urban development have recently been developed by OMNR. These documents are intended for use by staff of the OMNR, OMMA, Conservation Authorities, and municipalities as well as by proponents of development and their consultants and staff.

Michigan/Ontario Wetland Evaluation System

A habitat inventory needs to address both the quantity and quality of remaining areas in the AOC, including wetlands. The definition of a wetland is the basis for the evaluation of the quality or functional capacity of a wetland area, as well as delineating the specific size and location of wetland areas. Currently, Ontario and Michigan/U.S. have differing definitions. A common definition and the development of a common wetland evaluation system would be beneficial in establishing a consistent approach to wetland protection in both Michigan and Ontario. In addition, a common definition and evaluation system is important in developing the habitat inventory for the AOC (recommendation #1) and the GIS database (recommendation #3).

Recommendation 15: Encourage the development of a common wetland evaluation system for use in both Michigan and Ontario.

Agreement on a definition and evaluation system for wetlands needs to be accomplished before the habitat inventory can be conducted. State and provincial wetland regulatory staff are needed to determine how a common evaluation system can be developed and implemented. Michigan's wetland evaluation manual is in draft form. The Ontario Wetland Evaluation Manual has been consulted.

Improved Communication

Recommendation 16: Improve communication among the public, local governments and developers with MDNR and OMNR to preserve and protect existing habitat in the Detroit River AOC.

Implementation 16:

Communication among provincial agencies, municipalities, the public and the development industry could be achieved through active distribution of guidance documents outlined previously (recommendation 13) and by presentations to municipal councils and staff, real estate boards, developers, and contractors. Prepare and distribute presentations on video tape to ensure that the message is conveyed to a wide audience.

Recommendation 17: Encourage local agencies in the Detroit River AOC to review existing plans and local zoning ordinances/by-laws to incorporate environmental aspects and be aware of existing environmental legislation over all program areas.

If the developer or local government would confer with OMNR and ERCA to discuss the concept, a better project design (from an ecological perspective) which meets both provincial requirements and the needs of the developer/local government can be developed from the start. This would avoid confrontation between the landowners and the agencies and eliminate extra work.

Implementation 17:

Recent revisions to the Planning Act will make it compulsory for local municipalities to revise planning documents and incorporate ecosystem planning principals into all planning and development exercises. However, this planning can only be effective in protecting habitat if OMNR and ERCA are able to provide timely and accurate data and comments. This underlines the need for a detailed habitat inventory and Habitat Management Plan.

It should be emphasized that recent revisions to the Planning Act will make the implementation of recommendations 11, and 13-16 a necessity if habitat features of the Ontario portion of the Detroit River AOC are to be protected.

Education Programs

Recommendation 18: Establish an education program in the Detroit River AOC to train local planning and zoning officials, real estate agents, consultants, developers, municipal building officials, and conservation officers in identifying permitting requirements, wetland violations, and habitat enhancement/protection opportunities.

The Science and Technology Transfer Unit (STTU) of OMNR developed a province-wide aquatic habitat training initiative which should improve staff efficiency in protecting fish habitat. This initiative is intended for OMNR field staff (biologists, planners, technicians, conservation officers, etc.) involved in the implementation and enforcement of habitat protection legislation and planning mechanisms, but it is recommended that in the Detroit River AOC, training be extended to appropriate staff of ERCA and local municipalities (e.g. planners, engineers and regulation/bylaw enforcement officers).

IMPLEMENTATION 18:

The implementation of an education program to train local planning and zoning officials, consultants developers, etc. will require the participation of experienced state and provincial regulatory staff in the development of an effective education program. This program will be successful if the local governments are supportive of the benefits of environmental protection and are interested in pursuing various environmentally-sensitive options for development.

As mentioned earlier, training of local OMNR staff by the STTU took place in 1994. The same training should be extended to ERCA, municipalities, and the development industry. The major challenge to the implementation of this recommendation is the identification of a stable funding source and adequate staffing levels necessary to expand training beyond OMNR staff. The public should be allowed and encouraged to attend these education programs.

RECOMMENDATION 19: DEVELOP A PUBLIC EDUCATION PROGRAM IN THE DETROIT RIVER AOC, INVOLVING A NETWORK OF ANGLER, ENVIRONMENTAL AND CONSERVATION GROUPS AND SCHOOLS TO PARTICIPATE IN ENVIRONMENTAL AWARENESS ACTIVITIES.

This recommendation was developed in order to include students and the interested public in a water quality education program. The implementation of such a program would assist the public in changing habits in order to protect the environment. Also, it would help mold today's students into environmentally sensitive adults.

IMPLEMENTATION 19:

Effective implementation will require a partnership of the RAP Team, BPAC, members of various school systems and organizations such as Friends of the Detroit River and ERCA. Friends of the Detroit River is currently implementing water quality education programs in three Michigan downriver schools. ERCA currently conducts various public education programs, including school programs. Thus, ERCA would be effective in conducting a water quality education program, if additional funding is identified.

The community stewardship of the Little River watershed is a good example of a successful public education program that developed in the Windsor and Sandwich South Township School Districts. The project started with a teacher at Concord Elementary School who wanted to involve his students, their parents, fellow teachers, and the community in an environmental activity. The project chosen was cleaning the old channel of the Little River located in a city park beside a former garbage dump and a sewage treatment plant. The Windsor Parks and Recreation Department got involved because they own the park land along the river and had an interest in its development.

The first river cleanup in the spring of 1989 involved clearing garbage and debris from the stream (tires, car parts, stoves, refrigerators, etc.). Cleanup crusades of the Little River set the stage for further work like planting trees and building hiking trails with wood chips. Over 11,000 trees have been planted along the Little River by students of Concord and other area elementary and secondary schools.

The students, their parents, and the staff of Concord received a United Nations Environmental award along with 29 other North American schools in 1991. Their work has been featured in several magazines and a National Geographic film special along with the schools of the Rouge River Basin.

Incentive Programs for Habitat Preservation

RECOMMENDATION 20: ENCOURAGE PARTICIPATION IN EXISTING FEDERAL, STATE AND PROVINCIAL INCENTIVE PROGRAMS FOR HABITAT PROTECTION AND REHABILITATION ACTIVITIES IN THE DETROIT RIVER AOC.

There are a number of existing federal, state and provincial incentive programs which provide either funding for local habitat enhancement projects or tax incentives to maintain existing habitat.

Michigan/U.S. Incentive Programs

The FWS Wetland Restoration Program provides an opportunity for landowners to restore drained wetlands by removing field tiles or plugging ditches that were installed for draining these areas. Most projects are done by the Fish and Wildlife Service at no cost to the landowner. However, costly projects require cost-sharing for implementation. The purpose of this popular program is to help restore some of the 5.6 million acres (50%) of wetlands that have been destroyed in Michigan. There are no income requirements to participate in the program. However, the private partner must own the land on which the restoration activities will occur.

For further information concerning this program, contact:

Bob Seppala
U.S. Fish and Wildlife Service
2651 Coolidge Road
East Lansing, Michigan, 48823
517-351-2555

The Michigan Farmland and Open Space Act (P.A. 116) provides tax credits for maintaining property in farming and property tax reductions for open space lands. Minimum requirements for enrolling in either farmland agreements or open space easements vary depending on the type of agreement or easement. The application for admission to enroll in agreements and designated open space easements must first be approved by the local unit of government and then by the state. Participants in agreements or easements are not subject to special assessments for sanitary sewer, water, lights or non-farm drainage caused by adjacent development. Early withdrawal from an agreement or easement, can result in the repayment of all or a portion of the tax benefits received, depending on the basis for the withdrawal request.

For further information concerning this program, contact:

Richard Harlow
Chief, Farmland and Open Space Preservation Unit
Land and Water Management Division
Michigan Department of Environmental Quality
P.O. Box 30449
Lansing, Michigan 48909
517-373-3328

Pheasants Forever, is an international nonprofit conservation group that will provide free seed to all rural landowners, schools, gardeners, companies and farmers who wish to plant cover and food plots for pheasant and other wildlife. Pheasants Forever will provide $30 per acre and free seed for the first 5 acres of cover per landowner, and, free seed for larger plots so long as supplies last. Seeds include: sorghum, corn, clover mix, and native prairie grasses, such as switchgrass. Such plantings ensure the survival of pheasant, song birds, and other wildlife populations of national interest.

Since 1984 this group has provided seed for thousands of projects encompassing hundreds of thousands of acres in Canada and the United States. Planting the seed in no way commits landowners to allow others onto their land. This wildlife habitat program is highly successful, creative, and well established with many local governmental bodies, schools, and civic groups. There are no site, size, physical or engineering constraints involved. Adequate funding levels for the program exist. Local, state, provincial and federal agencies have all endorsed or worked with Pheasants Forever already.

For further information concerning this program, contact:

Pheasants Forever, Inc.
P.O. Box 75473
St. Paul, Minnesota, 55175
612-481-7142

Nature and Land Conservancies, which are often non-profit charitable corporations with tax exempt status, are empowered to acquire land through private donations, conservation easements, or direct purchase. Lands acquired through conservancies will remain protected in perpetuity. The incentives for taxpayers to donate tracts and/or parcels of land to a conservancy is the ability to deduct the full fair market value of the charitable gift of appreciated property, whether it is land or easements. Land that is acquired through conservation easements is still privately owned, but has permanent deed restrictions for conservation and preservation placed on the portion of land that is designated as the easement.

The Grosse Ile Nature and Land Conservancy is a member of a national organization, the Land Trust Alliance, which is based in Washington D.C.. The conservancy was formed in 1993 by Grosse Ile residents who have a common interest in preserving and protecting the environmentally significant lands on and around the island of Grosse Ile. Through the conservancy movement, land donations and conservation easements can provide a "win-win" situation for both the taxpayer and the Great Lakes ecosystem. There are currently 24 conservancies in operation within the State of Michigan.

For further information concerning this program, contact:

Bruce D. Jones, President, Grosse Isle Nature Conservancy and Land Trust
P.O. Box 12
Grosse Ile, Michigan, 48138
313-676-8657

Ontario/Canadian Incentive Programs

The Ontario Conservation Land Tax Reduction Program, provides up to 100% rebate of property taxes to those landowners who agree to protect and maintain the natural character of their eligible property for a 10 year period. The rebate equals up to 100% of eligible property taxes. More specifically, rebates will be made for taxes levied for municipal and school purposes. The minimum rebate made is $20, even if the actual taxes paid were less than this amount. The maximum rebate is $25,000 for a single landowner, excluding Conservation Authorities.

Only conservation lands of at least one-half acre (0.2 hectare) in size are eligible for the program. Conservation lands include the following:

- class 1, 2 and 3 wetlands,
- provincially significant Areas of Natural and Scientific Interest (areas of land and associated waters that best represent Ontario's geologic and biological history and diversity)
- areas designated as Escarpment Natural Areas in the Niagara Escarpment Plan (areas containing significant plant and animal habitats and geologic features and are the most important natural and scenic areas of the escarpment), and
- other conservation lands owned by non-profit charitable organizations, that do not fit into one of the above categories.

Should the owner decide to withdraw early from the program, he or she would be required to repay all of the accrued tax rebates, plus 10% interest.

For further information concerning this program, contact :

Subsidies Management Branch , Ministry of Municipal Affairs
777 Bay Street, 12th Floor
Toronto, Ontario M5G 2E5
1-800-268-8959 or 416-971-8071

The Community Fisheries Involvement Program provides up to $8,000 to local angler clubs, community associations, schools, and municipalities for projects which improve the quality of local fishery habitat or increases the production of fish. Examples of these projects include:

- vegetation plantings, installation of deflectors and riprap to restore stream banks;
- construction of fencing to protect stream banks from grazing cattle. construction, operation and maintenance of incubation boxes;
- creation of spawning beds in lakes and streams by adding gravel; and
- operation of small approved hatcheries.

To be eligible for funding, projects must:

- improve Ontario's fishery resource,
- comply with OMNR's fisheries management strategies;
- provide 100% voluntary labor; and
- provide a public benefit.

The Community Wildlife Involvement Program provides up to $5,000 to landowners, sportsmen groups, naturalists' organizations, homeowners associations and youth groups to participate in hands-on wildlife management. Eligible projects will increase the number and diversity of local wildlife and improve opportunities for outdoor recreation. Options for activities include, but are not limited to:

- construction of viewing towers;
- implementation of songbird enhancement programs;
- wildlife monitoring;
- emergency deer feeding; and
- brushpile construction.

To be eligible for funding, projects must:

- improve wildlife resource;
- comply with OMNR's wildlife management objectives;
- provide voluntary labor; and
- involve a cooperative effort among groups with divergent outdoor interests.

For further information concerning the above two programs contact your local or district OMNR office. For projects within the Detroit River AOC, contact:

Ontario Ministry of Natural Resources, Chatham Area Office
1023 Richmond Street West
Chatham, Ontario N7M 5J5
519-354-7340

Additional incentives programs include the following:

- OMNR, Wildlife Habitat Canada, and Ducks Unlimited signed a Wetland Habitat Agreement in 1990 to conserve and protect wetland habitat. The three year, $2.9 million agreement places emphasis on working with private landowners by providing incentives to maintain and protect natural areas.
- OMNR has a five year agreement with Ducks Unlimited to manage waterfowl habitat in Ontario. OMNR contributed $3 million while Ducks Unlimited contributed $16 million to develop and rehabilitate wetlands as waterfowl habitat.
- Tree Plan Canada is a Green Plan initiative to foster and encourage planting of up to 325 milion trees. In Ontario it is partnered withTrees Ontario to form Project Tree Cover which seeks to establish 16 million trees on private lands, particularly where tree cover is 12% or less. In Essex County, where little tree cover remains, Project Tree Cover especially targets partnerships featuring re-establishment of Carolinean species.

RECOMMENDATION 21: REINSTATE THE APPLICABILITY OF THE ONTARIO CONSERVATION LAND TAX REBATE TO CONSERVATION AUTHORITY LANDS IN ORDER TO PROTECT THESE HOLDINGS LOCATED WITHIN THE VARIOUS AOCS.

Up until 1993, Conservation Authorities received a 100% rebate for all taxes associated with non-revenue producing conservation lands. With decreased provincial grants to Conservation Authorities, as well as other priority resource management needs, elimination of this rebate grant reduces funding available for maintenance of existing land and new acquisitions.

Objective #2: Restore and Enhance Habitat

The second objective established by the Habitat TWG to address relevant water use goals is to restore and enhance habitat in the Detroit River AOC. The Habitat TWG proceeded to evaluate potential sites in the river where the technical experts felt habitat could be restored or created, and the potential funding sources for conducting that work. These twenty-one potential sites for implementation of remedial actions could preserve, protect and restore habitat in the river. If fully implemented, these remedial actions will restore healthy, diverse, and self-sustaining populations of fish and wildlife to the Detroit River and provide more and varied recreational opportunities and access to the river for people who fish, hunt, boat or otherwise enjoy nature.

This section of the TWG report will:

1. identify past remedial actions that have been conducted to restore or enhance habitat in the AOC;
2. list and briefly describe on-going activities that also serve to restore or enhance the habitat; and
3. provide a list of potential sites for remediation.

Many of these activities have not occurred directly as a result of the RAP. Since a function of the RAP is to coordinate and focus these types of multi-agency efforts, these activities are listed to provide a broad picture of the many actions that result from the on-going research, regulatory programs, and citizen environmental involvement.

Additional activities and funding sources can be forwarded to the TWG via the RAP Coordinators for inclusion in the RAP process.

Past Actions

HABITAT TECHNICAL WORK GROUP

After examining historic maps of the Detroit River, the National Biological Survey (NBS) estimated that over 90% of wetlands present in the river in 1873 were destroyed as the shoreline was modified and developed. The TWG prepared maps of all known remaining fish spawning and wildlife nesting, feeding, and staging areas in the Detroit River. Additional habitat information such as the dredged navigation channels, location (extent) of the littoral zone, areas of environmental significance (e.g. habitat areas for rare, threatened, or endangered species), and locations for drinking water intakes and major industrial discharges were also identified on AOC base maps. Information from these maps is being entered into the Michigan Resource Information System (MIRIS) Geographic Information System (GIS) of the MDNR. The US Army Corps of Engineers, through funding by the EPA, has digitized sediment contamination data for the AOC (historic and current). These data have been entered into a system which is somewhat compatible with the MIRIS database. An on going project will integrate the two systems to provide a method of evaluating sediment contaminant concerns in conjunction with fish and wildlife habitat issues.

Waterfowl use of the Detroit River over the past 40 years has been documented by the TWG from data gathered during aerial surveys of the river by Michigan and Ontario biologists (Appendix 5.5). The National Audubon society is providing the TWG an analysis of trends in the numbers of song birds using the Detroit River AOC.

Other Efforts in the AOC

Initial attempts to obtain funding from the U.S. EPA to remediate contamination and or restore habitat at three sites in the Detroit River—Belle Ile, Grassy Island, and Celeron Island—were unsuccessful. Proposals have been submitted by the OMNR to the Great Lake Protection Fund to remediate habitat at Windsor Salt. Some remediation of fish and wildlife habitat on Belle Isle is being implemented with funds from the MDNR Trust Fund Program and the Great Lakes Cleanup Fund.

A modest research initiative is underway between the NBS, the COE, and Eastern Michigan University to inventory all remaining wetland habitat in U.S. waters of the Detroit River and calculate the total area of such habitat that has been lost to development since 1843.

- "Rescue the Riffleshell" was a collective effort among local businesses and citizens, the City of Detroit,

  MDNR, and the FWS amid growing concern over the rapid decline of native unionids in the Great Lakes following the invasion of the exotic zebra mussel. On October 10, 1992, a rescue group consisting of volunteers including 50 scuba divers from several police departments, 20 Boy Scouts, 6 biologists, and 50 community volunteers collected northern riffleshell mussels. The shore crew removed the zebra mussels from 110 riffleshell mussels, which were then transplanted. (Source: Endangered Species Update vol. 10 no. 5, May, 1993.)
- In order to mitigate and compensate for loss of littoral habitat resulting from infilling during construction of the Assumption Park Project in Windsor, rip rap gabion and granular stone totaling 2000 square meters were placed in front of an existing sheet steel breakwall. This provides fish spawning and hatching habitat. In addition, higher outcroppings afford shelter which at this time is highly deficient. Since this did not completely compensate for the loss of littoral habitat at the site, additional off site compensation was implemented in Conservation Authority and City of Windsor Department of Recreation projects at Coventry Gardens and Alexander Park.
- The Little River Enhancement Group (Lil' Reg), a volunteer multi-discipline advisory group, was formed in 1991 to oversee projects and provide professional input. The group refocused the project on the entire watershed promoting the ecosystem approach and greenway connections. This "community stewardship" project is a good example of a successful activity to restore and enhance habitat in the Detroit River AOC.

  The Lil' Reg has created a partnership that includes schools, businesses, labor, OMNR, ERCA, MOEE, the City of Windsor, and Sandwich South Township. Since 1989, the group has participated in 14 cleanup crusades of the Little River and its riparian zone. The group actively approaches other schools in the watershed and encourages involvement in environmental projects. They have also approached municipal councils to encourage them to use the ecosystem approach. In 1994, the Lil' Reg partnership approached two private land owners who agreed to participate in habitat projects. One, a farmer, will participate in a demonstration project for drain management. The other land owner agreed to participate in the Natural Habitat Restoration Program and reforest 10 acres of land. Both of these projects will improve water quality.
- The ERCA Turkey Creek Channelization Project includes such activities as flood and erosion control, contaminated sediments removal and enhancement of fish habitat. Initial removal of contaminated sediment is followed by the construction of gabion mattresses at bridges, thus providing erosion protection as well as fish habitat. Deep pools and riffle areas have also been created and lined with rip rap providing additional fish habitat. Also included in the project plan is the planting of native trees for beautification and enhancement of the entire area.
- The Purple Loosestrife problem continues to worsen in the Detroit River AOC, resulting in significant habitat degradation and loss. Currently the most adversely affected areas, containing very high concentrations of Purple Loosestrife, are along the south shore of Lake St. Clair; the Detroit River from Windsor to Amherstburg; and the watercourses of Big Creek, River Canard and Turkey Creek.

- The ERCA, in cooperation with the University of Guelph Biological Control Laboratory, has recently initiated a "biological control" program at three different sites in Essex County, including an ERCA owned wetland along the Detroit River. This involves the release of a host specific insect that feeds only on Purple Loosestrife, reducing its population density and suppressing its spread, without adversely affecting native plants or important agricultural crops. This control method is long-term, cost-effective and environmentally acceptable, and will allow these degraded wetland habitats to regain their native biodiversity. A biological control program has also been initiated at the Canard River marshes.
- Two European insects (Galerucella calmariensis and G. pusilla)which are specific herbivores on loosestrife have been released in Michigan through a cooperative effort of the MDNR and the Michigan Department of Agriculture. The objective of this project in Michigan is the reduction of purple loosestrife abundant's to 10 percent of its current level over 90 % of its range.
- The Windsor Skin and Scuba Club Inc. performed their annual Crystal Bay Clean up for the sixth year. The dive was conducted on April 24, 1994 as part of an Earth Day celebration. Over 30 volunteer divers along with organizers and coordinators participated in successfully retrieving approximately 45 cubic feet of garbage from the bay.

ON-GOING ACTIVITIES

- The purpose of the Windsor Salt River Front Rehabilitation Project is to remove salt from along the shoreline, control runoff from the salt piles to the river, and restore habitat conditions.

  Funding for core sediment samples and a coastal zone process study have been requested from the Great Lakes Cleanup Fund for 1994. A proposal has also been submitted to the Great Lakes Protection Fund for wetland creation at the site. OMNR engineers are working on an island design study to ensure the habitat creation project yields the most benefit with the least impacts. The OMNR also recently began the Environmental Assessment process necessary for project approval and performed an inventory of fish at the project site in June and July of 1994. An electrofishing survey of the area yielded 22 species (8 game species) in just over one hour (64 minutes).
- Windsor Salt is presently upgrading equipment to discontinue outflow of brine water into the Detroit River through installation of a cyclone in the area where Phase 1 construction is scheduled to begin in 1995.
- The Detroit River Area of Concern has two bald eagles associated with it. The most upstream nest site, Essex County territory #4 came into being in 1992 but with zero production. In 1993, the nest also had zero production with one uncollected, addled (dead) egg in the nest. Addled egg cause and effect is related to chlorinated organic compounds such as DDT and PCBs. In 1994, the nest had one eaglet that reached fledgling age.

  The most down stream site, Essex County Territory #2 has been in production since 1981 and had produced a total of 23 eaglets, 1994 inclusive. Two eaglets fledged from this nest during 1992 followed by one eaglet in 1993 and one in 1994. Eaglets at both sites have been biologically sampled and banded under the Environment Canada CWS —OMNR Southern Region Partnership Project. This partnership project is responsible for implementing the Canada-Ontario Great Lakes Raptor Rehabilitation Project which specifically includes the bald eagle. Analytical data is forthcoming as the endangered bald eagle is utilized as a biological indicator of environmental health for the southern portion of the Detroit River.

  There are two bald eagle nests located on the Michigan side, both are outside of the AOC and located near grossly polluted areas. The most northern nest site produced two eaglets, one with a minor crossbill. The southern most nest produced one eaglet which had a gross crossbill. Research has linked the crossbill abnormality in eagles to the PCBs.
- The Environment Canada CWS—OMNR Southern Region Partnership Project has recently received funding for the coordination of Peregrine Falcon nest box program. Two nest boxes have been constructed through for placement along the Detroit River. Hiram Walker & Sons is

presently constructing a nest box for placement at their facility. It is anticipated that through a partnership with a local group additional boxes can be constructed and placed along the river in hopes of establishing a viable breeding population in Ontario. Presently the endangered Peregrine Falcon is not an environmental monitor for the AOC.

- Detroit River RAP planners have been contacted by the managers of the Ruwe Marsh property regarding a proposed protection/rehabilitation project. This marsh is part of a 580 hectare (1,433 acre) complex and is one of the most significant wetlands in the Detroit River. This project has recently been funded by Environment Canada's Great Lakes Clean-up Fund for implementation of phase 1. Phase 1 of the project involves the repair of an existing finger dike. The recognized significance of the Canard River Marsh ecosystem as staging areas for Canvasback and Redhead ducks, especially during fall migration, results from the finger dike's diversion of suspended sediments from the marsh. The finger dike effectively creates a significant amount of calm water area and associated aquatic vegetation. Decreased turbidity allows diverse, abundant aquatic vegetation with high wildlife food value.
- A 40-acre parcel owned by the U.S. EPA on the southern end of Grosse Ile has many feet of natural shoreline on Gibraltar Bay. The FWS and the MDNR are interested in protecting this shoreline and adjacent uplands as fish and wildlife habitat. The Grosse Ile Nature Conservancy and Land Trust is working with local schools to establish an outdoor classroom and nature center on the property.
- Redevelopment of BASF's 84 acre Southworks complex is being implemented. The project, which is a joint effort between BASF, City of Wyandotte, and the Michigan Department of Natural Resources, consists of a rowing club house, amphitheater, riverfront promenade, walking trails, "green areas", and a nine hole golf course. The project has had has had a positive effect on the quality of the surrounding community, illustrating the cooperative partnership between city, industry and state to achieve brownfield restoration and a sustainable community.
- The Michigan Resource Information System (MIRIS) of Land and Water Management Division (MDEQ) for the Detroit River AOC is to be updated to incorporate the sediment inventory data as well as habitat information (Fish Spawning and nursery areas, macrophyte growth areas, duck habitat, benthic communities, etc.) the system currently includes a base map and data for land cover, wetlands, State lands (lower river only), flood prone areas, environmental areas (lower river only), natural features, surface water intakes and discharges (1988 data) bathymetry, spawning sites, and sediment deposition areas. Funding for this project is to be provided from a "watershed" grant from the U.S. EPA, Region V under Section 104 (b)(3).
- BASF has donated a 113-acre marsh (Hennepin Marsh) and two adjacent upland lots just north of the toll bridge across the Trenton Channel of the river to northwest Grosse Ile to the Grosse Ile Nature Conservancy and Land Trust. This land borders the last stretch of undeveloped shoreline on the island of Grosse Ile and will be linked to other wildlife habitat on the island by a greenway. The marsh habitat is used by a wide variety of wildlife, including blue heron, snowy egret, swan, ducks, gulls, and woodcock, and will be a valuable resource to area residents for years to come. We commend BASF Corp. for protecting and enhancing wildlife habitat in the Detroit River.
- With over 3300 acres in local, county and regional river-side parks and open space, urban recreation opportunities along the Michigan side of the Detroit River are numerous and diversified. Recreational opportunities range from passive activities such as hiking, biking, picnicking and fishing to boating and golf. However, access is limited in particular areas.
- With the Detroit and Windsor metropolitan centers at the head of the Detroit River, citizens of the area are treated to elaborate riverside festivals throughout the summer months. Sport fishing is a major recreational industry along the Detroit River contributing to the economy on both sides of the river.

- To restore and enhance habitat for fish and wildlife on Belle Isle, $375,000 were received by the City of Detroit from the MDNR Land Trust Fund. City funds totaling $245,000 were spent on this project in 1993. The project will replace water pumps, enhance aquatic habitat diversity, stock desirable fish, eliminate nutrient enrichment from the zoo, deepen the canals, and open part of the canal system to the Detroit River. The entire project will cost $1,222,000 and be done in three years. The components of the Management Program were developed in cooperation and supported by the MDNR, Recreation Division, Land and Water Management Division, Fisheries division, and the City of Detroit Recreation Department. Implementation of the complete Management Program will provide improved water quality, fishery resource, recreational opportunities and an aesthetic character deserving of such a unique and quality resource. For many of the eight million annual visitors, Belle Isle is the only opportunity to experience, explore, and learn about the natural environment of which they are a part.

Recommendations for Future Actions

Based on their review of a draft OMNR document entitled "Survey of Candidate Sites on the St. Clair and Detroit Rivers for Potential Habitat Rehabilitation and Enhancement" and professional judgement, the TWG selected 20 candidate sites for habitat restoration and enhancement. The TWG supported the Candidate Sites Report in concept, with the understanding that as remediation activities are initiated at a specific site, those activities would include detailed assessment for potential negative impacts (biological, engineering, hydrologic concerns etc., all need to be addressed on a site specific basis).

RECOMMENDATION 22: COMPLETE A CUMULATIVE IMPACT HYDROLOGIC STUDY FOR THE DETROIT RIVER.

This should not impede the implementation of habitat restoration projects which will not adversely impact the hydrology of the Detroit River system.

RECOMMENDATION 23: BEGIN REMEDIAL ACTIONS ON THE LIST OF 19 PROPOSED CANDIDATE SITES FOR HABITAT RESTORATION.

Ontario sites

- Peche Island Provincial Park,
- Windsor Waterfront,
- Ambassador Bridge,
- Black Oak Woods,
- Windsor Salt,
- Detroit River Wetland,
- Fighting Island,
- Grass Island,
- Turkey Island,
- Canard River Marshes,
- Canard River Access,
- Crystal Bay Island,
- Bois Blanc Island, and
- the Livingstone Channel Trainer.

Michigan sites

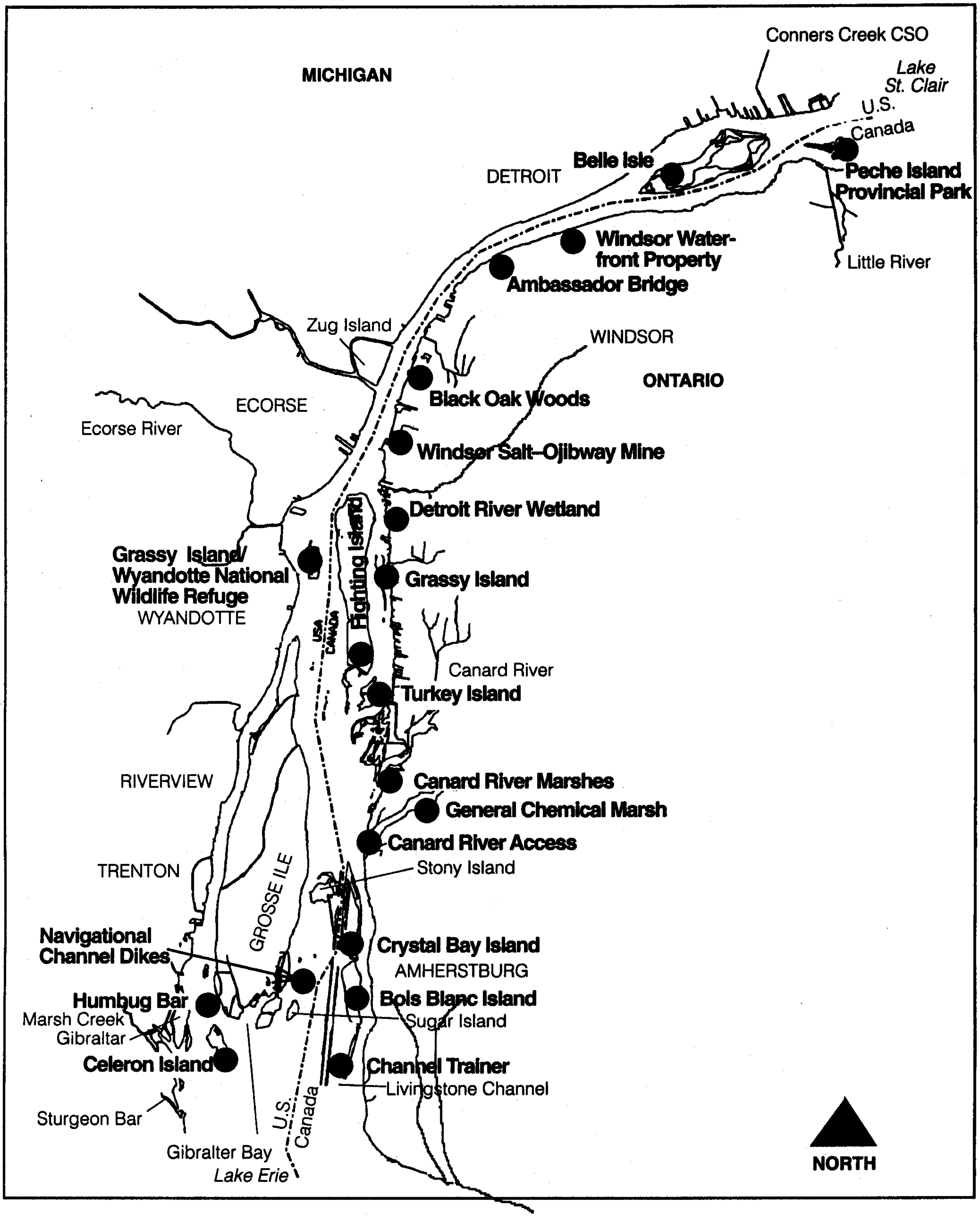
- Belle Isle,
- Celeron Island,
- Grassy Island in the Wyandotte National Wildlife Refuge
- Humbug Bar, and
- Navigation Channel Dikes.

A summary of each of the projects is included in appendix 7.1.

RECOMMENDATION 24: THE TWG RECOMMENDS THAT THE SHORELINES BE PROTECTED AND THAT PUBLIC ACCESS TO THE DETROIT RIVER BE INCREASED TO PROVIDE THE PUBLIC WITH MORE WILDLIFE-ORIENTED RECREATION AND ENVIRONMENTAL EDUCATION OPPORTUNITIES.

Specific opportunities for restoration and enhancement of shoreline include the previous 19 candidate sites as well as additional sites to be provided by the MDNR, OMNR and ERCA.

Figure 4
U.S. and Canadian Habitat Sites



Implementation 24:

Support for habitat restoration and enhancement in the Detroit River AOC exists within such diverse groups as Ducks Unlimited, ERCA, Environment Canada, DFO Canada, Friends of the Detroit River, Great Lakes United, Grosse Isle Conservation Club, Grosse Isle Nature & Land Conservancy, MDNR, MDEQ, Michigan United Conservation Clubs, NBS, OMNR, Public Sector Consultants, Southeast Michigan Council of Governments (SEMCOG), The Nature Conservancy, United Auto Workers, Conservation Division, COE, and the FWS. One local association, the Grosse Ile Nature and Land Conservancy, is excited about forming partnerships to assist in the management of habitat lands in the Detroit River and has contacted the Grosse Isle Power Squadron and the Detroit River Walleye Federation for assistance. Citizens' advisory groups that include members of local boating, conservation, fishing, hunting and public education organizations, and natural resource professionals are partners in the habitat and biological resource management activities across America. The TWG recommends that such advisory groups participate in the management of fish and wildlife habitat in the St. Clair-Detroit River ecosystem.

Recommendation 25: Develop specific "yardsticks" with which to judge the status of fish populations in the Detroit River.

At the July 14, 1995 meeting the TWG formulated a recommendation to develop specific "yardsticks" with which to judge the status of fish populations in the Detroit River. This was due to a non consensus opinion about the current status of the beneficial use. A sub group was formed and charged with developing these guidelines and reporting back to the TWG for further discussion of the matter.

Surveillance and Monitoring Plan

Specific monitoring programs necessary to support modeling efforts and evaluate the remedial options designed to restore the beneficial uses in the Detroit River ecosystem include biological, sediment, and water quality surveys, as well as habitat evaluation, mapping, and interpretation. Recommendations for monitoring relating to each of the four TWG focuses (Habitat, CSOs, Point Source/Nonpoint Source, and Contaminated Sediments) are detailed within the individual TWG Reports.

The Point Source/Nonpoint Source TWG recommended the formation of a Monitoring/Modeling Committee to coordinate these efforts for the entire RAP. This would increase consistency and efficiency while also eliminating redundancies. The Habitat TWG supports the formation of such a committee with the understanding that the TWG would be represented on the committee.

The U.S. EPA initiated in 1988 an Environmental Monitoring and Assessment Program (EMAP) to estimate the current status of ecological resources, monitor indicators of pollutant exposure and habitat condition, and to provide annual summaries and interpretive reports of the ecological status and trends to both managers and the public (EPA 1992). There is now an EMAP program designed specifically for the Great Lakes. Several resource classes (nearshore, offshore, island areas, harbors/embayments) have been identified for the lakes. The connecting channels have not been identified as a resource class, but the incorporation of connecting channels into the monitoring program is anticipated shortly. The Detroit River AOC would benefit from participation in such a comprehensive monitoring and assessment program.

There are numerous other programs in both the United States and Canada that focus on monitoring and assessment in the Great Lakes. Cooperative interaction between these agencies through the Detroit River RAP process would be beneficial to all parties.

The Habitat TWG developed a biomonitoring plan to evaluate the fate of biological contaminants in biota representing different trophic levels. The biomonitoring plan includes specific taxa, related beneficial use impairments, metrics to be obtained, criteria for measurement, and indicates the availability of baseline data. The Habitat Biomonitoring Plan, in table form follows this short description.

Table 11
Recommended habitat biomonitoring plan

Species	*Related impaired use*	*Metrics to be measured*	*Criteria for measurements*	*Previous data available*
1. Adult Aquatic Insects	Contaminant levels in sediments (degraded benthic communities)	*Hexagenia* and *Hydropsychidae* Adults; measure levels of metals and organic contaminants over time (suggested 2 to 5 year intervals)	Compared to reference stations as appropriate, and for trend analysis	Yes. Ciborowski and Corkum, 1988/Kovats and Ciborowski, 1989 and 1993
2. Benthic surveys				
Sediments	Contaminant levels in sediments (dredging restrictions and degraded benthic communities)	Levels of metals and organic contaminants at established study locations	Compared to most restrictive of U.S./Canadian criteria (including biologically-based criteria if available)	Yes. Referenced in RAP and 1991 MOEE study
Benthic populations	Contaminant levels in sediments (degraded benthic communities)	Species diversity; number of individuals per species; incidence of deformities in *Chironomidae* and *Chironomid*	Compared to reference stations as appropriate, and for trend analysis	Yes. Referenced in RAP and 1991 MOEE study, Trenton Channel Study, Hudson and Ciborowski, *et al*, 1992b
Sediment toxicity tests		*Hexagenia* and *Chironomid* growth and survival, contaminant levels of insects (in lab tests) and *Chironomid* abnormalities	EPA draft criteria, compared to reference sites or lab-formulated sediments	Yes. Referenced in RAP; Ciborowski, *et al*, 1992a; Corkum, *et al*, 1995; Hudson, 1994; Trenton Channel Study, Hudson and Ciborowski, 1995

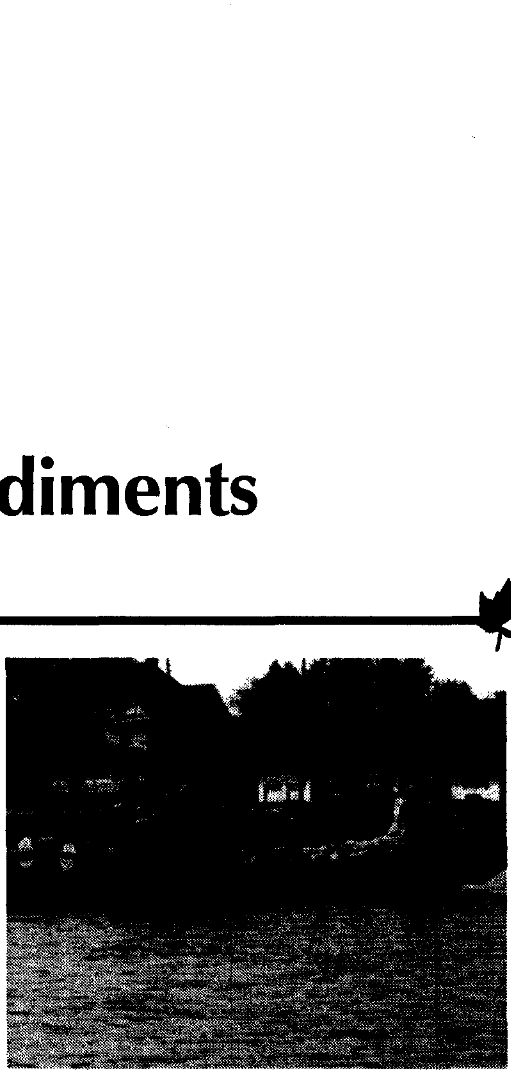
Species	Related impaired use	Metrics to be measured	Criteria for measurements	Previous data available
3. Fish stock assessment				
- Rock bass >25 cm - Walleye >45cm - Fresh-water drum>30cm - Carp (all sizes) - Yellow perch - White bass - Muskellunge - Largemouth bass, Small-mouth bass	Restrictions on fish consumption	Mercury, PCB, mirex, pesticides	Compared to most restrictive U.S./Canadian criteria	Yes. Referenced in RAP
- Carp, walleye	Fish consumption advisories	Concentration in whole fish	MDNR Trend program	Yes. 1990, 1992 and 1993
- Lake sturgeon	Degradation of fish populations	Presence of spawn adults on historical spawning grounds	Presence versus absence	No.
4. Wildlife - Mink - Eagles, Osprey - Otter	Degradation of wildlife populations	Presence in AOC	Presence versus absence; numbers of mating pairs	Yes, but in checkered form. Whole system approach is needed for comparability
- Snapping turtle - Muskrat - Mallard ducks	Degradation of wildlife populations	Tissue concentrations of organochlorine compounds and heavy metals	Compare to study results in scientific literature for animals from uncontaminated areas	Yes. MDNR Wildlife Contaminant Monitoring Program
5. Clams (*Elliptio complanata)*	Contaminants in water column (and in other studies, sediments and suspended solids)	Organic contaminants and metals in clams caged on and off shore in the Detroit River (Canadian side) at biweekly intervals throughout open water season—additional samples exposed throughout season	Four stations include reference station or control site upstream of Windsor. Site 2 at Ouelette Avenue, Site 3 at Ambassador Bridge, Site 4 at Fighting Island. Also trend analysis and comparison with previous	Yes. Puglsey et *al*, 1985; Kauss and Hamdy, 1985; Russell and Gobas, 1989

Species	*Related impaired use*	*Metrics to be measured*	*Criteria for measurements*	*Previous data available*
6. Wetland habitat flora and fauna	Overall wetland habitat impairment (degraded wetland habitat quality/ quantity)	Attributes of four principal components: biological, social, hydrological and special features studies	Numerical values (points assigned to components of evaluation system resulting in a wetland "class")	Yes. 1984-86 OMNR Wetland Evaluations; NBS evaluation; L&WMD Presettlement Survey
7. Migratory Bird Flyover Surveys	Loss of fish and wildlife habitat	Population estimates of migratory birds' (particularly diving ducks) use of the system during migrations. Will take a whole system approach (e.g. Lake St. Clair and Ontario side) rather than piecemeal as in the past. Numbers of individuals per species	Compared to previous population estimates and within the rest of the system in any given year	Yes, but in checkered form. Whole system approach is needed for comparability.
8. Fish Toxicity Analysis	Contaminant levels in the sediment and water column	Bottom dwellers (suckers) and other species (walleye, perch): Measure MFO induction and reproductive steriod levels	Compared to reference stations	Some. DFO studies in Trenton Channel
	Loss of fish habitat	Measure other parameters for overall health (weight, length, LSI, GSI, etc.)	Compare to reference stations as appropriate and for trend analysis	Some information available in MDNR Fisheries Reports
9. Macrophytes (*Vallisneria american*)	*(Macrophytes are related to several impaired uses)*			
	Degradation of fish and wildlife populations Degradation of benthos Restrictions on dredging Eutrophication Degradation of aesthetics Loss of fish and wildlife habitat	Concentration of metals and organochlorines in plant tissues Relative survival, growth and reproduction of cloned plants at different sites Genetic diversity of plants in beds of *V. americana* Ratio of leaf surface area to root surface area	Comparison to reference sites in Great Lakes basin Comparison to levels in other biota, sediment and water column Plant growth measures have been standardized under lab conditions	Yes. L. Lovett *et al*, 1993; J. Lovett *et al* in review. Yes. Biemacki *et al*, 1993. Yes. Schlosser and Manny, 1986; Lovett and Laporte.

Contaminated Sediments TWG Report

Stage 2 of the RAP has documented the contamination of the Detroit River sediments by both historical, now inactive, industrial sources and by active sources. Next we must we must identify the specific causes of the various hotspots. Then, we can plan for the control of the active contributing sources and evaluate the best method for a cost effective remediation of the problem after determining that ongoing sources will not recreate the contamination.

Dr. Ralph Kummler,
Director, Hazardous Waste Management Programs, Wayne State University



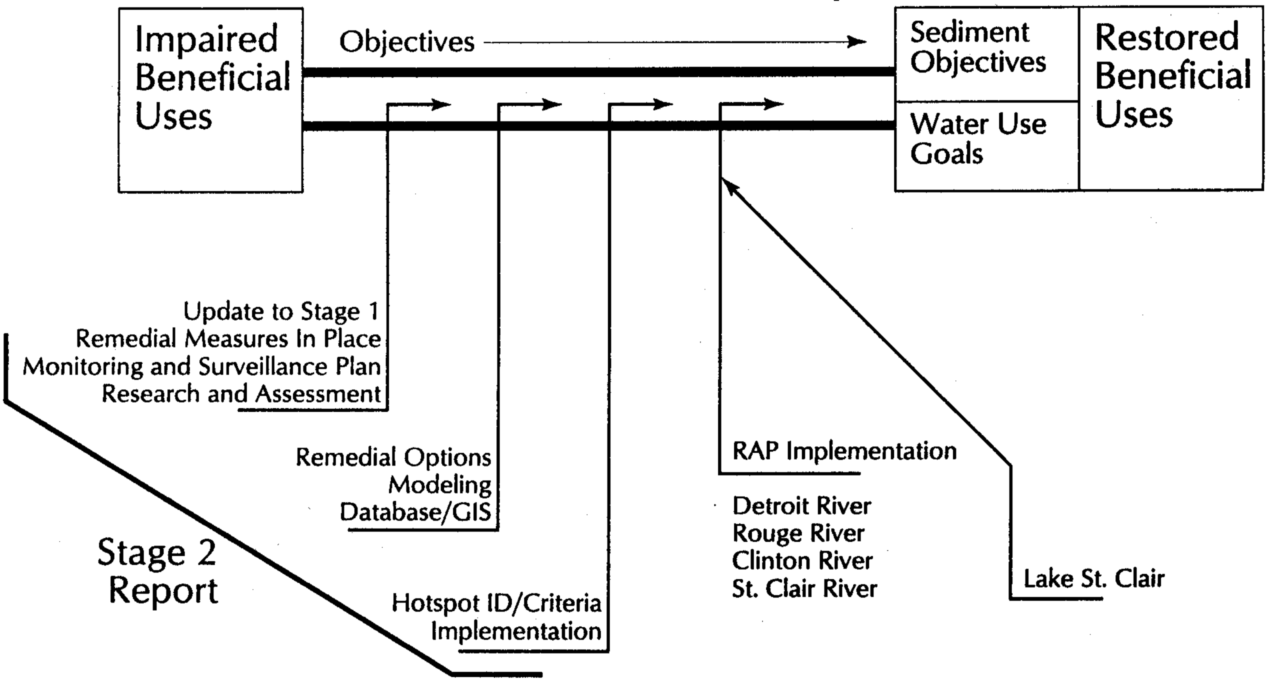
The issue of contaminated sediments is broad in scope and effects or is affected by many interrelated segments of our ecosystem. The concern centered on contaminated sediments in the Detroit River is well founded, as several impaired beneficial uses are attributed directly to the sediments and the pollutants that are harbored therein. A technical workgroup was created to address contaminated sediments issues within the Detroit River Area of Concern (AOC) and devise a strategy for their remediation.

In developing this report, the efforts of the Contaminated Sediments Technical Workgroup were guided by the milestones initially established for the Biennial Update process. Within the limited timeframe, the workgroup has reported progress towards achieving each milestone. Several tasks associated with particular milestones were intentionally omitted, as the workgroup had no authority to initiate what appropriately would have been an agency (MDEQ/MOEE) action. The workgroup has gone as far as recommending specific actions to be implemented by the agencies sponsoring the Remedial Action Plan.

The field of assessing and remediating contaminated sediments is evolving at rapid pace. Detroit River Sediments themselves pose specific challenges that hinder the technical workgroup from endorsing any individual remedial technologies. The workgroup has identified and reference the available technologies developed to date.

This report does not contain the entirety of remedial measures that are necessary for the complete restoration of the impaired beneficial uses identified with contaminated sediments in the Detroit River. The workgroup has identified various sediment parameter objectives, which when met, would restore the beneficial uses impaired by contaminated sediments and further the AOC towards delisting. To meet these objectives, implementation of the Detroit River Remedial Action Plan (RAP), along with the St. Clair River, Clinton, and Rouge River, are critical. The following pages are a first step in addressing prominent areas where the sediments are grossly polluted, and laying the foundation for further research, investigation and remediation.

Figure 5
Overview of the Detroit RIver RAP Contaminated Sediments Report



Goals/Objectives/Rationale

The Contaminated Sediments Technical Workgroup addressed two specific impaired beneficial uses – Degradation of Benthos and Restriction on Dredging. Objectives for impairments were developed to meet the Water Use Goals.

These goals and objectives, along with the corresponding rationale, are presented in this section.

Impairment: Degradation of Benthos

Goal

Establish and maintain benthic communities such that populations are diverse and appropriate for the physical characteristics of the area, and include pollution intolerant organisms.

Objective

Detroit River sediments should have balanced benthic macroinvertebrate communities as determined using appropriate scientific analysis (such as a multivariate analysis relating the benthic macroinvertebrate data to various physical and chemical data) and interpretation of species and abundance (MOEE, Environmental Assessment of Detroit River Sediments and Benthic Communities, 1991).

Rationale

The use of measurable numbers (i.e. Ephemeroptera less than 300 organisms per square meter) were discouraged by the Contaminated Sediment Technical Workgroup. The reason being that any given density of organisms is too highly dependent on the natural physical conditions present. More information can be gained from examining the entire range of organisms found at a site, applying the appropriate statistical analysis and relating the benthic macroinvertebrate data to the various physical and chemical (sediment) data.

Similarly, the Contaminated Sediment Workgroup also decided not to create a rigid list of appropriate pollution intolerant organisms which should be present at a given site. Once again, the community is too dependent on the natural physical conditions present. In addition, a unanimous agreement could not be reached between aquatic ecologists on what organisms best represented pollution intolerant organisms, or on what they were to be intolerant of. For example, a particular organism may be intolerant to elevated levels of metals while another may be intolerant only of organic enrichment.

Clearly, the task of interpreting the macroinvertebrate data is complex and not easily itemized into fixed rules based on numerical guidelines. The wording in the specific objective allows for the future evolution of statistical analyses as well as changes in our understanding of benthic macroinvertebrates.

Impairment: Restriction on Dredging

Goal

Concentrations of pollutants in sediments shall be below levels that restrict dredging activities.

Objective

Sediment contaminant levels of all parameters shall be below the most restrictive value (basinwide/ jurisdictional) likely to be protective of sediment dwelling organisms, cognizant of historical background conditions (pre-ambrosia, pre-colonial).

Rationale

The rationale for establishing quantitative objectives is inherent to the impairments in that they must be the most restrictive values and biologically based because they must protect benthic organisms. Additionally, the objectives must be feasible and achievable relative to the natural condition of the Detroit river environment. The workgroup recognizes that the quantitative objectives potentially have a wide number of uses and applications in the Detroit River system.

The two primary sources for quantitative Detroit River sediment quality objectives were sediment guidelines from the MOEE and the USEPA. These guidelines were compared and the Detroit River objectives were based on the evaluation of several criteria:

1. the guidelines must be biologically based,
2. the guidelines were the most restrictive, and
3. the guidelines must be feasible and achievable.

These points were evaluated in a sequential manner and objectives established; however, in some cases, objectives are proposed which could not meet these requirements or could not be stringently evaluated. In these cases, long-held sediment quality guidelines have been adopted.

The workgroup recommends conditional acceptance of the sediment objectives described below. Conditional acceptance reflects the potential for re-examination and revision of the objectives as new information becomes available. When Detroit River sediments are found to contain one or more contaminants which exhibit concentrations equal to or greater than the objectives, sediments from that site exceed Detroit River Sediments Quality Objectives.

Recommendations

Recommendations for conditional acceptance of Detroit River Sediment Objectives are as follows:

A. Organic Contaminants: Polychlorinated Biphenyls, Organochlorine Pesticides, and Polycyclic Aromatic Hydrocarbons as stated by the MOEE Lowest Effect Level (LEL) or when specified, No Effect Level (NOEL).
B. Heavy Metals/Trace Elements: Chromium, Copper, Lead, and Mercury as stated by the MOEE, LEL.
C. Heavy Metals/Trace Elements: Barium, Cyanide, and Zinc as stated by the USEPA/FWPCA.
D. Heavy Metals/Trace Elements: Cobalt and Silver as stated by the MOEE (carried over from Open Water Disposal Guidelines).
E. Conventional Parameters: Total Organic Carbon, Total Kjeldahl Nitrogen and Total Phosphorus as stated by the MOEE.
F. Other Parameters: Ammonia, Chemical Oxygen Demand, Oil and Grease, and Volatile Solids as stated by the USEPA/FWPCA.

The Workgroup assessed the available sediment data pertaining to background conditions potentially applicable to the Detroit River. This is presented in Table 12. In the development of Detroit River Sediment Objectives, background conditions were taken into account to ensure that the objectives were attainable and not below background conditions. The pretense for establishing Detroit River Sediment Objectives is outlined in the section entitled "Summary of General Considerations for Establishing Quatitative Sediment Objectives for the Detroit River".

Table 12
Comparison of Background Conditions in the Huron-Erie Corridor Using Sediment Cores and Bluff Concentrations

	Lake Huron[1]	Lake Huron[2]	Lake Huron[3]	Lake St. Clair[4] Range	Sand	Slt/Cl	Detroit River[5]	Lake Erie[6]	Lake Erie[7]	Lake Erie[8]	Lake Erie[9]
As			4.2	8.4+					6.1		
Ba		145.7									
Cd	1	1.6	1.2	0.78-2.5	1.3	1.4	0.18	2.0	1.3	1	1.1
Cr		52.7	21	11-23	16	19.1	21.8				79
Co							4.6				
Cu	38	29.5	18	5.1-11.8	7	9.5	10.2	30	15	29	29
Fe		2.5%							22102		38200
Pb	39	27.1	18	0-13.1	8.4	10.6	11.9(BLD)	28	17	28	28
Mn		.036%						600	697		929
Hg	0.15		0.023	0.017+				0.1	0.02	0.078	0.08
Ni		34.9	15	8.5-21.1	13.6	17.6	14.6		18		68
Zn	94	62.9	29	29.4-55.4	36.5	45.2	40.6	70	46	98	98
TP			436					655	700		917

Concentrations are shown in ppm, unless otherwise indicated. Blank intervals = no data available.

Legend

1. Kemp and Thomas, 1976. Pre-colonial/Ambrosia horizon. Three cores from Lake Huron (whole lake).
2. Robbins, 1980. Stable zone (20-50cm). 27 cores from southern basins of Lake Huron.
3. Thomas and Haras, 1978. Average bluff concentrations for Lake Huron.
4. Rossmann, 1988. Stable zone. Twelve cores from Lake St. Clair (whole lake). +One core, unpublished data.
5. USEPA/LLRS, 1987. Lowermost interval. One core from Detroit River. Unpublished data.
6. Kemp and Thomas, 1976. Pre-colonial/Ambrosia horizon. Western basin of Lake Erie.
7. Thomas and Haras, 1978. Average bluff concentrations for Lake Erie.
8. Kemp and Thomas, 1976. Pre-colonial/Ambrosia horizon. Six cores from Lake Erie (whole lake).
9. Mudroch and Sandilands, 1979. Pre-colonial/Ambrosia horizon. Cores from Lake Erie (whole lake).

Table 13
Sediment Quality Objectives

Note: This table can be adjusted as new information becomes available. These objectives are biologically based, unless noted (*). Sediment objectives were not chosen for those parameters where existing background data was limited or exceeded the biologically based value. This was noted by ***.

All units = ppm dry weight, unless noted (%).

	USEPA1	Guidelines MOEE2	MOEE3	Sediment Quality Objective	Backgrounds Lake St. Clair	Backgrounds Detroit River	Detroit River Sediment Range RAP Stage 1	
ORGANIC								ORGANIC
Volatile Solids	5%		6%	5%				Volatile Solids
Solvent Extractables (Oil and Grease)	<1000	1500		1000			20-47226	Solvent Extractables (Oil and Grease)
PCB (total)	1	0.01		0.01			<0.001 - 40	PCB (total)
Aldrin		0.002		0.002				Aldrin
BHC		0.003		0.003				BHC
a-BHC		0.006		0.006				a-BHC
b-BHC		0.005		0.005				b-BHC
g-BHC		0.0002		0.0002				g-BHC
Chlordane		0.005		0.005				Chlordane
DDT (total)		0.007		0.007				DDT (total)
op+pp-DDT		0.008		0.008				op+pp-DDT
pp-DDD		0.008		0.008				pp-DDD
pp-DDE		0.005		0.005				pp-DDE
Dieldrin		0.0006		0.0006				Dieldrin
Endrin		0.0005		0.0005				Endrin
HCB		0.01		0.01				HCB
Heptachlor		0.0003		0.0003				Heptachlor
H-epoxide		0.005		0.005				H-epoxide
Mirex		0.007		0.007				Mirex
PAH (total)		4		4				PAH (total)
PAH (Individual)								PAH (Individual)
Anthracene		0.22		0.22				Anthracene
Benz[a]anthracene		0.32		0.32				Benz[a]anthracene
Benzo[k]fluoranthene		0.24		0.24				Benzo[k]fluoranthene
Benzo[a]pyrene		0.37		0.37				Benzo[a]pyrene
Benzo[g,h,i]perylene		0.17		0.17				Benzo[g,h,i]perylene
Chrysene		0.34		0.34				Chrysene
Dibenzo[a,h]anthracene		0.06		0.06				Dibenzo[a,h]anthracene
Fluoranthene		0.75		0.75				Fluoranthene
Fluorene		0.19		0.19				Fluorene
Indeno[1,2,3-cd]pyrene		0.20		0.20				Indeno[1,2,3-cd]pyrene
Phenanthrene		0.56		0.56				Phenanthrene
Pyrene		0.49		0.49				Pyrene
METAL								METAL
Cadmium	<6	0.6		***	0.78-2.5	0.18	<0.1 - 41	Cadmium
Lead	<40	31		31	0.0-13.1	11.9	<1.0 - 810	Lead
Zinc	<90	120		90	29.4-55.4	40.6	6-53000	Zinc
Mercury	<1	0.2		0.2	0.017		<0.01-55.8	Mercury
Copper	<25	16		16	5.1-11.8	4.6	0.5-280	Copper
Nickel	<20	16		***	8.5-21.1		3-300	Nickel
Cobalt			50	50 *		10.2		Cobalt
Iron	<17000	20000		***			2600-180000	Iron
Chromium	<25	26		25	11-23	21.8	4-680	Chromium
Manganese	<300	460		***			71-2800	Manganese
Arsenic	<3	6		***	8.4		0.86-36	Arsenic
Silver			0.5	0.5 *				Silver
Barium	20			20 *				Barium
CONVENTIONAL								CONVENTIONAL
COD	<40000		5%	40000				COD
Phosphorus	<420	600		420				Phosphorus
Ammonia	<75	100		75				Ammonia
Cyanide	<0.1	0.1		0.1 *				Cyanide
TKN	<1000	550		550				TKN

1. USEPA: USEPA Region V Guidelines for the classification of Great Lakes harbor sediments (1977)
2. MOEE: Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (1992)
3. MOEE: Open Water Disposal Guidelines (1978)
4. USEPA: Rossmann, 1988 (As, Hg values unpublished). Lake St. Clair - Stable zone 12 Cores - Basin
5. USEPA/LLRL (unpublished) Detroit River - 1 core

Summary of General Considerations for Establishing Quantitative Sediment Objectives for the Detroit River

- Quantitative sediment objectives are of interest to several impairment topic areas for the Detroit River and may be used for protection of bottom dwelling organisms, as restrictions for dredging and disposal practices, and as target concentrations for mitigative and remedial actions;
- There are two primary sources of sediment quality guidelines for the Great Lakes and for the purposes of Detroit River objectives, the developmental history of both required examination;
- Development of MOEE guidelines are biologically-based and have been derived using state-of-the-art methods;
- There does not appear to be sufficient evidence that the parameters (5) carried over by the MOEE from the Open Water Disposal Guidelines are biologically based;
- There appears to be sufficient evidence that the 1968 FWPCA guidelines are biologically based and five parameters (five of ten) were retained, as stated, in the 1977 USEPA guidelines;
- There does not appear to be sufficient evidence that the 1977 USEPA guidelines, in part, should be considered biologically based;
- Additional anthropogenic substances and contaminants which were not initially examined by the workgroup have been identified and included in the objectives;
- Of the several hundred contaminants reported in the Great Lakes system, many have not been considered due to their omission in the 2 sources of guidelines and a lack of information regarding background conditions;
- Background conditions should be equal to or lower than conditionally accepted sediment quality objectives for Detroit River sediment to demonstrate achievable and feasibility of the guidelines;
- Background conditions need not necessarily be achieved for the protection of bottom dwelling organisms in the Detroit River;
- The paleolimnological approach for determining pre-European settlement background conditions (with associated caveats) should be the primary approach for determining background concentrations for heavy metals;
- The reference approach and the inference that organic contaminants should be below the limit of detection should be used for determining background conditions for organic contaminants;
- The conditionally accepted objectives for organic contaminants for Detroit River sediment quality are greater than background conditions determined using a reference approach and the theoretical approach that background conditions approach zero;
- Regional, pre-settlement averages of the Huron-Erie corridor should not be calculated due to differences in regional glacial history and geochemistry;
- Lake St. Clair and Detroit River background concentrations for heavy metals are the most appropriate for comparison of background and objective concentrations for the Detroit River, although concentrations from the Huron-Erie corridor should be generally examined.
- The conditionally accepted guidelines for heavy metal for Detroit River sediment quality are greater than background conditions.
- Sediment quality objectives for the Detroit river could not be established for Arsenic, Cadmium, Nickel, Iron and Manganese when compared to background conditions, or due to a lack of information.
- Sediment quality objectives for the Detroit River have been established from the MOEE and USEPA guidelines and their respective precursors, which are biologically based, the most stringent, and are achievable when background levels are considered.
- Sediment contaminant guidelines (MOEE and USEPA) for Cobalt, Silver, Barium, COD and Cyanide have been recommended as Detroit River Sediment Objectives which are not biologically based (biological criteria unavailable).

Contaminated Sediments Site Prioritization and Agency Activities

The Contaminated Sediments Workgroup has summarized the most recent sediment information pertinent to the Detroit River and updated the reference list of studies since the Stage 1 Report. This is presented in the update portion of the RAP document. Utilizing data from the latest system-wide survey, the workgroup also developed criteria to prioritize sites and choose hotspots.

Hotspot Identification and Prioritization

In order to identify those areas within the Detroit River which for one reason or another are deemed hotspots, a review of the most recent data was required. The source of information used by the Contaminated Sediments Technical Workgroup in determining sites was the report "Environmental Assessment of Detroit River Sediments and Benthic Macroinvertebrate Communities - 1991", MOEE-Beak, 1993.

The 1991 study results provided valuable information. In particular, the following results were relied upon:

1. Summary of the level of benthic macroinvertebrate community impact: Severely impacted, moderately impacted or slightly impacted.
2. Summary of the level of sediment contamination: Severely contaminated, moderately contaminated or slightly contaminated.
3. Sediment bioassay results using fathead minnow fry, *Chironomus tentans* and *Hexagenia limbata*.

Based on a review of this data, the Technical Workgroup developed a set of criteria in order to prioritize the most impacted sites. The following criteria was used:

Priority 1 Sites

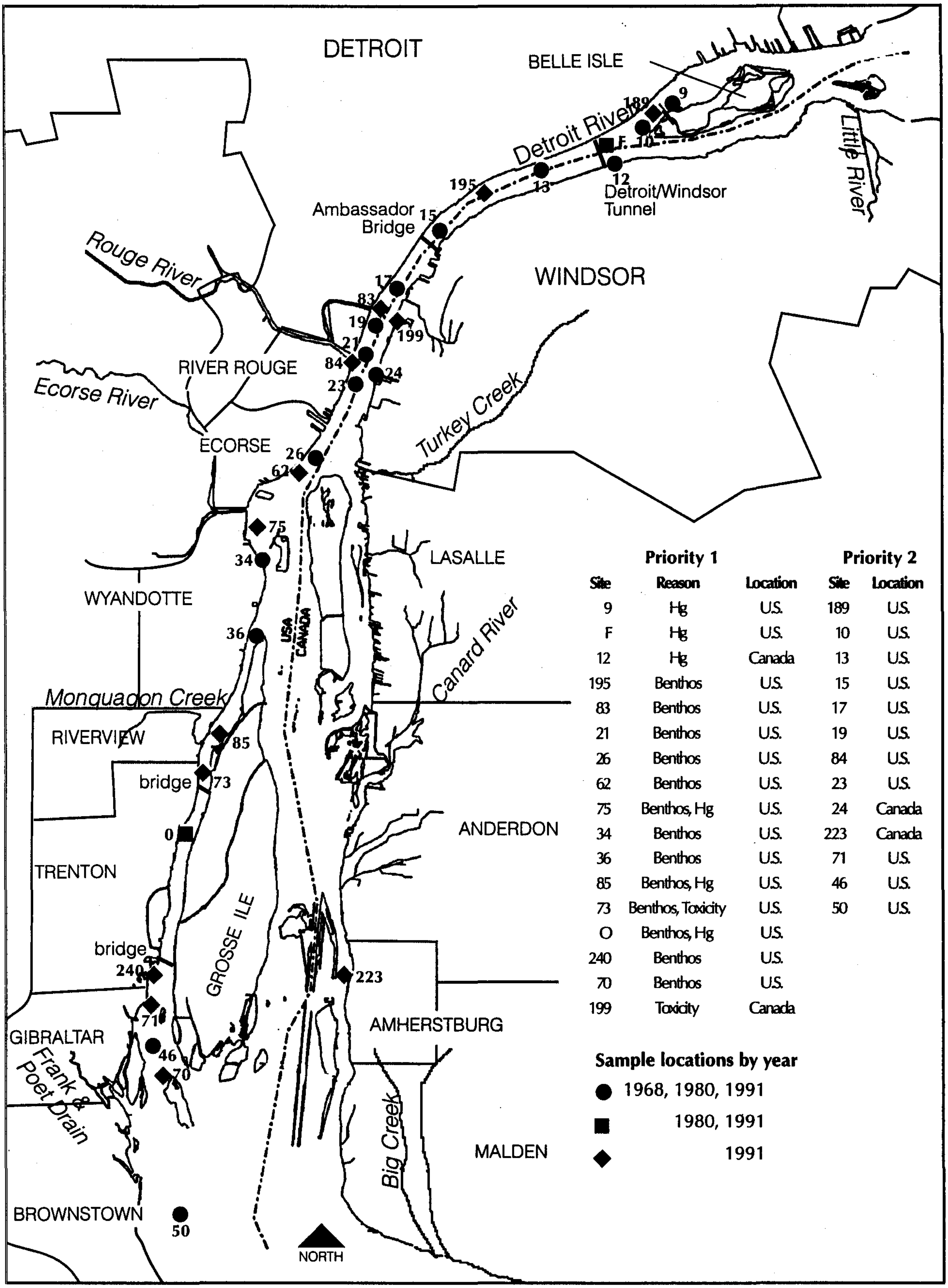
a. sites which were identified as having severely impacted benthic macroinvertebrate communities and/or
b. sites which were identified as having sediment toxicity results of greater than 80% toxicity for one or more test species and/or
c. sites with sediments containing elevated levels (above the severe effect level) of any parameter identified by the fish consumption advisories (mercury and PCBs)

Priority 2 Sites

a. sites with sediment chemistry parameters other than mercury and PCBs in excess of the severe effect level.

Applying this criteria to the 1991 Detroit River data generated the following Priority 1 and Priority 2 sites (see following map).

Figure 6
Detroit River Priority 1 and 2 Hotspots.



Priority 1			Priority 2	
Site	Reason	Location	Site	Location
9	Hg	U.S.	189	U.S.
F	Hg	U.S.	10	U.S.
12	Hg	Canada	13	U.S.
195	Benthos	U.S.	15	U.S.
83	Benthos	U.S.	17	U.S.
21	Benthos	U.S.	19	U.S.
26	Benthos	U.S.	84	U.S.
62	Benthos	U.S.	23	U.S.
75	Benthos, Hg	U.S.	24	Canada
34	Benthos	U.S.	223	Canada
36	Benthos	U.S.	71	U.S.
85	Benthos, Hg	U.S.	46	U.S.
73	Benthos, Toxicity	U.S.	50	U.S.
O	Benthos, Hg	U.S.		
240	Benthos	U.S.		
70	Benthos	U.S.		
199	Toxicity	Canada		

Sample locations by year

● 1968, 1980, 1991
■ 1980, 1991
◆ 1991

Agency Updates of Sediment Related Activities

MDNR Activities

The Michigan Department of Environmental Quality – in conjunction with USEPA Region 5, USEPA GLNPO and USEPA LLRS – has initiated several sediment activities in the Trenton Channel of the Detroit River. These activities are collectively known as the Trenton Channel Project. The Trenton Channel was identified in the UGLCC Study and the Stage 1 RAP as the most polluted segment of the AOC in terms of degraded sediment. This was supported by the 1991 BEAK-MOEE Sediment and Benthic Assessment.

The goal of the Trenton Channel Project is to develop a process which will facilitate the assessment and remediation of contaminated sediments in large river systems. Once successful in the Trenton Channel, key components of the study can then be applied to rest of the AOC.

The Trenton Channel Project is concentrating efforts in two primary areas:

1. Developing a specific contaminant fate and transport mass balance model for the Trenton Channel (PCB and mercury); and,
2. Delineating the scope of currently known hotspot contamination (type of contaminant, volume and sources) and assessing contamination in previously unsampled areas.

Research begun in 1993 and continuing in 1994 and 1995 has included many studies that directly support the mass balance modeling effort and/or sediment hotspot assessment. These include:

1. Resuspension potential measurements made by the University of California-Santa Barbara in key depositional zones. This research sheds light on the erosion rates of sediments in Trenton Channel hotspots.
2. Sediment assessment using surfical and core sampling methods done by MDNR and USEPA. Sediment chemistry has included organics, metals, AVS/SEM, and searches for distinctive trace compounds.
3. Hydroacoustic profiling of sediments by Caulfield Engineering of British Columbia. This innovative technology has shown great promise as an assessment tool in delineating layers of contaminated sediment.
4. Ecosystem response of dredging in the nearshore area of the Trenton Channel studied by Michigan State University. Baseline benthic structure, sediment toxicity and sediment chemistry were performed in a recently dredged marina (Elizabeth Park Marina). Yearly follow up will shed light on the quality of sediments being deposited in the Trenton Channel and benthic community recolonization.
5. Low level contaminant loadings will be accessed in a joint effort by Michigan State University, USEPA-LLRS and MDNR. This project will encompass seasonal and flow variations in PCBs, Hg, Zn, and Pb contaminants in particulate and dissolved fractions. It will also look for sources of these contaminants using conventional and innovative techniques.

Proposed projects call for sediment assessment in areas upstream of current hotspots, development of the mass balance model components, and evaluating remedial technologies applicable to Trenton Channel sediments. Through the cooperation of state and federal agencies, the Trenton Channel Project will generate a greater understanding of contaminated sediment dynamics in the Detroit River.

MOEE Activities

Sampling Update

The Ontario Ministry of the Environment and Energy (MOEE) carried out further sediment quality investigations on the Detroit River during the summer of 1994. The following is a brief description of the areas sampled:

1. In partnership with the City of Windsor and the University of Windsor, the Ministry collected sediment samples from 18 sites located along the City of Windsor's waterfront area. Historical data (1991) indicated elevated levels of heavy metals (greater than SEL) at two sites within this

sampling area (stations 12 and 24; 1991 sites). Samples were split and are currently being analyzed by the City of Windsor and the University of Windsor.

2. The Ministry collected sediment samples from six sites in the vicinity of Allied Chemical where historical data revealed elevated levels of copper. These samples are currently being analyzed for heavy metals by the Ministry.
3. Sediment samples were collected from the immediate vicinity of two tributaries to the Detroit River; the Canard River and Turkey Creek. These sites were sampled in response to comments received by the BPAC that the 1991 study failed to assess the areas immediately adjacent to the tributaries. Samples are presently being analyzed for heavy metals by the Ministry.

USEPA Activities

Sediment Activities Underway at the Region 5 Water Division

Region 5 has been working on contaminated sediment issues for over a decade, but these activities rapidly accelerated in 1990 with the creation of the Region 5 Sediment Initiative. To better pursue regional concerns about risks associated with contaminated sediments, the Water Division expanded the role of its In Place Pollutant Task Force (IPPTF) with the addition of members collectively representing Clean Water Act, RCRA, CERCLA, TSCA and other authorities. As this was done, Region 5 also recognized the need to broaden our base to include external communications/coordination with designated sediment contacts within other federal (i.e. Corps and USFWS) and state agencies. Building on these relationships we've now been able to significantly improve regional and agency-wide sediment assessment, prioritization and remediation efforts.

A Description of the IPPTF

Primarily the IPPTF provides technical consultation and project management at the request of divisional programs and other federal and state agencies.

IPPTF's emphasis is primarily on:

- Region 5 Sediment Initiative
- Single & Multi-Media Sediment Remediation Actions
- Geographic Initiatives
- Forum Reviews on Rules, Regulations, Risk, Criteria, Data, Impacts, and QA/QC
- Forum Review of National Sediment Strategy, Sediment Criteria, and ARCs
- Support for Corps Navigational Project Reviews
- Special Projects
- General Technical Consultation

Members and Participants number around 40 with personnel from Water, Planning & Assessment Branch, Waste (RCRA & CERCLA), ESD (Monitoring, QA/QC, and TSCA), Counsel, GLNPO, and Air. The group also receives participation by one or more sediment staff from each of the six states within Region 5.

Current IPPTF sediment activities supporting the Region 5 Sediment Initiative and beyond (with many parallel at the National level) are:

- National/Regional Contaminated Sediment Sites Inventory
- National Sediment Criteria
- Prioritization System for Contaminated Sediment Sites
- USEPA and USEPA/States Remediation of Sediment
- Joint USEPA/Army Corps of Engineers Sediment Enforcement/Remediation
- Guidance Document for Disposal of Contaminated Sediment
- Sediment Contamination Prevention/Remediation Pilot Projects
- CWA Section 404 National/Great Lakes Test Guidance Document for Dredged Materials

- Sediment Quality-Based Permits
- Opportunities For Remediating Contaminated Sediments Through Natural Resource Damage Assessment Process
- Calculating Biota-to-Sediment Accumulation Factors
- Sediment-Based Risk Assessments/Cleanup Goals
- Statistically-Based Sediment Sampling Guidance
- Model Sediment Sampling Quality Assurance Project Plan

A Description of the Sediment Management Team

To further advance the sediment efforts of the Water Division, IPPTF, and the Region 5 Sediment Initiative, a small team of technically diverse staff was formed. Under management by the Senior Technical Advisor to the Director of the Water Division, this Sediment Management team delivers technical advisory services for IPPTF activities and beyond; basically, those requiring management of the regional sediment program. To date, the team operates out of the Water Division's front office as it provides cross-divisional, cross-regional and statewide technical support.

Aside from supporting IPPTF projects listed above, other activities of the Sediment Management team include:

- Support to Regional RAPs and LaMPs projects
- Support of CWA Enforcement Cases Involving Sediment Remediation
- Support of Sediment Issues at Superfund NPL and SACM Sites
- Support to RCRA and TSCA Sediment Issues
- Development/Implementation of a Regional Sediment Enforcement Training Program
- Support to GLNPO's Assessment and Remediation of Contaminated Sediments (ARCs) Program

USEPA Region 5 Interim Contaminated Sediment Site Prioritization

In order to help evaluate the nature and extent of contaminated sediments, the United States Environmental Protection Agency (USEPA) Region 5 has undertaken the development of an Inventory of Contaminated Sediment Sites (the Inventory), with some financial support from Headquarters and Coastal Environmental Management funds. The primary goal of the Inventory is to consolidate into one repository sediment-related information that has been collected by numerous federal, state and local agencies for sites within the Great Lakes region. This information will be used for a variety of purposes including:

- to help determine the magnitude and distribution of sediment contamination in the Region (including the Great Lakes Basins);
- to identify problem areas and sites which need more assessment;
- to aid in prioritizing sites where prevention, remediation, and enforcement actions are needed;
- to supplement other priority setting efforts of USEPA and the States, among them the identification of the Great Lakes Areas of Concern; and
- to serve as a framework for USEPA's National Sediment Inventory.

The Region 5 Inventory thus far includes summary information for over 500 sites within the States of Minnesota and Wisconsin, and the basins of Lakes Superior, Michigan, as well as Southeast Michigan waterways and portions of the Ohio and Mississippi Rivers. The Inventory does not include all available data points for a given site, but presents a summary (e.g., minimum, maximum and median values) of sediment chemistry, sediment bioassay and fish tissue information. In addition, other site summary and characterization information (e.g., latitude and longitude, receiving waters, fish advisories issued, known impacts, etc.) is provided in the Inventory.

In order to prioritize sites within the Inventory for future assessment and remediation actions the Region 5 Water Division formed a Sediment Prioritization Workgroup (workgroup) under the direction of the Chairman of the In Place Pollutant Task Force, to formulate a process by which to evaluate sites. The primary charge to this group was to develop a process to identify a list of sites from the Inventory which were contaminated, but were receiving little or no attention.

The Prioritization Workgroup developed a two-tiered scheme. The first tier only uses information in the Region 5 Inventory and is primarily intended to substantially narrow down the number of sites to be investigated further in the second tier. In the second tier, other information (e.g., formal site-specific reports) is used to evaluate the sites in addition to what is contained in the Inventory. The workgroup's approach considered parameters included in other prioritization processes such as Superfund's Hazard Ranking System and the International Joint Commission's fourteen beneficial use impairment criteria for designating Great Lakes Areas of Concern. Interim products from the first and second tiers were reviewed by the Region 5 States and the USEPA Region 5 In Place Pollutant Task Force.

The Prioritization System described was essentially an internal effort to help focus additional attention where needed for sediment sites throughout Region 5, as well as provide a starting format for States/RAPs and other groups trying to prioritize contaminated sediment sites. This system was presented to the Detroit River RAP Sediment Workgroup and was part of the numerous sources drawn upon in developing the Stage 2 Detroit River RAP Sediment Quality Objectives (SQOs). Results of the Region 5 Prioritization system where omitted from this document because they are extraneous to the well-developed, site-specific recommendations made by the RAP's Contaminated Sediment Workgroup.

Information Needs

The Contaminated Sediments Workgroup identified Modeling and a Contaminated Sediments Database as tools needed to process information and make decisions. The need to model contaminant fate and transport within the Detroit River AOC was established. A search was conducted to identify existing models that were applicable to the needs for Stage 2. Two models, Wayne State's Atmospheric and Sediment Deposition Model (ASDM), and MOEE's KETOX Model were chosen to be pursued by the workgroup, [Table 14 (from Lin, 1994)].

The **ASDM Model** is an unsteady-state model capable of predicting the fate of contaminants in many compartments including the water column, sediments, and biota. Being of an unsteady-state, it has the dimension of time and can answer how long it will take a parameter to reach a certain level in the sediments under a given loading condition. Wayne State University, along with the MDEQ is looking at ways to fund the ASDM model for use as a planning tool in the remediation of sediments in the Detroit River.

The **KETOX Model** can predict the fate of contaminants in the water and sediment. It is a steady-state model with funding provided by MOEE. The Contaminated Sediments Workgroup chose to model the 6 parameters of concern used by the PS/NPS and CSO TWGs with the MOEE Ketox Model.

Modeling the Water Column Sediment and Biota Concentrationsof the Detroit River with ASDM

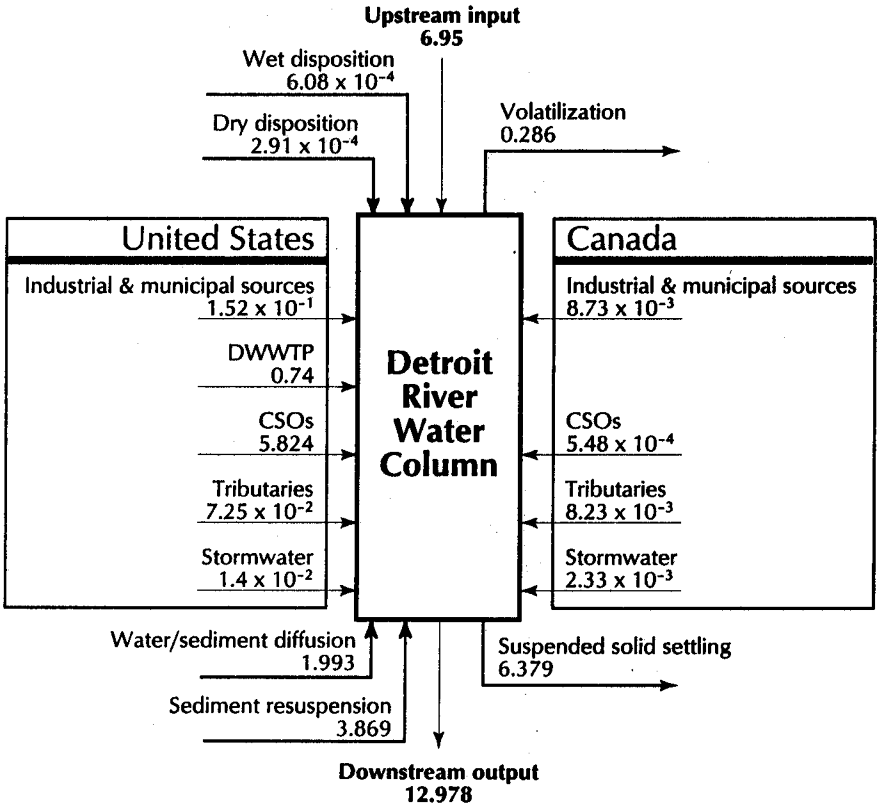
Wayne State University's ASDM is a generalized temporal and spatial transport and fate model for predicting water, sediment, fish, suspended solid, plankton, porewater and benthos phase contaminant concentration profiles in the river. The model includes water column and surface sediment advection and dispersion, multimedia contaminant transport processes, intermedia contaminant partitioning processes, and contaminant transformation processes.

Three compartment (air, water, and sediment) contaminant interaction source/sink rates, and contaminant sorption effect of water and porewater exposure to suspended solids, plankton, fish, sediment and benthos can be calculated from this model and applied to the water and sediment equations of continuity in one, two and three dimensions for both steady state and transient conditions. Two equations of continuity for the water column and surface sediment can be solved by the Finite Difference Method, Crank-Nicolson Method {1}, and Iteration Method. The model computer program USSMPX{2} is run on a SUN work station and MTS utilizing databases.

The most important six models are compared with this model (ASDM) by author, source, layer, partitioning process, transport process, and transformation process (See Table 14). The advantages of the ASDM model include surface sediment flow, a food chain model, and parameter estimation.

The ASDM model can be used to identify potential sources or sinks of contaminants among three compartments (air, water, and sediment), and to quantify contaminant loading rates from air/water diffusion, dry deposition, wet deposition, water/sediment diffusion, suspended solid settling, sediment resuspension and burial in the river system. The major sources for mercury in the Detroit River water column, according to the ASDM model, are upstream input (51%), combined sewer overflows (43%), and Detroit Wastewater Treatment Plant (5%). The major sinks for mercury in the Detroit River water column are downstream output (94%), deposition to sediment (4%), and volatilization to air (2%). The Detroit River water column is a source of mercury for Lake Erie, river sediment, and air. In addition, the Detroit river water column overall mercury mass balance showed that the total input is equal to the total output. The ASDM model which is a mass conservation model can accurately predict contaminant fluxes among three compartments (air, water and sediments).

Figure 7
ASDM Results — Detroit River Water Column Mercury Mass Balance Result
(Sediment Flow, 1983-1991. Predicted CSO flow rates)



All measurements are shown in kg/day

Total input = 19.64 kg/day Total output = 19.64 kg/day

The ASDM can also be used to predict water, sediment, suspended solid, plankton, fish, porewater and benthos phase contaminant concentration profiles in the river aquatic and sediment systems. The steady state model results showed that all Detroit River water mercury concentrations exceed Michigan's Rule 57(2) Criteria (0.6 ng/l); the UGLCC study also found the same results. In addition, regression analysis for steady state sediment mercury give a general indication of goodness of fit (Regression Line Slope = 1.3, Regression Line intercept = 0, Regression Coefficient = 0.6. The steady state model outputs also showed that most of large fish methyl mercury concentrations are above the MOEE Criterion, similar to the fish methyl mercury concentrations in Lake St. Clair.

Table 14
Model Comparison Table

MODEL	WASPS	TOX14	TOXFATE	QWASI	SMCM	ASDM	KETOX
AUTHOR	Ambrose (1991)	Ambrose (1991)	Halton (1990)	Mackay (1989)	Cohen (1990)	Lin (1992)	McCorquodale (1992)
SOURCES	WASP TOXIWASP WASTOX WASP4	EXAMS2 WASP4	Hydrodynamic				
LAYERS	surface water subsurface water surface benthic subsurface benthic	water benthic benthic	water sediment	water sediment	water sediment	water surface sediment deep sediment (surface sediment flow)	water active bed
PARTITIONING PROCESSES	water ↑↓ sand, silt & clay porewater ↑↓ sediment dissolved organic carbon	chemical ↑↓ ionic water ↑↓ sand, silt & clay porewater ↑↓ sediment	water X plankton/fish X suspended sediment porewater X sediment/ benthos	water ↑↓ sediment porewater ↑↓ sediment	water X biota X suspended sediment porewater ↑↓ sediment	water ↑↓ plankton/ small fish ↑↓ large fish ↑↓ suspended solid porewater ↑↓ sediment/ benthos	water ↑↓ biota ↑↓ fine solid ↑↓ coarse solid porewater ↑↓ coarse sediment
				PARTITION COEFFICIENT ESTIMATION			
TRANSPORT PROCESSES	advection dispersion volatilization water/sediment diffusion wet deposition settling resuspension sediment burial	advection dispersion volatilization settling resuspension sediment burial	advection dispersion volatilization	advection dispersion air/water diffusion water/sediment diffusion dry deposition wet deposition settling resuspension sediment burial	advection dispersion air/water diffusion water/sediment diffusion dry deposition wet deposition	advection dispersion air/water diffusion water/sediment diffusion dry deposition wet deposition settling resuspension sediment burial	advection dispersion settling resuspension sediment burial
					TRANSPORT PARAMETER ESTIMATION		
TRANSFER PROCESSES	biolysis hydrolysis oxidation photolysis	biolysis hydrolysis oxidation photolysis				biolysis hydrolysis oxidation photolysis	biolysis hydrolysis oxidation photolysis

↑↓ = equilibrium X = nonequilibrium

KETOX (D4SEDS) Model Methods

The hydrologic modelling technique used as a basis for simulating the hydrodynamics of the Detroit River is referred to as Lagrangian. This form of hydrologic investigation provides time series data relative to a specific parcel of water as it changes its location with time.

The Detroit River KETOX ("D4SEDS") model is designed to simulate the far-field region of a contaminant plume. At this point the plume is vertically well mixed and chemicals are diluted by additional stream flow, i.e. longitudinal and transverse mixing. The river is divided into segments, referred to as "REACHES". Reaches are numerical representations of distinct channels in the river. The reaches are further subdivided into "Cross (X-) Sections". The exact position of individual point source discharges are then referenced within this framework. A series of physical, chemical and biological transport and transformation processes, to determine the "fate" of a contaminant within the river, are empirically incorporated into the model using a collective kinetic loss coefficient.

Steady-state modelling (e.g., the KETOX model) simulates a single scenario (i.e. a single river flow rate and single [set] of loading conditions) per model run per specified contaminant, (Appendix 8.1 Table N). Various combinations of loading rates and river flow can be used to simulate loading impacts to the water column, suspended solids and bed layer (i.e. upper sediment layer - depth = 3 cm).

Should one model simulation, based on an average loading rate and average river flow rate prove insufficient, a statistical approach, known as "stochastic modelling", can be used to better characterize the fate and transport of contaminants in the river. This method incorporates the variability inherent in flow and loading rates. A distribution of predicted concentrations in the water column, suspended solids and sediment phases is thereby generated.

Sediment Phase Sub-Model

The sediment phase sub-model of the KETOX Model is limited to the mathematical simulation of contaminant concentrations within the "Active Bed Layer (i.e. suspended and bed sediments)". Three different particle groups are stipulated, i.e. "Biotic/Fine Abiotic/Coarse Abiotic Particles", for this layer.

1986–90 Loading Data By Reach and Category of Point Source Discharge

The results of the modelling work are presented in three different formats. The first set of results provides a clear "picture" of the relative importance, with respect to total contaminant loadings, each reach and category of point source discharges has on the Detroit River (Appendix 8.1 Table O).

"D4SEDS" KETOX Model Output

Dispersion Mass Balance; Mass Rates Into and Out Of Each Reach

The third set of model results provides information related to the transport of the contaminants within the various reaches of the Detroit River, as demonstrated by the whole water (i.e. unfiltered water) concentrations of each contaminant. The "HEAD" refers to the Lake St. Clair region of the river. The contaminant mass associated with the head is referred to as the "Upstream input". The "MOUTH" refers to the Lake Erie region of the river. In this case, mass represents the "Downstream output" from modelled sources only. Data from all nonpoint sources to the river is unavailable (Appendix 8.1 Table P).

To determine the "NET" change in the mass (or quantity) of a contaminant attributed to point sources within the Detroit River, during CSO discharge periods, subtract the "HEAD" mass entering into the River from the "MOUTH" mass entering into Lake Erie. For example:

For PCBs: the quantity of PCB attributed to loadings into the
Detroit River = 9.23 - 0.70 = 8.53 kg/day.

IMPORTANT POINT TO REMEMBER:

Model runs were carried out to determine the impact of all point source discharges to the Detroit River. Therefore, this mass of PCBs represents that mass which would enter Lake Erie when CSO discharges occurred. The mass would be smaller, obviously, on "nice sunny days" when CSO discharges were zero.

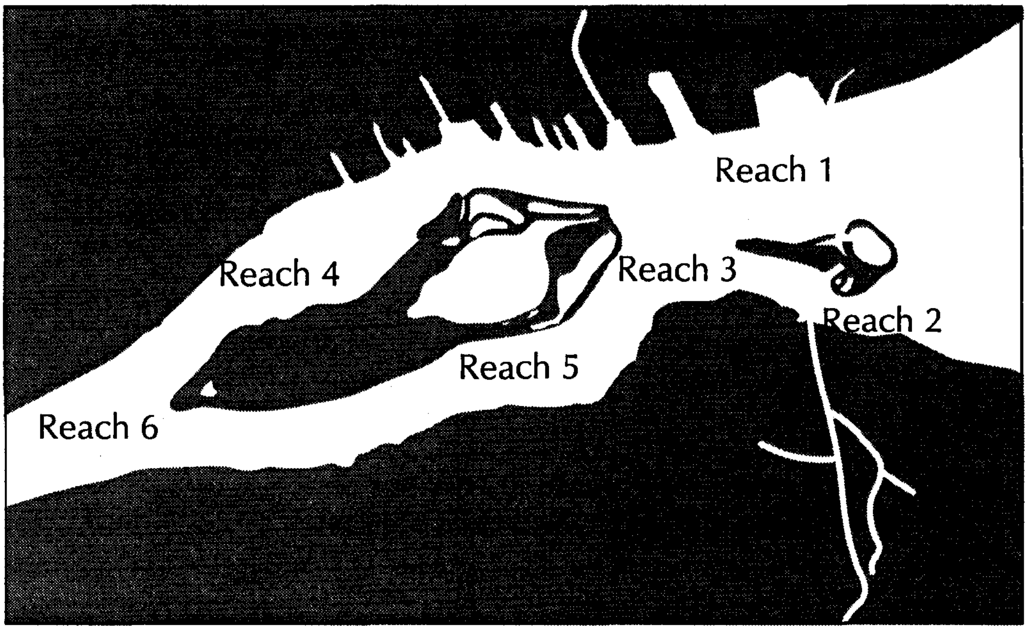
Information available for individual CSOs included:

1. Number of Events per Year (CSO specific);
2. Total Volume per year (CSO specific);
3. Average Duration of Event (CSO specific);
   a. FLOW PER EVENT (in cubic feet per second) was calculated from the above three-mentioned pieces of information.
   b. Concentration Data, on a contaminant specific basis, was obtained from published literature.

An EVENT SPECIFIC LOAD RATE on a CSO specific basis was derived from A * B.

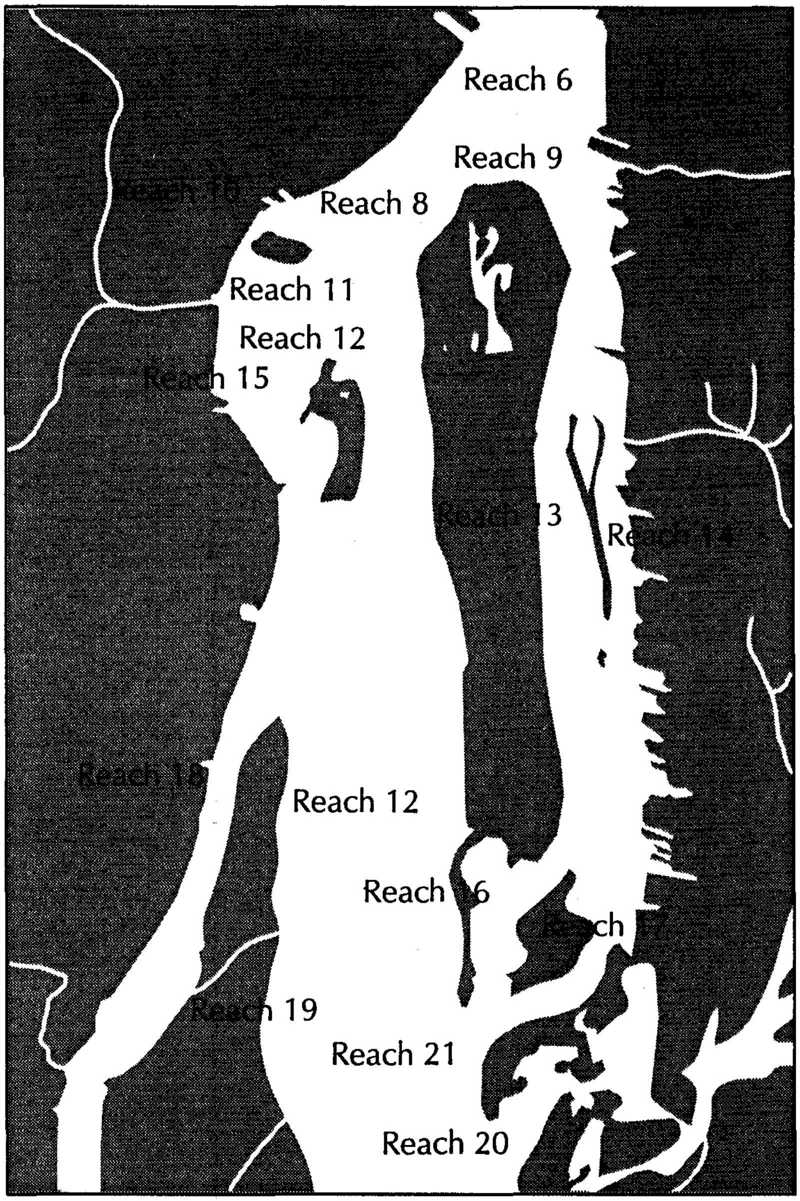
The number of events for an individual CSO ranges from 7 events per year for the LEIB (B08) CSO to 48 events per year for a number of them; the MEAN NUMBER OF EVENTS PER YEAR = 30.4, n = 41. The duration of each event ranges from 0.17 day (4 hours) for the St. Aubin (B13) CSO to 1.63 days (39 hours) for Conners Creek CSO; the MEAN DURATION OF EACH EVENT = 0.53 day (12.7 hours), n = 41.

Figure 8
Detroit River AOC Reaches 1 through 6



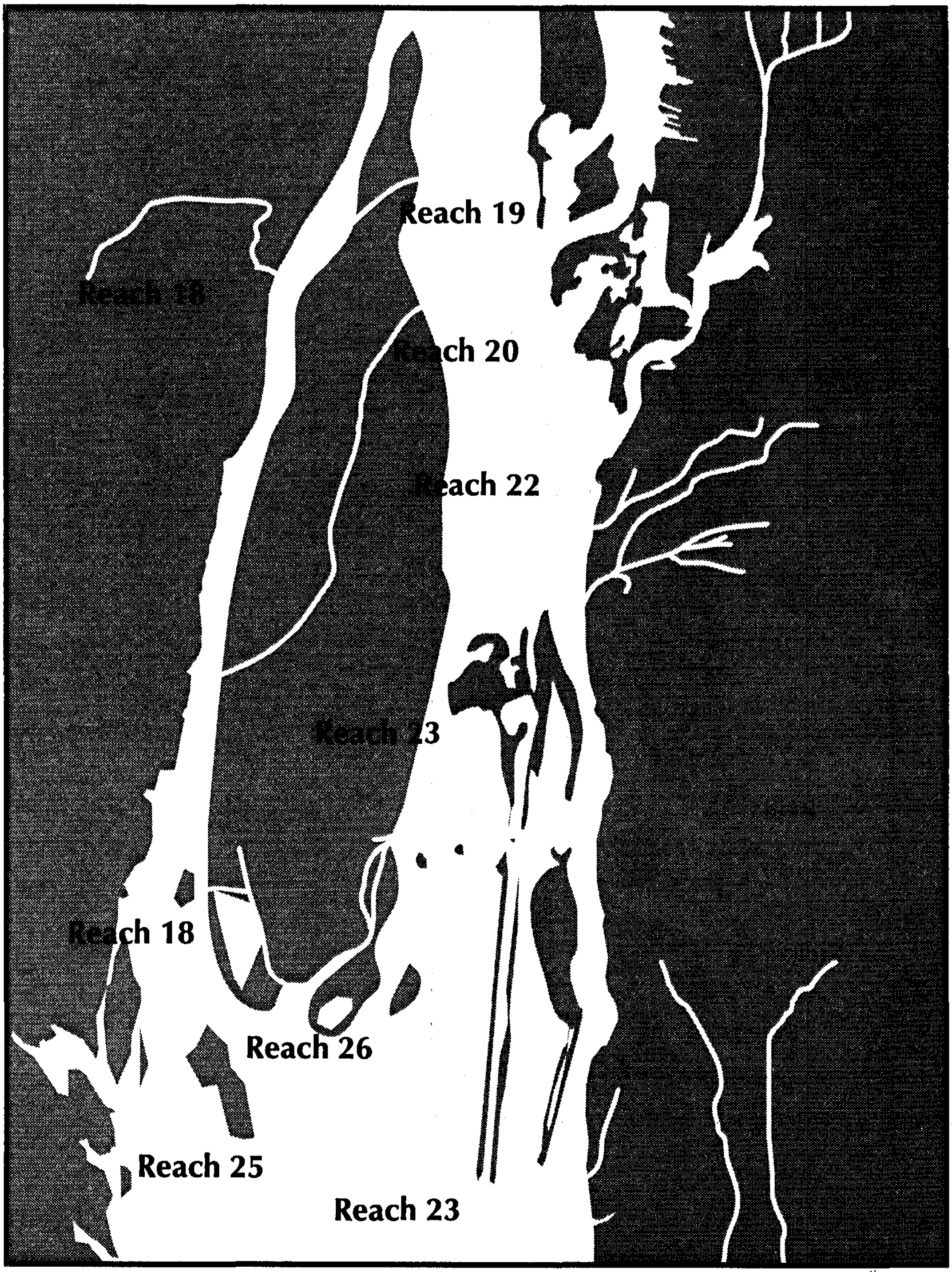
Source: MOEE Environmental Monitoring and reporting science and technology.

Figure 9
Detroit River AOC Reaches 6 through 20



Source: MOEE Environmental Monitoring and reporting science and technology.

Figure 10
Detroit River AOC Reaches 19 through 23



Source: MOEE Environmental Monitoring and reporting science and technology.

As has been pointed out in the preceding text, CSO discharges are intermittent point sources. These point sources discharge a load to the river on an average 30 times per year for a duration of approximately half a day.

A new proposal was raised to reduce CSO/SS loading rates by a factor of 12. The rational brought forth for undertaking this action was to more or less reflect a continuous flow as is normally associated (assumed) with industrial and municipal point sources. It was suggested that the loadings would thereby more closely reflect a yearly loading average. It would be prudent to determine the exact nature of the variations to an industrial/municipal point sources' effluent characteristics prior to undertaking action to reduce contaminant loadings associated with CSO/SS discharges.

Discussion and Conclusions

Assessment of the Quality of the Loading Data

Loading data were obtained from the Detroit River Stage I RAP Report (June 1991) and DWSD model development status report by Camp Dresser & McKee, September 30, 1993. In many cases annual loading data were used to calculate a contaminant's concentration; or to infer a specific point source flow rate.

It should not be interpreted as suggesting point source loading data is adequate. The currently available point source data is satisfactory for providing some guidance on the relative significance of individual point source loadings to the river. The available data permits a clarification of the relative significance of each Reach, with respect to contaminant loadings. Further runs of the Ketox model using updated loadings will permit a more focussed analysis of loadings to the river.

"D4SEDS" KETOX Model Output — Dispersion Mass Balance

The initial set of model predictions, for each contaminant, represents 100 percent of the MEAN estimate of the 1986 to 1990 contaminant loading rates. These loadings are discharged to the Detroit River flowing at the MEAN 1986 to 1990 flow (i.e. 203,694.99 cu.ft./sec.). The second and third sets of model predictions represent contaminant mass fluxes based on 25% and 50% reductions, respectively, of contaminant loadings from major Michigan combined sewer overflows (CSOs). The fourth set of model predictions assumes that absolutely "No Loadings", i.e. VIRTUAL ELIMINATION, from Detroit River point sources occur. Therefore, the only source of a contaminant load is attributed to Lake St. Clair.

From Tables N and P, Appendix 8.1, it is possible to determine the reaches which experienced the largest mass loading of a particular contaminant, due to the modeled point sources, during the modeled time frame.

For PCBs: Reaches 4 and 6 receive the largest loads; mainly from CSO discharges.

For Lead: Reaches 4, 5, 6 and 18 receive the largest loads; mostly from CSO discharges, together with the Rouge River.

For Copper: Reaches 4, 6 and 24 receive the largest loads; mostly from CSO discharges, together with the Rouge River.

For Zinc: Reaches 4, 5, 6, 18 and 24. Loadings in this case appear to be more or less shared between CSO/SS and Industrial/Municipal sources, together with the Rouge River.

For Cadmium: Reaches 4 and 6 receive the largest loads; mostly from CSO discharges, together with the Rouge River.

"D4SEDS" KETOX Model Predictions for Whole Water, Suspended Solids, Surficial Sediments Versus Field Measurements

Contaminant concentrations have been predicted for whole water (i.e. unfiltered water sample), suspended solids and surficial sediments (upper 3 cm. of the bed layer). The results of the model predictions can be found in Appendix 8.1, table O. Reaches have been identified and segmented in distance downstream (feet) along the horizontal axis of the river from the start of the reach.

The contaminant specific Lowest Effect Level (LEL) and Severe Effect Level (SEL) concentrations for each contaminant were incorporated into their respective tables. Surficial sediment concentrations at Stations 177, 178 and 180, which are based on loadings exclusively from Lake St. Clair, were examined. It was concluded that the Lowest Effect Level (LEL) is closely approached for total PCBs and lead at the start of the Detroit River. A possibility exists that the LELs for copper, zinc and cadmium would be exceeded through Lake St. Clair loadings alone.

Based on field measurements of contaminant concentrations in the water column, suspended solids and bed layer versus model predictions, it is concluded that current model predictions are representative of loading impacts to the Detroit River, over the period modelled.

Assessment of the Quality of Model Predictions

It is possible to discern steep concentration gradients perpendicular from the Michigan shoreline (Node 15) to Mid-Channel (Node 8) and on to the Ontario shoreline (Node 1). Node 12 to Node 15 represents eight (8) percent of the river flow closest to the Michigan shoreline. The above-mentioned direction is mainly intended for reference purposes for those reaches entirely in Ontario or Michigan waters. The close "hugging" of the contaminant plume along the Michigan shoreline agrees very well with the results of previous modelling work.

The Ketox model predicts beneficial use impairments to benthos and restrictions on dredging due to contaminant loadings associated with point sources in Reach 4, i.e.: Connors Creek CSO, Freud P.S. CSO, Fairview P.S. CSO, McClellan (BO3) COS, Fisher (BO4) CSO, Iroquois (BO5) CSO, and Helen (BO6) CSO.

The "D4SEDS" Ketox model demonstrates the magnitude of contaminant loadings from Michigan outfalls to the Fighting Island Channel (Reach 12), the Livingstone (Reach 23) and Amherstburg (Reach 24) Channels. Contaminant fluxes into and out of the Trenton Channel (Reach 18) and Fighting Island Channel (Reach 12) are very similar (Appendix 8.1, Table P). The difference lies in the flow rates for these two channels.

Trenton Channel flow rate: 42,776 cu. ft./sec.

Fighting Is. Channel flow rate: 103,884 cu. ft./sec.

The contaminant mass per unit volume of water is much greater for the Trenton Channel (i.e. higher contaminant concentration) than for the Fighting Island Channel. This is expected, due to the nature of the contaminant plume "hugging" the Michigan shoreline. The contaminant load down the Fighting Island Channel is approximately equal, due to the much greater volume of water flowing down this channel versus the Trenton Channel, (Reach 23, Reach 24).

Summary of KETOX Recommendations

1. Loading data, preferably flow rate and contaminant concentration, should be obtained in a manner to properly assess the exact characteristics, with adequate precision, of the point source loadings (i.e. industrial, municipal, CSO or storm sewer).
2. A field sampling program should be designed in a manner to properly coincide (i.e. in the correct temporal framework) with the collection of pertinent upstream loading data.
3. The Ketox model should be updated with the Ketox 2 version (graphics output) and run using the most current loading estimates.

Contaminated Sediments Database

The compilation of a central contaminated sediments database is critical now that sediment assessment in the Detroit River is in the forefront of activities performed by various agencies and consultants. The U.S. Army Corps of Engineers (ACOE) is developing this database under the direction of U.S. EPA Region 5 (USEPA) in cooperation with the Michigan Department of Environmental Quality (MDEQ). Funding for the project comes from USEPA via an inter-agency agreement between the two agencies. The database includes all sediment chemistry information from the Detroit River as well as the Rasin, Rouge, Huron and Clinton Rivers.

After hearing recommendations made by the Detroit River RAP Contaminated Sediment TWG to focus on addressing contaminated sediment issues in the Trenton Channel, USEPA, ACOE, and MDNR decided that the database should be expanded to include a GIS-mapping capablility. this effort is underway in the form of remapping the Trenton Channel to overlay contaminated sediment data and other relevant information to support furthur assessment, modeling, prioritization and remediation decisions

Surface Modeling of Sediment Data for Rouge and Detroit Rivers (Michigan) Using GIS Technologies

The U.S. Army Corps of Engineers (US ACOE), Detroit District, initiated work in 993 to support the USEPA-Region 5, under the Southeast Michigan Initiative (SEMI). SEMI is a multi-media (air and water) program to identify pollution sources and enforce compliance with federal statutes. The US ACOE will provide both agencies with a geographic information system (GIS) for importing, analyzing, modelling, and displaying contaminated sediment sampling data for the SEMI region. The SEMI project area includes the Detroit River, as well as the Clinton, Huron, Rouge, and Raisin River Watersheds. A tentative work plan outlines several tasks which consists of selecting base maps, inventorying sediment sampling data, designing the data base structure, populating the relational data base management system with sampling data, and creation of visualization techniques using surface modelling tools.

A pilot study was undertaken regarding the Detroit River and bottom sediment data acquired by the USEPA in 985. The base map for the Detroit River was derived from design files available at the US ACOE, Detroit District. Although a more elaborate data base file structure will eventually be implemented, the pilot data base consisted of three data files which included the sample station location, sampling information, and parameter data. Using a Unix-based Intergraph work station and the Modular GIS Environment (GIS) family of software, several visualization techniques were developed. These visualization techniques can involve planimetric and isometric views as well as single and multiple parameters. Preprocessing with gridding and statistical tools provide for normalization and spatial display of the sampling data. As a preliminary conclusion, the functionality of the visualization techniques are limited by the density of sampling data and the robustness of the available surface modelling tools.

In view of this pilot study, the following interim conclusions are suggested:

- Further coordination between the US ACOE, USEPA, MDNR, and MOEE is needed in regard to sediment sampling methods.
- The spatial density of the sediment sampling grid needs to be increased.
- The SEMI project database has to be finalized, populated and documented.
- A customized user interface needs to be developed with linkages to Arc/View and/or Microstation compatible PC software.
- Surface modelling and contouring routines will require additional developmental effort.
- Sediment sampling displays should be referenced to CSOs, municipal water intakes, industrial storm water outfalls, current land use, wetlands and two-dimensional flow models of the Detroit River.

In Place Remedial Measures

Currently identified in the Michigan's Sites of Environmental Contamination list (April 1994 for Fiscal Year 1995), progressing towards sediment remediation in the Detroit River is Monguagon Creek, site ID number 820216 in category 3 with a SAM score of 34. Pursuant to Michigan's Act 307, Potential Responsible Parties (PRPs) have been notified and work plans for further assessment have been submitted.

Background Information and Site History

Monguagon Creek is a tributary to the Detroit River Trenton Channel. There is one tributary to the creek, Huntington Drain. Huntington Drain is an urban storm drain that serves the City of Riverview. The total length of the Creek is approximately 0.7 miles. The creek has received wastewater discharges from industrial facilities as well as surface runoff from the town of Riverview. The only current industrial discharger to the creek is Elf Atochem North America, Inc. (formerly, Pennwalt Chemical West Plant). That site has been involved in the production of pesticides, phenols and organic amine compounds.

The Detroit River Area of Concern identified Monguagon Creek as a site of environmental contamination pursuant to Act 307 because of the contaminated sediments in the Creek. According to MDNR's report dated April 3, 1991, the sediment in Monguagon Creek is highly polluted with heavy metals such as mercury, chromium, zinc, and lead and numerous organic contaminants including PCBs, phenols, heptachlor, hexachlorobenzene, and extractable oil and grease.

Site Status

The MDNR sent Potential Responsible Party (PRP) notification letters to owners of property adjacent to Monguagon Creek on July 1, 1991. In the letter, MDNR requested the PRPs to voluntarily undertake corrective actions to remedy the environmental and human health problems at the site by fencing the site, conducting a remedial investigation, performing a feasibility study, and implementing a final remedial action. In August, 1991, the creek was fenced as a method of restricting public access.

On October 5, 1992, Firestone Tire and Rubber Company conducted an investigation of surface water and sediment quality adjacent to their landfill area. Based on this investigation, Firestone Tire and Rubber Company concluded that they are not a PRP. MDNR has not officially determined Firestone Tire and Rubber Company's PRP status.

The Superfund Section of Environmental Response Division collected water and sediment samples from the creek at ten different locations on July 20, 1993. The raw data is available for review. The BASF Corporation submitted on August 31, 1993 a work plan for sampling water and sediments upstream and downstream of their railroad bridge. On September 24, 1993, MDNR recommended that the Company coordinate their study with Elf Atochem to avoid duplication of sampling locations. However, the Company decided to wait for the Elf Atochem's sampling results to pursue their work plan.

Elf Atochem North America, Inc. submitted on July 19, 1993 a work plan for sampling water and sediments in the creek between the Elf Atochem plant and the mouth of the creek. Upstream sampling locations were also proposed. The work plan of Elf Atochem was approved on November 3, 1993. Elf Atochem North America, Inc. performed the sampling as proposed on November 30 and December 1, 1993. The MDNR split water and sediments samples at two locations (#3 and #5) with the Company. The sediment samples from location #5 were black and oily and had a very strong odor of organic chemicals.

On May 11, 1994, Elf Atochem submitted their site investigation report to MDNR. Based on this study, the Company concluded that potential chemicals of concern include benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, 2,4-di-tert-pentyphenol, lead, zinc, and PCB Aroclor 1260. The Company also proposed further investigation of the creek. The purpose being to collect specific data on; a profile of the Creek; depth of constituent migration, if any, into the underlying native clay; bottom elevations along Huntington Drain; and average and maximum flows of Huntington Drain.

On July 6, 1994, MDNR and Elf Atochem had a meeting to discuss MDNR's review of Elf Atochem's investigation report and a need for a feasibility study. Elf Atochem had conducted the additional studies of the creek that they proposed in May. The additional work indicates that; the contaminated sediments have not impacted the native clay underlying the creek; the profile of the bottom of creek is flat, so flow rate and direction of flow in the creek depends on the water level in the Detroit River; the predicted storm flows in Huntington Drain are 339 cubic feet second (cfs), 797 cfs, and 1067 cfs for the 2-year, 25-year and 100-year storm events, respectively; the estimated sediment volume in the creek is 15,000 cubic yards.

Elf Atochem's investigation reports were well done and comprehensive and are acceptable to MDNR.

Based on the MDNR review of all the various studies, there are a number of potential parameters of concern. Two of the more significant are zinc and 2,4-DP. These two were found at elevated levels at all sampling locations.

Feasibility Study

Elf Atochem submitted an outline of a proposed feasibility study on July 6, 1994. The outline of the proposed feasibility study was acceptable. The Company will submit the proposed feasibility study by the end of November 1994.

Future Response Needs

MDNR is in the process of renotifying the potential responsible parties to voluntarily undertake corrective actions to remedy the contamination in the creek. The MDNR will review the proposed feasibility study and evaluate remediation options after they are submitted.

Monitoring and Surveillance Plan

The monitoring and surveillance (M/S) plan developed by the Contaminated Sediments Technical Workgroup is a binational multi-staged tiered strategy for assessing the status of sediment quality in the Detroit River.

The main stages of the plan involve AOC assessment, AOC trend analysis, Hotspot site/Sensitive area evaluation, and remedial action monitoring. The main tier components of the M/S plan include benthic community, sediment chemistry, and sediment toxicity/bioaccumulation testing.

AOC Assessment: Tier I, II, III, IV

System-wide sediment surveys in the Detroit River were conducted in 1985 by the USEPA/MDNR and 1968, 1980, 1991 by MOEE. The Detroit River RAP Contaminated Sediments Technical Workgroup recommends a 5 year cycle in assessing the sediment quality of the Detroit River AOC, with the next survey beginning in 1996. MDEQ and MOEE should be responsible in coordination of this effort and bringing resources of other agencies together.

Tier I involves the sampling of benthic community populations in approximately 80 stations in the Detroit River (Figure 3.1 Beak-MOEE). Using multivariate cluster analysis as in the "Beak-MOEE:Environmental Assessment of Detroit River Sediments and Benthic Macroinvertebrate Communities-1991", 1993., sites would be distinguished as unimpacted, severely, moderately, or slightly impacted.

Once a site has been deemed impaired with respect to benthos, a sampling plan using a number of problem definition strategies would be developed. Taking into account any historical site information, Tier II would involve taking sediment chemistry samples including conventional, organic, and inorganic parameters, and methods including total and leachable, to help solve the reason for impaired benthos at a specific site. Using biologically-based criteria such as MOEE: "Guidelines for the protection and management of Aquatic Sediment Quality in Ontario", 1993., a determination can be made if particular parameters may be involved in degrading a site.

If sediment chemistry results cannot account for the benthic degradation, then sediment toxicity sampling using Daphnia magna (eight hour immobility), *Chironomus tentens* (10d growth) and/or Microtox (photobacterium) would be used to confirm the cause of the degradation is contamination. (Giesy, J.P. and R.A. Hoke. 1989.) The use of caged fish studies (Fathead Minnow) should also be made available as a tool to access bioaccumulative affects.

Tier III Hotspot/Sensitive Areas of Interest and Tier IV Remedial Action Monitoring should be initiated by agencies as needed. The data should be made available to organizations involved in Detroit River sediment sampling.

AOC Trend Analysis

Fifty eight stations were identified in the BEAK-MOEE, 1993 report with temporal contaminant trends. The proposed 1996 survey should include several of these stations as part of continued trend analysis.

Hotspot/Sensitive Area Evaluation

Both MDNR and MOEE have informed the CSED TWG of ongoing sediment investigation in the Detroit River to further identify hotspots and to characterize the sediments in areas of interest.

MDNR and USEPA are coordinating efforts to assess contaminated sediments in the Trenton Channel area of the Detroit River. Core and surficial sediment sampling took place in 1993 and 1994 at known contaminated sites and in wetland/habitat areas.

MOEE has taken sediment samples in hotspot areas of the Detroit River on the Canadian side in 1994 to confirm contamination and determine possible sources.

The 1996 survey should include hotspots and sensitive areas as identified by the agencies. The survey should also solicit proposed sites from the BPAC and general public.

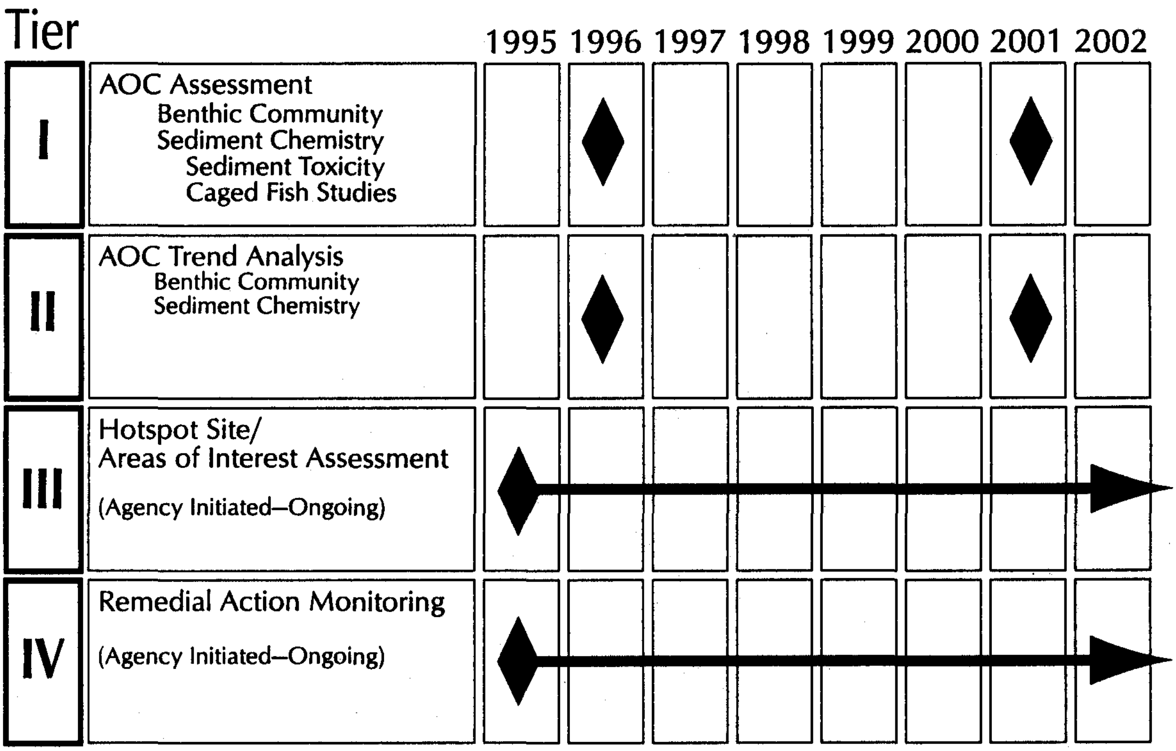
Remedial Action Monitoring

Michigan State University is currently monitoring sediment chemistry, sediment toxicity, and benthic community structure at a site recently (1993) dredged in the lower Trenton Channel. The study will assess the impact of dredging on these elements over several years.

Coordination

Agencies, industry and municipalities involved in sediment assessment need to communicate their methods and results to avoid duplication and further the goals of restoring the beneficial uses impaired by contaminated sediments. Discussions on a Contaminated Sediments Database and Graphic Information Systems are addressed in the Information Needs section of the Contaminated Sediments Technical Workgroup Report.

Figure 11
Overview of Monitoring and Surveillance Plan Stages/Tiers



Agencies and Municipalities Involved in Sampling Sediments in the Detroit River AOC

United States

City of Detroit
MDNR – Michigan Dept. of Natural Resources
US ACOE – U.S. Army Corps of Engineers
USEPA – U.S. Environmental Protection Agency
US F&WS – U.S. Fish & Wildlife Service
USGS – U.S. Geological Survey

Canada

CCG – Canadian Coast Guard
City of Windsor
DFO – Dept. of Fisheries & Oceans
EC – Environment Canada
ERCA – Essex Regional Conservational Authority
OMNR – Ontario Ministry of Natural Resources
MOEE – Ontario Ministry of Environment & Energy

Remedial Options

The Contaminated Sediments Workgroup has compiled a reference list of appropriate documentation with regards to potential sediment remediation technologies. The workgroup recognizes that certain source control remedial options are being developed by the CSO and PS/NPS Workgroups.

Realizing that without additional field data to determine the extent of contamination, without modeling efforts tied to sediment fate and transport trends, the workgroup chose not to recommend specific remedial options for individual contaminated sediment areas. The mechanism for the remediation of contaminated sediments in Michigan (Act 307) also precludes the workgroup from making specific remedial option determinations.

The current reference list includes:

- Workshop on the Removal and Treatment of Contaminated Sediments
- Environment Canada's Great Lakes Clean-up Fund, 1993.
- Sed-Tech Database of Remedial Technologies, 1994.
- Detroit River Technical Options Study. MOEE (Beak), 1993.
- Remediation of Contaminated Sediments. USEPA, 1991
- Workshop on Innovative Technologies for the treatment of Contaminated Sediments. USEPA, 1990.
- Selecting Remedial Techniques for Contaminated Sediments. USEPA, 1993.

Estimates of Sediment Remediation Costs at Selected Sites in the Detroit River

The cost estimates provided in this discussion are preliminary. They have been calculated for discussion purposes and would require considerably more detail and investigation if actual costs were calculated for remediation. The calculations are based upon approximations of surface area, volume, and cost range. In each case, a range of values have been calculated to approximately bound the range of area, volume, and cost estimates. These scenarios or bounds are intended for discussions to examine the magnitude of potential fiscal resources required for mitigation/remedial action of sediments.

Remedial costs for sediments will ultimately require consideration in the RAP process and are usually substantial. If each of the 43 Great Lakes Areas of Concern (AOC) required remediation of 1,000,000 cubic yards of sediment each, the total estimated cost at $250 per cu yd is projected to be in excess of $10 billion. Actual and estimated sediment remediation costs for individual sites in AOCs are expected to cost in the multi-million dollar range (e.g. $60 M). An estimate for the lower Detroit River has been previously calculated at $1.5 M, but is considered to be very conservative. Various cost estimates for particular remedial actions are used in these calculations: $50, $350, and $1000 per cubic yard. These values are general cost estimates for capping, advanced treatment, and hazardous waste disposal, respectively. These are used for discussion purposes and other sediment remediation techniques and cost estimates (potentially higher and lower) could be used for planning estimates. There are usually other infrastructural or logistic costs associated with a remedial action which may include ship construction, maintenance, and operations, personnel training, transport of sediments, pre-treatment, disposal area construction and maintenance, effluent treatment, etc. which may impact the above cost estimates.

A range of calculations are provided for a relatively small site in the Trenton Channel and a large reach of the lower Detroit River to contrast costs within and between sites. Calculations are provided for: 1) a site in the mid-section of the Trenton Channel known as the Black Lagoon and 2) the western nearshore zone of the Detroit River from the Rouge River to Lake Erie which encompasses the Trenton Channel. Both areas have a history of impacts which include degraded benthos, relatively high sediment contaminant concentrations, and have exhibited toxicity in several toxicity testing procedures. Both areas examined also have considerably degraded sediments with depth.

1. The first site considered is located in the central portion of the Trenton Channel on the western (mainland) shore of the State of Michigan. The site, commonly referred to as the Black Lagoon, is known to be a depositional basin, and a degraded condition of sediments has been documented.

The zone of interest is a small embayment and depending on the map used, varies in shape and surface area. Estimates for an upper and lower surface area (dependent on the morphology used) and a mean of the two estimates are provided for calculations. Past and recent studies have indicated highly contaminated sediments at depths of two to three yards and are used for volume calculations; depth of the contaminated material will vary with location within this site. The intent would be to remove sediments to a depth which would, at a minimum, not expose a more contaminated level, negate any side-slumping of contaminated sediments, and would desirably yield concentrations which would adhere to those established for quality sediments. Cost estimates for the Black Lagoon are presented below.

Table 15
Estimated Sediment Remediation Costs for the Black Lagoon, Trenton Channel, Detroit River

	Surface Area (square yards)	Depth (yards)	Volume (cubic yards)	Cost	Total Cost (million $)
1.	6500	NA	NA*	50/sq. yd.	0.3
2.	6500	2	13000	350/cu. yd.	4.5
3.	6500	2	13000	1000/cu. yd.	13.0
4.	6500	NA	NA*	50/sq. yd.	0.3
5.	6500	3	19500	350/cu. yd.	6.8
6.	6500	3	19500	1000/cu. yd.	19.5
7.	9000(ave)	NA	NA*	50/sq. yd.	0.5
8.	9000(ave)	2	18000	350/cu. yd.	6.3
9.	9000(ave)	2	18000	1000/cu. yd.	18.0
10.	9000(ave)	NA	NA*	50/sq. yd.	0.5
11.	9000(ave)	3	27000	350/cu. yd.	9.5
12.	9000(ave)	3	27000	1000/cu. yd.	27.0
13.	11,250	NA	NA*	50/sq. yd.	0.6
14.	11,250	2	22500	350/cu. yd.	7.9
15.	11,250	2	22500	1000/cu. yd.	22.5
16.	11,250	NA	NA*	50/sq. yd.	0.6
17.	11,250	3	33700	350/cu. yd.	11.8
18.	11,250	3	33700	1000/cu. yd.	33.7

*NA= not applicable; capping technique

Cost estimates vary considerably dependent on surface area, depth, volume, and method cost. At approximately $50 per square yard, cost ranges from $0.3M to $0.6M; at $350 per cubic yard, cost ranges from $4.5M to $11.8M; at $1000 per cubic yard, cost ranges from $13.0M to $33.7M.

2. The second area considered is the western nearshore zone of the Detroit River extending from the Rouge River, south to Lake Erie. This area is considered for an examination of a large-scale, sediment remedial action and has a documented history of contamination and impacts. For the calculation, the north-south transect or length is estimated to be approximately 15 miles (=26,400 yd). The shoreline is undoubtedly irregular in this zone and the length used is an estimate. Two estimates for width are provided (from the shoreline moving east) at 10 and 25 yd. These have been estimated and the width sediments in potential need of remediation varies considerably when the meander of the river and embayment/tributary areas are considered. An average of 1 yd sediment depth is used for the calculation considering that certain areas may be scoured and other areas are depositional. Cost estimates used are those presented earlier.

Table 16
Estimated Sediment Remediation Costs for the Lower Detroit River in the Western Nearshore Zone, Rouge River to Lake Erie, Including the Trenton Channel

	Length (yards)	Width (yards)	Depth (yards)	Volume (cubic yards)	Cost	Total Cost (million $)
1.	26400	10	1	NA*	50/sq. yd.	13.2
2.	26400	10	1	264000	350/cu. yd.	92.4
3.	26400	10	1	264000	1000/cu. yd.	264
4.	26400	25	1	NA*	50/sq. yd.	33
5.	26400	25	1	660000	350/cu. yd.	231
6.	26400	25	1	660000	1000/cu. yd.	660

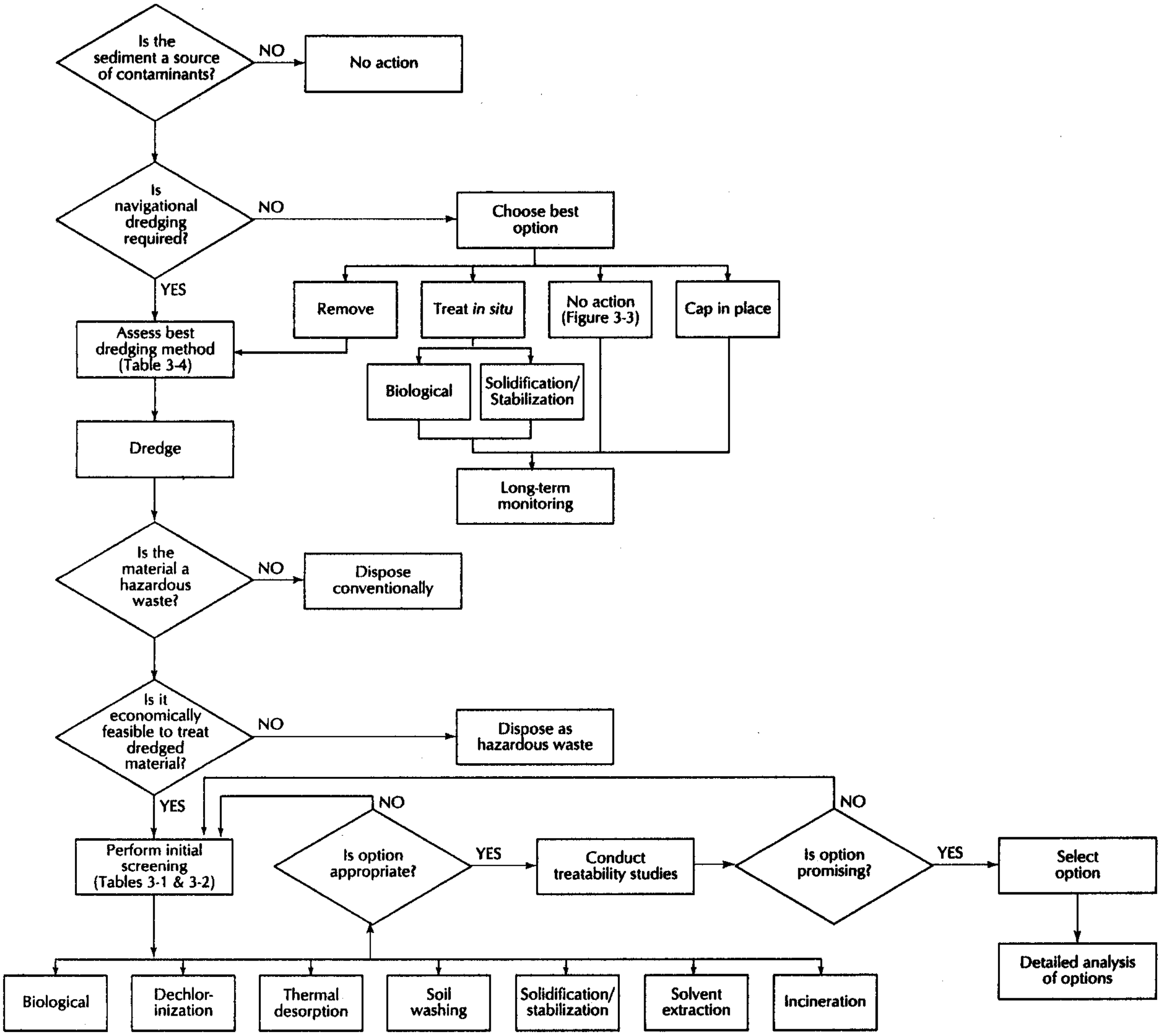
* NA = not applicable; capping technique

Again, cost estimates vary considerably dependent on surface area, depth, volume, and method cost. At approximately $50 per square yard, cost ranges from $13.2M to $33M; at $350 per cubic yard, cost ranges from $92.4M to $231M; at $1000 per cubic yard, cost ranges from $264M to $660M.

As would be expected, estimated costs associated with the larger area are considerably greater than those of the smaller site. Estimated costs for large-scale, sediment remediation range from $13.2 to $660 M; costs for a smaller site range from $0.3 to 33.7 M. These estimates indicate that the costs for sediment remediation can be substantial and must be considered in the RAP process. When considering an expenditure of this magnitude in a benefit-cost framework, a reasonable degree of certainty must be demonstrated that the remediation will be a long-term, sustainable action and that the probability of site recontamination is very low.

The Detroit River Technical Options Study (BEAK) examined many of the remedial technologies currently available. A summary of full-scale contaminated sediment treatment options and evaluation criteria (Bewtra et al., 1992) is presented from the report.

Figure 12
Remedial Options Decision Flowchart



Source: USEPA; *Selecting Remediation Techniques for Contaminated Sediment, 1993).*

Table 17
Summary of Evaluation Criteria for Full-scale Contaminated Sediment Treatment Options

Technology	Target	Application	Cost	Effectiveness
Indirectly heated thermal desorption	all organics	Europe	moderate-high	very effective
Lurgi travelling grate pelletizing process	all organics & inorganics	Europe	low	very effective
ABR/CIS microbiological *In situ* treatment	selected organics	Europe	moderate	mod. effective for organics
SILT bacteriological remediation	selected organics	Europe	low-moderate	very effective for organics
IHC rotary kiln incinerators	all organics	Europe	high	highly effective for organics
OES circulating bed combustor incinerator	all organics	USA	high	highly effective for organics
Desorption & vapor extraction (DAVE) system	VOCs & hydrocarbons	USA	N/A	very effective for organics
Mobile pit cleaning unit (PCU)	all organics	USA	N/A	very effective for organics
Chem-Matrix stabilization/solidification	all substances	North America	N/A	very effective
Krofchak solidification & stabilization	metal	Canada	low	very effective
Silt fixation	metal	Europe	low–moderate	effective
ToxCo chemical fixation & stabilization	metals & hydrocarbons	USA	low	effective
Beaver dredging pretreatment	all contaminants	Europe	low	effective
Bergman soil/sediment washing	all contaminants	Europe	moderate-high	effective
DJN dewatering	all contaminants	Europe	low	effective
IHC froth floatation	all organics & metals	Europe	high	very effective
Silt fraction separation & dewatering	all substances	Europe	low	effective
Vacuum & pressure filtration/dewatering	all substances	USA	low-moderate	very effective
DJN floatation	all substances	Europe	low	moderately effective
Melt-all electric fusion process	organics, radioactives & metals	Europe/Japan	moderate	effective
Phosphate fixation	selected	Europe	N/A	very effective

N/A = not available

(Bewtra et al, 1992. Virtual Elimination of Persistant Toxic Substances from Contaminated Sediments. Report prepared fot the International Joint Commission).

Proposed Detroit River Confined Disposal Facility

Background

The Detroit River is a major international shipping/navigational route which is subject to natural deposition of sediment. Periodic dredging of the lower river, on both sides of the Canadian/United States border, is required in order to maintain the shipping channels. Dredged material from this river is generally considered contaminated and is currently disposed of inside the U.S. Army Corps of Engineers' Confined Disposal Facility (CDF) at Pointe Mouillee, Michigan. The Canadian Coast Guard, as the Canadian agency responsible for shipping channels, has identified the need for a long term use CDF to be located in Canadian territory that will meet the lower Detroit River dredging needs for Canadian portions of the channel. Most dredging in Canadian water occurs in the Lower Livingstone and Amherstburg Channels.

In recognition of this need, the Canadian Coast Guard initiated a CDF site selection study in 1991. Their site selection study identified seven sites which would potentially meet the Canadian dredged material disposal needs in the lower Detroit River area. A detailed review of the seven sites, on the basis of technical, environmental and cost considerations, reduced the number of potential sites to three.

As the next planning step, it is intended to proceed with an initial assessment of the three alternative sites in accordance with the Environmental Assessment and Review Process (EARP) Guidelines Order of 1984. Also, a "do-nothing" alternative will be evaluated in the initial assessment.

Facility Design
The proposed CDF would be designed to contain about 1.5 million cubic meters of dredged material. This design should meet the dredged material disposal needs for approximately 25 years. The basic layout would be a multi-cell arrangement comprised of an overall rock perimeter dike, internal cross dikes forming internal cells, a decant area and an unloading dock facility. Access to the dock would typically require excavating a channel of sufficient width and depth to permit entry of barges.

Candidate Sites
The Phase 1 of a Site Selection Study for a Confined Disposal Facility at Amherstburg, Ontario (MacLaren Engineers, 1991) considered eight candidate sites in the lower Detroit River and recommended the following three candidate sites for further study.

Candidate Site #1

Candidate Site #1 is located at the southern end of Fighting Island. Up until 1980, this site was used for disposal of propylene oxide production byproducts and calcium carbonate waste slurry. The southern-most of three diked containment was identified as a potential CDF site.

Candidate Site #2

Site #2 abuts the western berm of the Upper Livingstone channel and is located southwest of Amherstburg in the Township of Malden. The area is situated between the international boundary to the west and the western berm of the Livingstone shipping channel to the east.

Candidate Site #3
Site #3 is adjacent to the south end of Boblo Island, directly across from the Town of Amherstburg. The boundaries are Boblo Island to the north, the Upper Livingstone shipping channel (downbound) to the west, and the west berm of the Amherstburg shipping channel (upbound) to the southeast.

Following the completion of the initial assessment and assuming a suitable site can be selected, construction would likely take place in 1995 or 1996.

Implementation

Priority Contaminated Sediments Areas

Key aspects concerning implementation of contaminated sediment remedial measures in the Detroit River are site location, source control, funding, and the cost/benefits associated with remediation. The primary implementation for the majority of the contaminated sites is the Michigan Environmental Response Act (MERA) 1982 PA 307 (now referred to as Part 201 of Act 451 of 1994). Act 307 requires the Department of Natural Resources to identify, evaluate, and rank all sites of environmental contamination in the state based on a site assessment which evaluates the risk a site poses to public health and the environment (please see discussion on page 61 of this document). The Act provides for an objective approach to site ranking by requiring the application of a numerical risk assessment model. The sediments of the Detroit River have been ranked collectively (no individual sites) with a score of 34 out of a worst-case 48. There is no similar corresponding legistation in Ontario.

The Contaminated Sediments Workgroup has prioritized the list of hotspots in Section 2 of this report for immediate individual Michigan Act 307 site consideration from MDNR, and immediate attention from MOEE. Sites from the 1991 MOEE (Beak) Survey with Mercury levels above the SEL (Severe Effect Level - MOEE Aquatic Sediment Guidelines) were targeted. This level is 2 ppm/dry weight. If the immediate upstream or downstream station also had elevated levels of Hg, (1/2 the SEL), 1 ppm/dry weight, then the sites were grouped.

The rationale behind using Mercury for prioritization over other parameters is because it is bioaccumulative and has pathways to humans via fish consumption. This is an impaired use in the Detroit River. The workgroup is aware that the majority of the contamination in the Detroit River directly impacts the benthos and indirectly impacts human health. The workgroup prioritized the indirect human health pathway above those of direct impairement to benthic communities in constructing this priority list.

The following Hg Zones are proposed for immediate Michigan Act 307 or Canadian Action:

U.S. Sites

Hg Zone 1:	Sites 9 & 189	South tip of Belle Isle
Zone 2:	Sites F & 13	Cobo Hall to Free Press
Zone 3:	Site 75	Ecorse Channel
Zone 4:	Site 85	Upper Trenton Channel
Zone 5:	Site O	Lower Trenton Channel

Canadian Site

	Site 12	Downstream of Railway dock

These zones are prioritized threats to the Detroit River ecosystem as related to mercury contamination. Sources to these zones, whether historical or current, appear to be partially of local origin. Levels of Hg are close to or below the LEL (Lowest Effect Level) immediately upstream of each impacted area. As an example, five sites at the head of the Detroit River all have Hg levels below the LEL. Sources to these Zones should be confirmed with a remedial investigation. In all cases, it will be up to the agencies to determine responsible parties at individual sites.

It is evident that to fully restore the use impairments "Restrictions on Dredging" and "Degraded Benthic Communities", many actions in the vicinity of the Detroit River watershed need to be completed. Timelines for action in the St. Clair River (year 2000), Clinton River, Rouge River (permits-2005), Detroit CSOs (control-2035) have direct impact on when the sediments in the Detroit River will be free from impact.

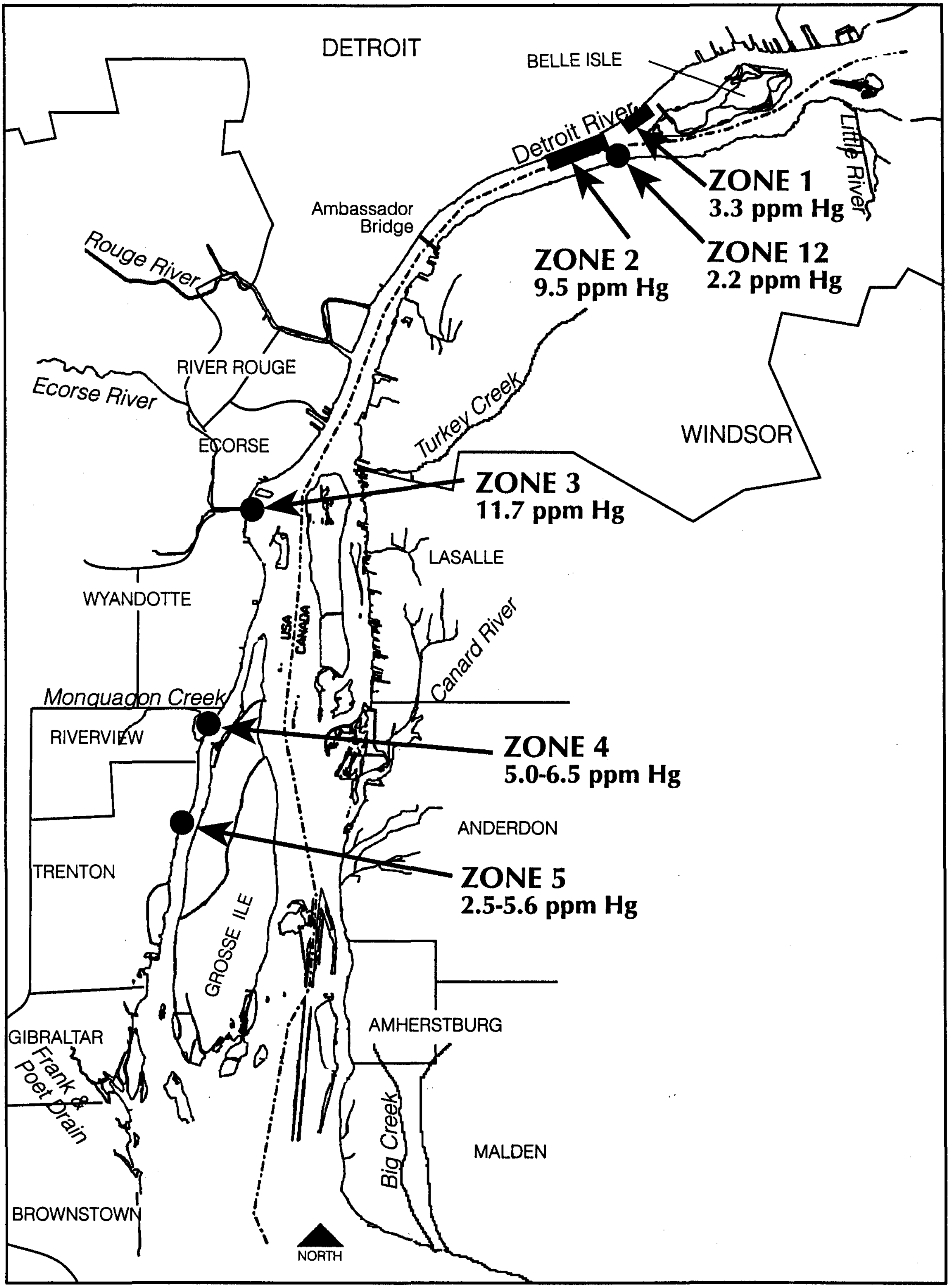
With the workgroups prioritized list of hotspots, immediate attention can be focused on those areas that are the highly contaminated above levels that current sources can account for. These sites can be progressively eliminated as sources of impairment to the AOC.

Other funding references applicable to contaminated sediment assessment and remediation include:

- Michigan RAP Financial Planning Guide. MDNR (Apogee Research Inc.) 1993.
- Ontario Potential Funding Mechanisms for Implementation of Remedial Action Plans and their Impact on User's,
- Beneficiaries, Polluters, and Society. MOEE (Hickling), 1992.
- Inventory of Ontario Provincial Funding Programs Applicable to Remedial Action Plans. MOEE, 1991.

There are also programmatic avenues to accomplish remediation objectives. One such effort is the Southeast Michigan Initiative, SEMI.

Figure 13
Canadian and U.S. Mercury zones



The Southeast Michigan Initiative

The United States Environmental Protection Agency (USEPA) and the Michigan Department of Natural Resources (MDNR) have launched a geographic initiative in the Southeast Michigan area because of the magnitude of contaminant releases and human population in the area. The Southeast Michigan Initiative (SEMI) area is defined as St. Clair, Macomb, Oakland, Livingston, Washtenaw, Wayne, Lenawee, and Monroe Counties.

There are several aspects to SEMI. One aspect is to approach environmental problems with flexibility and innovation that are not necessarily addressed by the traditional regulatory approach. Another aspect is to concentrate available resources from participating programs, as much as possible, on activities in the area that will result in a reduction of the overall risk to human health and the environment. The USEPA and MDNR recognize that in order for the SEMI to be fully implemented, that a Federal and State partnership must be secured.

The Cross-Media Geographic Approach

Concerns regarding environmental quality and the impacts of pollution are not media of facility specific. Citizens are concerned about the overall quality of their environment. Traditionally, environmental regulatory programs have focused on specific media and individual facilities.

The identification of Areas of Concern and the associated development of Remedial Action Plans, as well as the development of multimedia Lakewide Management Plans, has stimulated our Agencies to look at environmental problems from a geographic perspective. At the same time, we have recognized that most of our agencies program activities have been focused on individual facilities. However, in the natural world, pollution does not stop at the boundary of a facility, nor does it nicely remain in one medium. A facility, by itself, may be releasing contaminants at a rate which meet Federal and State standards, but taken in sum with its neighbor s releases, creates pollution at unacceptable levels. Furthermore, our focus on single media has led to pollution controls which sometimes merely transfer the pollution from one medium to another.

The Southeast Michigan area is major population center and numerous pollution sources in close proximity. The cross media focus of the Initiative will allow our individual programs to have a synergistic effect on the whole geographic area. Concurrently, the SEMI will initiate pilot programs to address environmental problems holistically.

Concentration Base Program Resources

In all likelihood, the Initiative will accelerate base programs in the Initiative area. It is recognized that the initiatives acceleration of a base program in the SEMI area may necessitate the re-prioritization of activities and the redirection of funds from other geographic areas of Michigan or the rest of Region 5 states.

Developing a Public Involvement Strategy for SEMI

The agencies will develop a public involvement strategy with the local communities concerning environmental issues, including prioritization of environmental programs, environmental risk, and issues of environmental justice. The strategy will be based on a dialogue that will keep the public informed about their environment, informed about and involved in agency decision-making where appropriate, and will inform the agencies about needs, issues, concerns, and priorities of the people whose environment the agencies are mandated to protect. The general public, local agencies, interest groups, and the regulated community will be included in the public involvement strategy, as well as other facets of the SEMI. The approach is intended to be bottom-u, rather than top-down.

The SEMI public involvement plan will be developed after concentrated work with the affected public. That will include interviews and round-table discussions to determine interest, level of knowledge, desire for education and input opportunities, etc. USEPA will coordinate its efforts to build upon the public involvement work of the Remedial Action Plans, the Rouge River Wet Weather Demonstration Project, and other State work.

Key Aspects of the SEMI

The SEMI is designed to provide a comprehensive and coordinated focus on environmental issues and regulatory actions in the designated geographical area. Key aspects of the initiative include:

1. Pollution Prevention

   For years, the regulatory agencies stressed end-of-pipe treatments rather than reducing the sources of releases. While this strategy has resulted in a significant reduction in pollution and corresponding environmental improvements, new strategies must be employed to realize continued improvements in the environment.

   The pollution prevention aspect of the SEMI will build on past regulatory successes, as well as current pollution prevention efforts in Southeast Michigan to effectuate further environmental improvements. Spill prevention controls and reduction of release sources will be parts of the pollution prevention efforts. A list of chemicals may be developed to assist in targeting pollution prevention efforts. At the same time, we recognize the need to incorporate pollution prevention goals into our base programs, where prevention is not already commanded by an environmental statute. An important facet of this activity will be to build a network of those engaged in pollution prevention activities in the SEMI region. Another will be to initiate and continue work toward these goals with industry.

2. Public Participation

   The SEMI area's multi-cultural population offers many perspectives on environmental issues. A SEMI public involvement strategy will be developed as a result of concentrated work with effected public. The strategy will focus on building on existing public participation activities and developing partnerships to further environmental protection, as well as a dialogue with the public about environmental justice issues, environmental risk and privatization of environmental programs. It is expected that one of the tasks initiated in the public involvement strategy will be to demographically chart exposure to contaminants and to share that information with the public.

3. Compliance and Enforcement

   The USEPA interdivisional enforcement workgroup will periodically meet with its MDNR counterpart to develop and implement a compliance and enforcement strategy. A key aspect of the strategy will be to utilize innovative methods such as multi-media inspection to promote and determine compliance in the SEMI region. Efforts will be made by the participating programs to secure the necessary data integration systems. One role of the enforcement workgroup is to ensure that pollution prevention, risk-reducing acceptable supplemental environmental projects, and critical habitat protection and enhancement are implemented in as many settlements as possible.

4. Remedial Action Plans & Sediments

   The Remedial Action Plans (RAPs) being developed under a MDNR lead for the five Area of Concerns in the SEMI region will be a priority activity. The initiative will highlight and further the work being done on these RAPs. A hot spot sediment remediation strategy will be developed and implemented.

The SEMI RAPs and Sediments Workgroup

The SEMI RAPs and Sediments Workgroup has drafted, as of August 1994, four primary goals to achieve with respect to sediment issues in Southeast Michigan. The goals are intended to fully support sediment issues, activities, and priorities being addressed by respective RAP efforts. They are:

Goal 1

Facilitate site-specific cleanups in support of RAPs based on currently available information.

Goal 2

Support a broad-scale sediment cleanup demonstration project from start to finish.

Goal 3
Support characterization of contaminated sediment problems in areas where more information is required, including initial assessments, identification of continuing and historic sources of contaminants, and determination of the lateral and vertical extent of contamination.

Goal 4
Provide technology support and transfer about sediment issues to load, state, and federal programs and organizations, as well as identify the resources potentially available to them.

These and other USEPA Region 5 Sediment Activities will continue to be developed, implemented, and completed under increased coordination with input from Stage 2 of the Detroit River RAP.

Detroit River Stage 2 Economic and Social Considerations

Stage 1 of the Remedial Action Plan (RAP) identifies impaired beneficial uses in the Detroit River Area of Concern (AOC). Each impaired beneficial use has an accompanying statement indicating a specific remediation goal. In particular, the Stage 1 RAP addresses an array of fish and wildlife issues as well as related biological concerns (e.g., benthic communities). There is also an identification of impaired beneficial uses that pertain to beach closings, restrictions on drinking water consumption, and aesthetics. While the latter concerns and fish consumption advisories are part of social and economic interests, they do not embrace the very substantial potential economic and social benefits from jobs creation, tax base retention and enhancement, infrastructure savings and recreational prospects that may occur from eliminating or mitigating contamination in the river sediments.

Based on studies undertaken for the Hamilton Harbor and Toronto AOCs, it is plausible to expect that the achievement of the Detroit River RAP goals will cost a minimum of several hundred million dollars and possibly exceed one billion dollars. To expedite acceptance of the goals and the requisite follow-through expenditure of such large sums, it is appropriate to analyze the returns that may be anticipated. While some will be satisfied with the fish, wildlife and water consumption goals as stated, others will be far more willing to support remediation expenditures if there is evidence of the economic and social advantages to be obtained as categorized above. The public is entitled to know, in advance of expenditures, what the approximate returns will be.

Economic benefits from the expenditures for cleanup per se are fairly direct and not the major consideration. Rather, it is the longer-term benefits from reinvestment and reuse of the shoreline land, and also the benefit in renewed use of water resources (e.g., fishing industry enhancements and recreation activities that provide the more substantial, relatively self-sustaining economic and social returns that might be appropriate for the justification of some remediation expenditures. Efforts to evaluate the possible economic and social returns described have resulted in estimates that indicate an approximately four-fold or greater financial benefit. (That is, for each dollar of cleanup costs, there are four dollars or more of economic benefits in terms of jobs creation, reduced expenditures for infrastructure, etc.). It may be inferred that the returns are higher, as no figure was provided for some of the benefits, (e.g., aesthetic improvements). Market potential, a critical component of any economic activity that may occur and a crucial consideration for reinvestment in previously developed waterfront properties, was not addressed in a document supporting the estimates. However, the importance of market feasibility analyses was underscored.

Riverfront housing, retail and commercial facilities, offices, recreational development, expansion of fishing industry activity and other uses that have been impaired may respond with positive, recurring and non-polluting benefits if the existing contamination problems are rectified. Examples of riverside investment with long-term positive impacts on jobs creation, tax base enhancement and other economic as well as social benefits include such well-known developments as the Renaissance Center, the City of Detroit's linked parks, Dodge Fountain and the Joe Louis Arena. These projects pre-date most of the stigma associated with polluted sites or water as well as the current liability for contaminated property. Therefore, they have had different investment desiderata than anything that might be developed along the river today. In response to legislation, combined with court interpretations, there is great resistance to any involvement by developers or financial institutions with any site that is contaminated or suspected of being contaminated. However, there are ways to overcome this problem. Among the contributing factors that would help to restore beneficial shoreline land use and revitalization of properties to the point of making a contribution to the region (as opposed to many existing instances intensifying blight and tax base losses) would be the remediation of sediment contamination as proposed by the Stage 1 RAP. Moreover, if restrictions to land use are applied, such as certain zoning categories, it may be possible to provide an important component of protection from future contamination, based solely on reuse of shoreline land.

It is reasonable to know, in advance of major expenditures for cleanup, what the economic and social benefits may be and to evaluate those benefits using analyses which address the crucial role of market prospects and land use changes. Realistic projections of potential jobs, real estate investments, marina developments, fishing industry gains, port facility developments and recreational uses, all of which may have beneficial impacts from cleanup, are part of the research warranted as are shoreline land uses which will inhibit future contamination.

Future Role of the Detroit River Contaminated Sediments Technical Workgroup

The workgroup has decided to remain as a forum for discussing contaminated sediments issues in the Detroit River. As agencies take responsibility for remedial implementations, the workgroup with its representation of BPAC, industry, academia, and agency personnel will serve as a platform to address issues and provide comments. The workgroup will continue to update the BPAC on the progress of contaminated sediment remediation in the Detroit River and the restoration of beneficial uses associated with them.

Closing

The Contaminated Sediments Workgroup met on eleven occasions from January 1993 to November 1994. MDNR and MOEE wish to thank those individuals who attended, especially the core participants whom without their help this report would have never been compiled.

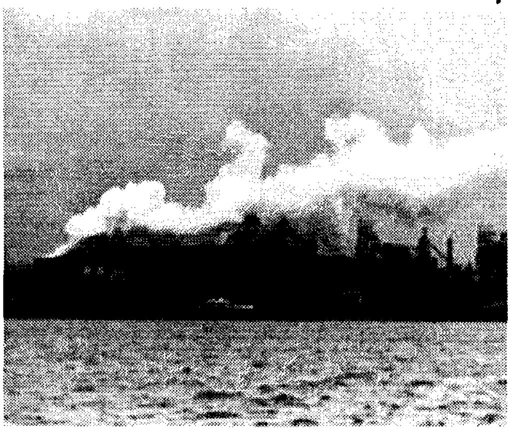
We wish to thank the facilities that hosted the workgroup. Changing the meeting locations provided a fresh perspective on the places that people live and work along the river.

A list of the topics covered at the meetings, along with the technical workgroup mailing list is located in Appendix 6.2.

Point/Non-point Source TWG Report

"The improved water quality in Lake Erie is a direct result of tremendous community effort and a commitment to utilize advanced technology to treat both industrial and domestic wastewater. We have before us, however, a major challenge in determining how to address pollutant sources that to date have been ignored like household waste and non-point sources. I have a reservoir of optimism that tells me we can do it if we decide we should."

Kathleen Leavey
Deputy Director
Detroit Water And Sewerage Department



The Point Source/Nonpoint Source Technical Work Group (PS/NPS TWG) focused on the six parameters identified in the Stage 1 Detroit River RAP as having exceeded water quality standards or objectives in the water column at some time in the past. These six parameters are; cadmium, copper, lead, zinc, mercury and PCB. Other parameters may also contribute to problems in the Detroit River. However, these substances have not yet been clearly identified. As research shows other substances or groups of substances to cause beneficial use impairments, the sources of the substance(s) should be evaluated and potential methods for load reductions should be examined.

The PS/NPS TWG defined point sources as input from clearly defined sources such as pipes which discharge directly to the Detroit River. Inputs from Lake St. Clair and the Detroit River tributaries were also generally treated as point sources. Combined sewer overflows (CSOs) are intermittent point sources, however, they are dealt with separately in their own chapter (chapter 10). Nonpoint sources were defined as inputs from defuse sources such as air deposition and runoff.

Monitoring/Modeling: The ASDM and KETOX models were used by the Contaminated Sediments TWG to model conditions in the Detroit River. Their results are detailed in chapter 8. The PS/NPS TWG has not performed an evaluation of the models or the model output as they relate to specific sources. Rather the group questions the adequacy of the currently available data. This is reflected in general point source recommendations 32 and 33, in several nonpoint recommendations, and in the high number of category 2 and 3 estimates present in the point source loading estimates. The PS/NPS TWG members felt their group lacked the expertise to fully carry out model evaluation and execution, and that such an activity should be carried out for the RAP as a whole rather than for individual TWGs.

Recommendation 31: The PS/NPS TWG recommends the formation of a Monitoring and Modeling group to oversee the collection of data and the evaluation of available models and model output for the Detroit River RAP.

Point Source Discharges

The Point Source Writers Group was formed by the PS/NPS TWG to evaluate the available information in the Stage 1 Detroit River RAP, update information and write regulatory, technical and monitoring recommendations for the Stage 2 Detroit River RAP. Membership was determined by volunteers from the PS/NPS TWG and consisted of representatives of direct dischargers from Michigan and Ontario, MDEQ and MOEE.

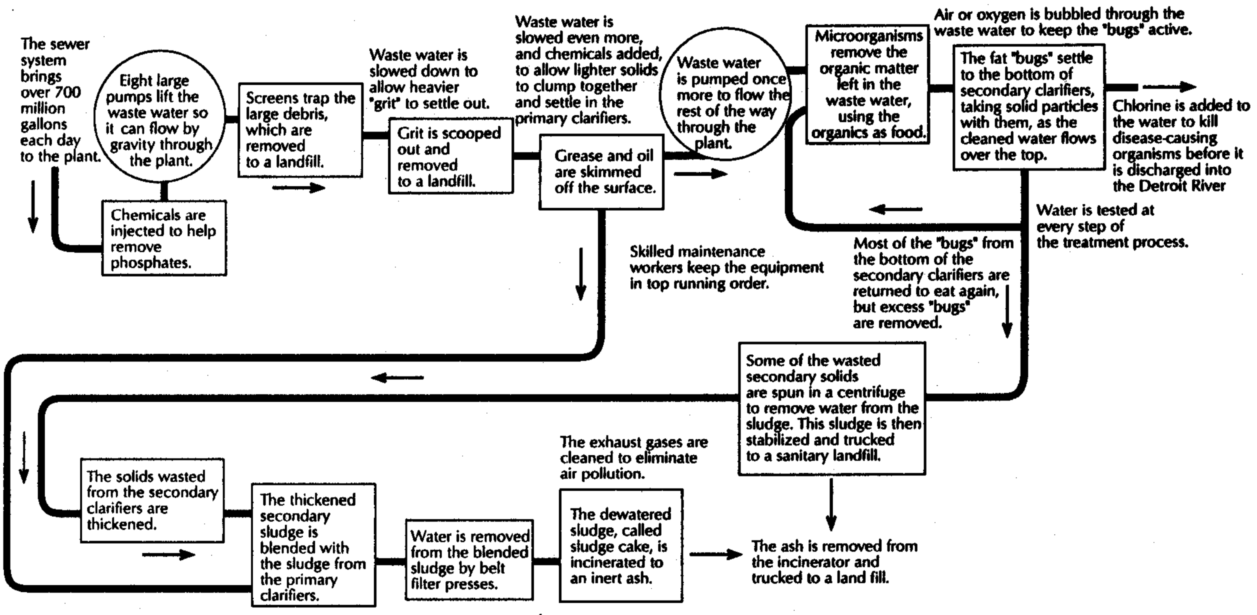
The various types of human water use create wastewaters that vary in the kinds and concentrations of pollutants that they contain. Industrial or commercial facilities may use water as a raw material, a means of production (process water), or for cooling purposes. Domestic or household water use (generally for cleaning and sanitary needs) also produces wastewater.

Municipal wastewater treatment facilities are primarily designed to address domestic wastewaters. However, they may receive wastewater from industrial, and commercial, as well as domestic sources. Extensive industrial pretreatment programs are therefore needed to "pre-treat" or clean up the industrial/commercial effluents prior to entering the municipal wastewater system (please refer to descriptions of the Industrial Pretreatment Program later in this report).

Treatment of municipal wastewater (Figure 14) generally consists of mechanical purification and chemical coagulation and flocculation (primary system), biological wastewater treatment (secondary system), carbon and/or sand filtration (tertiary system), and disinfection. Granular activated carbon may be added to the secondary treatment, this is referred to as the PACT (powdered activated carbon treatment) process. In this process activated carbon is regenerated by incomplete combustion of sludge.

Generally speaking, most metals will be removed by primary and tertiary treatments, while most organics are removed in the secondary and tertiary treatments. However, toxic metals and toxic organics should be prevented from entering the municipal wastewater collection system, since they may enter the receiving waters and end up in municipal sludge.

Figure 14
WWTP flow chart



Source: Adapted from City of Detroit, Wastewater Treatment Training Section and Public Relations Department, 1994.

Loading Updates

The PS/NPS TWG spent considerable time discussing methods to estimate point and nonpoint source loadings of the six parameters of concern in the Detroit River AOC. Methods for the treatment of values listed as "less than detection" were particularly contentious. In the end a method similar to that used on the Niagara River was used. A description of the protocol for calculating the estimates and of the categories is included below. The TWG supported this method with the knowledge that the resulting estimates would be higher than those generated by methods previously used and that the estimates could not therefore,be compared to previous load estimates. Support for this method was further based on the understanding that the resulting estimates would not be used for enforcement or permitting activities. Rather the point source estimates would be used in comparison to loading estimates of other sources using similar methodologies.

Complete estimates for 1992 and 1993, a cumulative discharge estimation table, and a description of the protocol used in the development of the estimates are located in Appendix 9.1. The estimated discharges which account for 95% of the estimated total load from regulated point sources to the Detroit River for 1992, and 1993 are listed in Appendix 9.1 Table Q. This is a summary table only; the full appendix and parameter examination section must be referred to in order to understand the implications of this summary data. Table Q does not include the confidence intervals for the category 1 estimates and confidence intervals were not possible for estimates in categories 2, 3 and 4. These estimates represent gross values as they do not consider concentrations of the parameters of concern in the facilities intake water. This is an important consideration when discussing facilities which use the Detroit River as a source for their non-contact cooling water.

Estimated loadings were generated for the Rouge River for copper, cadmium, lead, and zinc using this method. However, the data analyst was not comfortable generating loads for the head and mouth of the Detroit River due to the high number of results below the detection limits in monitoring carried out by MDEQ. The data from this monitoring is also included in appendix 9.1. The data base for nonpoint sources was also not of sufficient quality for load estimations.

Estimates for combined sewer overflows (CSOs) were updated by the CSO TWG and are contained in the CSO TWG report (chapter 10).

Point Source Load Estimation Protocol

A procedure was established for estimation of current (1992 and 1993) total point source loadings of parameters of concern in the Detroit River AOC and the individual loadings of significant point sources. The Technical Work Group agreed on the following principles to guide in the establishment of the procedure:

1) The best available data and information should be used in making the estimates.
2) Data will be analyzed and reported using appropriate methods consistent with good statistical practice.
3) Censored data (values reported as "less than detection limit") will be handled in a manner that will avoid arbitrarily high or low estimates.

The resultant procedure was based on work done previously for estimating point source loadings to Lake Superior (Dolan, et al., 1993) and load estimation for the Niagara River (El-Shaarawi and Dolan, 1989) and the Detroit River (Dolan and El-Shaarawi, 1989 and 1991).

Briefly, the procedure was to categorize each pipe from the Detroit River point sources into one of four categories and then using the above guiding principles to make annual load estimates for each point source. The estimates were sorted by load and placed in summary tables which include the number of samples taken and confidence intervals (where possible) as well as explanatory notes.

Category 1: Pipes in this category all had self-monitoring requirements for the parameter during the year being reported. Any data reported as "less than detection limit" was handled using the maximum likelihood estimation procedure. The computer program used to perform the calculations is called MANYDL. For data that is reported as "above detection" for the entire year, the MANYDL program gives a loading estimate equivalent to the annual average of monthly loads (weekly or daily if available). All data were assumed to be log-normally distributed in order to avoid problems with negative estimates for censored data. The confidence interval reported is the 95% confidence interval. The results are sorted by magnitude of the load.

Category 2: Facilities in this category all had compliance sampling by the Michigan Department of Natural Resources (MDNR) or the Ministry of Environment and Energy (MOEE). The results of these inspections were averaged to estimate a "typical concentration" and then multiplied by the annual average flow to obtain a load.

Category 3: Facilities in this category had no reported data for the year or all reported data was "less than detect". Other sources of information were used to estimate "typical concentrations" which were then multiplied by the annual average flow to obtain the load.

Category 4: Pipes in this category include point sources that have more than 75% of their self-monitoring data reported as "less than detect." Appropriate methods for the other categories were used to obtain loading estimates for the parameters of concern.

Sources of Data

All facility and pipe information for Michigan point sources was obtained from the U.S. EPA's Permit Compliance System (PCS). Equivalent information for Ontario point sources was obtained from printed reports on Ontario municipal and industrial dischargers published by MOEE. Effluent flows and concentrations for Michigan point sources were obtained from PCS with supplemental information for some facilities provided by MDNR. Effluent data for Ontario were supplied by the dischargers through the MOEE except for West Windsor and Little River which were provided directly by the municipality.

Inspection data for facilities in Category 2 were obtained directly from MDNR (CSI data) and MOEE (MISA Inspection data). Typical concentrations for facilities in Category 3 were obtained from a variety of references:

1) Point Source Methods Document (NOAA, 1993)
2) Source Investigation for Lake Superior (Dolan et al, 1993)
3) A Review of Pretreatment Programs at Municipal Sewage Treatment Plants in the Great Lakes (Municipal Pretreatment Task Force, 1990)
4) Detroit River Remedial Action Plan - Stage 1 (1991)
5) Upper Great Lakes Connecting Channels Study (1988)

Load Calculations

In keeping with the principles described above, annual average load estimates were made using all data available at the most intense frequency feasible. The basic procedure was to make a load estimate for each sample by multiplying flow times concentration and converting to kilograms per day. The sample size varied from 4 (quarterly) to 365 (daily) depending on existing monitoring requirements. The individual loads were then input to the program MANYDL and processed as described above under Category 1. If at least four samples were not available, then the calculations were handled as described under Category 2 or 3. (Appendix 9.1)

Cumulative Estimations

A summary was prepared for each parameter and year sorted by magnitude of the estimated load. The facilities were divided into groups representing 95% and 98% of the cumulative load estimate. The categories were retained in this summary to allow assessment of adequacy of monitoring and concentration values were retained to give an indication of the level of treatment. (Appendix 9.1)

Parameters of Concern

The TWG produced an individual examination of each parameter of concern with a discussion on the treatment mechanisms, inputs to the Detroit River and recommendations for point source control. These evaluations were done on the basis of total loading to the Detroit River and did not include the localized effects from individual discharges.

Several observations were common to almost all the individual parameter write ups. These write ups and resulting observations were based on the information that was available at the time and may change with the analysis of new data. The common observations include;

- Existing monitoring efforts are not complete. Many point source dischargers are not required to regularly monitor for all these parameters. In order to adequately evaluate if point source dischargers are a significant part of this problem regular sampling for all 6 parameters from all point source discharges where adequate data is not available will be necessary.
- Information from Stage 1 shows that, depending on the parameter, other sources contribute as much or more total loading to the Detroit River. Some of these sources, such as stormwater, have been uncontrolled. Greater total loading reduction may be accomplished through control of those sources.
- Generally, source control options (recycle/reuse/elimination) show the most promise for the reduction of the parameters of concern. Source control will also provide further gains toward the philosophy of zero discharge which will lead to the goal of virtual elimination of persistent toxic substances.

The recommendations for controlling the point source contribution to the total loading to the Detroit River could be summed up in three general recommendations (32, 33, and 34);

Recommendation 32: Continue data acquisition and evaluation on all point source dischargers for the parameters of concern at acceptable frequency and detection level to accurately define the total loading from each individual point source as well as the total load.

The implementation of this recommendation is affected by the activities of the other technical work groups. The linkages among the various remedial actions, their impacts on the restoration of beneficial uses, and the monitoring needed to confirm the expected improvements is provided by modelling. The KETOX and ASDM models have been endorsed by the Contaminated Sediments TWG. The other TWGs have not examined modeling to any great extent. Other modeling approaches, both in terms of level of detail and target media, are also appropriate and may be necessary in order to achieve all the goals of the Detroit River RAP. The following implementation strategy is made with the intention of providing sound data for use in this process.

Some definitions are necessary before outlining the implementation strategy:

Acceptable frequency A method for determining the acceptable frequency for a significant contributor of a parameter of concern needs to be established using scientific and statistical methods. If a point source is not a significant contributor of a particular parameter of concern, only the minimal data to verify the current status will be needed.

Detection levels Appropriate detection levels for the United States and Canada are found in 40CFR136 or Protocol for Sampling and Analysis of Industrial/Municipal Wastewater (Aug. 1994) respectively.

Implementation Strategy:

1. Data acquisition will begin for the purpose of updating the point source data base by October 1, 1996. The data acquired will be the results of all samples taken for significant contributors of the parameters of concern in the AOC and the associated flow rates. The data will be from computerized data bases such as the Permit Compliance System (PCS) or the Industrial Monitoring Information System (IMIS) to ensure the speed and accuracy of the update.
2. An annual review of all point source data will be conducted and completed within six months of the end of the calendar year under review.
3. Recommendations will be made, based on the results of the review, for changes in monitoring and or effluent limits consistent with the goals of the RAP.
4. The results of the review, in terms of summaries of total loadings of the parameters of concern and relative contributions of significant dischargers will be made publicly available in both hard copy and computer accessible formats.

Implementing Parties: MDEQ and MOEE will acquire and supply data to a RAP standing committee responsible for the review and analysis of the data.

Recommendation 33: Set up a river monitoring program which will determine the local impacts of discharges as well as the total loading to the river.

The monitoring program must be able to provide an ongoing assessment of environmental conditions to determine if the rehabilitation goals and objectives are being achieved (restoration of beneficial uses) and once established, that theses conditions are being maintained. The second purpose of this monitoring is to suggest corrective actions in the event that objectives are not being met. The programs should focus on two scales of monitoring, the local scale (where the impacts of individual outfalls are determined) and the river scale (where the impact of the entire AOC is determined in terms of total loading). The methods of sampling will be somewhat different for these two scales, although it is possible that there will be some overlap.

Total Loadings: Monitoring to determine the ambient water quality conditions in the Detroit River has been conducted by the MDNR since 1969. Consistent consecutive monthly sampling of the Detroit River, during the open water period, has been carried out for both upstream (Windmill Point) and downstream (Fermi) transacts since 1973. The upstream and downstream transects each consist of four and seven sampling stations respectively, located in both United States and Canadian waters. Monitoring was designed to document water quality, calculate loading rates, and determine water quality trends over time (MDNR 1993).

Local Impacts of Discharges: The strategy above provides "snapshots" in time and misses diurnal variations and would only by chance sample storm events or slug discharges. Lipid bags, sediments and biomonitors can be used to derive impacts over time. This type of monitoring has been used for a number of years to determine both local and larger scale impacts. Sites near outfalls would be chosen to determine local impacts, and sites identified in the MOEE Beak study (1991) would be used to determine river scale impacts. Sites similar to those outlined in the Beak study will need to be identified in United States waters.

A number of programs currently exist that could be modified or coordinated to achieve the objectives. Sampling programs at water treatment plants, MDEQ Ambient Water Monitoring, the U.S. Geological Survey National Water Quality Assessment (NAWQA) program for Lake Erie, the long term sensing project (MOEE), intake studies by Ontario Industrial Dischargers, sediment and benthic community sampling by MDEQ and MOEE, and ongoing and proposed studies by municipalities and industrial dischargers are all examples of efforts that could be coordinated to achieve the objectives. The U.S. EPA's Environmental Monitoring and Assessment Program (EMAP) can provide statistically based monitoring designs that would allow statements to be made about the condition of the river with known confidence.

Sampling and Analysis:Adequate protocols for sampling, analysis and reporting the data should be developed to ensure accuracy. This will result in appropriate and cost effective remedial actions. A work group similar to the River Monitoring Committee of the Niagara Toxics Management Committee which involved technical experts in each subject needs to be established to develop these protocols. Sampling and analysis protocols should be developed using current references (e.g. EPA and ACS recommendations). Reporting should include statistically based confidence intervals for all data.

Generally the source identification will be a local issue while methods of sampling, analysis, and data reporting should be a regional effort. Information exchange regarding equipment, protocols, training, and QA/QC methods is encouraged. This may involve a Great Lakes basin wide initiative. Official guidelines should be identified or developed and instituted.

Mass Balances: Balancing the results of load estimation for inputs, outputs and accumulation within the Detroit River system is a necessary step although sufficient accuracy may initially be elusive. Such balances should be attempted across the river and it's tributaries including all direct and indirect sources including atmospheric deposition.

Implementation Strategy:

1. A Monitoring and Modeling Committee should be formed (see recommendation 30). This committee should make an assessment of ongoing monitoring efforts and an evaluation of how current modelling efforts can assist the sampling and monitoring process.
2. The Monitoring and Modeling Committee should make recommendations for additional monitoring or modification of existing monitoring to address the following three areas:
   A. Tracking the restoration of beneficial uses
   B. Estimation of the total load of the parameters of concern at the head and mouth of the Detroit River.
   C. Monitoring of local impacts
3. The Monitoring and Modeling Committee will report these results to the RAP Team and BPAC on an annual basis. This report will be made publicly available in both hard copy and computer accessible formats.

Responsible Parties:

The MDEQ and MOEE should take the lead in implementing and insuring appropriate technical support for the above strategy.

Recommendation 34: Institute rigorous industrial pretreatment and source elimination programs to reduce the parameters of concern to the lowest practical level.

The best alternative for load reductions is to stop the parameters of concern from entering the waste stream in the first place. Some suggestions on how to strengthen existing IPP programs are included in the regulatory program recommendation section later in this chapter. Source elimination programs should be developed by all dischargers to identify where the parameters of concern are used in their processes and how that substance's use can be eliminated, reduced or recycled.

Industrial Pretreatment in the City of Detroit

The Environmental Protection Agency (EPA) through the Clean Water Act (CWA) and related regulations requires all Publicly Owned Treatment Works (POTW) to develop and implement Industrial Pretreatment Programs to control and monitor discharges into the POTW's collection system. As the control authority, the POTW must enforce effluent limits against certain industries and define conditions for discharge into the system by all other users through local ordinances.

The City of Detroit Wastewater Treatment Plant is a POTW and serves as the control authority throughout its service area of over 800 square miles. All of the approximately 77 local governments in Detroit service area have in place ordinances which delineate local limits (these are in addition to nationally required effluent limits) and generally outline the conditions for discharge into the collection system. The control authority has the ability to prohibit and take action to prevent any discharge by any user of the system (including domestic) which it determines has the potential to harm the system. Detroit enforces the Industrial Pretreatment ordinances for all of its service customers having acquired that authority via Delegation Agreements with each of its customers.

There are approximately 13,000 commercial and industrial sources which discharge into the Detroit POTW. Of those, approximately 446 meet either the federal or local criteria so as to require them to be monitored regularly. The POTW through its Industrial Waste Control (IWC) division issues permits to each of these 446 commercial and industrial facilities. These permits outline the conditions for discharge into the Detroit collection system including the specific effluent limits for the permittee. The permits also require the user to sample and report regularly to the control authority. The permits are renewable on a one year to five year cycle depending on the compliance history of the particular permittee. In addition to the self-monitoring and reporting, the industrial users (IU) are subject to comprehensive inspections and sampling by the control authority on a regular basis.

IU's found to be in noncompliance with their permits or the federal or local laws are subject to enforcement by the control authority. Enforce can range from a formal Notice of Violation to the prohibition of further discharges by the IU. There are some industries like metal platers that have literally disappeared because of their inability to stay in compliance.

Detroit's Industrial Pretreatment Program (IPP) has been in place for approximately ten years. It is currently being revised to reflect those ten years of experience in operation as well as to address changes in the federal legislation. In order to evaluate the success of the IPP in reducing harmful discharges to the surface waters, the IWC program has evaluated the character of the influent to the POTW for the years preceding the implementation of the IPP and the most recent year for which complete data was available.

Table 18 reflects an evaluation performed by IWC staff in 1980/81 of all known significant industrial users (144 at that time). The focus of the evaluation was metals which was the focus of the IPP legislation and program. Table 19 reflects the IWC evaluation performed in 1993 of all known significant industrial users (528 at that time). Significant industrial users was defined in both evaluations as those industries having flows greater than 50,000 gpd.

Table 18
1980/81 DWSD SIU Results

	Cadmium (Cd)	Copper (Cu)	Chromium (Cr)	Nickel (Ni)	Zinc (Zn)
SIU Contribution lbs/Year	24,185	148,470	432,800	370,510	506,000
Avg. Daily Loading lbs/Day	66.3	406.8	1,185.8	1,015.1	1,386.3

Table 19
DWSD SIU Contributions To Influent

	Cadmium (Cd)	Copper (Cu)	Chromium (Cr)	Nickel (Ni)	Zinc (Zn)
SIU Contribution lbs/Year	7,490	30,247	30,755	34,117	114,435
Avg. Daily Loading lbs/Day	20.52	82.87	84.26	93.47	313.52
% Reduction	69.3%	79.6%	92.9%	90.8%	77.4%

Table 19 also shows the percentage reduction in metals loading to the POTW from SIUs that have occurred since the initial study. Since implementation of the IPP began in 1986, it is not difficult to conclude that this activity significantly affected the discharge of metals to the POTW. A more detailed representation showing each year from 1982 to 1993 is found in Table 20. The major drop in influent loadings corresponds to the year the IPP was implemented, thus further supporting the conclusion that the IPP was the most significant cause of this drop. It should also be noted that average daily flows at the POTW have increased during this time frame.

Table 20
Detroit WWTP Influent Loadings 1982-1993 (lbs/day)

Year	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Nickel (Ni)	Zinc (Zn)	Avg. Daily Plant Flow
82/83	102	1,471	1,336	683	3.1	1,044	3,536	673,000,000
83/84	95	1,661	1,010	592	2.7	1,156	3,480	703,000,000
84/85	101	1,459	561	691	2.2	225	3,222	693,000,000
85/86	79	561	494	687	2.2	471	2,559	734,400,000
86/87	112	561	516	599	2.5	516	2,391	713,000,000
87/88	58	494	494	466	2.2	786	2,391	720,000,000
88/89	112	427	427	338	2.2	528	2,582	712,000,000
89/90	77	483	370	238	2.8	314	887	809,000,000
90/91	70	337	415	297	1.7	314	1,134	824,000,000
91/92	81	370	314	167	1.7	303	1,718	768,000,000
1993	75	265	316	160	1.41	221	1,198	717,600,000

Ambient water quality testing by the MDEQ also indicates substantial improvements at the mouth of the Detroit River beginning about 1986 (MDNR 1993). Further reductions in metals loading can be expected when the local limits study is completed since it is believed that the study will provide the basis for reducing the effluent limits allowed in IU permits.

Parameters of Concern

Parameter Examination: Cadmium

Background

Cadmium is a metallic element, atomic number 48 in Group IIB of the periodic table. The other Group IIB elements are zinc and mercury. Cadmium often appears in combination with other heavy metals, and its principal derivations are from zinc ores and zinc refining processes.

Levels of Concern

Levels of cadmium in the Detroit River are of direct concern as specified below:

GLWQA Annex 1 Specific Objectives: "The concentration of total cadmium in an unfiltered water sample should not exceed 0.2 ug/l to protect aquatic life."

Ontario Provincial Water Quality Objectives (PWQO): 0.2 ug/l

Michigan Water Quality Standards (Rule 57(2)): 0.4 ug/1.

Here are some additional water quality criteria for cadmium:

USEPA maximum contaminant level for drinking water (40 CFR 141.11(b)): 0.010 mg/1

USEPA Great Lakes Water Quality Initiative (GLWQI) Tier 1 aquatic life criteria (USEPA notes that the toxicity of cadmium is hardness dependent; therefore, all data used in their criteria calculations were normalized to a hardness of 50 mg/1):

Final Acute Value (FAV): 4.591 ug/1
Criterion Maximum Concentration (CMC): 2.3 ug/1
Final Chronic Value (FCV): 0.3166 ug/1
Criterion Continuous Concentration: 0.32 ug/1

Cadmium is included in the GLWQI list of "pollutants that are neither bioaccumulative chemicals of concern nor potential bioaccumulative chemicals of concern".

Waste Water Treatment Technologies

Treatment processes employed for the reduction of soluble cadmium and its compounds in waste waters are similar to those used for other heavy metals: precipitation and disposal of resulting sludge solids, or a recovery process such as ion exchange, electrolysis, reverse osmosis, or evaporation. Final polishing can be achieved by the use of various adsorbents, notably charcoal.

Metals precipitate at various pH levels, depending upon such factors as the metal itself, the insoluble salt that has been formed (e.g., hydroxide, carbonate, sulfide, etc.), presence of complexing agents such as ammonia, citric acid, EDTA, etc. When two or more heavy metals are found in the same wastewater, the optimum pH for precipitation may be different for each ion. The question then becomes whether it is possible and practical to precipitate one or more of the metals separately at one pH, and then the remaining ions at another pH. Alternatively, it must be determined if one pH can be found which will produce satisfactory, though not optimum, insolubility for each of the metal ions present in the wastewater. Additionally, the pH of the treated effluent must then be readjusted to render it acceptable for discharge.

Cadmium as hydroxide, carbonate, and sulfide forms an insoluble precipitate. Whit lime or caustic used to form the hydroxide, pH should be maintained at about 11 for maximum insolubility. This will result in optimal precipitation of nickel and zinc hydroxides, but will result in solubilization of the hydroxides of iron (III), chromium, and copper. Treatment of cadmium with sodium carbonate will give good levels of removal at a slightly lower pH, in the range of 9.5 - 10. Sulfide precipitation can be carried out at low pH with good removals.

The cost-effectiveness of the various recovery processes is largely dependent upon the concentration of cadmium in the wastewater and the presence of other interfering compounds. These processes are probably only economically feasible for treatment of wastestreams such as cadmium electroplating solutions.

Levels and Inputs in the Area of Concern

Table 21
Cadmium — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	12.5364	0.5	4.099	0.0274
1993	11.8352	0.4	N/E	N/E

(See Appendix 9.1 and 9.2 for 1992, & 1993 Point Source Estimates) On a national scale, about half of the cadmium produced is used in electroplating other metals. Cadmium metal is use in a wide variety of products: bearings, brazing and low-melting alloys, nickel-cadmium batteries, welding rods, and nuclear reactor control rods. Cadmium compounds are employed in such common and diverse products such as TV phosphors, pigments in glazes and enamels, dyeing and printing textiles, power transmission wire, lasers, photography and lithography, dry film lubricants, plastic stabilizers, semiconductors, pyrotechnics, rectifiers, photoelectric and solar cells, and fungicides.

Cadmium levels in the Detroit River are a function of several input mechanisms, including: loadings in influent waters (the Upper Great Lakes and tributaries, most notably the Rouge and Ecorse Rivers); point source discharges (effluents from POTWs and industrial sources); non-point source discharges (stormwater including CSOs, atmospheric deposition, household hazardous wastes, etc.); and re-entrainment of contaminated sediments. Table 8-43 in the Stage 1 RAP document shows the relative contributions of cadmium to the Detroit River from these various input mechanisms.

Direct discharge of cadmium to surface waters are already regulated by the NPDES Permit Program in Michigan and the Clean Water Regulations in Ontario. POTWs on both sides of the Detroit River have authority to identify and regulate industrial users which discharge cadmium into the POTW sewer systems. However, the relative contributions of cadmium to the Detroit River in discharges of the DWSD WWTP and the Wayne County Wyandotte WWTP indicate that there are significant sources of cadmium in the sewer system influent to their respective treatment processes. Considering the diverse sources of cadmium, it is likely that many sources of cadmium to the POTW sewer system have not yet been identified, and controls on these discharges have not been implemented.

Also, considering the relative contribution of cadmium to the Detroit River by Michigan CSOs, it is possible that urban runoff during non-CSO periods could also be contributing to influent loading of the POTW sewer systems. Atmospheric deposition of cadmium onto land surfaces and areas which have been contaminated by current or past industrial practices could be sources of contaminated runoff during both CSO events and non-CSO periods.

Conclusions

- Due to the AOC loadings from the effluent of the Detroit Water and Sewerage Department (DWSD) WWTP and the Wayne Count Wyandotte WWTP, sources of cadmium to the POTW influents should be investigated and identified; and, reductions made where required.
- Continue monitoring for cadmium in effluents from all major point source discharges on both sides of the Detroit River.
- Air quality data should be reviewed to determine the amount of cadmium which is deposited on the surrounding land surfaces and subsequently washed into surface waters in stormwater runoff, during CSO events and non-CSO periods.

Recommendation 35: Further investigative work should be conducted on the Rouge and Ecorse Rivers to determine the sources of cadmium loadings in these tributaries to the Detroit River.

PARAMETER EXAMINATION: COPPER

Background

Copper is a common metallic element found in the earth's crust. Sources and pathways that allow copper to enter the aquatic environment include natural sources such as weathering of minerals. Anthropogenic activities release significant quantities, up to 60% of the total impact; these include corrosion of copper pipes, sewage treatment effluents, run off from agricultural uses and industrial sources.

Copper exhibits complex behaviors in the aquatic environment. It may be present in solution as cupric ions or complexed with inorganic or organic ligands and can be in bed sediments. Copper is readily accumulated by plants and animals but it is believed that copper is not biomagnified to any significant extent. Copper salts do not appear to be carcinogenic.

Levels of Concern

Copper in drinking water (Ontario):
- M.D.C. - aesthetic objective 1.0 mg/l
- M.A.C. - no health level is set

Ontario provincial water quality objective is 5 ug/l

Ontario recommended criteria of livestock watering is 0.5 mg/l

U.S. EPA has set the maximum contaminant level for drinking water at 1.3 mg/l, and most other U.S. agencies use 1.0 mg/l.

U.S.S.R., however, set the acceptable level as 0.05 mg/l.

Waste Water Treatment Technology

Treatment processes employed for the reduction of soluble copper compounds in waste waters include precipitation and disposal of resulting sludge solids or a recovery process such as ion exchange, evaporation and electrolysis.

Precipitation The standard method for copper removal is precipitation as the relatively insoluble hydroxide, at alkaline pH. Lime is the usual material used. The lowest level achievable is 0.01 mg/l which is the minimum solubility of cupric oxide which forms from the hydroxide at a pH between 9.0 and 10.3. However, it is to be noted that this theoretical level is not reached very often and the presence of other compounds complicates the process and affects the levels that can be achieved. Ranges from 0.3 mg/l to 2.2 mg/l have been reported from various waste water treatment processes designed for copper removal.

Capital costs vary, depending on the process, from $245 per 1,000 US gallons/day treated (1979 dollar basis).

Ion Exchange Costs are high compared to other treatment processes and is not considered practical.

Electrolytic Recovery This process is possible for relatively concentrated waste solutions. Dilute solutions; treatment for concentrations less than 2 g/l is impractical due to high power consumption.

Levels and Inputs in the Area of Concern

Table 22
Copper — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	63.5618	13.4	5.953	1.096
1993	67.1429	14.0	N/E	N/E

(See Appendix 9.1 and 9.2)

Loadings

Loadings from the Detroit WWTP were estimated at 46.9 Kg/d (concentration 16.5ug/L) and 52.3 Kg/d (concentration 19.25 ug/L) for 1992 and 1993 respectively, making this the largest point source of copper for the two years. Appendix 9.1 contains a comprehensive list of point source estimates for 1992 and 1993.

Concentrations

From Ambient Water Quality Data (Appendix 9.2) the concentrations of copper at the lower transect of the Detroit River are within water quality criteria (the current Michigan Rule 57 level is 11.0 ug/L, Ontario PWQO is 5 ug/L). Some exceedances may be occurring in the Trenton Channel.

These values are far lower than the required standards for drinking water of 1.0 mg/l.

It is noted that the 1987 UGLCCS report gives a value of 20.5 kg/d for the combined loading from the Rouge and Ecorse Rivers; this is a significant contribution.

Conclusion

Due to the high loadings from the Detroit WWTP, sources of copper in the area served by the WWTP should be investigated under the Industrial Pretreatment Program and, if possible, reductions be made at source.

Recommendation 36: Further investigative work should be conducted on the Rouge and Ecorse Rivers to determine where the high loadings are originating.

Implementing Parties: MDEQ Timeline: Immediate and continuing

Possible Funding: Additional funding from existing sources

Parameter Examination: Lead

Background

Lead is one of the oldest metals known to man; artifacts have been discovered that date from 3000 B.C. It was mined in considerable quantities by the Greeks and Romans and has continued to be of commercial significance throughout modern history. In North America, lead was mined and smelted as early as 1621.

Leads properties include: low melting point, ease of casting , high density, low strength, ease of fabrication, acid resistance, electrochemical resistance, electrochemical reaction with sulfuric acid and chemical stability in air, water, and earth. The principal uses of lead and its compounds in descending order are storage batteries (about half of total U.S. consumption), pigments, ammunition, solders, plumbing, cable covering, bearings, and caulking. Lead ranks fifth in tonnage consumed after iron, copper, aluminum, and zinc. Secondary lead (recycled) is becoming the main source of lead. This supply, supported mainly by recycled automobile batteries, should continue its steady growth as an increasing proportion of the total consumption is for lead batteries continues.

Levels and Inputs in the Area of Concern

Table 23
Lead — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	68.7768	9.1	13.222	0.822
1993	66.0277	69.9	N/E	N/E

(See Appendix 9.1 and 9.2)

- The largest estimated point source loading for 1992 and 1993 was the Detroit WWTP at 32.7 and 27.1 Kg/d.
- MISA data (1990) indicate loading from Ford at 4.7 kg/d, and General Chemical at 10.7 kg/d. 1992 estimates are 5.5 kg/d and 2.1 kg/d respectively, while 1993 estimates are 3.8 kg/d and 2.1 kg/d.
- Most NPDES permits for U.S. point sources only have monitoring requirements for lead.

Conclusions

- Continue monitoring for lead in effluent from all major point source discharges.
- Implement and enforce Industrial Pretreatment Programs and Municipal Sewer Use Bylaws to reduce inputs of lead to lowest practicable level.
- Domestic water distribution systems should be investigated as sources of lead to the Detroit River.

Parameter Examination: Polychlorinated Biphenyls (PCBs)

Background

PCBs are synthetic organic compounds that were first described in 1881 by Schmit and Schultz. The potential industrial applications were not fully realized until about 1930 (Waid, 1986). PCBs are produced by chlorinating the biphenyl compound which has 10 positions available for chlorine atom. Different structural arrangements make possible 209 compounds distributed among the 10 levels of chlorination. The individual isomers of the chlorobiphenyls vary from liquids to waxes to crystalline solids. Commercially processed isomers were produced to give products having properties that are quite different, particularly in crystallinity and liquid range, compared to the individual isomers. PCBs are considered to be generally chemically inert but, will react with certain material under high temperatures conditions. PCBs are essentially insoluble in water, glycerol, and glycols but are soluble in most of the common organic solvents. The outstanding physical and chemical characteristics of PCBs are their thermal stability, resistance to oxidation, acids, bases and other chemical agents, as well as their excellent dielectric (insulating properties), low solubility in water, low vapor pressure, low flammability, high heat capacity, and suitable viscosity-temperature relationships.

The physical properties of PCBs prompted their use in numerous industrial products. PCBs have been used extensively in the electrical industry and in coolant systems, because they do not conduct electricity and are capable of withstanding high temperatures for long periods. PCB was used as a dielectric medium in transformers, either alone or in blends with other materials such as trichlorobenzene and as the dielectric impregnating medium in capacitors. Other uses included plasticizers; as ingredients in lacquers, paints and varnishes and adhesives; as water proofing compounds in various types of coatings; as lubricants or lubricant additives under extreme conditions; as heat transfer fluids; as fire resistant hydraulic fluids; as vacuum pump fluids; and as air compressor lubricants. PCBs were also found in such materials as pesticides extenders and for microencapsulation of dyes for carbonless duplicating paper. They were also used as a catalyst carrier in the polymerization of olefins, in the conversion of water-permeable solids to non-permeable states and combined with insecticide and bactericide formulations. Mixtures of PCBs and chlorinated naphthalenes were also used to insulate electric wires and cables in mining and shipbuilding.

Initial concern about the health effects of the various commercial PCB mixture originated when chloracne and hepatic changes were seen in workers who were involved in the production of these compounds or who were in direct contact with materials containing them. Later concerns over environmental impacts of vast quantities of PCB in the environment became evident in a 1966 in a toxicology report by Jensen on fish. The report found elevated levels of PCB in the tissues of fish. PCBs are fat soluble and are stored in the lipids of animals. They tend to be concentrated in animals high in the food chain because of their resistance to metabolic change. The higher the chlorine content of PCBs, the more resistant they are to biodegradation. Animal studies have also shown that PCBs can cross the placental barrier and are excreted in the mother's milk.

The largest producer of PCBs in the U.S. was Monsanto Chemical Company, which sold them from 1929 to 1975 under the Aroclor trademark. The most common Aroclor preparation include 1242, 1248, 1254 and 1260. The first two digits are the number of carbon atoms on the biphenyl group and the last two digits give approximate % Cl content in the PCB preparations.

U.S sales of Arochlors ranged from 32 million pounds in 1957 to eight million pounds in 1970. Transformers and capacitors comprised the largest applications segment for this compound, accounting for 29 million pounds in 1969. From 1929 to 1975, approximately 1.4 billion pounds of PCBs were manufactured in the United States. Although most U.S. manufacturers voluntarily halted large-scale PCB production in 1972, minute quantities of PCBs are manufactured for analytical test standards or inadvertently created in chemical processes. PCBs were also produced in France, Germany, Italy and Japan, and used in industrial applications worldwide.

Enacted in 1976, Toxic Substances Control Act directed the U.S. EPA to regulate the manufacture, processing, distribution in commerce, use, marking, storage and disposal of PCBs. Most industrialized nations have since imposed their own controls of the use and disposal of PCBs. For example, Japan has strictly regulated PCBs since 1973; Canada and Germany passed their first PCB ordinances in 1978, and Norway followed in 1980; the United Kingdom controls halogenated wastes, mainly under its 1980 Control of Pollution Regulations; and most members states of the Organization for Economic Cooperation and Development have also imposed some regulations on the manufacture and disposal of PCBs.

The abrupt U.S. PCB ban in 1976 was partly motivated by the discovery of widespread, low-level PCB contamination worldwide. Numerous studies had revealed the presence of PCBs in European rivers, lakes and oceans, as well as in the Great Lakes and in the Arctic ice caps.

Levels of Concern

Michigan Rule 57 (2) Allowable level -0.00002 ug/l

Ontario provincial water quality objective - 0.0001 ug/l

Detroit River RAP Water Use Goal - 0.00002 ug/l

PCB Disposal and Destruction

The *PCB Management Handbook* provides the following information on this issue:

Toxic Substances Control Act limited the options to generators of PCB waste and provided detailed technical requirements for PCB destruction by disposal companies. The disposal of PCBs under TSCA and hazardous waste under RCRA are mutually exclusive; a PCB disposal permit does not automatically allow disposal of RCRA hazardous waste and vice versa.

EPA has approved several PCB disposal approaches:

- High temperature incineration
- Landfill disposal
- Other techniques, including chemical dechlorination

Levels and Inputs in the Area of Concern

Table 24
PCB — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	0.5426	N/E	0.016	0.003
1993	0.6214	N/E	N/E	N/E

(See Appendix 9.1 and 9.2)

The Detroit WWTP reported a discharge of 0.89 Kg PCB in 1993 (Ross and Associates 1994).

Conclusions

- Since PCBs have been banned, they will most likely stem from sources other than traditional point sources such as: contaminated sediments, Act 307 sites, unknown sites and atmospheric deposition.
- Considering the PCB ban already in place and stringent regulations on PCBs, future reductions in the PCB loadings will be more difficult to achieve.

Recommendation 37: A quantitative evaluation of nontraditional sources is necessary to accurately qualify and quantify source loadings for the expressed purpose of control and elimination.

Recommendation 38: A program for the elimination of PCBs currently in use (electrical transformers and capacitors for example) should be actively pursued.

Recommendation 39: A minimization plan for PCBs in the Detroit Waste Water System will be developed and implemented. (Please refer to Chapter 10, CSO Report - PCB and Mercury Minimization Program)

Parameter Examination: Zinc

Background

Zinc is a lustrous, blue-white metal that is relatively active and forms many stable compounds. Zinc is present in all living organisms and ranks with the most abundant of trace metals in man. As far as is known all living things require zinc; it is a constituent of all cells serving in many essential enzyme systems. Zinc is not found free in nature but in many different compounds and as a result was discovered much later then less-reactive metals such as copper, gold, silver, iron, and lead. The Romans used zinc found in copper ores as early as 200 BC to make brass. Zinc smelting is thought to have originated in China in the seventh century. Zinc was first produced in the United States at the arsenal in Washington D.C., in 1835, and by 1860 The New Jersey Zinc Company had well-established smelting operations at Bethlehem, Pennsylvania.

Zinc is a metal that has a low intermediate hardness and can be formed into virtually any shape by common metal forming techniques such as rolling, drawing, extruding. It also has a standard electrode potential and is electropositive to most structural metals except Aluminum and Magnesium. These properties are the basis for many important applications such as zinc usage in batteries. The most significant chemical property of zinc is its high reduction potential. For this reason, zinc is used extensively in coating steel by galvanizing. Methods of zinc galvanizing include hot-dip galvanizing, continuous-line galvanizing, electrogalvanizing, zinc plating, zinc spraying, and painting with zinc-bearing paints.

Zinc is used in die-casting alloys. The principle consumer is the automobile industry where uses include handles and locks, mechanical components, electrical components, body hardware and trim, lamp and lighting fittings, instruments, and other components. Zinc die-casting is also used in building and construction industry for covered door and window hardware, locks and keys, furniture and cabinet hardware, hand tools and cutlery, bathroom and plumbing fittings, and general hardware.

Levels of Concern

1 U.S. EPA Drinking Water Level - No maximum contaminant level or maximum contaminant level goal.

2 Michigan Department of Health Fish Consumption Advisory Trigger Level - None

3 U.S. EPA Region V Guidelines for Classification of Great Lakes Harbor Sediments:

- Non-polluted <90 mg/kg
- Moderately polluted 90-200 mg/kg
- Heavily polluted > 200 mg/kg

4 Great Lakes Water Quality Agreement, Ambient Water Quality Specific Objective - 30 ug/l.

5 Michigan Water Quality Standards Rule 57 (2) Level - 49 ug/l Ontario Provincial Water Quality Objective - 30 ug/l

Wastewater Treatment Technology

1 Solids Filtration
  - low to medium cost
  - effective on suspended solids only

2 Ion Exchange - Remove and exchange zinc ions from the water
  - high capital and maintenance costs
  - effective on suspended and dissolved solids

3 Reverse Osmosis - Filter contaminated water through semipermeable membranes
  - high capital and maintenance costs
  - effective on suspended and dissolved solids

4 pH Adjustment/Precipitation/Filter Press Removal
  - high capital, maintenance and operation costs
  - require full time personnel to maintain and operate

Levels and Inputs in the Area of Concern

Table 25
Zinc — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	371.933	44.1	33.274	3.562
1993	402.284	67.0	N/E	N/E

(See Appendix 9.1 and 9.2)

- MDNR 20 year trend analysis (MDNR 1993) for zinc in the Detroit River indicate a downward trend for both concentration and loading.
- Due to galvanized roofing materials, roof runoff is a significant source of zinc.

Conclusions

Direct point sources contribute approximately 25% of the zinc loadings. The majority of point source zinc concentrations are near or below the Michigan Rule 57 (2) Water Quality Standards and the GLWQA specific objective. Therefore, no additional end of pipe treatment is recommended at this time to reduce point source inputs of zinc.

- The MISA regulation passed in 1994 for the Ford of Canada casting plant required a reduction of zinc levels in the discharge to the Detroit River. Ford Canada has plans to install a physical/ chemical plant. Currently they are conducting pilot plant work with consultants to determine the most effective process.

PARAMETER EXAMINATION: MERCURY

Background

Mercury is a dense, silvery-white metal that is in the liquid state at room temperature. Pure mercury generally has a clean, bright appearance. Below its melting point, mercury is a white solid while above its boiling point a colorless vapor. Mercury in nature occurs mainly in combination with sulfur to form more than a dozen different minerals. Amalgams have a lower specific gravity and float on the surface, causing the bright, mirror-like surface to become dull and black.

The first recorded mention of mercury was by Aristotle in the fourth century BC, and was used during religious ceremonies. The ancient Egyptians, Greeks, and Romans used mercury in cosmetic and medical preparations and for amalgamation. In 1643 Torricelli invented the barometer using mercury to measure atmospheric pressure of the atmosphere, and in 1720, Fahrenheit invented the mercury thermometer. Continued research on mercury's physical and chemical properties resulted in rapidly expanding industrial use after 1900, particularly in electrical applications. The invention of the mercury battery in 1944 immediately caused a sharp and continuous rise in mercury consumption.

Mercury has a uniform volume expansion over its entire liquid range. This property along with its high surface tension and inability to wet and cling to glass, makes it useful for barometers, manometers, and the thermometers, as well as many other measuring devices. Mercury has the ability to form alloys with almost all other metals including iron at high temperatures. Because of its low electrical resistivity, mercury is rated as one of the best electrical conductors among the metals. Mercury also has a high thermal conductivity which enables it to be used as a coolant. At room temperature, Mercury is stable and does not react with air, ammonia, carbon dioxide, nitrous oxide, or oxygen. It combines readily with the halogens and sulfur, but is little affected by hydrochloric acid, and is attacked only by concentrated sulfuric acid.

Mercury is used in a variety of applications these including agriculture use (in compounds to make pesticides), as catalysts, electrical applications (including batteries, electric lamps, and wiring and switching devices), electrolytic preparation of chlorine and caustic soda, industrial and control instruments use to measure and control reactions and equipment functions (examples include: thermometers, barometers, pressure-sensing devices, gauges, valves, seals, and navigational devices), paint, laboratory uses, pharmaceutical and other uses include heat transfer, pigments, refining lubricating oils, and research.

Levels and Inputs in the Area of Concern

Table 26
Mercury — Current Loading Estimate

Year	PS Est.	Rouge	CSO-DWSD	CSO-Windsor
1992	0.7291	N/E	2.893	0.006
1993	0.7857	N/E	N/E	N/E

(See Appendix 9.1 and 9.2)

Conclusions
No additional end of pipe treatment is recommended at this time with respect to reducing direct point source inputs of mercury.

- Continue monitoring for mercury in effluent from all major point source discharges.
- Implement and enforce Industrial Pretreatment Programs and Municipal Sewer Use Bylaws to reduce inputs of mercury to lowest practicable level.

Recommendation 40: A quantitative evaluation of nonpoint and nontraditional point sources is necessary to accurately quantify and qualify source loadings of mercury for the purpose of control and elimination.

Recommendation 41: A minimumization plan for mercury in the Detroit Waste Water System will be developed and implemented (Please refer to Chapter 10, CSO Report - PCB and Mercury Minimization Program).

Point Source Regulatory Program Recommendations

The TWG also evaluated the regulatory programs of Michigan and Ontario and listed recommendations to help those programs work better. Those recommendations immediately follow this summary and can be grouped into three common areas;

Recommendation 42: Maintain good communication, in both directions, from the National level to the facility level. Some facilities need regulatory requirements to be fully explained and help with technical issues. More, well trained regulatory field staff are needed to interact with a greater number of dischargers more frequently.

Implementing Parties: State, Provincial, and Federal Governments

Timeline: Immediate and continuing

Possible Funding: Much can be accomplished under existing programs. The Michigan DNR has recently established an Environmental Services Division which will implement many facets of this recommendation.

Recommendation 43: Streamline the data acquisition process. Use computer data bases and electronic transfers of monitoring data to make data more accessible, easier to use, and readily accessible to the public. Eliminate unnecessary or redundant paper work.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: Existing programs

Recommendation 44: New, long term planning programs are needed. A pollution prevention program needs to be established or continued as necessary to help keep substances out of the waste stream to begin with. New funding mechanisms are needed. Stronger authority to local governments to levy fines for programs under their direct jurisdiction is necessary.

Three pollution prevention activities were funded in Southeast Michigan in 1995 through SEMI (Southeast Michigan Initiative, a joint US EPA - MDEQ venture). They include;

1) $95,000 grant to SEMCOG to work with publicly owned treatment works to develop pollution prevention technology and management practices,
2) $50,000 grant to MERRA for the developing an industrial pollution prevention network in Southeast Michigan. A self-sustaining organization of pollution prevention service providers has been formed and an organization for industry, organized by the industrial sector is in the process of being formed.
3) $35,000 grant to SEMCOSH to explore labor/management pollution prevention focus groups.

Information/Education

Recommendation 45: DNR and MOEE should provide more information to dischargers on their programs and treatment technology. Industrial dischargers were particularly interested in receiving detailed administrative information for permit applications or proposed future regulations. Municipal dischargers were interested in technical assistance with treatment system operation as well as administrative information. Suggestions on how to accomplish this were;

- Have an office of Public Information to ensure accurate and regular delivery of information.
- A Pollution Prevention Unit should be maintained to help dischargers with long term planning aimed at methods to prevent pollutants from getting into the waste stream.
- Develop a computer data base for data collected relating to permit development and water quality. The data base should be accessible to all both inside and outside the DNR or MOEE. The data base would give regulators quicker access to information to make informed decisions in a timely manner and give dischargers easy access to the water quality information necessary to develop site specific treatment plans.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: Much improvement is possible within the constraints of current funding sources. New or additional funding will be required for more extensive changes such as pollution prevention outreach

Recommendation 46: Regulatory staff need to be better trained in order to 1.) Understand the technical issues of various wastewater treatment systems and 2.) Be able to help discharges with clear, consistent advice on administrative procedures or technology transfer.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: Increase current sources to hasten implementation

Recommendation 47: Maintain good communication between all parties involved, Federal, State/ Provincial, City/County and the facility. All are players in the process of improving water quality and information must be shared with everyone involved.

Implementing Parties: USEPA, MDEQ, EC, MOEE, local governments and facilities

Timeline: Immediate and continuing

Possible Funding: None Required

Reducing Bureaucracy/Streamlining Regulatory Process

Recommendation 48: Allow permit and monitoring data to be submitted by the discharger electronically.

Implementing Parties: MDEQ and MOEE

Timeline: 2 to 3 years

Possible Funding: On going with current funding. However, federal grants would hasten the implementation

Recommendation 49: Review paper work and monitoring requirements and be sure they are relevant and necessary. Cutting unnecessary paperwork will give regulatory staff more time to spend with dischargers and dischargers more time to spend with treatment systems.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: None needed

Recommendation 50: Review permits and certificates every 5 years. Make any appropriate changes.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: None required

Recommendation 51: Increase the number of field staff in regulatory programs and clearly prioritize their workload. This recommendation was one of the most often recommended by both regulatory agencies and dischargers.

Implementing Parties: MDEQ and MOEE

Timeline: One to three years

Possible Funding: In Michigan; General funds and Federal grants

Recommendation 52: Do multi-media inspections at least once per year with staff from all applicable regulatory programs.

Implementing Parties: MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: None Required

Specific Legislative or Regulatory Changes

Recommendation 53: Change legislation to allow local governments to levy significant fines for programs which fall under their jurisdiction. This is particularly necessary with pretreatment programs.

Implementing Parties: Michigan legislature and Ontario Provincial Government

Timeline: One year

Possible Funding: None needed

Recommendation 54: Institute a toxic chemical source elimination or reduction program.

Implementing Parties: Local governments, commercial establishments, and industries

Timeline: One year

Possible Funding: Sewer use fees, private funds, and grants

Recommendation 55: Additional funding mechanisms should be identified.

Implementing Parties: Local government

Timeline: Immediate and continuing

Possible Funding: User fees

Recommendation 56: Streamline penalty collection mechanisms. An example is greater use of the Administrative Consent Order in Michigan instead of going to court.

Implementing Parties: Local, state, and provincial governments

Timeline: Immediate and continuing

Possible Funding: None needed

Recommendation 57: A clearly defined strategy for enforcing compliance in local IPP programs should be developed. The current process of allowing each community to develop its own compliance and enforcement strategy creates inconsistent and ineffective strategies.

The US EPA has established this for the Michigan side of the AOC by way of the requirements for enforcement response plans. This guidance was developed in 1989.

General Recommendations

Recommendation 58: Control documents and discharge permits should consider both concentration and loading limitations of pollutants and included when applicable.

Implementing Parties:MDEQ and MOEE

Timeline: Immediate and continuing

Possible Funding: Existing program in Michigan

Recommendation 59: In order to properly implement the stormwater program and obtain sound data on which to make decisions about stormwater discharges from industrial sites monitoring should initially occur at a frequency determined to provide statistically accurate representations of the stormwater. This data should then be used to make specific, long term monitoring recommendations.

Implementing Parties: Industries

Timeline: Immediate and continuing

Possible Funding: Private Funds

Recommendations for Nonpoint Source Pollutants

Recommendations on remedial measures for nonpoint sources of pollutants to the Detroit River AOC were determined by the Point Source/Nonpoint Source Technical Work Group (PS/NPS TWG). The following recommendations came about as a result of discussion of nonpoint source problems and potential solutions at the December 3, 1993 PS/NPS TWG. The six parameters considered were cadmium, copper, lead, zinc, mercury and PCB. The parameters were not considered individually, rather treatment mechanisms which would be expected to reduce loadings of all six substances to some degree were recommended. The expected reduction in loadings from most recommendations was not possible to predict.

The loadings of pollutants from nonpoint source inputs is often based on estimates of national averages. Monitoring of all inputs should be carried out to produce more accurate loading estimates for the Detroit River AOC. River sampling and/or modeling is needed to apportion the point source, nonpoint source, and tributary loadings. The PS/NPS TWG identified 7 categories of NPS problems affecting the Detroit River AOC;

1. Soil Erosion
2. Urban Stormwater
3. Rural Stormwater
4. Air Deposition
5. Spills
6. Remediation Sites/Landfills
7. Household Hazardous Wastes

ERCA Private Sewage Disposal Proposal Summary

The PS/NPS TWG received an implementation plan from the Essex Region Conservation Authority (ERCA) for the reduction of phosphorus and bacteria from rural areas. The proposal does not address the six parameters of concern and was produced entirely outside the RAP process. The proposal and recommendations were discussed at the June 1, 1994 meeting. The TWG members present at that meeting felt the proposal had several good points and generally supported it. The proposal has been endorsed by both the BPAC and the RAP Team. A brief summary of the proposal is included below. The ERCA proposal applies only to the Canadian portion of the AOC.

Background: Rural residents within the AOC are serviced by private sewage disposal systems (Class 4). Through the MOEEs Clean Up Rural Beaches (CURB) Program, studies conducted by ERCA have shown that the main cause of bacterial pollution affecting rural watercourses and their tributaries is from faulty septic systems. A study conducted in the Big Creek watershed revealed that approximately 70 % of bacterial pollution was a result of faulty private sewage disposal systems.

In terms of phosphorus, a loading rate of 2.68 kg/yr per faulty private sewage disposal system was calculated using CURB algorithms.

The tributary watersheds of the Detroit River (Canard, Turkey, and Little River) are similar in topography, land use, and management to the Big Creek watershed study area. Information from this study can be extrapolated to reflect the severity of malfunctioning septic systems within the three tributary watersheds of the Detroit River. Furthermore, this data supports the conclusion that upstream receiving bodies greatly impact on downstream outlets, such as the Detroit River.

Poor management practices in these areas has led to the degradation of water quality which affects recreational uses, wildlife habitat, and water quality within the Detroit River.

Recommendation 60: Monitor water quality on a watershed basis to show the effect of remedial measures.

Recommendation 61: Implement a remedial plan for faulty private sewage disposal systems as outlined in ERCA's full proposal (ie grant assistance program to update septic systems where communal sewage treatment systems are not feasible).

Recommendation 62: Determine the magnitude of faulty septic systems impacting rural watercourses to determine annual loading rates for tributary watersheds of the Detroit River (ie land use/ building inventory to further extrapolate the Big Creek data).

This proposal could be implemented by ERCA if funding can be secured. Total costs are estimated at $250,000 over a four year period.

Soil Erosion

In discussing soil erosion the group recognized that soil itself is not one of the six substances identified above. However, soil may contain one or more of the pollutants listed above or these substances may attach to soil during transport in the water column and deposit wherever the soil settles out. Soil therefore acts as a transport mechanism for many or all of these substances and if the soil is controlled then so is some portion of the pollutant load.

Recommendation 63: Create a strong Soil Erosion Control program to reduce the amount of erosion and sedimentation. Construction sites should be considered a priority in such a program.

Implementing Parties: MDEQ and MOEE with input from local and other experts

Timeline: 3 to 5 years

The PS/NPS TWG received an implementation plan from ERCA dealing with control of soil erosion from agricultural lands. This plan was developed out side the RAP process but was discussed at the TWGs June 1, 1994 meeting. The members present at that meeting generally supported the proposal. The proposal has also been endorsed by the BPAC and RAP Team.

ERCA Agricultural Soil Erosion Control Proposal Summary

Background: Essex County is predominated by flat, fertile clay plains which have been identified in past studies (PLUARG) as being the highest contributors of phosphorus to the Great Lakes.

During peak storm events, loadings of sediment and associated contaminants travel to the Detroit River. The resulting high delivery ratio is a result of intensive row cropping and minimal retention areas within the AOC. The Stage 1 Report states that the Ontario tributary loadings contribute a higher percentage of total phosphorus, nitrates and nickel per hectare than the Michigan tributaries, which is a result of this high delivery ratio.

The MOEE has specified the following recreational water quality guidelines for phosphorus: 0.01 mg/l (Lakes) 0.03 mg/l (Rivers/Streams)

Excessive runoff results in sediments and associated pollutants such as phosphorus being carried downstream. Phosphorous loading leads to excessive aquatic growth, eventually depleting oxygen from the watercourse causing poor water quality and degradation of wildlife habitat.

Recommendation 64: Implement a remedial plan, as outlined in ERCAs proposal for the reduction of soil erosion from agricultural lands (soil erosion and sediment control assistance programs, subject to funding availability).

Recommendation 65: Educate and promote sound management practices through conservation farm management plans.

Recommendation 66: Monitor, on a sub-watershed basis the effects of remedial actions on improving water quality.

Recommendation 67: Further investigative work should be done within the tributary watersheds of the Detroit River to determine loading rates of various pollutants associated with sediment runoff from agricultural lands (ie. establish a monitoring program to determine the loading rates of various contaminants such as pesticides and fertilizers).

This proposal could be implemented by ERCA if funding can be secured. Total costs are estimated at $1,100,000 over a four year period.

Stormwater

The stage 1 Detroit River RAP reported that the loadings of some metals to the Detroit River from stormwater are significant. After upstream inputs, stormwater is the greatest source of lead and zinc to the River.

In Michigan stormwater permits will be issued to construction sites and industrial sites. Michigan's program at present will not cover most of the municipal stormwater discharges to the Detroit River because most of the contributing watershed is exempted by the regulations at this time.

In Ontario regulations to control stormwater are being developed in the Industrial MISA program which will address a particular metal or contaminant (i.e. PCB) problem. For new development before construction can begin a stormwater management plan must be approved and implementation started before construction begins. Municipalities are encouraged but not required to prepare watershed management plans to address urban and rural stormwater runoff.

Both Michigan and Ontario have prepared guidance documents to help prepare watershed management plans and design Best Management Practices (BMPs). Michigan provides grants for nonpoint source demonstration projects based on watershed management and Ontario provides some grant money to help communities prepare watershed management plans.

Although application of these recommendations may vary between urban and agricultural sources, the recommendations for control are basically the same and so were combined under one category.

Recommendation 68: Develop an illegal connections elimination program to identify and remove illegal connections to the stormwater system. These programs have had a high degree of success in other areas.

Recommendation 69: Develop a strong stormwater regulatory program. A strong program would set requirements for the quality and quantity of runoff from urban or urbanizing areas such as construction sites, large developed areas and industrial sites. To be effective requirements must be based on principles of watershed management.

Recommendation 70: The loadings contributed by stormwater which are listed in the Stage 1 RAP are based on average urban stormwater quality and predicted runoff. Some site specific monitoring is needed to confirm or adjust the loadings so that decisions can be based on sound data. The monitoring should also evaluate control measures as they are installed.

Recommendation 71: Methods should be evaluated to reduce the quantity of stormwater into the collection system of developed areas through retention and detention. Reducing the quantity of stormwater helps to maintains the pre-development hydrologic balance, removes pollutants in the retention/detention practices and causes CSOs to discharge less frequently. To be practical and cost efficient the time frame for implementing such a plan could be 15 to 40 years.

Recommendation 72: The regulatory agencies should act as a clearinghouse for current information on control measures.

Recommendation 73: Expand data acquisition to accurately define total loadings from tributaries to the Detroit River specifically including sampling to reflect storm events. Implementing Parties: MDEQ and MOEE with input from the regulated community and local governments

Timeline: Implementation within 5 years

Possible Funding: Use cost share monies to promote use of control measures.

Air Deposition

The contribution of pollutants from air deposition must be established and control alternatives investigated.

Recommendation 74: The work group proposed a joint U.S. - Canadian air deposition study.

Estimates of air deposition of some of the parameters of concern (cadmium, copper, lead and zinc) to the Detroit River AOC suggest that loadings from the atmosphere are the same order of magnitude as the sum of loadings from known point sources. Further, data on background concentrations of these metals in the air over the Great Lakes (from the International Air Deposition Network - IADN, described below) suggest that the cause of high air deposition rates is, for the most part, elevated local air concentrations in the Detroit/Windsor area. For example, the estimated zinc loading from point sources for 1991 was approximately 115 metric tones per year (MTA) while the annual air deposition for that parameter was estimated to be about 100 MTA. The percentage of contaminants that are eventually washed into the Detroit River after deposition on the catchment area is unknown, but most estimates range between 50 and 90 percent. Therefore, although air deposition is currently considered a nonpoint source problem, a multi-media approach to controlling these parameters of concern is warranted. The implementation of this recommendation follows approaches recently presented at the MDNR workshop "Air Toxics in the Great Lakes" and previously developed at the IJC "Mass Balance Workshop".

A number of programs currently exist in the Great Lakes Basin that could be focused on the problems in the Detroit River AOC. These programs, in whole or partially, can assist in the implementation of the strategy described below. These programs can be considered to be some of the response to Annex 15 of the Great Lakes Water Quality Agreement of 1978 as amended in 1987 which has the following purpose:

> "The Parties, in cooperation with State and Provincial Governments, shall conduct research, surveillance and monitoring and implement pollution control measures for the purpose of reducing atmospheric deposition of toxic substances, particularly persistent toxic substances, to the Great Lakes Basin Ecosystem."

Concurrent Programs

Clean Air Act amendments of 1990

The Clean Air Act Amendments of 1990 mandate many new programs and improvements to existing U.S. and state air pollution control programs. Among the most important with respect to the Great Lakes Basin ecosystem and the Detroit River AOC are the following:

Title I programs include State Implementation Plans (SIPs) for the attainment and maintenance of national Ambient Air Quality Standards (NAAQS) for six criteria pollutants (particulates, sulfur dioxide, oxides of nitrogen, carbon monoxide, lead, and ozone). Most of these programs deal with major stationary sources of these pollutants and volatile organic compounds (VOCs), which, along with oxides of nitrogen, are precursors to tropospheric ozone.

Title II programs include controls for mobile source emissions, which are primarily hydrocarbon, carbon monoxide, oxides of nitrogen, and diesel particulate. Transportation control planning, reformulated gasoline, and alternate fuels are also part to Title II.

Title III programs go beyond the criteria pollutants of Title I, to identify and control major point and area sources of listed Hazardous Air Pollutants (HAPs). Among the HAPs on the final Title III list are cadmium compounds, lead compounds, mercury compounds, and PCBs. In addition, by November 15, 1995, USEPA must list categories of sources of 189 specific HAPs (including alkylated lead compounds; polycyclic organic material (POM); mercury; PCBs; 2,3,7,8-TCDF; and 2,3,78-TCDD) to ensure that sources which account for at least 90% of the aggregate emissions of each pollutant are subject to technology-based standards (either the maximum degree of emission reduction or a technology-based standard based on an ample margin of safety using a health threshold level, if there is one) by November 15, 2000.

Section 112(m) of Title III requires USEPA to establish a Great Lakes atmospheric deposition network in accordance with Annex 15 of the Great Lakes Water Quality Agreement; this is the Integrated Air Deposition Network (IADN). USEPA will use the data provided by IADN to identify and track the movement of HAPs through the Great Lakes, to determine the portion of water pollution loading attributable to atmospheric deposition of these pollutants, and to support development of RAPs and LaMPs. USEPA must submit a biennial report to Congress (the "Great Waters Report") which summarizes its findings regarding contribution of atmospheric deposition to water pollution, the sources and rates of the atmospheric deposition, and its evaluation of any adverse effects to public health or the environment by these pollution loadings. Based on these findings, USEPA must promulgate any additional regulations if necessary to provide adequate protection. The first such Report was published May 20, 1994. USEPA must also sample for HAPs in biota, fish, and wildlife of the Great Lakes, and characterize the sources of these pollutants.

Title IV programs to reduce acid rain institute new controls to reduce and cap emissions of sulfur dioxide and oxides of nitrogen from utility boilers.

Title V programs will result in comprehensive new operation permits for major sources of criteria pollutants and HAPs. These permits will specify operation schedules, emission limits, required control techniques, enhanced pollutant monitoring, and record keeping/reporting requirements. Major sources will also be required to develop risk management plans designed to identify and correct conditions which might release listed pollutants.

Title VI programs implement the requirements of the Montreal Protocol regarding substances may deplete stratospheric ozone.

Title VII programs will result in enhanced enforcement of compliance programs required by other Titles.

1986 Great Lakes Air Permitting Agreement

This Agreement was entered into by the Environmental Administrators of the eight Great Lakes States; it commits the air regulatory program of each state to require the air emission sources of seven Great Lakes critical pollutants to use Best Available Control Technology (BACT) for toxics to the maximum extent allowed under existing authority. Title III programs will extend this authority to additional categories of sources, and to smaller sources in all categories. The Agreement also specifies that the states will enter all pertinent information into a national permitting database and that they will exchange permit applications for potentially significant sources to ensure consistent reviews and control requirements.

MDEQ Air Quality Division (AQD)

Programs MDEQ AQD has been working to develop new and revised regulations for implementation of the federal Clean air Act provisions, as amended in 1990. the requirements under Section 112 (Title III) must be meshed with the current state regulations which apply to new and modified sources of any toxic air contaminant.

Michigan's Rules 230-232 apply to any contaminant for which there is not a National Air Quality Standard or which is not specifically exempted in the rules (40 compounds). These rules do not apply to existing sources. The federal program applies to both new and existing major sources of 189 listed Hazardous Air Pollutants (HAPs). A major source emits at least 10 tons of any single HAP or 25 tons per year of all HAPs combined. It also applies to smaller sources in 8 categories that the USEPA has listed for regulation as area sources.

Both programs require a control technology approach, followed by a health risk analysis to determine if additional standards or control requirements are needed. However, the specific requirements and timing differ:

The federal program requires the application of Maximum Achievable Control Technology (MACT for major sources and generally available control technology (GACT) for area sources. The state air toxic rules require the application of best available control technology for toxics (T-BACT).

The federal program requires the health risk analysis for each source category to be done with 8 years after the MACT standard is promulgated, whereas the state program requires the analysis for each permitted source before the permit to install is issued. Additionally, the federal requirement for a health risk analysis applies only to major sources, and not area sources.

The toxics control provision of Section 112 (Title III) and the criteria pollutant requirement will be primarily implemented through the Title 5 operation permit program. The resulting reductions in air pollutant emissions due to Clean Air Act implementation will also lead to a reduction in atmospheric loadings of these pollutants and the potential of atmospheric deposition to the Great Lakes watershed.

WCAPCD Programs

The Wayne County Air Pollution Control Division (WCAPCD) of the Wayne County Department of Public health has been authorized by the State to act as the agent for MDEQ AQD in reviewing, evaluation, and issuing air permits-to-operate under Michigan's Title V Operation Permit Program. Powers and duties of WCAPCD are prescribed in the Wayne Count Air Pollution Control Ordinance. Additionally, WCAPCD has for years operated and maintained its ambient air quality monitoring network.

Wayne County/Rouge River - Wet Weather Demo Project

The Wayne County Rouge River Wet Weather National Demonstration Project will undertake an Air Deposition Study. Including installing sampling equipment at urban, suburban, and rural locations. Samples will be collected for both wet and dry deposition, as well as ambient air quality. Concentrations will be determined in an "ultra clean" laboratory at the University of Michigan for PCB, Mercury, Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Selenium, Vanadium, Zinc, PAHs, and Nutrients. Annual loads for the watershed will be calculated. A computer model of air deposition phenomena in Southeast Michigan will project atmospheric loadings to the Rouge River.

Canada-Ontario Agreement, 1994

This federal-provincial agreement includes a commitment to an integration of existing air toxic monitoring networks and data management systems to track the deposition of contaminants within the Great Lakes Basin Ecosystem. The measurement of air toxics will be continued through IADN to assess the atmospheric contribution to toxic chemical pollution in the Great Lakes.

Windsor Air Quality Study

The Windsor Air Quality Study is the First of a series of planned studies of urban air quality in Ontario. These studies focus on the measurement of airborne pollutants and the assessment of their potential effects on human health. This information will be used to direct abatement activities.

Reduction in emissions to the atmosphere will reduce the loadings available for atmospheric deposition.

The study has been conducted by MOEE in cooperation with Environment Canada. Health Canada, and the Windsor-Essex County Health Unit. The study was spurred by residents' concerns about emissions from heavy industry on both sides of the Detroit River. Activities conducted in support of the study include: ambient air quality monitoring; mobile monitoring; personal exposure sampling; soil and vegetation sampling; modelling and emissions inventory; risk assessment.

Working Draft of Great Lakes Nonpoint Source Toxics Reduction Effort Activity Outline: Air Deposition, April 1994.

This document summarizes existing Federal laws, regulations, and agreements; international agreements, state laws, rules, and basin-wide agreements; recent significant reports, studies, or data; and significant recent of ongoing activities.

Implementation Strategy

There are five components to this strategy:

- Improve the ambient air monitoring data base. Currently, all parameters of concern are not routinely monitored. Also, both wet and dry deposition measurements are needed.
- Establish an Emissions Inventory Data Base. This should include information on locations and amounts of emissions of the parameters of concern and be accessible via an interactive computer data base.
- Conduct Transport, Dispersion and Deposition Modelling. This should be able to describe the delivery of the parameters of concern to the Detroit River watershed. Also, the major sources of these parameters should be identifiable through receptor modelling.
- Attribute the Atmospheric Sources. Using a combination of components 1-3 above, estimate the relative contributions of the parameters of concern from their actual point of emission.

- Recommend the Reduction in Emissions of Key Sources. When sufficient information from components 1-4 is available to document the effect of individual sources, recommendations should be made for emissions reduction or elimination consistent with the goals of the RAP.

Some tasks are already underway within the five components of the strategy (much of this information is from the Working Draft of Great Lakes Nonpoint source Toxics Reduction Effort Activity Outline: Atmospheric Deposition, April 1994).

1. *Improve the Ambient Air Quality Monitoring Data Base*
   The Great Lakes Air Regulatory Agencies' Toxics Monitoring Coalition was formed in December 1990 as a result of a recognition on the part of state, local, and provincial regulatory agencies of the potential benefits of increased efforts to coordinate and cooperate on air toxics monitoring activities.

   The Integrated Atmospheric Deposition Network (IADN) is the air toxics research and monitoring network for implementation of Annex 15 of GLWQA. The network is designed to consist of several Master (research grade) stations augmented by a number of Satellite (routine) stations with continuous monitoring and analysis year-round. The intent is to collect and evaluate atmospheric pollutant data at a regional level of detail.

   Selected stations in existing ambient air monitoring networks operated by MDEQ, WCAPCD, and MOEE could be upgraded to provide similar data on a local scale.

2. *Establish an Emissions Inventory Data Base*
   The Regional Air Toxic Emissions Inventory is a comprehensive, computerized, updatable database of emissions of airborne toxic pollutants; focus is on 49 substances that have been identified as significant contributors to contamination of the Great Lakes. Work by the eight Great Lakes States is being coordinated by the Great Lakes Commission and USEPA. The current pilot phase of the project covered the region of the urban areas of southwest Lake Michigan: Chicago, Milwaukee, and Gary. The next phase of the inventory project will include the entire eight-state Great Lakes Region, and completion is anticipated in December 1996.

   Some of the emission inventory in RAPIDS is taken from the Toxic Release Information Report (TRIR) submitted by industrial sources as required by Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). Other components of RAPIDS are taken form Emission Inventory Systems (EISs) of the individual States, although these data mostly relate to emissions of criteria pollutants rather than HAPs.

   Information on industrial emissions required on the permit applications for the Title V Operation Permit Program will be much more comprehensive than in the past. This will become part of each State's emission inventory database, which will in turn be accessible through RAPIDS. Enhanced monitoring requirements of the new Title V operation permits may require periodic or continuous emission testing/monitoring and reporting by permitted sources.

3. *Conduct Transport, Dispersion, and Deposition Modelling*
   On a regional scale, much of the work being conducted under the Great Waters Program will support this task. A number of projects are currently underway by USEPA offices.

4. *Recommend the Reduction in Emissions of Key Sources*
   Major industrial sources of HAPs will be subject to Maximum Available Control technology (MACT) standards to be promulgated under Title III. Smaller, more widely distributed sources (area sources) of certain HAPs will be subject to Generally Available Control Techniques (GACT) where the cost of MACT is deemed to be excessive. Title III further requires USEPA to evaluate the "residual risk" for cancer-causing pollutants emitted from sources for which MACT has been implemented; and, if necessary, promulgate additional standards to protect exposed populations from the residual risk.

Schedule
Components 1-3 should begin immediately and continue in parallel. Component 4 should be attempted annually, beginning in 1995. This component may require two or three iterations before sufficient accuracy can be achieved for all sources. Component 5 should be implemented anytime there is sufficient documentation for a specific source, but, in particular, recommendations should follow a successful attribution of sources.

Responsible Parties
MDEQ and MOEE should take the lead on all components of this strategy. Technical support should be provided for components 1-4 by U.S. EPA and the Atmospheric Environment Service in Canada. Industrial and Municipal sources of significant air emissions of the parameters of concern should contribute to component 2.

Spills

Spills are a very small part of the total loading of pollutants to the Detroit River. A large portion of the volume of spills to the Detroit River are from pleasure craft and marinas. Small spills from industrial facilities and CSOs commonly occur but the relative load contribution to the Detroit River is estimated to be less than from pleasure craft. Large spills are rare.

Recommendation 75: Begin an intensive education effort aimed at pleasure craft and marina owners on how to avoid discharges of pollutants to the river.

For discharges from pleasure boats Ontario has ticket writing authority under Regulation 305 of the Environmental Protection Act. These tickets range from $153.00 for spills or discharges of sewage, gas, oil or garbage to $78.00 for improper toilet or connections. Michigan does not have ticket writing authority for discharges from pleasure boats.

Recommendation 76: Larger fines for spills from industrial facilities.

Recommendation 77: Quicker, more efficient methods of enforcement. For spills from facilities Michigan has been making more use of administrative consent orders which has cut down on the time involved in resolving a case and results in a mutually agreed upon solution between the discharger and the DNR. Ontario's only enforcement tool for these types of spills is to go to court.

Recommendation 78: Pollution Incident Prevention Plans (PIPPs) should be developed by any industrial or commercial facilities which store or use materials which, if lost to the environment could directly or indirectly reach the Detroit River.

Michigan requires development of such plans. Ontario encourages the development of PiPPs but has not made them mandatory. In Ontario the new Pollution Prevention Program is designed to encourage industries to put in such works creating a pledge tracking program with targets to reduce persistent toxic and biocumulative chemicals 90% by 2000.

Remediation Sites/Landfills Remediation sites and landfills are an extremely small part of the loading to the Detroit River. Most sites have been identified and catalogued by state, provincial or local governments.

Recommendation 79: Continue to catalog all existing and abandoned landfills and remediation sites or any other identified groundwater contamination problems.

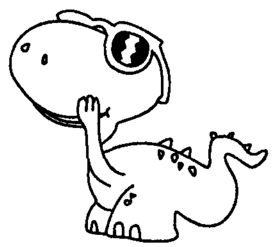
Recommendation 80: Include remediation sites in stormwater regulations which are developed.

Recommendation 81: Identify zones of local impact where possible.

Household Hazardous Wastes

Household hazardous wastes were not identified in the Stage 1 RAP as a separate category of pollutants. There is no information indicating the relative load contribution to the Detroit River. However, the Point Source/Nonpoint Source Technical Work Group believed that much household hazardous waste finds it's way to the Detroit River via the wastewater treatment plant, storm sewer system, and solid waste collection system.

Figure 15
SnoopAsaurus is the Detroit Water and Sewerage Department's Environmental Awareness Representative.



Meet SnoopAsaurus, the Detroit Water and Sewerage Department's (DWSD's) environmental awareness representative. SnoopAsaurus made his debut for DWSD's Environmental Awareness Campaign in the June 12, 1994 edition of the Detroit News and Free Press. The goals of the DWSD campaign are to make the public aware of the various forms of

pollution prevention techniques. The campaign is applicable to a diverse group of individuals made up of customers, residents, businesses, educational institutions and public officials. SnoopAsaurus as a logo symbolizes the need to return our environment to that era when dinosaurs inhabited the earth, representing a clean, safe and pristine place. SnoopAsaurus' image promotes environment awareness and the need to keep our surroundings clean, safe and healthy.

As a DWSD environmental macot, SnoopAsaurus will appear in the environmental media on behalf of DWSD's environmental awareness campaign. SnoopAsaurus will also help the Rouge River Demonstration Project promote environmental awareness through their pollution prevention activities.

Help support SnoopAsaurus by doing your part to clean up our environment.

Source: Rouge River News and Views, Volume IV, Winter 1995, National Wet Weather Demonstration Projeåct

Recommendation 82: Develop an education program at the local level for homeowners and commercial properties that targets waste reduction. Concepts that should be stressed are; identification of less harmful alternatives, recycling, and proper disposal of waste products.

The greatest benefits to the Detroit River AOC from such programs would be realized if they covered not only the Detroit River AOC but encompassed the entire Southeast Michigan area. The programs then would not only reduce inputs from the AOC but also upstream inputs to the AOC. The Southeast Michigan Initiative would be an appropriate implementing party.

Implementing Parties: MDEQ and EPA (SEMI)

Timeline: Immediate and continuing

Possible Funding: Existing program in Michigan additional funding through SEMI and local sponsors (see Hazardous Waste Disposal Program section, Chapter 10).

Recommendation 83: Institute deposits or disposal fees on items which are composed of significant portions of the parameters of concern and are often improperly disposed of such as tires and batteries.

Combined Sewer OverflowsTWG Report

"We have known for some time that combined sewer overflows (CSOs) are a significant source of pollution to the Detroit River. The control of CSOs will take unequivocal local, state, provincial and federal cooperation with citizen input to ensure that dedicated resources are effectively utilized. The ellimination of untreated CSOs in the Detroit River AOC will require the development of new technology. CSO control technology that can benefit the Detroit River is now being demonstrated on the Rouge River–a major tributary and source of pollutionto the Detroit River."

Jim Murray
Director
Wayne County Department of Environment

An Introduction to Combined Sewer Overflows

History of Combined Sewers

When cities first began developing in this part of the continent, most grew on the banks of rivers and lakes, because in the early days the primary means of transportation and commerce were the water courses. There was rarely a general plan for the growth of the cities and the result was a system of buildings and roadways that were either parallel to or perpendicular to the shoreline. Since the roadways were primarily dirt or gravel, streets remained muddy for a significant period of time following rainy weather. Citizens of these cities grew tired of muddy streets and requested the government do something about the inconvenience.

The immediate solution was to build sewers to drain the stormwater off of the streets during wet weather so that the streets would not remain muddy for a long period of time. These sewers were either open ditches or pipes buried in the ground. As the communities grew, these sewers needed to be quite substantial in size to carry away the stormwater. Remember, of course, that the vehicles on these roads were horses and carriages – the horses leave behind more than footprints. Domestic water use was very low, but the wastewater that was generated was disposed of simply by dumping it in the gutter where it would be flushed away during the next rain. During rains, the sanitary wastewater as well as the manure from the streets was flushed into the sewers, where they were transported directly to the nearest watercourse. This was the cause of significant odor problems in the receiving water and the citizens, now pleased to have dry, passable streets, became concerned with the sewage stench in their nearby river.

To address the sewer related aromas, a new kind of sewer evolved to take care of the immediate problem. The new kind of improved sewer, known as an interceptor sewer, was constructed primarily parallel to the watercourse and designed to carry the wastewater further downstream. It was acceptable in the later 1800s and early 1900s to move the polluting materials further downstream where there were fewer or no people to complain. At about the same time, the domestic use of water was increasing rapidly with the advent of public water supplies and electric motors and pumps for running water in homes. This water use increase resulted in an increase in sanitary wastewater being discharged to the sewers which were designed to carry away only stormwater. In addition, the interceptor sewers were sized to intercept only the sanitary waste (or dry weather flow) because of budget constraints and practical construction problems. As a result, the interceptor sewers could not carry the full volume of wastewater during wet weather periods. Therefore, one of two things had to happen during a rain storm. Either the sewers would exceed capacity and flood the streets (thus getting them all muddy again), or there needed to be a relief discharge directly into the river near the populated areas. Structures, called regulators, were constructed to provide this relief. They operate when the flow rises above the height of the overflow weir, allowing the combined storm and sanitary sewer flow to overflow to the receiving waterbody – thus causing what has come to be called a combined sewer overflow or CSO.

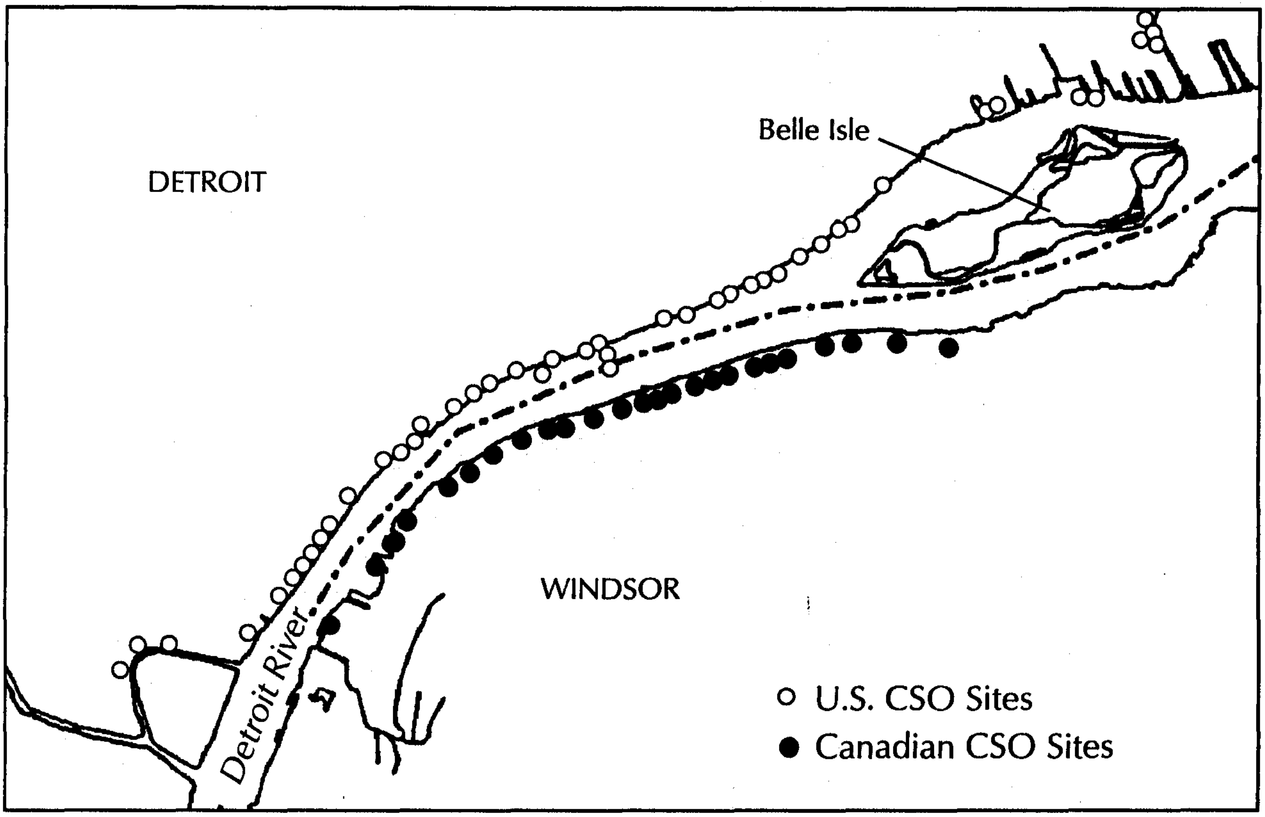
As time went by, the idea of building sewers that handled both the sanitary wastewater and the stormwater gave way to the concept of building a separate system just for the sanitary wastes. These separate sewers came to be called sanitary sewers and the original type of sewer came to be called combined sewers. When many of these combined sewers were constructed, they were simply called "sewers". Later on in the 30s and 40s, the distinction between storm sewer, sanitary sewer, and combined sewer became well accepted.

The Detroit River Remedial Action Plan

CSOs are one area of water pollution control that require special attention. Overflow conditions constitute a serious environmental issue by contributing to violations of water quality standards and posing significant public health concerns. In order to successfully remediate the CSOs on the Detroit River (See Figure 16), a comprehensive, collaborative effort is necessary. This iteration of the Stage 2 of the Detroit River Remedial Action Plan (RAP) is designed to update the Stage 1 Detroit River Remedial Action Plan (Michigan Department of Natural Resources (MDNR, 1991) and to recommend actions necessary to remediate impaired uses in the Detroit River.

In October of 1992, a Technical Workgroup (TWG) was established to develop the CSO portion of the RAP. This document, developed by the CSO TWG, reviews the current strategies designed to solve the CSO problem, assesses the adequacy of current CSO control activities and strategies, and describes recommended remedial options the CSO TWG believes should be used to address Detroit River CSOs.

Figure 16
Detroit and Windsor Combined Sewer Overflows to the Upper Detroit River



Source: Upper Great Lakes Connecting Channel Study (UGLCCS), 1988 CSO Effluent Characteristics

A CSO results in the discharge of floatables, organic material, sediment, nutrients, pathogens, oil and grease, metals and other pollutants into the receiving waters. Floatables and oil and grease cause short-term impacts like aesthetic problems. Elevated bacteria levels may cause the posting of beaches as being unsafe for swimming. These impacts are in effect for two or three days after the CSO event and are the most obvious to the public. Long-term impacts refer to effects that occur over a period of time longer than a few days. They are related to the loads from an entire season or year or decade. Biodegradable organic matter, suspended solids and nutrients from CSOs may result in dissolved oxygen depression, eutrophication, and sediment contamination. Heavy metals and other toxic pollutants may cause long-term toxic effects.

Represenative water quality characteristics of CSOs compared with raw sewage are shown in Table 27. CSO effluent resembles dilute sewage and has higher pollutant concentrations than wastewater treatment plant (WWTP) effluent and urban runoff with the exception of total nitrogen. The water quality characteristics of CSOs measured for various studies are extremely variable in both quantity and quality. Table 27 also illustrates that CSOs have suspended solids concentrations comparable to raw sewage. Although not noted in the table, average concentrations of total and fecal coliform in CSO discharges are typically at least several orders of magnitude higher than disinfected WWTP effluent.

Table 27
Represenative Concentrations of Pollutants in Raw Sewage and CSO's

Source	**BOD** (mg/l)	**SS** (mg/l)	**Total N** (mg/l)	**Total P** (#/100 ml)	**Total Coliforms** (#/100 ml)	**Facal Coliforms** (#/100 ml)
Raw Sewage	165	225	30	6.5	10^8	10^7
CSO	41	190	8.3	1.4	10^7	10^6

Source: Obtained from MOEE, 1993

Receiving Water Impacts from CSOs

Possible receiving water quality impacts from CSOs include elevated bacteria levels, dissolved oxygen depression, eutrophication, sediment contamination, and chronic and acute toxicity. These changes are dependent on the volume and frequency of the overflow and the receiving water's assimilative capacity. Generally the larger the receiving water the lesser the immediate impact of CSOs. Toxic discharges (metals) from industrialized combined sewer areas can be a concern. Aesthetic impairment typical of CSOs include sanitary and industrial wastewater debris, floatables, suspended solids, oils and grease.

CSOs are intermittent discharges which occur for relatively short periods of time. This makes them different from continuous WWTP discharges for which many water quality standards have been developed and proven. Toxic impacts are difficult to define because toxicant criteria are developed for continuous exposure. The occurrences of CSOs are random because they depend on the occurrences of precipitation. The annual pollutant loads from CSOs depend on the flow and duration of each overflow event, the pollutant concentrations and the number of overflow events per year. The flow and the pollutant concentrations vary between events and years.

The occurrence of the CSO depends on the available capacity in the collector system and WWTP. The number of overflow events varies from year to year depending on precipitation. In addition, the impact on the receiving water depends on its condition at the time of occurrence which is influenced by other factors. Since the CSO loadings vary from storm to storm the impact on the receiving water from CSOs is difficult to determine.

In assessing the impacts of CSOs it is important to consider both the temporal and spatial scales. The time scale impacts can be defined as short term impacts and long term impacts. Short term impacts are those that are mainly in effect within a few days of the CSO event. They are related to a single CSO event. Two examples are impacts caused by bacteria and biodegradable organic matter. Long term impacts refer to impacts that occur over a period of time longer than a few days and are related to the loads from an entire season or year. The long term impact stems from the effects of suspended solids, nutrients, and heavy metals. The impacts caused by these pollutants include degradation of aesthetics, loss of fish habitat, restriction on drinking water consumption, restriction of fish consumption and harbor dredging.

Dissolved Oxygen

Heaney et al (1980) found that the worse case conditions did not always occur during the low flow periods following storms. Urban runoff effects on dissolved oxygen (DO) may occur at times substantially different from the actual storm period. DO is generally present in sufficient quantities in the Detroit River (UGLCCS, 1987).

Nutrients

The release of nutrients (phosphorus and nitrogen) causes the growth of aquatic weeds or algae. The accumulation of nutrients in the receiving water may cause a long term impact by disturbing the balance in the water system. Although eutrophication is not a problem in the Detroit River, accumulated nutrient loadings from the river's CSOs may impact Lake Erie (Stage 1 RAP, and Chapter 5, figure1).

Bacteria

Since CSOs are a mixture of sanitary wastewater and stormwater they contain fecal waste. CSOs are therefore human health concerns since the fecal waste may contain pathogens or disease causing organisms. Since it is difficult to measure the presence of viruses and pathogens, indicator organisms such as fecal coliform are used as an indication of the presence of fecal matter. The Ontario Ministry of Environment and Energy's (MOEE) Blue Book states that a potential health hazard exists if *Escherichia coli (E. coli)* densities are greater than 100 per 100 ml. The Michigan water quality standard is 130 *E. coli* per 100ml. Both of these standards are in-stream criteria. The Stage 1 Detroit River RAP implictaed CSOs as the source of bacteria loading to the IBU-Beach Closings.

When a CSO occurs there is usually a high load of bacteria discharged to the receiving stream with a corresponding peak of concentration. This peak often drops to an acceptable level for recreation in a matter of days due to bacteria die-off. Bacteria also adsorbs on suspended particles in the runoff. As the particles settle the bacteria is removed from the water phase. However the particles are still carried along the bottom of the stream. The bacteria is also carried along in the water phase over long distances. The distribution of bacteria adsorbed to suspended, settleable solids compared to those transported in the water phase is important in determining the impact. Higher solids concentration in urban runoff might result in a relatively high removal rate of bacteria to the bottom sediments. Bacteria survive longer in the sediments because of the available nutrients and the protection from the sunlight.

Toxic Heavy Metals and Organic Pollutants

The diffuse nature of the contributing areas to CSOs makes source identification difficult. Sources of toxics and heavy metals can include household hazardous wastes, illicit sewer connections, illegal dumping, overflow from contaminated sites, contaminated groundwater, and indirect industrial dischargers. A variety of contaminants have been found in CSO effluent (see Tables 27 and 30).

Michigan

There is a concern that CSOs significantly contribute toxic substances to the Detroit River and possibly cause toxic conditions to exist in the River from time to time. A major CSO planning effort was conducted by the City of Detroit under Section 201 funding of the Clean Water Act in the late 70s. The program was coordinated with the engineering firm Giffels, Black and Veatch and included a comprehensive toxics sampling effort, directed at documenting and understanding the character of CSO flow and composition as well as its impact on the river. In addition to the multimillion dollar sampling program, a comprehensive, dynamic predictive model of the quality and quantity in the runoff, sewer system, Rouge River, the Detroit WWTP was used to interpret the results. The sampling data was used to validate the model and the model provided the estimates of CSO loadings reported in the Stage I Detroit River RAP as well as estimates of the river concentrations during wet weather. The Stage I RAP used 1978 data to estimate the quantity of toxic substances discharged to the Detroit River through CSOs. While the 1978 data remains the best empirical data available on the concentrations of toxic substances in CSOs, the method used to estimate the loading was flawed. New sewer construction as well as other changes render the Stage I CSO loading data somewhat obsolete, and hence this TWG has reestimated the concentrations and loadings as shown in Tables 28 and 30.

The Stage I RAP identified "Specific Goals" for six toxicants: Polychlorinated Biphenyls (PCBs), mercury, zinc, copper, cadmium, and lead. PCB and mercury are a chronic toxicity concern, while the others were acute toxicity concerns. The CSO TWG used the same concentrations for zinc, copper, cadmium, and lead (1978 CSO Concentration) and extrapolated them to derive a "best estimate" of current toxic discharges to the River from CSOs. This allowed for the determination of the potential for CSOs to cause acute toxicity.

Due to the Industrial Pretreatment Program (IPP) (see Chapter 9, Point/Nonpoint Source, for description), the general decline of industrial activity in the area, the conscientious efforts of industries to reduce discharges through pollution prevention, and other factors, the CSO TWG concluded that the "current" (1992) concentrations of toxic substances from CSOs were substantially less than the 1978 concentrations. To estimate how much less, a ratio (1992/1983 Ratio) for each parameter for which data were available from WWTP influent monitoring records in 1983 and 1992 (1983 Influent Concentration and 1992 Influent Concentration, respectively) was calculated. This ratio then was applied to the 1978 CSO toxicant concentration to achieve a "current" estimate of toxicant concentrations (Calculated Concentration). If data from 1978 through 1992 were available, it is expected that a larger correction factor would apply. Hence the use of the 1992/1993 ratio should provide a conservative estimate of the reduction in pollutant concentrations since 1978.

For an indication of potential Acute Toxicity in the CSO plume, the Michigan Water Quality Standards' Final Acute Value (FAV) was estimated for each parameter. The FAV is used to determine the necessary water quality based effluent limits for National Pollutant Discharge Elimination System (NPDES) permits. The individual FAV calculations are influenced by the ambient water hardness for many metals. The influence of water hardness on determining each metal's potential toxicity, or FAV is therefore different, and each FAV thus requires separate calculations and equations for each specific metal. The procedures are detailed in the MDNR's "Guidelines to Rule 57(2)". A hardness of 250 mg/l was used in these calculations.

The resulting values (Acute Toxicity Concentration) are compared to the calculated concentration for each toxicant in Table 28 titled "Estimated CSO Toxicant Concentrations from DWSD". Based on this comparison, the CSO TWG does not expect the CSOs to be a cause of Acute Toxicity in the Detroit River.

Table 28
Estimated CSO Toxicant Concentrations from DWSD

Parameter	1978 CSO Concentration (ug/l)	1983 Influent Concentration (ug/l)	1992 Influent Concentration (ug/l)	1992/1983 Ratio	Calculated Concentration (ug/l)	Acute Toxicity Concentration* (ug/l)
Cadmium	41	18	14	0.78	32	180
Copper	218	240	51	0.21	46	100
Lead	447	126	29	0.23	103	1200
Zinc	555	656	306	0.47	259	490

* FAV pursuant to Michigan Water Quality Standards
Source: CSO TWG IPP Writing Team

To add confidence to the resulting calculations the MDEQ plans on running direct toxicity tests, known as whole effluent toxicity (WET) tests, on CSO effluent as part of the Rouge River National Wet Weather Demonstration Project (Rouge Demo Project) and the Detroit River CSO Toxics Sampling Project (discussion follows). These data are beginning to become available. Hopefully the two analyses will support each other. Sampling to obtain more current data on the concentrations of toxic substances in the CSO discharges to the Detroit River is currently under way, but data from that work are not likely to be available until late 1994 or 1995. The MDEQ also plans to run WET tests on separate storm sewer discharges as part of the Rouge Demo, so we will be able to compare the toxicity of stormwater to that of combined sewage during wet weather. Sampling and analysis for these studies will be conducted in accordance with appropriate procedures and practices.

A similar analysis was used to calculate "current loadings" to the Detroit River from the Detroit Water and Sewerage Department (DWSD) CSOs of these and other substances of interest. Again the 1978 CSO concentration data were used, then converted to "current" by use of an influent concentration ratio. The most current model results for Total Annual CSO flow to the Detroit River was used to convert these concentrations into loading (1992 Annual Average Loading to Detroit River). These data are compared to the loading reported in the Stage I RAP (1978 Annual Average Loading to Detroit River). These data are presented in Table 30 titled "Estimated CSO Contaminant Concentrations and Load from DWSD".

Ontario

Table 2A lists the average concentration of the critical contaminants in municipal wastewater for the City of Windsor in 1992. Also listed are average concentrations of wet weather samples collected from interceptor/overflow chambers in 1993. The 1970 concentrations of some of these parameters in the influent to West Windsor Pollution Control Plant (WWPCP) are also listed showing the significant reduction in metals concentrations in sanitary sewage which have been achieved principally as a result of the City's aggressive industrial waste control program (Sewer Use Bylaw).

As noted in the discussion of the Detroit discharges, both the current WWPCP influent and effluent levels are less than Michigan's FAV and as with the Detroit discharges would not be expected to cause acute toxicity in the Detroit River.

The total treated sewage discharged by the Little River Pollution control Plant (LRPCP) and the WWPCP and the volume bypassed during 1992 are also listed in Table 29. The Windsor Riverfront PCP Study modeling of the interceptor sewer system estimates that 17,832,000 m3 of combined sewer overflow and storm relief sewage would be discharged to the Detroit River in a typical rainfall year. Using the average effluent concentrations, for treated flows, influent concentrations for bypass flows, and average wet weather concentrations in overflow chambers, estimated loadings to the Detroit River of these parameters are calculated in Table 31.

The current and Stage 1 Detroit River RAP estimates of WWTP, CSO, and stormwater loadings (1985) are compared in Table 31. These preliminary estimates of pollutant loadings from the Windsor CSOs and Storm Relief Sewers are being refined as part of the Windsor Riverfront Pollution Control Planning Study.

Moreover, there is a major need for updated measurements; there are two significant endeavors underway to supply the information – the Detroit River CSO Toxics Sampling Project and the Windsor Riverfront Pollution Control Planning Study.

Table 29
Critical Contaminants in Municipal Wastewater, City of Windsor–1992

Parameter	*LRPCP–1992* *Inf. Conc. (ug/L)*	*LRPCP–1992* *Eff.* Conc. (ug/L)*	*N*	*WWPCP–1992* *Inf. Conc. (ug/L)*	*WWPCP–1992* *Eff. Conc. (ug/L)*	*N*	*1993 Wet Weather Overflows** (ug/L)*	*WWPCP 1970 Inf. Conc. (ug/L)*	*Acute Toxicity Conc.*** (ug/L)*	*1993 Wet Weather Data Overflow Chambers (ug/L)*	*1993 Wet Weather Data Overflow Chambers (kg/yr)*
Cadmium (Cd)	8	6	11	6	6	10	2.5	100	180	2.5	10
Chromium (Cr)	35	9	10	21	12	9	180	1,750		180	720
Copper (Cu)	54	16	11	66	13	10	100	300	100	100	400
Lead (Pb)	30	18	11	42	23	10	70		1,200	70	300
Nickel (Ni)	32	17	11	52	34	10	110	750		110	440
Zinc (Zn)	76	20	11	261	31	10	340	1,300	499	340	130
Mercury (Hg)	1.35	1.61	9	1.92	0.67	9	0.48			.48	2.0
PCB	0.23	ND	1	0.33	ND	1	0.21			0.21	1.0
Total Treated Flow†	14,713.9			46,960.2							
Total Bypass†	589.7			767.8			7,231			7,231	

NOTES:
N = Number of Samples
ND = Not Detected
* = January 1, 1992 to March 18, 1993
** = Preliminary Data, Average Wet Weather Sampling of Overflow Chambers, Windsor Riverfront PCP Study
*** = FAV pursuant to Michigan Water Quality Standards
† = data shown are X1,000 m^3
Source: Windsor PCP

Table 30
Estimated CSO Contaminant Concentrations and Load from DWSD

Parameter	*1978 CSO Conc. (ug/L)*	*1983 Influent Conc. (ug/L)*	*1992 Influent Conc. (ug/L)*	*1982/1993 ratio*	*Calculated Conc. (ug/L)*	*1992 Avg. Annual Loading to Det. River* (lbs/yr)*	*1992 Avg. Annual Loading to Det. River* (kg/yr)*	*1978 Avg. Annual Loading to Det. River** (lb/yr)*	*1978 Avg. Annual Loading to Det. River** (kg/yr)*
Cadmium	41	18	14	0.78	32	3324	1496	5745	2585
Chloride	44000	125000	141000	1.13	49632	5174136	2328361	6164928	2774218
Copper	218	240	51	0.21	46	4829	2173	30544	13745
Lead	447	126	29	0.23	103	10725	4826	62630	28184
Mercury	45	0.56	0.28	0.50	23	2346	1056	6305	2837
Nickel	139	191	53	0.28	39	4021	1809	19476	8764
PCBs	2.4	6.2	0.33	0.05	0.13	13	6	336	151
Phosphorus	3900	4460	3376	0.76	2952	307757	138491	546437	245897
Silver	38	14	6	0.43	16	1698	764	5324	2396
Zinc	555	656	306	0.47	259	26989	12145	77762	34993

NOTES:
* Based on Annual Average Total CSO discharge to the Detroit River of 12.5 billion gallons
** Based on Annual Average Total CSO discharge to the Detroit River of 16.8 billion gallons
Source: CSO TWG IPP Writing Team

Table 31
Estimated Annual Contaminant Loadings (kg/yr), City of Windsor–1992

Parameter	*LRPCP* *Treated*	*Bypass*	*WWPCP* *Treated*	*Bypass*	*CSO* *(Typical *)*	*Total*	*Stage 1 RAP* *CSOs***	*Storm***	*TOTAL ***
Cadmium (Cd)	88	5	282	5	10	389	5.2	6.5	11.7
Chromium (Cr)	132	21	564	16	720	1,453	–	–	0
Copper (Cu)	235	32	610	51	400	1,328	520	613	1,133
Lead (Pb)	265	18	1,080	32	300	1,695	260	3,539	3,799
Nickel (Ni)	250	19	1,597	40	440	2,346	52	285	337
Zinc (Zn)	294	45	1,456	200	1,300	3,295	1,770	4,600	6,370
Mercury (Hg)	24	1	31	1	2.0	59.4	0.2	0.6	0.8
PCB	0.000	0.136	0.000	0.253	1.0	1.4	0.5	0.5	1.0

NOTES:
* Typical Year, Preliminary Estimates Windsor Riverfront PCP Study (1993)
** Stage 1 Detroit River RAP Estimates
Source: Windsor PCP

The Detroit River CSO Toxics Sampling Project

The Detroit River CSO Toxics Sampling Project is a two-phased joint effort between Michigan Department of Natural Resources (MDNR), United States Geological Survey (USGS), Southeast Michigan Council of Governments (SEMCOG), and Detroit Water and Sewerage Department (DWSD). The primary objectives of the project include the following:

- identifying a wide variety of CSO effluent pollutants, including 17 conventional, 17 metal, and 17 organic constituents,
- calculating annual pollutant loadings from the sampled outfalls,
- determining the relationships between drainage area characteristics and CSO pollutant loadings, and
- developing a predictive tool to estimate CSO outfall toxic constituency/loadings from unsampled CSOs based on service area, land use, and other factors.

Project funding was made available through the MDNR from the United States Environmental Protection Agency pursuant to Section 104(b)(3) of the Federal Clean Water Act. Phase-1 sampling determined pollutant loads from two CSO outfalls to the Detroit River. Phase-2 of the project, expanded the sampling to three additional outfalls and began the development of a model to predict CSO toxic loadings based on land use characteristics. Each phase includes a full year of sampling and another year of analysis. Because this study is being funded in part by the United States Environmental Protection Agency (EPA), a Quality Assurance Project Plan (QAPP) describing appropriate sampling, handling, analytical, quality assurance, and quality control procedures to be followed during the study was approved by EPA prior to commencement of actual sampling. Results of this project are now becoming available.

The Windsor Riverfront Pollution Control Planning Study

The Windsor Riverfront Pollution Control Planning Study is a comprehensive effort to characterize the quantity and quality of major discharges to the Detroit River along the Windsor riverfront. With regard to CSOs, outfall samples will be characterized with open scan GC/MS and specific analysis for PCB, Dichloro diphenyl trichloroethane (DDT), dieldrin, mirex, hexachlorobenzene, and toxaphene. In addition, the study involves some in-stream monitoring, particularly in the area of major CSOs. This monitoring includes sediment analyses and biomonitoring, using fresh water clams, during dry and wet weather. The clams will be analyzed for bioaccumulation of heavy metals and toxic organics.

Sampling and analysis shall be in accordance with procedures which include quality control sampling and analysis described in the MOEE publication entitled "Protocol for Sampling and Analysis of Industrial/Municipal Wastewater", dated July 1993. The procedures can be applied to stream or surface water sampling. The laboratory methods are performance based rather than specific methods based. The Ministry will be requesting all laboratories to be certified by obtaining CAEAL accreditation through the Canadian Association of Environmental Laboratories.

Sediment Impacts from CSOs

Refer to the Contaminated Sediments TWG Report.

Potential CSO Control Objectives and Options

See Appendix 10.1 for an excerpt from the proposed Ontario CSO Strategy which describes a variety of CSO control objectives and technologies. The CSO TWG is not recommending or endorsing any specific technology. Appendix 10.1 is presented for information purposes only.

Combined Sewer Overflow Control Strategies

Michigan CSO Strategies

EPA CSO Strategy Update

EPA's final Combined Sewer Overflow Control Policy was issued on April 19, 1994. The Policy grew out of extensive negotiations among municipal interests, environmentalists, the states, and EPA during the summer and fall of 1992. The Policy expands upon EPA's 1989 National CSO Strategy, and is intended to direct and guide the development and implementation of CSO controls to meet the requirements of the federal Clean Water Act (CWA). It applies to all combined sewer systems in the U.S. that overflow as a result of storm water flow.

Eight guidance documents currently under development by EPA will give added weight and significance to the Policy. Also, the stature of the Policy will be enhanced considerably if Congress passes pending CWA reauthorization legislation that would codify the Policy by incorporating it by reference into the CWA. The Policy contains two general control requirements: the "Nine Minimum Controls" and compliance with water quality standards. The Nine Minimum Controls are designed to be implemented quickly with relatively little capital cost. It is expected that CSO controls will comply with water quality standards, however, will entail substantial expenditures.

The Nine Minimum Controls are as follows:

1. Proper operation and regular maintenance programs for the sewer system and the CSOs;
2. Maximum use of the collection system for storage;
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized;
4. Maximization of flow to the Publicly Owned Treatment Works (POTW) for treatment;
5. Prohibition of CSOs during dry weather;
6. Control of solid and floatable materials in CSOs;
7. Pollution prevention;
8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts; and
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

Water quality standards compliance can be established under the Policy using one of two approaches at the option of the CSO community. Under the "presumption" approach, compliance is presumed at the time of plan preparation if one of three performance criteria are met. The "demonstration" approach requires that standards compliance be demonstrated at the time of plan preparation. Regardless of the approach selected, however, CSO communities must demonstrate compliance with water quality standards through water quality monitoring conducted at the conclusion of plan implementation. Communities unable to make such a demonstration will be required to install whatever additional controls may be needed to comply with water quality standards. All flows controlled under either the presumption or demonstration approaches must at a minimum receive the equivalent of primary clarification, disposal of solids and floatables, and disinfection and disinfectant removal, if necessary, to meet water quality standards.

The three performance criteria of the presumption approach are as follows:

1. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a combined sewer system as the result of a precipitation event that does not receive the minimum of primary treatment; or
2. The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis; or
3. The elimination or removal of no less than the mass of the pollutants, identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph 2. above.

In conclusion, while the requirement to ultimately demonstrate compliance with water quality standards will pose a significant challenge for most CSO communities, the flexibility built into the Policy provides opportunities to make this demonstration through site-specific, cost-effective control measures.

Relationship Between EPA and Michigan CSO Strategies

At present, the Michigan permitting strategy reflects many of the elements of the EPA Policy. For example, recently issued NPDES permits for the Rouge River watershed communities and the Detroit WWTP include implementation in the short term of minimum controls very similar to the "Nine Minimum Controls" defined in the EPA guidance. These NPDES permits also require long-term CSO control plans to ultimately result in compliance with Water Quality Standards, and development of financial plans, all of which are elements described in the EPA Policy. In order to clearly understand the development of Michigan's CSO policies, it is important to realize that they were developed prior to EPA Policy development and significantly influenced the final EPA policy. The following is a historical perspective on Michigan CSO Policy development.

History of Michigan CSO Policy Development

The First Generation Permits (1974)

In general, first round NPDES permits were issued by the Michigan Water Resources Commission (MWRC) to "CSO only" dischargers in 1974 or early 1975, and to "CSO and Wastewater Treatment Plant" dischargers in 1973 or 1974. These permits (almost) all expired on 6-30-77, one day prior to the federal statutory deadline of 7-1-77 for meeting water quality standards. It was expected at the time of issuance that water quality standards would not be met by the statutory deadline. Typically, these permits required maximum transportation for treatment and implementation of an effective CSO Control Program. These permits did not explicitly require compliance by 7-1-77, but they did include a number of interim requirements. Interim CSO requirements included:

- A plan to obtain information on CSOs, due in 1975;
- A CSO Analysis Report and Basis of Design for control facilities that would meet water quality standards, due in 1976 or early 1977; and
- A certification requirement that construction grants will be pursued or that construction will not involve grant funding, due in 1975.

A few permits included only the maximum transportation requirement and explicitly "deferred" any control requirements until such time as the MWRC determined that the discharges violated Act 245. A few others included only a requirement to identify the existence of any existing CSOs. Another few permits included explicit requirements to implement plans already underway.

The Second Generation Permits (1977–1978)

Second round permits were issued between 6-30-77 and the end of 1978. These CSO permits typically required the same maximum transportation and "effective" CSO Control Program requirements of the first round. In addition, these required that the permittee "attain control" by date certain (the permit expiration date). Control was defined as retention of the one year one hour storm flows and the equivalent of primary sedimentation, skimming and disinfection for all flows in excess thereof. More or less stringent controls may be required or approved by the Chief Engineer on a case-by-case basis to assure that water quality standards will not be violated. Other conditions included:

- A requirement for a basis of design and plans & specifications for control facilities in a "timely manner" to attain control by the required date.
- A requirement to pursue grant funds with a "good faith effort" or to complete the control program without grant funds.
- An opportunity to request an extension if grant funds are not available.

Committee work to develop CSO policy (1983 - 1987)

The first CSO Committee formed by MDNR staff met in January, 1983. The discussions evolved into a "Draft Policy Statement" considered by the MWRC in October of the same year. This statement called for CSO control to be based on "unacceptable interruption of the designated uses". Discharges from combined sewers were to be treated no differently than discharges from storm sewers or sanitary sewers. Discharges due to storms greater than the once in ten year storm were considered uncontrollable and not regulated. The MWRC concurred with staff's recommendation to take the proposed policy to public meetings to gather and provide information. No public meetings were ever held on this draft and it never was presented to the MWRC for action.

The next committee was appointed in early 1985. The committee's purpose was to develop a CSO policy. The action was taken in response to a Region V EPA Draft National Pollutant Discharge Elimination System (NPDES) Permit Strategy for Combined Sewer Systems dated December 1984. The Committee met six times in 1985 and on February 20, 1986, staff proposed the resulting Combined Sewer Overflow Resolution and Goal Statement to the MWRC for approval to public notice. Comments made by the public at the MWRC meeting led to an expanded committee to review the matter further. The expanded committee discussed many issues including:

- The February 1986 Proposed WRC Combined Sewer Overflow Resolution and Goal Statement, which was used as a working draft for the committee's work.
- Minimum level of treatment.
- Basis for determining required level of treatment for each overflow.
- Potential for revised Water Quality Standards.
- Schedules for achieving CSO Control.
- CSO Control Implementation and Sewer Construction Policy.

The effort ended with a draft CSO Resolution and Goal Statement that called for elimination of CSOs wherever economically and technically feasible. Where elimination was not feasible, retention and complete treatment would be required for the design storm. The design storm was defined as that event exceeded no more than six times in an average year. Upon review, Division management concluded that the approach taken would not be enforceable under current law and regulation, and that water quality standards changes were necessary to address CSOs. The committee's approach was then abandoned, and an NPDES Permit Strategy for Combined Sewer Systems was drafted following the format of EPA Region V strategy.

The draft NPDES Permitting Strategy included two phases. Phase I called for short term improvements, monitoring, and maintenance of existing CSOs while a modification of the MWRC Rules to address CSOs was promulgated. Phase II would require upgrading to comply with the rule changes promulgated in Phase I. The MWRC did not explicitly adopt the "Strategy", but unanimously passed a motion directing staff to process CSO permits in accordance with Phase I on a case-by-case basis, and form a committee to address long range requirements and a process for achieving those requirements.

In August 1987 the MDNR staff presented draft permit language to the MWRC that it had public noticed for three communities and intended to bring to the Commission for issuance in September. The draft permit language used a different approach for Phase II of the CSO strategy. It required development of a site-specific "Final CSO Control Program" which will result in the elimination or adequate treatment of combined sewage discharges containing raw sewage and compliance with the Water Quality Standards. The MWRC was generally agreeable with this approach.

The Third Round CSO permits

On September 17, 1987 the MWRC issued the first three of the third round CSO permits to the Cities of Lansing, Port Huron, and Belding. The Cities of Lansing and Port Huron contested the permits on the basis that they establish state-wide policy without following proper procedures and that they establish vague, yet overly restrictive and expensive, requirements. One of the most significant concerns dealt with the level of treatment that MDNR would consider "adequate treatment".

A committee of MDNR Environmental Engineers was established to recommend an "adequate treatment definition". The committee made its recommendation which became the basis for the definition contained in the next CSO permit issued on September 15,1988. It called for containing all sewage flows within the sewerage system generated by storms up to the One Year - One Hour Storm Event, and providing a minimum of sedimentation, skimming, and disinfection for greater flows up to the Ten Year - One Hour Storm Event.

Quite a few permits for CSOs were issued in 1989 using this permit as a model, although each permit was negotiated individually. This resulted in continued refinement of the "standard language" used to initiate negotiation. The most controversial CSO permits to be issued in 1989 were the Rouge River CSOs (13 individual communities) and the City of Detroit. These permits contained three phases of CSO control instead of two. This was done to conform with the Rouge River Remedial Action Plan which called only for elimination of raw sewage discharges and the protection of the public health by the year 2005 (Phase II). Water Quality Standards would only be met at some unspecified future date (Phase III). All of these permittees, however, contested the issuance of their respective permits. The City of Lansing, at the same time, settled their contested case following inclusion of the adequate treatment definition in their permit by modification. (Port Huron also settled its contested case without inclusion of the adequate treatment definition.) The Rouge River communities settled their contested cases in October 1992 following permit modifications that included much more specific actions to be taken leading to the 2005 deadline.

The Current Michigan CSO Permitting Strategy

On August 10, 1989 EPA issued the "National Combined Sewer Overflow Control Strategy" which required all NPDES delegated states to submit permitting strategies to their respective regions by January 15, 1990. Since Michigan was well into implementation of its "case-by-case" CSO permitting program, a written document was prepared to fulfill the requirement. This was submitted on January 11, 1990 and remains the only written description of the Michigan CSO program. The strategy has been aggressively pursued by MDEQ staff, and currently (as of July 1994), 80 of the 92 permits authorizing CSOs have conditions consistent with the strategy in effect.

The CSO permitting strategy, which calls for establishment of enforceable deadlines for CSO control, will lead to the elimination or adequate treatment of all CSOs in Michigan. NPDES permits containing schedules for development of corrective programs will be required for all CSOs. The regulatory approach regarding CSOs is intended to provide flexibility for individual communities to develop site-specific corrective programs.

The corrective program established in the NPDES permit for addressing CSOs is a phased approach. Phase I (short term improvements) requires operational improvements of the existing system to minimize overflows, sampling and other monitoring requirements to establish a strong data base on the existing system, and construction of interim CSO control projects where feasible. Under Phase I, all CSO communities are required to notify the MDEQ, public health department, and a local newspaper (Part 31 of P.A. 451 of 1994) when there is a discharge of raw sewage to surface waters from CSOs. Phase I also requires development of a final program leading to elimination or adequate treatment of CSOs. The final program must contain a fixed-date schedule to achieve the maximum feasible progress in accomplishing these corrections, taking into account technical and economic considerations.

Phase II is the implementation of the final program in subsequent NPDES permits. The schedule developed under Phase I will be incorporated into the NPDES permit, and the permittee will be required to proceed with implementation. The permits require that final programs provide for elimination or adequate treatment of CSOs. This will be accomplished on a case-by-case basis with professional staff of the department working closely with municipalities to define appropriate corrective programs and milestone compliance dates.

The modified Detroit WWTP Permit, which covers all of Detroit's CSOs to the Detroit River, takes a two phased approach and is discussed in the Current Activities section. Phase I requires short term improvements and Phase II requires elimination of raw sewage discharges, protection of human health, and requires implementation of long term controls to meet water quality standards. Detroit's Rouge River CSOs follow a three phased approach.

Enforcement

NPDES permits are required under the CWA, the MWRCA, and Part 31 of P.A. 451 of 1994 for all point source discharges to surface waters of the State, including CSOs. Any violation of a permit condition, including compliance schedules for implementing CSO controls, or a point source discharge (including CSOs) to surface waters without a permit is a violation of the CWA and MWRCA. Such violations of the Acts may be subject to civil and/or criminal action for injunctive relief, substantial monetary penalties, and reimbursement for environmental damages.

A permit violation may be detected by the MDNR through routine review of compliance schedules. Violations may also be directly reported to MDNR. Upon recognition of a permit violation or a violation of related sections of the CWA or the MWRCA, an appropriate compliance/enforcement action is taken. The compliance/enforcement response will be timely, and appropriate for the nature and severity of the violation.

The Rouge River National Wet Weather Demonstration Project

The Rouge River National Wet Weather Demonstration Project (Rouge Demo Project) is a major effort toward restoring the Rouge River. Design and construction of retention basins to prevent untreated CSOs represents the largest part of the project. Nine CSO retention basins with varying capacity and retention times and one on-line storage tunnel are being constructed. In addition, approximately 8 communities will separate their combined sewer systems. MDNR issued NPDES permits to all of the Rouge River watershed communities establishing compliance schedules for completion of these CSO controls. The permits require the retention basins to be completed by the end of 1996 (for most of the basins; 1997 for the rest). The permits require the separation projects to be completed in accordance with community specific schedules which vary from completion by the end of 1996 to the end of 1999.

The Rouge Demo Project will determine just how effective these retention basins and sewer separation project, as well as structural nonpoint source controls and best management practices, are in achieving compliance with Water Quality Standards. The NPDES permits require permitees to conduct and complete evaluation studies of basin effectiveness by 1999. The results of the Rouge Demo Project may be useful in considering the most cost-effective methods for CSO control on the Detroit River.

Ontario CSO Strategies

Proposed CSO Strategy

Historical Perspective

The MOEE has not adopted a policy regarding CSOs although the current proposed strategy is the latest of a number of attempts made over the last 15 years. In 1980, MOEE developed a position paper on the minimum requirements for combined sewer performance. The basic positions of the document were that no dry weather overflows would be accepted and that municipalities must achieve total abatement of wet weather overflow at some future (but unspecified) time. Minimum requirements included:

- to inventory sewers and overflow systems
- to demonstrate adequacy of sewer and treatment capacities for dry weather flows
- to allow no additional sanitary servicing in cases of inadequate capacities unless capacities are increased adequately
- to carry out a comprehensive pollution control planning study

In 1985, MOEE developed a draft CSO control policy with similar minimum requirements to the 1980 position paper. The draft policy's ultimate goal was total containment and treatment of all CSOs with a 50-year implementation period.

Although CSOs occur typically during a significant rainfall or snowmelt, they may also occur during dry weather. There are many causes of dry-weather overflows. The more common ones are under-design of pipe capacity, seepage or infiltration of excess groundwater and poorly maintained or blocked regulators. Seepage usually occurs during periods after storm events because of proximity to high water tables or leakage from the watermains. Dry-weather overflows are unacceptable because of their high pollutant loads.

For specific water quality problems, taking care of the CSOs alone may not be adequate. For example, in the Kingston PPCP study, it was found that eliminating CSOs would not solve the water quality problem at the Kingston beaches because of the bacteria loadings from the separated storm sewers. Therefore, resources should be targeted toward identifying and correcting significant pollution sources to solve the water quality problem at a particular location.

Goals of the 1992 Proposed Policy

The goals of the proposed CSO Policy are:

(a) to eliminate dry weather overflows

(b) to minimize impacts to aquatic life and human health resulting from CSOs

(c) to ensure that body contact recreational criteria at beaches would not be violated for at least 95% of the swimming season for an average year

Proposed Control Criteria

Combined sewer systems must be of sufficient capacity and appropriate design, and be operated, maintained and managed in such a way as to minimize identified or potential impacts of CSOs on health and receiving water quality.

For areas with combined sewers, the Ministry would require:

(a) minimum control criteria for all combined sewer areas

(b) water-quality-based standards in areas where recreational water uses are impaired as a consequence of CSOs

The Ministry through its Regional Offices would require that the operating authorities of combined sewer systems submit to the Regional Office for review and approval:

> *a pollution prevention and control plan (PPCP) consisting of all feasible measures to eliminate dry-weather overflows and all practical measures to minimize wet-weather overflows in order to reduce the impact upon health or receiving water quality.*

The PPCP should contain an implementation plan with cost estimates and timing schedule. The timing for review and approval procedures should also be taken into consideration.

Minimum Control Criteria

All municipal sewer systems would be required to meet the following minimum criteria in their operation:

(a) No overflows of untreated sanitary wastewater would be allowed during dry-weather periods. Only under conditions of emergency, e.g., sewer failure, would the discharge of untreated sanitary wastes be permitted in periods of dry weather at any point within the sewer system or at the WWTP.

(b) Each municipality would be required to provide to the Ministry thorough documentation of their combined sewer systems. This would allow the existence and severity of suspected deficiencies to be confirmed and allow future deficiencies to be considered. Municipalities would be required to develop and maintain records of all critical components and operational procedures for combined sewer systems including the following:

- location and receiving water body for all combined sewer outfalls
- combined sewer system flow capacities and present and future expected peak flow rates during dry weather
- location, physical description, flow capacity, present and future expected peak flow rates during any weather, and overflow capacity of all regulators and cross-connections
- combined sewer maintenance programs
- regulator and cross-connection inspection and maintenance programs
- all points within separated sanitary sewers allowing the discharge of untreated sanitary wastes
- bypass locations at the WWTP or its associated pumping facilities

(c) Each municipality would be required to establish proper operation and regular maintenance programs for the combined sewer system.

(d) Each municipality should demonstrate that the combined sewer system, including the regulators, and associated treatment facilities are adequate for the transmission and treatment of all dry weather flows for the design population. Where elements of the sewer system or the treatment facility are found to have inadequate capacity for the transmission and treatment of all dry weather flows additional sanitary servicing should be curtailed and the municipality would be required to upgrade the inadequate facilities.

(e) Each municipality should establish Pollution Prevention/water efficiency programs, preferably through by-laws, for the reduction of extraneous dry weather flow (infiltration) and inflow such as roof-leader disconnection and foundation drain disconnection.

(f) Each municipality should establish a plan for the control of solid and floatable materials from CSO discharges.

(g) Each municipality should establish the baseline annual CSO volume and frequency which is the annual CSO volume and frequency estimated to occur based upon the existing sewer system and the historical rainfall record. This should be done by conducting monitoring studies either independently or as part of a PPCP study.

(h) Each municipality should make maximum use of the collection system for storage and shall maximize the flow to the WWTP for treatment.

(i) Where possible, the WWTPs should be modified to implement Step Feed operation to maximize the storm flow capacity treated at the WWTP. Plant modifications for step feed operation are less expensive than plant upgrading by adding aeration basins or secondary clarifiers.

(j) Each municipality would be required to control 90 % of the wet weather flow (as compared to baseline conditions) in the combined sewer system for an average year and ensure that this contained volume receives a treatment level equivalent to primary treatment. The equivalent primary treatment means that there should be an average of 30 % BOD removal and 50 % total suspended solids removal as well as disinfection. The average removal is based on the total contained volume while different portions of the contained volume may pass through treatment processes of different efficiencies. The treatment facilities can either be located at a central location (at the WWTP) or at distributed locations (satellite treatment). The 90 % volumetric control criteria is applied at each regulator.

(k) Bypasses at WWTPs are considered the same as CSOs. They will be subject to the conditions in (j).

Water Quality-Based Criteria on a Case-by-Case Basis

Additional controls for CSOs beyond the minimum criteria may be required on a case-by-case basis in areas where there are local water quality concerns or water uses are impaired as a consequence of CSOs. In cases where CSOs are one of many sources contributing to water use impairment, the required solution has to deal with all of the pollutant sources. The level of CSO control is site-specific to meet local water quality objectives.

Beaches Protection

The Ministry of Health criterion for body contact recreational waters is 100 E. coli/100 ml (geometric mean of at least 10 samples per month). The primary sources of bacteria in recreational waters are CSOs and stormwater. Achieving this water quality standard at beaches is a high priority issue with a number of municipalities in Ontario.

The criterion for body contact recreation at beaches should be maintained for at least 95% of the season from June 1 to September 30 on the average. If it is assumed that the impact from a storm that causes a violation of the E. coli criterion for body contact recreation would last for three days, this means that not more than two violations per season would be allowed. The controlled volume of combined sewage is to receive treatment at a level equivalent to primary treatment as well as disinfection.

Aesthetics

Receiving waters should be free from pollutants that settle to form objectionable deposits or float as debris. Measures to control CSOs should be taken to control this problem.

Combined Sewer Monitoring

MOEE may require monitoring (quantity and quality) of wastewater flows and overflows at locations within the sewer system for purposes of determining compliance with the Ministry's minimum requirements. The nature of monitoring programs will be determined by the Ministry's Regional staff. The responsibility for monitoring will rest with the municipality served by the combined sewer system. The Ministry, at its discretion, may provide assistance.

Environmental Assessment Act Requirements

The requirements of the Environmental Assessment Act as they relate to sewer systems, must also be taken into account when preparing pollution control plans. The proposed works identified in the plan may either be exempted by Regulation or Minister's Order, or require a Class Environmental Assessment.

New Connections to Combined Sewer Systems

New storm drainage systems will not be permitted to connect to existing combined systems except where validated evaluations indicate that circumstances allow no other practical alternative. The evaluations must be documented as part of a pollution control plan approved by the Ministry. "Piece-meal" construction on existing combined sewer systems will be permitted only with overriding justification such as for the purpose of relocation, e.g., to accommodate underground utilities, subway structures, new buildings and pedestrian tunnels, or for the purpose of capacity improvement, e.g., to relieve basement flooding or to provide emergency additional conveyance capacity to treatment works to reduce overflows.

Implementation

The draft CSO Policy has been planned to be released to stakeholders, municipalities, and to the public through the RAP review process and news releases. The program will initially focus on the following priority areas:

- Beach areas,
- RAP AOCs, and
- STPs with high bypass flows.

The CSO remedial measures required to satisfy the Policy shall be implemented within 25 years of the Policy promulgation. These remedial measures must identified in an MOEE-approved PPCP. Each PPCP will consist of an implementation plan with time schedule and cost estimates. The PPCPs for municipalities with combined sewer areas shall be completed within three years of the Policy promulgation.

Deviations from Policy/Guidelines

Any deviation or relaxation from this Policy and its guidelines must receive the concurrence of the Director of the Water Resources Branch and the Regional Director.

The Municipal Assistance Program for CSO Control in Ontario

The Ontario Water Resources Commission was formed in the early 1960's and its purpose was to build water and sewer plants and the necessary infrastructure. Today the Ministry, through the Clean Water Agency, operates over 400 plants in the Province. The Ministry's initial financing programs were only for new works under the Direct Grant Program. In the mid 1980's, money was made available for planning studies (including CSOs) and, through the Lifelines Program, money was available for infrastructure studies and the repair of these works. With the association of beach closings due to bacteria contamination in 1989 to 1993 money was specifically available for CSO studies, works upgrading and building of new works. Late in 1993 the Clean Water Agency was created through legislation passed by the Ontario government. The role of the agency is to finance, build, and operate water and sewage facilities throughout the Province and provide service and advice on a cost recovery basis. Under the authority of the new agency, the grant program's name changed to the Municipal Assistance Program (MAP).

Grants available under the Beaches Program include assistance towards the cost of completing Pollution Control Planning (PCP) studies. Such studies will outline the nature, cause and extent of water pollution problems, propose alternative remedial measures and recommend an implementation program for a defined municipal area. The level of grant assistance is based on the municipal population with a minimum grant of 50%.

Projects conducted under these programs are usually initiated by municipalities experiencing water quality problems. Beach postings have provided the motivation behind the majority of the PCP studies conducted to date.

Pollution Control Plans

Generally, there are three main phases to the development of a PCP. The first phase is the determination of nature, cause and extent of the pollution problems. The second phase requires the identification and evaluation of remedial options. Finally, the third phase is the development and scheduling of an implementation plan. The implementation horizon of the plans typically extent 20 to 25 years.

In all three phases there is a high level of public involvement and interaction. This is to ensure the public is properly informed and educated on the plan development so they can contribute effectively to the decision process. Public involvement is also a statutory requirement imposed by Ontario's Environmental Assessment Act.

The Windsor Pollution Control Plan

For all PCP studies a wide range of remedial alternatives are examined. These alternatives include: source control; operational and maintenance improvements; structural controls (storage, conveyance and treatment); and the "Do Nothing" option. The alternatives are sized based on the water use impairment.

The Ministry of Environment and Energy required the City of Windsor to undertake a pollution control planning study for its portion of the Little River. The Ministry stated that a study would be required to evaluate the latest upgrading of the sewage treatment plant in order to determine if further environmental improvements would be necessary.

Little River's lower reach is channelized to provide flood protection and is utilized for pleasure boating. The Little River receives municipal and industrial discharges, combined sewage, urban runoff and agricultural drainage.

The study focus was to determine the health of the Little River ecosystem. Consequently, in addition to examining and determining impacts from the sewage treatment plant, stormwater runoff and combined sewer overflows, the assessment also included macroinvertebrate sample analysis and biomonitoring.

The implementation plan targeted specific reaches of the Little River watershed. The recommendation for the original Little River channel is for enhancements to provide an expanded wetlands habitat area. In addition, a more detailed infrastructure study is on-going to develop an abatement strategy for combined sewer overflow and sewage treatment plant bypass.

In the middle reach, the recommendations were based on the potential for aquatic habitat improvement. The recommendations call for development of riparian vegetation and vegetation buffer zones as well as stormwater control utilizing best management practices.

Implementation of Remedial Measures

Implementation of remedial measures as recommended by the PCP studies is costly. In order to ease their financial burdens, municipalities often seek assistance from either the Provincial or the Federal governments. Citing the needs from the municipalities, the Ontario government initiated the Beach Improvement Program (BIP) to provide grant for construction of capital works.

Municipalities which have undertaken a PCP study will be ranked a higher priority when come to the evaluation of the submissions for this grant. Facilities supported by this grant include upgrading and expansion of sewage treatment plants; sewers separation; construction of underground CSO storage tanks, trunk relief sewers, localized treatment facilities, instrumentation for real-time CSO control, wiring for bird management, etc. Numerous municipalities also received grants through this program for their infra-structure works.

Program Direction

The one issue in PCP studies that generates the most debate among the study team members is the level of control to be achieved by the remedial measures; specifically on CSOs. As no specific guideline exists for CSO control, the determination generally is based on site-specific factors. In practice, this has resulted in different levels of control being accepted in different regions of the province. The province is currently developing a CSO guideline together with an implementation mechanism. With the development of this guideline, a more systematic approach to CSO abatement can be realized.

Municipal/Industrial Strategy for Abatement — MISA

In 1986, the Ministry of the Environment initiated the Municipal/Industrial strategy for Abatement (MISA) to identify and reduce the pollutants discharged from industrial and municipal sources into Ontario's lakes and rivers. The first phase of the program - effluent monitoring for over 300 major industrial direct dischargers -has been completed. The ministry has embarked upon the second phase - the regulation of industrial sector dischargers to reduce the amount of conventional and toxic contaminants being discharged.

The goal of MISA is the virtual elimination of toxic contaminants in municipal and industrial discharges to Ontario's lakes and rivers. The fulfillment of this goal is essential for reducing the risk of damage to the ecosystem and to protect human health.

Prior to 1986, Ontario's approach to water pollution abatement was centered on the identification of site-specific environmental concerns. It was followed by control of effluents being discharged from individual industries and municipalities either through legal instruments (i.e., Control Orders, Requirements and Directions, Stop Orders and Certificates of Approval), guidelines or voluntary abatement programs.

This approach was satisfactory for dealing with pollution problems such as oxygen depletion or conventional pollutants such as suspended solids, sewage and oils. Applied to persistent toxic contaminants, it had several shortcomings. Control Orders varied from region to region or company to company - a level playing field was lacking. Effluent guidelines, by themselves, did not have legal status. Also, there were no procedures in place to assess the impact of toxic contaminants on a local basis, especially for those substances which accumulate in the environment. By the time environmental impacts were assessed and proven, it was often too late to stop the damage.

MISA targeted industrial polluters from nine sectors that discharge directly into Ontario's lakes and rivers:

- Pulp and Paper
- Petroleum Refining
- Organic Chemical Manufacturing
- Iron and Steel
- Mining
- Inorganic Chemicals
- Metal Casting
- Electric Power Generation
- Industrial Minerals
- Municipal Sewage Treatment Plants (412)

In addition, approximately 12,000 facilities currently discharging into municipal sewer systems are to be regulated through the MISA Sewer Use Control program.

In September 1991, the Ministry of Environment and Energy published the Issue Resolution Final Report which defined concepts crucial to the development and implementation of the clean water limits regulations. At the same time, the ministry introduced a new direction for the program which included:

- the identification of pollution prevention as the preferred approach to achieve the virtual elimination of persistent toxic substances
- the establishment of effluent limits for a list of sector-specific parameters
- the establishment of a ban or phase-out list for specific persistent toxic substances
- the requirement that final effluents cannot kill fish or water fleas as measured by standardized tests

Since 1993, legally enforceable limits have been finalized for seven industrial sectors: petroleum, pulp and paper, metal mining, metal casting, industrial minerals, organic chemical manufacturing and inorganic chemical sectors. Final regulations are being prepared for the electric power and iron and steel sectors.

The Major Environmental Concerns

Some wastewaters from the industrial sectors contain persistent toxic chemicals such as chlorinated solvents, polychlorinated dibenzodioxins and dibenzofurans, polychlorinated biphenyls (PCBs) and heavy metals such as mercury, nickel, zinc and chromium. The wastewaters also contain conventional pollutants such as suspended solids, phosphorus and nitrogen compounds which could impair the uses of receiving waters.

Persistent toxic chemicals including heavy metals can accumulate in sediments on the bottom of a body of water and can be harmful to human health, fish, aquatic plants and other aquatic life. These chemicals have been linked to cancers and birth defects in humans.

Establishing the Discharge Limits

The clean water limits in the regulation are based on the results of a 12-month monitoring program and an examination of the best available technology (BAT) for reducing the discharge of contaminants in each sector.

The ministry defines BAT as a combination of demonstrated treatment technologies and industrial process changes that can reduce or eliminate pollution and are affordable to the industry. To determine BAT, the ministry hired consultants to conduct a world-wide search for modern wastewater treatment practices and process technologies applicable to the two sectors.

Regulated plants are free to choose how they meet the limits. For example, rather than installing end-of-pipe treatment, companies may choose to implement pollution prevention measures. A description of the available technologies for the seven sectors are contained in the BAT consultant's reports.

The sector clean water regulations will result in the application of legally enforceable limits across the province.

Applying the Discharge Limits

There are two general approaches to reducing the quantities of pollutants in plant effluents: in-plant pollution prevention and end-of-pipe treatment.

In-plant pollution prevention consists of process modifications, chemical substitution and water reduction and recycling. In-plant recycling of wastewaters is becoming a common practice in industry. Typically, pollutants can be removed from wastewaters by treatment such as filtration and the cleaned-up water can be re-used in the process.

End-of-the-pipe treatment processes commonly used in the sectors to improve effluent quality include filtration or sedimentation, biological treatment and activated carbon adsorption.

The regulations incorporate a number of standard monitoring and reporting requirements in common clean water regulations for the MISA sectors. Sections of the regulations govern: compliance monitoring, the location of sampling points, sampling and analytical procedures, toxicity testing, the calculation of loadings, effluent flow measurement, quality control, record keeping and reporting to the ministry and to the public.

How the Regulations Were Finalized

The regulations were finalized following a 60-day public comment period. Consultations were held with affected plants and trade unions, as well as with First Nations representatives. The draft regulations were also reviewed by the MISA Advisory Committee, which is made up of environmental experts from academia, industry and public interest groups.

Penalties for violations

Corporations not complying with clean water regulations can be subject to a maximum fine of $50,000 per day for a first conviction and $100,000 per day for subsequent convictions.

Enforcement/Implementation

With the present proposed CSO control policy, enforcement is through normal procedures under the Ontario Water Resources Act. At present, and since the early 1980s, the Ministry has encouraged municipalities to conduct PCP studies by offering 50% cost grants and also in the sewer repair grant program stating infrastructure studies have to be complete before construction grants will be granted.

To date the program has been quite successful with 32 Pollution Control Plans complete or in preparation from the 67 municipalities with CSOs. It is estimates that the completed or planned studies covers about 70% of the total population services by CSOs. Over $100 million in grants for works has already been given for CSO works.

Current CSO Remediation Activities

It is important to note that communities with combined sewer systems tributary to the Detroit River have already undertaken numerous activities which are reducing the impact of CSOs on the Detroit River and are providing crucial information which will aid in the development of specific CSO control projects in the neat future. These activities represent important components of an overall, comprehensive Detroit River CSO control program.

Michigan Activities

The City of Trenton

The City of Trenton, population 20,586, is located in southern Wayne County, Michigan on the west shore of the Detroit River. Single family residential occupies approximately one quarter of the land. There is also a mobile home park of approximately 125 units. Multiple Family residential is scattered through the central and eastern areas of the city. The City's central business district is located along West Jefferson Avenue which runs parallel with the Detroit River. There is much commercial zoned property along other major roads in the area. Industrial development is mainly centered in the northeast and southeast sections of the city utilizing the Detroit River, the Grand Trunk Railroad and the expressways. Industrial zoning occupies approximately 30% of the land in the city. Leading industries located in the city include Chrysler Corporation, Monsanto Chemical, McLouth Steel and Detroit Edison. All of these industries abut the Detroit River.

The City of Trenton's WWTP was put into operation in 1964. Throughout the years the WWTP has had various upgrades and uses conventional activated sludge with incineration for sludge disposal and phosphorous removal using alum. The average design flow is 6.5 MGD with a maximum design flow of 13 MGD. The current average daily flow is 5.08 MGD with a maximum flow of 12.67 MGD.

The existing sewer system in the city consists of gravity sewers, four pump stations and force mains, one retention basin with pump station, and two emergency sanitary storm pump stations. There are two remaining modified sanitary sewer by-passes located in the "Old Town District". The condition of the existing sewer system in the city has some problem areas which will require action in the near future. In addition to closing the two remaining modified sanitary by-passes, there are some deteriorating pipes and/or joints and sources of inflow which need to be corrected. The city is presently developing a Project Plan and will be applying for State Revolving Fund to accomplish these projects.

Trenton's CSOs

1. The Wastewater Treatment Plant (outfall 001) has no written policies or procedure's at this time. Management of wet weather flows are dealt with on a storm by storm basis. When overwhelmed, the sewer system is allowed to back up to a level where excess flows enter a 10 MG retention

basin and are held until the treatment plant can handle the extra hydraulic loading. The treatment plant has the capability of treating 13.0 MGD of secondary treated effluent. When the retention basin reaches capacity the West Jefferson Emergency pumping station (outfall 002) is activated.

2. George Street Lift Station (outfall 003) is equipped with a 1,000 gpm River pump which is only used during heavy rainfall events in order to prevent basement flooding. Riverside Hospital is the only Significant Industrial User to discharge into this pump station.
3. Fifth & Elm Diversion Chamber (outfall 006) is equipped with a 20' overflow weir. During heavy rain events wet weather flows overflow the weir to an adjacent storm sewer which discharges to the Detroit River. Once again control is done through inflow/infiltration elimination. Significant Industrial Users that discharge to this system are Riverside Hospital, McLouth Steel Sanitary sewer.

The only control currently available is to eliminate inflow/infiltration from the service areas. During overflow events the city monitors all outfall's for NPDES Parameters.

The City of Trenton has selected two methods for the future control of overflows to the Detroit River. The methods are sewer separation and storage. During heavy rains the sanitary sewer system is overwhelmed by stormwater from; surface drainage, roof conductor, industrial site runoff, etc. The City installed a 10 MG design criteria retention basin for excess flows along with a sewer separation/inflow reduction program. With these efforts in place overflows still occur. During 1991 the City contracted an engineering firm for studies and design plans for correction of CSOs at the George Street pump station (003). The conclusions of the studies showed that recycled flows and further separation should be performed. The project was completed in mid 1991, and the system modifications appeared to stop discharges at outfall 003 until May 27, 1992. On that date a significant storm system overwhelmed George Street pumping station causing a discharge. It is now known modifications have helped to reduce CSO's at 003; however, additional modifications are required for complete elimination.

On March 26, 1991 an engineering firm was authorized to commence work on the study entitled "Elimination of Combined Sewer Overflows, Sewer System Backup and other Sanitary Sewer Deficiencies". 006 outfall and other deficiencies are addressed in this study. Additionally, the engineering firm has developed the City's State Revolving Fund (SRF) Project Plan. The City's intention is to acquire funding through the SRF to eliminate 003 and 006 outfalls.

At present, the City of Trenton is expanding efforts to locate and quantify potential fugitive sources of stormwater inflow. Existing data examination of flow, rainfall vs time has shown that flows to the treatment plant simultaneously increase with each rain event, thus indicating a strong influence from direct inflow connections to the sanitary sewers from surface runoff. Potential sources being scrutinized are; industrial user site drainage, county road drainage, city road drainage, and residential roof conductors.

The City is presently under an Administrative Order by U.S. EPA for failure to comply with Permit requirements for 003 and 006 closure by June 1, 1991, which constitutes a violation of the terms and conditions of the permit and Section 301 (a) of the Act.

Under the EPA Order and new NPDES Permit, the two existing outfalls could be closed by the year 2000.

The City of Detroit

The MDNR incorporated its CSO Strategy into NPDES permits in 1989. Several communities in the Rouge River Basin in Southeastern Michigan, including Detroit, contested the CSO implementation sections of the permit through the State's Administrative Law procedures and through the Federal Courts. After several years of negotiations, the communities and the MDNR were able to agree on an approach to the CSO problem in Southeastern Michigan. While the majority of these permits were for communities in the Rouge River Basin, the NPDES CSO program for the City of Detroit also addresses CSOs on the Detroit River since the City discharges CSOs into both waterways.

The Operational Plan (O.P.) developed by DWSD has been submitted to the MDEQ in accordance with the NPDES Permit. In essence, this plan is to describe the current status of the various components of the sewage collection and transport system. The O.P. further includes the procedures that DWSD follows to ensure that: (a) the system is operated to its maximum capacity so as to provide treatment for all dry weather flows and the greatest quantity of wet weather flows possible; and (b) the system is inspected and maintained so that it operates at its optimum operational capability.

Simultaneously, DWSD is to submit an Interim Combined Sewer Overflow Control Program (Phase I of CSO Control Program as described in the NPDES permit - short term improvements) which details the system's response to rainfall events including current operational status and needed rehabilitation for the mechanical portions of the flow control devices in place in the system. A Computerized Hydraulic Model of the system has been submitted. The model simulates the system reaction to rainfall events and assesses potential CSO control measures within the region tributary to the Detroit WWTP. More specifically, the model should assist in planning future CSO control measures by evaluating the impact of various CSO control measures currently being implemented for CSO control in the Rouge River watershed (Phase II of the CSO Control Program as described in the NPDES permit - protection of human health). At this point, calibration and verification of the model are near completion. Phase I also requires DWSD to undertake a long-term monitoring program to quantify volume and quality of CSOs — this is underway as a joint effort with the USGS, MDNR, and SEMCOG as the Detroit River CSO Toxics Sampling Project. In addition, as part of the report, DWSD must define the maximum time of concentration for the collection system. In other words, DWSD must be able to estimate the time of travel of wastewater flow in the sewer from the most remote inlet to the Detroit WWTP during wet weather flow conditions.

Phase II and the Rouge Demonstration Basins

Phase II of the CSO portion of the NPDES permit describes the public health protection program which involves actual planning and construction dates for CSO control facilities in the Rouge River watershed. DWSD will construct three retention basins designed for settling, skimming and disinfection. The basins vary in size from 2.4 million gallons to 22 million gallons. The smaller basins are to be designed for a specific detention time (twenty minutes for one and thirty minutes for the other) and a specific size storm (one year-one hour storm for all basins). Site constraints at the larger basin required that it be designed to handle whatever flows are transported to it.

The Phase II basins are demonstration projects whose purpose is to determine the most efficient and effective basin sizing. They are part of the Rouge River National Wet Weather Demonstration Project and will be partially funded by Federal Grants. The construction phase will be completed in 1997 and will be followed by an evaluation study which in turn will be used in conjunction with the Hydraulic Model described above to plan the long-range CSO plan for both the Detroit and Rouge Rivers. These projects, therefore, do affect the Detroit River Remedial Action Plan. The protocol for the basin evaluation is currently being designed and will be coordinated through the Rouge Program Office.

Phase II also provides a specific time-frame for the physical rehabilitation of all regulators, tell-tales and isolation gates in the collection system (both Rouge River and Detroit River CSOs) as well as the construction of additional control devices in the system. This aspect of Phase II will be completed in 1998 and is expected to cost about $20 million dollars.

The elimination or adequate treatment of CSOs for the remainder of the discharge points on the Rouge River must be completed by 2005 (as established in the Rouge RAP). This will involve planning for twenty-seven outfalls. Control methodology, at this point, is left to the permittee as long as it provides adequate treatment or elimination of CSOs. There is no estimated cost at this time.

The Long-Range CSO Control Plan — Phase III

Phase III of the CSO program in the NPDES permit is the long-range plan. It requires planning for the Detroit River CSOs to be completed by 1996. It further requires that the permittee ensure and do whatever planning is necessary to ensure that the control devices on the Rouge River are capable of meeting water quality standards that are applicable at the time of submittal of the plan.

The NPDES permit contains required completion dates for numerous other projects some of which will impact CSO planning and implementation. A second major pump station has been constructed (Pump Station 2A) and is operational. The project is partially funded by Federal grants (55% for a portion and 75% for others).

The purpose of Pump Station 2A is to activate a large dormant interceptor - the North Interceptor East Arm -and to provide greater hydraulic control of the flows coming into the Detroit WWTP. Currently, the secondary treatment capacity of the Detroit WWTP is 859 MGD. The primary treatment capacity significantly exceeds this secondary capacity - with Pump Station 2A, potentially up to 1800 MGD. The North Interceptor East Arm was originally designed to serve a number of separate-sewer communities and transport separate sanitary sewage to the WWTP. Because population projections used during the design have not been fully realized, the current capacity of the North Interceptor East Arm is larger than necessary to serve the original service area. DWSD has taken advantage of this excess capacity and will be able to divert separate sanitary flows from the upper reaches of the Northwest Interceptor to the North Interceptor East Arm. This diversion will alleviate some overflows in the Northwest Interceptor service area without increasing the potential for overflows in the Detroit River and provides "preferential transport" of separated sanitary flows to the WWTP. Further, the added capacity and controls of Pump Station 2A give DWSD flexibility to provide "preferential treatment" of the separated sanitary flows in the North Interceptor East Arm, ie., the more concentrated separated flows from the North Interceptor East Arm can be routed from primary to secondary treatment preferentially over more dilute combined sewage from combined-sewer areas during wet weather events.

DWSD has completed design and has begun construction of instrumentation at most of the CSO facilities including pump stations and control devices at the outfalls. The instrumentation will provide real-time information about the system's reaction to wet weather flows and will allow DWSD to better manage flow during a wet weather event to enable utilization of the system storage capacity. Previous studies have indicated that the collection system has a large amount of in-system storage space particularly in its large trunk sewers. The intent is obviously to maximize storage volume within the existing sewer system during storm events until such time that it can be bled back into the interceptors for treatment at the WWTP. Such storage would remove the burden from the interceptors thereby allowing more capacity for wet weather transport and thus fewer overflows. The collection system is expected to be on line in October 1, 1998. There are no federal monies involved in this project, rather, it is totally locally funded. Some specific instrumentation sites are noted in the NPDES permit with attendant construction deadlines (October 1, 1998).

DWSD has begun to evaluate and where necessary calibrate all master meters which measure flow from its service customers. DWSD intends to use this information to calculate with greater accuracy the available capacity in its system. There is a possibility that additional capacity can be offered to the service customers when all of the additional construction described above is on line. In addition, the process has identified several communities that have wet sanitary flow (inflow and infiltration into the sanitary portion of a separated system). Once these communities have corrected their inflow and infiltration problems, even more capacity may be available.

PCB and Mercury Minimization Program

The DWSD NPDES permit requires the development of a PCB and mercury minimization program. While this portion of the permit is currently contested in the state court process, DWSD has proceeded to develop and implement the program. (Note: This minimization program is required because, though the Water Quality Based effluent limitations for PCB and Mercury for the Detroit WWTP discharge are below the levels of detection, effluent analysis shows actual effluent PCB and Mercury concentrations above detection levels. Detroit WWTP's effluent concentrations for the other four parameters of concern identified in Stage I of the RAP (Cadmium, Copper, Lead, and Zinc) are not a cause for concern.) Essentially, the program is to identify and control (to the extent possible) all point and nonpoint sources of PCB and mercury (including site run-off which could eventually be discharged to the river via CSOs). In an effort to identify point sources, the Industrial Waste Control section conducted a file search of its records on Significant Industrial Users who are currently discharging under permit to the DWSD system. The purpose was to identify industrial users who used or stored either of these products. DWSD also conducted a survey of industrial users not under permit to the Department to determine if they used or stored either of these materials. The goal is to put industrial users who use or store these materials under permit and to place limits for PCB and mercury in the new permits and in the existing permits as they were re-issued. The permits will also require the permittees to do regular self-monitoring for these constituents.

The PCB and mercury minimization program has also involved a sewer assessment or system surveillance. Through this sampling program, DWSD is attempting to trace the source of discharges into the system from either point or nonpoint sources. A pattern of sampling has been developed on a citywide basis. DWSD began with the two large active interceptors one of which follows the shoreline of the Detroit River. Initial sampling revealed fairly consistent detectable levels of mercury throughout the system and occasional hits of PCB. The testing was done for a sufficient period of time to allow correlation with wet weather flows.

As part of the above sewer assessment, DWSD sampled the sewers around a site known to be contaminated with PCBs. In the United States these are known as either 307 sites (under the control of the State government, i.e. MDNR) or Superfund sites (under the control of the federal government, i.e. EPA) or both. Very high amounts of PCB were found and as a result, DWSD has negotiated with the Potentially Responsible Parties (the people responsible for the contamination) for a thorough sewer assessment and subsequent cleanup to the extent possible. The assessment will cover the entire length of the sewers which have the potential to receive runoff from this particular site. DWSD has computer-mapped all Superfund and 307 sites within the city and intends to investigate responsibility in each case. The law in the United States permits a municipality as a citizen to sue parties responsible for contamination.

Once the goal of controlling sources of PCBs and mercury to the extent possible is achieved, it is expected that there will be a reduction of mass loading of these constituents to the Detroit River via CSO discharges and the WWTP effluent.

In an effort to determine whether or not the presence of these contaminants is from service customers other than the city of Detroit, DWSD has a program to install sampling devices at all master meter sites where these customers feed into the system. DWSD intends to involve the suburban customers to a greater extent in the monitoring and control of discharges into the system.

As a result of its need to identify all sources of these contaminants, DWSD began a program to sample all discharges of Hauled in Waste (HIW). While this is supposed to be solely domestic septage, the sampling performed to date shows consistent detectable amounts of mercury, occasional detectable levels of PCB and large concentrations of conventional pollutants. A survey of several other Publicly Owned Treatments Works(POTWs) in the state found that several of them have refused to take septage waste precisely because of this problem. While some of the contaminants are due to dishonest haulers including industrial waste in their domestic waste discharges, the bulk of the haulers who show exceedences have not engaged in such practices. DWSD is currently communicating with all parties including the MDNR to determine what control should be effected to resolve this problem, e.g. pretreatment, refusal, etc.

Also in conjunction with the Minimization Program, DWSD has just advertised for proposals for an Air Deposition Study. While many such studies are ongoing at present, this study will focus on quantification of the levels entering the sewers from wet weather runoff. This study will probably not be completed in time for the Stage 2 RAP.

DWSD strongly believes that the primary sources of both PCB and Mercury are noncontrollable nonpoint sources such as air deposition and contaminated site runoff. Thus far, the research and data obtained are not conclusive.

Hazardous Waste Disposal Program

DWSD first sent out a bill stuffer informing Detroit residents of the necessity of disposing of household hazardous waste properly in 1991. Emphasis was placed on the importance of not pouring paints, oils, or chemicals down drains or sewers. Instead, residents were urged to bring the waste to the Special Household Waste Unit operated by the Greater Detroit Resource Recovery Authority.

Since then, the Department has taken further steps to educate the public of proper household hazardous waste disposal techniques. Currently, in final production, is a public service announcement concerning this topic. In addition, work is being done to incorporate the topic of "Household Hazardous Waste Disposal" in presentations, brochures, and press releases.

DWSD Conner Creek/Belle Isle Study

In October, 1993 DWSD published a report on the potential impacts on the Conner Creek CSO on the Belle Isle Bathing Beach. The report examined water quality samples collected on Belle Isle and the Detroit River between 1989 and 1992, and correlated these results to pump discharge records at the Conner and Freud Pump Stations. Mixing and dispersion patterns in the Detroit River were considered to evaluate the potential for pollutant transport from the shoreline to the beach.

Although approximately 18% of the samples at the beach showed excessive fecal coliform levels, the data did not indicate that the CSOs were the source of the problem. Fecal coliform problems were observed as frequently on non-discharge days as they were on discharge days. Fecal coliform levels during CSO events did not correlate to the size and duration of the overflow event. The report detected no cause and effect relationship between CSO discharges at Conner Creek on the Belle Isle Bathing Beach. Rather, the bacterial problems identified on the island are suspected to be attributed to excretions from waterfowl residing in the area.

Wayne County

There are several traditional one-pipe combined sewer systems tributary to Wayne County interceptors that are included in the Detroit River AOC. A brief description of the status of each of these systems is given below. Most other areas are "wet separate sewers" which often respond like combined systems during wet weather conditions. A brief description of the status of the Downriver system, which includes these wet separate sewer areas, is also given.

Southgate-Wyandotte Drainage District No. 5

This combined system serves the cities of Southgate and Wyandotte and is part of the Downriver System, which is tributary to the Wyandotte WWTP. A CSO retention basin of 15 million gallons was constructed in 1976 to serve these communities. During large rain events, a portion of the Southgate-Wyandotte system flow cannot be handled through the basin and is bypassed directly to the Detroit River. This situation will be corrected as an integral part of the Downriver System's correction program which is described below. Renewal of the NPDES permit for Southgate-Wyandotte Drainage District No. 5 is currently pending.

City of Ecorse

The City of Ecorse is partially served by combined sewers. It is part of the Downriver System which is tributary to the Wyandotte WWTP. Overflows are directly tributary to the Detroit River. Ecorse is separating its combined sewer areas in conjunction with the Downriver System correction program (see discussion below) and is expected to be completed by 1995. Renewal of the NPDES permit for this system is currently pending. Ecorse's separation project as well as provisions of the Consent Order will be incorporated into the NPDES permit.

City of Inkster

The City of Inkster is a combined system tributary to the Rouge Valley collection system which discharges to the Detroit WWTP. Most of Inkster's CSOs are tributary to the Rouge River, however, there are five CSO points which are tributary to Ecorse Creek and, therefore, fall within the Detroit River AOC. In conjunction with the RRNWWDP and as required by the its NPDES permit, the City of Inkster is currently designing a CSO retention basin which will eliminate several of its CSOs tributary to the Rouge River by 1996. The NPDES permit also requires control of the remaining Rouge River CSOs and the Detroit River CSOs by 2005. It is expected that Inkster's control program will consist of separation for the Detroit River CSOs.

Downriver System

The Downriver System consists of 13 communities (some combined and some "wet separate") tributary to the Wyandotte WWTP. Many of the "wet separate" communities cannot meet their contract capacities during wet weather. These excess wet weather flows have resulted in wet weather by-passes from the collection system (in "wet separate" areas), by-passing of treatment at the WWTP, and effluent violations at the WWTP. As a result, the EPA and MDNR initiated a lawsuit against Wayne County (the owner and operator of the Wyandotte WWTP) and the 13 individual communities. Under the direction of the US Federal Court, MDNR, Wayne County and the communities have been negotiating a correction program to address the problems. Flow monitoring of the regional and local collection systems has already been conducted to characterize dry and wet weather flows. In addition, an evaluation of the WWTP capabilities has been conducted. Numerous alternatives and combinations of alternatives have been considered to arrive at the overall Downriver System correction program. Alternatives considered include (1) expansion of the WWTP, (2) upgrade of individual processes at the WWTP, (3) relief sewers, (4) off-line storage, (5) on-line tunnel storage, (6) rehabilitation of existing local collection systems, and (7) rehabilitation of the existing regional collection system.

A final overall correction program has been agreed to and has been incorporated into a Consent Order entered into by Wayne County, MDNR, and all of the local communities. The Consent Order provides for monetary penalties for failure to comply and is enforceable in federal court. The provisions of the Consent Order will be incorporated into the appropriate NPDES permits. The final correction program - which will eliminate all by-passing from the separate collection areas and WWTP violations - consists of providing additional preliminary, primary, and secondary treatment capacity at the WWTP; one tunnel storage project for peak flows; several relief sewers throughout the collection system; one off-line retention basin; rehabilitation of the regional collection system; and rehabilitation of each individual communities' collection system.

Ontario Activities

The City of Windsor

The City of Windsor undertook a serious approach to the source control of industrial waste discharge in the early 1970's when few North American cities had an effective industrial pretreatment program for industries in their jurisdictions. All industries are monitored and, if required, on-site treatment is mandated. This was deemed necessary to protect the global environment i.e., Sewage Treatment Plant process, Sewage Treatment Plant employees, Sewage Treatment plant effluent and the quality of the sewage sludge. In Windsor, sewage sludge has always been recycled to farmland or parks or used as a fertilizer component, so heavy metals and other toxic chemicals in the sludge had to be minimal to meet stringent reuse criteria.

Combined sewers are common in Windsor, as this urban community dates back some 150 years. As in many older urban areas, the drainage originally consisted of a one pipe system that handled both sanitary and storm flows. Because of the flat topography of this area, weeping tiles around buildings were connected to the sanitary sewers which, of course, were generally much lower than the shallow storm sewers. The discharge was directly to the Detroit River as, at the turn of the century, it was assumed that the River could assimilate this waste and the aesthetic and health problems were not really addressed.

When the urban area expanded back south from the Detroit River, the original sewer pipe size was totally inadequate and during wet weather, the vastly increased area caused major sewer back-up into dwellings even to the point of sewage water depth in basements to near ground level.

The construction of parallel storm relief sewers including overflow chambers in the 1950's, 60's, 70's and 80's substantially reduced widespread basement flooding.

In 1970, construction of the Riverfront Interceptor Sewer and the West Windsor PCP were completed. The trunk interceptor sewer accepts sewage flows of between 2.5 and 4 times Dry Weather Flow (DWF) at 26 interceptor chambers and conveys this flow to the West Windsor PCP for treatment. Excess flows are discharged from the interceptor chambers to the Detroit River.

In the last decade, the Federal, Provincial and Municipal governments became concerned with the impaired water quality in the area watercourses attributable to CSO discharges. Several programs have been initiated by the three levels of government to monitor the effects and institute planning strategies to reduce or eliminate CSO in certain selected areas.

Integrated Watershed Planning and Stormwater Quality Control have just begun to be addressed in the 1990's.

Discussion

The City of Windsor passed its first sanitary and storm sewer use by-law in 1971 and actively embarked on a thorough and ambitious industrial pre-treatment program. This by-law to monitor, prohibit, inspect and regulate industrial discharges into the Municipal sewer system, has been upgraded four times since 1971 and the fifth more stringent by-law was promulgated on May 17, 1993 by the City Council. The Chemist-Pollution Control Officer, an official statutory position designated to enforce the by-law, with power to enter into any premises, is supported by a dedicated technical staff of four. The laboratory staff is equipped with the latest mobile sampling equipment and permanent analytical equipment. Only "GC-MS" analyses are contracted out.

The more than four hundred industries located in Windsor are divided into three groups: i) Significant Potential Industrial Waste Dischargers, ii) Minor Potential Industrial Waste Dischargers, iii) High Strength Amenable Biodegradable Waste Dischargers (e.g. food and beverage industries).

There are about 40 significant potential industrial waste dischargers in the City and these are monitored on a bi-monthly basis for heavy metals, organic and inorganic compounds, oil and grease, phenols and cyanide. A liquid waste survey is undertaken with all of the industries listing raw products, purchased and finished products, and possible content of wastewater constituents. If deemed expedient a "GC-MS" scan is requested (but at this time can not be demanded) of the industry.

Fortunately for the City of Windsor in regards to water pollution control, the major industrial sector in the city is automotive related and the number and quantity of volatile organic compounds, base neutral acid extractables, herbicides, pesticides, chlorinated organics and polychlorinated biphenyls, from industry are not great. In order to have a cross check on the above compounds, the City undertakes bi-yearly "GC-MS" scans of the influents, effluents and dewatered sludges from the City's two sewage treatment plants, to be certain there are no appreciable concentrations above the detectable level for any of the toxic priority pollutants listed under the Ontario MISA program.

The result is that industry in Windsor, with an urban population of one-quarter million, has installed over $100 million of on-site pretreatment facilities to reduce or eliminate toxic compounds before they enter the sewer system. This, along with good sewage treatment process control, results in a non-toxic effluent from the two sewage treatment plants. This is confirmed by effluent toxicity tests for rainbow trout and *Daphnia magna* which showed the effluent to be non-lethal, with an LC50 greater than 100%, for both plants and a recyclable sewage sludge that is applied to farmland. With the above controls any CSO discharge should not be chemically toxic to aquatic biota or fish species in the River.

Presently the City of Windsor undertakes the control of indirect industrial dischargers (I.P.P.) on its own authority, as to date, proposed regulations under Ontario's Municipal Industrial Strategy for Abatement have not moved into law. MISA was modeled after the EPA NPDES and its implementation is long overdue.

In regards to CSO, the City in conjunction with MOEE has undertaken several large scale studies on tributaries to the Detroit River. In one area of the eastern section of the City a fairly ambitious program of sewer separation and rehabilitation has been taking place and will continue for the next several years if funding permits. The Pollution Control strategy plans produced so far will be incorporated into a City-wide master plan. The latest and largest pollution control planning study being undertaken is the recently commenced Windsor Riverfront CSO Study. This being jointly funded by the three levels of Canadian government.

The Windsor Riverfront CSO Study will form a part of Canada's contribution to the Detroit River RAP. It will investigate all of the CSO overflows from Windsor to the River including the West Windsor Pollution Control Plant's wet weather bypass episodes. The quality of the River's water column, sediment and biota will also be evaluated. The study will go a long way towards completing a master pollution control planning strategy for the City.

More recently, the development of Master Drainage plans, Stormwater Management and Best Management Practices are being put forth for the planning and design of urban drainage systems.

Windsor has just contracted with the Essex Region Conservation Authority (ERCA) to assist the City's Planning Department in the development of watershed planning. This will be an integrated study of both land use planning and resource management to effect sound environmental and ecological approaches to urban development. This study has just got off the ground and more will have to be reported later as progress is made.

Relationship to the Detroit River RAP

The identification of the Detroit River as an Area of Concern in the Great Lakes and the development of the Detroit River RAP was in our opinion, the force that brought the Windsor Riverfront CSO Study to fruition.

The CSO Study that is underway will finally quantify the level of degradation that the Detroit River may be suffering because of periodic wet weather overflows from the City's combined sewers. Presently this is not known other than there are periodic high levels of bacterial counts in the water column of the shore line.

The innovative bio-monitoring to be undertaken by the Great Lakes Institute besides being a scientific breakthrough that might be used to assess bio-accumulative toxic uptake by aquatic life on both sides of the River, can produce a new measurement dimension on both short and medium term toxic impact on aquatic life.

There are very few direct stormwater discharges from Windsor to the Detroit River but they will be monitored and analyzed and a comparison made to the combined sewer quality. This will give answers whether or not stormwater must be controlled at least with Best Management Practices (BMP).

The Windsor Riverfront CSO Study with the Detroit River RAP will determine the level of remedial works required on the core City's combined sewer system, and on the level of treatment quantity and quality required at the West Windsor Pollution Control Plant.

The excellent industrial pretreatment program that the City of Windsor has put in place has protected the downstream aquatic habitat and fish populations. As noted by anglers in this area, there is excellent Walleye fishing immediately downstream of the City of Windsor.

All industries locating in Windsor and those already here face stringent water pollution control requirements. Some industries that have moved or gone out of business have blamed the wastewater control costs as the final, financial blow. However, as most industries here can attest to, the costs of on-site treatment have not been overwhelming, and in a few instances, industry has been financially better, with the elimination of the use of costly components discharged to the sewer system.

The Town of Amherstburg

The Town is serviced by 25 km. of storm sewers, 25 km. of sanitary sewers, 15 km. of combined sewers and one pump station. There are three CSO's discharging to the Detroit River. In the last 18 years there has been only one CSO discharge and that was in July 1989 during the highest storm rainfall on record. There were pumping station overflows of 64 in 1992 and 87 in 1993.

Before 1968 the sewers were all combined and discharged to the River. The primary sewage plant was built in 1968 and expanded in 1985. Grant programs have helped the municipality separate it's sewers as well as do infrastructure studies to determine infiltration rates and the structural state of the sewers. The last project was completed in 1992 and the next to separate about half the remaining sewers is planned to start late this year or next.

CSO Strategies Assessment

CSO Strategies Comparison

Before developing specific recommendations for the RAP, the CSO TWG spent a considerable amount of time and effort analyzing the Michigan and Ontario CSO strategies with the goal of assessing their differences and adequacy. Specifically, the TWG tried to answer the following questions about the strategies: How are MI and Ont strategies different? Are the differences significant? If so, should the RAP recommend changes to one or both of the strategies? Acknowledging that both the Ontario and EPA policies are proposed (and that changes in the EPA policy could result in changes in the Michigan strategy), will the Ontario and Michigan strategies result in adequate CSO control if implemented? Are the available implementation mechanisms adequate?

Both strategies are based on design requirements of a ten-year, one-hour event. In addition, Ontario also has a performance based assessment of 30% BOD and 50% SS removal. The two approaches (with Michigan based on a design storm and Ontario based on performance and a design storm) will probably result in similar outcomes. The one major difference is that Michigan requires year-round disinfection, whereas Ontario only requires disinfection in the summer months when beaches or swimming areas are impacted. Table 32 summarizes the comparison of the Ontario and Michigan CSO strategies.

Conclusions

After comparing and assessing the Michigan and Ontario CSO strategies, the CSO TWG came to the following basic conclusions: That the differences between the Michigan and Ontario CSO strategies are not significant, thus the RAP shouldn't recommend specific changes to either strategy. And, that implementation of both the Michigan and Ontario strategies will result in adequate CSO control, thus the RAP should recommend that Michigan and Ontario proceed to implement their proposed strategies.

The CSO TWG decided it was appropriate to recommend time frames for implementation of CSO controls. After considerable discussion, the CSO TWG chose "no later than 2000" for complete implementation of short term CSO controls., By short term controls, the TWG means those controls which can be accomplished without lengthy planning efforts or major capital expenditures. The phrase "no later than 2000" was chosen specifically to imply that short term controls should be implemented starting immediately and be completed as soon as possible but also recognize that some short term controls could take time to implement.

Table 32
Goals of the Michigan and Ontario CSO control programs.

Topic	Michigan	Ontario
Dry Weather Flow	Prohibition of CSO discharges during dry weather	Eliminate Dry Weather Overflows
Impacts	Full achievement of Water Quality Standards and designated use protection	Minimize impacts to aquatic life and human health resulting from CSO's
Total Body Contact	Full achievement of Water Quality Standards and designated use protection	Ensure that body contact recreation criteria at beaches would not be violated for at least 95% of the swimming season (June 1 to Sept. 30)
Short Term	Phase I requires: Develop database; Operational improvements of existing system to minimize overflows; Construction of interim control where feasible; Notification of advisories; Pollution prevention plans; Develop final plan	Inventory sewers and overflow; Demonstrate adequacy of DWF control; No additional service without additional capacity; Comprehensive pollution control study
Long Term	Phase II implementation through: NPDES permits; Fixed-database schedules; Elimination or adequate treatment of CSO's to achieve maximum feasible progress taking into account technical and economic considerations; 100% containment of One Year-One Hour Storm Event; Sedimentation, skimming and disinfection of Ten Year-One Hour Storm Event	Provide primary treatment to a minimum of 90% of the wet weather flow; Elimination of overflow during dry weather periods; Establish pollution prevention/water efficiency program for reduction of DWF; Beach protection as above

The CSO TWG chose "no later than 2035" for complete implementation of final long term CSO controls. Again, the phrase "no later than" was chosen specifically to promote commencement of interim and long term controls as soon as possible and to the extent possible, but to recognize that in some instances completion of CSO control could likely take many years. The sewerage system tributary to the Detroit WWTP serves over 75 communities covering more than 1200 square miles. Sewer pipes range in size from 8 inches to over 25 feet in diameter. The system includes dozens of sanitary and stormwater pumping stations. Interconnections between sewer districts are common. Given this complexity, the TWG felt that 40 years for completion of all CSO controls was not unreasonable, as long as reasonable and measurable progress can be demonstrated starting immediately.

Objectives for Water Use Goals

Detroit River Remedial Action Plan Stage 2

Combined Sewer Overflow Technical Workgroup, October 22, 1992

The Stage I Detroit River RAP identified impaired beneficial uses. The Detroit RAP team and BPAC then developed Water Use Goals for each of the impaired beneficial uses. These were finalized in April, 1992. The impaired uses and associated water use goals are general in nature and their relationship to potential causes are not explicitly identified. At one of its first meetings (October 22, 1992), the CSO TWG reviewed the "Stage 2 Detroit River Remedial Action Plan Water Use Goals" list of impaired uses and corresponding water use goals and determined which ones relate directly to the impacts of CSOs (the TWG identified impairments 1, 6, 7, 10, and 11). The TWG then developed CSO-specific objectives for each of the five goals. All of the recommendations work toward meeting Michigan and Ontario water quality standards and/or objectives (Standards 1a and 1b).

The following list shows each impairment identified in Stage I, the associated water use goal developed by the RAP team and BPAC, and the CSO-specific objectives developed by the CSO TWG. Using these objectives, the CSO TWG developed the CSO Remediation Recommendations starting in the next section.

Impairment 1	Restrictions on fish and wildlife consumption.
Goal	Levels of contaminants such as PCBs and mercury in fish tissue shall be less than MI DPH and OMNR/MOEE action levels (See Note).
Objective	Implement CSO controls (IPP) such that there are no measurable point source discharges of PCBs and mercury into the CSO system.
Impairment 6	Degradation of benthos.
Goal	Establish and maintain benthic communities such that populations are diverse and appropriate for the physical characteristics of the area, and include pollution intolerant organisms.
Objective	Implement CSO controls to reduce the discharge of contaminants.
Impairment 7	Restrictions on dredging activities.
Goal	Concentrations of pollutants in sediment shall be below levels that restrict dredging activities.
Objective	Control metals, PCBs, and cyanide in CSO discharges through IPPs and removal of floatable and settleable solids.
Impairment 10	Beach closings
Goal	All areas of the AOC shall be safe for total body contact activities. Bacteria levels shall meet MOEE/MDNR criteria. There shall be no beach closings in the AOC or impacted areas in Lake Erie due to AOC contamination.
Objective	Provide disinfection for all CSO discharges.

Impairment 11	Degradation of aesthetics.
Goal	Elimination of the discharges from CSOs and spills from point sources and nonpoint sources (into any media) such that debris and persistent objectionable deposits are not found in the river or along the shoreline. There shall be no visible oil sheens on the river from any discharge.
Objective	Implement CSO controls to remove levels of floatable and settleable solids.

GLWQA
MICHIGAN WATER QUALITY STANDARD
ONTARIO PROVINCIAL WATER QUALITY OBJECTIVE

Standard 1a GLWQA Annex 1 Specific Objectives/ and Ontario PWQO for contamination in water.

Goal Ambient water quality shall not exceed the following criteria in all areas of the AOC (See Note).

total PCBs	0.00002 ug/l
copper	5.0 ug/l
mercury	0.0006 ug/l
cadmium	0.2 ug/l
zinc	30.0 ug/l
lead	2.88 ug/l

Objective Implement CSO measures to control PCBs, mercury, zinc, copper, cadmium, and lead.

Standard 1b	MI WQS Rule 57(2) Allowable Levels.
Goal	Same as above.
Objective	Same as above

Note: Refer to Stage 2 Detroit River Remedial Action Plan Water Use Goals (Appendix 2.1).

CSO Remediation Recommendations

Overview

The CSO TWG was charged with evaluating the available information in the Stage I Detroit RAP, updating Stage I information as appropriate, assessing effectiveness of in-place remedial and regulatory measures, and developing regulatory, technical and monitoring recommendations for the Stage 2 Detroit River RAP.

Note: All of the recommendations work toward meeting GLWQA, Michigan Water Quality Standards, and Ontario Provincial Water Quality Objectives (1a and 1b from "Stage 2 Detroit River RAP Water Use Goals").

The CSO TWG placed the recommendations into the following four categories: Strategy and Policy, Programmatic, Education, and Characterization. The Strategy and Policy recommendations address recommended modifications, changes, or improvements to the existing MI Strategy and proposed Ontario Policy relating to how CSOs are managed. Programmatic recommendations refer to modifications, changes, or improvements to specific programs or practices that can reduce or eliminate the volume and/or pollutant loadings of CSO discharges. The Education recommendations address the need to disseminate information to municipalities, industries, and the general public concerning environmentally sound practices. Lastly, the Characterization recommendations identify the needed monitoring and surveillance necessary to characterize CSO discharges.

Implementing parties, timeline, and possible funding sources are provided for each recommendation to assist in implementing the recommendations. Table 33 presents a summary of potential grant and loan sources.

Table 33
Partial List of Potential Grant and Loan Sources

Ontario	Michigan
Municipal Assistance Program (MAP) - Administered by the Ontario Clean Water Agency to provide financial assistance for rebuilding the infrastructure, new treatment works (satellite) CSO treatment and upgrading of wastewater treatment plants.	State Revolving Fund - Administered by the MDEQ. Provides low interest loan assistance to municipalities to enable them to construct water pollution control structures.
National Information Program (NIP) - Administered by the Federal and Ontario government jointly to each provide 1/3 financing for rebuilding the infrastructure such as sanitary reviews and CSO systems. The municipality provides the final 1/3 of the financing.	Great Lakes Protection Fund - A unique regional endowment fund established by the eight Great Lake States to achieve enhanced Great Lakes water quality and biological integrity. Research and demonstration projects that focus on issues relevent to the Great Lakes are supported by the fund.
Beaches Program - Administered by the Ministry of the Environment and Energy to help finance PCP studies on CSO works.	The EPA publication Watershed Protection (EPA-841-B-93-002) is a catalog of federal programs oriented to water quality and ecosystem management.
The Great Lakes Cleanup Fund - Administered by Environment Canada for the Federal Government supplies funds for studies and capital projects and will look for joint funding with the Provincial Government.	

Source: CSO TWG, 1994

Recommendations

After thorough assessment of existing data, current regulatory programs, and existing and proposed CSO control strategies, the CSO TWG recommends the following:

Strategy and Policy Recommendations

84. *Implement MI CSO permitting strategy through effective NPDES permit application and enforcement.*

    Achieves progress toward remediating the following impairments: All 5 impaired uses.

    Implementing Party(ies): MDNR

    Timeline: Immediate and continuing.

    Possible Funding Sources: Currently funded through the Michigan General Fund and federal grants to MDNR.

85. *Adopt and implement the proposed Ontario Policy for CSO Control.*

    The MOEE should evaluate the effectiveness of its current methods of implementing the Ontario CSO Control Policy (i.e. voluntary implementation made more attractive because of grant money made available to communities, or denial of certificates for new sewerage construction unless CSO controls are provided). If necessary, MOEE should seek stronger legislation which would ensure implementation of its proposed CSO Control Strategy (for example, 5 year expiration and renewal of certificates).

    Achieves progress toward remediating the following impairments: All 5 impaired uses.

    Implementing Party(ies): MOEE to adopt policy.

    Timeline: Adopt within one year. Implement upon adoption and continuing.

    Possible Funding Sources: Ontario Clean Water Agency, local municipal taxes, and sewer use charges.

86. *Implement pollution prevention programs, particularly with respect to reduction or elimination of discharge of the contaminants of concern to municipal sewers.*

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): Municipalities with CSOs or regional entity should implement pollution prevention programs. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of industries, businesses, citizens, and state, federal, and provincial agencies is essential for implementation.

    Timeline: Immediate and on-going.

    Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

87. *Identify the CSOs with greatest impact on the Detroit River (loadings of contaminants of concern or adversely affecting beneficial uses including sediments) and develop and implement appropriate remedial programs to control those CSOs as described in A.6.*

    Achieves progress toward remediating the following impairments: All 5 impaired uses.

    Implementing Party(ies): EPA, MOEE, MDNR and municipalities with CSOs.

    Timeline: Identify and plan by 1997; control by no later than 2005.

Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

88. *Complete implementation of short term CSO controls by no later than 2000. Short term CSO controls are actions or measures that (1) can reduce CSO discharges and their effects on receiving water quality, (2) do not require significant engineering studies or major construction, and (3) can be implemented in a relatively short time (less than two years). At a minimum, short term CSO controls should consist of the following:*

- *Proper operation and regular maintenance programs for the collection system*
- *Maximum use of the collection system for storage*
- *Review and modification of Industrial Pretreatment Programs and Sewer Use By-laws to minimize CSO impacts from indirect industrial discharges*
- *Maximization of flow to WWTPs for treatment*
- *Elimination of overflows during dry weather*
- *Control of solid and floatable materials in CSO discharges*
- *Implementation of pollution prevention programs*
- *Implementation of procedures to notify the public of CSO occurrences and impacts*
- *Monitoring to characterize CSOs and evaluate controls*

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): Municipalities with CSOs should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, provincial and federal agencies is essential for implementation.

Timeline: Complete implementation no later than 2000.

Note: For the US: Mostly accomplished; remaining communities are subject to ongoing enforcement actions. For Canada: As proposed in the Ontario CSO Control Policy, municipalities with combined sewer system shall complete the Pollution Control and Prevention Plans (PPCP) within three years of the Ontario CSO policy promulgation. Therefore, the timeline suggested by the Detroit River CSO TWG committee to implement the short term programs by 2000 is reasonable.

Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

89. *Complete development of long term plans by 1997 and implementation of final long term CSO controls no later than 2035. Long term CSO control programs should establish milestone schedules for accomplishing complete control by no later than 2035 which demonstrate steady and continuous progress. The programs should also describe periodic reporting to demonstrate the progress.*

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): Municipalities with CSOs should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, provincial and federal agencies is essential for implementation.

Timeline: Immediate through 2035.

Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

90. *Meet the Michigan water quality standards and Ontario water use criteria for toxicity due to CSOs.*

    Achieves progress toward remediating the following impairments: All 5 impaired uses.

    Implementing Party(ies): Municipalities with CSOs should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of industries, businesses, citizens, and state, federal, and provincial agencies is essential for implementation.

    Timeline: Immediate through 2035.

    Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

91. *Provide adequate disinfection of CSOs for protection of human health.*

    Achieves progress toward remediating the following impairments: 10.

    Implementing Party(ies): Municipalities with CSOs should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, federal, and provincial agencies is essential for implementation.

    Timeline: Immediate through 2035.

    Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

92. *Remove settleable solids and control all floatable sanitary waste from CSO discharges to ensure that downstream deposition and discharge of identifiable objects of human origin is minimized.*

    Achieves progress toward remediating the following impairments: 7, 11.

    Implementing Party(ies): Municipalities with CSOs should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, federal, and provincial agencies is essential for implementation.

    Timeline: Immediate through 2035.

    Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

93. *Provide preferential treatment for separate sanitary flow and regulated combined sewer flows.*

    Note: "Preferential treatment" refers to operating collection and treatment systems to transport more-concentrated, separate sanitary sewage on a higher priority basis than more-dilute, combined sewage; and to treat more-concentrated, separate sanitary sewage. In other words, operating the system to ensure that the more-concentrated separated sewage all gets transported to the WWTP and treated to the highest level of treatment before utilizing capacity to transport and treat combined sewage. An example of how DWSD is providing preferential treatment is described on page 22. Other opportunities for providing *preferential treatment may exist in the Detroit River Area of Concern and should be implemented where possible.*

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): Municipalities should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, federal, and provincial agencies is essential for implementation.

Note: DWSD - via appropriate operation and maintenance of the Detroit WWTP and the DWSD collection system; in particular, appropriate operation of PS2A will allow DWSD to preferentially treat separate sanitary flows and regulated combined sewer flows to full secondary treatment while excess combined flows would receive primary treatment only. Communities tributary to DWSD - via proper operation and maintenance of local collection systems. Wayne County - via appropriate operation and maintenance of the Wyandotte WWTP and the Wayne County collection systems. Communities tributary to the Wyandotte WWTP - via proper operation and maintenance of local collection systems.

Timeline: Immediate and continuing.

Possible Funding Sources: Local sewer use charges, local taxes, local bonding, bonding through a county agency, bonding through the State Revolving Fund, stormwater utilities (where they are created), and federal, state, and provincial grant assistance.

Programmatic Recommendations

94. *Promote voluntary public and industrial pollution prevention initiatives particularly with respect to prevention of spills to the collection system.*

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): State/Provincial Agencies and Municipalities; industry; citizen's groups (League of Women Voters); environmental organizations (MUCC, GLU); and professional organizations (MWEA).

    Timeline: Immediate and on-going.

    Possible Funding Sources: Private and/or public sources, depending on implementing party.

95. *Assure proper implementation of the Industrial Pretreatment Program (U.S.) and Municipal Sewer Use Bylaws (Ontario) as they relate to toxicant discharges to municipal sewer systems.*

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): Wayne County, City of Detroit, City of Trenton, City of Windsor, Town of Amherstburg, Town of LaSalle Industrial Pretreatment Programs/Municipal Sewer Use By-Laws with oversight by state and provincial agencies.

    Timeline: Immediate and on-going.

    Possible Funding Sources: Municipalities.

96. *The Industrial Pretreatment Program and Municipal Sewer Use By-law should be expanded to require indirect industrial dischargers that are tributary to CSOs to minimize their discharges during wet weather, where feasible.*

    For example, indirect dischargers that have batch treatment processes should not be allowed to discharge those batches during wet weather because they could wait until dry weather, thus ensuring that these flows reach the WWTP. Other possibilities should be explored and implemented as well.

Achieves progress toward remediating the following impairments: 1, 6, 7.

Implementing Party(ies): Wayne County, City of Detroit, City of Trenton, City of Windsor, Town of Amherstburg, Town of LaSalle Industrial Pretreatment Programs/Municipal Sewer Use By-Laws with oversight by state and provincial agencies.

Timeline: Immediate and on-going.

Possible Funding Sources: Municipalities.

97. *The Industrial Pretreatment Program and Municipal Sewer Use By-law should be expanded to require indirect dischargers to develop and implement Pollution Prevention Plans.*

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): Wayne County, City of Detroit, City of Trenton, City of Windsor, Town of Amherstburg, Town of LaSalle Industrial Pretreatment Programs/Municipal Sewer Use By-Laws with oversight by state and provincial agencies.

    Timeline: Immediate and on-going.

    Possible Funding Sources: Municipalities.

98. *Adopt best management practices at facilities including "good housekeeping" to prevent stormwater runoff from collecting pollutants and depositing them in a combined sewer. Such practices may include the following examples, among others.*

    - *Contain stormwater from raw material piles - discharged later to the combined sewer system, when not raining.*
    - *Contain runoff from contaminated abandoned sites.*
    - *Contain or protect off/on loading areas from the elements. Another possibility is dripless connectors.*
    - *Contain contaminated stormwater until municipalities are able to handle excess flows without causing a CSO event.*
    - *Initial flush of contaminated stormwater to municipality for a predetermined time (20 minute .1 inch rainfall) then discharge to NPDES or stormwater discharge.*
    - *Eliminate contaminated stormwater discharge to municipal sewers, user treats and discharges own stormwater.*

    Facilities may be selected/prioritized based on the quantity, pass through and types of materials at the facility.

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): Companies, municipalities, government agencies, and other entities that store, dispose, or handle materials that may potentially contaminate stormwater. Timeline: Immediate and on-going.

    Possible Funding Sources: Private and/or public sources depending on implementing parties.

99. *Develop and implement region-wide recycling and disposal programs for household hazardous waste.*

    Achieves progress toward remediating the following impairments: 1, 6, 7.

    Implementing Party(ies): SEMCOG and local governments/authorities (EWSWA) and industries that produce hazardous materials.

    Timeline: 1995 (and continuing)

Possible Funding Sources: Private and/or public sources depending on implementing parties.

100. *Develop and implement a source control program for Mercury and PCBs.*

Achieves progress toward remediating the following impairments: 1, 6, 7.

Implementing Party(ies): DWSD should continue to implement its PCB and Mercury minimization plan. Further, DWSD should adopt more stringent local limitations for PCB and Mercury as appropriate based on the findings of the plan. Other communities should implement source control programs for Hg and PCBs as necessary.

Timeline: Immediate to 2004.

Possible Funding Sources: Sewer revenues, grants, fees (from identified sources).

Education Recommendations

101. *Municipalities within the area of concern should disseminate information to indirect dischargers encouraging waste reduction practices.*

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): Municipalities should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, provincial and federal agencies is essential for implementation.

Timeline: Fully implemented by 2000 with ongoing updates thereafter.

Possible Funding Sources: Municipal taxes; public and private grants; and state/provincial programs.

102. *Educate public with regard to appropriate disposal of household hazardous waste.*

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): State/Provincial Agencies and Municipalities; citizen's groups (such as the League of Women Voters); environmental organizations (such as Michigan United Conservation Clubs or Great Lakes United); and professional organizations (such as the Water Environment Federation).

Timeline: Immediate and ongoing.

Possible Funding Sources: Municipal taxes; public and private grants; and state/provincial programs.

Characterization Recommendations

103. *Continue to gather data to quantify and qualify pollutant levels (particularly for toxics) in CSOs and pollutant loadings from CSOs to the Detroit River.*

Three major studies currently underway, The Detroit River CSO Toxics Sampling Project, Windsor Waterfront Pollution Control Study, and MOEE Detroit River fate and transport modeling efforts should be completed. Once completed, the information should be used to assess the need for more stringent local limits for toxics.

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): DWSD/SEMCOG/USGS/EPA; Windsor/MOEE; City of Amherstburg; Wayne County; City of Trenton.

Timeline: Immediate through 2000.

Possible Funding Sources: Municipalities should implement. Municipalities include all communities within the Detroit AOC or tributary to collection systems that discharge to the Detroit River. The cooperation of state, provincial and federal agencies is essential for implementation..

104. *Complete the development of regional hydraulic models to demonstrate appropriate CSO controls.*

For example, the Greater Detroit Regional Sewer System Model should be used to prioritize and evaluate potential options for minimizing and ultimately controlling CSOs to the Detroit River. The model is scheduled for completion in 1994. Models developed as part of the Windsor Riverfront Pollution Control Planning Study should be used to prioritize and evaluate potential options for minimizing and ultimately controlling CSOs to the Detroit River. The model is scheduled for completion in 1995.

Achieves progress toward remediating the following impairments: All 5 impaired uses.

Implementing Party(ies): Agencies responsible for sewer system operation.

Timeline: Immediate and on-going.

Possible Funding Sources: Federal, state, provincial, and municipal sources.

Proposed Recommendation

Mr. Falk Ware, a public citizen, submitted the following proposal regarding public participation in CSO improvements to the CSO TWG for consideration and possible inclusion as a formal RAP recommendation.

June 14, 1994

To: Detroit RAP CSO TWG
From: Falk Ware
Re: Public Participation in CSO Improvements

The public shall have the right to recommend improvements on individual CSO and floatable discharges. If these suggestions are deemed unfeasible or are ignored the Public shall have the right to implement these improvements at their own expense.

All plans must be approved by municipal inspectors and normal building and fabricating practices shall be followed. The municipality shall provide the Public with the hydraulic discharge parameters that can not be altered due to Public Health and Safety, or equipment infrastructure protection.

All plans that are not approved must have a signed reason for their denial and issued in a timely manner.

Thank you for your consideration,

Falk Ware

Mr. Ware attended one meeting prior to participating in the last two CSO TWG meetings (May 26 and June 15) and his proposal was produced outside the TWG. Nonetheless, the CSO TWG gave serious consideration to the proposal at its June 15 meeting (the final CSO TWG meeting before the report was finalized).

In general, the CSO TWG members strongly support and encourage public participation in CSO control planning and decision making. Further, the TWG believes that non-traditional funding opportunities should be investigated further. However, the TWG believes that many aspects of the proposal are not possible or practical as discussed below. Therefore, the TWG does not endorse this proposal as written and is including it in the TWG report for informational purpose only.

- Under Part 41 of P.A. 451 of 1994 (Act 98, The Waterworks and Sewerage Systems Act, Michigan Public Act of 1913, as amended) all additions or alterations to existing sewer and treatment facilities must be submitted to the MDEQ for review and issuance of a construction permit, Act 98 requires that plans and specifications for any such additions or alterations e submitted to MDEQ by the owner of the system and that the construction permit be issued to the owner and operator of the facility. Act 98 also requires that any plans and specs submitted by prepared by a licensed professional engineer. Additionally, the act requires adequate operation and maintenance of any proposed facilities once constructed.

  The vast majority of CSO controls will require permitting under Act 98. It is unclear how the public, as referenced in Mr. Ware's letter, would be able to comply with the requirements of Act 98, particularly in regard to expertise in design of facilities and continuous operation and maintenance of facilities.
- Allowing the public to implement and construct CSO controls could create liabilities for the owner(s) of the existing system(s), ie., liability for damage to existing systems and/or liability for personal injury.

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CHAPTER 10

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Appendices

Appendix 1.1
Detroit River Remedial Action Plan
Stage 2 Work Plan, September 1, 1992

This work plan is being drafted to direct the development of the Detroit River Stage 2 Remedial Action Plan (RAP). The elements of the work plan are related to the Stage 2 Milestones as excerpted from the joint OME/MDNR Stage 2 Process document (May 7, 1992, excerpt attached). The attached timeline identifies several major activities: Development of the water use goals; Development of a work plan; Production of a major report for each of four issues; Update for the Stage 1 RAP; Preparation of the Draft Stage 2 RAP; and a series of review periods.

In the process of developing a draft work plan, the RAP Team agreed that, based on the number and complexity of problems in the Detroit River as identified in the Stage 1 RAP, a logical approach for developing the Stage 2 RAP would be to group the problems into two main issues: habitat and sources. These two issues were further split to identify four primary topic areas: Point/Nonpoint sources, combined sewer overflows (CSOs), habitat, and contaminated sediments. The RAP Team agreed that members of the RAP Team, Binational Public Advisory Council (BPAC) and Technical Advisory Committee (TAC) should jointly develop work plans to (1) detail the methodology for developing a report which meets the Stage 2 requirements and (2) interface with the BPAC and the general public. Four planning committees consisting of RAP Team members, BPAC members, and technical experts have been established to develop work plans for the four topic areas identified by the RAP Team. When the four work plans are completed (possibly by the end of July), they will be reviewed and approved by the technical workgroups and incorporated into this Stage 2 work plan. The Stage 2 work plan will then go to the agencies, the RAP Team and the BPAC for review.

A report will be produced to address each of the four topic areas (habitat, contaminated sediments, point and nonpoint sources, and CSOs). The components of each report will, at a minimum, satisfy the requirements of a Stage 2 RAP as described in the joint OME/MDNR Stage 2 Process document. For example, each report will include an assessment of completed and in place remedial and regulatory measures as related to protecting the beneficial uses of the River, a list of potential remedial options and recommendations for preferred remedial options. Each report will be produced by a technical workgroup consisting of the planning committee, additional RAP Team members, BPAC members, and appropriate technical experts, including agency personnel, academicians, and consultants. All industrial dischargers will be invited to participate in the Technical Workgroups. Participation within each technical workgroup by RAP Team/BPAC members and the technical experts will require a commitment to attend meetings and review and discuss materials. In many instances, workgroup members will be called on to present material (or arrange for presentations) and draft portions of the report. Communication between the workgroups and the RAP Team and BPAC will be critical to the acceptance and success of the plan.

The elements of the work plan are as follows:

Develop Water Use Goals. (Milestone IV)

This activity was initiated in May of 1991 by the RAP Team and BPAC, and completed at the April 1992 BPAC meeting. Time required: 11 months.

Develop Work Plan including Public Involvement Components. (Milestones I, II and III)

This activity was initiated by the coordinators prior to the April 1992 RAP Team meeting. Work Plans are still in the development stage by the established planning committees. Initial meetings were held in June 1992, and it is hoped that second and, if necessary, third planning committee meetings will be held in late July and early August. Public involvement in RAPs consists of two components: participation in the RAP development, and a program for public education/outreach activities. The involvement of the BPAC and the general public in the development of the RAP will be fully described in the final work plan. A public education/outreach program includes RAP Team/BPAC participation at various events, lectures to various audiences, newsletters, public meetings, and other activities such as boat tours and photo contests, etc. Estimated time required: 4 months.

Identify Information Needs and Update the Stage 1 RAP. (Milestone V, VI)
This activity has been initiated as the Detroit River Studies project. Members of the TAC have meet with the RAP Team and BPAC members to discuss information needs as identified in the Stage 1 RAP and develop draft proposals for research projects. As these and other studies are completed and reported in the literature, the data in Chapters 6 and 8 of the Stage 1 RAP will be updated, and the impairment status of the beneficial uses (Chapter 7) will be reviewed and modified as appropriate.

Report Development. (Milestones IV, V, VII, VIII, IX, X, XI, XII and XIII)
Work groups will each produce a series of products and a summary report addressing the specific topic (see attached Suggested Format for Work Plans). Each technical workgroup will review and approve the proposed work plans prepared by the planning committee. The workgroup reports will include at a minimum, the information required by the indicated milestones for each topic:

IV. Goals - (completed).

VII. Assessment of completed and in place remedial and regulatory measures - includes evaluation of effectiveness of these actions.

VIII. Prepare surveillance and monitoring plan.

IX. Identify list of remedial options - prepare discussions paper, identify responsible parties. Possible subject for RAP newsletter.

X. Identify preferred remedial actions - develop evaluation criteria; selection of preferred options via workshop of RAP Team, BPAC, and TAC members. Remedial actions should be prioritized based on cost estimates and cost/benefit analysis to assure the effective use of public resources.

XI. Prepare Recommended Implementation Plan and schedule - estimate associated timing for actions. XII. Update Surveillance and Monitoring Plan.

XIII. RAP Implementation Management - Management structure, Tracking mechanism, Role of the public, and Funding and commitment strategies. To be done jointly by the four technical workgroups, possibly via workshop.

The technical workgroup summary reports will be suitable for direct input to the Stage 2 RAP. The indicated report period on the timeline includes reviews of each report by the RAP Team and BPAC. It is noted that the four topics have overlapping concerns. Efforts will be made in the development of the work plans for each topic area to describe the concerns to be addressed so that duplicate work is avoided. Communication between technical workgroups and the entire RAP Team and BPAC and the general public (for some elements) is critical to the acceptance of the reports by the RAP Team and BPAC. Communication will be accomplished though meetings with the RAP Team and BPAC (including joint meetings), public meetings, and workshops. Workshops including the entire RAP Team, BPAC and TAC will be used to obtain consensus as appropriate. Workshop results will be subsequently confirmed by the RAP Team and BPAC. Estimated time required: 20 months.

Prepare Draft Stage 2 RAP. (Milestone XIV)
Collate and edit the four reports (if necessary for format and consistency). This would include developing an executive summary highlighting the process and the recommendations from the four reports. The Draft Stage 2 document would include (in addition to the four reports) the water use goals as developed by the BPAC/RAP Team, components describing the public involvement program, the education/outreach activities, and the participants involved in the Stage 2 plan, and any outstanding components of a Stage 2 RAP. Coordinators agree that the format for this document does not necessarily need to be in the format suggested at the IJC Stage 2 workshop. Estimated time required: 4 months.

RAP Team/BPAC Review. (Milestone XV)
This review is an integral part of the report development. The draft Stage 2 RAP will reflect a RAP Team/BPAC review. This review will occur prior to formal agency review. Estimated time required: 6 weeks followed by a 4 week revision period.

Agency Review. (Milestone XVI)
Estimated time required (based on Stage 1 experience): 6 weeks followed by a 6 week revision period.

Public Review. (Milestone XVII)
A Public Meeting will be held during this period to provide opportunity for discussion and public comment. Written comments will also be accepted. Estimated time required (based on Stage 1 experience): 2 months followed by a 6 week revision period.

Final BPAC/RAP Team Review.
A BPAC/RAP Team meeting will be scheduled during this period to discuss changes made to the document as a result of the agency and public review comments.

Agency Sign-off, Submit Stage 2 to the IJC. (Milestone XVII)
Estimated time required (based on Stage 1 experience and COA needs): 2 months.

Attachments: Stage 2 Milestones
Stage 2 Work Plan Timeline
Suggested Format for Work Plans

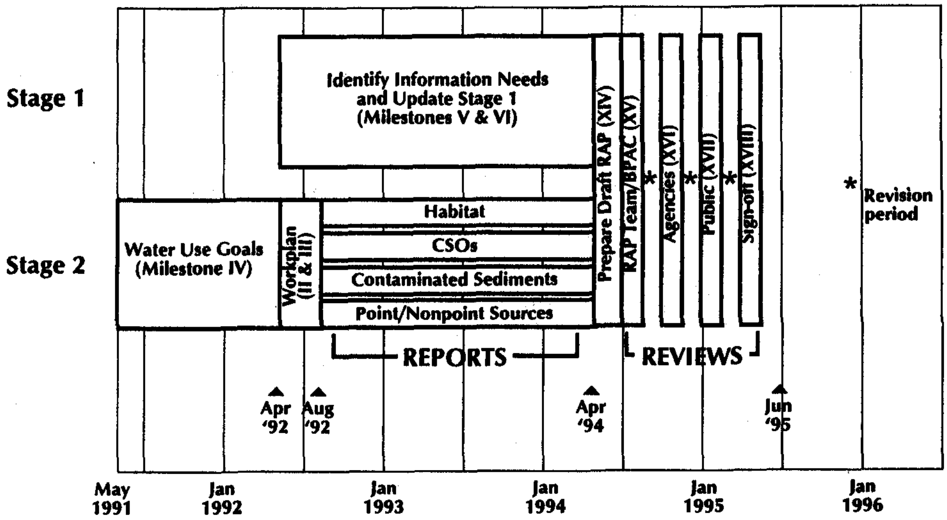
Milestones	Major Tasks*	Responsibility (Input)	Public Involvement Elements
I. Establish Agency-Specific Public Involvement	1. Develop Agency-Specific Strategies including Communications/ Outreach Activities	OMOE/MDNR (RAP Coordinators) (BPAC)	
II. Establish RAP-Specific Stage 2 Workplan	1. Develop Detailed Process Workplan for Each Binational RAP	Lead Agency OMOE/MDNR (RAP Team) (BPAC)	
III. Establish RAP-Specific Stage 2 Public Involvement Plan	1. Develop an Ontario Workplan for Public Involvement Activities—RAP-Specific	OMOE (Canadian RAP Coordinators) (Canadian BPAC)	
IV. Establish RAP Goals	1. Goals Definition	Combined effort by BPAC & RAP Team	
	2. Public Release	OMOE/MDNR (RAP Team) (BPAC)	✔
V. Update For Stage 1 RAP	1. Identify New Information 2. Evaluate New Information 3. Determine Reporting Format	OMOE/MDNR RAP Team (BPAC)	
	4. Public Release	OMOE/MDNR (RAP Team) (BPAC)	✔
VI. Identify Information Needs	1. List Data Needs & Rationale	OMOE/MDNR (RAP Team) (BPAC)	
	2. Development of Study Plans – ongoing – additional	RAP Team (BPAC) (other experts)	
VII. Assessment of In Place Remedial and Regulatory Measures	1. Description of Pertinent Remedial and Regulatory Measures	RAP Team (other experts) (BPAC)	
	2. Evaluation of Effectiveness of These Actions	RAP Team (other experts) (BPAC)	
VIII. Prepare Surveillance & Monitoring Plan	1. Information Gathering	RAP Team (BPAC) (Responsible Parties)	
	2. Design Plan and Develop Associated Timeframes	RAP Team (BPAC) (Responsible Parties)	

Milestones	Major Tasks*	Responsibility (Input)	Public Involvement Elements
IX. Identify List of Remedial Options (Options Discussion Paper)	1. Identification of Responsible Parties	RAP Team (BPAC)	
	2. Identification of Potential Remedial Options	RAP Team (BPAC) (other experts)	
	3. Assemble & Complete Options Discussion Paper	Lead Agency	
	4. Public Release	OMOE/MDNR	✔
X. Identify Preferred Remedial Actions	1. Selection Factors for Preferred Options	RAP Team (BPAC)	
	2. Evaluation (Selection)	OMOE/MDNR (RAP Team) (BPAC) (Responsible Parties)	
	3. Initiate Responsible Parties Commitments	OMOE/MDNR (RAP Team) (BPAC)	
	4. Priorities	OMOE/MDNR (RAP Team) (BPAC)	
XI. Prepare Implementation Plan & Schedule	1. Assemble & Complete Information	RAP Team (BPAC) (Responsible Parties)	
	2. Design Plan	RAP Team (BPAC) (Responsible Parties)	
	3. Estimate Associated Timing	RAP Team (BPAC) (Responsible Parties)	
XII. Update Surveillance & Monitoring Plan	1. Update Information	RAP Team (BPAC) (Responsible Parties)	
	2. Modify Plan, if needed	RAP Team (BPAC) (Responsible Parties)	
	3. Finalize Estimate of Associated Timing	RAP Team (BPAC) (Responsible Parties)	
XIII. RAP Implementation Management	1. Management Structure	OMOE/MDNR (RAP Team) (BPAC)	
	2. Tracking/Audit Mechanism	OMOE/MDNR (RAP Team) (BPAC)	
	3. Role of the Public	OMOE/MDNR (RAP Team) (BPAC)	✔

Milestones	Major Tasks*	Responsibility (Input)	Public Involvement Elements
	4. Funding and Commitment Strategies	OMOE/MDNR (RAP Team) (BPAC)	
	5. Periodic Modifications/Additions	OMOE/MDNR (RAP Team) (BPAC)	
XIV. Draft RAP Document Stage 2	1. Assemble & Complete Information	Lead Agency OMOE/MDNR	
	2. Responsible Parties Endorsement/Commitments	OMOE/MDNR (RAP Team) (BPAC)	
XV. Review & Complete Revisions to Draft Stage 2 Document	1. Review	OMOE/MDNR (RAP Team) (BPAC)	
	2. Revisions	Lead Agency (Second Agency) (RAP Team) (BPAC)	
XVI. Agency Review	1. Directing of Internal Management Reviews	OMOE (COA) MDNR	
XVII. Public Review and Comment of Draft Stage 2 Document	1. Public Release	OMOE/MDNR	✔
	2. Revisions	Lead Agency (Second Agency) (RAP Team) (BPAC)	
XVIII. Submit Stage 2 RAP to IJC	1. Submit to BPAC	OMOE/MDNR	
	2. Agency Signoff/Approval	OMOE (COA) MDNR	
	3. Transmittal Letter	OMOE/MDNR (RAP Team) (BPAC) (other experts)	
XVIX. Update of Stage 2 Document (as needed)	1. Review and Assessment of New Information 2. Document New/ Revised Commitments	OMOE/MDNR (RAP Team) (Responsible Parties)	

* Second Generation List would add in the Secondary Tasks (including administrative work and internal and external reviews that may be required)

Stage 2 - Work Plan Timeline



Suggested Format for Work Plans

Products	Technical Workgroup (RAP Team/BPAC/TAC) **Tasks**	**Communication Component**
Approved Work Plan	Discussion and approval	
Objectives	Develop objectives for goals	
Options/Discussion Document	Assess completed and in-place remedial actions and regulatory programs	
	Identify and describe remedial options/ Program recommendations • cost estimates • funding potential • cost/benefit analysis • socio-economic analysis	
Option evaluation methodology	Develop method for evaluation of options	Meeting with BPAC
Workshop Report: Preferred options		Workshop (RAP Team/ BPAC/TAC) to select preferred options
Draft recommended implementation plan and schedule	Prepare draft recommended implementation plan and schedule	
	Recommend management structure (to be developed jointly by the four Technical Workgroups)	
Draft Stage 2 RAP (Component covering specific topic area)	Prepare report	

Appendix 1.2

April 1994 Draft Detroit River RAP Stage 2 Report Schedule

Activity	Date	BPAC Meetings
TWG reports due	July 1	
		July 14 *TWG report comments*
Assemble document	July 1 - August 15	
Review by RAP Team,	August 15 - October 1	September 12 *comment on non-TWG portions*
		September 29 *finalize comments for RAP Team*
	Two-week period to compile and distribute comments	
Comments to TWGs	October 15	
TWG meetings to discuss comments	November 1	
RAP Team meeting to finalize revision	November 30	November 30 *review revisions*
RAP Team/BPAC signatures	January 1	
Document to printer		

Technical Workgroup Reports - Draft Outline

1.0 Introduction
- 1.1 Detroit River ecosystem
- 1.2 Impaired beneficial uses 3 and 14
- 1.3 Water use goals
- 1.4 Objectives
- 1.5 Process (TWG membership, work plans, meeting dates, discussion topics)

2.0 Update for Stage 1
- 2.1 Impairments of beneficial uses
- 2.2 Regulatory programs (Chapter 4)
- 2.3 Land use (Chapter 5)
- 2.4 Environmental description (Chapter 6)
- 2.5 Sources and loadings (Chapter 8)

3.0 Objective 1 (Recommended actions)
- 3.1 Past actions
- 3.2 Current activities
- 3.3 Recommendations for future actions
- 3.4 Implementation and endpoint/evaluation

4.0 Objective 2 (Programmatic recommendations)
- 4.1 Assessment and evaluation of existing programs
- 4.2 Data gaps/program needs
- 4.3 Recommendations
- 4.4 Implementation and endpoint/evaluation (suggested responsible parties costs/benefits schedule)

5.0 Survellance and monitoring plan
- 5.1 Existing programs and research efforts
- 5.2 Information needs
- 5.3 Recommendations
  - media/species
  - draft work plans (including schedules)
  - budgets
  - suggested agency/party
  - potential funding sources
- 5.4 Implementation

6.0 Next steps (Summary)

Appendix 1.3

Strategies to Improve Michigan's RAP Process

Background and Introduction

The Remedial Action Plan (RAP) process is constantly changing, and is evolving into a true ecosystem approach to environmental problem solving. This means that the identification of environmental problems and solutions in the Areas of Concern (AOCs) is broadening, more diverse groups of individuals with different interests, perspectives, authorities and expertise are participating in the process, and partnerships with other governmental agencies and local communities are becoming stronger. Michigan RAP participants agree that the RAP process must remain flexible to react to those changes and to allow for continuous improvement in the RAP process. Many changes to improve a RAP process can be initiated on a case-by-case basis and with little effort. However, at times it is necessary to take a close look at the routine way of developing and implementing RAPs, facilitate changes across the state, and modify the Michigan Department of Natural Resources' (MDEQ) approach to overseeing the RAPs.

The RAP planning process that has been followed for the past several years had become very complex, time consuming and cumbersome as a result of incorporating a more comprehensive ecosystem approach. Increasingly, the focus of the RAP process became development of detailed, voluminous documents rather than identification and implementation of actions to address priority environmental issues in the AOCs. Therefore, in February 1993, RAP participants initiated a process to improve the statewide approach to RAPs, and to identify strategies for implementing the required changes.

This document presents strategies for streamlining the RAP document, its development and review, and for increasing the focus on action. Further, this document describes how the strategies were derived, identifies the pros and cons associated with their implementation, describes what is needed to most successfully implement the strategies, and identifies how to proceed with implementation.

Methods

A highly participatory, team-driver process was selected to identify specific problems with the RAP process, to discuss why those problems exist, to recommend changes to improve the efficiency and effectiveness of the statewide approach to RAPs, and to identify strategies for implementing the required changes. A tiered approach was used for participant input that called for broad-based information gathering and "brainstorming" at the onset, followed by refinement of the ideas by a more intimately involved group the Statewide Public Advisory Council (SPAC) and the AOC Program staff. This process allowed for maximum input among RAP participants and was manageable in terms of reaching consensus on the recommendations and strategies for improvements.

The RAP improvement process was initiated at the Third Annual Citizens' Conferences on Great Lakes AOCs in February 1993. Invited speakers from the MDEQ, U.S. Environmental Protection Agency (EPA), and environmental and regulated communities shared their views on the problems with the RAP process, and provided suggestions for improvements. Small group discussions among the approximately 100 participants resulted in 36 distinct but broad recommendations.

In June 1993, the Surface Water Quality Division sponsored an interactive workshop to build on the initial effort. Participants of the workshop included members of the SPAC, the MDEQ RAP Coordinators, MDEQ management, and representatives of the EPA Water Division and Great lakes National Program Office, other jurisdictions and the International Joint Commission (IJC). The workshop facilitator, Dr. Lorilee Sandmann, Director, Outreach Program Development at Michigan State University, led participants through a consensus building process to identify and prioritize specific problems, and to develop strategies to overcome the most critical and urgent problems.

Following the workshop, the MDEQ RAP Coordinators reviewed the recommendations for what was deemed to be the most urgent need streamlining the RAP document and its review and developed a more specific strategy for implementing the recommended changes. The strategy was discussed with the SPAC at its July 1993 meeting. Subsequently, a document outlining the recommended strategies was drafted and reviewed by the SPAC members, MDEQ RAP Coordinators and staff, staff of EPA, Ontario Ministry of the Environment and Energy (MOEE) and the Wisconsin Department of Natural Resources (WDNR) as well as representatives of the MDEQ management team. A memo from MDEQ Deputy Director Russell Harding to Ms. Diana Klemens dated October 29, 1993 (attached) states his support for the new strategies and urges their implementation. The strategies outlined in this document represent a consensus among Michigan RAP participants on the future direction for Michigan's AOC program.

Improvement Strategies

Strategies for improving the efficiency and effectiveness of Michigan's RAP process are:

- Agree on a long term "vision" and short term goals/objectives,
- Prioritize environmental issues and focus RAP activities on the highest priorities first,
- Document the issues and actions in a series of biennial reports, each containing components of Stage 1, Stage 2 and Stage 3 RAPs as appropriate,
- Submit each biennial report to the EPA and the IJC, and
- Delegate the responsibility and the authority to "approve" a RAP (biennial reports) on behalf of the MDEQ to the MDEQ RAP Team members.

Establish Goals and Priorities

A successful RAP process will be based on a long term "vision" for the AOC. The efficiency and effectiveness of that process, however, will ultimately be determined by the ability of RAP participants to establish short term goals, and to prioritize environmental issues in the AOC.

A long term goal, or vision, tends to be very general and serves the purpose of providing overall direction for the RAP process. As such, a great deal of time and energy need not be expanded on the identification of a "vision". It is suggested that RAP participants could quickly and easily agree on a long term vision based on the general goals of the AOC Program (to restore and protect beneficial uses) and the listing/delisting guidelines provided by the IJC.

Short term goals will help RAP participants to focus on "bite-size" pieces that when taken together move the area closer to the desired state. The short term goals must be realistic, specific and quantitative where at all possible. These goals must be based on a prioritization of environmental issues in an AOC. Therefore, RAP participants should focus on reaching agreement on the priority issues in an AOC and the short term goals for resolving those issues. Short term goals are likely to be most effective when they deal with a cause and/or source of problems identified in an AOC.

The prioritization of actions to achieve the short term goals is extremely important to most efficiently use limited resources. RAP participants will want to consider the order in which actions must be implemented, and which action(s) will accomplish the most in terms of risk reduction and restoration of beneficial uses when prioritizing actions. RAP participants should also be flexible in their approach of action implementation such that lower priority actions can be implemented if funding for them becomes available.

Develop Biennial Reports

Michigan RAP documents have been developed according to a strict interpretation of the staged approach outlined in the Great Lakes Water Quality Agreement (GLWQA). The result is excessively detailed documents and a problem solving process that is not optimum for restoring and protecting beneficial uses in the AOCs. The diversity of problems and their severity, and the inability to resolve all the problems in the same time frame necessitates a more flexible framework for reporting progress and identifying actions. In addition, a reporting format that requires less time for writing, reviewing, editing and revising is needed to increase the efficiency of the RAP process.

To resolve these problems, Michigan's RAP documents will be reformatted such that they consist of a series of biennial reports, each containing components of the Stage 1, Stage 2, and Stage 31 RAPs as identified in the GLWQA. Each biennial report will be a concise, yet comprehensive summary of progress achieved in the AOC over the two-year period and a description of the next steps required to move toward RAP goals. The biennial reports will focus on progress achieved and actions required at the state, federal and local levels. The level of detail relevant to each stage will be dependent on the type of work that was completed in the AOC over the two-year period and what needs to be done next. Although a departure from past practice, RAP participants feel strongly that this new RAP format is consistent with the reporting requirements outlined in the GLWQA.

To ensure flexibility and utility of the RAP documents for each AOC, a prescribed format and level of detail for biennial reports will not be provided. In general, the reports will include: an introduction, including a summary of the use impairments, causes of the problems, and sources of contaminants of concern; a summary of progress during the two-year period as measured against appropriate quantitative goals; a list of other actions (remedial, regulatory, studies, protection, etc.) that need to be taken, including the responsible party(s), cost, schedule, commitments, etc., and a list of participants and their roles. Detailed technical documentation, and in-depth discussions on the RAP process and decisions will not necessarily be included in the RAP biennial reports. However, it is crucial that the detailed information be readily accessible. Therefore, each RAP Coordinator will maintain the appropriate documentation, and will provide it on request to interested individuals and organizations.

The biennial reports will be written by RAP participants as appropriate for the individual RAP process. A teams approach, with diverse representation, is strongly encouraged to ensure that differing viewpoints are considered from the beginning of the process and that repetitive discussion and document revisions are minimized, and to facilitate consensus building on RAP issues. All local RAP participants, including RAP Team and Public Advisory Council (PAC), should review and provide comments on the draft report.

The RAP participants should strive for consensus on the contents and message contained in the biennial RAP report. Should there be a strong minority position, it is suggested that the minority position also be presented in the report, if requested by those holding the minority position. Upon finalization of the biennial report, the RAP Team and PAC should forward the report to the Director of the Office of the Great Lakes with a request that the report be forwarded to the IJC for review. At this time, the AOC Program Coordinator will also submit the biennial report to the EPA.

Delegate MDEQ Approval Authority

The RAP review and approval process within the MDEQ has been long and involved a number of hierarchical reviews. As many as four distinct opportunities existed for MDEQ staff and management to review each RAP document. These review opportunities were followed by revisions to the RAP document as necessary. Although the reviews were intended for different focus groups, including RAP Team members, MDEQ technical experts, Division Management and the Department Management Team, the responsibility to complete each review was delegated to the MDEQ RAP Team members and the RAP Coordinators. This resulted in the same, limited group of people reviewing the document multiple times. Although incremental improvements in the documents were made, there are clearly diminishing returns on this effort.

The RAP review and revision process will be streamlined through delegation of the responsibility and the authority to "approve" the RAP on behalf of the MDEQ to the MDEQ RAP Team members. Inherent in this responsibility is the responsibility to consult with other MDEQ staff, and the Divisions and Department Management Teams as appropriate throughout the process. This will be particularly important when technically or politically controversial issues arise.

Delegation of the MDEQ approval authority to RAP Team members will improve the efficiency and effectiveness of the RAP process in several ways. First, the review, revision, and approval process will be reduced from approximately one and one-half years to six months or less. This delegation will also decentralize the decision making and provide for decision making by those who are intimately involved in the RAP process and in the implementation of MDEQ programs at the local level. In addition, the effectiveness of the RAP process will increase due to the increased involvement of MDEQ staff resulting from the delegated responsibility and authority.

The MDEQ RAP Team members will have the authority to approve the RAP only on behalf of the MDEQ; other RAP participants will need to review the RAP as well. Therefore, it is important that all RAP participants agree on a process and schedule for review of the RAP and for reaching consensus on the content.

Strategy Analysis

Implementation of the "streamlining strategy" will result in a more efficient and effective RAP planning process. This section presents the pros and cons of the modifications, and identifies what is needed from the MDEQ and other RAP participants to most successfully implement the recommendations.

Pros

RAP participants identified several specific benefits to be derived from implementation of the new RAP strategies:

- Emphasize action, and restoration and protection of beneficial uses,
- Focuses on short term goals and progress,
- Decreases time spent on the review and approval process,
- Minimizes time spent to write and revise the document,
- Provides comprehensive, current information more often,
- Provides for consistency between "real life" environmental problem solving and RAP reporting requirements,
- Allows for greater flexibility in the RAP planning process at the local level,
- Increases communication among RAP participants,
- Improves partnerships,
- Decentralizes decision making, and
- Empowers MDEQ staff.

Cons

There may be a few drawbacks associated with implementation of the strategies provided in this paper. By and large, however, RAP participants believe that the following cons are minor in comparison to the pros.

- May provide opportunity for negative comments from IJC since biennial reports will not meet strict interpretation of "Stage" requirements, and
- May require review for several reports to get comprehensive, detailed technical information on the AOC.

Needs

The following will be needed to most effectively implement the suggested program modifications:

- Active participation from each MDEQ division throughout the RAP process. The participation of District staff will facilitate streamlining of the RAP process due to staff knowledge of local issues,
- Stronger, cooperative relationships between the RAP Teams and PACs,
- Assured funding and approval for printing of biennial reports to ensure that the reports are available to RAP participants,
- Increased staff assistance with printing, graphics and editing due to new RAP format and frequency of publication, and
- Ability to produce attractive, color-enhanced documents on recycled paper using soy-based ink.

Implementation of Strategy

The program modifications outlined in this paper will be implemented immediately in all active RAPs. Guidance and alternatives for implementing the recommendations will be provided, but, centralized and required procedures on how, specifically, to implement the recommendations will not. Instead, the local RAP participants will be encouraged to design their RAP process and to implement the program changes in the manner most appropriate for their unique circumstances. As the first step in this process, RAP coordinators have been asked to work with the PACs and RAP Team to revise their work plans to reflect the changes in the RAP planning process.

Implementation of the program improvements in the RAP processes shared with Ontario and Wisconsin will take additional time. However, discussions regarding the new strategies have already been initiated with staff from the MOEE and WDNR. Both agencies have experienced similar problems in their RAP processes and staff are very interested in the new approach. In fact, WDNR is proposing similar changes to its RAP process. Staff from both agencies expressed a desire to pursue discussions on how to incorporate Michigan's new strategies into the shared processes. Meetings and discussions with both agencies and representatives of the affected PACs are planned to facilitate this.

Appendix 2.1

DETROIT RIVER

Stage 2 Detroit River Remedial Action Plan Water Use Goals

REMEDIAL ACTION PLAN

Background

The Detroit River Binational Public Advisory Council at its April 1, 1992, meeting, adopted these water use goals to guide the preparation of the Stage 2 Remedial Action Plan (RAP) as well as its implementation to restore the beneficial uses of the river.

Primary Goal

To restore and maintain the integrity of the Detroit River ecosystem to a standard that will provide a safe, clean, and self-sustaining natural environment such that (1) self-reproducing, diverse biological communities are restored and maintained, and (2) the presence of contaminants does not limit the use or appreciation of fish, wildlife or waters of the river.

General Goals

1. The implementation of the RAP shall restore impaired beneficial uses in the Detroit River Area of Concern (AOC). These impaired uses have been identified in the Stage 1 RAP and specific goals for each beneficial use are identified in the following table. In addition, water quality shall be restored and maintained to meet the Objectives of the Great Lakes Water Quality Agreement (GLWQA), Michigan's Water Quality Standards and designated uses, and the Ontario Provincial Water Quality Objectives (PWQOs).

2. In the long term, it is the goal of the RAP to virtually eliminate the input of persistent toxic substances. The philosophy for the control of persistent toxic substances in the long term shall be zero discharge which will lead to virtual elimination of persistent toxic substances in the environment. All specific goals in the Detroit River RAP shall be consistent with the GLWQA's position regarding zero discharge and virtual elimination of persistent toxic substances. As steps toward these goals, the RAP endorses the principle of pollution prevention within the Detroit River AOC.

3. The implementation of the RAP shall restore impaired beneficial uses in the Detroit River AOC. Remedial actions, including the development of new initiatives and stronger enforcement of existing legislation, are needed to address point and non-point source discharges into all media that directly or indirectly impact the Detroit River. Possible impacts on other areas of the ecosystem (positive or negative) will be considered in the evaluation of remedial options. In addition, all aspects of the RAP should be integrated with the Lakewide Management Plans as developed by U.S. and Canadian federal governments. The RAP identifies some environmental concerns for which complete remediation is only possible through a Great Lakes Basin approach (e.g. the control of zebra mussels and elimination of fish consumption advisories). Local remediation efforts will enhance a basin-wide approach, and the RAP recognizes that local efforts should not be delayed.

Specific Goals

The specific goals are related to beneficial uses in the Detroit River AOC. The specific goals are not limited to the 14 beneficial uses listed in the Great Lakes Water Quality Agreement and may be added to as needed in the future. Restoration of some uses will require a phased approach, such as the elimination of fish consumption advisories. An initial objective is to reduce contaminant levels in fish tissue to levels commensurate with other areas of the Great Lakes. This step requires the elimination of all local sources of contaminants such as PCBs and mercury, including contaminated sediments. As basin-wide efforts result in the reduction of contaminant levels in ambient water in all the Great Lakes, corresponding reductions in fish tissue concentrations should be seen throughout the Great Lakes, including the Detroit River Area of Concern (AOC).

The RAP Team shall seek commitments from stakeholders for adequate funding through appropriate agencies to achieve these goals. The RAP Team, jurisdictions and the Binational Public Advisory Council (BPAC) recognize that the implementation of this RAP will require significant funding and citizen involvement.

GLWQA Impairment of Beneficial Use	Significance to the Detroit River AOC	Specific Goal
1. Restrictions on fish and wildlife consumption;	This use is impaired. The following fish consumption advisories apply to this AOC: Michigan: Carp (PCB) and Freshwater Drum (Mercury) Ontario: Carp (PCB); Freshwater drum, Rock bass. Walleye (Mercury)	Levels of contaminants such as PCBs and mercury in fish tissue shall be less than Michigan DPH and OMNR/OME action levels (Note #1).
2. Tainting of fish and wildlife flavor;	No reports of tainting.	No tainting.
3. Degradation of fish and wildlife populations;	Fish: This use is not impaired. The fish community is now structured more towards benthivores than it was originally, however over 60 species have been found in the river, with fish occupying all niches. Wildlife: Wildlife populations in the AOC have decreased due to urbanization. Some loss of reproductive capacity has occurred (bald eagles), however, this appears to be a problem associated with conditions in the Great Lakes Basin rather than specific to the Detroit River.	To maintain a healthy, diverse and self-sustaining fish and wildlife community.
4. Fish tumors or other deformities;	This use is impaired. Liver tumors at levels exceeding background incidence rates have been found in five species.	Liver and oral/dermal tumor incidence rates shall be no greater than rates at unimpacted control sites. Survey data shall confirm the absence of neoplastic or preneoplastic liver tumors.

Acronyms used in the table.

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Michigan DPH: Michigan Department of Health
Michigan WQS: Michigan Water Quality Standards
OME: Ontario Ministry of the Environment
OMNR: Ontario Ministry of Natural Resources
Ontario PWQOs: Ontario Provincial Water Quality Objectives
PCB: Polychlorinated Biphenyls
WPCP: Water Pollution Control Plant

(continued)

GLWQA Impairment of Beneficial Use	Significance to the Detroit River AOC	Specific Goal
5. Bird or animal deformities or reproductive problems;	No documented bird or animal deformities associated with the Detroit River AOC have been reported. Levels of contaminants in herring gull eggs from Fighting Island have decreased notably since 1974 but have not declined appreciably since the mid-1980's.	Deformities and reproductive problems shall be no greater than rates at unimpacted control sites.
6. Degradation of benthos;	This use is impaired. Degraded benthic communities have been noted: Michigan: Shoreline from Rouge River to the mouth.	Establish and maintain benthic communities such that populations are diverse and appropriate for the physical characteristics of the area, and include pollution intolerant organisms.
7. Restrictions on dredging activities;	This use is impaired: Michigan: Dredge spoils from shoreline downstream of Conners Creek are not suitable for open water disposal based on level of metals and, in some areas, PCBs in sediments. Midriver: Dredge spoils from the lower river not suitable for open water disposal based on levels of cyanide, copper, lead and zinc. Ontario: Concentrations of arsenic, chromium, copper, iron, lead, zinc, cyanide, mercury, and PCB sediment concentrations in some areas exceed OME Guidelines.	Concentrations of pollutants in sediments shall be below levels that restrict dredging activities.
8. Eutrophication or undesirable algae;	This condition has not been documented in the river and is unlikely to occur due to the short retention time of the river.	Nutrients from the river shall not impair uses downstream (nutrient loadings shall be consistent with the GLWQA).
9. Restrictions on drinking water consumption, or taste and odor problems;	This use is impaired. No restrictions on drinking water have occurred, however taste and odor problems were reported in July/August 1990 and in December 1990.	There shall be no taste and odor problems.
10. Beach closings;	This use is impaired. Total body contact activities in areas of the river are periodically impaired due to elevated bacterial levels (see below: Mich. WQS and Ontario PWQO). Beach closings have occurred in the Ontario AOC. The only beach in the Michigan AOC is on Belle Isle and it has not been closed due to bacteria concerns.	All areas of the AOC shall be safe for total body contact activities. Bacteria levels shall meet OME/MDNR criteria. There shall be no beach closings in the AOC or impacted areas in Lake Erie due to AOC contamination.

Acronyms used in the table.

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Michigan WQS: Michigan Water Quality Standards
OME: Ontario Ministry of the Environment
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Ontario PWQOs: Ontario Provincial Water Quality Objectives
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WPCP: Water Pollution Control Plant

(continued)

GLWQA Impairment of Beneficial Use	Significance to the Detroit River AOC	Specific Goal
11. Degradation of aesthetics;	This use is impaired. Debris and persistent objectionable deposits from CSOs exist along areas of shorelines. In addition, numerous spills of various materials have been noted to occur in the river (Chapter8). Industrial development and urbanization have detracted from the natural beauty of the area, although these are not water quality impacts.	Elimination of the discharges from CSOs and spills from point sources and nonpoint sources (into any media) such that debris and persistent objectionable deposits are not found in the river or along the shoreline. There shall be no visible oil sheens on the river from any discharge.
12. Added costs to agriculture or industry;	Not impaired, although the treatment of water intakes due to the presence of zebra mussels is required in some instances. This is a Great Lakes Basin-wide issue.	There shall be no added costs to agriculture or industry for water improvement.
13. Degradation of phytoplankton and zooplankton; and	Phytoplankton: Impairment has not been documented in the river is unlikely to occur due to the short retention time of the river. Zooplankton: No documented impairment. Further assessment of more permanent nearshore populations is recommended.	Assessment of nearshore populations of zooplankton shall indicate communities similar to those found in unimpacted control sites.
14. Loss of fish and wildlife habitat.	This use is impaired as a result of significant loss of wetlands and habitat which has occurred due to industrial development and urbanization. It is recognized that existing wetlands in the AOC should be protected. Draft fish community goals also emphasize the achievement of no net loss of the productive capacity of fish habitats and the restoration of habitats wherever possible. Fish and wildlife management goals are needed to help further determine the extent of impairment and guide future rehabilitation strategies. Impairment due to water quality concerns has not been adequately documented. This area of study needs further evaluation.	Wetlands shall be maintained at zero loss in the AOC, and no net loss of the productive capacity of fish habitats. Remediation, amelioration, and restoration of wetlands shall be conducted wherever feasible. Management plans for fish and wildlife should be developed, and subsequently evaluated to determine if the current level of habitat supports the management plans' goals. Additional evaluation is necessary to determine the effects of water and sediment quality on biota.

Acronyms used in the table.

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MDNR: Michigan Department of Natural Resources
Michigan DPH: Michigan Department of Health
Michigan WQS: Michigan Water Quality Standards
OME: Ontario Ministry of the Environment
OMNR: Ontario Ministry of Natural Resources
Ontario PWQOs: Ontario Provincial Water Quality Objectives
PCB: Polychlorinated Biphenyls
WPCP: Water Pollution Control Plant

(continued)

GLWQA Michigan Water Quality Standard Ontario Provincial Water Quality Objective	Significance to the Detroit River AOC	Specific Goal
1a. GLQW Annex 1 Specific Objectives/ and Ontario PWQO for contaminants in water;	Exceedences have occurred as follows: PCBs (entire river)Mercury (Trenton Channel); Zinc, Copper, Cadmium (MI and Ont waters - lower river).	Ambient water quality shall not exceed the following criteria in all areas of the AOC (NOTE #2): total PCBs 0.00002 ug/l; mercury 0.0006 ug/l; zinc 30 ug/l; copper 5 ug/l; cadmium 0.2 ug/l; lead 2.88 ug/l
1b. MI WQS Rule 57(2) Allowable Levels;	Exceedences have occurred as follows: Mercury, PCBs (entire river); Zinc, Cadmium, Lead (MI and Ont waters - lower river).	
2a. MI WQS Rule 62 (Total Body Contact);	Michigan: Not met in nearshore waters downstream of confluence with Rouge River. Areas immediately downstream of CSOs are also impaired.	Ambient water quality shall meet the applicable MDNR/OME criteria: MDNR: <200 fecal coliform bacteria/ 100 ml sample (geometric mean of 5 samples within a 30 day period). OME: <100 fecal coliform bacteria/ 100 ml sample.
2b. Ontario PWQO for fecal coliform;	Ontario: Not met in nearshore water downstream of Little R. Turkey Cr., Amherstburg WPCP, and the City of Windsor CSOs.	
3. Radioactivity levels;		There shall be no increase in radioactivity in ambient surface water which would result in an exceedence of MDNR/OME criteria.
4 Thermal pollution;		The river shall not receive a heat load which would warm the river to temperatures exceeding MDNR/OME criteria.

NOTES: 1. Rationale: Evaluation and statistical analysis of concentrations in equivalent fish (species, age/size) from Lake Huron is necessary. Remediation of Detroit River sources should reduce contaminant levels equivalent to upstream areas. Lower levels may not be achievable until ambient concentrations are decreased basin-wide.

2. Rationale: These concentrations are the most restrictive of the GLWQA Objectives, Ontario PWQOs, and Michigan WQS. Numbers should reflect any revisions/updates of criteria, such that these goals represent the most restrictive of the current criteria.

4/92

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Michigan DPH: Michigan Department of Health
Michigan WQS: Michigan Water Quality Standards
OME: Ontario Ministry of the Environment
OMNR: Ontario Ministry of Natural Resources
Ontario PWQOs: Ontario Provincial Water Quality Objectives
PCB: Polychlorinated Biphenyls
WPCP: Water Pollution Control Plant

Appendix 5.1

Table A
Environmental Legislation

Environmental legislation in the United States

Name of Legislation	*Description of Activity*	*Responsible Agency*
Anadromous Fish Conservation Act of 1985	Development and management of anadromous fishery resources	U.S. Fish and Wildlife Service (USFWS) and Michigan Departments of Environmental Quality and Natural Resources MDEQ/MDNR
Clean Water Act of 1977 — Section 404	Protection of water resources for fishery and wildlife management	MDEQ, U.S. Environmental Protection Agency (EPA), USFWS and ACOE.
Fish and Wildlife Conservation Act	Protection of fishery and wildlife resources	U.S. federal and state governments
Coastal Barrier Resource Act	Protection and management of coastal natural resources	USFWS
Coast Zone Management Act	Assistance to coastal states to protect and manage coastal resources	U.S. National Oceanic and Atmospheric Administration (NOAA)
Emergency Wetlands Resources Act of 1986	Created to intensify cooperative efforts between private interests and governments for the protection and management of wetlands	Agencies of local, state and U.S. federal governments
Endangered Species Act of 1973	Protection of endangered plants and animals and their habitat	U.S. federal government
Estuary Protection Act	Protection and management of estuary natural resources	U.S. federal government
Federal Water Pollution Control Act Amendments	An initiative to restore the quality of the nation's waters	U.S.EPA
Fish and Wildlife Act of 1956	Established a national comprehensive policy for the protection and management of fishery and wildlife resources	USFWS and National Biological Service (NBS)
Great Lakes Fishery Act of 1956	Implements the Convention on Great Lakes Fisheries for coordinated management of fisheries	USFWS, NBS,Michigan Department of Natural Resources (MDNR)
Great Lakes Fish and Wildlife Restoration Act of 1990	Enacted to assess the restorational needs of the Great Lakes fisheries and to effectively manage the resource	U.S. federal government
Migratory Birds Conservation Act	Provides for the acquisition of habitat for the effective management and protection of migratory birds	USFWS

Name of Legislation	*Description of Activity*	*Responsible Agency*
Lacey Act of 1900	Defines the Department of the Interior as a wildlife conservation agency and authorizes funds from Congress to carry out its charge	U.S. Department of the Interior
National Wildlife Refuge System Administration Act of 1966	Provides guidelines and directives for the protection and management of fish and wildlife in all national wildlife refuges, ranges, game ranges and related management areas	USFWS and U.S. Bureau of Land Management
Nonindiginous Aquatic Nuisance Prevention and Control Act of 1990	National program to address the problems related to unintentional introductions of nonindiginous aquatic species into waters of the United States	U.S. federal government
North American Wetlands Conservation Act of 1989	Encourages partnerships among public agencies under the North American Waterfowl Management Plan to protect, restore and create wetlands for fish and waterfowl	USFWS, MDNR, MDEQ, local and nonprofit groups
Oil Pollution Act of 1990	Protection and management of fisheries and wildlife resources through the development and implementation of oil spill response plans	U.S. Coast Guard, NOAA

Environmental legislation and guidance in Michigan

Name of Legislation	*Description of Activity*	*Responsible Agency*
Biological Diversity Conservation Act of 1992	Established a state goal to encourage the conservation of biological diversity	MDNR Legislative Committee
Farmland and Open Space Preservation Act	Institutes a voluntary incentive program to preserve open space and farmland by limiting development rights and use of property	MDEQ
Wetlands Conservation Strategy	Protect, enhance and restore wetlands. Goal of restoration, creation and enhancement of 500,000 wetland acres	MDEQ/MDNR

Environmental legislation, policy and guidance in Canada

Name of Legislation	*Description of Activity*	*Responsible Agency*
Canadian Environmental Assessment Act	Identifies which projects need full environmental assessments, under what statute and which projects are exempt	Federal government of Canada
Canadian Environmental Protection Act	Provides a framework for industries and government to identify substances that may be toxic, assess them to determine their hazard, and based on findings, apply controls to prevent them from harming human health and the environment	Health and Welfare Canada and Environment Canada
Canada Wildlife Act	Provides for the acquisition of wetlands for the management of migratory birds	Environment Canada, Canadian Wildlife Service and Ontario Ministry of Natural Resources (OMNR)
Fisheries Act	Protects aquatic and semiaquatic habitats through a "no net loss" of fish habitat approach	Federal Department of Fisheries and Oceans, OMNR
Fishing and Recreational Harbours Act	Provides for the establishment and maintenance of small craft harbours	Federal Department of Public Works
Navigable Waters Act	Regulates construction activities in navigable waters and provides for the preparation and review of plans for development affecting navigable waters	Transport Canada
Migratory Birds Convention Act	Implements the 1916 Canada-United States treaty to protect shared species of migratory birds and to sustain their populations	Canadian Wildlife Service, OMNR
Canada/Ontario Memorandum of Intent on Fish Habitat	Regulations for the conservation and management of fish populations	Federal Department of Fisheries and Oceans and OMNR
Canadian Great Lakes Wetlands Conservation Action Plan	A strategic plan developed by a number of governmental and non-governmental agencies for conservation, creation and enhancement of Great Lakes wetlands	Federal Departments of Agriculture, Fisheries and Oceans, and Environment; and Provincial Ministries of Agriculture, Food, Municipal Affairs, Natural Resources and Environment and Energy
Federal Policy for the Management of Fish Habitat	Guidance to the provinces on increasing fish habitat productivity through habitat protection and enhancement	Federal Department of Fisheries and Oceans, OMNR
Federal Policy on Wetland Conservation	National policy promoting the conservation and enhancement of wetlands	Federal Department of Fisheries and Oceans, OMNR

Environmental legislation and policy in Ontario

Name of Legislation	*Description of Activity*	*Responsible Agency*
The Conservation Authorities Act	Provides the legal basis for Conservation Authorities and defines their role	All Conservation Authorities
Fish and Game Act	Provides for the management, perpetuation and rehabilitation of the wildlife resources in Ontario consistent with the other uses of land and waters	OMNR
Ontario Environmental Bill of Rights (EBR)	EBR establishes more opportunities for public involvement in environmental reviews of policies, instruments and projects under consideration by a ministry.	All Provincial Ministries
The Planning Act	Requires municipalities to prepare/amend their official maps with regard to provincial policy statements designed to conserve, protect and manage natural resources	MOEE, OMNR
Provincial Shoreline Policy	Provides for the management of shoreline-related processes (flooding, erosion, dynamic beaches) in an environmentally-sound manner	OMNR, ERCA, MOEE
Public Lands Act	Provides for the management, sales and disposition of crown lands in Ontario	OMNR—with review responsibilities by OMNR, Conservation Authorities, MOEE and Transportation Canada

International treaties and agreements, policy and guidance

Name of Instrument	*Description of Activity*	*Responsible Agency*
Boundary Waters Treaty Act	Governs the use of the Great Lakes Connecting Channels, provides the basis for the IJC and GLWQA	Federal governments of the U.S. and Canada
Great Lakes Water Quality Agreement (GLWQA)	An agreement between the governments of the U.S. and Canada for the improvement of water quality in the Great Lakes	Federal governments of the U.S. and Canada
Migratory Birds Convention	Protects and sustains populations of migratory birds that annually traverse parts of Canada and the U.S.	Federal governments of the U.S. and Canada
The Convention on Great Lakes Fisheries	Signed in 1954, establishing the Great Lakes Fishery Commission to promote research programs for the effective management of the Great Lakes fishery	Federal governments of the U.S. and Canada; Ontario provincial government; Michigan state government
North American Waterfowl Management Plan	Developed jointly between the U.S. and Canada, the Plan works to reverse or modify activities that destroy or degrade waterfowl habitat—primarily wetlands	Federal governments of the U.S. and Canada; Ontario provincial government; Michigan state government
Ramsar Convention	An international convention that requires the development of principles and policies for the wise use and sustainability of wetlands especially for wildlife and humankind	Federal governments of the U.S. and Canada
Great Lakes Wetlands Policy Consortium	The U.S.A.-Canada Great Lakes Wetlands Policy Consortium was established in 1988 to coordinate a basin-wide wetlands conservation strategy	Federal governments of the U.S. and Canada; Ontario provincial government; Michigan state government; public organizations

Table B
Conversion Tables

NI = Not Included

ARTICLE I GENERAL PROVISIONS
General Powers and Duties
Part 5 Department of Natural Resources (1921 PA 17)

Code Section	*Old MCL Section*
501	299.1
502	299.2
503	299.3
504	299.3a
505	299.3b
506	299.4
507	299.6
508	299.7
509	299.8
509a	299.8a
509b	299.8b
510	299.9
511	299.10

Part 9 Joint Environmental Management Authorities (1991 PA 199)

Code Section	*Old MCL Section*
901	123.1031
902	123.1032
903	123.1033
904	123.1034
905	123.1035
906	123.1036
907	123.1037

Part 15 Conservation Officers (1986 PA 109)

Code Section	*Old MCL Section*
1501	300.21
1502	300.22

Part 17 Thomas J. Anderson, Gordon Rockwell Environmental Protection Act (1970 PA 127)

Code Section	*Old MCL Section*
NI (Short title)	691.1201
1701	691.1202
1702	691.1202a
1703	691.1203
1704	691.1204
1705	691.1205
1706	691.1206
NI (Effective date)	691.1207

ARTICLE II POLLUTION CONTROL
CHAPTER 1: POINT SOURCE Pollution Control
Part 31 Water Resources Protection (1929 PA 245)

Code Section	*Old MCL Section*
3101	323.11
3102	323.1
3103	323.2
3104	323.2a
3105	323.4
3106	323.5
3107	323.5a
3108	323.5b
3109	323.6
3110	323.6a
3111	323.6b
3112	323.7
3112a	323.7a
3113	323.8
3114	323.9
3115	323.10
3115a	323.10a
3116	323.12
3117	323.12a
3118	323.13
3119	323.13a

Part 33 Contamination of Waters (1865 PA 350)

Code Section	*Old MCL Section*
3301	307.22
3302	307.28
3303	307.30
3304	307.31
3305	307.32

Part 39 Cleaning Agents (1971 PA 226)

Code Section	*Old MCL Section*
3901	333.231
3902	323.232
3903	323.233
3904	323.234
3905	323.235
3906	323.236

Sewage Disposal and Waterworks Systems

Part 41 Sewerage Systems (1913 PA 98)

Code Section	*Old MCL Section*
4101	325.201
"	325.207
4102	325.201
4103	325.202
4104	325.203
4105	325.206
4106	325.208
4107	325.210
4108	325.211
4109	325.212
4110	325.213
4111	325.214

Part 43 Waterworks Systems, Sewers, and Disposal Plants (1927 PA 320)

Code Section	*Old MCL Section*
4301	123.241
4302	123.242
4303	123.243
4304	123.244
4305	123.245
4306	123.246
4307	123.247
4308	123.248
4309	123.249
4310	123.250
4311	123.252
4312	123.253

Part 47 Sewage Disposal and Water Supply Districts (1956 PA 211)

Code Section	*Old MCL Section*
4701	323.151
4702	323.152
4703	323.153
4704	323.154
4705	323.155
4706	323.156
4707	323.157
4708	323.158
4709	323.159
4710	323.160
4711	323.161
4712	323.162

Part 49 Construction of Collecting Sewers (1969 PA 159)

Code Section	*Old MCL Section*
4901	323.401
4902	323.402
4903	323.403
4904	323.404
4905	323.405
4906	323.406
4907	323.407
4908	323.408
4909	323.409
4910	323.410
4911	323.411
4912	323.412

Part 51 Wastewater Disposal (1974 PA 271)

Code Section	*Old MCL Section*
5101	323.291
5102	323.292
5103	323.293

Part 53 Clean Water Assistance (1988 PA 317)

Code Section	*Old MCL Section*
NI (Short title)	323.451
NI	323.452
5301	323.453
"	323.454
5302	323.455
5303	323.456
5304	323.457
5305	323.458
5306	323.459
5307	323.460
5308	323.461
5309	323.462
5310	323.463
5311	323.464
5312	323.465
5313	323.466
5314	323.467
5315	323.468
5316	323.469
NI (Effective date)	323.470

Air Resources Protection

Part 55 Air Pollution Control (1965 PA 348)

Code Section	*Old MCL Section*
NI (Short title)	336.11
5501	336.12
5502	336.14a
"	336.14b
5503	336.15
5504	336.15a
5505	336.15b
5506	336.15c
5507	336.15d
5508	336.15e
5509	336.15f
5510	336.15g
5511	336.15h
5512	336.17
5513	336.17a
5514	336.17b

5515	336.18
5516	336.21
5517	336.23
5518	336.24
5519	336.24b
5520	336.24c
5521	336.24d
5522	336.24e
5523	336.24f
5524	336.25
5525	336.25a
5526	336.26a
5527	336.26b
5528	336.26c
5529	336.26d
5530	336.26e
5531	336.26f
5532	336.26g
5533	336.26h
5534	336.28
5535	336.29
5536	336.30
5537	336.31
5538	336.32
5539	336.33
5540	336.34
5541	336.35
5542	336.36

Part 57 Small Business Clean Air Assistance (1993 PA 12)

Code Section	*Old MCL Section*
NI (Short title)	336.121
5701	336.122
5702	336.123
5703	336.124
5704	336.125
5705	336.126
5706	336.127
5707	336.128
5708	336.129

Chapter 2: Nonpoint Source Pollution Control

Part 83 Pesticide Control (1976 PA 171)

Code Section	*Old MCL Section*
NI (Short title)	286.551
8301	286.552
8302	286.553
8303	286.554
8304	286.555
8305	286.556
8306	286.557
8307	286.558
8308	286.559
8309	286.560
8310	286.561
8311	286.562
8312	286.563
8313	286.563a
8314	286.563b
8315	286.563c
8316	286.563d
8317	286.564
8318	286.564a
8319	286.565
8320	286.566
8321	286.567
8322	286.568
8323	286.568a
8324	286.568b
8325	286.569
8326	286.570
8327	286.571
8328	286.571a
8329	286.572
8330	286.573
8331	286.574
8332	286.575
8333	286.576
8334	286.577
8335	286.578
8336	286.579
NI (Repeal)	286.580
NI	286.581

Part 87 Groundwater and Freshwater Protection (1993 PA 247)

Code Section	*Old MCL Section*
NI (Short title)	286.851
8701	286.852
8702	286.853
8703	286.854
8704	286.855
8705	286.856
8706	286.851a
8707	286.857
8708	286.858
8709	286.859
8710	286.860
8711	286.861
8712	286.862
8713	286.863
8714	286.864
8715	286.865
8716	286.866
8717	286.867
NI (Cond. eff. date)	286.868

Part 89 Littering (1963 PA 106)

Code Section	*Old MCL Section*
8901	752.901
"	752.902
8902	752.901
8903	752.901a
8904	752.903
8905	752.903a
8906	752.904
NI (Repeal)	752.905
8907	752.906

Watercraft Pollution Part 95 Watercraft Pollution Control (1970 PA 167)

Code Section	*Old MCL Section*
NI (Short title)	323.331
9501	323.332
9502	323.333
9503	323.334
9504	323.335
9505	323.337
9506	323.338
9507	323.339
9508	323.340
9510	323.341
NI (Effective date)	323.342

Chapter 3: Waste Management

Part 111 Hazardous Waste Management (1979 PA 64)

Code Section	*Old MCL Section*
NI (Short title)	299.501
11101	299.502
11102	299.503
11103	299.504
11104	299.505
11105	299.506
11106	299.506a
11107	299.507
11108	299.507a
NI	299.508a
11110	299.509
11111	299.510
11112	299.511
NI	299.512
11114	299.513
11115	299.515
11115a	299.515a
11116	299.516
11117	299.517
11118	299.518
11119	299.519
11120	299.520
11121	299.521
11122	299.521a
11123	299.522
11124	299.523
11125	299.524
11126	299.525
11127	299.526
11128	299.527
11129	299.528
11130	299.529
NI	299.529a
11132	299.530
11133	299.531
11134	299.532
11135	299.533
11136	299.534
11137	299.535
11138	299.537
11139	299.539
11140	299.540
11141	299.541
NI	299.542
11143	299.543
11144	299.544
11145	299.545
11146	299.546
11147	299.546a
11148	299.547
11149	299.547a
11150	299.547b
11151	299.548
11152	299.549
NI (Effective date)	299.551

Part 113 Landfill Maintenance Trust Fund (1986 PA 171)

Code Section	*Old MCL Section*
11301	299.621
11302	299.622
11303	299.623
11304	299.624
NI (Effective date)	299.625

Part 115 Solid Waste Management (1978 PA 641)

Code Section	*Old MCL Section*
NI (Short title)	299.401
11501	299.402
11502	299.403
11503	299.404
11504	299.405
11505	299.406
11506	299.407
11507	299.408
11508	299.409
11509	299.410
11510	299.411

11511	299.412
11512	299.413
11513	299.413a
11514	299.413b
11515	299.414
11516	299.415
11517	299.415a
11518	299.416
11519	299.417
11520	299.418
11521	299.418a
11522	299.418b
11523	299.419
11524	299.419a
11525	299.419b
11526	299.420a
11527	299.421a
11528	299.422
11529	299.422a
11530	299.423
11531	299.424
11532	299.424a
11533	299.425
11534	299.426
11535	299.427
11536	299.428
11537	299.429
11537a	299.429a
11538	299.430
11539	299.430a
11539a	299.430b
11540	299.431
11541	299.432
11542	299.432a
11543	299.432b
11544	299.432c
11545	299.432d
11546	299.433
11547	299.434
11548	299.435
11549	299.436
NI (Repeal)	299.437

Part 117 Septage Waste Servicers (1986 PA 181)

Code Section	*Old MCL Section*
NI (Short title)	325.311
11701	325.312
11702	325.313
11703	325.314
11704	325.315
11705	325.316
11706	325.317
11707	325.318
NI	325.319
11708	325.320
11709	325.321
11710	325.322
11711	325.323
11712	325.323a
11713	325.324
11714	325.325
11715	325.326
11716	325.327
11717	325.328
11718	325.329
11719	325.330
NI (Repeal)	325.331
NI (Effective date)	325.332

Part 121 Liquid Industrial Wastes (1969 PA 136)

Note: This public act was rewritten and repealed in Senate Bill No. 764. After Senate Bill No. 764 passed both houses of the legislature, the substance of that Senate bill was included in Public Act No. 451 of 1994. Due to the substantial changes in Senate Bill No. 764, conversion tables would not be useful.

Code Section
12101
12102
12103
12104
12105
12106
12107
12108
12109
12110
12111
12112
12113
12114
12115
12116
12117
12118

Chapter 4: Pollution Prevention

Part 143 Waste Minimization (1993 PA 147)

Code Section	*Old MCL Section*
NI (Short title)	299.891
14301	299.892
14302	299.893
14303	299.894
14304	299.895
14305	299.896
14306	299.897
NI (Cond. eff. date)	299.898

Part 145 Waste Reduction Assistance (1993 PA 148)

Code Section	*Old MCL Section*
NI (Short title)	299.871
14501	299.872
14502	299.873
14503	299.874
14504	299.875
14505	299.876
14506	299.877
14507	299.878
14508	299.879
14509	299.880
14510	299.881
NI (Cond. eff. date)	299.882

Part 147 PCB Compounds (1976 PA 60)

Code Section	*Old MCL Section*
14701	299.351
14702	299.352
NI	299.353
NI	299.354
14703	299.355
NI	299.356
NI	299.357
14704	299.358
14705	299.359
NI	299.360

CHAPTER 5: RECYCLING AND RELATED SUBJECTS

Part 161 Plastic Products Labeling (1988 PA 414)

Code Section	*Old MCL Section*
16101	299.481
16102	299.482
16103	299.483
16104	299.484

Part 163 Plastic Degradable Containers (1988 PA 145)

Code Section	*Old MCL Section*
16301	445.581
16302	445.582
16303	445.583
NI (Effective date)	445.584

Part 165 Office Paper Recovery (1988 PA 411)

Code Section	*Old MCL Section*
NI (Short title)	299.461
16501	299.462
16502	299.463
16503	299.464

Part 167 Used Oil Recycling (1980 PA 411)

Code Section	*Old MCL Section*
NI (Short title)	319.311
16701	319.312
16702	319.313
16703	319.314
16704	319.315
16705	319.316

Part 169 Scrap Tires (1990 PA 133)

Code Section	*Old MCL Section*
NI (Short title)	299.561
16901	299.562
16902	299.563
16902a	299.563a
16903	299.564
16904	299.565
16905	299.566
16906	299.567
16907	299.568
16908	299.569
16909	299.570
NI (Effective date)	299.571
NI (Cond. eff. date)	299.572

Part 171 Battery Disposal (1990 PA 20)

Code Section	*Old MCL Section*
17101	299.861
17102	299.862
17103	299.863
17104	299.864
17105	299.865
17106	299.866
17106a	299.866a
NI	299.867
17107	299.868
NI (Effective date)	299.869

CHAPTER 6: ENVIRONMENTAL FUNDING

Part 191 Clean Michigan Fund (1986 PA 249)

Code Section	*Old MCL Section*
NI (Short title)	299.371
19101	299.372
19102	299.373
19103	299.374
19104	299.375
19105	299.375a
NI	299.376
19106	299.377
19107	299.378
19108	299.379
19109	299.380

19110	299.381
19111	299.382
19112	299.383
19113	299.384
19114	299.385
19115	299.386
19116	299.387
19117	299.388
19118	299.389
19119	299.389a
NI	299.390
19120	299.391
19121	299.392
NI	299.393

Chapter 7: Remediation

Part 201 Environmental Response (1982 PA 307)

Code Section	*Old MCL Section*
NI (Short title)	299.602
20101	299.603
20101a	299.603a
20102	299.601
20103	299.604
20104	299.605
20105	299.606
20106	299.607
20107	299.608a
20108	299.609
20109	299.609a
20110	299.609b
20111	299.609c
20112	299.609d
20113	299.610
20114	299.610a
20115	299.610b
20116	299.610c
20117	299.610d
20118	299.610e
20119	299.610f
20120	299.611a
20121	299.611b
20122	299.611c
20123	299.611d
20124	299.611e
20125	299.611g
20126	299.612
20127	299.612a
20128	299.612b
20129	299.612c
20130	299.612d
20131	299.613
20132	299.614
20133	299.614a
20134	299.614b
20134a	299.614c
20135	299.615
20136	299.615a
20137	299.616
20138	299.616a
20139	299.616b
20140	299.617
20141	299.618

Part 203 Volunteer Immunity (1990 PA 91)

Code Section	*Old MCL Section*
20301	30.431
20302	30.432

Chapter 8: Underground Storage Tanks

Part 211 Underground Storage Tanks (1984 PA 423)

Code Section	*Old MCL Section*
21101	299.701
NI (Short title)	299.701a
21102	299.702
21103	299.703
21104	299.703a
21105	299.704
21106	299.707
21107	299.707a
21108	299.708
21109	299.709
21110	299.710
21111	299.710a
21112	299.711
21113	299.712

Part 213 Leaking Underground Storage Tank (1988 PA 478)

Code Section	*Old MCL Section*
NI (Short title)	299.831
21301	299.832
21302	299.833
21303	299.834
21304	299.834a
21305	299.835
21306	299.835a
21307	299.836
21308	299.836a
21309	299.836b
21310	299.836c
21311	299.836d
21312	299.836e
21313	299.836f
21314	299.836g
21315	299.836h
21316	299.836i
21317	299.838
21318	299.839

21319	299.840
21320	299.841
21321	299.841a
21322	299.842
21323	299.843
21324	299.843a
21325	299.843b
21326	299.844
21327	299.845
21328	299.846
21329	299.847
21330	299.848
21331	299.849
NI (Cond. eff. date)	299.850

Part 215 Underground Storage Tank Financial Assurance (1988 PA 518)

Code Section	*Old MCL Section*
NI (Short title)	299.801
21501	299.803
21502	299.804
21503	299.805
21504	299.802
21505	299.802a
21506	299.806
21507	299.807
21508	299.808
21509	299.808a
21510	299.809
21511	299.809a
21512	299.810
21513	299.812
21514	299.813
21515	299.815
21516	299.815a
21517	299.815b
21518	299.816
21519	299.817
21520	299.817a
21521	299.818
21522	299.819
21523	299.819a
21524	299.819b
21525	299.819c
21526	299.819d
21527	299.819e
21528	299.819f
21529	299.819g
21530	299.819h
21531	299.819i
21532	299.819j
21533	299.819k
21534	299.819l
21535	299.819m
21536	299.819n
21537	299.819o
21538	299.819p
21539	299.819q
21540	299.819r
21541	299.820
21542	299.821
21543	299.821a
21544	299.822
21545	299.822a
21546	299.823
21547	299.824
21548	299.824a
21549	299.824b
21550	299.825
21551	299.826
NI (Cond. eff. date)	299.828

Appendix 5.2
Description of the Area

Michigan Area of Concern

The land use along the Michigan side of the AOC has changed somewhat over the last ten years. Industrial and commercial uses have decreased from 19.0 miles of shoreline as documented in the Stage 1 RAP to 17 miles (Table C). These uses have given way to such new uses as recreational and residential.

There are 13 islands in the Detroit River on the Michigan side (Table D). These islands contain over 7000 ac/2800 ha of land used for recreation, residential, governmental wildlife refuges, private undeveloped, and a governmental confined disposal facility. In addition some 40 miles of island shoreline provide habitat for fish and wildlife.

Recreational opportunities along the Detroit River is both diversified and abundant. However, in some neighborhoods, access may be limited. Over 30 local, county and regional river-side parks, access points and sites of openspace totaling over 3,400 acres provide residents and visitors with a variety of recreational opportunities that range from passive activities such as hiking, biking, picnicing and fishing to boating, diving and golf (Table E).

Table C
Detroit River shoreline land use in the Michigan AOC
(7/95 – miles of shoreline has been updated)

Land Use Cover Type	*Miles of Shoreline*	*Percent*
Residential	6.94	10.4
Commercial/Institutional	1.60	2.4
Industrial	15.40	23.0
Transportation/Utilities	5.72	8.5
Extractive	2.50	3.7
Open Land and Other		
• outdoor recreation	11.52	17.2
• cemetaries	.05	0.1
Forested		
• central hardwood	2.24	3.3
• lowland hardwood	0.71	1.1
Non-Forested		
• herbaceous	3.39	5.0
• shrub	4.81	7.2
Wetlands	4.16	6.2
Agricultural	.51	0.8
Stream/Lake	7.45	11.1
Total	**67.00**	**100.0**

Source: SEMCOG's 1990 Land use Coverage Update
Note: This update was performed on SEMCOG's ARC-Info GIS. The system does not measure the land use along a lineal line but follows the inflection of the shoreline into all bays, inlets, etc. Thus, a river length of 67 miles instead of 31miles is calculated.

Table D
Michigan Island Shoreline Use in the Detroit River

		Distance of Shoreline		Area of Island	
Land Use Type	*U.S. Islands*	*Kilometers*	*Miles*	*Kilometers²*	*Miles²*
Recreation	Belle Isle	12.472	7.750	3.900	1.506
Private-undeveloped	Calf Island	1.006	0.625	0.040	0.015
State-owned-undeveloped	Celeron Island	5.230	3.250	0.540	0.208
Private-undeveloped	Dynamite Island	0.209	0.130	0.010	0.004
Private-undeveloped	Fox Island	0.306	0.190	0.013	0.005
Federal confined disposal facility-undeveloped	Grassy Island	3.621	2.250	0.330	0.127
Residential	Grosse Ile	25.951	16.125	22.300	8.610
Residential	Hickory Island plus Meso Island	3.621	2.250	0.470	0.181
Federal-natural undeveloped	Mud Island	1.408	0.875	0.090	0.035
Private-undeveloped	Round Island	2.454	1.525	0.165	0.064
Private-abandoned development	Stony Island	5.633	3.500	0.600	0.232
Private-undeveloped	Sugar Island	1.650	1.025	0.150	0.058
Totals	**63.561**	**39.495**	**28.608**	**11.046**	

Table E
Detroit River Waterfront Parks and Open Space along the Michigan Shoreline

Parks by Community	*Acres*	*Type of Recreation*	*User-base*
City of Detroit[1]			
1. Mariners Park	7.15	passive recreation	local
2. Riverfront-Lakewood East	28.13	passive recreation	local
3. Alfred Brush Ford Park	33.88	passive recreation	local
4. Maheras Memorial Ballfield	52.62	sports activities	local
5. Vaughn-Reid Memorial Park	18.69	passive recreation local	
6. George Engel Memorial Park	35.13	passive recreation	local
7. Muncie Park	1.00	passive recreation	local
8. David F. Stockton Memorial Park	2.75	passive recreation	local
9. Belle Isle	981.75	passive recreation, natural area, marinas, zoo, museums	regional
10. Henderson Park	35.95	passive recreation	local
11. John Owen Park	8.26	passive recreation	local
12. Gabriel Richard Park	22.87	passive recreation	local

Parks by Community	*Acres*	*Type of Recreation*	*User-base*
13. Mt. Elliott Park	8.15	passive recreation	local
14. Chene Park	16.06	concerts	regional
15. St. Aubin Park	12.41	marina	local
16. Hart Plaza	14.00	special events	regional
17. Municipal Parksite	0.50	river access	local
18. Detroit Free Press River Access	1.38	river access	local
19. Riverside Park	19.96	passive recreation	local
20. Historic Fort Wayne	100.00	historic structures, interpretations	regional
Total :	**1400.64**		
City of River Rouge			
21. Belanger Park	9.45	passive recreation	local
City of Ecorse			
22. John D. Dingell Park	2.60	passive recreation	local
City of Wyandotte			
23. Bishop Park	12.00	passive recreation	regional
BASF Southworks[2]			local
24. Golf Course	60.00	sporting recreation	
25. Park	24.00	passive recreation	
Total:	**96.00**		
City of Riverview			
26. Boat Launch	1.00	river access	local
City of Trenton			
27. Meyer Ellias Park	5.55	passive recreation	local
28. Rotary Park	2.35	passive recreation	local
Total:	**7.90**		
Wayne County			
29. Elizabeth Park	162.00	passive recreation,marina	regional
Grosse Ile Township[3]			
30. Open space Land	191.00	wildlife habitat	local
Brownstown Township			
31. Lake Erie/Huron-Clinton Metropark	1600.00	golf, passive recreation	regional
Total Acreage in AOC:	**3490.49**		

1 There are 96,150 linear feet of shoreline within the City of Detroit. 58,756.43 linear feet (61.11 %) are accessible to the public. Belle Isle comprises 67% (39,600 linear ft) of the accessible shoreline.

2 BASF Southworks is an on-going project.

3 Open space land, acquired through millage taxes, is located in several areas on Grosse Ile.

ONTARIO AREA OF CONCERN

Windsor is the largest city on the Ontario side of the Detroit River. Recreation and commercial are the major land uses along the Windsor water front. However, throughout the entire AOC residential is the predominant use and accounts for 15.5 Kilometers of shoreline (Table F). Commercial/Industrial and recreational uses have declined from the levels identified in the Stage 1 RAP. It is likely that these uses have been converted to public/municipal uses.

There are approximately six islands on the Ontario side within the Detroit River with 25.80 Km2/ 16.03 mi2 of shoreline. The major uses of the islands include: (1) commercial/industrial, (2)agricultural/undeveloped, and (3) private/recreation (Table G). Most of the islands play a role in the migration of water fowl in the Great Lakes and have been identified as candidate sites for habitat rehabilitation and enhancement.

There is a plethora of parks and open space along the Detroit River to serve the recreational needs of the residents and visitors(Table H). With over 45 local and regional parks and sites of open space totallying 2,525 ac/ 1,010 ha recreational opportunities such as hiking, biking, fishing, boating, hunting and diving are both abundant and diversified.

Table F
Ontario Mainland Shoreline use in the Detroit River AOC

	Distance of Shoreline		*Area of Island*	
Land Use Type	*Kilometers*	*Miles*	*Kilometers²*	*Miles²*
Residential	15.48	9.62	2.1	0.81
Commercial/Industrial	12.46	7.74	4.2	1.62
Public Lands and Buildings	12.53	7.79	0.6	0.23
Agricultural or Undeveloped	7.35	4.57	5.1	1.97
Private or Recreation	6.73	4.18	0.5	0.19
Total:	**54.55**	**33.90**	**12.50**	**4.83**

Table G
Ontario Island Shoreline Use in the Detroit River AOC

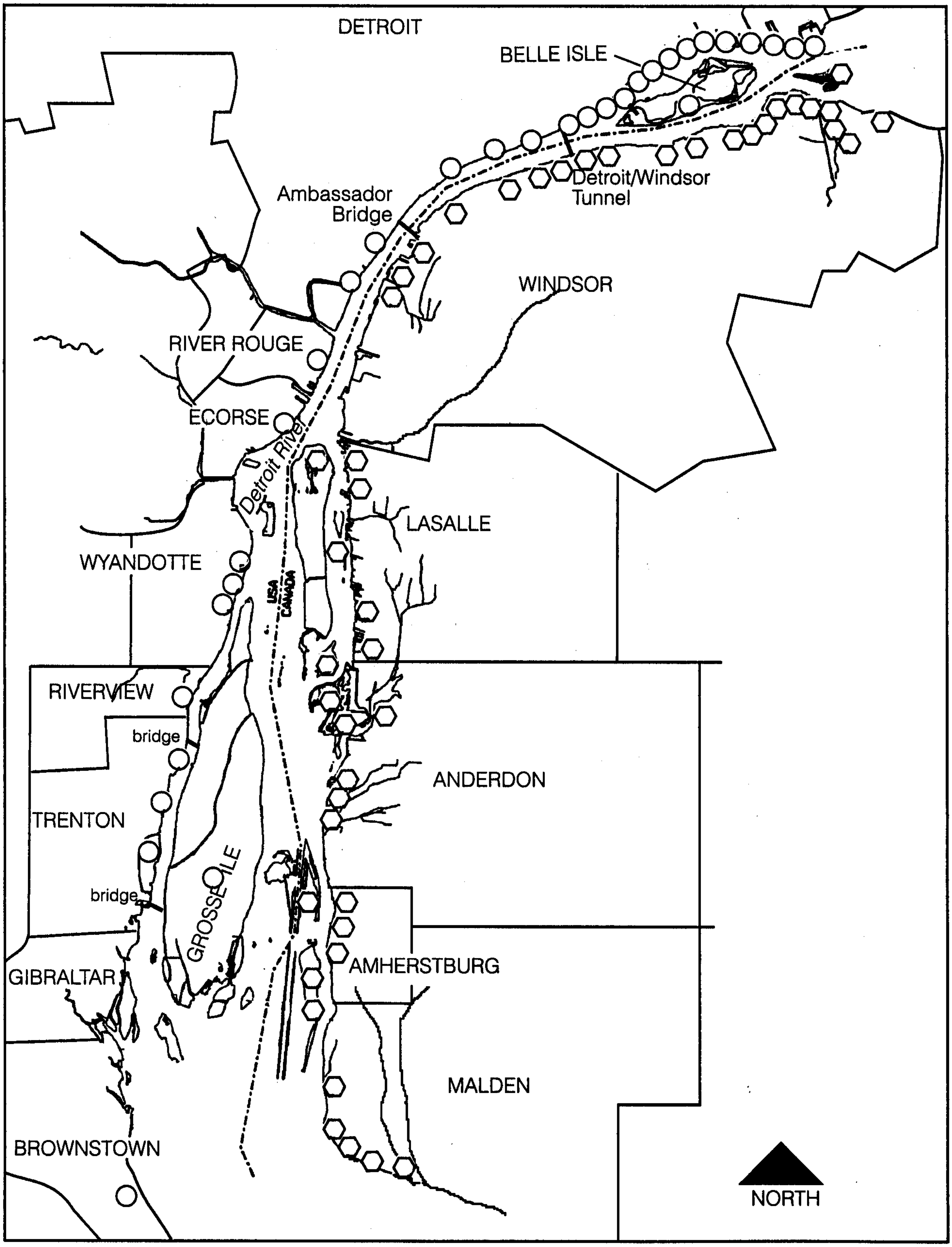
	Distance of Shoreline		*Area of Island*	
Land Use Type	*Kilometers*	*Miles*	*Kilometers²*	*Miles²*
Residential	–	–	–	–
Commercial/ Industrial	10.50	6.52	4.20	1.62
Public Lands and Buildings	–	–	–	–
Agricultural or Undeveloped	12.60	7.83	2.60	1.00
Private or Recreation	2.70	1.68	0.60	0.23
Total:	**25.80**	**16.03**	**7.40**	**2.86**

Table H
Detroit River Waterfront Parks and Open space along the Ontario Shoreline

Parks by Community	*Acres*	*Type of Recreation*	*User-base*
City of Windsor			
1. Sandpoint/Ganatchio-Stop 26	6.0	passive recreation	regional
2. Little River Cooridor	198.9	passive recreation	regional
3. Peche Island-mainland base	5.7	passive recreation	regional
4. Lakeview Marina	10.8	marina	regional
5. Peche Island	141.0	passive recreation	regional
6. East Riverview	0.1	passive recreation	regional
7. Peche Island Landing	0.2	passive recreation	regional
8. St. Paul Pump Station	4.1	passive recreation	regional
9. Bridges Bay	1.6	passive reacreation	regional
10. St. Rose Beach	1.5	passive recreation	regional
11. Reaume and Coventry Parks	11.7	passive recreation	regional
12. Goose Bay	2.1	passive recreation	regional
13. Alexander Park	17.7	passive recreation	regional
14. Great Western Park	0.7	passive recreation	regional
15. CNR River Front	33.0	passive recreation	regional
16. Dieppe Garden & Piazza Udine	6.3	passive recreation	regional
17. Caron Ave. Pump Station	3.4	passive recreation	regional
18. Centennial Park	10.3	passive recreation	regional
19. Ambassador/Assumption Parks	16.9	passive recreation	regional
20. McKee Street Park	2.0	passive recreation	regional
21. Brock Street Park	2.2	passive recreation	regional
22. Millcove Marina	3.5	marina	regional
Town of LaSalle			
23. Turkey Greek Mouth	5.0	natural area	regional
24. Fighting Island Marsh	330.0	natural area	private
25. LaSalle Arena Park	2.5	passive recreation	local
26. Grassey Island	15.0	natural area	local
27. Islandview Park	7.0	natural area	local
28. LaSalle Mariners Park	5.0	natural area	local
Anderdon Township			
29. Turkey Island (private)	120.0	natural area	regional
30. Ruwe Marsh (private)	530.0	natural area	regional
31. Canard River Marshes (private)	250.0	passive recreation	local
32. Leo N.J. Beaudoin	3.4	natural area	regional

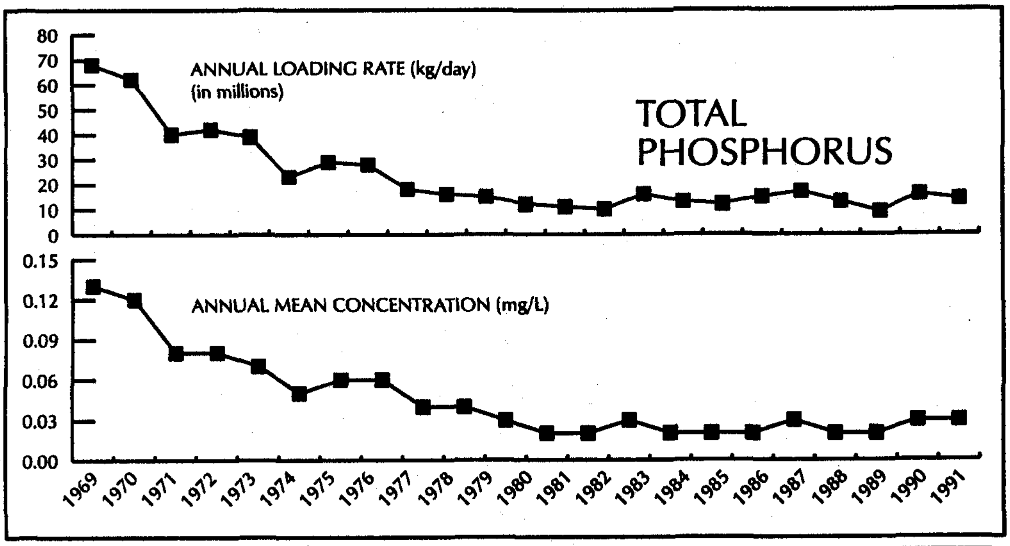
Parks by Community	*Acres*	*Type of Recreation*	*User-base*
33. Angstrom Park	0.4	passive recreation	local
34. K. Walter Ranta Park	17.0	passive recreation	local
35. Ranta Marina Park	13.0	open space marina	regional
36. Crystal Bay	150.0	water park	regional
Town of Amherstburg			
37. Seagrams Park	0.8	passive recreation	local
38. Fort Malden	21.5	historic structures, interpretations	regional
39. Kings Navy Yard	10.5	passive recreation	local
Malden Township			
40. Boblo Island (Bois Blanc Island)	271.0	former amusement park, proposed housing & golf, passive recreation	regional
41. Lighthouse Park (White Sands)	2.2	passive recreation	local
42. Bar Point	1.2	passive recreation	local
43. Sunset Beach	2.3	passive recreation	local
44. Willow Beach	1.7	passive recreation	local
45.Lakewood Beach	2.5	passive recreation	local
46. Holiday Beach	575.0	camping,natural area, passive recreation	regional
Total acreage	**2,816.75**		

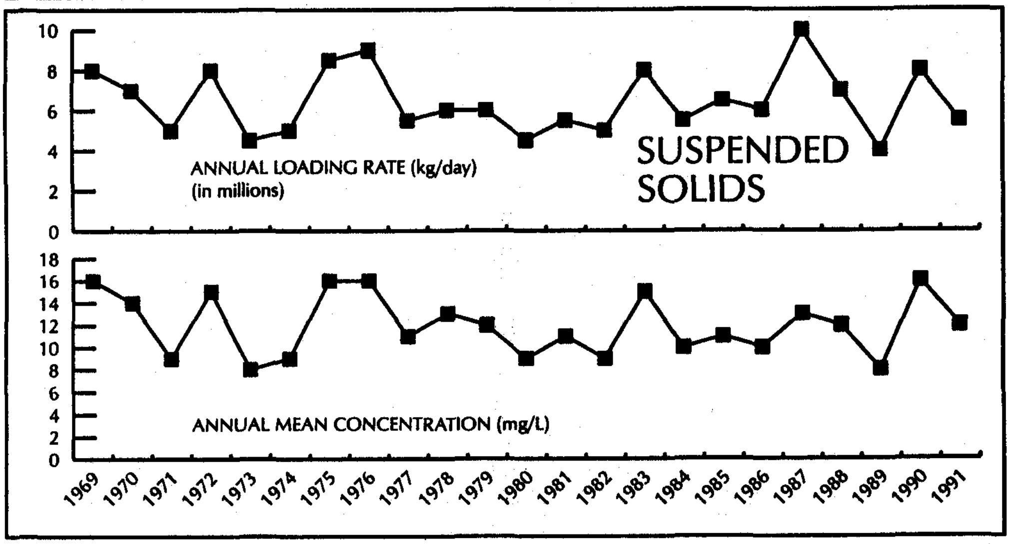
Figure A
U.S. and Canadian Site Parkland Map



Appendix 5.3

Figure B
Annual Contaminants at Detroit River Mouth
all stations combined (range 3-9)





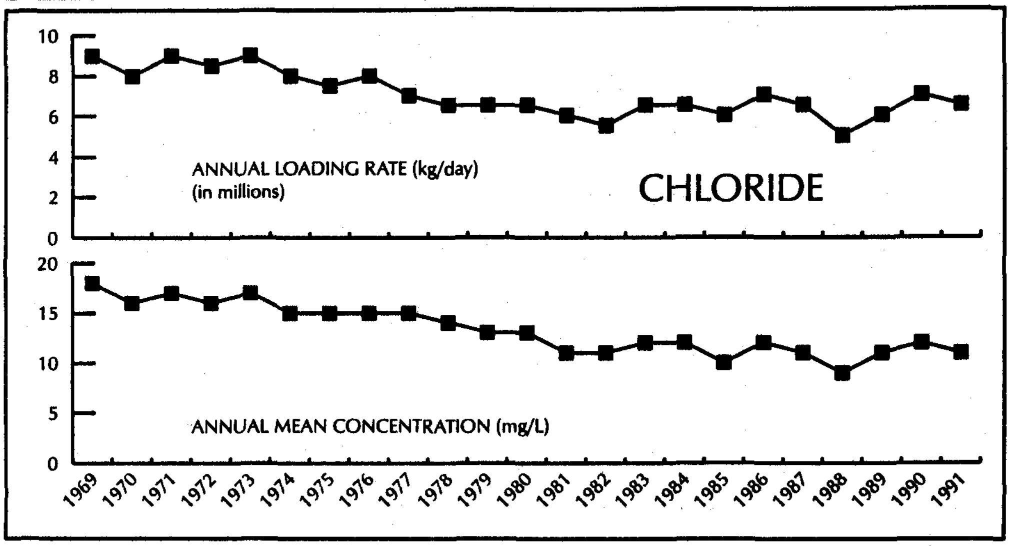


Figure C
Annual Contaminants at Detroit River Mouth
all stations combined (range 3-9)

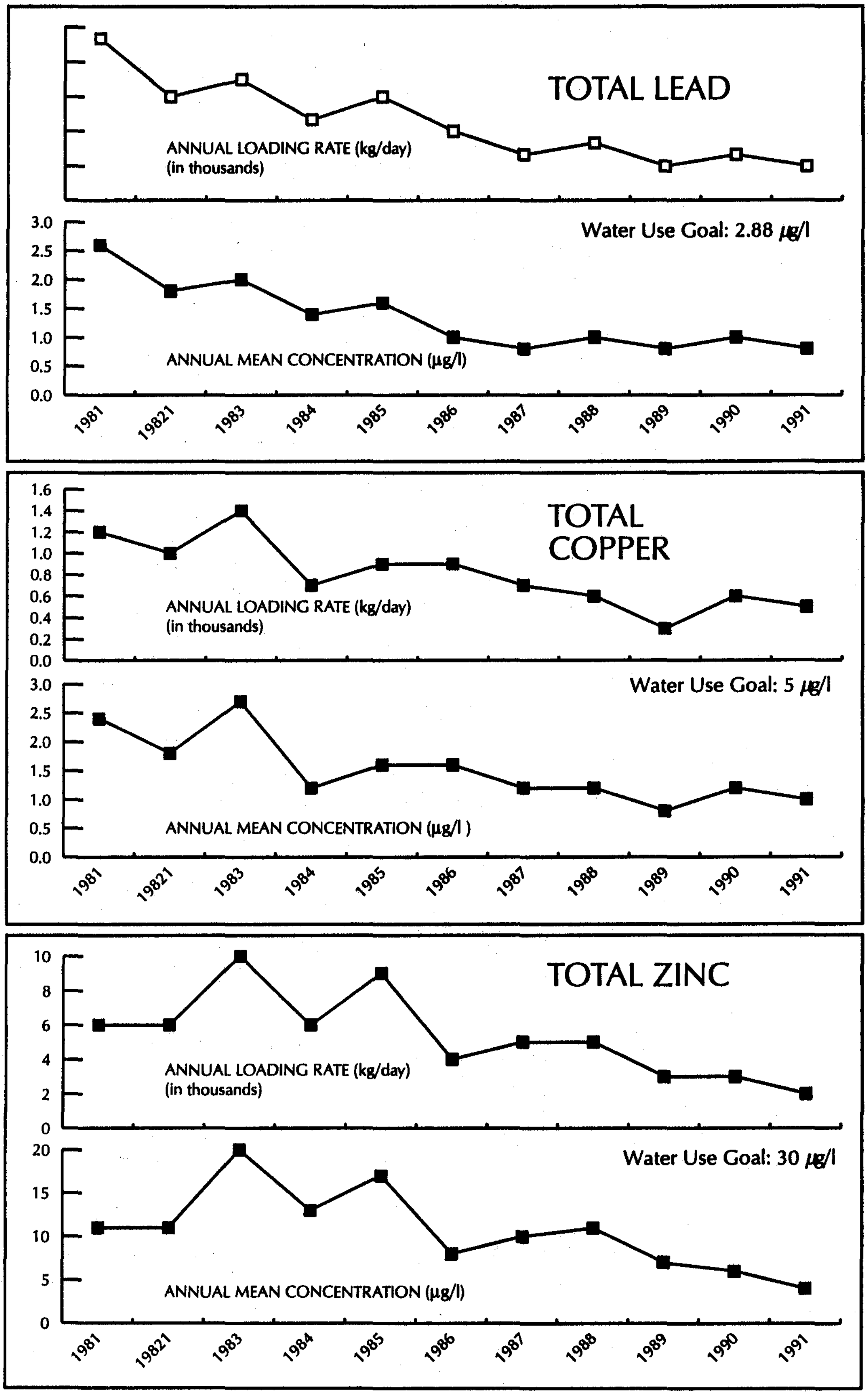


Table I
Mean contaminant concentrations in carp whole fish samples collected from the Great Lakes and Connecting Channel trend monitoring locations from 1990-1992. All chemical concentrations are in mg/kg.

	St. Clair River	Lake St. Clair		Lake Erie Brest Bay		Detroit River		Lake Huron Saginaw Bay		Lake Huron Thunder Bay	Lake Michigan Little Bay De Noc
Year Sampled	1992	1990	1992	1990	1992	1990	1992	1990	1992	1992	1992
Mean Age (yr.)	5-6	NA	4-6	NA	3-7	NA	3-6	NA	4-7	5-8	7-12
Mean Length (in.)	19.6	19.4	19.5	18.9	20.0	19.6	19.2	19.4	21.5	22.2	22.8
Mean % Fat	10.8	9.98	12.4	10.1	12.0	14.7	11.1	10.7	11.3	9.23	13.6
Chemical											
Mercury	0.14	0.07	0.09	0.04	0.05	0.12	0.10	0.13	0.07	0.12	0.17
Dieldrin	0.021	0.019	0.019	0.032	0.037	0.028	0.023	0.020	0.029	0.018	0.030
Hexachlorobenzene	0.007	0.007	0.004	0.004	0.006	0.014	0.008	0.004	0.005	0.002	0.003
Octachlorostyrene	0.056	0.011	0.010	0.008	0.011	0.026	0.013	0.017	0.018	0.002	0.005
Total PCB	1.58	1.89	1.55	3.09	5.35	4.35	3.75	4.14	3.98	0.943	3.14
Total Chlordane	0.152	0.165	0.153	0.066	0.073	0.105	0.146	0.051	0.129	0.094	0.202
Apparent Tocaphrene	ND	ND	ND	ND*	ND	ND	ND	ND*	ND	ND*	ND
Total DDT	0.326	0.436	0.385	0.250	0.458	0.504	0.378	0.619	0.626	0.448	0.970
Heptachlor Epoxide	0.006	0.012	0.007	0.006	0.007	0.006	0.008	0.005	0.007	0.006	0.005
Pentachlorostyrene	ND	0.006	ND	0.006	ND	0.014	ND	I	ND	ND	ND
Hexachlorostyrene	ND	0.002	ND	0.001	ND	0.006	ND	ND	ND	ND	ND
Heptachlorostyrene	ND	0.005	ND	0.006	ND	0.011	ND	0.003	ND	ND	ND

ND = Not detected in any fish analyzed.
ND* = Detected in some fish. However, the species mean calculated was less than the detection level.
I = Analytical interference; quantification not possible.
NA = Date not available.
The contaminated heptachlor, mirex, aldrin, lindane, terphenyl, and PBB were not detected in any of the fish analyzed.

Table J
Mean contaminant concentrations in walleye whole fish samples collected from the Great Lakes and Connecting Channel trend monitoring locations from 1990-1992. All chemical concentrations are in mg/kg.

	St. Clair River	Lake St. Clair	Lake Erie Brest Bay		Detroit River		Lake Huron Saginaw Bay			Lake Huron Thunder Bay	St. Mary's River	Lake Michigan Little Bay De Noc
Year Sampled	1992	1990	1990	1992	1990	1992	1990	1991	1992	1991	1991	1992
Mean Age (yr.)	5-10	NA	NA	4-7	NA	3-8	NA	5-7	4-6	3-11	6-10	5-7
Mean Length (in.)	20.6	20.9	20.4	18.5	19.6	19.2	20.8	21.0	21.2	23.3	20.8	21.1
Mean % Fat	8.80	5.24	9.82	10.7	6.30	8.59	4.77	7.97	9.32	10.8	5.31	7.28
Chemical												
Mercury	0.25	0.26	0.13	0.14	0.22	0.27	0.18	0.15	0.11	0.28	0.29	0.18
Dieldrin	0.044	0.032	0.044	0.039	0.019	0.026	0.015	0.024	0.028	0.048	0.021	0.052
Hexachlorobenzene	0.006	0.005	0.005	0.005	0.008	0.006	0.005	0.005	0.004	0.007	0.003	0.003
Octachlorostyrene	0.012	0.010	0.012	0.012	0.034	0.016	0.009	0.009	0.003	0.005	0.001	ND
Total PCB	1.79	2.38	2.30	1.94	1.97	3.13	1.52	2.25	2.76	1.82	0.555	1.19
Total Chlordane	0.240	0.209	0.130	0.191	0.102	0.176	0.065	0.147	0.147	0.226	0.164	0.164
Apparent Toxaphene	0.350	0.432	0.18	ND	0.220	ND	0.184	0.238	0.183	0.535	0.560	0.138
Total DDT	0.573	0.652	0.359	0.299	0.281	0.393	0.284	0.544	0.351	0.648	0.548	0.475
Heptachlor Epoxide	0.009	0.008	0.009	0.010	0.005	0.008	0.004	0.004	0.006	0.009	0.003	0.007
Pentachlorostyrene	ND	0.017	0.009	ND	0.019	ND	I	ND	ND	ND	ND	ND
Hexachlorostyrene	ND	0.001	0.002	ND	0.007	ND	ND*	ND	ND	ND	ND	ND
Heptachlorostyrene	ND	0.002	0.004	ND	0.008	ND	0.002	ND	ND	ND	ND	ND

ND = Not detected in any fish analyzed.
ND* = Detected in some fish. However, the species mean calculated was less than the detection level.
I = Analytical interference; quantification not possible.
NA = Date not available.
The contaminated heptachlor, mirex, aldrin, lindane, terphenyl, and PBB were not detected in any of the fish analyzed.

Figure D
Detroit River-Boblo Island Mercury in Walleye, 1983-1993

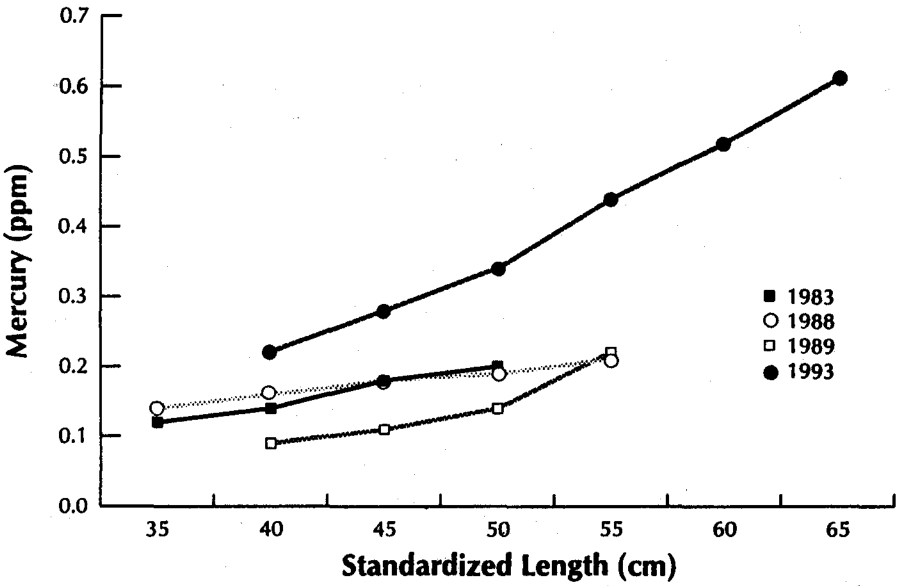


Table K
Contaminant concentrations in lake sturgeon collected from the Detroit River, April 1993
All chemical concentrations are in mg/kg.

	Sample Number 1	*SampleNumber 2*
Sample Type	Skin-off steak	Egg sample, collected in plastic milk jug
Length (in.)	63.0	63.0
Weight (lbs.)	69.76	69.76
Mean % Fat	16.00	9.40
Chemical	*(mg/kg)*	*(mg/kg)*
Mercury	0.53	0.04
Dieldrin	0.029	0.019
Hexachlorobenzene	0.014	0.010
Octachlorostyrene	0.238	0.137
PCB A-1260	3.710	2.680
a-Chlordane	0.037	0.020
g-Chlordane	0.017	0.008
cis-Nonachlor	0.047	0.022
trans-Nonachlor	0.050	0.024
Oxychlordane	0.007	0.003
Total chlordane	0.158	0.077
Heptachlor	0.005 K	0.005 K
Aldrin	0.005 K	0.005 K
g-BHC (Lindane)	0.005 K	0.005 K
Terphenyl	0.250 K	0.250 K
Apparent Toxaphene*	0.050 K	0.050 K
4,4'-DDD	0.124	0.049
4,4'-DDE	0.431	0.238
4,4'-DDT	0.053	0.027
Total DDT	0.608	0.314
Mirex	0.005 K	0.005 K
Pentachlorostyrene	0.001 K	0.001 K
Hexachlorostyrene	0.001 K	0.001 K
Heptachlorostyrene	0.001 K	0.001 K
PBB (Firemaster BP-6)	0.005 K	0.005 K
Heptachlor Epoxide	0.011	0.005

* = Residue exhibits chromatographic characteristics similar to toxaphene, however, it is not identified.
K = Undetected at the detection level shown.

Table L
Organochlorine residues in young-of-the-year spottail shiners from the Great Lakes and connecting channels from 1975 to 1993
Values are means +/- standard deviation.

Sampling Site	*Year*	*n*	*Total Length (mm)*	*Fat (%)*	*PCB (ng/g)*	*DDT (ng/g)*	*Mirex (ng/g)*	*Chlodane (ng/g)*	*BHC (ng/g)*	*HCB (ng/g)*	*OCS (ng/g)*
Peche Island	1978	8	57-2	2.0-0.2	269-55	17-4	ND	10-9	ND	ND	-
	1979	4	63-6	2.1-0.5	114-61	46-19	ND	10-4	TR	5-4	-
	1980	7	62-6	1.2-0.2	67-21	18-3	ND	7-1	2-1	3-1	-
	1982	7	61-6	1.7-0.2	64-10	11-4	ND	TR	TR	1-1	5-2
	1983	7	52-4	2.0-0.0	29-5	2-3	ND	TR	TR	ND	3-1
	1984	6	60-5	1.6-0.2	95-50	8-10	ND	3-1	ND	ND	3-2
	1987	7	71-6	2.9-0.4	40-16	14-4	ND	ND	ND	3-0	5-1
	1989	5	51-3	5.8-0.6	ND	14-8	ND	ND	ND	4-2	7-5
	1990	7	63-3	2.5-0.7	TR	5-3	ND	ND	ND	TR	4-1
	1993	5	60-1	2.0-0.3	138-38	6-2	ND	ND	ND	1-1	3-1
Fighting Island	1980	6	55-4	2.2-0.5	96-24	6-1	ND	8-2	4-2	11-3	-
	1983	6	59-3	2.7-1.0	290-59	ND	ND	4-1	6-5	4-1	9-1
	1984	7	55-6	2.2-0.3	203-37	10-8	ND	TR	ND	6-1	9-2
	1986	2	52-1	1.8-0.1	184-69	7-4	ND	ND	ND	ND	4-1
	1990	7	56-2	1.9-1.0	99-73	6-4	ND	ND	ND	TR	3-3
Amherstburg	1982	5	66-3	2.9-0.2	304-116	2-1	ND	9-3	2-1	7-1	10-2
	1983	7	64-6	2.3-0.7	153-65	17-12	ND	6-2	4-1	5-2	8-2
	1984	7	67-10	3.4-0.3	330-86	7-3	ND	TR	TR	6-2	9-2
	1985	6	67-4	4.0-0.7	481-69	TR	ND	ND	ND	11-2	8-1
	1986	7	61-5	1.9-0.2	214-67	11-2	ND	TR	ND	7-1	11-1
	1987	7	60-5	2.5-0.6	124-31	10-4	ND	ND	ND	3-1	5-1
	1990	7	64-2	2.7-0.6	69-27	8-6	ND	ND	ND	ND	2-1
	1991	7	68-1	1.6-0.3	46-10	8-2	ND	ND	ND	ND	3-1
	1992	5	66-2	2.2-0.3	158-6	14-4	ND	ND	ND	ND	3-1
	1993	7	67-1	2.0-3.0	132-14	6-3	ND	ND	ND	TR	2-1
Big Creek	1977	9	57-3	0.9-0.1	447-40	75-15	ND	ND	ND	ND	-
	1978	6	55-2	1.0-0.2	510-93	42-22	ND	8-5	TR	ND	-
	1980	7	66-4	1.1-0.1	387-95	27-11	ND	6-3	TR	ND	ND
	1981	7	60-5	2.1-0.3	307-85	31-15	ND	7-3	5-1	3-2	ND
	1982	7	57-5	1.7-0.3	189-69	2-1	ND	ND	ND	3-1	5-1
	1984	5	65-7	1.9-0.2	480-73	2-2	ND	ND	ND	2-1	6-2
	1985	4	61-7	2.0-0.3	205-117	2-1	ND	ND	ND	3-3	4-2
	1986	7	61-7	1.7-0.3	201-70	17-7	ND	ND	ND	2-1	4-2
	1987	6	57-7	1.5-0.2	95-17	10-4	ND	ND	ND	2-0	2-0
	1990	7	61-2	2.3-1.2	81-41	7-7	ND	ND	ND	ND	ND
	1991	7	61-3	1.0-0.3	54-15	6-2	ND	ND	ND	ND	ND
	1993	6	57-4	1.2-0.2	115-24	3-2	ND	ND	ND	ND	ND

Table M
Detroit River Waterfowl Surveys, 1947 to 1992. Michigan Department of Natural Resources, District 14 Wildlife

Year/ Mo./Day	Loc.	Canada Goose	Mute Swan	Tundra Swan	Unident. Swan	Mallard Duck	Black Duck	Green-wing Teal	Gadwall	Wigeon	Pintail	Canvas-back	Redhead	Lesser Scaup	Greater Scaup	Golden-eye	Buffle-head	Ruddy Duck	Ring-neck	Shoveler	Coot	Unident. Puddle	Unident. Diver	Unident. Duck	Merganser	Totals	Comments
920107		225	245	45		4110	1360					4150	300		3700								100		200	14435	All species
911211		660	2		190	450	20			10		6200	200			40								50	885	8707	Geese survey
911106		225	245	45		4100	1360					4150	300		3700										200	14325	Diver survey
901108	B	150										300														450	Diver survey
900103	B	80	2									300														382	All species
891211	G	420																								420	
891211	B	250																								250	
891106	B	200										300														500	Diver survey
890113	B	200			10	40						120	60											20		450	
890113	G	457			135	398	32									215										1237	
890104	B	200	10			40						4145	60											20		4475	All species
881222	B	275																								275	
881222	G	810																								810	
881102		140	120			200	100		100			250	75		400							100	200		20	1705	Diver survey
881102	B	140				200	100		100			250	75		400							100	200		20	1585	
880108	B					50						300														400	
880108	G	1725			180	800	100					13200				610									9100	25715	
871214	B	312			1																			510		823	
871214	G	142			61																			1540		1743	
871124	G	150	50			500						300			250	100	300								350	2000	
871124	B	150										200														350	
871121	B	150										200														350	Scaup survey
871105		300				200						300			100											900	Diver survey
870108	B	100				30																				130	All species
861205												1350														1350	Geese survey
861121	B	200				50						500			150	50										950	Scaup survey
861106	B	300				50						250			150											750	Diver survey
860211		1215				450	20					1750	25		30	50	50								3250	6840	Diver survey
860107		1000			156	150						3755	950			200	100								400	6711	
851118												2150														2150	Diver survey
851118	G			20			150					2150	700		500	500	100	50	100	30			250		12000	16550	
851109						405	50			50		2800			1000						200					4505	
851108						300																	2000			2300	Diver survey
841108		65																					2000			2065	Diver survey
841108		65				300	75								400	12										852	
840106		140	50			889	234					1160	35			182									7360	10050	All species
831213		135		45		541	23				80	5270				82									300	6476	CWS
831108	B					110				400														300		810	Diver survey
821201		60	30			60	30									30										210	Diver survey
821117						130										50								200		380	Diver survey
821103						50						150	100													300	Diver survey
821021						35	26															RN	300	15		376	
811125	G				30	330	400					2130			30	110									20	3050	
811125	B					30						130			130											290	
811013						10							50		300				50		50			75		535	
811002						90	10			500									50					75		725	
801203	G				70	131	200					30	40				1	50						185		707	
801203	B					333						400	590		17	19								85		1444	
801202	B	20				50	250					100				10										430	
801202	G			80		6										5								18	1	110	

Loc. = Location (B = Belle Isle, G=Grosse Ile)
Unident. = inidentified

Year/ Mo./Day	Loc.	Canada Goose	Mute Swan	Tundra Swan	Unident. Swan	Mallard Duck	Black Duck	Green-wing Teal	Gadwall	Wigeon	Pintail	Canvas-back	Redhead	Lesser Scaup	Greater Scaup	Golden-eye	Buffle-head	Ruddy Duck	Ring-neck	Shoveler	Coot	Unident. Puddle	Unident. Diver	Unident. Duck	Merganser	Totals	Comments
801130	B	30				50			50			300	100											85		615	
801120	B					40	7									122								94		263	
801120	G		15			22	5																			42	
801113	B					141	20			20		50					10							25	5	271	
801113	G						6									8										14	
801113	G					68				150		6500	1000		252						200			100		8270	Inc. CWS
801106	G					113						2	93		18	4							5			235	
801022	B												620				4									624	
801022	G					700				400														20		1120	
740108	B			8		85	97								236	140								450		1016	
740108	G											6758			2300	4435								800	265	14558	
730108	G											525	350		11800											12675	
720104	G											1070	550		8950											10570	
710107	G											2300	4300		5000											11600	
691120												150	50		9000											9200	
690000	G											2775	1800		26775											31350	
681210												20			490											510	
671215	G														3475											3475	
660104	G											413	1180		1195											2788	
650104	G											9850	1400		10930											22180	
640406	G				1213	100	50					3700	2800		14000				200					200	200	22463	
640106	G											12150	50		7580											19780	
630115	B											2500	50		4650											7200	
620115	G											1300	1		2180											3481	
610109	G											5275	177		4525											9977	
600104	G											800			5165											5965	
590110	G											33200	200		49300											82700	
580116	G											18600	300		10500											29400	
570108	G											26400	1100		16600											44100	
560109	G											10600			9200											19800	
550104	G											21700	400		48400											70500	
540106	G											28625			75440											104065	
530113	G											21470	520		13630											35620	
520109	G											4788	140		6305											11233	
510110	G											16800			4600											21400	
500112	G											7020			4680											11700	
490112	G											11123			3730											14853	
480113	G											18488			7395											25883	
470115	G											4000	1000		11000											16000	

Loc. = Location (B = Belle Isle, G=Grosse Ile)
Unident. = inidentified

Appendix 6.1

Outreach at Schools and at other Events

BPAC member Dr. Eugene Perrin has made several presentations on the Detroit River RAP to the Southeast Michigan Sierra Club, East Michigan Environmental Action Council and Southeast Michigan Audubon Society.

BPAC member Saulius Simoliunas organized a symposium on RAPs at the 4th Chemical Congress of North America, the 202nd American Chemical Society National meeting and at the 35th and 36th conferences of the International Association for Great Lakes Research (IAGLR).

BPAC member, Mary Ginnebaugh, made the following presentations about the Detroit Diver RAP:

Sierra Club, Lake Erie Chapter, Flatrock , MI, August 10, 1993

Greenpeace — Windsor Canvas Office, Windsor, Ontario, September 28, 1993

Creekside Community Development Corporation, Detroit, MI, October 26, 1993

Hugh Beaton Elementary School, Windsor, Ontario, February 1, 1994

Grosse Ile Presbyterian Church, Grosse Ile, MI, March 12, 1994

Youth 2000 Project, Windsor, Ontario, May 4, 1994

Belleriver High School, Belleriver, Ontario, May 6, 1994

BPAC members Saulius Simoliunas, Rick Coronado and Mary Ginnebaugh presented a paper on the the Detroit River RAP at the 37th conference of IAGLR.

BPAC member, Dr. Ralph Kummler, Wayne State University, made the following technical presentations on the Detroit River RAP or related water quality issues:

"Modelling for the Detroit River Remedial Action Plan," Seminars at Wayne State University: Chemical Engineering Department, November, 1993 and the Geology Department, April 1994

"Modeling Trace Mercury in Detroit River Aquatic and Sediment Systems," Joint U.S.-Mexico Conference on the Fate, Transport and Interactions of Heavy Metals in the Environment, Tucson, Arizona, April 1993, with C.C. Lin.

"Modelling the Water Column, Sediment and Biota Concentrations of the Detroit River," U.S. EPA Stormwater and Water Quality Management Modelling Conference, Toronto, Ontario, March 3-4, 1994.

"Modelling the Detroit River for Short term and Long Term Strategies," OMOEE, Binational RAP modeling Seminar, Sarnia, Ontario, September 1992. U.S. BPAC members helped plan and staff the BPAC booth during the 1993 Day at the River event at Hart Plaza.

During the 1993 -1994 fiscal year, the Canadian RAP display was involved in the Lasalle Strawberry Festival, Day at the River, the IJC Conference and RAP Forum, the American Waterworks Association Convention, and Earth Day. The entire Canadian BPAC were involved in staffing the display at these various events.

U.S. RAP coordinator Susan Benzie made a number of RAP presentations as well as participating in other forms of public outreach:

Detroit RAP Presentation, 4th grade classes, Hickory Grove School and Eastern School, Bloomfield Hills School District, December 1993

Eastern Michigan University, Geo 479 and Geo 579, Environmental Issues, March 16 and April 2, 1992.

Wayne State University, Public Issues in Hazardous Waste Management, June 17, 1992

"The Environmental Problems in the Windsor Area: Detroit River Pollution and the Remedial Action Plan," University of Windsor, 1993 Environmental Conference, March 27, 1993, with Dan Gaudenzi, OMOEE.

"Detroit River RAP," Southeast Michigan Health Director's Meeting, Wayne County Health Department, March 27, 1994.

"The RAP Process - Where Do We Go From Here? (MDNR Perspective)," Third Annual Michigan Citizens Conference on Great Lakes Areas of Concern, Kellogg Conference Center, East Lansing, Michigan, February 29, 1994.

International Joint Commission Conference on Institutional Frameworks for RAPs, International Joint Commission, Conference

"Detroit River RAP Presentation," Downriver Walleye Association, October 18,1993

"Detroit River RAP Presentation," Areawide Water Quality Board Meeting, Detroit, Michigan. March 3, 1994.

"Detroit RAP Presentation," Press Briefing for Public Release of the Stage 1 RAP, SEMCOG Offices, Detroit, Michigan, January 1991.

"Detroit RAP Presentation," Public Meeting for the Presentation of the Detroit River RAP, Riverview Municipal Offices, Riverview, Michigan. February 21, 1994.

"Detroit River RAP Presentation," Joint BPAC/RAP Team Meeting, University of Windsor, Windsor, Ontario. February 28, 1991.

"Detroit River RAP Presentation," Michigan State Water Resources Commission Meeting, Detroit, Michigan. June 21, 1991.

Staffed MDNR display at 1993, COBO Hall Boat Show – distributed pamphlets.

Other Michigan Department of Natural Resources (MDNR) outreach activities include participation at outdoor shows such as: OUTDOORRAMA, COBO Hall Boat Show and the Auburn Hills Palace Fishing Exposition. In 1993, MDNR staff distributed angler surveys at these various shows to determine if Detroit River fish had taste and odor problems. A display board highlighting Southeast Michigan's five Areas of Concerns was used at the 1994 OUTDOORRAMA. In addition, RAP posters and pamphlets were distributed to some of the 100,000 attendees of the event.

SEMCOG staff have participated in the following outreach activities: 1) promotion of the Detroit River RAP at the third Annual Michigan Citizens Conference on Great Lakes Areas of Concern; 2) Development and oversight of the 1993 Day at the River, 3) regular updates at SEMCOG's Environmental Policy Advisory Council, Areawide Water Quality Board, Executive Committee, and General Assembly, 4) promotion of the RAP through the display at the 1993 International Joint Commission Biennial Conference, made a Detroit River RAP Slideshow presentation, to an environmental conservation class at Schoolcraft College, Livonia, Michigan, on February 15, 1994.

Appendix 6.2

US BPAC Members

Representative	Service Dates
Bill Anderson, Michigan United Conservation Clubs	1/88-7/94
Scott Anderson (Alt.), City of Trenton	8/92-present
Richard Armstrong, Detroit Yacht Club	1/88-present
Tom Boritzki, Mayor of Trenton	8/92-present
James Cisek, MD Toxicologist	7/94-5-95
Deborah Cole (Alt.), Citizen	7/94-present
Fred Eaton, U.S. Representative Dingell's Office	8/92-present
Ron Fodor, Grosse Ile Township	8/92-7/94
Mary Ginnebaugh, Citizen	8/92-present
Max Gloor, Citizen	7/94-present
Russ Gossman, United Auto Workers	1/88-7/94
Dennis Gould,National Steel Corporation	2/91-present
James Kellow, Detroit Wayne County Port Authority	8/92-5/94
Thomas Heidtke, Wayne State University	5/91-6/93
Arthur Heidrich, Detroit Edison	7/94-present
Tom Hoermann, BASF Corporation	6/93-10/95
Lawton K. Jackson, Clean Water Action	8/92-present
Steven Jelnick, Texaco Lubricants	7/94-present
Jim Jones, Downriver Community Conference	8/92-7/94
Ralph Kummler, Wayne State University	1/88-present
Kathleen Leavey, Detroit Water and Sewerage Department	1/90-present
Cheryl Minniefield, Citizen	7/94-present
Jim Murray, Wayne County Department of Environment	3/90-present
John Nasarzewski, Citizen	7/94-present
Dr. Eugene Perrin, Wayne State University	1/88-present
Tom Radtke (Alt.), Citizen	8/92-present
Peter Rotteveel, City of Riverview	1/88-7/94
Saulius Simoliunas, Citizen	11/89-present
Bill Slattery (Alt.), Citizen	7/94-present
Raj Syal (Alt.), Citizen	1/88-7/94
Elizabeth Toomer (Alt.), Citizen	7/94-present
Doug Thiel, BASF Corporation	6/92-6/93
Harlan Toy, Monsanto Corporation	8/92-present
Dean Tuomari, Wayne County Department of Environment	7/94-present
Illona Varga, State Representative	8/92-present
James Weathers, City of Detroit	8/92-1/94
Don Windeler, McLouth Steel	8/92-present

Canadian BPAC Members

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Rick Aldi, Hiram Walker & Sons, Inc.	7/88 - present
Kevin Arnold (Alt.), Citizens Environment Alliance	8/92-1993
Chris Alsop (Alt.), Essex Region Conservation Authority	8/92-present
Bob Bailey, Township of Anderdon	2/95-present
Tim Bendig (Alt.), Windsor Essex County Health Unit	1995-present
David Broad (Alt.), Citizens Environment Alliance	1994-present
Lynda Corkum (Alt.), University of Windsor	10/94-present
Rick Coronado, Citizens Environment Alliance	1/88-present
David Cree, Windsor Harbour Commission	8/92-present
Ron Drynan (Alt.), City of Windsor	8/92-present
Don Dukelow (Alt.), City of Windsor	1995-present
Joe Durocher, Town of LaSalle	8/92-present
Diana Furlong, Citizens Environment Alliance	1993-present
George Georgiou, Windsor Skin and Scuba Club	1993-present
Doug Haffner, University of Windsor	8/88-present
Tom Hamilton, Town of Amhurstburg	1/88-present
Paul Hansen, Chrysler Canada Limited	8/92-present
Gord Harding, City of Windsor	6/89- present
Allen Heimann, Windsor Essex County Health Unit	8/92-present
Patricia Hunt (Alt.), Windsor Harbour Commission	1994-present
Saad Jasim, Windsor Chamber of Commerce	11/93-present
Colin Johnson, General Chemical Canada	1/88-present
Daniel Lebedyk, Essex Region Conservation Authority	8/92-present
Rose Menyes, RAM Enterprises	8/92-3/93
Gray Otton, Canadian Cancer Society	1/88-present
Scott Rhude (Alt.), Ford Motor Company of Canada	1995—present
John Riggs, Anderdon Township	8/92-5/94
Louis Romano, City of Windsor	6/89-present
Ken Schmidt, Essex Region Conservation Authority	11/89-present
Rob Sheehan, Canadian Auto Workers	8/92-present
Jerry Spanik (Alt.), Ford Motor Company of Canada	1993-present
Martin Strong (Alt.), Windsor Essex County Health Unit	8/92-1995
Gord Taylor, Canadian Auto Workers	1/88-present
Marcia Valiante, University of Windsor	1994-present
John Vandereerdon, LaSalle Mariners Yacht Club	8/92-1995
Ron Vermey, Proctor and Redfern, Ltd.	5/91-present
Maurice Victor, Windsor Chamber of Commerce	1/88-5/94
Jim Vincent, Canadian Salt Company	8/92-present

Mike Walsh, Citizens Environment Alliance	5/89-present
Dan Watkin, Pounders Fishing Club	1989-1993
David White, Anderdon Township	6/94-12/94
Mark Willis (Alt.), Canadian Salt Company	1990-present
Kirk Windibank, Citizens Environment Alliance	1/88-1993

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* *Core Members*

Appendix 6.3

BPAC Meetings and Major Topics

August 26, 1992

Welcome new BPAC members for the start of Stage 2 planning

Stage 2 Workplan Timeline

BPAC participation in Stage 2

Agency Views on Participation in the RAP Process
Frank Ruswick, Acting Deputy Director for Environmental Protection
Doug McTavish, Regional Director, OMOEE

Election of BPAC Officers

December 3, 1992

Progress on Stage 2 Activities

Michigan Waste Load Allocation for the Detroit River
Brenda Sayles and Sandra Kosek, MDNR

Financial Planning Guide for the Detroit River RAP/Michigan
Ann Carey, Apogee Research, Inc.

Support for Day at the River and Establishment of Day at the River Steering Committee.

March 9, 1993

Progress on Stage 2 Activities

Public Involvement Report

Statewide Public Advisory Council Election

June 16, 1993

Progress on Stage 2 Activities

Storm Water Regulations
Gary Boerson, MDNR

OMOEE's Sediment and Benthic Assessment Report
Bruce Hawkins

Candidate Sites Report for Habitat Rehabilitation/Enhancement
Don Hector, OMNR

BPAC Elections

Update on Day at the River Preparations

August 18, 1993

Progress on Stage 2 Activities

Perspectives on the Proposed U.S. Great Lakes Water Quality Guidance Document

BPAC Involvement in the IJC Biennial Report

January 18, 1994

Discussion of RAP Workshop Format
Dr. Vernon Miller, Wayne State University

RAP Recommendations and Remedial Options
Dr. Vernon Miller, Wayne State University

Public Involvement in Watershed Management
Jim Graham, Friends of the Rouge

Thunder Bay Shoreline Clean up Program
Bob Hartley, Thunder Bay PAC

April 27, 1994

Progress of the Technical Work Groups

Review and Evaluation of the Technical Work Group and Workshop Process

Draft Stage 2–RAP Report Format and Outline

Continuing Stage–RAP Process

Socio-Economic Benefits of RAPs
Dr. Robert Schwartz, Wayne State University

July 14, 1994

Elections

Mongaugon Creek Update

Review of TWG reports for Biennial RAP Report – tabled.

September 12, 1994

Review of the TWG Report section of the Biennial RAP Report – comments taken on the habitat, Contaminated sediments and CSO TWG reports only.

September 29, 1994

Review of the PS/NPS TWG report and additional comments on the other TWG reports.

November 30, 1994

Continued review of the TWG reports and recommendations as well as the KETOX modeling efforts and the non-TWG portion of the RAP Report

BPAC reconsideration of its April 27, 1994 motion supporting the Michigan RAP Approach.

Public Involvement Reports addressing: Day at the River, SPAC Report, By-laws Committee Report, Environmental Justice, and Detroit River RAP Newsletter.

March 9, 1995

Review of 1995 Detroit River RAP Biennial Report presentation of new RAP process and development schedule/question and answer session on the content of the RAP document.

Public Involvement Reports addressing: Day at the River, Detroit River RAP Secondary School Forum, SPAC Report, By-laws Committee Report, Environmental Justice – committee prepared to develop a chapter, and Detroit River RAP Newsletter.

March 28, 1995

Consideration of the draft Environmental Justice Chapter

Facilitated consensus building BPAC workshop to develop group input on the draft Biennial RAP Report.

June 14, 1995

Consideration of the Draft Environmental Justice chapter

Passage of a resolution of support for the Grosse Ile Land and Nature Conservancy's nomination of Stony Island to be acquired by the Natural Resources Trust Fund.

Passage of a resolution supporting funding a study to determine the condition of the confined disposal facility on Grassy Island and carry out any action to prevent leakage.

Reports to BPAC addressing: Fifth Annual Michigan AOC Conference, Results of 1995 Day at the River, Agency Reports

Facilitated BPAC/RAP Team Consensus Building Workshop to prioritize the recommendations of the draft Detroit River RAP Biennial RAP Report.

February 6, 1996

Considered changes to the RAP process.

Discussed options for restructuring the BPAC.

Public Involvement Reports to BPAC.

TWG Meeting Dates, Locations, and Discussion Topics

Habitat Technical Work Group Meetings

November 24, 1992 (SEMCOG)

The following topics were addressed at the meeting: (1) historical loss of wetlands in the Detroit River, (2) Humbug Bar and associated bars, (3) OMNR's "Survey of Candidate Sites on the St. Clair and Detroit Rivers of Potential Habitat Rehabilitation/Enhancement"; and (4) shoreline land use along U.S. and Canadian sides. In addition, the following objectives were adopted: (a) Preserve and protect existing habitat, and (b) Re-establish or create habitat where possible.

February 4, 1992 (SEMCOG)

Presentations were given by Larry Halyk, OMNR; Barry Horney, MDNR; and Ken Schmidt, ERCA, on existing state and provincial programs to protect habitat. Lynda Corkum, Great Lakes Institute, discussed her paper on "Contaminant Body Burdens of Aquatic Insects as a Monitoring Tool in Areas of Concern."

April 5, 1992 (Windsor Public Library)

Presentations were given by Tim Payne, MDNR; Ron Spitler, MDNR; and, Bob Kavetsky, USFW, on existing Michigan/U.S. Fish and Wildlife programs. In addition, presentations were given on: (1) the historical loss of wetlands in the Detroit River — approximately 97% of the original wetlands have been lost, (2) "Adult Aquatic Insects as Biomonitors of Organic Contaminants and Metals in the Detroit River.", and (3) replacement language on mayflies as an update to the Stage 1 RAP.

May 13, 1992 (SEMCOG)

The following topics were discussed at the (1) the bio-monitoring proposal "Adult Aquatic Insects as Biomonitors of Organic Contaminants and Metals in the Detroit River", and (2) the OMNR "Survey of Candidate Sites on the St. Clair and Detroit Rivers for Potential Habitat Rehabilitation/ Enhancement. In addition, the workgroup members agreed that there was a need for coordinated efforts to identify candidate sites for habitat rehabilitation and enhancement on both sides of the river.

July 27, 1994 (Great Lakes Institute (GLI) House — University of Windsor)

The following issues were discussed at the (1) Biomonitoring using Macrophytes (2) a long term biomonitoring plan, (3) a draft proposal to develop a U.S. candidate site report for habitat rehabilitation/enhancement.

September 22, 1993 (GLI House — University of Windsor)

The following issues were addressed at the (1) long term bio-monitoring plan, (2) proposals submitted to the Great Lakes National Program Office (GLNPO) to rehabilitate Celeron and Grassy Islands, (3) proposal submitted to the Great Lakes Protection Fund to support the biomonitoring proposal "Adult Aquatic Insects as Biomonitors of Organic Contaminants and Metals in the Detroit River", and (4) review of replacement data on diving ducks as an update to stage 1.

October 14, 1993 (Pointe Mouillee State Game Area)
The meeting began with a tour of the Point Mouillee State Game Area. The following issues were addressed at the (1) the draft long term bio-monitoring plan, (2) USGS' National Water Quality Assessment Program (NAWQA) and OMOEE's Great Lakes Monitoring program, (3) CWS shoreline bird and other studies, (4) draft Habitat TWG programmatic recommendations, and (5) potential U.S. candidate sites for habitat rehabilitation/enhancement.

December 14, 1993 (Belle Isle Park — City of Detroit)
The meeting started out with a presentation by Dick Hautau of the City of Detroit's Recreation Department on the Belle Isle Canal rehabilitation project followed by a tour of the island's habitat areas. The following issues were addressed at the (1) Workshop Format, and (2) draft Habitat TWG recommendations and remedial options.

January 31, 1994 (SEMCOG)
The following issues were addressed by the TWG: (1) continued efforts to establish a water fowl census in the Detroit River AOC, and (2) draft Habitat TWG recommendations and remedial options. Additionally, members agreed that an introduction to the recommendations package was needed which relates the recommendations to the impaired beneficial uses, various habitat types and the need for public access to the river.

January 31, 1994 Joint Habitat/Contaminated Sediments TWG Meeting (SEMCOG)
The following issues were addressed at the (1) process used by both workgroups to develop their recommendations, (2) issue of creating "attractive nuisances" , (3) sediment quality at proposed sites of rehabilitation, (4) habitat at contaminated sites(current use by fish and wildlife), and (5) workshop coordination (areas of overlap or issues not being addressed by either workgroup).

March 22, 1994 (U.S. EPA Large Lakes Research Station — Grosse Ile)
The following issues were addressed at the (1) schedule of meetings and activities for the development of the Stage 2 RAP Report, (2) preparation of the Habitat TWG report and update of the Stage 1 RAP, and (3) comment on the March 1 and 2 RAP workshop.

June 24, 1994 (SEMCOG)
Presentation by Mike Shaw, Water Issues Division, Canadian Center for Inland Water on fills in Great Lakes connecting channels; followed by a review of June 1, 1994 draft Habitat Technical Workgroup Report.

February 8, 1995 (SEMCOG)
Finalized TWG report for inclussion in the Draft Biennial Report. Discussed the current schedule and future activities of the group.

July 14, 1995 (SEMCOG)
Purpose of meeting to "add detail" to the list of priority habitat recommendations. Concerns of the TWG members for continuation of the RAP process were addressed. Assignments were given to various TWG members which will assure the completion of this portion of the RAP Document with only a slight (two week) extension in the overall schedule.

September 14, 1995 (Detroit River)
The group toured several of the active and planned habitat rehabilitation sites in the Detroit River.

Contaminated Sediments TWG Meeting Dates/Location/Agenda Items

January 14, 1993
SEMCOG Conference Rm.
1) Modeling as a method of assessment
2) C.Sed Criteria

March 25, 1993
SEMCOG
1) Act 307/SEMI
2) Benthic Study/Trib. Monitoring
3) Detroit River Model Comparison Results

May 13, 1993
Windsor Public Library
1) C.Sed Inventory/Hotspot Criteria
2) Detroit River Objectives

June 30, 1993
SEMCOG
1) River Objectives
2) Work Plan
3) Ketox needs

September 16, 1993
Windsor
1) River Objectives
2) Hotspot Identification
3) Monitoring/Surveillance Plan

November 18, 1993
BASF Wyandotte
1) River Objectives
2) Hotspot Identification
3) RAP Documentation

December 13, 1993
Monsanto Corp, Trenton
1) Socio-economic Discussion
2) River Objectives
3) Ketox Results
4) Hotspot Identification
5) Workshop/RAP Documentation

January 31, 1994
SEMCOG
1) Comments from Workshop
2) River Objectives
3) Workshop/RAP Documentation

April 6, 1994
National Steel Corp.
1) Comments from Workshop
2) Ketox Update
3) Implementation

June 27, 1994
BASF Corp. Fighting Island
1) Status of TWG Report
2) Issues/Studies Update

November 8, 1994
Belle Isle
1) TWG Report
2) Updates

POINT SOURCE - NONPOINT SOURCE MEETING DATES, LOCATIONS AND MAJOR ITEMS OF DISCUSSION

1/12/93 MOEE
Finalize Objectives for Water Use Goals, and review "Questionaire for Technical Experts"

5/4/93 MOEE
Discussion of recommendations, id tech. experts

7/14/93 SEMCOG
Non-point sources, spills and drinking water, progress reports.

9/25/93 SEMCOG
Waste load allocation - MDNR, Discharge limit development - MOEE, writing group reports

10/4/93 West Windsor Treatment Plant
ps parameter of concern writeups

10/26/93 West Windsor Treatment Plant
Spill response - US Coast Gaurd, Workshop, progress reports -ps &nps

12/2/93 SEMCOG
Workshop Update and NPS control recommendations

1/27/94 SEMCOG
Discuss BPAC comments on draft Reccomendations

3/25/94 West Windsor Treatment Plant
Discuss 3/1-2/94 workshop results

4/22/94 SEMCOG
Finalize reccommendations

6/1/94 SEMCOG
Implementation language for final reccommendations

6/20/94 SEMCOG
Review of TWG Report

11/2/94 MOEE
Discussion of parameter write ups, Air deposition study.

11/17/94 SEMCOG
Discuss new loading data, Implementation Strategies.

2/7/95 MOEE
Loading data and methods, final report.

8/22/95 SEMCOG
Add detail to Priority Recommendations.

Combined Sewer Overflows Technical Work Group Meetings

October 20, 1992 (SEMCOG)
The following topics were addressed at the meeting: (1) Stage 2 Workplan process, (2) role of the technical workgroup, (3) tentative meeting topics, (4) review of Stage 1/ Chapter 8, (5) discussion of objectives for Water Use Goals.

November 23, 1992 (SEMCOG)
The following presentations were given: (1) Windsor CSO Study by Jim Drummond and Ron Drynan, (2) Detroit River CSO Study by Ted Starbuck, (3) discussion of data gaps by Susan Benzie.

December 1, 1992 (SEMCOG)
Subgroup meeting to review on-going and proposed CSO studies including the Windsor Riverfront Pollution Control Study and the Detroit River CSO Toxic Sampling Project. The subgroup identified data gaps and developed recommendations.

January 19, 1993 (MOEE — Windsor)
The TWG reviewed the recommendations prepared at the December 1, 1992 Subgroup meeting. In addition the following presentations were made: (1) USEPA CSO Control Strategy by Paul Blakeslee, MDNR; (2) Michigan CSO Control Strategy by Fred Cowles, MDNR; (3) Ontario CSO Control Strategy, Al Stephens and Jim Drummond, MOEE; Detroit CSO Model, Mark TenBroek, Camp Dresser and McKee.

February 18, 1993 (SEMCOG)
The following presentations on U.S. and Canadian discharge permits to the Detroit RIVER were made: (1) Detroit Water and Sewerage Department by Kathleen Leavey, (2) Other Michigan Permits, Kevin Cook, MDNR; (3) Ontario Permits by Jim Drummond, MOEE.

March 17, 1993 (MOEE — Windsor)
A special meeting of the CSO TWG was held to complete discussions of the CSO stategies.

April 6, 1993 (Edison Service Building)
This was a joint meeting of the CSO/PS/NPS TWGs. Presentations on the following topics were made: (1) addressing indirect industrial dischares under MISA by Dale Henry, MOEE; (2) Perspectives on Indirect Industrial Discharges, Combined Sewer Overflow (CSO) Strategies, and Stormwater Management by Steven Jann, USEPA, Gary Boerson, MDEQ, Jim Drummond and Al Stephens, MOEE; Bob Babcock, MDEQ, Dave Drullinger, MDEQ; Kathleen Leavey, DWSD; Jack Durbin, Wayne County DPW, Scott Anderson, City of Trenton.

May 6, 1993 (MOEE — Windsor)
The following topics were discussed: (1) approach to addressing stormwater; (2) are the TWGs fulfilling their jobs, (3) approach to addressing industrial pretreatment programs, (4) continue developing Water Use Goals objectives.

July 15, 1993 (SEMCOG)
The following Issues were discussed: (1) Review of draft reports on — US/MI CSO Strategy, Can/Ont CSO Strategy, compare/contrast strategies, (2) established writing teams to address industrial pretreatment programs, and (3) finalize Water Use Goals.

September 1, 1993 (Edison Service Building)
The following topics were addressed: (1) progress of writing teams and review of drafts; (2) continued developing Water Use Goals objectives; (3) identified and described potential remedial options.

October 27, 1993 (West Windsor Water Pollution Control Plant)
Discussions addressed such issues as: (1) continued identification and description of remedial options, (2) discusion of longterm monitoring and surveilance needs, (3) preparation for March 1 and 2 workshop.

December 7, 1993 (SEMCOG)
The following items were addressed: (1) progress of writing teams and review of draft; (2) continued identifying and describing remedial options; (3) long-term monitoring and surveillance needs; (4) discussion of March 1 and 2 workshop.

January 25, 1994 (SEMCOG)
The following items were addressed: (1) progress of writing teams and review of drafts; (2) overview of recommended remedial options; (3) continued discussion of long -term monitoring and surveillance needs.

March 23, 1994 (MOEE–Windsor)
The following issues were addressed: (1) progress of writing teams and review of drafts; (2) reaction to March 1 and 2 workshop; (3) continued discussion on long-term monitoring and surveillance needs.

April 13, 1994 (MOEE – Windsor)
The following issues were addressed: (1) reaction to draft March 1 and 2 workshop summary; (2) finalizing the RAP Stage 2 Document (schedule for completion, overall format, BPAC and RAP Team review, signoff); (3) Finalizing CSO TWG Report (format, additional writing assignments, addressing Workshop comments, long term monitoring and surveillance needs).

May 26, 1994 (SEMCOG)
The following issues were addressed: (1) formalize Stage 2 recommendations and review implementation write-ups; (2) formalize Stage 2 recommendation and review implementation write-ups; (3) future of CSO TWG.

June 15, 1994 (SEMCOG)
The following items were addressed: (1) review of the TWG Report; (2) evaluation of the TWG process; (3) what comes next.

November 10, 1994 (SEMCOG)
The TWG addressed comments received from members of the BPAC, RAP Team and the public.

Appendix 6.4

Evaluation and Recommendation for Next Steps from BPAC and TWGS

BPAC comments

The BPAC generally supported the public involvement process which was used in the development of the Stage 2 RAP Report. However, a number of perceptions and suggestions were voiced including the following: 1) A more diverse group of technical experts should be used in the next planning phase, 2) the comments of the TWG participants should be incorporated into the TWG reports, 3) TWG meetings should be held in the evening for more involvement of BPAC members as well as members of the public, 4) there was little or no coordination among the TWGs, 5) The relationship of the TWG issues need to be explained in the RAP, 6) RAP decisions should be based on accurate quantitative data, and, 7) BPAC meetings should be held in various communities around the AOC in order to create interest in the RAP and involvement by the citizens.

Technical Workgroup comments

Technical workgroup (TWG) members were surveyed on the effectiveness of the TWG process. Only 21 (25%) of the 85 TWG members responded with a completed survey. The TWG members who responded, agreed (score: 4.0 of a scale of 1-5) that the workgroup process should be used in the next planning phase. The results of the survey also indicates that members for the most part were willing to cooperate to achieve consensus (4.1), meetings were staffed and chaired effectively (4.1), agendas were received on time (3.6), and there was adequate participation by members of the BPAC (3.7) and technical experts (4.3).

The TWG responders felt that the public was not adequately involved in the planning process (2.9). The fact that meetings were held during the day instead of the evenings probably contributed to the publics absence.

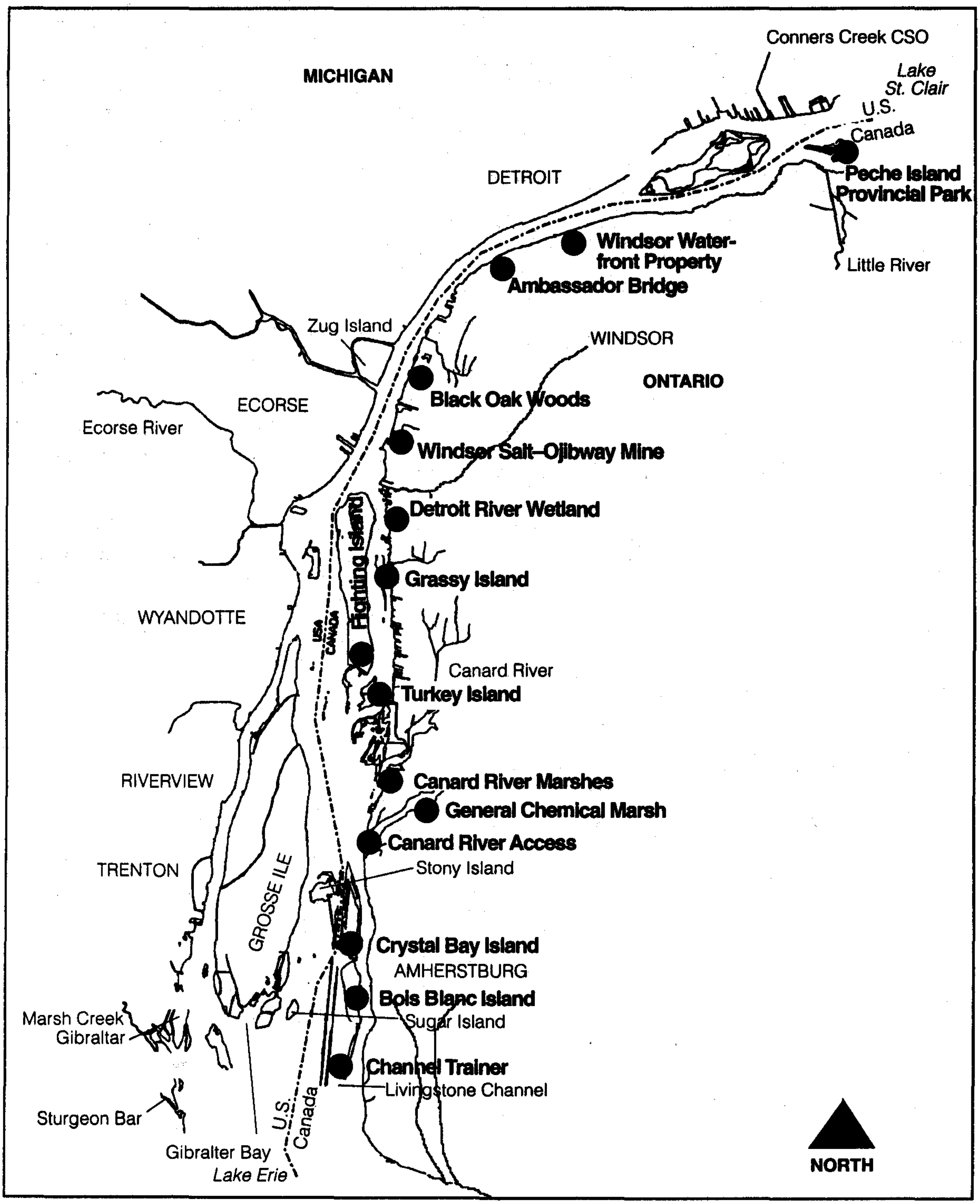
The responders also noted their concerns with the TWG process regarding: the effective utilization of time by the TWGs to develop the reports (3.1), adequacy of time provided to prepare the TWG reports including the recommendations and remedial options (3.1), the quality of the TWG reports in addressing the milestones and impaired beneficial uses (3.1), and the effectiveness of the workshops for providing useful input to the TWGs with regard to refining and finalizing the recommendations (3.1).

Appendix 7.1

Description of Proposed U.S. and Canadian Candidate Sites for Habitat Rehabilitation/Enhancement in the Detroit River Area of Concern

Proposed Canadian Sites

Figure E
Proposed Canadian Habitat Rehabilitaion/Enhancement Sites in the Detroit AOC



Peche Island Provincial Park

Project Summary: Peche Island is owned by the Province of Ontario and is located at the mouth of the Detroit River. To the north and east of the island are shallow areas which are mostly devoid of vegetation. The substrate is mostly sand and gravel. The area to the south of the island contains a good quantity of submergent vegetation. However, excessive sedimentation is having a detrimental effect on the vegetation. The inner portion of the island contains a series of canals which are heavily sediment loaded but still contain a good stand of submergent and emergent vegetation. The canals are primarily closed off from flow through river water due to siltation in the upstream canal entrance. River currents are strong to the north of the island preventing the establishment of submergent/emergent vegetation.

Recommend Action: The project proposal identifies 4 sites where aquatic habitat can be enhanced. The recommended actions are as follows:

- construct a series of off-shore breakwaters or series of islands around the shallows to the north and east of the island to create backwater calms,
- construct an off-shore current deflector to the south of the island to redirect some river flow towards the vegetation beds as a cleansing mechanism to reduce sedimentation,
- dredge the upstream canal entrance to allow water to flow through the canals to increase water quality and reduce sedimentation.
- A small current deflector could be constructed at the entrance to the canal to ensure siltation does not occur again.

Benefits: The proposed remediation would create calm habitat areas which are conducive for the growth of aquatic vegetation, spawning and nursery areas for various varieties of fish, and a staging, nesting, brood rearing and feeding area for waterfowl. The inner wetland canal areas would be used by both fish and waterfowl once water quality and sedimentation problems are corrected.

Windsor Waterfront Property

Project Summary: The vacant property located along the Detroit River waterfront is currently owned by the City of Windsor. The property was previously used as a rail car terminal. A large amount of infilling has occurred on the property, with a variety of vertical wall structures at the land/water interface. Some contaminated soil is suspected.

Recommended Action: Development of a waterfront city park. A habitat area could be developed through the excavation of a spawning and nursery by-pass channel within the park. A by-pass pond could be excavated within the channel to provide recreational fishing opportunities. The channel and pond could be kept in a natural setting with sloping vegetated shorelines and undercut banks.

Benefits: The project would provide quality urban aquatic habitat for fish spawning and nursery opportunities. It would also provide additional shoreline recreational uses for the citizens of the Detroit River AOC.

Ambassador Bridge

Project Description: Two small shallow coves are located along the Detroit River shoreline immediately south of the Ambassador Bridge. Except for a few scattered small pockets of submergent vegetation, the two coves are almost completely devoid of aquatic vegetation.

Recommended Action: Construction of breakwaters across the coves to create calm backwaters to allow the development of aquatic vegetation.

Benefits: The breakwaters would provide enhanced aquatic habitat opportunities for fish and waterfowl species.

Black Oak Woods

Project Description: Black Oak Woods, located within the City of Windsor's corporate boundaries, is part of a natural area which provides a continuous link of natural areas from the Detroit River to the Ojibway Prairie Provincial Nature Reserve. These linked areas also include the Ojibway Nature Reserve and two Candidate Natural Heritage Sites. Approximately 20% of the area is open grass land and does contain some mature trees. Portions of the area are not currently protected and zoned for industrial uses. The shoreline contains shallow waters with pockets of submergent aquatic macrophyte vegetation.

Recommended Action: Implement an overall management plan for the vacant areas within Black Oak Woods in order to determine the maximum habitat benefit. Conduct an inventory of all savannah or grassy areas to determine their natural values. Once the inventory is completed, an overall management plan can be produced emphasizing the rehabilitation of the area for tall grass prairie and oak savannah.

Benefits: This project would restore and maintain the site as a habitat area for the citizens of the Detroit River AOC. The site is the only natural area adjacent to the Detroit River in its upper reaches.

Windsor Salt-Ojibway Mine

Project Descriptions: The Canadian Salt Company operates a mine and processing facility on a site in the City of Windsor, along the Detroit River northeast of Fighting Island. Over the years salt has encroached upon the shoreline of the site degrading shoreline habitat areas. A second site south of the salt mine facility is experiencing excessive sedimentation from river currents.

Recommended Action: Construct a clay berm between the salt piles and shoreline providing protection for enhancement activities. The salt contaminated shoreline soil should then be excavated and replaced with clean fill. The enhancement area will be graded and landscaped to allow inundation and creation of a wetland island complex. A barrier channel for spawning and nursery uses would be excavated around the island. A series of natural islands would be created adjacent to the shoreline of the salt facility and across the cove to provide further shoreline protection and to reduce sedimentation of the cove.

Benefits: The recommended action would restore and create a highly functional wetland/habitat park area for numerous varieties of Detroit River fish and waterfowl.

Detroit River Wetland

Project Description: The Detroit River Wetland is comprised of six individual units totaling 575 hectares in size The complex is located between Fighting Island and the east shore of the Detroit River. It also includes Turkey Island and a few areas around Grassy Island. However, the remediation site includes only wetlands adjacent to the mainland shoreline. The wetland is 96% marshland and 4% swamp vegetation, often in matted growth patterns. Biologically, the wetland is quite diverse with a number of significant flora and fauna. However, the wetland is receiving excessive sedimentation from river flow. The major threat to the wetland site is from encroaching development. A number of development proposals are in a variety of stages. A key component of the rehabilitation efforts of the Detroit River wetlands is the protection of existing natural features.

Recommended Action: This proposal identifies 13 shoreland wetland sites for habitat enhancement activities. The actions recommended for nearly all of the sites are:

- Construction of a barrier channel around the wetland to prevent further sediment infilling. Small pockets can be cut within the mat of the wetland vegetation to provide access for various fish species.
- Construction of a series of off-shore barrier islands parallel to the shore to create calm backwater environments. This will assist in the development of fish and water fowl habitat and protection from sedimentation.

Benefits: The benefits of the Detroit River Wetlands project is the restoration, enhancement, maintenance and protection of wetland habitat for a healthier and diverse ecosystem. The project would also provide expanded recreational opportunities for the citizens of the Detroit River AOC.

Fighting Island

Project Description: Fighting Island is located in the middle of the Detroit River, opposite the Town of LaSalle, Ontario. The island is currently owned by BASF Corporation which operated a disposal site on it until 1981. Fighting Island has extensive shallow water areas including coves which would be prime areas for development of aquatic habitat. However, these areas are continually disturbed by boat wakes, and river currents which create sedimentation problems.

Recommended Action: Six sites for habitat remediation have been identified on Fighting Island. Proposed remediation techniques include the following:

- Construction of a series of off-shore islands to create a calm backwater environment and reduce sedimentation problems.
- Construction of current deflectors to create backwater environments.
- Construction of multiple nesting islands for waterfowl and shoreland birds within the calm areas created by the current deflectors and off-shore islands.

Benefits: The proposed project would create prime aquatic habitat for increased fish spawning and nesting areas for waterfowl. The project would also assist in enhancing the aquatic ecosystem for improved use of the Detroit River.

Grass Island

Project Description: Grass Island is a narrow strip of land in the Detroit River, located between the Canadian mainland, west of LaSalle and Fighting Island. A large expansive shallow underwater shelf exists immediately west of the island. This shelf is generally less than one meter deep and has an abundant supply of submersed vegetation. The submerged shelf extends approximately 300 meters west of the island and extends approximately 800 meters south of the island, gradually tapering off. Vegetation in the shelf is heavily clogged with silt as the vegetation acts as a filter for suspended solids. The objective of the project is to maintain and enhance the existing submersed vegetation.

Recommended Action: Construction of a series of off-shore islands along the western limit of the submersed shelf. These islands would prevent excessive erosion and disturbances to the submerged macrophyte vegetation. The islands will also direct sediments around the macrophyte beds, promoting better growth and possible biological plant diversity. The islands may also be used for waterfowl nesting habitat.

Benefits: The proposed project would assist in the enhancement of a large aquatic habitat, providing increased opportunities for plant diversity, waterfowl nesting and possibly fish spawning areas.

Turkey Island

Project Description: Turkey Island is a series of dry islands with several small islands of emergent vegetation scattered to the west and south of the main island. An expansive shallow underwater shelf surrounds the existing island with a well established submersed bed of macrophyte vegetation. Current within the area is minimal. The current is directed around the island within the channel. The shallow shelf surrounding the island complex provides an opportunity to create a substantial area of submergent vegetation.

Recommended Action: Construct a series of off-shore islands surrounding the existing island complex. The islands would be constructed in sufficient widths to provide water fowl nesting areas.

Benefits: The proposed project would assist in the enhancement of a large aquatic habitat, providing increased opportunities for plant diversity, waterfowl nesting and possibly fish spawning areas.

Canard River Marshes

Project Description: A large marsh complex exists near the mouth of the Canard River at the junction of the Detroit River. This marsh complex, which is one of the most important existing habitat areas on the Detroit River, consists of two water impoundment cells, located mostly within the boundary of the Detroit River. The marshes contain large shallow calm water areas outside of the impoundments, with considerable amounts of aquatic vegetation. These calm shallow water areas are particularly important as staging grounds for canvasback and redhead ducks, especially during fall migration. There is no direct fish access to the wetlands because of the impoundment dikes which control the level of water within the wetlands.A deteriorating finger dyke runs parallel to the impoundment, protecting the shallow calms from wave and current disturbances.

Recommended Action: The project proposal includes six sites at which the following remediation activities would occur:

- provision of fish access to the marsh canal system and impoundment areas by the construction of culverts and a series of fjords in the impoundment dikes,
- repair gaps in the finger dikes to protect vegetated calm backwaters, and
- construct a series of off-shore islands to protect and enhance emergent vegetation in backwater calms.

Benefits: The proposed project would enhance one of the most important habitat resources within the Detroit River. The project would contribute to enhanced opportunities for waterfowl, and feeding, spawning and nursery opportunities for fish. Recreational uses within the river would also be enhanced.

General Chemical Marsh

Project Description: The General Chemical Company operates a brine well facility on the south side of the Canard River in Anderdon Township. The site, at one time, was a wetland which was open to the river. The wetlands were dyked off in the mid 1980's as a precautionary measure. In case of an accident, the dykes would prevent the leaching of brine into the Canard River. The wetland is of considerable size and should be protected from brine contamination and hydrologically reconnected with the Canard River.

Recommended Action: The proposed project recommends the following remediation activities be included in the final site closing plan (25-30 years in the future):

- plug the brine wells permanently,
- breach the dike to hydrologically reconnect the wetlands to the Canard River, and
- restore uplands with tree plantings and prairie restoration activities.

Benefits: The opened wetland would provide new feeding, spawning and nursery opportunities for fish as well as nesting opportunities for waterfowl, song birds and small mammals.

Canard River Access

Project Description: The Canard River Access site is located where Highway 18 crosses the Canard River. The property, which is currently owned by the Province of Ontario, contains wetlands. The site which was owned by Allied Chemical Corporation of Amherstburg has been severely altered overtime. The shoreline consists of shallow water with scattered pockets of submerged aquatic vegetation. Strong Canard River flow has created a large amount of suspended solids restricting vegetation expansion.

Recommended Action: Construction of a broken off-shore breakwater to create backwater calms to promote development of submersed aquatic vegetation. Breaks along the breakwater should be kept to a minimum to prevent sediment plumes from invading the calm backwater. Two islands should be created in the backwater calms to provide nesting and protection for waterfowl. Fish spawning shoals should be constructed when installing the islands.

Benefits: The calm backwater area created by the breakwater would clear of silt leading to the establishment of emergent and submergent vegetation. This would provide enhanced opportunities for fish and waterfowl on the site.

Crystal Bay Island

Project Description: Crystal Bay Island is a man made island that was constructed during the construction of the Livingstone Channel. The island consists of two arms joined at an apex on the upstream side. The two arms effectively create a large calm bay which is extremely clear and approximately 80 hectares in size. The substrate is a mix of rocks and organic material. Submersed aquatic vegetation is abundant because of reduced suspended solids. The proposed project would diversify the substrate by adding structures.

Recommended Action: The proposed project would add diversity to the inner bay by the addition of logs, stumps and brush bundle structures.

Benefits: The proposed project would provide enhanced habitat opportunities for fish and benthic organisms. It would also improve the recreational opportunities of an already popular recreational area.

Bois Blanc Island

Project Description: Bois Blanc or Boblo Island is a kidney shaped island located in the lower reaches of the Detroit River. The island contains a number of coves and calm shallows, especially along the north, east and southern shores which provide good opportunities to enhance fish and waterfowl aquatic habitat. A spit to the south of the island named White Sands Island, also provides excellent opportunities to enhance aquatic habitat around Bois Blanc Island.

Recommended Action: The Project proposal identifies five sites where aquatic habitat can be enhanced. The recommended enhancement actions are as follows:

- use of current deflectors to increase flow into wetland areas;
- construction of breakwaters, groynes, or submersed reefs to reduce the flow into coves to create backwater calms to allow introduction of vegetation or expansion of existing vegetation;
- reconstruction of existing shoals into exposed islands to provide nesting and spawning opportunities for fish and water fowl; and
- addition of logs, stumps and brush bundle structures along the shore to diversify habitat.

Benefit: The benefits from this project are minimal. It would provide diversified habitat for fish and waterfowl needs.

Channel Trainer

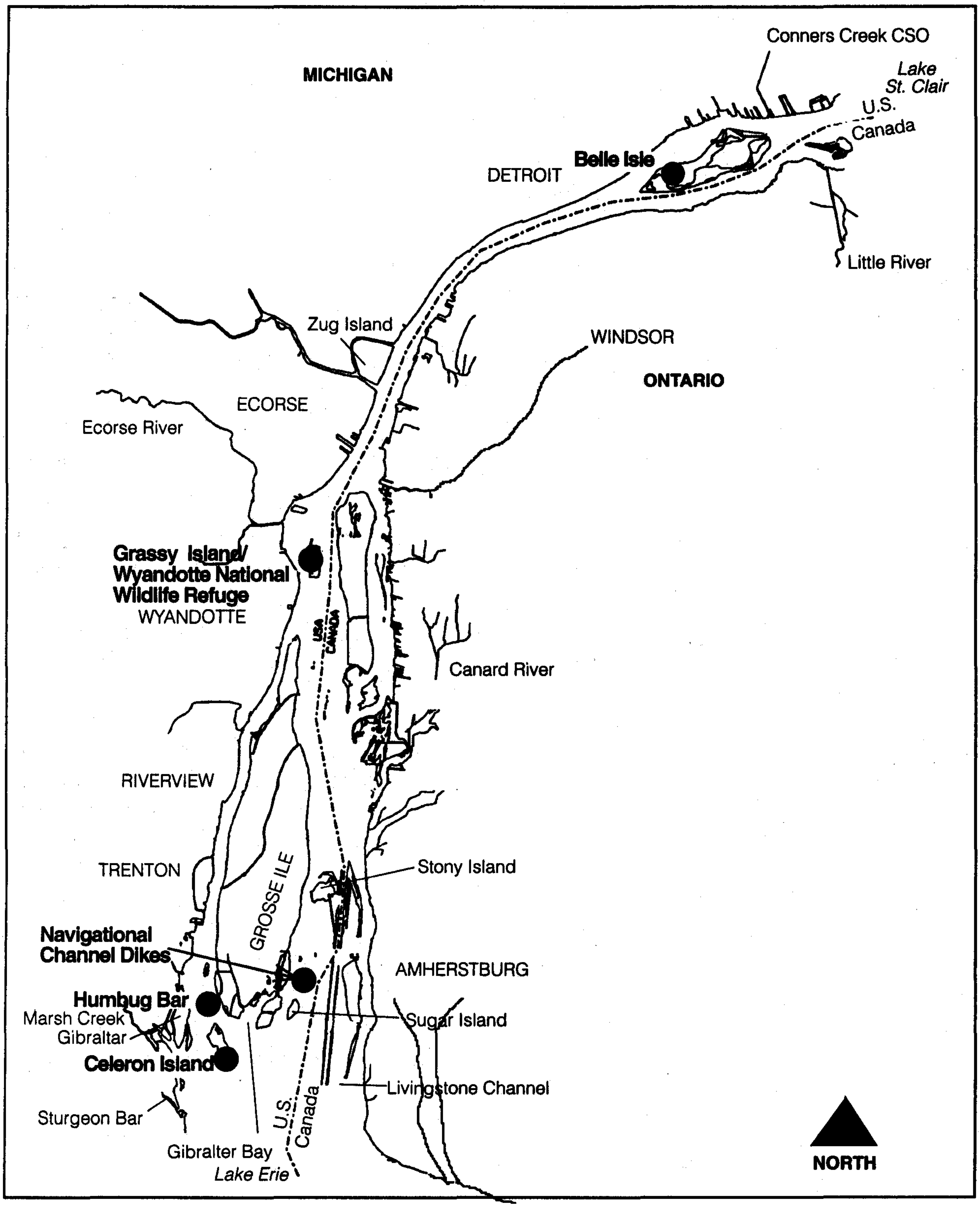
Project Description: A permanent channel trainer was constructed as part of the Livingstone Channel facilities. The area immediately south of the trainer is a calm water area averaging 1-3 meters in depth. The area has a significant amount of submersed aquatic vegetation. The purpose of the project is to provide additional littoral zone and structure in the open area.

Recommended Action: Construct a series of four islands with expanded shoals around their perimeter for fish spawning purposes. The islands should be constructed with a layer of fill and top soil for vegetation to provide nesting areas for waterfowl.

Benefits: The proposed project would provide additional opportunities for fish and waterfowl in the lower stretches of the Detroit River.

Staff Note: These summaries of proposed Canadian remediation site projects have been taken from the Ontario Ministry of Natural Resources draft document "Survey of Candidate Sites on the St. Clair and Detroit Rivers For Potential Habitat Rehabilitation/Enhancement".

Figure F
Proposed U.S. Habitat Rehabilitaion/Enhancement Sites in the Detroit AOC



Belle Isle Park Habitat Resoration Project

Project Description: Belle Isle is a 982 acre island located in the Detroit River which is owned and operated by the City of Detroit as an urban park. The City of Detroit has recognized the importance of Belle Isle's four lakes and 2.2 miles of canals to the ecosystem of the Detroit River, as well as the fish and waterfowl which occupy the island's waterway's. The Belle Isle canal system is no longer connected to the Detroit River, preventing new species of fish from entering and occupying the canals. Other problems with the canal include water quality, sedimentation, and undesirable wetland vegetation.

The Belle Isle Habitat Restoration Project will be a multiphase project. This proposal will address the following issues:

- Replacement of Blue Lagoon pumps and renovation of the casino and Lake Muskoday;
- Relocation of the main pump station to Lake Muskoday to improve water quality.
- Outlet control structure modification to control water elevation.
- Eliminate the point source discharge from the zoo.
- Dredge canals, enhance wetlands, and stabilize banks to provide positive flow.
- Create Deep water habitat in Lake Muskoday Lake Okonnoka to protect sport fishery.
- Connect the Blue Heron Lagoon directly to the Detroit River to provide improved fishery resource and water quality.
- Provide a successful fishery resource with a fish stocking program.

Benefits: The project will restore and reconnect the Belle Isle aquatic habitat to the Detroit River — providing further diversification of the ecosystem. The project will also enhance urban recreational opportunities by providing improved fishery resources to the citizens of the Detroit River Area of Concern.

Feasibility: The canal and lake dredging, coupled with pump station improvements will improve water flows, water quality and habitat. Over-winter survival of fish populations within the system will be assured. Connecting Blue Heron Lagoon to the Detroit River for water and fish movement will enhance the Lagoon's fishery value while contributing spawning, nursery and feeding habitat for a variety of Detroit River fish. The end results will be a greater expanded fishery, improved aquatic environment, improved recreational opportunities for AOC citizens and a more aesthetically pleasing waterway.

Cost: The total cost of the Belle Isle Habitat Restoration Project is approximately $1,222,000.

Remediation of Contaminated Sediments at the Wyandotte National Wildlife Refuge in the Detroit River

Project Summary: Remediation of toxic contamination in the river is a high priority. This project may be the first ever to remediate sediments in a confined disposal facility for contaminated dredged spoils. The site is Grassy Island, part of the Wyandotte National Wildlife Refuge just upstream from Grosse Ile. A 72-acre island on the refuge is covered to a depth of 12 feet with contaminated sediments from the Rouge River and Trenton Channel. Objectives of the project are: 1) to characterize the volume and composition of contaminated sediments; 2) to characterize the kinds and amounts of contaminants in the sediments and their distribution over Grassy Island and surrounding shoals; 3) to demonstrate on Grassy Island practices that destroy toxic organic compounds and immobilize heavy metals in contaminated sediments.

Benefits: Remediation of contaminated soils on Grassy Island by the Army Corps of Engineers and the U.S. Fish and Wildlife Service will restore fish and wildlife habitat on the island and surrounding shoals. The site will no longer be an attractive nuisance for fish, wildlife, and humans. Improved water quality and increased species diversity of fish and wildlife will result. Remediation practices will be demonstrated.

Feasibility: Site constraints are few if any because Grassy Island and surrounding shoals are in public ownership. Engineering requirements are minimal or nonexistent. Funds are being sought from the U.S. Environmental Protection Agency (USEPA) and are available at the Army Corps of Engineers (ACOE), under the conditions mentioned below. Regulatory agencies and land owner U.S. Fish and Wildlife Service (USFWS) have expressed support for the project. No time-lag exists to start the project, tasks for each stage of the project have been budgeted and prioritized. The project has been endorsed by local politicians and environmental groups.

Cost: About $6.2 million. This cost will be borne by several federal agencies and others. Section 1135 of the Water Redevelopment Act permits the ACOE to create or improve habitat at sites previously affected by its activities, provided that 25% matching funds are committed from non-federal sources. The USFWS intends to participate financially in this project through its Action for Angling, Partners for Wildlife, and/or other programs. Financial participation will be sought from state, local, and private sources.

Restoration of Fish and Wildlife Habitat at the Wyandotte National Wildlife Refuge in the Detroit River

Project Summary: In the 1950s, Grassy Island and the 300 acres of surrounding shoals in this refuge was prime habitat for thousands of migratory ducks and whistling swans and a spawning area for lake sturgeon and lake whitefish. This area in the Detroit River is identified as critical in the North American Waterfowl Management Plan because it is a staging area for most of the eastern population of canvasback ducks and many redhead ducks, both of which are native only to North America. As pollution increased in the river and the island was converted to a confined disposal facility for contaminated dredge spoils, sediments around the island were contaminated, the density of submersed wild celery beds on surrounding shoals was reduced, and the numbers of waterfowl, sturgeon, and whitefish using the area dwindled. This project will restore habitat for fish and waterfowl on Grassy Island and shoals surrounding it.

Benefits: The project will restore critical, stable habitat for fish and wildlife populations that are native only to North America, of international importance, and have declined to very low levels in recent decades. The lower Detroit River area would again provide food for large numbers of migratory waterfowl. This project will enhance the fish and wildlife productivity of this river and arrest the precipitous decline in survival of several desirable waterfowl populations of national significance. It will satisfy IJC guidelines for restoring impaired fish and wildlife habitat in the Detroit River and permit it to be delisted as an Area Of Concern.

Feasibility: Likely. The project would be done by the Army Corps of Engineers (ACOE) and the U.S. Fish and Wildlife Service (USFWS). This project has been endorsed by all needed regulatory agencies. Engineering services have been offered and budgeted by the ACOE. Funding has been sought from the U.S. Environmental Protection Agency (USEPA). No time-lag exists to initiate the project. The project is locally and politically acceptable.

Cost: $7.5 million. USEPA has been asked to contribute $123,000 in 1994 and $128,000 in 1995. The Remaining costs will be borne by several federal agencies and others. Section 1135 of the Water Resources Development Act of 1990 permits the ACOE to create or improve habitat at sites previously affected by its activities, provided that 25% matching funds are committed from non-federal sources. The USFWS intends to participate financially in this project. Financial participation will be sought from state, local, and private sources.

Restoration of Diving Duck Habitat at Humbug Bar in the Lower Detroit River

Project Summary: Wild celery beds on Humbug Bar and nearby submersed shoals in the lower Detroit River once provided critical food reserves for migrating canvasback and redhead duck populations, both of which are found only in North America. Since the 1950s, these wild celery beds have been degraded to only 28% of their former abundance by water and sediment pollution. Consequently, numbers of these ducks have dwindled proportionally. This area in the Detroit River is identified now as critical in the North American Waterfowl Management Plan because it is a staging area for the eastern population of canvasback ducks and redhead ducks before they migrate to the Atlantic coast. Completion of this project will restore wildlife use of habitat in the river and permit it to be delisted by the IJC in the Detroit River Area of Concern.

Benefits: This project would restore beds of wild celery on Humbug Bar and nearby shoals and attract rafts of diving ducks again to the lower Detroit River. These wildlife provide many opportunities for active and passive recreation and a higher quality of life for people in the Detroit River area and along the Atlantic coast.

Feasibility: The project would be completed by the National Biological Survey and Michigan Dept. Natural Resources using wild celery plants provided by the University of Windsor, Great Lakes Institute.

Wild celery is specially adapted to toxic conditions in the Detroit River. Physically, the sediments of Humbug Bar may need to be remediated before plants will grow optimally. Plantings of wild celery in former duck feeding areas have succeeded in Lake St. Clair and the upper Mississippi River. There are no regulations for such planting programs. Institutional arrangements have been made. Procedures are tested and proven. The project has been endorsed by all concerned state and local governmental agencies and is locally and politically acceptable. No funds have been sought or identified yet for this project. However, the project is highly suitable for volunteer participation by local hunt clubs and community groups.

Cost: About $25,000 for a pilot demonstration of feasibility. Perhaps $65,000 to plant wild celery on all six submersed bars used historically by diving ducks.

Remediation and Enhancement of Fish and Wildlife Habitat on Heavy-stone Navigation Dikes in the Detroit River

Project Summary: Habitat for fish and wildlife has been seriously impaired by shoreline modifications in the Detroit River. Numerous large dikes, constructed of large boulders, were built by the Army Corps of Engineers (ACOE) along navigation channels in the lower Detroit River to stabilize banks of the shipping channel and direct water flows. Boulders and large stones that armor such structures presently offer limited habitat for fish and wildlife. This project would create fish and wildlife habitat on the top and edges of candidate dikes, such as Pointe Mouillee, navigation dikes along the Livingstone Channel, and retaining dikes around Grassy Island, all previous COE projects.

Benefits: The project would restore habitat for food and reproduction of shorebirds and fish in the river. These fish and wildlife provide many opportunities for active and passive recreation and a higher quality of life for people in the Detroit River area.

Feasibility: Very likely. Section 1135 of the Water Resources Development Act of 1990 permits the ACOE to create or improve habitat at sites previously affected by its activities, provided that 25% matching funds are committed from non-federal sources. Enhancement could include adding gravel, sand, and vegetation to the tops of such dikes for nesting by shorebirds, gravel at intervals at the base of such dikes for spawning by fish, and smaller (perhaps submersed) dikes 250 m or more away from the retaining dikes of Point Mouillee to allow sediments to settle and encourage wild celery and emergent marsh vegetation to colonize near the base of the retaining dikes. Such additions would diversify habitat available at such sites for uses by fish and wildlife, including waterfowl. The project would be done by the ACOE, Michigan Department of Natural Resources, and the National Biological Survey. No time or site-size constraints exist. No funding has been sought yet for this project. Regulatory bases and institutional arrangements are in place to conduct this project without time lags. Some engineering may be required on a pilot basis to define scope and feasibility of some project alternatives. Social aspects of the project are presently unknown but would likely be approved by responsible agencies and the public.

Cost: $50,000 for a pilot project of modest scope. Much more for construction of smaller submersed dikes near existing dikes.

Restoration of Fish and Wildlife Habitat at Celeron Island in the Detroit River

Project Summary: In the 1960s, Celeron Island and the 500+ acres of surrounding shoals in this state-owned refuge was prime habitat for thousands of migratory ducks and whistling swans. As pollution increased in the river and water levels fluctuated, sediments around the island were contaminated, the density of submersed wild celery beds on surrounding shoals was reduced, the island eroded to 13% of its former size, and the numbers of waterfowl using the area dwindled. This area in the Detroit River is identified as critical in the North American Waterfowl Management Plan because it is a staging area for most of the eastern population of canvasback ducks and many redhead ducks, both of which are native only to North America. This project will restore habitat for fish and waterfowl on Celeron Island and 500 acres of surrounding shoals.

Benefits: The project will restore critical, stable habitat for fish and wildlife populations that are native only to North America, of international importance, and have declined to very low levels in recent decades. The lower Detroit River area would again provide food for large numbers of migratory waterfowl. This project will enhance the fish and wildlife productivity of this river and arrest the precipitous decline in survival of several desirable waterfowl populations of national significance.

Feasibility: Likely. The project would be done by the Michigan Department of Natural Resources, Army Corps of Engineers (ACOE) and the U.S. Fish and Wildlife Service (USFWS). This project has been endorsed by all needed regulatory agencies. Engineering services have been offered and budgeted by the ACOE. Funding has been sought from the U.S. Environmental Protection Agency (USEPA). No time-lag exists to initiate the project. The project is locally and politically acceptable.

Cost: $5.3 million; $163,000 in 1994, and $98,000 in 1995 from the USEPA. Section 1135 of the Water Resources Development Act of 1990, permits the ACOE to create or improve habitat at sites previously affected by its activities, provided that 50% matching funds are committed from non-federal sources. The USFWS intends to participate financially in this project. Financial participation will also be sought from state, local, and private sources.

Protection of Detroit River Fish and Wildlife Habitat through Acquisition of Available Lands

Project Summary: The largest remaining area of habitat for fish and wildlife populations in the river is a crescent of several islands and 40+ acres of Gibraltar Bay at the southern end of Grosse Ile. This habitat must be protected to sustain and enhance these populations. We recommend that these lands be acquired and returned to public ownership.

Benefits: The survival of fish and wildlife populations of national and international significance that depend on habitat around these lands would be ensured. These populations provide many opportunities for active and passive recreation and a higher quality of life for people in the Detroit River area.

Feasibility: Likely. On Grosse Ile, 40+ acres is owned by the USEPA and available for transfer to a natural resource agency. Nearby Celeron Island is a state-owned wildlife area and Calf, Stony, Fox, and Dynamite Islands were once state-owned, and Calf is for sale. The Wyandotte National Wildlife Refuge includes Grassy Island and shoal areas north and east of Grosse Ile. The Grosse Ile Nature and Land Conservancy, a member of the National Land Trust Alliance, has close working relationships with local governmental bodies and has offered to coordinate this project. No engineering is needed. Funding is being sought through several public agencies and land trusts. Regulatory basis and agency/institutional arrangements are in place and fully functional. Public awareness of the project is being actively encouraged and strengthened through meetings, letters, and educational literature. Local citizen and political support are being sought and secured. A declaration of intent to protect these lands is being sought from interested governmental agencies. Calf Island could be purchased within one year. Two or more years would be needed to transfer ownership of the EPA property to a natural resource agency. Acquisition of remaining islands and bottom-land patents would take place as opportunities arise and leases expire. No zoning restrictions apply.

Costs: Costs for transfer of lands already in public ownership will be minimal. About $50,000 would be needed for title work on lands acquired when bottom-land patents expire. Through the Nature and Land Conservancy or land trusts, private lands or development rights to them may be acquired by direct donation, conservation easements, deed restrictions, and sale purchase. Such rights and purchases would be based on current market values of the lands.

Appendix 8.1

Table N
KETOX model loadings by reach and containment

REACH	*CSO/SS LOADS (kg/day)*	*INDUSTRIAL./MUNICIPAL LOADS (kg/day)*	*(kg/day)*	*TOTAL (kg/day)*
Total PCBs				
2 (Ontario)	0.0	0.0		0.0
4 (Michigan)	3.242E+00	0.0		3.242E+00
5 (Ontario)	2.610E-04	3.920E-02		3.946E-02
6 (Ontario & Michigan)	4.203E+00	2.918E-01		4.495E+00
9 (Ontario)	4.639E-05	0.0		4.639E-05
15 (Michigan)	0.0	6.277E-04		6.277E-04
18 (Michigan)	0.0	4.528E-02		4.528E-02
24 (Ontario)	0.0	0.0		0.0
1: Fox Creek (Michigan)			0.0	
2: Little River (Ontario)			3.00E-02	
3: Connors Creek (Michigan)			0.0	
6: Rouge River (Michigan)			1.10E-01	
9: Turkey Creek (Ontario)			0.0	
10: Ecorse River (Michigan)			0.0	
22: Canard River (Ontario)			9.00E-02	
Lead				
2 (Ontario)	0.0	1.100E-01		1.100E-01
4 (Michigan)	6.038E+02	0.0		6.038E+02
5 (Ontario)	0.0	3.030E+01		3.030E+01
6 (Ontario & Michigan)	7.848E+02	6.772E+00		7.916E+02
9 (Ontario)	1.908E-01	0.0		1.908E-01
15 (Michigan)	0.0	1.100E-02		1.100E-02
18 (Michigan)	0.0	5.696E+00		5.696E+00
24 (Ontario)	0.0	2.500E-02		2.500E-02
1: Fox Creek (Michigan)			0.0	
2: Little River (Ontario)			4.60E-01	
3: Connors Creek (Michigan)			0.0	
6: Rouge River (Michigan)			2.06E+01	
9: Turkey Creek (Ontario)			0.0	
10: Ecorse River (Michigan)			0.0	
22: Canard River (Ontario)			6.40E-01	
For copper				
2 (Ontario)	0.0	1.140E+00		1.140E+00
4 (Michigan)	2.945E+02	0.0		2.945E+02
5 (Ontario)	2.114E-01	3.440E+00		3.651E+00
6 (Ontario & Michigan)	3.825E+02	9.025E+01		4.727E+02
9 (Ontario)	2.642E-02	0.0		2.642E-02
15 (Michigan)	0.0	6.250E-02		6.250E-02
18 (Michigan)	0.0	8.621E+00		8.621E+00
24 (Ontario)	0.0	1.776E+01		1.776E+01
1: Fox Creek (Michigan)			0.0	
2: Little River (Ontario)			4.50E-01	
3: Connors Creek (Michigan)			0.0	
6: Rouge River (Michigan)			1.432E+01	
9: Turkey Creek (Ontario)			0.0	
10: Ecorse River (Michigan)			0.0	
22: Canard River (Ontario)			9.60E-01	

Table N cont.

REACH	CSO/SS LOADS (kg/day)	INDUSTRIAL/MUNICIPAL LOADS (kg/day)	(kg/day)	TOTAL (kg/day)
For zinc				
2 (Ontario)	0.0	4.500E+00		4.500E+00
4 (Michigan)	7.497E+02	0.0		7.497E+02
5 (Ontario)	1.649E+00	1.320E+02		1.336E+02
6 (Ontario & Michigan)	9.758E+02	2.979E+02		1.274E+03
9 (Ontario)	2.349E-01	0.0		2.349E-01
15 (Michigan)	0.0	4.080E-01		4.080E-01
18 (Michigan)	0.0	1.368E+02		1.368E+02
24 (Ontario)	0.0	1.103E+01		1.103E+01
1: Fox Creek (Michigan)			0.0	
2: Little River (Ontario)			1.770E+00	
3: Connors Creek (Michigan)			0.0	
6: Rouge River (Michigan)			2.665E+02	
9: Turkey Creek (Ontario)			0.0	
10: Ecorse River (Michigan)			0.0	
22: Canard River (Ontario)			3.350E+00	
For cadmium				
2 (Ontario)	0.0	0.0		0.0
4 (Michigan)	5.538E+01	0.0		5.538E+01
5 (Ontario)	2.838E-02	7.970E-01		8.254E-01
6 (Ontario & Michigan)	7.185E+01	4.463E+00		7.631E+01
9 (Ontario)	0.0	0.0		0.0
15 (Michigan)	0.0	3.260E-03		3.260E-03
18 (Michigan)	0.0	5.345E+00		5.345E+00
24 (Ontario)	0.0	1.300E-01		1.300E-01
1: Fox Creek (Michigan)			0.0	
2: Little River (Ontario)			3.0E-02	
3: Connors Creek (Michigan)			0.0	
6: Rouge River (Michigan)			3.06E+00	
9: Turkey Creek (Ontario)			0.0	
10: Ecorse River (Michigan)			0.0	
22: Canard River (Ontario)			0.0	

Table O
1986–1990 "D4SEDS" KETOX model predictions
for surficial sediments versus 1980 and 1991 field measurements by contaminant

*WATER RESOURCES BRANCH STATION NUMBER**	*MEASURED VALUES FROM DETROIT RIVER SEDIMENT 1980 (ppm)*	*1991 (ppm)*	*"D4SEDS" KETOX MODEL PREDICTED VALUES (ppm)*
Total PCBs			
177	ND		0.06
178	ND		0.06
180	ND		0.06
181	0.37		0.20
182	ND		0.05
183	ND		0.05
188–PRI	0.04		4.0
189		0.23	4.0
185		0.04	0.01
186	0.04		0.01
187	0.03		0.06
190	0.48		7.0
191–PRI	0.09	1.2	5.0
193	0.09	1.1	4.0
194	0.26		0.06
195–PRI		3.0	4.0
55	0.21	0.04	0.06
196	3.0	0.61	3.0
197	0.25		0.06
83 –PRI		0.19	3.0
202–PRI	2.84		3.0
203	0.33	0.13	3.0
207	0.02		0.03
205–PRI	3.8	2.0	2.0
75 –PRI		0.58	0.4
237–PRI	0.12	0.45	0.3
238–PRI	1.58	0.53	0.3
240–PRI			0.3
216	0.03	0.12	0.5
226	0.34	0.12	0.2
223		0.04	0.05

** Lowest Effect Level: 0.07
** Severe Effect Level:530 ppm dry weight

Table O cont.

WATER RESOURCESMEASURED VALUES BRANCH STATION NUMBER*	"D4SEDS" KETOX MODEL FROM DETROIT RIVER SEDIMENT 1980 (ppm)	1991 (ppm)	PREDICTED VALUES (ppm)
Lead			
177	5.5	20.0	30.0
178	5.5	5.0	30.0
180	18.0	28.0	40.0
181	79.0	87.0	40.0
182	16.0	21.0	30.0
183	14.0	55.0	40.0
188–PRI	490.0	1100.0	800.0
189		1000.0	800.0
185		35.0	7.0
186	46.0	9.0	7.0
187	17.0	22.0	30.0
190	44.0		1000.0
191–PRI	220.0	450.0	1000.0
193	68.0	430.0	900.0
194	210.0	60.0	40.0
195–PRI		220.0	700.0
55	36.0	39.0	30.0
196	470.0	230.0	500.0
197	56.0	66.0	30.0
83 –PRI		72.0	700.0
202–PRI	180.0		500.0
203	180.0	180.0	500.0
207	26.0	25.0	200.0
205–PRI	460.0	127.0	400.0
75 –PRI		94.0	70.0
237–PRI	100.8	93.0	60.0
238–PRI	760.0	200.0	300.0
240–PRI		120.0	300.0
216	19.0	21.0	40.0
226	78.0	37.0	100.0
223		32.0	70.0

** Lowest Effect Level: 31

** Severe Effect Level:250 ppm dry weight

Table O cont.

WATER RESOURCESMEASURED VALUES BRANCH STATION NUMBER*	"D4SEDS" KETOX MODEL FROM DETROIT RIVER SEDIMENT 1980 (ppm)	1991 (ppm)	PREDICTED VALUES (ppm)
Copper:			
177	0.5	13.0	50.0
178	8.7	11.0	40.0
180	11.0	26.0	50.0
181	110.0	21.0	50.0
182	10.0	18.0	40.0
183	7.5	39.0	40.0
188–PRI	310.0	530.0	400.0
189		470.0	400.0
185		27.0	9.0
186	25.0	18.0	50.0
187	12.0	14.0	40.0
190	39.8		700.0
191–PRI	18.0	140.0	500.0
193	80.0	170.0	500.0
194	14.0	34.0	40.0
195–PRI		190.0	400.0
55	18.0	31.0	40.0
196	370.0	250.0	300.0
197	24.0	36.0	40.0
83 –PRI		58.0	40.0
202–PRI	84.0	69.0	300.0
203	190.0	210.0	500.0
207	21.0	15.0	9.0
205–PRI	380.0	163.0	300.0
75 –PRI		100.0	200.0
237–PRI	44.3	66.0	40.0
238–PRI	300.0	123.0	200.0
240–PRI		94.0	40.0
216	21.0	19.0	30.0
226	62.0	51.0	100.0
223		173.0	30.0

** Lowest Effect Level: 16

** Severe Effect Level:110 ppm dry weight

Table O cont.

WATER RESOURCESMEASURED VALUES BRANCH STATION NUMBER*	"D4SEDS" KETOX MODEL FROM DETROIT RIVER SEDIMENT 1980 (ppm)	1991 (ppm)	PREDICTED VALUES (ppm)
Zinc:			
177	20.0	47.0	200.0
178	30.0	47.0	300.0
180	47.0	110.0	300.0
181	140.0	96.0	300.0
182	37.0	67.0	300.0
183	33.0	96.0	300.0
188–PRI	520.0	470.0	1000.0
189		970.0	4000.0
185		73.0	60.0
186	81.0	50.0	100.0
187	46.0	47.0	300.0
190	64.0		200.0
191–PRI	67.0	290.0	200.0
193	230.0	300.0	1000.0
194	51.0	100.0	300.0
195–PRI		380.0	1000.0
55	110.0	120.0	1000.0
196	760.0	380.0	1000.0
197	120.0	160.0	300.0
83 –PRI		200.0	900.0
202–PRI	1100.0		1000.0
203	550.0	740.0	2000.0
207	60.0	58.0	500.0
205–PRI	2400.0	550.0	1000.0
75 –PRI		350.0	200.0
237–PRI	220.0	310.0	200.0
238–PRI	1600.0	477.0	800.0
240–PRI		560.0	800.0
216	127.0	84.0	100.0
226	280.0	180.0	100.0
223		96.0	70.0

** Lowest Effect Level:120

** Severe Effect Level:820 ppm dry weight

Table O cont.

WATER RESOURCES BRANCH STATION NUMBER*	MEASURED VALUES FROM DETROIT RIVER SEDIMENT 1980 (ppm)	1991 (ppm)	"D4SEDS" KETOX MODEL PREDICTED VALUES (ppm)
Cadmium			
177	< 0.30	0.60	2.0
178	< 0.30	0.14	2.0
180	0.30	1.10	2.0
181	0.83	0.17	2.0
182	0.30	0.74	2.0
183	0.30	1.30	3.0
188–PRI	16.0	11.0	20.0
189		18.0	70.0
185		0.62	0.4
186	0.5	0.49	0.4
187	0.4	0.37	2.0
190	0.73		100.0
191–PRI	0.35	1.60	80.0
193	1.30	1.30	80.0
194	0.30	0.68	2.0
195–PRI		3.20	3.2
55	0.68	0.43	2.0
196	6.90	2.50	40.0
197	0.73	0.49	2.0
83 –PRI		1.90	60.0
202–PRI			40.0
203	14.0	7.10	60.0
207	< 0.30	0.23	0.7
205–PRI	11.0	28.67	40.0
75 –PRI	1.10	6.0	
237–PRI	1.10	1.00	6.0
238–PRI	17.0	9.53	6.0
240–PRI		5.70	6.0
216	1.05	1.40	4.0
226	3.60	3.40	3.0
223	1.20	0.9	

** Lowest Effect Level: 0.6

** Severe Effect Level: 10 ppm dry weight

* From a 1991 surficial sediments survey of the Ontario Ministry of the Environment and Energy.

** From: "Guidelines for the protection and management of aquatic sediment quality in Ontario," D. Persaud, Jaagumagi R. and A. Hayton, Water Resources Branch, Ontario Ministry of the Environment and Energy, June 1992, ISBN 0-7729-9248-7.

Table P
"Dispersion Mass Balance" (flux in/out [kg/day])
of selected reaches under various modelling scenarios

REACH	*1986-1990**	*25%***	*50%***	*VIRTUAL ELIMINATION*
PCB				
0: Head	**0.70**	**0.70**	**0.70**	**0.70**
3: In	0.72	0.72	0.72	0.70
3: Out	0.72	0.72	0.72	0.70
4: In	0.16	0.16	0.16	0.16
4: Out	3.39	2.84	1.93	0.16
5: In	0.57	0.57	0.57	0.54
5: Out	0.60	0.60	0.60	0.54
6: In	4.57	4.00	2.85	0.70
6: Out	9.13	7.74	6.28	0.69
8: In	8.84	7.47	6.05	0.53
8: Out	8.83	7.47	6.05	0.53
9: In	0.33	0.30	0.26	0.16
9: Out	0.33	0.30	0.26	0.16
12: In	3.83	3.24	2.62	0.35
12: Out	3.82	3.23	2.61	0.35
18: In	4.07	3.44	2.79	0.14
18: Out	4.08	3.46	2.82	0.14
23: In	3.53	2.98	2.41	0.27
23: Out	3.53	2.98	2.41	0.27
24: In	1.63	1.41	1.18	0.27
24: Out	1.62	1.41	1.18	0.27
Mouth:	**9.23**	**7.85**	**6.41**	**0.69**

90% Reduction: 4.16 kg/day to Lake Erie. (data not shown for individual reaches)
Virtual Elimination: No loads, other than Lake St. Clair.

* : 100 % of the estimated 1986 to 1990 loading data (kg/day).

** : % reduction in the 1986 to 1990 contaminant loadings associated with major Michigan CSOs.

The above CSO discharges occur, on average, 30 days per year.
The indicated mass flux represents those days with a CSO event.

Table P cont.

REACH	1986-1990*	25%**	50%**	VIRTUAL ELIMINATION
Lead				
0: Head	**394.7**	**394.7**	**394.7**	**394.7**
3: In	397.1	397.1	397.1	396.6
3: Out	397.0	397.0	397.0	396.5
4: In	88.43	88.4	88.4	88.4
4: Out	690.4	541.3	392.0	88.1
5: In	308.6	308.6	308.6	308.0
5: Out	339.5	339.5	339.5	307.5
6: In	1141.9	966.7	790.9	395.8
6: Out	1943.1	1602.2	1260.4	393.6
8: In	1831.8	1497.3	1161.8	300.7
8: Out	1830.9	1496.6	1161.2	300.6
9: In	116.7	109.3	102.1	92.9
9: Out	116.7	109.3	102.2	92.8
12: In	849.0	702.1	555.0	200.4
12: Out	846.6	700.1	553.4	199.9
18: In	797.2	645.1	492.2	80.7
18: Out	796.9	645.9	494.1	80.1
23: In	760.6	625.4	489.9	152.0
23: Out	759.5	624.5	489.2	151.8
24: In	382.5	329.9	277.9	158.8
24: Out	381.5	329.1	277.2	158.4
Mouth:	**1936.8**	**1598.6**	**1259.9**	**390.2**

90% Reduction: 718.46 kg/day to Lake Erie. (data not shown for individual reaches)
Virtual Elimination: No loads, other than Lake St. Clair.

* : 100 % of the estimated 1986 to 1990 loading data (kg/day).

** : % reduction in the 1986 to 1990 contaminant loadings associated with major Michigan CSOs.

The above CSO discharges occur, on average, 30 days per year.
The indicated mass flux represents those days with a CSO event.

Table P cont.

REACH	1986-1990*	25%**	50%**	VIRTUAL ELIMINATION
Copper				
0: Head	**524.3**	**524.3**	**524.3**	**524.3**
3: In	527.6	527.6	527.6	527.1
3: Out	527.6	527.5	527.5	527.0
4: In	112.1	112.1	112.1	112.1
4: Out	405.4	339.1	272.8	111.7
5: In	415.4	415.4	415.4	414.8
5: Out	418.3	418.3	418.3	414.1
6: In	877.1	798.5	719.9	526.0
6: Out	1356.5	1205.6	1054.7	523.0
8: In	1235.2	1087.2	938.4	398.0
8: Out	1234.6	1086.7	938.0	397.9
9: In	126.9	123.5	120.9	124.9
9: Out	126.8	123.4	120.9	124.8
12: In	581.0	516.1	451.4	266.4
12: Out	579.3	514.6	450.1	265.7
18: In	531.7	464.3	396.1	106.0
18: Out	536.2	469.3	401.6	105.2
23: In	516.4	456.6	396.8	201.7
23: Out	515.6	455.9	396.2	201.4
24: In	310.8	287.7	265.2	212.6
24: Out	327.6	304.5	282.1	212.0
Mouth:	**1378.8**	**1229.2**	**1079.5**	**518.5**

90% Reduction: 840.08 kg/day to Lake Erie. (data not shown for individual reaches)
Virtual Elimination: No loads, other than Lake St. Clair.

* : 100 % of the estimated 1986 to 1990 loading data (kg/day).

** : % reduction in the 1986 to 1990 contaminant loadings associated with major Michigan CSOs.

The above CSO discharges occur, on average, 30 days per year.
The indicated mass flux represents those days with a CSO event.

Table P cont.

REACH	1986-1990*	25%**	50%**	VIRTUAL ELIMINATION
Zinc				
0: Head	**3811.4**	**3811.4**	**3811.4**	**3811.4**
3: In	3782.7	3782.7	3782.6	3780.5
3: Out	3781.8	3781.8	3781.8	3779.6
4: In	831.8	831.8	831.8	831.8
4: Out	1576.6	1391.4	1206.0	828.8
5: In	2949.8	2949.8	2949.8	2947.5
5: Out	3078.1	3078.1	3078.1	2942.4
6: In	4822.8	4604.7	4386.4	3767.8
6: Out	6320.2	5883.4	5446.0	3746.2
8: In	5466.4	5024.2	4577.1	2888.2
8: Out	5463.8	5021.8	4574.9	2886.9
9: In	877.3	881.5	869.0	857.9
9: Out	876.7	880.9	868.5	857.2
12: In	2796.7	2614.0	2434.6	1913.3
12: Out	2788.8	2606.7	2427.8	1907.9
18: In	2168.7	1958.0	1740.8	784.7
18: Out	2288.3	2079.1	1863.4	778.9
23: In	2386.5	2212.8	2039.1	1453.9
23: Out	2383.0	2210.0	2036.1	1451.8
24: In	1775.7	1724.6	1679.5	1487.0
24: Out	1781.7	1730.8	1685.7	1483.0
Mouth:	**6450.9**	**6017.6**	**5583.7**	**3712.6**

90% Reduction: 4890.04 kg/day to Lake Erie. (data not shown for individual reaches)
Virtual Elimination: No loads, other than Lake St. Clair.

* : 100 % of the estimated 1986 to 1990 loading data (kg/day).

** : % reduction in the 1986 to 1990 contaminant loadings associated with major Michigan CSOs.

The above CSO discharges occur, on average, 30 days per year.
The indicated mass flux represents those days with a CSO event.

Table P cont.

REACH	*1986-1990**	*25%***	*50%***	*VIRTUAL ELIMINATION*
Cadmium				
0: Head	**24.9**	**24.9**	**24.9**	**24.9**
3: In	24.9	24.9	24.9	24.9
3: Out	24.9	24.9	24.9	24.9
4: In	5.7	5.7	5.7	5.7
4: Out	61.0	49.1	37.3	5.7
5: In	19.2	19.2	19.2	19.2
5: Out	20.0	20.0	20.0	19.1
6: In	90.9	77.0	63.2	24.8
6: Out	169.4	142.5	115.6	24.7
8: In	161.9	135.6	109.3	19.0
8: Out	161.8	135.5	109.2	19.0
9: In	8.15	7.5	6.9	5.7
9: Out	8.15	7.5	6.8	5.7
12: In	71.7	60.1	48.6	12.6
12: Out	71.5	60.0	48.4	12.6
18: In	73.2	61.3	49.3	5.2
18: Out	78.0	66.1	54.3	5.1
23: In	65.7	55.0	44.4	9.6
23: Out	65.6	55.0	44.4	9.6
24: In	30.4	26.2	22.0	9.8
24: Out	30.4	26.2	22.0	9.8
Mouth:	**174.0**	**147.3**	**120.6**	**24.5**

90% Reduction: 77.88 kg/day to Lake Erie. (data not shown for individual reaches)
Virtual Elimination: No loads, other than Lake St. Clair.

* : 100 % of the estimated 1986 to 1990 loading data (kg/day).

** : % reduction in the 1986 to 1990 contaminant loadings associated with major Michigan CSOs.

The above CSO discharges occur, on average, 30 days per year.
The indicated mass flux represents those days with a CSO event.

Appendix 9.1

Point Source Load Estimation Procedure

Data from discharge monitoring reports, compliance surveys, MISA investigations and inspections, etc., have been processed and summarized to provide load estimates for the Detroit River. Details of the protocol used are described in the body of the PS/NPS TWG report, Chapter 9.

The first step was to decide what category a given effluent pipe was in. The categories are explained below, but basically they depend on the amount of actual data available in the year of interest. Category 1 has the most data available, while category 3 has the least. Category 4 includes point source data that are predominantly at levels "less than detect."

The next step was to estimate the load for each pipe by category.

Category 1: If the pipe was in this category, a check was made to see if any of the values have been reported as censored or "less than detect." If there was no censoring, then daily loads were estimated by multiplying flow times concentration and converting to kilograms per day (kg/d). The daily loads were then transformed by taking the natural logarithm of the value and then averaging over the year. The average was then back-transformed to the original units of kg/d. The transform was used to reduce the influence of large values on the final estimate.

If the data were censored, a computer program called MANYDL was used. The name of the program refers to the fact that it will accommodate a set of data with more than one detection limit. It employs the principle of maximum likelihood estimation (MLE) to estimate the average loading of censored data. This method is not a simulation or prediction of the load, but rather an estimation based on the statistical theory of maximum likelihood. Put simply, this method selects the average (and standard deviation) that has the greatest probability of being the "true average" given the values included in the sample. This method will successfully estimate the average as long as at least 25% of the data are not censored. If none of the data are censored, then MANYDL gives exactly the same estimate as the simpler procedure described above. When there is censoring, MANYDL also gives the "replacement value" for each censored data value. This "replacement value" is the quantity that could be used in place of the censored value in a simple average to obtain the same estimate that MANYDL provides.

The annual average load estimate for each pipe in category 1 was carried forward to the Summary along with the reported annual average flow and the number of samples taken. If the sampling period did not correspond to the entire year, the load estimate was adjusted by the ratio of average sampled flow to annual average flow. Also included in the category 1 summary is the "effective concentration" and the 95% confidence interval for the load (lower conf; upper conf). The "effective concentration" is the annual average load estimate divided by the reported annual average flow and converted to micrograms per liter (ug/L). The confidence interval is calculated according to straightforward statistical procedures and is the range of values that is 95% likely to include the "true loading". At the end of the category 1 summary is the confidence interval for the total load in that category. This is not the sum of the upper and lower confidence intervals for each pipe, but rather the range of values 95% likely to contain the "true total loading".

Category 2: Pipes in this category have all had compliance sampling by the Michigan Department of Environmental Quality (MDEQ) or the Ministry of Environment and Energy (MOEE). The results of these inspections were averaged to estimate a "typical concentration" and then multiplied by the annual average flow to estimate the loading. If only one sample was available, or if only one value was above the detection limit, then the value of that sample was used. If all the compliance samples were below the detection limit, then the pipe was moved to category 3. Selection of a representative concentration for category 2 is sometimes a matter of judgement and may also reflect past sampling results. No confidence intervals can be calculated for category 2 loadings.

Category 3: pipes in this category had no sampling results reported for the year that could be used to estimate a concentration. Other sources of information (published studies and /or historical data) were used to estimate a "typical concentration" which were then multiplied by the annual average flow to obtain the load. The study used most often to estimate "typical" municipal effluent concentrations was the IJC's Municipal Pretreatment Task Force Report which estimated effluent concentrations of various metals and organic contaminants based on the type of treatment provided. "Typical" industrial effluent values were estimated using a matrix of contaminant concentrations by Standard Industrial Classification (SIC) codes published by the Strategic Assessment Branch of the National Oceanic and Atmospheric Administration (NOAA) and used in a national (U.S.) study of pollutant loadings. If no typical concentration could be found, then a value of zero was used. As with category 2, no confidence intervals were calculated.

Category 4: Pipes in this category include point sources that have more than 75% of their self-monitoring data reported as "less than detect." Appropriate methods for the other categories were used to obtain loading estimates for the parameters of concern.

Estimated loadings were summarized by category and year for each parameter of concern and a total load was calculated. This estimated total was used to produce the table on cumulative discharge estimates from point sources which has all of the pipes sorted in descending order and indicates the dischargers that contribute 95, 98 and 100 percent of the estimated total load.

Table Q
Cumulative Gross Discharge Estimates From Point Sources

CADMIUM - 1992

Permit	Pipe		Facility Name	Category	Cd (kg/D)	Cumulative Cd (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	9.4743	9.4743	
0000020107	001		Ford Motor Co. of Canada Ltd.	1	0.7061	10.1805	
0020001103	001		West Windsor WPCP	1	0.6761	10.8565	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	0.5314	11.3879	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	0.2279	11.6158	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.2197	11.8356	
0020001096	001		Windsor Little River WPCP	1	0.1984	12.0340	
0000010009	002		General Chemical Canada Ltd.	3	0.0895	12.1235	95%
MI0002399	001A	1	McLouth Steel - Trenton	2	0.0558	12.1793	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0503	12.2297	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0473	12.2770	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.0319	12.3089	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0308	12.3396	98%
MI0002399	002A	1	McLouth Steel - Trenton	2	0.0270	12.3667	
MI0021164	001A	1	Trenton WWTP	2	0.0212	12.3879	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0203	12.4082	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0158	12.4239	
0020001087	001		Amherstburg WPCP	3	0.0158	12.4397	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0142	12.4539	
MI0000558	001A	1	Monsanto Co.	3	0.0119	12.4657	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0104	12.4761	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0085	12.4846	
0000010009	001		General Chemical Canada Ltd.	3	0.0067	12.4913	
MI0000540	001A	1	BASF - Wyandotte	2	0.0064	12.4978	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0061	12.5039	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0057	12.5096	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0055	12.5151	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0046	12.5197	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0023	12.5220	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0019	12.5240	
0010000837	001		Essex Lagoon S.W.	3	0.0019	12.5259	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0016	12.5275	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0015	12.5290	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.0014	12.5304	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0011	12.5315	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0011	12.5326	
MI0000540	003A	1	BASF - Wyandotte	2	0.0010	12.5336	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0009	12.5345	
MI0000540	002A	1	BASF - Wyandotte	2	0.0008	12.5353	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0008	12.5361	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0003	12.5364	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	12.5364	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	12.5364	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	12.5364	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	12.5364	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	12.5364	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	12.5364	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	12.5364	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	12.5364	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	12.5364	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	12.5364	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	12.5364	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	12.5364	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	12.5364	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	12.5364	

Total Load **12.5364**

Table Q cont.

CADMIUM - 1993

Permit	Pipe		Facility Name	Category	Cd (kg/D)	Cumulative Cd (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	9.5157	9.5157	
0000020107	001		Ford Motor Co. of Canada Ltd.	2	0.7034	10.2191	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	0.5327	10.7518	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	0.1877	10.9395	
0020001103	001		West Windsor WPCP	1	0.1722	11.1117	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.1715	11.2832	95%
0000010009	002		General Chemical Canada Ltd.	3	0.0895	11.3727	
MI0002399	001A	1	McLouth Steel - Trenton	2	0.0655	11.4381	
0020001096	001		Windsor Little River WPCP	1	0.0419	11.4800	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.0414	11.5215	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0396	11.5611	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0376	11.5988	98%
MI0002399	002A	1	McLouth Steel - Trenton	2	0.0295	11.6282	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0244	11.6526	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0229	11.6755	
MI0021164	001A	1	Trenton WWTP	2	0.0188	11.6943	
MI0000540	001A	1	BASF - Wyandotte	1	0.0186	11.7128	
0020001087	001		Amherstburg WPCP	3	0.0158	11.7286	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0157	11.7443	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0145	11.7588	
MI0000558	001A	1	Monsanto Co.	3	0.0109	11.7697	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0089	11.7787	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0087	11.7873	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.0082	11.7956	
0000010009	001		General Chemical Canada Ltd.	3	0.0067	11.8023	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0054	11.8077	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0046	11.8123	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0043	11.8165	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0029	11.8194	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0028	11.8223	
0010000837	001		Essex Lagoon S.W.	3	0.0019	11.8242	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0017	11.8259	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0017	11.8275	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0016	11.8292	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0016	11.8308	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0011	11.8318	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0009	11.8327	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0009	11.8336	
MI0000540	003A	1	BASF - Wyandotte	2	0.0008	11.8343	
MI0000540	002A	1	BASF - Wyandotte	2	0.0006	11.8349	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0003	11.8352	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	11.8352	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	11.8352	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	11.8352	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	11.8352	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	11.8352	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	11.8352	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	11.8352	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	11.8352	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	11.8352	
Total Load					**11.8352**		

Table Q cont.

COPPER - 1992

Permit	Pipe		Facility Name	Category	Cu (kg/D)	Cumulative Cu (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	46.9462	46.9462	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	2.8916	49.8378	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	1.7889	51.6266	
0020001103	001		West Windsor WPCP	1	1.7472	53.3739	
0000010009	002		General Chemical Canada Ltd.	3	1.6829	55.0568	
MI0002399	001A	1	McLouth Steel - Trenton	1	1.2868	56.3436	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	1.2154	57.5591	
0000020107	001		Ford Motor Co. of Canada Ltd.	1	0.8526	58.4117	
0020001096	001		Windsor Little River WPCP	1	0.7143	59.1260	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.6440	59.7700	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.4944	60.2644	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.4727	60.7371	95%
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.3775	61.1146	
MI0002399	002A	1	McLouth Steel - Trenton	2	0.3405	61.4551	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.3130	61.7681	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.2211	61.9892	
0001040005	001		The Canadian Salt Company Ltd.	3	0.1904	62.1796	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1664	62.3460	98%
0020001087	001		Amherstburg WPCP	3	0.1624	62.5084	
MI0026191	001A	1	Grosse Ile Township WWTP	2	0.1319	62.6403	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1263	62.7665	
MI0002381	001A	1	ELF Atochem North America Inc	2	0.1180	62.8846	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0935	62.9780	
MI0000558	001A	1	Monsanto Co.	2	0.0860	63.0640	
0000010009	001		General Chemical Canada Ltd.	3	0.0830	63.1470	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0612	63.2082	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0550	63.2632	
MI0021164	001A	1	Trenton WWTP	2	0.0509	63.3141	
MI0000540	001A	1	BASF - Wyandotte	2	0.0474	63.3616	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0415	63.4031	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0399	63.4429	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0183	63.4613	
0010000837	001		Essex Lagoon S.W.	3	0.0181	63.4794	
MI0004227	001A	1	McLouth Steel - Gibraltar	2	0.0171	63.4964	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0157	63.5121	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.0141	63.5262	
MI0000540	003A	1	BASF - Wyandotte	2	0.0111	63.5373	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0087	63.5460	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0081	63.5541	
MI0000540	002A	1	BASF - Wyandotte	2	0.0068	63.5609	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0010	63.5618	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	63.5618	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	63.5618	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	63.5618	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	63.5618	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	63.5618	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	63.5618	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	63.5618	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	63.5618	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	63.5618	
Total Load					**63.5618**		

Table Q cont.

COPPER - 1993

Permit	Pipe		Facility Name	Category	Cu (kg/D)	Cumulative Cu (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	52.3210	52.3210	
0020001103	001		West Windsor WPCP	1	2.1138	54.4348	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	1.7932	56.2280	
0000010009	002		General Chemical Canada Ltd.	3	1.6829	57.9109	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	1.6456	59.5565	
MI0002399	001A	1	McLouth Steel - Trenton	1	1.2891	60.8455	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	1.0007	61.8463	
0000020107	001		Ford Motor Co. of Canada Ltd.	2	0.6540	62.5003	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.6148	63.1151	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.4816	63.5967	95%
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.4185	64.0152	
MI0002399	002A	1	McLouth Steel - Trenton	2	0.3712	64.3864	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.3523	64.7387	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.2998	65.0384	
0020001096	001		Windsor Little River WPCP	1	0.2958	65.3342	
0001040005	001		The Canadian Salt Company Ltd.	2	0.1904	65.5246	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.1736	65.6982	98%
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1655	65.8637	
0020001087	001		Amherstburg WPCP	3	0.1624	66.0261	
MI0002381	001A	1	ELF Atochem North America Inc	2	0.1211	66.1472	
MI0026191	001A	1	Grosse Ile Township WWTP	2	0.1157	66.2629	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1152	66.3781	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0981	66.4762	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0867	66.5629	
MI0000558	001A	1	Monsanto Co.	2	0.0860	66.6489	
0000010009	001		General Chemical Canada Ltd.	3	0.0830	66.7319	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.0824	66.8143	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0515	66.8658	
MI0000540	001A	1	BASF - Wyandotte	2	0.0477	66.9135	
MI0021164	001A	1	Trenton WWTP	2	0.0451	66.9586	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0428	67.0014	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0318	67.0332	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0201	67.0533	
0010000837	001		Essex Lagoon S.W.	3	0.0181	67.0714	
MI0004227	001A	1	McLouth Steel - Gibraltar	2	0.0169	67.0883	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0164	67.1046	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0157	67.1203	
MI0000540	003A	1	BASF - Wyandotte	2	0.0085	67.1288	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0084	67.1372	
MI0000540	002A	1	BASF - Wyandotte	2	0.0047	67.1419	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0010	67.1429	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	67.1429	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	67.1429	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	67.1429	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	67.1429	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	67.1429	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	67.1429	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	67.1429	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	67.1429	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	67.1429	
Total Load					**67.1429**		

Table Q cont.

MERCURY - 1992

Permit	Pipe		Facility Name	Category	Hg (kg/D)	Cumulative Hg (kg/D)	
MI0022802	049F	1	Detroit WWTP	4	0.3690	0.3690	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	3	0.2492	0.6182	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.0324	0.6506	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0157	0.6663	
MI0000558	001A	1	Monsanto Co.	3	0.0148	0.6812	
0000010009	002		General Chemical Canada Ltd.	3	0.0138	0.6949	95%
MI0021164	001A	1	Trenton WWTP	1	0.0085	0.7034	
MI0000540	003A	1	BASF - Wyandotte	2	0.0066	0.7100	
0020001103	001		West Windsor WPCP	1	0.0065	0.7166	98%
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0037	0.7203	
0000010009	001		General Chemical Canada Ltd.	3	0.0024	0.7226	
0020001096	001		Windsor Little River WPCP	1	0.0017	0.7243	
MI0026191	001A	1	Grosse Ile Township WWTP	3	0.0013	0.7256	
0020001087	001		Amherstburg WPCP	3	0.0011	0.7267	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0011	0.7278	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0008	0.7286	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.0002	0.7288	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0001	0.7289	
0010000837	001		Essex Lagoon S.W.	3	0.0001	0.7290	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0001	0.7291	
0000020107	001		Ford Motor Co. of Canada Ltd.	3	0.0000	0.7291	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0000	0.7291	
MI0000540	001A	1	BASF - Wyandotte	3	0.0000	0.7291	
MI0000540	002A	1	BASF - Wyandotte	3	0.0000	0.7291	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	0.7291	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	0.7291	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7291	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	0.7291	
MI0002399	001A	1	McLouth Steel - Trenton	3	0.0000	0.7291	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	0.7291	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0000	0.7291	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	0.7291	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7291	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	0.7291	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	0.7291	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7291	
Total Load					**0.7291**		

Table Q cont.

MERCURY - 1993

Permit	Pipe		Facility Name	Category	Hg (kg/D)	Cumulative Hg (kg/D)	
MI0022802	049F	1	Detroit WWTP	4	0.4868	0.4868	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	3	0.2052	0.6920	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.0325	0.7245	
0000010009	002		General Chemical Canada Ltd.	3	0.0138	0.7382	
MI0000558	001A	1	Monsanto Co.	3	0.0136	0.7518	95%
0020001103	001		West Windsor WPCP	1	0.0117	0.7636	
MI0000540	003A	1	BASF - Wyandotte	2	0.0051	0.7687	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0035	0.7722	98%
MI0021164	001A	1	Trenton WWTP	4	0.0024	0.7746	
0000010009	001		General Chemical Canada Ltd.	3	0.0024	0.7770	
0020001096	001		Windsor Little River WPCP	1	0.0020	0.7790	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0012	0.7802	
MI0026191	001A	1	Grosse Ile Township WWTP	3	0.0011	0.7813	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.0011	0.7824	
0020001087	001		Amherstburg WPCP	3	0.0011	0.7835	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0010	0.7845	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0009	0.7853	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0002	0.7855	
0010000837	001		Essex Lagoon S.W.	3	0.0001	0.7856	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0001	0.7857	
0000020107	001		Ford Motor Co. of Canada Ltd.	3	0.0000	0.7857	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0000	0.7857	
MI0000540	001A	1	BASF - Wyandotte	3	0.0000	0.7857	
MI0000540	002A	1	BASF - Wyandotte	3	0.0000	0.7857	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	0.7857	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	0.7857	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.7857	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	0.7857	
MI0002399	001A	1	McLouth Steel - Trenton	3	0.0000	0.7857	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	0.7857	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0000	0.7857	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	0.7857	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.7857	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	0.7857	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	0.7857	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	0.7857	
Total Load					**0.7857**		

Table Q cont.

LEAD - 1992

Permit	Pipe		Facility Name	Category	Pb (kg/D)	Cumulative Pb (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	43.2599	43.2599	
0000020107	001		Ford Motor Co. of Canada Ltd.	1	5.5146	48.7745	
0020001103	001		West Windsor WPCP	1	3.1353	51.9098	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	2.6840	54.5938	
MI0002399	001A	1	McLouth Steel - Trenton	1	2.6422	57.2359	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	2.2605	59.4964	
0000010009	002		General Chemical Canada Ltd.	3	2.1484	61.6448	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	1.7513	63.3961	
0000010009	001		General Chemical Canada Ltd.	3	1.6997	65.0958	
0020001096	001		Windsor Little River WPCP	1	0.9024	65.9981	95%
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.4240	66.4221	
MI0021164	001A	1	Trenton WWTP	4	0.3757	66.7978	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	0.3292	67.1270	
0001040005	001		The Canadian Salt Company Ltd.	3	0.2187	67.3457	
MI0002399	002A	1	McLouth Steel - Trenton	2	0.2163	67.5619	98%
0020001087	001		Amherstburg WPCP	3	0.1930	67.7549	
MI0004227	001A	1	McLouth Steel - Gibraltar	1	0.1302	67.8851	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	0.1170	68.0021	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.1169	68.1190	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.1091	68.2281	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0939	68.3220	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0846	68.4066	
MI0000558	001A	1	Monsanto Co.	3	0.0771	68.4837	
MI0002381	001A	1	ELF Atochem North America Inc	2	0.0582	68.5419	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0541	68.5961	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	0.0456	68.6416	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0336	68.6752	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0154	68.6907	
0010000837	001		Essex Lagoon S.W.	3	0.0150	68.7057	
MI0000540	001A	1	BASF - Wyandotte	3	0.0134	68.7190	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0130	68.7320	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0097	68.7417	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0068	68.7485	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0067	68.7552	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0055	68.7607	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0036	68.7643	
MI0000540	002A	1	BASF - Wyandotte	2	0.0035	68.7678	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0033	68.7711	
MI0000540	003A	1	BASF - Wyandotte	3	0.0032	68.7743	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.0016	68.7759	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0009	68.7768	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	68.7768	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	68.7768	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	68.7768	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	68.7768	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	68.7768	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	68.7768	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	68.7768	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	68.7768	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	68.7768	
Total Load					**68.7768**		

Table Q cont.

LEAD - 1993

Permit	Pipe		Facility Name	Category	Pb (kg/D)	Cumulative Pb (kg/D)	
MI0022802	049F	1	Detroit WWTP	1	40.7978	40.7978	
MI0002399	001A	1	McLouth Steel - Trenton	1	4.6228	45.4206	
0000020107	001		Ford Motor Co. of Canada Ltd.	2	3.8296	49.2503	
0020001103	001		West Windsor WPCP	1	3.2741	52.5243	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	2.3360	54.8603	
0000010009	002		General Chemical Canada Ltd.	3	2.1484	57.0087	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	1.7638	58.7725	
0000010009	001		General Chemical Canada Ltd.	3	1.6997	60.4722	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	1.4670	61.9392	
0020001096	001		Windsor Little River WPCP	1	0.7098	62.6490	
MI0000540	001A	1	BASF - Wyandotte	1	0.4635	63.1125	95%
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	0.4333	63.5458	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.4252	63.9709	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	0.2710	64.2419	
MI0002399	002A	1	McLouth Steel - Trenton	2	0.2357	64.4776	
0001040005	001		The Canadian Salt Company Ltd.	2	0.2187	64.6963	
0020001087	001		Amherstburg WPCP	3	0.1930	64.8893	98%
MI0021164	001A	1	Trenton WWTP	1	0.1660	65.0553	
MI0002399	004A	1	McLouth Steel - Trenton	2	0.1520	65.2073	
MI0004227	001A	1	McLouth Steel - Gibraltar	1	0.1275	65.3348	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	0.1234	65.4582	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0866	65.5448	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0842	65.6289	
MI0000558	001A	1	Monsanto Co.	3	0.0708	65.6997	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0702	65.7700	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0609	65.8309	
MI0002381	001A	1	ELF Atochem North America Inc	2	0.0598	65.8906	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0417	65.9323	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0169	65.9492	
0010000837	001		Essex Lagoon S.W.	3	0.0150	65.9642	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0130	65.9772	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0096	65.9869	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.0092	65.9960	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0085	66.0045	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0064	66.0110	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0043	66.0153	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0033	66.0186	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0029	66.0215	
MI0000540	003A	1	BASF - Wyandotte	3	0.0025	66.0239	
MI0000540	002A	1	BASF - Wyandotte	2	0.0020	66.0259	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0018	66.0277	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	66.0277	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	66.0277	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	66.0277	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	66.0277	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	66.0277	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	66.0277	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	66.0277	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	66.0277	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	66.0277	
Total Load					**66.0277**		

Table Q cont.

ZINC - 1992

Permit	Pipe		Facility Name	Category	Zn (kg/D)	Cumulative Zn (kg/D)	
0000020107	001		Ford Motor Co. of Canada Ltd.	1	153.9000	153.9000	
MI0022802	049F	1	Detroit WWTP	1	127.7000	281.6000	
MI0002399	001A	1	McLouth Steel - Trenton	1	13.2080	294.8080	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	12.7740	307.5820	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	10.6350	318.2170	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	9.3640	327.5810	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	8.3090	335.8900	
MI0002399	002A	1	McLouth Steel - Trenton	2	6.0550	341.9450	
0020001103	001		West Windsor WPCP	1	4.3290	346.2740	
0000010009	002		General Chemical Canada Ltd.	3	2.8650	349.1390	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	2.7070	351.8460	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	2.6280	354.4740	95%
MI0002399	004A	1	McLouth Steel - Trenton	2	2.5500	357.0240	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	2.2140	359.2380	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	1.9690	361.2070	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	1.4220	362.6290	
MI0021164	001A	1	Trenton WWTP	1	1.2920	363.9210	
MI0000558	001A	1	Monsanto Co.	2	1.2750	365.1960	98%
0020001087	001		Amherstburg WPCP	3	1.2030	366.3990	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.9470	367.3460	
0020001096	001		Windsor Little River WPCP	1	0.8410	368.1870	
MI0002381	001A	1	ELF Atochem North America Inc	1	0.6180	368.8050	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	0.6030	369.4080	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.4760	369.8840	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.2870	370.1710	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.2850	370.4560	
0001040005	001		The Canadian Salt Company Ltd.	3	0.2770	370.7330	
MI0000540	001A	1	BASF - Wyandotte	2	0.1730	370.9060	
MI0026191	001A	1	Grosse Ile Township WWTP	2	0.1630	371.0690	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.1580	371.2270	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.1110	371.3380	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1070	371.4450	
0010000837	001		Essex Lagoon S.W.	3	0.0820	371.5270	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0700	371.5970	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0630	371.6600	
MI0004227	001A	1	McLouth Steel - Gibraltar	1	0.0620	371.7220	
MI0000540	003A	1	BASF - Wyandotte	2	0.0550	371.7770	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0550	371.8320	
MI0000540	002A	1	BASF - Wyandotte	2	0.0430	371.8750	
0000010009	001		General Chemical Canada Ltd.	3	0.0390	371.9140	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0190	371.9330	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	371.9330	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	371.9330	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	371.9330	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	371.9330	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	371.9330	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	371.9330	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	371.9330	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	371.9330	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	371.9330	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	371.9330	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	371.9330	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	371.9330	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	371.9330	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	371.9330	

Total Load **371.9330**

Table Q cont.

ZINC - 1993

Permit	Pipe		Facility Name	Category	Zn (kg/D)	Cumulative Zn (kg/D)	
0000020107	001		Ford Motor Co. of Canada Ltd.	2	152.5750	152.5750	
MI0022802	049F	1	Detroit WWTP	1	125.5450	278.1200	
MI0002399	001A	1	McLouth Steel - Trenton	1	44.4400	322.5600	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	2	12.8050	335.3650	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	2	8.7560	344.1210	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	7.3060	351.4270	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	6.9600	358.3870	
MI0002399	002A	1	McLouth Steel - Trenton	2	6.5990	364.9860	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	5.8640	370.8500	
0020001103	001		West Windsor WPCP	1	4.6390	375.4890	
MI0002399	004A	1	McLouth Steel - Trenton	2	3.3160	378.8050	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	3.0470	381.8520	
0000010009	002		General Chemical Canada Ltd.	3	2.8650	384.7170	95%
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	2.3580	387.0750	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	1	2.1390	389.2140	
MI0021164	001A	1	Trenton WWTP	1	1.7580	390.9720	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	1.6560	392.6280	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	1	1.6210	394.2490	98%
0020001087	001		Amherstburg WPCP	3	1.2030	395.4520	
MI0000558	001A	1	Monsanto Co.	2	1.1700	396.6220	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.9410	397.5630	
0020001096	001		Windsor Little River WPCP	1	0.7390	398.3020	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.6740	398.9760	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.6410	399.6170	
MI0002381	001A	1	ELF Atochem North America Inc	1	0.5470	400.1640	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.3530	400.5170	
0001040005	001		The Canadian Salt Company Ltd.	2	0.2770	400.7940	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.2300	401.0240	
MI0004227	001A	1	McLouth Steel - Gibraltar	1	0.2150	401.2390	
MI0000540	001A	1	BASF - Wyandotte	2	0.1740	401.4130	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.1730	401.5860	
MI0026191	001A	1	Grosse Ile Township WWTP	2	0.1430	401.7290	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.1270	401.8560	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.1030	401.9590	
0010000837	001		Essex Lagoon S.W.	3	0.0820	402.0410	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.0700	402.1110	
MI0000540	003A	1	BASF - Wyandotte	2	0.0430	402.1540	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0430	402.1970	
0000010009	001		General Chemical Canada Ltd.	3	0.0390	402.2360	
MI0000540	002A	1	BASF - Wyandotte	2	0.0290	402.2650	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	2	0.0190	402.2840	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	402.2840	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	402.2840	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	2	0.0000	402.2840	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	402.2840	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	402.2840	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	402.2840	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	402.2840	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	402.2840	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	402.2840	
Total Load					**402.2840**		

Table Q cont.
PCB - 1992

Permit	Pipe		Facility Name	Category	PCB (kg/D)	Cumulative PCB (kg/D)	
MI0022802	049F	1	Detroit WWTP	4	0.4730	0.4730	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.0217	0.4947	
MI0002399	004A	1	McLouth Steel - Trenton	3	0.0136	0.5084	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0100	0.5184	95%
0000020107	001		Ford Motor Co. of Canada Ltd.	3	0.0049	0.5232	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	3	0.0042	0.5274	
MI0002399	002A	1	McLouth Steel - Trenton	3	0.0034	0.5308	
0020001103	001		West Windsor WPCP	3	0.0026	0.5334	98%
MI0000558	001A	1	Monsanto Co.	3	0.0021	0.5355	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0018	0.5373	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0011	0.5384	
0020001096	001		Windsor Little River WPCP	3	0.0008	0.5392	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0006	0.5398	
MI0000540	001A	1	BASF - Wyandotte	3	0.0005	0.5403	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0004	0.5407	
0020001087	001		Amherstburg WPCP	3	0.0003	0.5410	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0003	0.5413	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0003	0.5416	
MI0001791	005A	1	Detroit Edison - Trenton Plant	3	0.0003	0.5419	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0003	0.5421	
MI0021164	001A	1	Trenton WWTP	4	0.0003	0.5424	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0001	0.5425	
0010000837	001		Essex Lagoon S.W.	3	0.00004	0.5425	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.00003	0.5425	
MI0000540	002A	1	BASF - Wyandotte	3	0.00003	0.5426	
0000010009	001		General Chemical Canada Ltd.	3	0.0000	0.5426	
0000010009	002		General Chemical Canada Ltd.	3	0.0000	0.5426	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0000	0.5426	
MI0000540	003A	1	BASF - Wyandotte	3	0.0000	0.5426	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	0.5426	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	0.5426	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.5426	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0000	0.5426	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	0.5426	
MI0002399	001A	1	McLouth Steel - Trenton	3	0.0000	0.5426	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	0.5426	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	0.5426	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.5426	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.5426	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.5426	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.5426	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.5426	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	0.5426	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	0.5426	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	0.5426	
Total Load					**0.5426**		

Table Q cont.

PCB - 1993

Permit	Pipe		Facility Name	Category	PCB (kg/D)	Cumulative PCB (kg/D)	
MI0022802	049F	1	Detroit WWTP	4	0.5421	0.5421	
MI0021156	001A	1	Wayne County - Wyandotte WWTP	3	0.0218	0.5638	
MI0002399	004A	1	McLouth Steel - Trenton	3	0.0177	0.5815	
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0084	0.5899	
0000020107	001		Ford Motor Co. of Canada Ltd.	3	0.0049	0.5948	95%
MI0002399	002A	1	McLouth Steel - Trenton	3	0.0037	0.5985	
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80" Mill	3	0.0034	0.6019	
MI0001724	002A	1	Detroit Edison - River Rouge Plant	3	0.0030	0.6049	
MI0001775	00C1	P	Detroit Edison - Conners Creek Plant	3	0.0030	0.6079	
MI0001791	004A	1	Detroit Edison - Trenton Plant	3	0.0030	0.6109	98%
0020001103	001		West Windsor WPCP	3	0.0025	0.6134	
MI0000558	001A	1	Monsanto Co.	3	0.0019	0.6154	
MI0002381	001A	1	ELF Atochem North America Inc	3	0.0019	0.6172	
MI0004227	001A	1	McLouth Steel - Gibraltar	3	0.0011	0.6183	
0020001096	001		Windsor Little River WPCP	3	0.0007	0.6191	
MI0043800	001A	1	Wayne County, Huron Valley WWTP	4	0.0005	0.6196	
MI0000540	001A	1	BASF - Wyandotte	3	0.0005	0.6201	
MI0026191	001A	1	Grosse Ile Township WWTP	4	0.0003	0.6204	
0020001087	001		Amherstburg WPCP	3	0.0003	0.6208	
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0002	0.6210	
MI0021164	001A	1	Trenton WWTP	4	0.0002	0.6212	
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.00004	0.6213	
0010000837	001		Essex Lagoon S.W.	3	0.00004	0.6213	
0010002407	001		Anderdon Edgewater Beach Lagoon	3	0.00003	0.6213	
MI0000540	002A	1	BASF - Wyandotte	3	0.00002	0.6214	
0000010009	001		General Chemical Canada Ltd.	3	0.0000	0.6214	
0000010009	002		General Chemical Canada Ltd.	3	0.0000	0.6214	
0001040005	001		The Canadian Salt Company Ltd.	3	0.0000	0.6214	
MI0000540	003A	1	BASF - Wyandotte	3	0.0000	0.6214	
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	3	0.0000	0.6214	
MI0001953	001A	1	Michigan Foundation Inc.	3	0.0000	0.6214	
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Ecorse Plt	3	0.0000	0.6214	
MI0002356	002A	1	Chrysler Trenton Engine Plant	3	0.0000	0.6214	
MI0002364	002A	1	Amoco Oil - Taylor	3	0.0000	0.6214	
MI0002399	001A	1	McLouth Steel - Trenton	3	0.0000	0.6214	
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3	0.0000	0.6214	
MI0024911	001A	1	Ashland Petroleum - Taylor	3	0.0000	0.6214	
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.6214	
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.6214	
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.6214	
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.6214	
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug Island	3	0.0000	0.6214	
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI Plant	3	0.0000	0.6214	
MI0036803	001A	1	Union Oil - Romulus	3	0.0000	0.6214	
MI0036846	001A	W	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
MI0036846	002A	W	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
MI0036846	003A	P	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
MI0036846	004A	P	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
MI0036846	005A	1	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
MI0036846	006A	P	Detroit Metro Wayne County Airport	3	0.0000	0.6214	
Total Load						**0.6214**	

Table R
Estimated Gross Loadings from Permitted Discharges

Cadmium 1992
Category 1

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Cd µg/L*	*n*	*Cd Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0022802	049F 1	Detroit WWTP	4952	750.7500	3.330	335	9.4743	(8.6278;	10.4406)	Daily flow and concentration data used to calculate daily load. MANYDL used to estimate average load. Average load adjusted by annual average flow divided by sample flow.
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	10.180	36	0.7061	(0.1952;	5.9408)	Daily flow and concentration data used to calcluate daily load. MANYDL used to estimate average load. Average load and confidence interval adjusted by annual average flow divided by average sample flow.
0020001103	001	West Windsor WPCP	4952	33.9533	5.260	10	0.6761	(0.2851;	2.2731)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
0020001096	001	Windsor Little River WPCP	4952	10.6374	4.900	10	0.1984	(0.0778;	0.7586)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow. There was one duplicate pair with one concentration less than detect and the other above detect. All Cd concentrations were run the MANYDL and a replacement value for less than detect calculated. For the one duplicate, the replacement value was used to compute an average and treated as uncensored.
Category 1 Subtotal				**813.6636**			**11.0549**	**(6.8654;**	**15.2444)**	

Cadmium 1992
Category 2

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Cd µg/L*	*Cd Kg/Day*	*Notes*
MI0021156	001A	1	Wayne Co. - Wyandotte WWTP	4952	65.9158	2.130	0.5314	Compliance inspection concentrations (µg/L) of 2.6, 2.5, and 1.3 averaged (2.13) and used as typical concentration.
MI0026778	009A	1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	0.900	0.2279	Compliance inspection concentration of 0.9 µg/L used as typical concentration.
MI0026786	003A	1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	7.850	0.2197	Compliance inspection concentrations (µg/L) of 0.9 and 14.8 averaged (7.85) and used as typical concentration.
MI0002399	001A	1	McLouth Steel - Trenton	3312	16.3917	0.900	0.0558	Compliance inspection concentrations (µg/L) of 1.5 and 0.3 averaged (0.9) and used as typical concentration.
MI0026786	001A	1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	0.750	0.0503	Compliance inspection concentrations (µg/L) of 0.9 and 0.6 averaged (0.75) and used as typical concentration.
MI0026786	008A	1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	0.450	0.0473	Compliance inspection concentrations (µg/L) of 0.3 and 0.6 averaged (0.45) and used as typical concentration.
MI0002399	004A	1	McLouth Steel - Trenton	3312	14.0333	0.600	0.0319	Compliance inspection concentrations of 0.6 µg/L used as typical concentration.
MI0026786	002A	1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	0.550	0.0308	Compliance inspection concentrations (µg/L) of 0.8 and 0.3 averaged (0.55) and used as typical concentration.
MI0002399	002A	1	McLouth Steel - Trenton	3312	14.2833	0.500	0.0270	Compliance inspection concentration of 0.5 µg/L used as typical concentration.
MI0021164	001A	1	Trenton WWTP	4952	5.6042	1.000	0.0212	Quarterly samples of sufficiently poor quality as to be unusable for calcluating loading rates. Compliance inspection concentration of 1.0 µg/L used as typical concentration.
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	0.600	0.0203	Compliance inspection concentrations (µg/L) of 0.9 and 0.3 averaged (0.6) and used as typical concentration.
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	0.550	0.0158	Compliance inspection concentrations (µg/L) of 0.5 and 0.6 averaged (0.55) and used as typical concentration.
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	0.550	0.0085	Compliance inspection concentrations (µg/L) of 0.6 and 0.5 averaged (0.55) and used as typical concentration.

Cadmium 1992
Category 2

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
MI0000540	001A	1	BASF - Wyandotte	2891	2.4333	0.700	0.0064	Compliance inspection concentrations (µg/L) of 0.8 and 0.6 averaged (0.7) and used as typical concentration. Weekly monitoring began in December, 1993.
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	0.250	0.0023	Compliance inspection concentrations (µg/L) of 0.3 and 0.2 averaged (0.25) and used as typical concentration.
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	0.600	0.0015	Compliance inspection concentrations (µg/L) of 0.5 and 0.7 averaged (0.6) and used as typical concentration.
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	0.900	0.0011	Compliance inspection concentrations (µg/L) of 0.6 and 1.2 averaged (0.9) and used as typical concentration.
MI0000540	003A	1	BASF - Wyandotte	2891	0.6500	0.400	0.0010	Compliance inspection concentrations (µg/L) of 0.5 and 0.3 averaged (0.4) and used as typical concentration.
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	0.400	0.0009	Compliance inspection concentration of 0.4 µg/L used as typical concentration.
MI0000540	002A	1	BASF - Wyandotte	2891	0.3167	0.700	0.0008	Compliance inspection concentrations (µg/L) of 0.7 and 0.7 averaged (0.7) and used as typical concentration.
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.700	0.0003	Compliance inspection concentration of 0.7 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.300	0.0000	Compliance inspection concentration of 0.3 µg/L used as typical concentration.
Category 2 Subtotal					**278.9516**		**1.3024**	

Cadmium 1992
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
0000010009	002		General Chemical Canada Ltd.	2812	47.3016	0.500	0.0895	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
0020001087	001		Amherstburg WPCP	4952	1.8105	2.300	0.0158	Municpal pretreatment report. Typical concentration for Ontario primary treatment.
MI0002381	001A	1	ELF Atochem North America Inc	2819	8.3167	0.450	0.0142	Compliance inspection concentrations (µg/L) of <20, 0.9, and <0.2 reported. NOAA typical concentration 30 µg/L. 0.45 µg/L used as typical concentration.
MI0000558	001A	1	Monsanto Co.	2819	7.8333	0.400	0.0119	Compliance inspection concentrations (µg/L) of 0.6 and <0.2 reported. NOAA typical concentration is 30 µg/L. 0.4 µg/L used as typical concentration.
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	0.300	0.0104	Compliance inspection concentrations (µg/L) of 0.4 and <0.2 reported. NOAA typical concentration is 10 µg/L. 0.3 µg/L used as typical concentration.
0000010009	001		General Chemical Canada Ltd.	2812	3.5359	0.500	0.0067	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
MI0001724	002A	1	Detroit Edison - River Rouge Plan	4911	0.1798	9.000	0.0061	NOAA typical concentration.
MI0002356	002A	1	Chrysler Trenton Engine Plant	3519	0.1453	10.000	0.0055	NOAA typical concentration.
0001040005	001		The Canadian Salt Company Ltd.	1400	6.0890	0.200	0.0046	Two concentrations of <0.2 µg/L reported in 1993. This concentration was used as a typical concentration.
0010000837	001		Essex Lagoon S.W.	4952	0.2644	1.900	0.0019	Municipal pretreatment report. Typical concentration for Ontario Lagoons.
0010002407	001		Anderdon Edgewater Bch. Lagoon	4952	0.2258	1.900	0.0016	Municipal pretreatment report. Typical concentration for Ontario Lagoons.
MI0001791	005A	1	Detroit Edison - Trenton Plant	4911	0.0420	9.000	0.0014	NOAA typical concentration.
MI0004227	001A	1	McLouth Steel - Gibraltar	3316	1.4083	0.200	0.0011	Compliance inspecion concetration of <0.2 µg/L reported. NOAA typical concentration 10 µg/L. 0.2 µg/L used as typical concentration.

Cadmium 1992
Category 3

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Cd µg/L*	*Cd Kg/Day*	*Notes*
MI0001775	00C1	P	Detroit Edison - Conners Creek Pl	4911	0.0237	9.000	0.0008	NOAA typical concentration.
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A	1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	NOAA typical concentration.
MI0002364	002A	1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0003221	001A	1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A	1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026794	019A	1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	10.000	0.0000	NOAA typical concentration.
MI0036803	001A	1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A	W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A	W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A	P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.
MI0036846	004A	P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**137.2144**		**0.1715**	

Cadmium 1992
Category 4

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.5328	0.200	0.0057	Quarterly Concentrations of sufficiently poor quality as to be unusable for load calcluation. Compliance inspection concentration of <0.2 µg/L reported. This value is less than any concentration in the Municipal pretreatment report and is used as a typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.5617	0.200	0.0019	Both yearly samples reported as 0. Data unusable. Compliance inspection concentration of <0.2 µg/L reported. This value is less than any value in the Municipal pretreatment report and was thus used as a typical concentration.
Category 4 Subtotal				**10.0945**		**0.0076**	
Grand Total				**1,239.9241**		**12.5363**	

Cadmium 1993
Category 1

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Cd µg/L*	*n*	*Cd Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0022802	049F 1	Detroit WWTP	4952	717.2500	3.510	334	9.5157	(8.5910;	10.5860)	Daily flow and concentration data used to calculate daily load. MANYDL used to estimate average load. Average load adjusted by annual average flow divided by sample flow.
0020001103	001	West Windsor WPCP	4952	32.8108	1.387	10	0.1722	(0.0351;	4.6499)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
0020001096	001	Windsor Little River WPCP	4952	9.7414	1.136	11	0.0419	(0.0083;	1.5038)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4467	2.000	5	0.0186	(0.0165;	0.0210)	Compliance inspection concentrations (µg/L) of 0.8 and 0.6 reported. Weekly concentration and flow, beginning in December, used to calculate load. MANYDL used to estimate average load. Load and confidence intervals adjusted by annual average flow divided by average sample flow.
Category 1 Subtotal				**762.2489**			**9.7483**	**(6.5423;**	**12.9543)**	

Cadmium 1993
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	4.947	0.7034	1993 MISA Inspection flow weighted concentration used as typical concentration. (8.3 µg/L, 77889 m3/Day; 1.7 µg/L, 80427 m3/Day) 1992 flow reported.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	2.130	0.5327	Compliance inspection concentrations (µg/L) of 2.6, 2.5, and 1.3 averaged (2.13) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	0.900	0.1877	Compliance inspection concentration of 0.9 µg/L used as typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	7.850	0.1715	Compliance inspection concentrations (µg/L) of 0.9 and 14.8 averaged (7.85) and used as typical concentration.
MI0002399	001A 1	McLouth Steel - Trenton	3312	19.2250	0.900	0.0655	Compliance inspection concentrations (µg/L) of 1.5 and 0.3 averaged (0.9) and used as typical concentration.
MI0002399	004A 1	McLouth Steel - Trenton	3312	18.2500	0.600	0.0414	Compliance inspection concentrations of 0.6 µg/L used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	0.450	0.0396	Compliance inspection concentrations (µg/L) of 0.3 and 0.6 averaged (0.45) and used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	0.750	0.0376	Compliance inspection concentrations (µg/L) of 0.9 and 0.6 averaged (0.75) and used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	15.5667	0.500	0.0295	Compliance inspection concentration of 0.5 µg/L used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	0.550	0.0244	Compliance inspection concentrations (µg/L) of 0.8 and 0.3 averaged (0.55) and used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	0.600	0.0229	Compliance inspection concentrations (µg/L) of 0.9 and 0.3 averaged (0.6) and used as typical concentration.
MI0021164	001A 1	Trenton WWTP	4952	4.9633	1.000	0.0188	Quarterly samples of sufficiently poor quality as to be unusable for calcluating loading rates. Compliance inspection concentration of 1.0 µg/L used as typical concentration.

Cadmium 1993
Category 2

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	0.550	0.0157	Compliance inspection concentrations (µg/L) of 0.5 and 0.6 averaged (0.55) and used as typical concentration.
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	0.550	0.0089	Compliance inspection concentrations (µg/L) of 0.6 and 0.5 averaged (0.55) and used as typical concentration.
MI0002313	016A	1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	0.250	0.0029	Compliance inspection concentrations (µg/L) of 0.3 and 0.2 averaged (0.25) and used as typical concentration.
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	0.600	0.0017	Compliance inspection concentrations (µg/L) of 0.5 and 0.7 averaged (0.6) and used as typical concentration.
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	0.900	0.0009	Compliance inspection concentrations (µg/L) of 1.2 and 0.6 averaged (0.9) and used as typical concentration.
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	0.400	0.0009	Compliance inspection concentration of 0.4 µg/L used as typical concentration.
MI0000540	003A	1	BASF - Wyandotte	2891	0.5000	0.400	0.0008	Compliance inspection concentrations (µg/L) of 0.5 and 0.3 averaged (0.4) and used as typical concentration.
MI0000540	002A	1	BASF - Wyandotte	2891	0.2175	0.700	0.0006	Compliance inspection concentrations (µg/L) of 0.7 and 0.7 averaged (0.7) and used as typical concentration.
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.700	0.0003	Compliance inspection concentration of 0.7 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.300	0.0000	Compliance inspection concentration of 0.3 µg/L used as typical concentration.
Category 2 Subtotal					**278.8321**		**1.9075**	

Cadmium 1993
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
0000010009	002		General Chemical Canada Ltd.	2812	47.3016	0.500	0.0895	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data. 1992 flow reported.
0020001087	001		Amherstburg WPCP	4952	1.8105	2.300	0.0158	Municipal pretreatment report. Typical concentration for Ontario primary treatment. 1992 flow reported.
MI0002381	001A	1	ELF Atochem North America Inc	2819	8.5333	0.450	0.0145	Compliance inspection concentrations (µg/L) of <20, 0.9, and <0.2 reported. NOAA typical concentration is 30 µg/L. 0.45 µg/L used as typical concentration.
MI0000558	001A	1	Monsanto Co.	2819	7.1917	0.400	0.0109	Compliance inspection concentrations (µg/L) of 0.6 and <0.2 reported. NOAA typical concentration is 30 µg/L. 0.4 µg/L used as typical concentration.
MI0001724	002A	1	Detroit Edison - River Rouge Plan	4911	0.2545	9.000	0.0087	NOAA typical concentration.
MI0001791	004A	1	Detroit Edison - Trenton Plant	4911	0.2420	9.000	0.0082	NOAA typical concentration.
0000010009	001		General Chemical Canada Ltd.	2812	3.5359	0.500	0.0067	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data. 1992 flow reported.
0001040005	001		The Canadian Salt Company Ltd.	1400	6.0890	0.200	0.0046	Two concentrations of <0.2 µg/L reported. This concentration was used as a typical concentration 1992 flow reported.
MI0002356	002A	1	Chrysler Trenton Engine Plant	3519	0.1130	10.000	0.0043	NOAA typical concentration.
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	0.300	0.0028	Compliance inspection concentrations (µg/L) of 0.4 and <0.2 reported. NOAA typical concentration i 10 µg/L. 0.3 µg/L used as typical concentration.
0010000837	001		Essex Lagoon S.W.	4952	0.2644	1.900	0.0019	Municipal pretreatment report. Typical concentration for Ontario lagoons. 1992 flow reported.
MI0001775	00C1	P	Detroit Edison - Conners Creek Pl	4911	0.0480	9.000	0.0016	NOAA typical concentration.
0010002407	001		Anderdon Edgewater Bch. Lagoon	4952	0.2258	1.900	0.0016	Municipal pretreatment report. Typical concentration for Ontario lagoon. 1992 flow reported.

Cadmium 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Cd µg/L*	*Cd Kg/Day*	*Notes*
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	0.200	0.0011	Compliance inspecion concentration of <0.2 µg/L reported. NOAA typical concentration is 10 µg/L. 0.2 µg/L used as typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	NOAA typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	10.000	0.0000	NOAA typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**121.0538**		**0.1722**	

Cadmium 1993
Category 4

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cd µg/L	Cd Kg/Day	Notes
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.1175	0.200	0.0054	Quarterly Concentrations of sufficiently poor quality as to be unusable for load calcluation. Compliance inspection concentration of <0.2 µg/L reported. This value is less than any concentration in the Municipal pretreatment report and is used as a typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.2467	0.200	0.0017	Both yearly samples reported as 0. Data unusable. Compliance inspection concentration of <0.2 µg/L reported. This value is less than any value in the Municipal pretreatment report and was thus used as a typical concentration.
Category 4 Subtotal				**9.3642**		**0.0071**	
Grand Total				**1,171.4990**		**11.8351**	

Copper 1992
Category 1

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cu µg/L	n	Cu Kg/Day	Lower Conf	Upper Conf	Notes
MI0022802	049F 1	Detroit WWTP	4952	750.7500	16.520	335	46.9462	(44.2700;	49.8497)	Daily flow and concentration used to calculate daily load. MANYDL used to estimate average load. Load and confidence intervals adjusted by annual average flow divided by sample flow.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.5328	101.420	4	2.8916	(1.3355;	8.2800)	Quarterly loads and confidence intervals calculated (Log) and adjusted by annual flow divided by sample flow.
0020001103	001	West Windsor WPCP	4952	33.9533	13.600	10	1.7472	(1.2262;	2.6258)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0002399	001A 1	McLouth Steel - Trenton	3312	16.3917	20.700	12	1.2868	(0.7426;	2.5973)	MANYDL used on monthly values. Effective concentraion back calclulated.
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	12.290	36	0.8526	(0.6396;	1.1997)	Daily flow and concentration data used to calcluate daily load. MANYDL used to estimate average load. Average load and confidence interval adjusted by annual average flow divided by average sample flow.
0020001096	001	Windsor Little River WPCP	4952	10.6374	17.742	10	0.7143	(0.4142;	1.4001)	Daily flow and concentration values used to calculate daily loads. MANYDL used to estimate the average load. Average load/ confidence intervals adjusted by yearly annual flow divided by sample average flow.
Category 1 Subtotal				**837.5880**			**54.4388**	**(48.6242;**	**60.2534)**	

Copper 1992
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Cu µg/L*	*Cu Kg/Day*	*Notes*
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	65.9158	7.170	1.7889	Compliance inspection concentrations (µg/L) of 8.7, 4.3, and 8.5 averaged (7.17) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	4.800	1.2154	Compliance inspection concentration of 4.8 µg/L used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	9.600	0.6440	Compliance inspection concentrations (µg/L) of 8.2 and 11.0 averaged (9.6) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	4.750	0.4944	Compliance inspection concentrations (µg/L) of 3.8 and 5.6 averaged (4.7) and used as typical concentration.
MI0002399	004A 1	McLouth Steel - Trenton	3312	14.0333	8.900	0.4727	Compliance inspection concentrations of 8.9 µg/L used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	6.750	0.3775	Compliance inspection concentrations (µg/L) of 8.4 and 5.1 averaged (6.75) and used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	14.2833	6.300	0.3405	Compliance inspection concentration of 6.3 µg/L used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	9.250	0.3130	Compliance inspection concentrations (µg/L) of 14.4 and 4.1 averaged (9.25) and used as typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	7.950	0.2211	Compliance inspection concentrations (µg/L) of 6.4 and 9.4 averaged (7.9) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	5.800	0.1664	Compliance inspection concentrations (µg/L) of 5 and 6.6 averaged (5.8) and used as typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.5617	13.600	0.1319	Yearly samples of 0 and 22 µg/L reported.Compliance inspection concentration of 13.6 µg/L used as typical concentration.
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	12.150	0.1263	Compliance inspection concentrations (µg/L) of 14.7 and 9.6 avervaged (12.15) and used as typical concentration.

Copper 1992
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.3167	3.750	0.1180	Compliance inspection concentrations (µg/L) of <20 3.6, and 3.9 reported. The <20 was discarded and the remaining two values averaged (3.75) and used as typical concentration.
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	6.050	0.0935	Compliance inspection concentrations (µg/L) of 8 and 4.1 averaged (6.05) and used as typical concentration.
MI0000558	001A 1	Monsanto Co.	2819	7.8333	2.900	0.0860	Compliance inspection concentrations (µg/L) of 3.4 and 2.4 averaged (2.9) and used as typical concentration.
MI0021164	001A 1	Trenton WWTP	4952	5.6042	2.400	0.0509	Quarterly samples of sufficiently poor quality as to be unusable for calcluating loading rates. Compliance inspection concentration of 2.4 µg/L used as typical concentration.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4333	5.150	0.0474	Compliance inspection concentrations (µg/L) of 4.6 and 5.7 averaged (5.15) and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	4.450	0.0415	Compliance inspection concentrations (µg/L) of 5 and 3.9 averaged (4.45) and used as typical concentration.
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	32.650	0.0399	Compliance inspection concentrations (µg/L) of 29.3 and 36 averaged (32.65) and used as typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	7.300	0.0183	Compliance inspection concentrations (µg/L) of 3.5 and 11.1 averaged (7.3) and used as typical concentration.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.4083	3.200	0.0171	Compliance inspecion concetration of 3.2 µg/L used as typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.6500	4.500	0.0111	Compliance inspection concentrations (µg/L) of 5.4 and 3.6 averaged (4.5) and used as typical concentration.
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	3.900	0.0087	Compliance inspection concentration of 3.9 µg/L used as typical concentration.
MI0000540	002A 1	BASF - Wyandotte	2891	0.3167	5.650	0.0068	Compliance inspection concentrations (µg/L) of 5.5 and 5.8 averaged (5.65) and used as typical concentration.

Copper 1992
Category 2

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	2.600	0.0010	Compliance inspection concentration of 2.6 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	3.500	0.0000	Compliance inspection concentration of 3.5 µg/L used as typical concentraion.
Category 2 Subtotal					**285.4258**		**6.8322**	

Copper 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	9.400	1.6829	Historic concentration and flows used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. Based on12 samples.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	8.260	0.1904	Flow weighted concentration from 1993 used as typical concentration.
0020001087	001	Amherstburg WPCP	4952	1.8105	23.700	0.1624	Municipal pretreatment report. Typical concentration Ontario primary treatment.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	6.200	0.0830	Historic concentration and flows used to calculate daily loads. MANYDL used to estimate average load. (Two samples removed from data set. They had extremely large less than concentrations and the load was much higher than any actual load.) Effective concentration calculated and used as typical concentration. Based on 10 samples.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.1798	90.000	0.0612	NOAA - typical concentration
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1453	100.000	0.0550	NOAA - typical concentration.
0010000837	001	Essex Lagoon S.W.	4952	0.2644	18.100	0.0181	Municipal pretreatment report. Typical concentration for Ontario lagoon.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	18.100	0.0157	Municipal pretreatment report. Typical concentration for Ontario lagoon.
MI0001791	005A 1	Detroit Edison - Trenton Plant	4911	0.0420	90.000	0.0141	NOAA - typical concentration.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0237	90.000	0.0081	NOAA - typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	NOAA - typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	20.000	0.0000	NOAA - typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.

Copper 1992
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**116.9103**		**2.2910**	
Grand Total					**1,239.9241**		**63.5619**	

Copper 1993
Category 1

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cu µg/L	n	Cu Kg/Day	Lower Conf	Upper Conf	Notes
MI0022802	049F	1	Detroit WWTP	4952	717.2500	19.250	365	52.3210	(48.7516;	56.2610)	Daily concentration and flows used to calculate load. MANYDL used to estimate average load.
0020001103	001		West Windsor WPCP	4952	32.8108	17.020	10	2.1138	(1.3963;	3.4440)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0043800	001A	1	Wayne Co., Huron Valley WWTP	4952	7.1175	61.083	4	1.6456	(0.9301;	3.3769)	Quarterly loads and confidence intervals calcluated (Log) and adjusted by annual flow divided by sample flow.
MI0002399	001A	1	McLouth Steel - Trenton	3312	19.2250	17.720	12	1.2891	(1.0353;	1.6374)	Monthly flows and concentrations used to calculate loads
0020001096	001		Windsor Little River WPCP	4952	9.7414	8.800	11	0.2958	(0.1866;	0.6478)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.
Category 1 Subtotal					**786.1447**			**57.6653**	**(51.8040;**	**63.5266)**	

Copper 1993
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	7.170	1.7932	Compliance inspection concentrations (µg/L) of 8.7, 4.3, and 8.5 averaged (7.17) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	4.800	1.0007	Compliance inspection concentration of 4.8 µg/L used as typical concentration.
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	9.430	0.6540	1993 MISA Inspection flow weighted concentration used as typical concentration. (11 µg/L, 77889 m3/Day; 7.9 µg/L, 80427 m3/Day). 1992 flow reported.
MI0002399	004A 1	McLouth Steel - Trenton	3312	18.2500	8.900	0.6148	Compliance inspection concentrations of 8.9 µg/L used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	9.600	0.4816	Compliance inspection concentrations (µg/L) of 8.2 and 11.0 averaged (9.6) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	4.750	0.4185	Compliance inspection concentrations (µg/L) of 3.8 and 5.6 averaged (4.7) and used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	15.5667	6.300	0.3712	Compliance inspection concentration of 6.3 µg/L used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	9.250	0.3523	Compliance inspection concentrations (µg/L) of 14.4 and 4.1 averaged (9.25) and used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	6.750	0.2998	Compliance inspection concentrations (µg/L) of 8.4 and 5.1 averaged (6.75) and used as typical concentration.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	8.260	0.1904	Flow weighted concentration reported. 1992 flow reported.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	7.950	0.1736	Compliance inspection concentrations (µg/L) of 6.4 and 9.4 averaged (7.9) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	5.800	0.1655	Compliance inspection concentrations (µg/L) of 5 and 6.6 averaged and used as typical concentration.

Copper 1993
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Cu µg/L*	*Cu Kg/Day*	*Notes*
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.5333	3.750	0.1211	Compliance inspection concentrations (µg/L) of <20, 3.6, and 3.9 reported. The <20 was discarded and the remaining two values averaged (3.75) and used as typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.2467	13.600	0.1157	Yearly samples reported as 0 and 22 µg/L. Data unusable. Compliance inspection concentration of 13.6 µg/L used as typical concentration.
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	12.150	0.1152	Compliance inspection concentrations (µg/L0 of 14.7 and 9.6 averaged and used as typical concentration.
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	6.050	0.0981	Compliance inspection concentrations (µg/L) of 8 and 4.1 averaged (6.05) and used as typical concentration.
MI0000558	001A 1	Monsanto Co.	2819	7.1917	2.900	0.0860	Compliance inspection concentrations (µg/L) of 3.4 and 2.4 averaged and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	4.450	0.0515	Compliance inspection concentrations (µg/L) of 5 and 3.9 averaged (4.45) and used as typical concentration.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4467	5.150	0.0477	Compliance inspection concentrations (µg/L) of 4.6 and 5.7 averaged (5.15) and used as typical concentration.
MI0021164	001A 1	Trenton WWTP	4952	4.9633	2.400	0.0451	Quarterly samples of sufficiently poor quality as to be unusable for calcluating loading rates. Compliance inspection concentration of 2.4 µg/L used as typical concentration.
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	32.650	0.0318	Compliance inspection concetrations (µg/L) of 29.3 and 36 averaged (32.65) and used as typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	7.300	0.0201	Compliance inspection concentrations (µg/L) of 3.5 and 11.1 averaged (7.3) and used as typical concentration.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	3.200	0.0169	Compliance inspecion concetration of 3.2 µg/L used as typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.5000	4.500	0.0085	Compliance inspection concentrations (µg/L) of 5.4 and 3.6 averaged (4.5) and used as typical concentration.

Copper 1993
Category 2

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	3.900	0.0084	Compliance inspection concentration of 3.9 µg/L used as typical concentration.
MI0000540	002A	1	BASF - Wyandotte	2891	0.2175	5.650	0.0047	Compliance inspection concentrations (µg/L) of 5.5 and 5.8 averaged (5.65) and used as typical concentration.
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	2.600	0.0010	Compliance inspection concentration of 2.6 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	3.500	0.0000	Compliance inspection concentration of 3.5 µg/L used as typical concentration.
Category 2 Subtotal					**290.0136**		**7.2872**	

Copper 1993
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	9.400	1.6829	Historic concentration and flows used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. 1992 flows reported. Based on 12 samples.
0020001087	001	Amherstburg WPCP	4952	1.8105	23.700	0.1624	Municipal pretreatment report. Typical concentration for Ontario primary treatment. 1992 flow reported.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.2545	90.000	0.0867	NOAA - typical concentration.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	6.200	0.0830	Historic concentrations and flows used to calculate daily loads. MANYDL used to estimate average load. (Two samples removed from data set. They had extremely large less than concentrations and the load was much higher than actual load.) Effective concentration calculated and used as typical concentration. 1992 flows reported. Based on 10 samples.
MI0001791	004A 1	Detroit Edison - Trenton Plant	4911	0.2420	90.000	0.0824	NOAA typical concentration.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1130	100.000	0.0428	NOAA - typical concentration.
0010000837	001	Essex Lagoon S.W.	4952	0.2644	18.100	0.0181	Municipal pretreatment report. Typical concentration for Ontario lagoon. 1992 flow reported.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0480	90.000	0.0164	NOAA - typical concentration.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	18.100	0.0157	Municipal pretreatment report. Typical concentration for Ontario lagoons. 1992 flow reported.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	NOAA typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	20.000	0.0000	NOAA - typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.

Copper 1993
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Cu µg/L	Cu Kg/Day	Notes
MI0036846	003A	P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.
MI0036846	004A	P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**95.3406**		**2.1904**	
Grand Total					**1,171.4990**		**67.1429**	

Mercury 1992
Category 1

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*n*	*Hg Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0021164	001A 1	Trenton WWTP	4952	5.6042	0.400	48	0.0085	(0.0035;	0.0619)	Compliance inspection concentration of <0.5 µg/L reported. Weekly concentrations and flows used to calculate loads. MANYDL used to estimate average load. Load and confidence intervals adjusted by annual average flow divided by average sample flow.
0020001103	001	West Windsor WPCP	4952	33.9533	0.051	5	0.0065	(0.0038;	0.0127)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
0020001096	001	Windsor Little River WPCP	4952	10.6374	0.042	5	0.0017	(0.0014;	0.0021)	Daily flow and concentration values used to calculate daily loads. MANYDL used to estimate the average load. Average load/ confidence intervals adjusted by yearly annual flow divided by sample average flow.
Category 1 Subtotal				**50.1949**			**0.0167**	**(0.0014;**	**0.0722)**	

Mercury 1992
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*Hg Kg/Day*	*Notes*
MI0000540	003A 1	BASF - Wyandotte	2891	0.6500	2.700	0.0066	Compliance inspection concentrations (µg/L) of 2.7 used as typical concentration.
Category 2 Subtotal				**0.6500**		**0.0066**	

Mercury 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	0.984	0.2492	NOAA typical concentration is 0.0 µg/L. Source Investigation for Lake Superior typical concentration of 0.984 µg/L used.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	65.9158	0.130	0.0324	Compliance inspection concentrations (µg/L) of <0.5, <0.5, and <0.5 reported. Source Investigation for Lake Superior report typical concentration for municipal secondary effluent.
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.3117	0.500	0.0157	Compliance inspection concentrations (µg/L) of <0.5, <0.5, and <0.5 reported. NOAA typical concentration is 1.8 µg/L. 0.5 µg/L used as typical concentration.
MI0000558	001A 1	Monsanto Co.	2819	7.8333	0.500	0.0148	Compliance inspection concentrations (µg/L) of <0.5 and <0.5 reported. NOAA typical concentration is 1.8 µg/L. 0.5 µg/L used as typical concentration.
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	0.077	0.0138	Historic concentration and flow data used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. Based on 52 samples.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	0.176	0.0024	Historic concentration and flow data used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. Based on 52 samples.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.5617	0.130	0.0013	Compliance inspection concentration of <0.5 µg/L reported. Source Investigation for Lake Superior report - typical concentration for municipal secondary effluent.
0020001087	001	Amherstburg WPCP	4952	1.8105	0.160	0.0011	Source Investigation for Lake Superior report - typical concentration for municipal primary treatment.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1453	2.000	0.0011	NOAA - typical concentration.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.1798	1.200	0.0008	NOAA - typical concentration.
MI0001791	005A 1	Detroit Edison - Trenton Plant	4911	0.0420	1.200	0.0002	NOAA - typical concentration.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0237	1.200	0.0001	NOAA - typical concentration.

Mercury 1992
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*Hg Kg/Day*	*Notes*
0010000837	001	Essex Lagoon S.W.	4952	0.2644	0.100	0.0001	Source Investigation for Lake Superior report - typical concentration for municipal lagoon.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	0.100	0.0001	Source Investigation for Lake Superior report - typical concentration for municipal lagoon.
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	0.000	0.0000	MISA inspection concentrations (µg/L) of <W 0.02, <W 0.06, <W 0.02, and <W 0.02 are reported. <W - no measurable response (zero): < reported value. NOAA typical concentration is 0.0
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	0.000	0.0000	MISA inspection concentrations (µg/L) of <W 0.02 reported for all four samples. No typical concentration could be found.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4333	0.000	0.0000	Compliance inspection concentrations of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0000540	002A 1	BASF - Wyandotte	2891	0.3167	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	NOAA - typical concentration.
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	0.000	0.0000	NOAA - typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.000	0.0000	NOAA - typical concentration.

Mercury 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0002399	001A 1	McLouth Steel - Trenton	3312	16.3917	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration. Stormwater Only.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.4083	0.000	0.0000	Compliance inspecion concetration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.000	0.0000	NOAA - typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	0.000	0.0000	Compliance inspection concentrations (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	0.984	0.0000	NOAA typical concentration is 0.0 µg/L. Source Investigation for Lake Superior report typical concentration of 0.984 µg/L used.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**402.4748**		**0.3331**	

Mercury 1992
Category 4

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0022802	049F 1	Detroit WWTP	4952	750.7500	0.130	0.3690	Compliance Inspection concentrations (µg/L) of <0.5 <0.5, and <0.5 reported. Weekly concentrations all less than 0.2 µg/L. Typical concentration of 0.13 µg/L from Source Investigation for Lake Superior report. Note: This agrees with effective concentration for 1993.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.5328	0.130	0.0037	All quarterly concentrations reported as 0. Compliance inspection concentration of <0.5 µg/L reported. Source Investigation for Lake Superior report typical concentration for municipal secondary effluent.
Category 4 Subtotal				**758.2828**		**0.3727**	
Grand Total				**1,211.6025**		**0.7291**	

Mercury 1993
Category 1

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	n	Hg Kg/Day	Lower Conf	Upper Conf	Notes
0020001103	001	West Windsor WPCP	4952	32.8108	0.095	5	0.0117	(0.0055;	0.0327)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
0020001096	001	Windsor Little River WPCP	4952	9.7414	0.055	5	0.0020	(0.0011;	0.0045)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.
Category 1 Subtotal				**42.5522**			**0.0137**	**(0.0000;**	**0.1115)**	

Mercury 1993
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0000540	003A 1	BASF - Wyandotte	2891	0.5000	2.700	0.0051	Compliance inspection concentration of 2.7 µg/L used as typical concentration.
Category 2 Subtotal				**0.5000**		**0.0051**	

Mercury 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*Hg Kg/Day*	*Notes*
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	0.984	0.2052	NOAA - typical concentration is 0.0; Source Investigation for Lake Superior typical concentration of 0.984 µg/L used.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	0.130	0.0325	Compliance inspection concentrations (µg/L) of <0.5, <0.5, and <0.5 reported. Source Investigation for Lake Superior report typical concentration for municipal secondary effluent.
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	0.077	0.0138	Historic concentration and flow data used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. 1992 flows reported. Based on 52 samples.
MI0000558	001A 1	Monsanto Co.	2819	7.1917	0.500	0.0136	Compliance inspection concentrations (µg/L) of <0.5 and <0.5 reported. NOAA typical concentration is 1.8 µg/L. 0.5 µg/L used as typical concentration.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	0.176	0.0024	Historic concentration and flow data used to calculate daily loads. MANYDL used to estimate average load. Effective concentration calculated and used as typical concentration. 1992 flows reported. Based on 52 samples.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.2545	1.200	0.0012	NOAA - typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.2467	0.130	0.0011	Compliance inspection concentration of <0.5 µg/L reported. Source Investigation for Lake Superior report - typical concentration for municipal secondary effluent.
MI0001791	004A 1	Detroit Edison - Trenton Plant	4911	0.2420	1.200	0.0011	NOAA - typical concentration.
0020001087	001	Amherstburg WPCP	4952	1.8105	0.160	0.0011	1992 flow reported. Source Investigation for Lake Superior report - typical concentration for municipal primary treatment.
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.5333	0.500	0.0010	Compliance inspection concentrations (µg/L) of <0.5, <0.5, and <0.5 reported. NOAA typical concentration is 1.8 µg/L. 0.5 µg/L used as typical concentration.

Mercury 1993
Category 3

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*Hg Kg/Day*	*Notes*
MI0002356	002A	1	Chrysler Trenton Engine Plant	3519	0.1130	2.000	0.0009	NOAA - typical concentration.
MI0001775	00C1	P	Detroit Edison - Conners Creek Pl	4911	0.0480	1.200	0.0002	NOAA - typical concentration.
0010000837	001		Essex Lagoon S.W.	4952	0.2644	0.100	0.0001	1992 flow reported. Source Investigation for Lake Superior report - typical concentration for municipal lagoon.
0010002407	001		Anderdon Edgewater Bch. Lagoon	4952	0.2258	0.100	0.0001	1992 flow reported. Source Investigation for Lake Superior report - typical concentration for municipal lagoon.
0000020107	001		Ford Motor Co. of Canada Ltd.	3321	18.3229	0.000	0.0000	1992 flow reported. MISA inspection concentrations (µg/L) of <W 0.02, <W 0.06, <W 0.02 and <W 0.02 reported. NOAA typical concentration is 0.0
0001040005	001		The Canadian Salt Company Ltd.	1400	6.0890	0.000	0.0000	1992 flow reported. MISA inspection concentrations (µg/L) of <W 0.02 reported for both samples. No typical concentration could be located.
MI0000540	001A	1	BASF - Wyandotte	2891	2.4467	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0000540	002A	1	BASF - Wyandotte	2891	0.2175	0.000	0.0000	Compliance inspection concentration (µg/L) of <0.5 reported. NOAA typical concentration is 0.0
MI0000931	001A	1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A	1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	NOAA - typical concentration.
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	0.000	0.0000	NOAA - typical concentration.
MI0002313	013A	1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0002313	015A	1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0

Mercury 1993
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.000	0.0000	NOAA - typical concentration.
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.
MI0002399	001A 1	McLouth Steel - Trenton	3312	19.2250	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration. Stormwater Only.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	0.000	0.0000	Compliance inspecion concetration of <0.5 reported. NOAA typical concentration is 0.0
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	0.000	0.0000	Compliance inspection concentrations of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	0.000	0.0000	Compliance inspection concentrations of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.000	0.0000	NOAA - typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	0.000	0.0000	Compliance inspection concentrations of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	0.000	0.0000	Compliance inspection concentration of <0.5 µg/L reported. NOAA typical concentration is 0.0
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	0.984	0.0000	NOAA typical concentration is 0.0; Source Investigation for Lake Superior report typical concentration used.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.

Mercury 1993
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Hg µg/L	Hg Kg/Day	Notes
MI0036846	004A	P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**365.2993**		**0.2742**	

Mercury 1993
Category 4

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Hg µg/L*	*Hg Kg/Day*	*Notes*
MI0022802	049F	1	Detroit WWTP	4952	717.2500	0.179	0.4868	Compliance inspection concentrations (µg/L) of <0.5, <0.5, and <0.5 reported. Weekly concentrations and MANYDL used to estimate effective concentration. No correlation assumed between flow and concentration. Annual load calculated by multiplying effective concentration times annual flow. Note: Three "less thans" assumed to be equal to the detection limit.
MI0043800	001A	1	Wayne Co., Huron Valley WWTP	4952	7.1175	0.130	0.0035	All quarterly concentrations reported as 0. Compliance inspection concentration of <0.5 µg/L reported. Source Investigation for Lake Superior report typical concentration for municipal secondary effluent used.
MI0021164	001A	1	Trenton WWTP	4952	4.9633	0.130	0.0024	Compliance inspection concentration of <0.5 µg/L reported. Weekly concentrations all less than 0.2 µg/L. 0.13 is typical concentration from Source Investigation for Lake Superior report.
Category 4 Subtotal					**729.3308**		**0.4927**	
Grand Total					**1,137.6823**		**0.7857**	

Lead 1992
Category 1

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	n	Pb Kg/Day	Lower Conf	Upper Conf	Notes
MI0022802	049F 1	Detroit WWTP	4952	750.7500	15.220	12	43.2599	(34.4673;	55.7535)	Monthly concentration and flow used to calculate load. MANYDL used to estimate average load. Load and confidence intervals adjusted by annual flow divided by average sample flow.
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	79.520	36	5.5146	(2.7746;	13.5730)	Daily flow and concentration data used to calcluate daily load. MANYDL used to estimate average load. Average load and confidence interval adjusted by annual average flow divided by average sample flow.
0020001103	001	West Windsor WPCP	4952	33.9533	24.400	9	3.1353	(1.6043;	7.7145)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.5328	94.140	4	2.6840	(2.1137;	3.4917)	Quarterly loads and confidence intervals calculated (Log) and adjusted by annual flow divided by sample flow.
MI0002399	001A 1	McLouth Steel - Trenton	3312	16.3917	42.600	52	2.6422	(1.6521;	8.7717)	Compliance inspection concentration of 8.2 µg/L reported. Daily concentration and flow used to calculate load. MANYDL used to estimate average load. Effective concentration calculated as 42.6 µg/L. Sample and annual average flow 16.4 MGD.
0020001096	001	Windsor Little River WPCP	4952	10.6374	22.410	10	0.9024	(0.5251;	1.6956)	Daily flow and concentration values used to calculate daily loads. MLE used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.

Lead 1992
Category 1

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Pb µg/L	n	Pb Kg/Day	Lower Conf	Upper Conf	Notes
MI0004227	001A	1	McLouth Steel - Gibraltar	3316	1.4083	24.550	52	0.1302	(0.1262;	0.4282)	Compliance inspecion concetration of 1.8 µg/L reported. Daily concentration and flow used to calculate load. MANYDL used to estimate average load. Effective concentration calculated as 46.5 µg/L. Both sample and annual flow are 1.4 MGD.
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	11.300	111	0.1170	(0.1090;	0.1270)	Compliance inspection concentrations (µg/L) of 1.7 and 2.1 reported. MANYDL used to estimate average load from daily concentration and flow data. Effective concentration calculated as 11.3 µg/L. Sample flow and annual average flow both 2.75 MGD.
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	2.940	111	0.0456	(0.0421;	0.0491)	Compliance inspection concentrations (µg/L) of 4.5 and 4.6 reported. Monitoring data from 014B processed to determine load (MANYDL - normal distribution.) Effective concentration for pipe 014 calculated by dividing load from 014B by annual flow for 014. Load and confidence intervals from 014B used as total load for pipe 014.
Category 1 Subtotal					**845.8239**			**58.4311**	**(43.9701;**	**72.8921)**	

Lead 1992
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	Pb Kg/Day	Notes
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	80.750	2.2605	Compliance inspection concentrations (µg/L) of 5.5 and 156 averaged (80.75) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	16.650	1.7513	Compliance inspection concentrations (µg/L) of 2.3 and 31.0 averaged (16.65) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	1.300	0.3292	Compliance inspection concentration of 1.3 µg/L used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	14.2833	4.000	0.2163	Compliance inspection concentration of 4.0 µg/L used as typical concentration.
MI0002399	004A 1	McLouth Steel - Trenton	3312	14.0333	2.200	0.1169	Compliance inspection concentrations of 2.2 µg/L used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	1.950	0.1091	Compliance inspection concentrations (µg/L) of 1.8 and 2.1 averaged (1.95) and used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	1.400	0.0939	Compliance inspection concentrations (µg/L) of 1.3 and 1.5 averaged (1.4) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	2.950	0.0846	Compliance inspection concentrations (µg/L) of 4.1 and 1.8 averaged (2.95) and used as typical concentration.
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.3167	1.850	0.0582	Compliance inspection concentrations (µg/L) of <50, 1.7, and 2.0 reported. The <50 was discarded and the remaining two values averaged (1.85) and used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	1.600	0.0541	Compliance inspection concentrations (µg/L) of 1.6 and 1.6 averaged (1.6) and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	3.600	0.0336	Compliance inspection concentrations (µg/L) of 5.1 and 2.1 averaged and used as typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	6.150	0.0154	Compliance inspection concentrations (µg/L) of 4.4 and 7.9 averaged (6.15) and used as typical concentration.
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	3.000	0.0067	Compliance inspection concentration of 3 µg/L used as typical concentration.

Lead 1992
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	2.950	0.0036	Compliance inspection concentrations (µg/L) of 4.2 and 1.7 averaged (2.95) and used as typical concentration.
MI0000540	002A 1	BASF - Wyandotte	2891	0.3167	2.900	0.0035	Compliance inspection concentrations (µg/L) of 2.9 and 2.9 averaged (2.9) and used as typical concentration.
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	8.800	0.0033	Compliance inspection concentration of 8.8 µg/L used as typical concentration.
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	3.300	0.0000	Compliance inspection concentration of 3.3 used as typical concentration.
Category 2 Subtotal				**192.1916**		**5.140**	

Lead 1992
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	12.000	2.1484	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	127.000	1.6997	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	65.9158	1.700	0.4240	Compliance inspection concentrations (µg/L) of 2.4, 1.8, and <1.0 reported. All values are less than typical concentrations found. 1.7 µg/L used as typical concentration.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	9.490	0.2187	Flow weighted concentration from 1993 used as typical concentration.
0020001087	001	Amherstburg WPCP	4952	1.8105	28.100	0.1930	Municipal pretreatment report. Typical concentration for Ontario primary treatment.
MI0000558	001A 1	Monsanto Co.	2819	7.8333	2.600	0.0771	Compliance inspection concentrations (µg/L) of 4.2 and <1.0 reported. NOAA typical concentration is 200 µg/L. 2.6 µg/L used as typical concentration.
0010000837	001	Essex Lagoon S.W.	4952	0.2644	15.000	0.0150	Municipal pretreatment report. Typical concentrations for Ontario lagoons.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4333	1.450	0.0134	Compliance inspection concentrations (µg/L) of 1.9 and <1.0 reported. No typical concentration found. 1.45 µg/L used as typical concentration. Weekly monitoring began in December, 1993.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	15.000	0.0130	Municipal pretreatment report. Typical concentration for Ontario lagoons.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.1798	10.000	0.0068	NOAA - typical concentration.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1453	10.000	0.0055	NOAA - typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.6500	1.300	0.0032	Compliance inspection concentrations (µg/L) of 1.6 and <1.0 reported. No typical concentration found. 1.3 µg/L used as typical concentration.
MI0001791	005A 1	Detroit Edison - Trenton Plant	4911	0.0420	10.000	0.0016	NOAA - typical concentration.

Lead 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	Pb Kg/Day	Notes
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0237	10.000	0.0009	NOAA - typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	NOAA - typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	40.000	0.0000	NOAA - typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**193.7427**		**4.8202**	

Lead 1992
Category 4

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	Pb Kg/Day	Notes
MI0021164	001A 1	Trenton WWTP	4952	5.6042	17.700	0.3757	Quarterly samples of sufficiently poor quality as to be unusable for calcluating loading rates. Compliance inspection concentration of <1.0 µg/L reported. 1992 and 1993 data pooled, run through MANYDL, and an effective concentration calculated and used as typical concentration.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.5617	1.000	0.0097	Both yearly samples report 0 µg/L. Compliance inspection concentration of <1.0 µg/L reported. This value is less than typical concentrations found and was thus used as a typical concentration.
Category 4 Subtotal				**8.1659**		**0.3854**	
Grand Total				**1,239.9241**		**68.7768**	

Lead 1993
Category 1

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*n*	*Pb Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0022802	049F 1	Detroit WWTP	4952	717.2500	14.660	12	40.7978	(33.4831;	50.6443)	Monthly concentration and flow used to calculate load. MANYDL used to estimate average load. Eight values in May and December assumed to be at detection level.
MI0002399	001A 1	McLouth Steel - Trenton	3312	19.2250	63.500	55	4.6228	(3.6397;	6.0181)	Compliance inspection concentration of 8.2 µg/L reported. Daily concentraion and flow used to calculate load. MANYDL used to estimate average load. Effective concentration calculated as 63.5 µg/L. Load and confidence intervals adjusted by annual avege flow divided by sample average flow.
0020001103	001	West Windsor WPCP	4952	32.8108	26.360	10	3.2741	(1.2282;	14.0854)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.1175	86.710	4	2.3360	(1.0250;	7.5973)	Quarterly loads and confidence intervals calcluated (Log) and adjusted by annual flow divided by sample flow.
0020001096	001	Windsor Little River WPCP	4952	9.7414	19.250	11	0.7098	(0.4187;	1.3726)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4467	50.000	5	0.4635	(0.4128;	0.5233)	Compliance inspection concentrations (µg/L) of 1.9 and <1.0 reported. Weekly concentration and flow, beginning in December, used to calculate load. MANYDL used to estimate average load. Load and confidence intervals adjusted by annual average flow divided by average sample flow.

Lead 1993
Category 1

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	n	Pb Kg/Day	Lower Conf	Upper Conf	Notes
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	45.630	89	0.4333	(0.3171;	0.6151)	Compliance inspection concentrations (µg/L) of 1.7 and 2.1 reported. MANYDL used to estimate average load from daily concentration and flow. Effective concentration calculated as 45.63 µg/L. Both sample and annual average flow are 2.51 MGD.
MI0021164	001A 1	Trenton WWTP	4952	4.9633	8.840	4	0.1660	(0.0518;	1.0213)	Quarterly samples run through MANYDL. Annual load and confidence intervals adjusted by annual flow divided by sample flow.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	24.200	52	0.1275	(0.1022;	0.1792)	Compliance inspecion concetration of 1.8 µg/L reported. Daily concentration and flow used to calculated load. MANYDL used to estimate average load. Effective concentraiton calculated as 24.2 µg/L. Estimated load and confidence intervals adjusted by annual average flow divided by average sample flow.
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	7.600	75	0.1234	(0.0979;	0.1588)	Compliance inspection concentrations (µg/L) of 4.5 and 4.6 reported. Monitoring data from 014B procesed to determine load (MANYDL). Effective concentration for pipe 014 calculated by dividing load from 014B by annual flor for 014. Load and confidence intervals from 014B used as total load for pipe 014.
Category 1 Subtotal				**801.7380**			**53.0542**	**(40.2209;**	**65.8873)**	

Lead 1993
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	55.220	3.8296	1993 MISA Inspection flow weighted concentration used as typical concentration. (73 µg/L, 77889 m3/Day; 38 µg/L, 80427 m3/Day). 1992 flow reported.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	80.750	1.7638	Compliance inspection concentrations (µg/L) of 5.5 and 156 averaged (80.75) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	16.650	1.4670	Compliance inspection concentrations (µg/L) of 2.3 and 31.0 averaged (16.65) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	1.300	0.2710	Compliance inspection concentration of 1.3 µg/L used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	15.5667	4.000	0.2357	Compliance inspection concentration of 4.0 µg/L used as typical concentration.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	9.490	0.2187	Flow weighted concentration reported. 1992 flow reported.
MI0002399	004A 1	McLouth Steel - Trenton	3312	18.2500	2.200	0.1520	Compliance inspection concentrations of 2.2 µg/L used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	1.950	0.0866	Compliance inspection concentrations (µg/L) of 1.8 and 2.1 averaged (1.95) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	2.950	0.0842	Compliance inspection concentrations (µg/L) of 4.1 and 1.8 averaged (2.95) and used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	1.400	0.0702	Compliance inspection concentrations (µg/L) of 1.3 and 1.5 averaged (1.4) and used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	1.600	0.0609	Compliance inspection concentrations (µg/L) of 1.6 and 1.6 averaged (1.6) and used as typical concentration.
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.5333	1.850	0.0598	Compliance inspection concentrations (µg/L) of <50, 1.7, and 2.0 reported. The <50 was discarded and the remaining two values averaged (1.85) and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	3.600	0.0417	Compliance inspection concentrations (µg/L) of 5.1 and 2.1 averaged (3.6) and used as typical concentration.

Lead 1993
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	6.150	0.0169	Compliance inspection concentrations (µg/L) of 4.4 and 7.9 averaged (6.15) and used as typical concentration.
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	3.000	0.0064	Compliance inspection concentration of 3 µg/L used as typical concentration.
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	8.800	0.0033	Compliance inspection concentration of 8.8 µg/L used as typical concentration.
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	2.950	0.0029	Compliance inspection concentrations (µg/L) of 4.2 and 1.7 averaged (2.95) and used as typical concentration.
MI0000540	002A 1	BASF - Wyandotte	2891	0.2175	2.400	0.0020	Compliance inspection concentrations (µg/L) of 2.9 and 2.9 averaged (2.9) and used as typical concentration.
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	3.300	0.0000	Compliance inspection concentration of 3.3 µg/L used as typical concentration.
Category 2 Subtotal				**198.4078**		**8.3727**	

Lead 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	12.000	2.1484	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	127.000	1.6997	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	1.700	0.4252	Compliance inspection concentrations (µg/L) of 2.4, 1.8, and <1.0 reported. All values are less than typical concentrations found. 1.7 µg/L used as typical concentration.
0020001087	001	Amherstburg WPCP	4952	1.8105	28.100	0.1930	Municipal pretreatment report. Typical concentration for Ontario primary treatment. 1992 flow reported.
MI0000558	001A 1	Monsanto Co.	2819	7.1917	2.600	0.0708	Compliance inspection concentrations (µg/L) of 4.2 and <1.0 reported. NOAA typical concentration is 200 µg/L. 2.6 µg/L used as typical concentration.
0010000837	001	Essex Lagoon S.W.	4952	0.2644	15.000	0.0150	Municipal pretreatment report. typical concentration for Ontario lagoons. 1992 flow reported.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	15.000	0.0130	Municipal pretreatment report. Typical concentration for Ontario lagoons. 1992 flow reported.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.2545	10.000	0.0096	NOAA - typical concentration.
MI0001791	004A 1	Detroit Edison - Trenton Plant	4911	0.2420	10.000	0.0092	NOAA - typical concentration.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1130	10.000	0.0043	NOAA - typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.5000	1.300	0.0025	Compliance inspection concentrations (µg/L) of 1.6 and <1.0 reported. No typical concentration found. 1.3 µg/L used as typical concentration.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0480	10.000	0.0018	NOAA typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	NOAA - typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.

Lead 1993
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Pb µg/L	Pb Kg/Day	Notes
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	40.000	0.0000	NOAA - typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**169.1064**		**4.5924**	

Lead 1993
Category 4

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Pb µg/L*	*Pb Kg/Day*	*Notes*
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.2467	1.000	0.0085	Both yearly samples reported as 0 µg/L. Compliance inspection concentration of <1.0 µg/L reported. **This value is less than typical concentrations found and was thus used as a typical concentration.**
Category 4 Subtotal				**2.2467**		**0.0085**	
Grand Total				**1,171.4990**		**66.0277**	

Zinc 1992
Category 1

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Zn µg/L	n	Zn Kg/Day	Lower Conf	Upper Conf	Notes
0000020107	001		Ford Motor Co. of Canada Ltd.	3321	18.3229	2,220.000	36	153.9000	(115.4000;	192.5000)	Daily flow and concentration data used to calcluate daily load. MANYDL used to estimate average load. Substitute load used and normal statistics were then used to calculated the average load and confidence intervals. They were then adjusted by annual average flow divided by average sample flow.
MI0022802	049F	1	Detroit WWTP	4952	750.7500	44.900	12	127.7000	(85.4680;	204.1360)	MANYDL used on monthly loads.
MI0002399	001A	1	McLouth Steel - Trenton	3312	16.3917	213.000	52	13.2080	(8.9820;	20.6030)	Daily data used to estimate load. Load and confidence intervals not adjusted as annual flow was the same as sample flow.
0020001103	001		West Windsor WPCP	4952	33.9533	33.680	10	4.3290	(2.7160;	7.5710)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	189.000	111	1.9690	(1.6630;	2.3580)	Available daily data used to estimate load using MANYDL. Sample flow and annual flow were equal so no adjustment was made to load and confidence intervals.
MI0043800	001A	1	Wayne Co., Huron Valley WWTP	4952	7.5328	4.380	4	1.4220	(1.1850;	1.7290)	Quarterly loads and confidence intervals calculated (Log) and adjusted by annual flow divided by sample flow.
MI0021164	001A	1	Trenton WWTP	4952	5.6042	60.900	4	1.2920	(0.9280;	1.8880)	MANYDL used on quarterly samples. Load and confidence intervals adjusted by annual flow divided by sample flow.
0020001096	001		Windsor Little River WPCP	4952	10.6374	20.900	10	0.8410	(0.7360;	0.9690)	Daily flow and concentration values used to calculate daily loads. MANYDL used to estimate the average load. Average load/ confidence intervals adjusted by yearly annual flow divided by sample average flow.

Zinc 1992
Category 1

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*n*	*Zn Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0002381	001A	1	ELF Atochem North America Inc	2819	8.3167	19.640	12	0.6180	(0.4650;	0.8510)	MANYDL used on monthly loads for Log statistics.
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	39.000	109	0.6030	(0.5100;	0.7210)	Monitoring data from 014B processed to determine load (MANYDL). Effective concentration for pipe 014 calculated by dividing load from 014B by annual flow for 014. Load and confidence intervals from 014B used as total load for pipe 014.
MI0004227	001A	1	McLouth Steel - Gibraltar	3316	1.4083	11.700	52	0.0620	(0.0520;	0.0760)	Weekly samples used to estimate load (MANYDL). Load and confidence intervals adjusted by annual flow divided by sample flow.
Category 1 Subtotal					**859.7447**			**305.9440(**	**226.2842;**	**385.6037)**	

Zinc 1992
Category 2

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Zn µg/L	Zn Kg/Day	Notes
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	65.9158	51.200	12.7740	Compliance inspection concentrations (µg/L) of 52, 63.7, and 38 averaged (51.2) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	42.000	10.6350	Compliance inspection concentration of 42 µg/L used as typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	334.500	9.3640	Compliance inspection concentrations (µg/L) of 49 and 620 averaged (334.5) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	79.000	8.3090	Compliance inspection concentrations (µg/L) of 21 and 137 averaged (79) and used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	14.2833	112.000	6.0550	Compliance inspection concentration of 112 µg/L used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	80.000	2.7070	Compliance inspection concentrations (µg/L) of 120 and 40 averaged (80) and used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	47.000	2.6280	Compliance inspection concentrations (µg/L) of 28 and 66 averaged (47) and used as typical concentration.
MI0002399	004A 1	McLouth Steel - Trenton	3312	14.0333	48.000	2.5500	Compliance inspection concentrations of 48 µg/L used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	33.000	2.2140	Compliance inspection concentrations (µg/L) of 19 and 47 averaged (33) and used as typical concentration.
MI0000558	001A 1	Monsanto Co.	2819	7.8333	43.000	1.2750	Compliance inspection concentrations (µg/L) of 74 and 12 averaged (43) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	33.000	0.9470	Compliance inspection concentrations (µg/L) of 46 and 20 averaged (33) and used as typical concentration.
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	235.500	0.2870	Compliance inspection concentrations (µg/L) of 134 and 337 averaged (235.5) and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	30.500	0.2850	Compliance inspection concentrations (µg/L) of 17 and 44 averaged (30.5) and used as typical concentration.

Zinc 1992
Category 2

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*Zn Kg/Day*	*Notes*
MI0000540	001A	1	BASF - Wyandotte	2891	2.4333	18.750	0.1730	Compliance inspection concentrations (µg/L) of 15.5 and 22 averaged (18.75) and used as typical concentration.
MI0026191	001A	1	Grosse Ile Township WWTP	4952	2.5617	16.800	0.1630	Yearly samples of 0 and 23 µg/L reported. Compliance inspection concentration of 16.8 µg/L used as typical concentration.
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	63.000	0.1580	Compliance inspection concentrations (µg/L) of 54 and 72 averaged (63) and used as typical concentration.
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	48.000	0.1070	Compliance inspection concentration of 48 µg/L used as typical concentration.
MI0000540	003A	1	BASF - Wyandotte	2891	0.6500	22.500	0.0550	Compliance inspection concentrations (µg/L) of 29 and 16 averaged (22.5) and used as typical concentration.
MI0000540	002A	1	BASF - Wyandotte	2891	0.3167	35.500	0.0430	Compliance inspection concentrations (µg/L) of 38 and 33 averaged (35.5) and used as typical concentration.
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	50.000	0.0190	Compliance inspection concentration of 50 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	27.000	0.0000	Compliance inspection concentration of 27 µg/L used as typical concentration.
Category 2 Subtotal					**263.2691**		**60.7480**	

Zinc 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	Zn µg/L	Zn Kg/Day	Notes
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	16.000	2.8650	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
0020001087	001	Amherstburg WPCP	4952	1.8105	175.500	1.2030	Municpal Pretreatment Report. Typical concentration for primary treatment.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.1798	700.000	0.4760	Typical concentration - NOAA
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	12.040	0.2770	Flow weighted concentration from 1993 used as typical concentration.
MI0001791	005A 1	Detroit Edison - Trenton Plant	4911	0.0420	700.000	0.1110	Typical concentration - NOAA
0010000837	001	Essex Lagoon S.W.	4952	0.2644	81.800	0.0820	Municipal Pretreatment Report. Typical concentration for Ontario Lagoons.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	81.800	0.0700	Municipal Pretreatment Report. Typical concentrations for Ontario lagoon.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0237	700.000	0.0630	Typical concentration - NOAA
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1453	100.000	0.0550	Typical concentration - NOAA
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	29.300	0.0390	MANYDL could not be used for historic data. MISA inspection data used to estimate typical concentration. Resultant estimate is not inconsistent with historic data.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	Typical concentration - NOAA
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	100.000	0.0000	Typical concentration - NOAA
MI0036803	001A 1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.

Zinc 1992
Category 3

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Zn µg/L	Zn Kg/Day	Notes
MI0036846	004A	P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**116.9103**		**5.2410**	
Grand Total					**1,239.9241**		**371.9330**	

Zinc 1993
Category 1

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Zn $\mu g/L$	n	Zn Kg/Day	Lower Conf	Upper Conf	Notes
MI0022802	049F	1	Detroit WWTP	4952	717.2500	46.200	12	125.5450	(104.9750;	152.1370)	MANYDL used on montlhly loads.
MI0002399	001A	1	McLouth Steel - Trenton	3312	19.2250	611.000	52	44.4400	(33.3300;	61.1880)	Available daily data used to estimate load (MANYDL). Load and confidence intervals adjusted by annual flow divided by sample flow.
MI0002313	018A	1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	617.000	102	5.8640	(4.8010;	7.2720)	Available daily data used to estimate load using MANYDL. Sample flow and annual flow were equal so no adjustment was mad to load and confidence intervals.
0020001103	001		West Windsor WPCP	4952	32.8108	37.400	10	4.6390	(3.1910;	7.1600)	Daily flow and concentrations used to calculate daily loads. MANYDL used to estimate average load. Load and confidence adjusted by annual flow divided by sample flow.
MI0002313	014B	1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	132.000	81	2.1390	(1.5850;	2.9870)	Monitoring data from 014B processed to determine load (MANYDL). Effective concentration for pipe 014 calculated by dividing load from 014B by annual flow for 014. Load and confidence intervals from 014B used as total load for pipe 014.
MI0021164	001A	1	Trenton WWTP	4952	4.9633	93.600	4	1.7580	(0.5590;	10.8800)	MANYDL used on quarterly loads. Load and confidence intervalse adjusted by annual flow divided by sample flow.
MI0043800	001A	1	Wayne Co., Huron Valley WWTP	4952	7.1175	57.300	4	1.6210	(1.1730;	2.3430)	Quarterly loads and confidence intervals calcluated (Log) and adjusted by annual flow divided by sample flow.
0020001096	001		Windsor Little River WPCP	4952	9.7414	20.000	11	0.7390	(0.5560;	1.0180)	Daily flow and concentration values used to calculate daily loads. MANYDL (Log Transform) used to estimate the average load. Average load/confidence intervals adjusted by yearly annual flow divided by sample average flow.

Zinc 1993
Category 1

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*n*	*Zn Kg/Day*	*Lower Conf*	*Upper Conf*	*Notes*
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.5333	16.900	12	0.5470	(0.4440;	0.6860)	MANYDL used on monthly loads.
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	41.000	52	0.2150	(0.1530;	0.3160)	Available daily samples used to estimate load (MANYDL). Load and confidence intervals adjusted by annual flow divided by sample flow.
Category 1 Subtotal				**807.8247**			**187.5070(**	**155.2240;**	**219.7900)**	

Zinc 1993
Category 2

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*Zn Kg/Day*	*Notes*
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	2,200.000	152.5750	1993 MISA Inspection concentrations (both 2200 µg/L) used as typical concentration. 1992 flow reported.
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	51.200	12.8050	Compliance inspection concentrations (µg/L) of 52, 63.7, and 38 averaged (51.2) and used as typical concentration.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	42.000	8.7560	Compliance inspection concentration of 42 µg/L used as typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	334.500	7.3060	Compliance inspection concentrations (µg/L) of 49 and 620 averaged (334.5) and used as typical concentration.
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	79.000	6.9600	Compliance inspection concentrations (µg/L) of 21 and 137 averaged (79) and used as typical concentration.
MI0002399	002A 1	McLouth Steel - Trenton	3312	15.5667	112.000	6.5990	Compliance inspection concentration of 112 µg/L used as typical concentration.
MI0002399	004A 1	McLouth Steel - Trenton	3312	18.2500	48.000	3.3160	Compliance inspection concentration of 48 µg/L used as typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	80.000	3.0470	Compliance inspection concentrations (µg/L) of 120 and 40 averaged (80) and used as typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	47.000	2.3580	Compliance inspection concentrations (µg/L) of 8.4 and 5.1 averaged (6.75) and used as typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	33.000	1.6560	Compliance inspection concentrations (µg/L) of 28 and 66 averaged (47) and used as typical concentration.
MI0000558	001A 1	Monsanto Co.	2819	7.1917	43.000	1.1700	Compliance inspection concentrations (µg/L) of 74 and 12 averaged (43) and used as typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	33.000	0.9410	Compliance inspection concentrations (µg/L) of 46 and 20 averaged (33) and used as typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	30.500	0.3530	Compliance inspection concentrations (µg/L) of 17 and 44 averaged (30.5) and used as typical concentration.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	12.040	0.2770	Flow weighted concentration reported. 1992 flow reported.

Zinc 1993
Category 2

Permit or CofA	Pipe		Facility Name	SIC	Flow MGD	Zn µg/L	Zn Kg/Day	Notes
MI0002313	011A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	235.500	0.2300	Compliance inspection concentrations (µg/L) of 134 and 337 averaged (235.5) and used as typical concentration.
MI0000540	001A	1	BASF - Wyandotte	2891	2.4467	18.750	0.1740	Compliance inspection concentrations (µg/L) of 15.5 and 22 averaged (18.75) and used as typical concentration.
MI0026786	007A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	63.000	0.1730	Compliance inspection concentrations (µg/L) of 54 and 72 averaged (63) and used as typical concentration.
MI0026191	001A	1	Grosse Ile Township WWTP	4952	2.2467	16.800	0.1430	Yearly samples reported as 0 and 23 µg/L. Data unusable. Compliance inspection concentration of 16.8 µg/L used as typical concentration.
MI0002313	012A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	48.000	0.1030	Compliance inspection concentration of 48 µg/L used as typical concentration.
MI0000540	003A	1	BASF - Wyandotte	2891	0.5000	22.500	0.0430	Compliance inspection concentrations (µg/L) of 29 and 16 averaged (22.5) and used as typical concentration.
MI0000540	002A	1	BASF - Wyandotte	2891	0.2175	35.500	0.0290	Compliance inspection concentrations (µg/L) of 38 and 33 averaged (35.5) and used as typical concentration.
MI0026786	005A	1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	50.000	0.0190	Compliance inspection concentration of 50 µg/L used as typical concentration.
MI0002313	017A	1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	27.000	0.0000	Compliance inspection concentration of 27 µg/L used as typical concentration.
Category 2 Subtotal					**268.3336**		**209.0330**	

Zinc 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*Zn Kg/Day*	*Notes*
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	16.000	2.8650	Historic data not suitable for processing. 1992 flows reported. 1993 MISA inspection data averaged and used as typical concentration.
0020001087	001	Amherstburg WPCP	4952	1.8105	175.500	1.2030	1992 flow reported. Municipal Pretreatment Report. Typical concentration for Ontario primary treatment.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.2545	700.000	0.6740	Typical concentration - NOAA
MI0001791	004A 1	Detroit Edison - Trenton Plant	4911	0.2420	700.000	0.6410	Typical concentration - NOAA
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0480	700.000	0.1270	Typical concentration - NOAA
0010000837	001	Essex Lagoon S.W.	4952	0.2644	81.800	0.0820	1992 flow reported. Municipal Pretreatment Report. typical concentration for Ontario Lagoons.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	81.800	0.0700	1992 flow reported. Municipal Pretreatment Report. Typical concentration for Ontario lagoon.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1130	100.000	0.0430	Typical concentration - NOAA
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	29.300	0.0390	Historic data not suitable for processing. 1992 flows reported. 1993 MISA inspection data from 1993 and 1993 averaged and used as typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	Typical concentration - NOAA
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration. Stormwater Only.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	100.000	0.0000	Typical concentration - NOAA
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.

Zinc 1993
Category 3

Permit or CofA	*Pipe*		*Facility Name*	*SIC*	*Flow MGD*	*Zn µg/L*	*Zn Kg/Day*	*Notes*
MI0036846	005A	1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A	P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal					**95.3406**		**5.7440**	
Grand Total					**1,171.4990**		**402.2840**	

PCB 1992
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*PCB µg/L*	*PCB Kg/Day*	*Notes*
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	65.9158	0.087	0.0217	Upper Great Lakes Connecting Channels Study
MI0002399	004A 1	McLouth Steel - Trenton	3312	14.0333	0.256	0.0136	Detroit River Remedial Action Plan Stage One
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	27.7891	0.095	0.0100	Upper Great Lakes Connecting Channels Study
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	0.070	0.0049	Effective concentration estimated from 1990-1991 MISA data.
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	66.9000	0.016	0.0042	Detroit River Remedial Action Plan Stage One
MI0002399	002A 1	McLouth Steel - Trenton	3312	14.2833	0.063	0.0034	Detroit River Remedial Action Plan Stage One
0020001103	001	West Windsor WPCP	4952	33.9533	0.020	0.0026	Compliance inspection concentrations (µg/L) of <0.032, <0.012, and <0.012 reported. Source Investigation for Lake Superior report typical concentration for municipal secondary treatment.
MI0000558	001A 1	Monsanto Co.	2819	7.8333	0.071	0.0021	Detroit River Remedial Action Plan Stage One
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.3117	0.058	0.0018	Detroit River Remedial Action Plan Stage One
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.4083	0.020	0.0011	Detroit River Remedial Action Plan Stage One
0020001096	001	Windsor Little River WPCP	4952	10.6374	0.020	0.0008	Compliance inspection concentrations (µg/L) of <0.032, <0.012, and <0.012 reported. Source Investigation for Lake Superior report typical concentration for municipal secondary treatment.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4333	0.054	0.0005	Detroit River Remedial Action Plan Stage One
0020001087	001	Amherstburg WPCP	4952	1.8105	0.044	0.0003	Source Investigation for Lake Superior typical concentration for municipal primary treatment.
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.1798	0.000	0.0003	Source Investigation for Lake Superior typical loading for electric generation.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0237	0.000	0.0003	Source Investigation for Lake Superior typical loading for electric generation.
MI0001791	005A 1	Detroit Edison - Trenton Plant	4911	0.0420	0.000	0.0003	Source Investigation for Lake Superior typical loading for electric generation.

PCB 1992
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*PCB µg/L*	*PCB Kg/Day*	*Notes*
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.7458	0.026	0.0003	Detroit River Remedial Action Plan Stage One
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.3225	0.046	0.0001	Detroit River Remedial Action Plan Stage One
0010000837	001	Essex Lagoon S.W.	4952	0.2644	0.038	0.00004	Source Investigation for Lake Superior report typical concentration for municipal lagoon.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	0.038	0.00003	Source Investigation for Lakes Superior report typical concentraiton for municipal lagoon.
MI0000540	002A 1	BASF - Wyandotte	2891	0.3167	0.026	0.00003	Detroit River Remedial Action Plan Stage One
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	0.000	0.0000	Zero used for typical concentration. None of the data examined indicate the presence of PCB at this facility.
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	0.000	0.0000	Zero used for typical concentration. None of the data examined indicate the presences of PCB at this facility.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	0.000	0.0000	MISA inspection concentrations (ng/L) of <W 40, <W 20, <W 20, and <W 20 reported. No typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.6500	0.000	0.0000	No typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.5283	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	21.9909	0.000	0.0000	No typical concentration.
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5900	0.000	0.0000	No typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5783	0.000	0.0000	No typical concentration.
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.0817	0.000	0.0000	No typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	8.9392	0.000	0.0000	No typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.4650	0.000	0.0000	No typical concentration.
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.000	0.0000	No typical concentration.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1453	0.000	0.0000	No typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.1813	0.000	0.0000	No typical concentration.
MI0002399	001A 1	McLouth Steel - Trenton	3312	16.3917	0.000	0.0000	No typical concentration.
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.1483	0.000	0.0000	No typical concentration.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0100	0.000	0.0000	No typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	17.7242	0.000	0.0000	No typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	14.7750	0.000	0.0000	No typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	7.3958	0.000	0.0000	No typical concentration.

PCB 1992
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	PCB µg/L	PCB Kg/Day	Notes
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.000	0.0000	No typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.6625	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	0.000	0.0000	No typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0345	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.9145	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	1.0362	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	11.4212	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.6030	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.0048	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	9.4192	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**473.4704**		**0.0682**	

PCB 1992
Category 4

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	PCB µg/L	PCB Kg/Day	Notes
MI0022802	049F 1	Detroit WWTP	4952	750.7500	0.167	0.4730	Weekly samples used. Arochlors summed to produce total PCB concentration. All arochlors and C.I.s reported as less than detection. Lowest value used as detection limit.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.5328	0.020	0.0006	All quarterly concentrations reported as 0 for 1992 and 1993. Concentration from Source Investigation for Lake Superior Report.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.5617	0.040	0.0004	Yearly samples for 1992 and 1993 have concentration of 0 reported. Concentration reported in Detroit River Remedial Action Plan Stage One.
MI0021164	001A 1	Trenton WWTP	4952	5.6042	0.012	0.0003	Quarterly samples with concentrations (µg/L) of 0, 0, <0.1, and 0.1 reported in 1992. Concentration reported in Detroit River Remedial Action Plan Stage One.
Category 4 Subtotal				**766.4487**		**0.4743**	
Grand Total				**1,239.9191**		**0.5426**	

PCB 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*PCB µg/L*	*PCB Kg/Day*	*Notes*
MI0021156	001A 1	Wayne Co. - Wyandotte WWTP	4952	66.0742	0.087	0.0218	Upper Great Lakes Connecting Channels Study
MI0002399	004A 1	McLouth Steel - Trenton	3312	18.2500	0.256	0.0177	Detroit River Remedial Action Plan Stage One
MI0026786	008A 1	Nat'l Steel, Great Lakes Div, Zug	3325	23.2775	0.095	0.0084	Upper Great Lakes Connecting Channels Study
0000020107	001	Ford Motor Co. of Canada Ltd.	3321	18.3229	0.070	0.0049	Effective concentration estimated from 1990-1991 MISA data. 1992 flow reported.
MI0002399	002A 1	McLouth Steel - Trenton	3312	15.5667	0.063	0.0037	Detroit River Remedial Action Plan Stage One
MI0026778	009A 1	Nat'l Steel, Great Lakes Div, 80"	3312	55.0825	0.016	0.0034	Detroit River Remedial Action Plan Stage One
MI0001724	002A 1	Detroit Edison - River Rouge Plan	4911	0.2545	0.000	0.0030	Source Investigation for Lake Superior typical loading for electric generation.
MI0001775	00C1 P	Detroit Edison - Conners Creek Pl	4911	0.0480	0.000	0.0030	Source Investigation for Lake Superior typical loading for electric generation.
MI0001791	004A 1	Detroit Edison - Trenton Plant	4911	0.2420	0.000	0.0030	Source Investigation for Lake Superior typical loading for electric generation.
0020001103	001	West Windsor WPCP	4952	32.8108	0.020	0.0025	Compliance inspection concentrations (µg/L) of <0.032, <0.012, and <0.012 reported. Source Investigation for Lake Superior report typical concentration for municipal secondary treatment.
MI0000558	001A 1	Monsanto Co.	2819	7.1917	0.071	0.0019	Detroit River Remedial Action Plan Stage One
MI0002381	001A 1	ELF Atochem North America Inc	2819	8.5333	0.058	0.0019	Detroit River Remedial Action Plan Stage One
MI0004227	001A 1	McLouth Steel - Gibraltar	3316	1.3942	0.020	0.0011	Detroit River Remedial Action Plan Stage One
0020001096	001	Windsor Little River WPCP	4952	9.7414	0.020	0.0007	Compliance inspection concentrations (µg/L) of <0.032, <0.012, and <0.012 reported. Source Investigation for Lake Superior report typical concentraion for municipal secondary treatment.
MI0000540	001A 1	BASF - Wyandotte	2891	2.4467	0.054	0.0005	Detroit River Remedial Action Plan Stage One

PCB 1993
Category 3

Permit or CofA	Pipe	Facility Name	SIC	Flow MGD	PCB µg/L	PCB Kg/Day	Notes
0020001087	001	Amherstburg WPCP	4952	1.8105	0.040	0.0003	Source Investigation for Lake Superior report typical concentration for municipal primary treatment. 1992 flow reported.
MI0002313	018A 1	Nat'l Steel, Great Lakes Div, Eco	3316	2.5050	0.026	0.0002	Detroit River Remedial Action Plan Stage One
MI0002313	011A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.2575	0.046	0.00004	Detroit River Remedial Action Plan Stage One
0010000837	001	Essex Lagoon S.W.	4952	0.2644	0.038	0.00004	Source Investigation for Lake Superior Report typical concentration for municipal lagoon. 1992 flow reported.
0010002407	001	Anderdon Edgewater Bch. Lagoon	4952	0.2258	0.038	0.00003	Source Investigation for Lake Superior report typical concentration for municipal lagoon. 1992 flow reported.
MI0000540	002A 1	BASF - Wyandotte	2891	0.2175	0.026	0.00002	Detroit River Remedial Action Plan Stage One
0000010009	001	General Chemical Canada Ltd.	2812	3.5359	0.000	0.0000	Zero used for typical concentration. None of the data examined indicate the presence of PCB at this facility. 1992 flows reported.
0000010009	002	General Chemical Canada Ltd.	2812	47.3016	0.000	0.0000	Zero used for typical concentration. None of the data examined indicate the presence of PCB at this facility. 1992 flows reported.
0001040005	001	The Canadian Salt Company Ltd.	1400	6.0890	0.000	0.0000	1992 flow reported. MISA inspection concentrations of <W 20 ng/L reported for both samples. No typical concentration.
MI0000540	003A 1	BASF - Wyandotte	2891	0.5000	0.000	0.0000	No typical concentration.
MI0000931	001A 1	Mobil Oil Corp. - Woodhaven	5171	0.4256	0.000	0.0000	No typical concentration.
MI0001953	001A 1	Michigan Foundation Inc.	1422	12.6218	0.000	0.0000	No typical concentration.
MI0002313	012A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.5675	0.000	0.0000	No typical concentration.
MI0002313	013A 1	Nat'l Steel, Great Lakes Div, Eco	3316	7.5375	0.000	0.0000	No typical concentration.
MI0002313	014B 1	Nat'l Steel, Great Lakes Div, Eco	3316	4.2842	0.000	0.0000	No typical concentration.
MI0002313	015A 1	Nat'l Steel, Great Lakes Div, Eco	3316	10.0617	0.000	0.0000	No typical concentration.
MI0002313	016A 1	Nat'l Steel, Great Lakes Div, Eco	3316	3.0592	0.000	0.0000	No typical concentration.
MI0002313	017A 1	Nat'l Steel, Great Lakes Div, Eco	3316	0.0000	0.000	0.0000	No typical concentration.
MI0002356	002A 1	Chrysler Trenton Engine Plant	3519	0.1130	0.000	0.0000	No typical concentration.
MI0002364	002A 1	Amoco Oil - Taylor	5171	0.0102	0.000	0.0000	No typical concentration.
MI0002399	001A 1	McLouth Steel - Trenton	3312	19.2250	0.000	0.0000	No typical concentration.

PCB 1993
Category 3

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*PCB µg/L*	*PCB Kg/Day*	*Notes*
MI0003221	001A 1	Ford Woodhaven Stamping Plant	3469	3.7629	0.000	0.0000	No typical concentration.
MI0024911	001A 1	Ashland Petroleum - Taylor	5171	0.0321	0.000	0.0000	No typical concentration.
MI0026786	001A 1	Nat'l Steel, Great Lakes Div, Zug	3325	13.2550	0.000	0.0000	No typical concentration.
MI0026786	002A 1	Nat'l Steel, Great Lakes Div, Zug	3325	11.7325	0.000	0.0000	No typical concentration.
MI0026786	003A 1	Nat'l Steel, Great Lakes Div, Zug	3325	5.7708	0.000	0.0000	No typical concentration.
MI0026786	005A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.1000	0.000	0.0000	No typical concentration.
MI0026786	007A 1	Nat'l Steel, Great Lakes Div, Zug	3325	0.7267	0.000	0.0000	No typical concentration.
MI0026794	019A 1	Nat'l Steel, Great Lakes Div, MI	3312	0.0000	0.000	0.0000	No typical concentration.
MI0036803	001A 1	Union Oil - Romulus	5171	0.0403	0.000	0.0000	No typical concentration.
MI0036846	001A W	Detroit Metro Wayne Co. Airport	4581	0.2783	0.000	0.0000	No typical concentration.
MI0036846	002A W	Detroit Metro Wayne Co. Airport	4581	0.4588	0.000	0.0000	No typical concentration.
MI0036846	003A P	Detroit Metro Wayne Co. Airport	4581	3.2254	0.000	0.0000	No typical concentration.
MI0036846	004A P	Detroit Metro Wayne Co. Airport	4581	5.8825	0.000	0.0000	No typical concentration.
MI0036846	005A 1	Detroit Metro Wayne Co. Airport	4581	3.5833	0.000	0.0000	No typical concentration.
MI0036846	006A P	Detroit Metro Wayne Co. Airport	4581	11.2236	0.000	0.0000	No typical concentration.
Category 3 Subtotal				**439.9215**		**0.0783**	

PCB 1993
Category 4

Permit or CofA	*Pipe*	*Facility Name*	*SIC*	*Flow MGD*	*PCB µg/L*	*PCB Kg/Day*	*Notes*
MI0022802	049F 1	Detroit WWTP	4952	717.2500	0.200	0.5421	Weekly samples used. Arochlors summed to produce total PCB concentration. Lowest reported value used as detection limit.
MI0043800	001A 1	Wayne Co., Huron Valley WWTP	4952	7.1175	0.020	0.0005	All quarterly concentrations reported as 0 for 1992 and 1993. Concentration from Source Investigation for Lake Superior Report.
MI0026191	001A 1	Grosse Ile Township WWTP	4952	2.2467	0.040	0.0003	Yearly samples for 1992 and 1993 have concentration of 0 reported. Concentration reported in Detroit River Remedial Action Plan Stage One.
MI0021164	001A 1	Trenton WWTP	4952	4.9633	0.012	0.0002	Quarterly samples with concentrations (µg/L) of <0.1, 0, 0, and 0. Concentration reported in Detroit River Remedial Action Plan Stage One.
Category 4 Subtotal				**731.5775**		**0.5431**	
Grand Total				**1,171.4990**		**0.6214**	

Appendix 9.2

Figure G
Detroit River Water Quality Monitoring Locations for Head and Mouth Transects

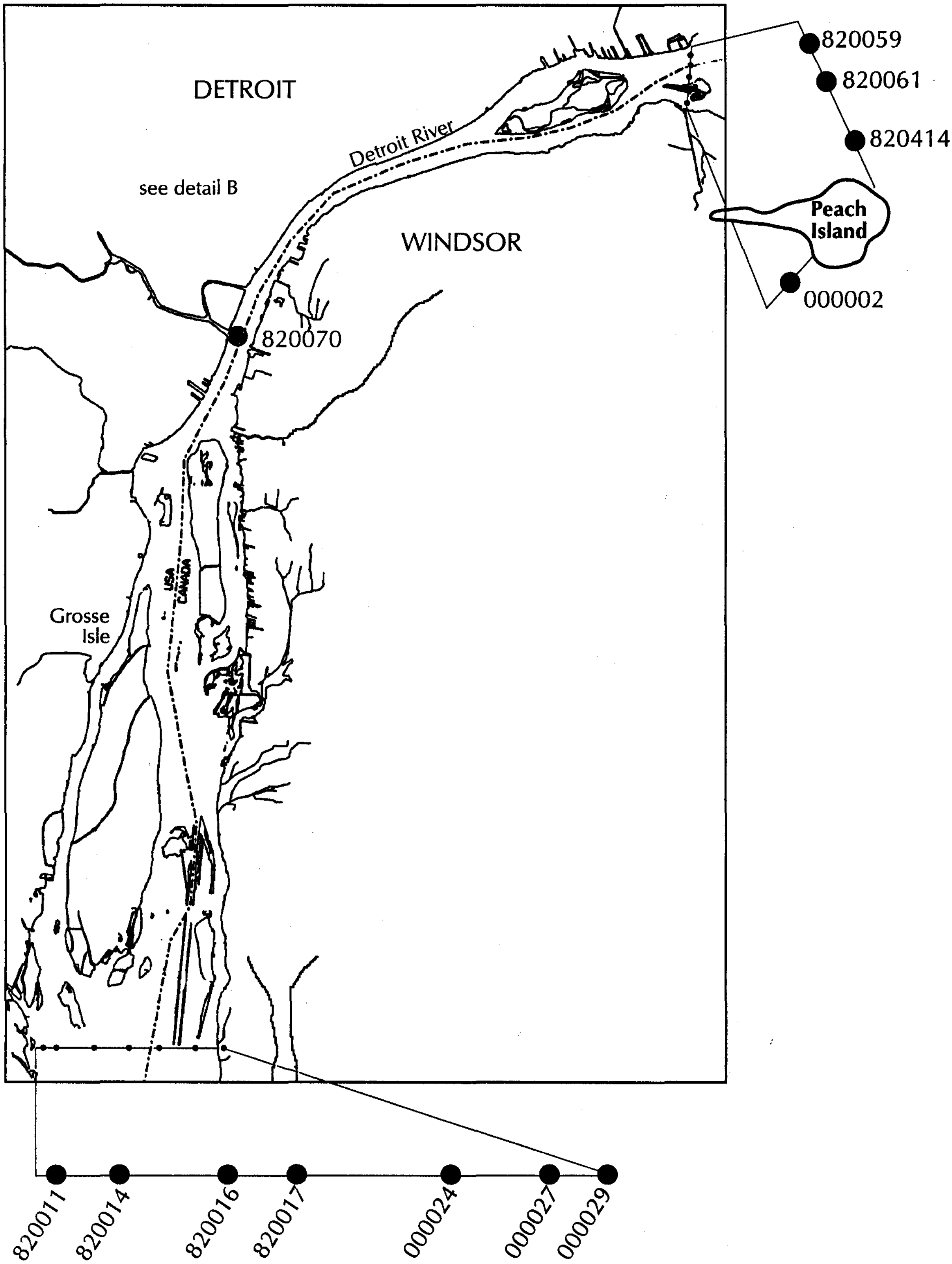


Table S
Detroit River Ambient Water Quality 1992-1993 for Head and Mouth Transects

STATION	DATE	TIME	01042 COPPER (ug/L)	01027 CADMIUM (ug/L)	01051 LEAD (ug/L)	01092 ZINC (ug/L)	71900 MERCURY (ug/L)
820059							
	92/05/05	1345	.2K	2	1K	4K	.2K
	92/07/07	1215	.2K	2	1K	4K	.2K
	92/08/04	1230	.2K	1	1K	4K	.2K
	92/09/01	1240	.2K	1K	1K	4K	.2K
	92/10/06	1330	.2K	2	1K	4K	.2K
	93/05/11	1250	.2K	1	1K	4K	.2K
	93/07/13	1240	.2K	1	1K	5	.2K
	93/08/10	1230	.2K	1	1K	7	.2K
	93/09/01	1220	.5	1K	1K	4K	.2K
	93/10/05	1250	.2K	1K	1K	4K	.2K
820061							
	92/05/05	1354	.2K	1K	1K	4K	.2K
	92/07/07	1223	.2K	2	1K	4K	.2K
	92/08/04	1241	.2K	1	1K	6	.2K
	92/09/01	1255	.2K	1	1K	5	.2K
	92/10/06	1340	.2K	1	1K	4K	.2K
	93/05/11	1307	.2K	2	1K	4K	.2K
	93/07/13	1255	.2K	1	1K	4K	.2K
	93/08/10	1250	.2K	1K	1K	4K	.2K
	93/09/01	1230	.2K	1K	1K	4K	.2K
	93/10/05	1303	.2K	1K	1K	4K	.2K
820414							
	92/05/05	1349	.2K	1	1K	4K	.2K
	92/07/07	1217	.2K	1	1K	4K	.2K
	92/08/04	1235	.2K	1K	1K	4K	.2K
	92/09/01	1245	.2K	1	1K	4K	.2K
	92/10/06	1335	.2K	1K	1K	9	.2K
	93/05/11	1302	.2K	1	1K	4K	.2K
	93/07/13	1245	.2K	1	1K	4K	.2K
	93/08/10	1240	.2K	1K	1K	18	.2K
	93/09/01	1225	.2K	1K	1K	4K	.2K
	93/10/05	1258	.2K	4	1K	5	.2K
000002							
	92/05/05	1405	.2K	1	1K	4K	.2K
	92/07/07	1239	.2K	1	1K	4K	.2K
	92/08/04	1300	.2K	1	1K	6	.2K
	92/09/01	1320	.2K	1	1K	14	.2K
	92/10/06	1350	.2K	2	1K	10	.2K
	93/05/11	1318	.2K	2	1K	4K	.2K
	93/07/13	1300	.2K	2	1K	4K	.2K
	93/08/10	1300	.2K	1K	1K	15	.2K
	93/09/01	1240	.2K	1	1K	4K	.2K
	93/10/05	1310	.2K	1K	1K	5	.2K

K = Actual value is less than the value given. Substance, if present, is below this limit.

STATION	DATE	TIME	01042 COPPER (ug/L)	01027 CADMIUM (ug/L)	01051 LEAD (ug/L)	01092 ZINC (ug/L)	71900 MERCURY (ug/L)
820011							
	92/05/05	1040	.2K	2	1	10	.2K
	92/07/07	1000	.2K	2	1	8	.2K
	92/08/04	1025	.2K	2	1	10	.2K
	92/09/01	1035	.2	2	2	11	.2K
	92/10/06	1020	.2K	2	1K	10	.2K
	93/05/11	1005	.2	1	1K	10	.2K
	93/07/13	1035	.2K	2	1K	10	.2K
	93/08/10	0945	.4	3	2	29	.2K
	93/09/01	0955	.2K	2	3	19	.2K
	93/10/05	1015	.3	2	2	14	.2K
820014							
	92/05/05	1050	.2K	1	1K	4	.2K
	92/05/05	1053	.2K	1	1K	4K	.2K
	92/07/07	1010	.2K	2	1K	4K	.2K
	92/07/07	1013	.2K	2	1K	4K	.2K
	92/08/04	1035	.2	2	1	22	.2K
	92/08/04	1041	.2K	1	1	5	.2K
	92/09/01	1045	.2K	1	2	7	.2K
	02/09/01	1048	.2K	1	1	6	.2K
	92/10/06	1030	.2K	1	1K	5	.2K
	92/10/06	1033	.2K	1	1K	6	.2K
	93/05/11	1015	.2K	2	1K	4K	.2K
	93/05/11	1018	.2K	2	1K	8	.2K
	93/07/13	1040	.2K	2	1K	4K	.2K
	93/07/13	1043	.2K	2	1K	12	.2K
	93/08/10	0955	.2K	1	2	9	.2K
	93/08/10	1003	.3K	1	1K	7	.2K
	93/09/01	1005	.2K	1	1	10	.2K
	93/09/01	1008	.2K	1	2	7	.2K
	93/10/05	1020	.2K	1	1K	7	.2K
	93/10/05	1025	.2K	1K	1K	6	.2K
820016							
	92/05/05	1100	.2K	1	1K	7	.2K
	92/07/07	1020	.2K	1	1K	4K	.2K
	92/08/04	1046	.2K	1	1K	5	.2K
	92/09/01	1055	.2K	1	1	8	.2K
	92/10/06	1040	.2K	1	1K	8	.2K
	93/05/11	1025	.2K	2	1K	4K	.2K
	93/07/13	1050	.2K	2	1K	4K	.2K
	93/08/10	1005	.2K	1	1	7	.2K
	93/09/01	1015	.2K	1K	1	4K	.2K
	93/10/05	1030	.2K	1K	1K	4K	.2K

K = Actual value is less than the value given. Substance, if present, is below this limit.

STATION	DATE	TIME	01042 COPPER (ug/L)	01027 CADMIUM (ug/L)	01051 LEAD (ug/L)	01092 ZINC (ug/L)	71900 MERCURY (ug/L)
820017							
	92/05/05	1106	.2K	1	1K	7	.2K
	92/07/07	1025	.2K	2	1K	4K	.2K
	92/09/01	1100	.2K	1	1	4K	.2K
	93/05/11	1045	.2K	1K	1K	4K	.2K
	93/05/11	1035	.2K	1	1K	4K	.2K
	93/07/13	1055	.2K	2	1K	4K	.2K
	93/08/10	1010	.2K	2	1K	6	.2K
	93/09/01	1025	.2K	1K	1K	6	.2K
	93/10/05	1035	.2K	1K	1K	4K	.2K
000024							
	92/05/05	1120	.2K	1K	1K	4K	.2K
	92/07/07	1037	.2K	2	1K	4K	.2K
	92/08/04	1108	.2K	1K	1K	6	.2K
	92/09/01	1115	.2K	1K	1K	4K	.2K
	92/10/06	1100	.2K	1	1K	4K	.2K
	93/05/11	1045	.2K	1	1K	4K	.2K
	93/07/13	1105	.2K	2	1K	4K	.2K
	93/08/10	1020	.2K	1K	1K	4K	.2K
	93/09/01	1040	.2K	1K	1K	4K	.2K
	93/10/05	1045	.2K	1	1K	4K	.2K
000027							
	92/05/05	1127	.2K	1K	1K	4K	.2K
	92/07/07	1044	.2K	2	1K	4K	.2K
	92/08/04	1115	.2K	1	1K	4K	.2K
	92/09/01	1120	.2K	1K	1K	6	.2K
	92/10/06	1104	.2K	1	1K	4	.2K
	93/05/11	1055	.2K	1	1K	4K	.2K
	93/07/13	1111	.2K	1	1K	4K	.2K
	93/08/10	1025	.2K	1K	1K	8	.2K
	93/09/01	1045	.2K	1K	1K	4K	.2K
	93/10/05	1050	.2K	1	1K	6	.2K
000029							
	92/05/05	1134	.2K	1K	1K	4K	.2K
	92/07/07	1047	.2K	2	1K	4K	.2K
	92/08/04	1130	.2K	1	1K	7	.2K
	92/09/01	1125	.2K	1	1K	4K	.2K
	92/10/06	1110	.2K	2	1K	8	.2K
	93/05/11	1103	.2K	2	1K	4K	.2K
	93/07/13	1118	.2K	2	1K	4K	.2K
	93/08/10	1030	.2K	2	1	9	.2K
	93/09/01	1055	.2K	1K	1K	5	.2K
	93/10/05	1100	.2K	1K	1K	4K	.2K

K = Actual value is less than the value given. Substance, if present, is below this limit.

STATION	DATE	TIME	01042 COPPER (ug/L)	01027 CADMIUM (ug/L)	01051 LEAD (ug/L)	01092 ZINC (ug/L)	71900 MERCURY (ug/L)
820070							
	92/01/28	1420	1	.2K	1K	6	
	92/02/18	1445	3	.2K	2	25	
	92/03/24	1520	3	.2K	1K	4K	
	92/04/27	1515	5	.2K	3	12	
	92/05/26	1505	5	.2K	4	11	
	92/06/22	1530	4	.2K	4	15	
	92/07/21	1345	7	.2	5	20	
	92/08/25	1330	4	.2K	3	11	
	92/09/22	1530	7	.2	6	26	
	92/10/27	1425	5	.2K	2	11	
	92/11/17	1345	7	.3	4	17	
	92/12/15	1545	3	.2K	2	13	
	93/02/23	1530	2	.2K	1K	9	
	93/03/09	1400	5	.2K	306	23	
	93/05/05	1445	4	.2K	5	21	.2K
	93/07/20	1435	4	.2K	3	10	.2K
	93/07/20	1445	4	.2K	5	27	.2K
	93/08/24	1505	5	.2K	7	19	.2K
	93/09/14	1425	8	.3	9	49	.2K
	93/10/26	1450	7	.2K	8	37	.2K
	93/12/14	1430	5	.2K	5	23	.2K

K = Actual value is less than the value given. Substance, if present, is below this limit.

ROUGE RIVER METALS LOADING — 1992 AND 1993

Loads from the Rouge River were estimated for the years 1992 and 1993 for cadmium, copper, lead and zinc. These estimates are based on the concentrations provided by Detroit River RAP staff and daily flows from the U.S. Geological Survey. No estimates were possible for mercury. The estimation with censored data was made easier by the fact that a constant detection limit was used for each metal. This allowed an estimate of a "replacement value" for each observation reported as "less than"; the same bias correction and flow adjustment equations typically used for phosphorus were then applied. Some trouble with cadmium was experienced (because it had less than 25% of values above detect), but a conservative estimate was obtained for those values also.

Note that all of the estimates are reasonable except for lead in 1993. This is due to one value (306 ug/L) which may be associated with a flow event. This is an indication that the sampling frequency (12 samples in 1992; 9 samples in 1993) may not be adequate to estimate lead loads accurately.

These estimates should be comparable to the 1984-1986 MDNR High Flow Event Study estimates, with two important caveats:

1. the 1984-1986 study handled censored data differently; and
2. the 1984-1986 estimates were based on weekly data.

The 1992-1993 estimates are probably not comparable to UGLCCS estimates which were based on composite samples and substantially lower detection limits, but made no attempt to sample the entire year.

Table T
Rouge River Loading Metals — 1992-1993

Parameter	1992		1993	
	Load (kg/D)	95% C.I.	Load (kg/D)	95% C.I.
Cadmium	0.5	(0.4, 0.6)	0.4	(0.3, 0.5)
Copper	13.4	(9.6, 17.2)	14.0	(10.4, 17.6)
Lead	9.1	(5.8, 12.4)	69.9	(0.0, 895.1)
Zinc	44.1	(29.2, 59.0)	67.0	(43.3, 90.6)
Annual avg. Flow	34.8m**3/sec		33.8 m**3/sec	

Appendix 10.1

Excerpt from the proposed Ontario CSO Strategy, MOEE, 1993.

CSO Abatement Technology

The technology used for CSO abatement range from non-structural alternatives such as source control and improvements in operation and maintenance to major structural alternatives including storage-treatment facilities. The CSO control technology can be categorized into nine groups:

- Source control
- Inflow/Infiltration Reduction
- Operation and Maintenance Improvements
- Control Structure Controls
- Collection System Improvements
- Storage Technologies
- Treatment Technologies
- Sewer Separation
- Emerging CSO Control Technologies

Source control refers to methods of reducing the quantity of pollutants entering the sewer system. It includes methods such as street cleaning, catch-basin, sewer flushing, anti-litter bylaw enforcement, industrial site runoff control and construction site erosion control.

Inflow refers to runoff that enters the sewer system directly. **Infiltration** refers to groundwater that enters the sewer system through leaks in the system, e.g., leaking sewers and manholes, leaking catchbasins and foundation drains. Minimizing the inflow/infiltration (I/I) would reduce the CSOs discharged into the receiving waters. I/I reduction include methods such as disconnection of roof leaders, disconnection of foundation or footing drains and inlet controls. However, implementation relies on public education and attitudes and there may be problems with legal access to private property.

Operation and maintenance of both the collection and treatment systems should be carried out with the objective of maximizing the use of existing capacity. Any improvements will reduce the requirements for more expensive structural controls. This objective can be met by developing an operational plan for the system by means of hydraulic modelling studies of the sewer system and process audit studies at the STP.

Control structure controls are methods that maximize the combined sewer storage capacity by means of regulator devices, polymer (friction reducing) flow additives and in-line storage.

Collection system improvements refer to capital works that eliminate or modify the outfalls, improve the operation or increase the capacity of sewers and pumping stations. Pumping stations may be improved by changing pump operation sequence or timing, wet well operating ranges and replacing impellers, or in some cases, constructing new pumping stations. Sewer capacity may be increased by eliminating bottlenecks in the sewer system.

Storage technologies provide various means of CSO control. Storage capacity is used to detain combined sewage until downstream conveyance and treatment capacity is available. Storage capacity in the collection system can be provided by several different means such as (a) In-line storage (b) Off-line storage (c) Tunnel storage.

Treatment technologies also provide some CSO control. Combined sewage that has been collected in the sewer system is conveyed for treatment either at the STP or at satellite treatment facilities. Some of the treatment components are screening, sedimentation, dissolved air flotation, high-rate filtration and disinfection. Primary treatment is the initial stage of a STP process that removes floating materials and suspended solids. It involves the processes of coarse screening, grit settling, comminution (shredding) and sedimentation. Secondary or biological treatment follows primary treatment. The most commonly used in Ontario is the activated sludge process. The step aeration or step feed activated sludge process is a modification of the conventional process. It allows a higher loading during wet weather conditions to the STP without hydraulic washout of the activated sludge.

Sewer separation refers to the installation of new sewers to separate the combined flow into sanitary and stormwater flows. Sometimes the existing combined sewer is used as the sanitary sewer while the new sewer becomes the storm sewer and sometimes it is vice versa.

The high costs of CSO control has led to research and investigation of new technology. Some of the new **emerging CSO control technology** include methods such as vortex valves, various storage tank designs, swirl concentrators or vortex solids separators, Dunkers flow-balancing system, helical bend regulator and real-time control.

The solutions to the problems in any combined sewer system are very site-specific. The most practical solutions would rely on a combination of these controls.

CSO Control Objectives

Combined sewer overflows and their impacts are highly variable, both in time and magnitude. Pollutants of concern and their impacts, based on local needs, would govern the CSO abatement strategy used to control the overflow. Defining and stating the need will allow a clear statement of the control objectives to be formulated. CSO control strategies can then be formulated to meet the control objectives, and the objectives used to evaluate the performance of various control technologies. Control objectives may be based on the aquatic ecosystem, the receiving water, end-of-pipe controls or minimizing impacts such as basement flooding. Frequency and volumetric control, and design storm events can also be the basis of control objectives.

The **aquatic environment** is a rational focus for control objectives. Since the overall objective of CSO control is to reduce impacts on the ecosystem, such a perspective would consider the effects of CSO on biota directly. However, this may be impractical because of the intrinsic complexity and high cost of establishing valid cause-and-effect relationships between CSO performance and impacts on biota.

Receiving water objectives are another focus for CSO control. The major challenge in implementing water quality-based criteria is the issue of determining the nature of the receiver-source interaction. A connection must be established between receiving water quality problems and the point of discharge. In many cases, this is difficult and costly to achieve, but it has been done for cases of beach pollution from CSOs. Establishing criteria would involve examining impacts of certain pollutants upon local receiving water characteristics, identifying pollutant-specific concerns and formulating specific control criteria. Obtaining wet-weather monitoring data and documenting the impacts on receiving waters present significant challenges. Different pollutant-source interactions require different time scales of analysis. For example, it may be necessary to consider seasonal event, or peak loads.

End-of-pipe control objectives are less directly representative of impacts on the receiving water and biota. However, end-of-pipe control objectives are an effective surrogate which can reasonably reflect these impacts without the requirements of exhaustive data collection and analysis. Administration by regulatory agencies is made simpler. There are four distinct end-of-pipe control criteria that can be considered: *frequency, volume, pollution* and *design storm* controls.

The *frequency control* criteria refers to how frequently overflows are allowed to occur on an annual or seasonal basis. Frequency control criteria have the advantage of being relatively easy to monitor. Where beach postings are of concern to citizens, frequency control can determine a specified, discrete number of beach postings (on average), but not impacts on receiving waters. Frequency criteria reflect only how often impacts occur and not the magnitude of the impacts.

There are several possible definitions of *volumetric control*. One definition is the volume of overflows that are discharged. Another definition is the percentage of the combined sewage flow during wet weather that is controlled, i.e., not discharged. Volumetric control can also be defined as the percentage of wet weather runoff in the combined sewer (stormwater runoff) that is controlled. Volumetric control criteria do not have a direct relationship to receiving water quality improvements. However, they can be used to estimate the pollutant loadings being controlled from discharge to the receiving water.

The *pollution control* criteria specifies how much of the pollutant load (specific parameters) is controlled (i.e., not discharged). It can be expressed as the percentage of the total pollutant load carried in the combined sewage. The amount of pollutant loads entering the receiving water is generally proportional to the total volume of CSO discharged. Pollution control-based CSO objectives require the particular pollutant parameters of concern to be specified. A pollution control criterion is also more difficult to assess for compliance.

A *design storm* event may also be used as a control objective, e.g., one-year design storm of one hour duration. This type of control criteria is easy to employ for design but does not adequately reflect average or long term performance.