

NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) PROGRESS REPORT AND WORK PLAN

October 2007

Prepared by:

THE NIAGARA RIVER SECRETARIAT



**Environment Canada
Environnement Canada**



**United States
Environmental
Protection Agency**



Ontario

**Ministry of the
Environment**



**New York State
Department of
Environmental
Conservation**

INTERIM FINAL

Table of Contents

Part I: Progress Report

<i>Executive Summary</i>	<i>v</i>
<u>1.0 INTRODUCTION.....</u>	<u>1</u>
<u>2.0 Point and Non-Point Sources.....</u>	<u>2</u>
1.1Point Sources.....	2
1.2Non Point Sources.....	3
<u>3.0 MONITORING.....</u>	<u>4</u>
1.3Water Quality Monitoring.....	4
<u>3.1.1 Comparison with Strictest Agency Criteria</u>	<u>7</u>
<u>3.1.2 Mercury in Water and Sediment</u>	<u>10</u>
<u>3.1.3 Trends of Contaminants and Sources to the Niagara River.....</u>	<u>11</u>
1.4Biomonitoring.....	21
<u>3.1.4 Mussels</u>	<u>21</u>
<u>3.1.5 Fish Monitoring</u>	<u>24</u>
<u>3.2.2.1 Young-of-Year</u>	<u>24</u>
<u>3.2.2.2 Sport Fish.....</u>	<u>26</u>
1.5Source Trackdown: Sediment Investigations in Tributaries.....	27
<u>3.1.6 Sediment Quality in Ontario Tributaries to the Niagara River.....</u>	<u>27</u>
<u>3.1.7 Sediment Quality in New York Tributaries to the Niagara River.....</u>	<u>28</u>
<u>4.0 ADDITIONAL ACTIVITIES relevant to NRTMP.....</u>	<u>31</u>
1.6New and Emerging Chemicals.....	31
<u>4.1.1 Brominated Flame Retardants.....</u>	<u>31</u>
<u>4.1.2 Fluorinated Compounds.....</u>	<u>32</u>
<u>4.1.3 Pharmaceuticals.....</u>	<u>33</u>
<u>4.1.4 Current Use Pesticides.....</u>	<u>35</u>
<u>4.1.5 Methyl Mercury in Sediments.....</u>	<u>35</u>
1.7Information Management.....	36
<u>4.1.6 Synthesis/Mapping Environmental Data of Niagara River Tributaries</u>	<u>36</u>
<u>4.1.7 Lakeviews and the Great Lakes Monitoring Inventory.....</u>	<u>37</u>
<u>5.0 Summary and Future Directions</u>	<u>39</u>
1.8Summary.....	39
1.9Future Directions.....	40
1.10Watch List.....	41
<u>6.0 REFERENCES.....</u>	<u>42</u>
<u>7.0 Acknowledgements.....</u>	<u>45</u>
<u>8.0 Contact Information.....</u>	<u>45</u>

Part II: NRTMP Annual Work Plan 2007

Controlling Point Sources.....	49
Controlling Non-Point Sources.....	49
Monitoring.....	51
Additional Actions to Reduce Toxic Chemical Inputs to the Niagara River.....	53
Public Involvement.....	54
Appendix.....Declaration of Intent and Letter of Support.....	55

List of Tables

<i>Table 1 Eighteen "Priority Toxics" Identified in the Niagara River Toxics</i>	<i>4</i>
<i>Table 2 Organic Pollutants and Metals Measured in the Niagara River Upstream/Downstream Program, 1986-2005.....</i>	<i>6</i>
<i>Table 3 Comparison of the 2004/05 Upstream/Downstream Program Upper 90% Confidence Interval and Predicted Mean for the 18 "Priority Toxics" to the Most Stringent Agency Water Quality Criteria (ng/L unless otherwise noted).....</i>	<i>8</i>
<i>Table 4 Percent Change in Concentrations of Upstream/Downstream Priority Toxics between</i>	<i>13</i>
<i>Table 5 Statistical Confirmation of U/D Differences for 2004/2005.....</i>	<i>20</i>
<i>Table 6 Pharmaceutical Concentrations in the Niagara River May 2004 - March 2005</i>	

List of Figures

<i>Figure 1 Annual Mean (\pmSE) Mercury Concentrations in Suspended Sediments in the Niagara River, 1984-2005.....</i>	<i>10</i>
<i>Figure 2 Annual Dissolved Phase MLE and Upper 90% CI of Dieldrin from 86/87 to 04/05</i>	<i>14</i>
<i>Figure 3 Annual Suspended Sediment MLE and Upper 90% CI of Hexachlorobenzene from 86/87 to 04/05.....</i>	<i>15</i>
<i>Figure 4 Annual Suspended Sediment MLE and Upper 90% CI of Mirex from 86/87 to 04/05</i>	<i>16</i>
<i>Figure 5 Annual Suspended Sediment MLE and Upper 90% CI of Benzo(b/k) Fluoranthene from 86/87 to 04/05.....</i>	<i>17</i>
<i>Figure 6 Annual Suspended Sediment MLE and Upper 90% CI of Benzo(a)Pyrene from 86/87 to 04/05.....</i>	<i>17</i>
<i>Figure 7 Annual Whole Water MLE and Upper 90% CI of Arsenic from 86/87 to 04/05</i>	<i>18</i>
<i>Figure 8 Concentration of Methyl Mercury in Suspended Sediment at Niagara-on-the-Lake</i>	<i>36</i>

INTERIM FINAL

Executive Summary

This 2007 Progress Report of the Niagara River Toxics Management Plan (NRTMP) summarizes progress made by the four parties in dealing with the 18 “Priority Toxics” through reductions in point and non-point sources to the Niagara River. It includes results from the Niagara River Upstream/Downstream Program (U/D) (Williams and Klawunn 2005) and related biomonitoring programs. This year’s report also discusses other initiatives that are pertinent to Niagara River.

Implementation of a new data flagging protocol had delayed release of U/D data collected after 2000/2001. This process is now complete and the 2007 NRTMP Progress report provides results up to the 2004/05 monitoring year. Beginning with this report, the Ontario Ministry of Environment “interim” guidelines for the polycyclic aromatic hydrocarbons (e.g. benzo(a)anthracene, benzo(b/k)fluoranthene, chrysene, benzo(a)pyrene) have been replaced with the New York State Department of Environmental Quality Conservation water quality standards. This change was due to the interim status of the Ontario guidelines.

Overall, the water quality of the river has improved significantly since the inception of the NRTMP in 1987. Based on a review of the most current trend information, the original goal of 50% reduction in the concentration of 10 of the 18 priority toxics either has been met or exceeded for all except PCBs, p,p'-DDE and the particulate phase PAHs. Despite this success, more work is needed to further reduce those compounds whose concentrations continue to statistically exceed the most stringent Agency criteria or standards (eg., hexachlorobenzene, mirex) in order to meet the purpose of the 1996 Letter of Support.

A recommendation is included to amend the list of “Priority Toxics” and, in keeping with the commitment made in the 1996 Letter of Support, to review available ambient monitoring information in order to broaden the list of chemicals upon which progress is measured. Furthermore, the Secretariat is considering creation of a “watch list” so that new and emerging chemicals are identified for potential monitoring activities.

This report also includes a discussion of recent projects that directly support the NRTMP, including findings of emerging chemicals not previously tracked by the NRTMP or any of the parties’ regulatory programs.

The annual Agency NRTMP work plan for 2007 is attached. The work plan outlines the status and future activities that the parties intend to undertake, as resources allow, in order to ensure the goals of the NRTMP are met and sustained.

INTERIM FINAL

Part I: Progress Report

1.0 INTRODUCTION

The Niagara River flows 60 kilometers or 37 miles from Lake Erie to Lake Ontario. The River serves as a source for drinking water, fish and wildlife habitat and recreation. It generates electricity and provides employment to millions of people. Unfortunately, the River is also the recipient of toxic chemicals that pollute its waters, and prevent us from fully enjoying its beneficial uses.

In February 1987, Environment Canada (EC), the U. S. Environmental Protection Agency Region II (USEPA), the Ontario Ministry of the Environment (MOE) and the New York State Department of Environmental Conservation (NYSDEC) -- the "Four Parties" -- signed the Niagara River Declaration of Intent (DOI; see Appendix). The purpose of the DOI is to reduce the concentrations of toxic pollutants in the Niagara River.

Eighteen "priority toxics" were specifically targeted for reduction, ten of which were designated for 50% reduction by 1996 because they were thought to have significant Niagara River sources. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions.

The Four Parties re-affirmed their commitment to the NRTMP in a "Letter of Support" signed in December, 1996 (see Appendix). The revised goal, as stated in that letter, is "to reduce toxic chemical concentrations in the River by reducing inputs from sources along the river", with the purpose of achieving ambient water quality that will protect human health, aquatic life, and wildlife, and while doing so, improve and protect water quality in Lake Ontario as well. Measurable milestones were identified in the Letter of Support that include maintenance of downward trends in concentrations of chemicals that exceed criteria or that are associated with Niagara River sources; and achievement of downstream concentrations that are statistically equivalent to those upstream.

The Four Parties committed to a Plan of Action in the 1996 Letter of Support that included implementation of point source control measures; trackdown and identification of new sources; monitoring progress through the Upstream/Downstream program, biomonitoring and the collection of sediment cores; remediation and monitoring of progress at hazardous waste sites; and, finally, relating remediation results to ambient conditions in the river.

This 2007 Progress Report is structured to follow the Work Plan. A discussion of the point and non point sources is followed by a discussion of monitoring activities, including related biomonitoring programs, which summarize the progress made in dealing with the 18 "Priority Toxics". Fifteen years of results from the Niagara River Upstream/Downstream Program (Williams and Klawunn 2005) are reviewed. As well, information is included regarding other initiatives that, while not part of the NRTMP, are pertinent to the Niagara River.

2.0 POINT AND NON-POINT SOURCES

In order to achieve the goals described in the DOI and the “Letter of Support”, the NRTMP focuses on reducing discharges from both point and non-point sources. Point sources are municipal/industrial wastewater sewers and storm drainage systems emptying into the Niagara River, whereas, non-point sources are generally considered to be uncontrolled discharges from hazardous waste sites and facilities, urban and agricultural run-off, atmospheric inputs and incidental pollution from spills, recreational boating and other public uses of the water.

1.1 Point Sources

According to the original U.S. and Canadian Stage 1 and Stage 2 Remedial Action Plans for the Niagara River Area of Concern, there were 26 US and 16 Canadian significant point sources in 86/87 along the Niagara River. Currently, the number of significant dischargers has decreased to 21 US and 13 Canadian.

In New York, nine of the 21 are municipalities and the remaining 12 are industrial facilities. These discharges are regulated under the State Pollutant Discharge Elimination System (SPDES) permit program. This is an ongoing program that requires self-reporting by regulated wastewater treatment facilities, including municipal, industrial and agricultural facilities, and periodic inspections by NYSDEC to enforce compliance with allowable discharge criteria for various pollutants, consistent with state water quality standards. Currently, all 21 significant dischargers are in general compliance with permit requirements. In addition, the nine municipalities operate either combined sewer systems (sanitary sewage and storm water), or have separate sanitary sewer systems. Only three municipalities have combined systems that experience occasional overflows during wet weather events (i.e., Buffalo Sewer Authority, Niagara Falls Water Board and Lewiston Master Sewer District). These municipalities have developed long term control plans (LTCPs) designed to abate overflows which are pending approval by the NYSDEC or USEPA. Five municipalities having separate sanitary sewer systems but only four (Town of Tonawanda, Town of Grand Island, Town of Amherst and the City of North Tonawanda) have systems that experience overflows that are required to be eliminated per SPDES permit.

In Ontario, the MOE operates the Municipal/Industrial Strategy for Abatement (MISA) program, which focuses on nine industrial sectors, covering the major toxic polluters. The nine sectors are petroleum, pulp and paper, metal mining, industrial minerals, metal casting, organic chemical manufacturing, inorganic chemical, iron and steel, and electric power generation. The regulations include monitoring and reporting requirements. For every chemical parameter in the MISA regulations there are enforceable limits. The program includes a required monitoring frequency to demonstrate compliance with the limits. The effluent must not be toxic to fish and water fleas and each plant must prepare an annual report to be available to the public and must submit summary

quarterly reports to the ministry. Incidents of non-compliance must be reported directly to the ministry followed by a letter.

Currently, the 6 Canadian industry and 7 municipal discharges into the Niagara River comply with the MISA program and Certificate of Approval limits.

1.2 Non Point Sources

Since 1987, hazardous waste sites were considered the most significant non-point source of toxics to the river. Therefore, the USEPA and NYSDEC identified 26 U.S. sites responsible for over 99% of the estimated input from all such sites on the U.S. side of the basin, and put them on ambitious remediation schedules. Remediation of the sites is intended to virtually eliminate the migration of toxic pollutants from the sites.

All remedial construction has been completed at 21 of the sites. The remedial technology will be operated and monitored for effectiveness for years to come at those sites. Remedial Actions (RAs) are underway at the 5 remaining sites, including 3 sites that are under interim remediation with significant remedial controls already operating while final remedies are being designed or investigated. For many of these sites, the pollutant load reductions to the river were substantial.

Based on various simplifying assumptions, USEPA estimates that remediation to date has reduced the potential pollutant inputs into the river by approximately 94%.

Estimates of the cost of remediation are available for most of the 26 priority hazardous waste sites. Based on these estimates, the costs incurred to date are at least \$411,958,000. Additional costs expected in the future are estimated at \$2,621,500.

26 PRIORITY HAZARDOUS WASTE SITES:

21 SITES ARE COMPLETED:

CECOS (Niagara Falls)
Bell Aerospace Textron (Niagara Falls)
Durez Corp., Packard Rd. (Niagara Falls)
Stauffer Chemical (Lewiston)
DuPont Buffalo Ave (Niagara Falls)
Frontier Chemical (Pendleton)
Occidental Chem. Durez (North Tonawanda)
Olin Corporation (Niagara Falls)
Buffalo Color Area D (Buffalo)
Occidental Chem. Buffalo Ave (Niagara Falls)
102nd Street (Niagara Falls)
River Road (Tonawanda)
Niagara Mohawk Cherry Farm (Tonawanda)
Niagara County Refuse Disposal (Wheatfield)
Iroquois Gas-Westwood Pharmac. (Buffalo)
Gratwick Riverside Park (North Tonawanda)
Occidental Chemical S-Area (Niagara Falls)
Solvent Chemical (Niagara Falls)
Booth Oil
Occidental Chem. Hyde Park (Niagara Falls)
DuPont Necco Park (Niagara Falls)

5 SITES HAVE REMEDIATION UNDERWAY:

Mobil Oil (Buffalo)
Frontier Chemical Royal Ave (Niagara Falls)
Vanadium Corporation (Niagara)
Bethlehem Steel Corporation
Buffalo Color Corporation Site

3.0 MONITORING

As identified in the Letter of Support, there are three components to the NRTMP monitoring plan. The first component is the U/D Program conducted by Environment Canada which focuses on monitoring ambient water quality at Fort Erie (FE) and at Niagara-on-the-Lake (NOTL). By comparing water and suspended sediment concentrations of priority chemicals at these two locations, the NRTMP can statistically determine which chemicals are originating upstream (i.e., Lake Erie and above) versus those being discharged from sources within the Niagara River watershed. The second component is biomonitoring, a qualitative screening methodology to determine the existence and relative concentrations of contaminants and the bioavailability of those substances to fish, mussels and other wildlife in various areas of the river. The third component involves source trackdown and analysis screening to hone-in on specific sources or areas of pollution in the river and tributaries.

1.3 Water Quality Monitoring

The U/D Program operated by Environment Canada under the auspices of the “Four Parties” formally began in 1986 although water quality monitoring has been conducted in the river since 1975 at the NOTL station. The purpose of the program is to measure concentrations of chemicals in the river in order to determine loads of contaminants and report on trends, specifically in relation to implemented control measures.

Eighteen “Priority Toxics”¹ were identified in the Niagara River Toxics Management Plan (NRTMP) for specific attention by the “Four Parties” (Table 1). They were selected because they exceeded the strictest agency criteria in water, sediment or biota in Lake Ontario and/or the Niagara River. Ten of the chemicals were slated for 50% reduction from both point and non-point sources in Ontario and New York State by 1996 because they were deemed to have significant sources along the Niagara River.²

Table 1 **Eighteen "Priority Toxics" Identified in the Niagara River Toxics Management Plan (NRTMP)**

Chlordane	PCBs*
Mirex/Photomirex*	Dioxin (2,3,7,8-TCDD)*
Dieldrin	Octachlorostyrene (OCS)
Hexachlorobenzene (HCB)*	Tetrachloroethylene*
DDT & metabolites	Benz(a)anthracene*
Toxaphene	Benzo(a)pyrene [B(a)P]*
Mercury*	Benzo(b)fluoranthene*
Arsenic	Benzo(k)fluoranthene*
Lead	Chrysene/Triphenylene

* designated for 50% reduction by 1996

¹ Called “Chemicals of Concern” in the Niagara River Declaration of Intent (DOI 1987).

² See the DOI Items 2 and 3.

In 1994, however, the “Four Parties” announced at a public workshop³ that, for a number of reasons, they would not be able to determine, with statistical confidence, whether a 50% reduction in the loads of these ten “Priority Toxics” from point and non-point sources had occurred (see also, El-Shaarawi and Williams 1989). Instead, a 50% reduction in the concentrations of these chemicals in the River became the surrogate measure for determining whether these two goals had been achieved.⁴ In consequence, the U/D Program became the primary mechanism for measuring progress under the NRTMP.

In addition to the “Priority Toxics” identified under the NRTMP, the U/D program also monitors for other pollutants. These compounds are identified in Table 2. Additional compounds include a suite of chlorobenzenes, additional banned or regulated organochlorine pesticides, PAHs, industrial by-product chemicals, two in use herbicides and a number of metals. These additional pollutants are routinely reported in the Niagara River U/D reports released through the River Monitoring Committee which is comprised of members from the Four Parties.

³ See the first report of the Technical Advisory Work Group (TAWG) distributed at the Niagara River Coordination Committee (NRCC) Public Workshop held on December 8, 1994 (TAWG 1994).

⁴ The problem, however, is that while one can state that an overall reduction in inputs to the river has occurred, it is not possible to relate this overall reduction back to reductions at point and non-point sources individually.

**Table 2 Organic Pollutants and Metals Measured in the Niagara River
Upstream/Downstream Program, 1986-2005**

Chlorobenzenes (CBs)

1,3-Dichlorobenzene	1,4-Dichlorobenzene
1,2-Dichlorobenzene	1,3,5-Trichlorobenzene
1,2,4-Trichlorobenzene	1,2,3-Trichlorobenzene
1,2,3,4-Tetrachlorobenzene	Pentachlorobenzene
Hexachlorobenzene*	

Organochlorine Pesticides (OCs)

α -HCH	α -Chlordane ¹ *	p,p'-DDT ² *
γ -HCH (lindane)	γ -Chlordane*	o,p-DDT*
Heptachlor	Methoxychlor	p,p'-DDE*
Heptachlor-epoxide	Aldrin	Endrin Aldehyde
p,p'-TDE	β -Endosulfan	Endrin
α -Endosulfan	Dieldrin*	PCBs*

Polynuclear Aromatic Hydrocarbons (PAHs)

2-Methylnaphthalene	1-Methylnaphthalene	Chrysene/Triphenylene*
2-Chloronaphthalene	Naphthalene	Anthracene
Fluorene	Phenanthrene	Pyrene
Dibenzo(<i>ah</i>)anthracene	Fluoranthene	Benzo(<i>b/k</i>)fluoranthene ³ *
Benzo(<i>a</i>)pyrene*	Indeno(123- <i>cd</i>)pyrene	Benzo(<i>ghi</i>)perylene
Acenaphthylene	Benzo(<i>a</i>)anthracene*	

Industrial By-product Chemicals

Octachlorostyrene*	Mirex*	Photomirex*
Hexachlorobutadiene	Hexachlorocyclopentadiene	

Herbicides

Atrazine	Metolachlor
----------	-------------

Metals

Aluminum	Antimony	Arsenic*	Barium	Boron
Beryllium	Cadmium	Cobalt	Chromium	Copper
Gallium	Lanthanum	Iron	Lithium	Manganese
Molybdenum	Nickel	Lead*	Rubidium	Selenium
Silver	Strontium	Tellurium	Uranium	Vanadium
Zinc	Mercury* (in solids)			

* NRTMP "Priority Pollutant" (PP)

¹ PP is total chlordane (+)

² total DDT is also a PP

³ benzo(*b*)fluoranthene + benzo(*k*)fluoranthene

3.1.1 Comparison with Strictest Agency Criteria

Annual mean concentrations, along with 90% confidence intervals (CI), are determined for each chemical in both the dissolved and suspended solids phases using a statistical protocol called Maximum Likelihood Estimation (MLE). “Recombined whole water” concentrations, and the associated 90% confidence limits, are then derived based on the concentration of suspended particulate matter in the water. The upper 90% CI for recombined whole water concentrations have traditionally been used by the “Four Parties” to compare to the strictest agency water quality criteria because they provide a more protective estimate of criteria exceedances than the annual mean.

The mean and Upper 90% CI concentrations for the recombined whole water (RWW) data for each “Priority Toxic” measured in 2004/2005 are compared to strictest agency criterion in Table 3. Exceedances of the criteria are shown bolded in red. The criteria exceedances are essentially the same for both the mean and upper 90% CI concentrations.

It should be noted that with this report, the MOE interim guidelines for the polycyclic aromatic hydrocarbons (e.g. benzo(a)anthracene, benzo(b/k)fluoranthene, chrysene, benzo(a)pyrene) have been replaced with the NYSDEC criteria. After consideration of the status of available criteria, the Niagara River Secretariat felt it was more appropriate to base comparisons on established rather than proposed criteria from the “Four Parties”, where possible. Currently, MOE has no plans to finalize the interim criteria that were used in previous reports. The NYSDEC criteria for PAHs are higher than the MOE interim guidelines by approximately an order of magnitude.

Table 3 Comparison of the 2004/05 Upstream/Downstream Program Upper 90% Confidence Interval and Predicted Mean for the 18 "Priority Toxics" to the Most Stringent Agency Water Quality Criteria (ng/L unless otherwise noted)

Parameter	1998 Criteria	Agency	Upper 90%CI		Predicted Mean	
			FE ²	RWW ¹ NOTL ³	2004/05 FE	NOTL
Total Chlordane	0.02	NYSDEC	0.009	0.012	0.008	0.011
Mirex	0.001	NYSDEC	ND ⁵	0.007	ND ⁵	0.006
Dieldrin	0.0006	NYSDEC	0.096	0.111	0.095	0.110
Hexachlorobenzene	0.03	NYSDEC	0.015	0.065	0.014	0.061
ppDDT	0.01	NYSDEC	0.018	0.022	0.016	0.019
ppDDD	0.08	NYSDEC	0.052	0.015	0.049	0.013
ppDDE	0.007	NYSDEC	0.054	0.051	0.049	0.047
Total DDT	0.011	NYSDEC	0.124	0.092	0.115	0.083
PCBs ⁴	0.001	NYSDEC	0.190	0.491	0.174	0.459
OCS	0.006	NYSDEC	ND ⁵	0.005	ND ⁵	0.004
Benzo(a)anthracene	2.0	NYSDEC	0.948	1.960	0.835	1.842
Benzo(b/k)fluoranthene ⁶	2.0	NYSDEC	2.220	5.107	2.019	4.750
Chrysene/Triphenylene ⁷	2.0	NYSDEC	1.100	2.681	0.998	2.500
Benzo(a)pyrene	1.2	NYSDEC	0.962	2.272	0.869	2.110

Whole Water

Arsenic (ug/L) [As]	5	CCME	0.981	1.161	0.971	1.134
Mercury [Hg]	1.3	USEPA	0.950	3.446	0.814	2.378
Lead (ug/L) [Pb]	2.5	USEPA	0.355	0.792	0.320	0.710

Note:

¹ Recombined whole water

² Fort Erie

³ Niagara-on-the-Lake

⁴ Equivalent water concentration of suspended sediment fraction only

⁵ Not detected

⁶ Criterion is for benzo(k)fluoranthene

⁷ Criterion is for chrysene

Bolded values represent Water Quality Criteria exceedances

Briefly, when considering the upper 90% CI, Table 3 shows the following:

the two metals (As and Pb), ppDDD, total chlordane, OCS and benzo(a)anthracene did not exceed strictest agency criteria;

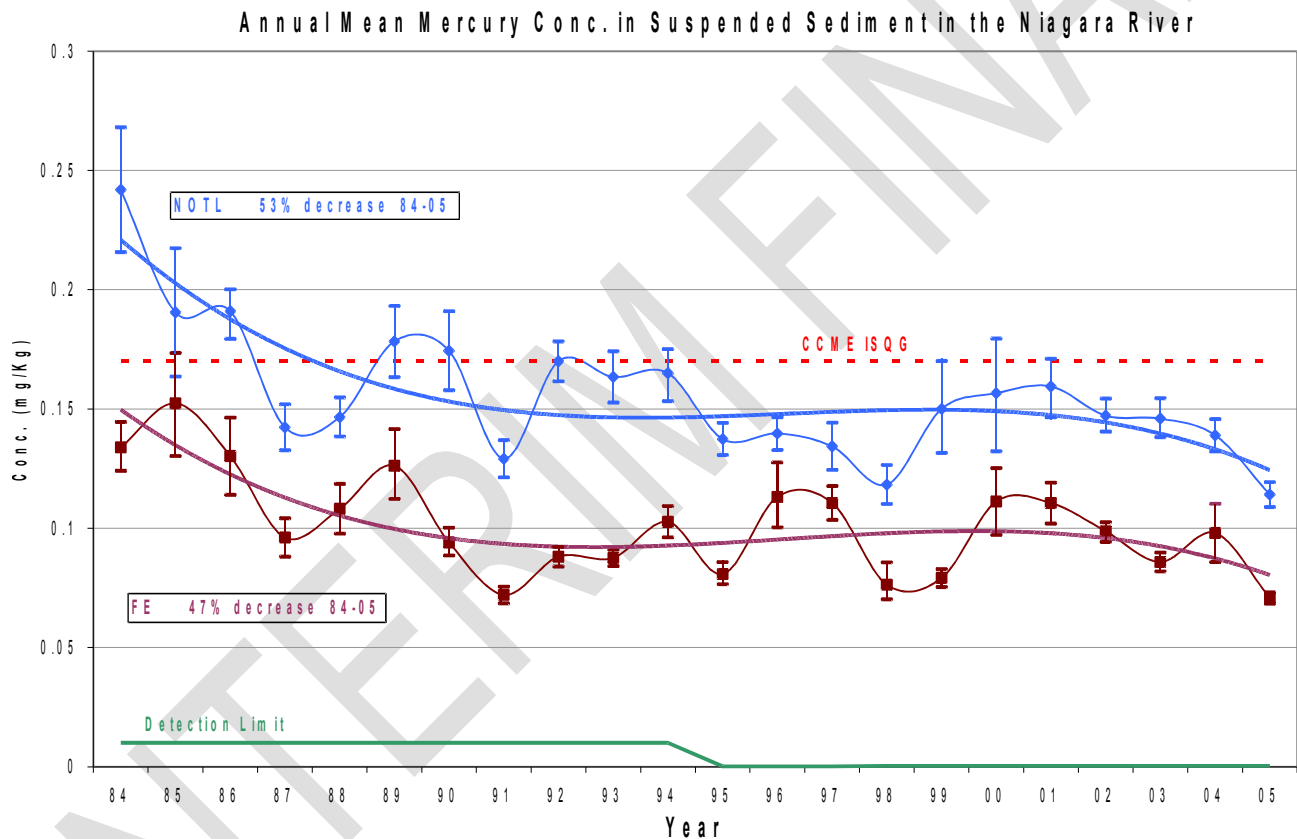
mirex, hexachlorobenzene, chrysene/triphenylene, benzo(a)pyrene and mercury exceeded their criteria only at NOTL

dieldrin ppDDT, ppDDE, total DDT, PCBs and benzo(b/k)fluoranthene exceeded strictest agency criteria at both FE and NOTL, suggesting Lake Erie/upstream sources to the River.

Our current analytical methodology does not distinguish between the two chemicals chrysene and triphenylene, nor the two isomers benzo(b)- and benzo(k)fluoranthene. Although the criteria are applicable to chrysene alone (i.e., there is no criterion for triphenylene), and to benzo(b)- and benzo(k)fluoranthene, individually, past practice has opted to be conservative in identifying exceedances. In its report on the 1999/2000 - 2000/01 data, the NRTMP River Monitoring Committee (RMC) states: "We suspect that chrysene is the contaminant that is being measured in the Niagara River (as opposed to triphenylene), given its potential sources. Chrysene is a ubiquitous environmental contaminant that occurs as a product of the incomplete combustion of organic compounds. Anthropogenic sources of chrysene include gasoline, diesel and aircraft turbine exhausts; coal combustion and gasification; emissions from coke ovens, wood burning stoves, and waste incineration; and various industrial processes such as iron, aluminum, and steel production. Chrysene is also a constituent of coal, oil, and their distillates, such as coal tar, and creosote. Triphenylene is a minor constituent of gasoline (0.030 mg/L) but is often found as a by product of industrial emissions."

3.1.2 Mercury in Water and Sediment

Analysis of mercury in whole water (as opposed to dissolved and particulate phases separately) was discontinued in 1996/97 due to sampling and analytical methodology problems; previous whole water mercury data are considered suspect. Analysis of whole water samples was recommenced in August, 2002, using improved methodology and the whole water MLE reported in Table 3 is based on these data. There are, however, valid suspended sediment mercury concentration data available for the period 1984-2005 (Figure 1) for trend analysis.



CCME ISQG = Canadian Council of Ministers of the Environment Sediment Quality Guideline.

NOTE: the trend lines represent polynomials fitted through the data.

Figure 1 Annual Mean (\pm SE) Mercury Concentrations in Suspended Sediments in the Niagara River, 1984-2005

Briefly, the data in Figure 1 show the following:

mercury concentrations at NOTL are greater than those at FE suggesting the presence of Hg sources along the River (the smoothed lines connecting the data points have been plotted for each station to show that the variation seen at NOTL tracks, fairly closely, that seen at FE);

concentrations have decreased since 1984, although there is considerable yearly variation in concentrations, the polynomial trend lines suggest that concentrations appear to have levelled off through the 90's, but recent data suggests a continued decline;

the distance between the polynomial trend lines seems fairly consistent which suggests that the changes in NOTL concentrations are due more to the changes in the inputs from Lake Erie/upstream than to changes in inputs from Niagara River sources; and

concentrations at both stations are now consistently below the CCME (Canadian Council of Ministers of the Environment) sediment quality guideline.

3.1.3 Trends of Contaminants and Sources to the Niagara River

The percent change in the concentrations of the NRTMP "Priority Toxics" in both the dissolved and particulate phases at FE and NOTL have been documented in past NRTMP Progress Reports. The model used for determining the percent change runs on the dissolved and particulate phases separately. The percent change from the base year (1986/87 except for OCS which is 1989/90) to 2004/05 is shown in Table 4.

For those "Priority Toxics" which have sufficient data for calculating a trend, the decreases in the concentrations for the majority of chlorobenzenes and organochlorine pesticides over this time period have been greater than 50%, except for the dissolved phase concentration of dieldrin at NOTL (-42.0%), the suspended sediment phase concentration of α -chlordane at NOTL (-48.9%) and the suspended sediment phase concentration of PCBs at FE (-45.0%). For many, the decreases have been greater than 70%.

It is interesting to note that two of the PAHs, benzo(a)pyrene and benzo(b/k)fluoranthene exhibited an increasing trend at both FE and NOTL in the suspended sediment phase concentration. The increases range from 55% to 110%. The reason for the increases is not known at present, but one theory is that they may be due to the change in the characteristics of the bottom sediments as a result of zebra and quagga mussel colonization of the eastern basin of Lake Erie. For example, changes in bottom sediment grain size from coarse sand to fine silt size particles and an increase in sediment total organic carbon (TOC) content have been documented at a

station just off the Niagara River in the eastern basin of the lake (Howell *et al.* 1996). Both these factors, along with the changes in contaminant cycling in the lake as a result of mussel colonization, would tend to favour greater adsorption of contaminants onto the sediments. Indeed, the same researchers found an increase in the bottom sediment PAH concentrations at the same station.

It should be noted that PAHs are routinely formed through the combustion process. Natural sources of PAHs include events such as forest fires while anthropogenic sources include the burning of petroleum and coal in vehicles, boats and industrial boilers/furnaces (EPA 2007). The conditions of combustion and the nature of the fuel consumed dictate the type and amount of PAH formed. Other sources of PAHs to the environment include the direct discharge or accidental spilling of PAH containing oil and gasoline.

Table 4 **Percent Change in Concentrations of Upstream/Downstream Priority Toxics between 1986/87 and 2004/05**

Chemical	Period of record	Fort Erie		Niagara-on-the-Lake	
		Concentration % change		Concentration % change	
		Dissolved	Susp. Part.	Dissolved	Susp. Part.
<i>Chlorobenzenes (CBs)</i>					
Hexachlorobenzene	1986-2005	-60.2	-54.8	-76.7	-69.9
<i>Organochlorine Pesticides (OCs) & PCBS</i>					
a-chlordane	1986-2005	--	-59.0	--	-48.9
g-chlordane	1986-2005	-76.1	-54.8	-77.3	-63.2
p,p'-DDT	1986-2005	--	-76.5	--	-72.4
o,p'-DDT	1986-2005	--	-84.7	--	--
p,p'-DDD	1986-2005	-75.5	-70.7	-76.0	-59.9
p,p'-DDE	1986-2005	-63.4	-66.7	-42.0	-51.0
Dieldrin	1986-2005	-75.4	-72.9	-72.9	-76.5
Mirex	1986-2005	--	--	--	-56.6
PCBs	1986-2005	NC	-45.0	NC	-53.9
<i>Polynuclear Aromatic Hydrocarbons (PAHs)</i>					
Benz(a)anthracene	1986-2005	-78.3	-24.9	-41.8	NS
Benzo(a)pyrene	1986-2005	-75.2	+110	-54.1	+85.3
Benzo(b/k)fluoranthene	1986-2005	-56.0	+83.6	-16.8	+54.8
Chrysene-triphenylene	1986-2005	-65.0	NS	-35.0	NS
<i>Industrial By-products</i>					
Octachlorostyrene	1989-2005	--	--	--	-93.7
<i>Trace Metals in Whole Water</i>		Whole Water Concentration % Change		Whole Water Concentration % Change	
Lead	1986-2005	NS		NS	
Arsenic	1986-2003**	NS		-31.3	
Mercury	1986-1997	*		*	

Notes:

NC Dissolved phase concentrations and loads not calculated because of known contamination problems with dissolved phase data.

NS No significant ($p < 0.05$) trend was detected by the model for the period of record.

-- Too few values above the detection limit to run the model.

* Analysis of mercury in water was discontinued in 1996/97 pending achievement of more sensitive detection limit.

** Change in analytical methodology (03/04) prevents meaningful comparison with earlier years.

Figures 2-6 show graphs of the annual MLEs and Upper 90% CIs for selected “Priority Toxics” over the period 86/87-04/05. The trends in “Priority Toxics” chemicals at FE and NOTL can be quite similar or drastically different. For example, the trends for dieldrin at both stations are very similar, while the trends for HCB at the two stations are quite different. Comparison of the trends at the two stations can provide insightful information on both the sources of the NRTMP “Priority Toxics” to the River, and also what is happening with respect to inputs from these sources. The trend of dieldrin concentration in the dissolved phase at NOTL and FE is shown in Figure 2. The concentrations and rate of decrease are similar at both stations. This suggests that the major input of dieldrin to the River is from Lake Erie/upstream, and that the changes occurring at both the FE and NOTL stations are being dictated by what is happening to dieldrin concentrations upstream of the River.

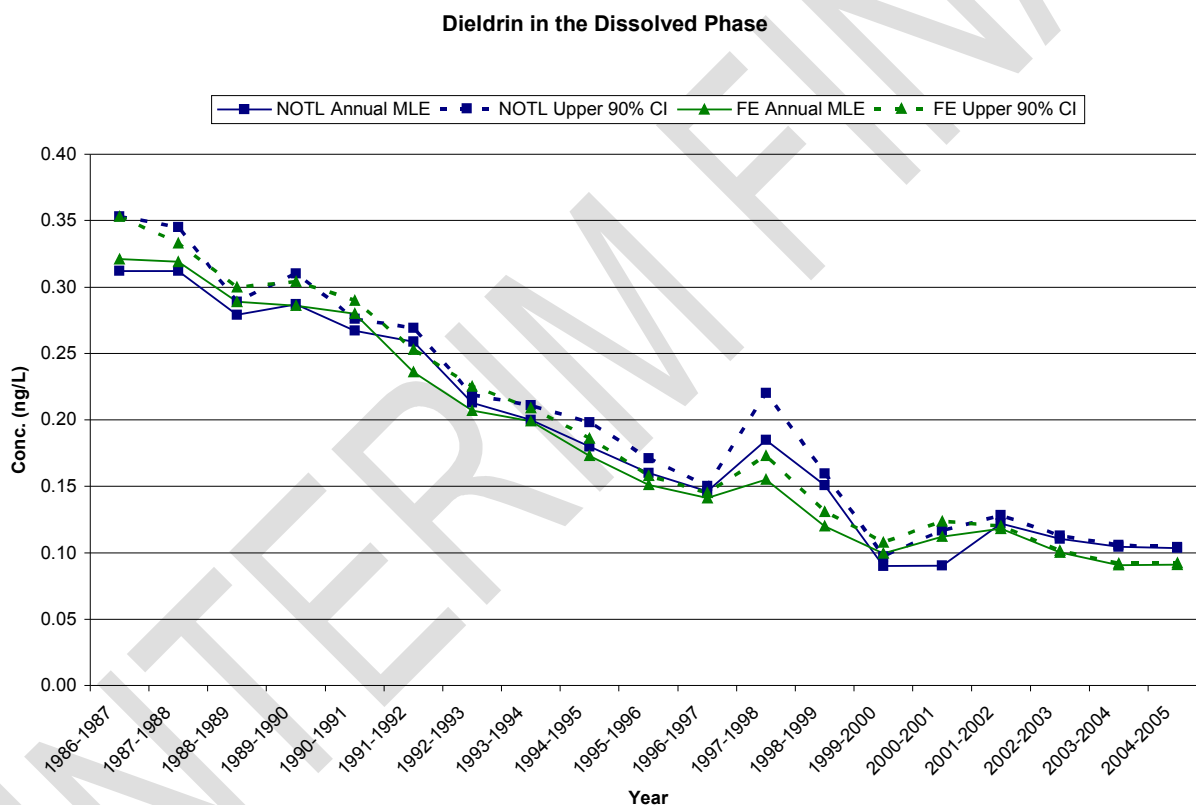


Figure 2 Annual Dissolved Phase MLE and Upper 90% CI of Dieldrin from 86/87 to 04/05

The changes in the HCB concentration on the suspended sediment using annual MLEs at the NOTL and FE stations is shown in Figure 3. In contrast to dieldrin, the concentrations are vastly different at the two stations. At NOTL, concentrations in 1986/87 were 30X times higher than those seen at FE. Concentrations decreased fairly rapidly in the 80s, and subsequently declined more slowly until 2004/05, when NOTL concentrations are about 10X greater than those measured at FE. In contrast, at FE

over the same time period, the concentrations are extremely low, often being below the PDL, but still show a decrease (this decrease, although small, is still significant – see discussion later in text). The FE data show that there is a small, but steady input of HCB to the River from sources in Lake Erie/upstream. The much higher concentrations measured in the mid-80s at NOTL indicate that there were major Niagara River sources of this chemical to the River. The rapid decline in concentrations seen from the mid-80s to the early 90s, however, points to the effectiveness of remediation at these sources in reducing HCB inputs to the River, thus, lowering the HCB concentration in the River. The slowing of this decline suggests that the implemented remedial measures are having less influence in further reducing the input of HCB to the River. The fact that suspended sediment concentrations at NOTL are still about 10X higher than at FE attests to the fact that there are still inputs of this chemical to the River from Niagara River sources.

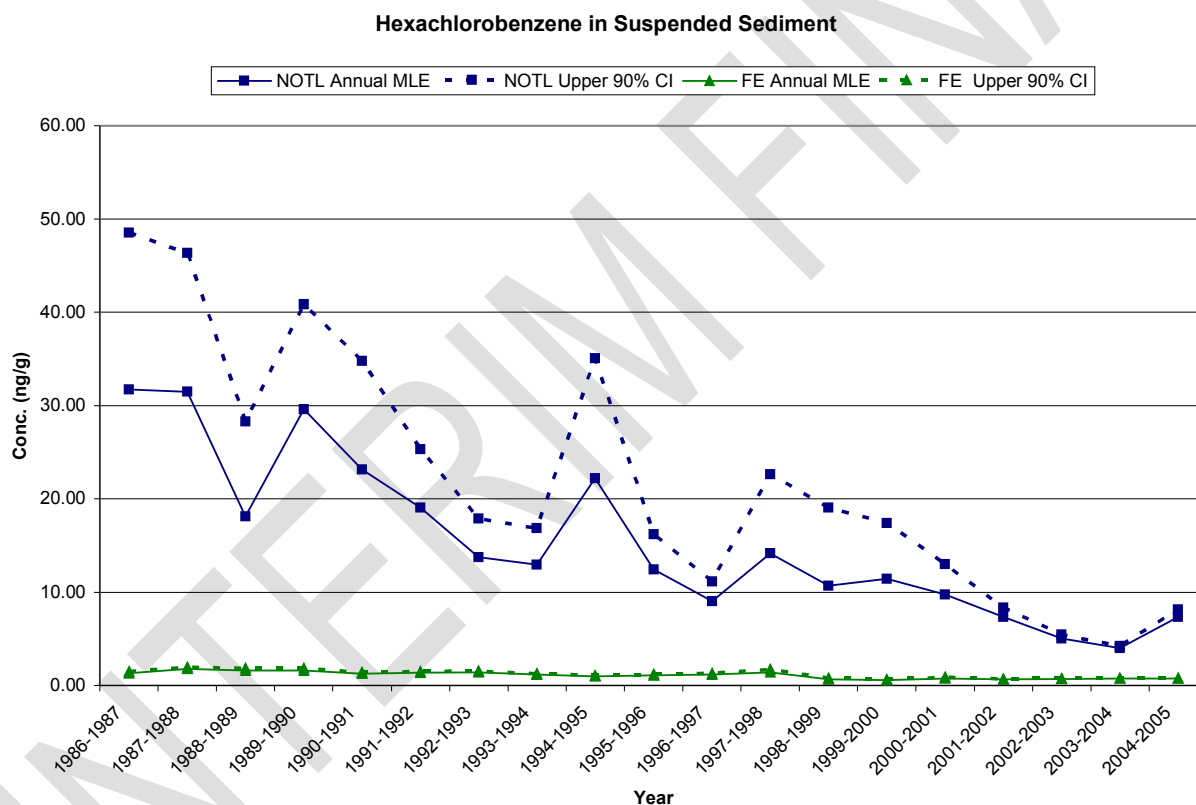


Figure 3 Annual Suspended Sediment MLE and Upper 90% CI of Hexachlorobenzene from 86/87 to 04/05

Sometimes a chemical is not detected at the upstream FE site, so that a trend can only be seen at NOTL. This is the case, for example, for OCS and mirex (see Figure 4). This indicates that the chemical is originating from Niagara River sources, and the concentrations and changes in concentration reflect what is happening at those sources.

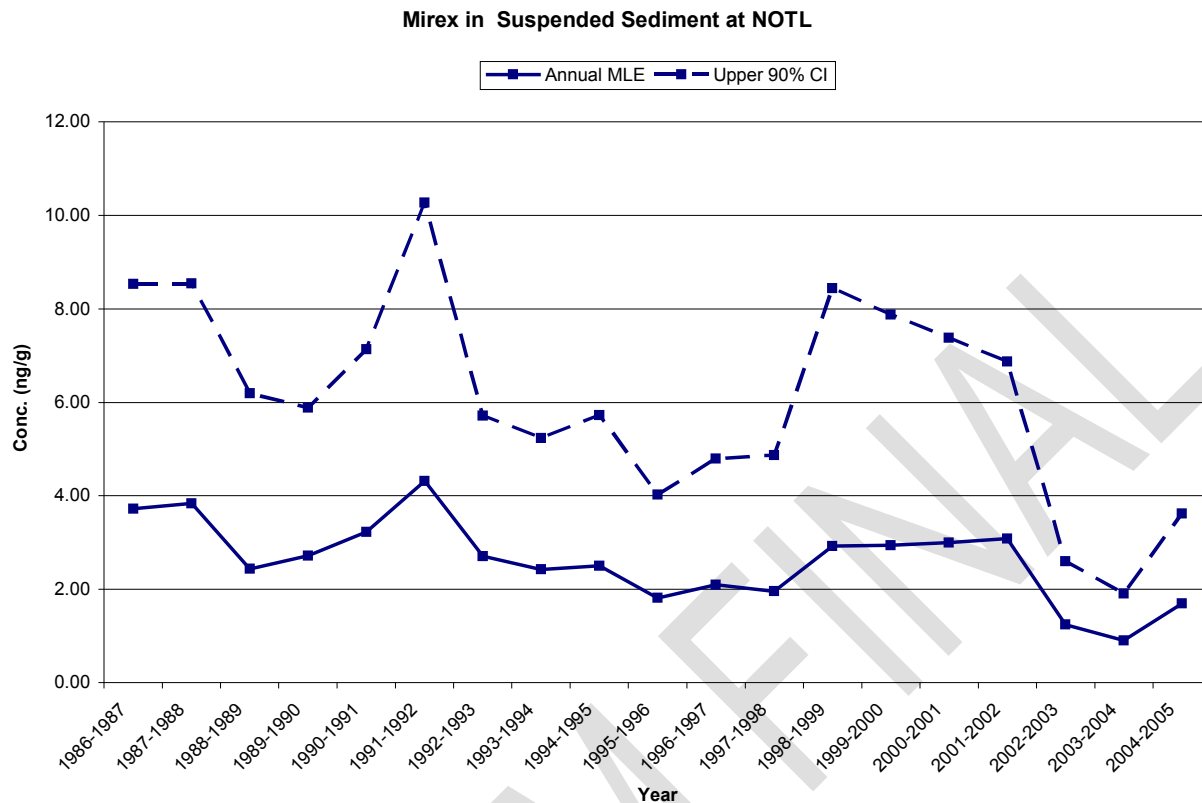


Figure 4 Annual Suspended Sediment MLE and Upper 90% CI of Mirex from 86/87 to 04/05

The PAHs, (Benzo(b/k)fluorathene and Benzo(a)pyrene) are shown in Figures 5 and 6, respectively. The results suggest that there is an increasing trend for these contaminants in the suspended sediment at FE and NOTL. Table 4 showed that the concentration of these PAHs has increased dramatically (55%-110%) in the suspended sediment phase. It is also interesting to note that the spike in the PAH concentrations at FE in 2000/01 (as previously reported) does appear to be an anomaly as recent data suggest that NOTL concentrations are consistently higher than those at FE. A review of the FE data indicates that the high annual mean concentration reported in 2000/01 was related to a few exceptionally high values in May and June 2000 for several of the PAHs.

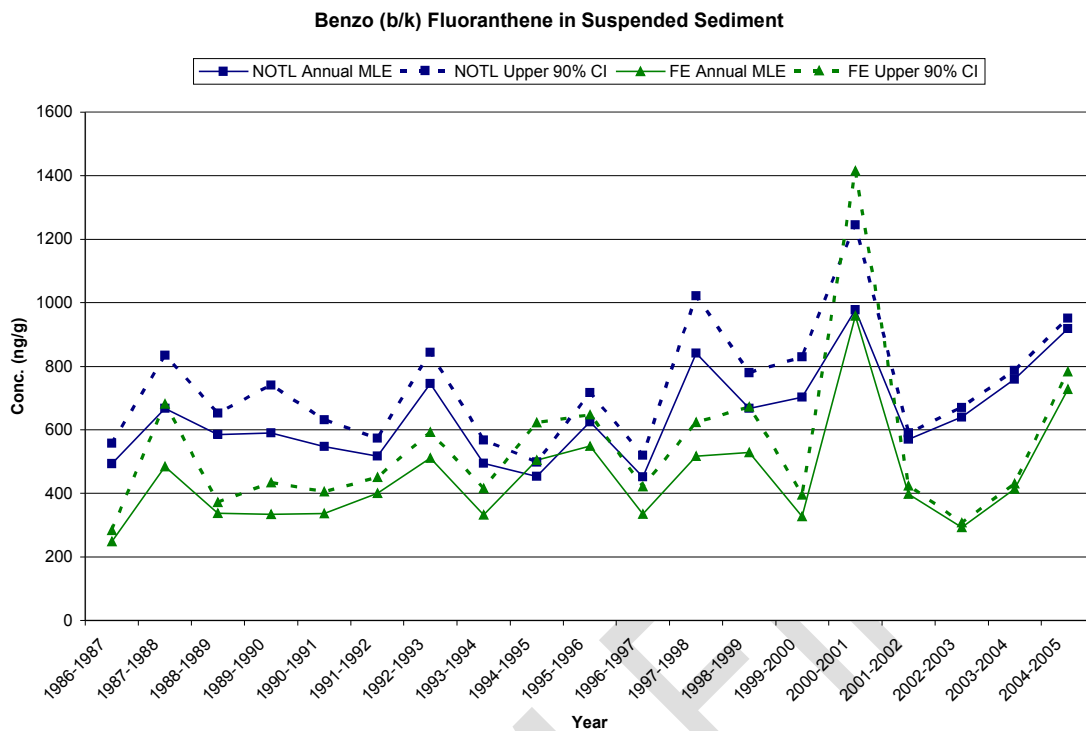


Figure 5 Annual Suspended Sediment MLE and Upper 90% CI of Benzo(b/k)Fluoranthene from 86/87 to 04/05

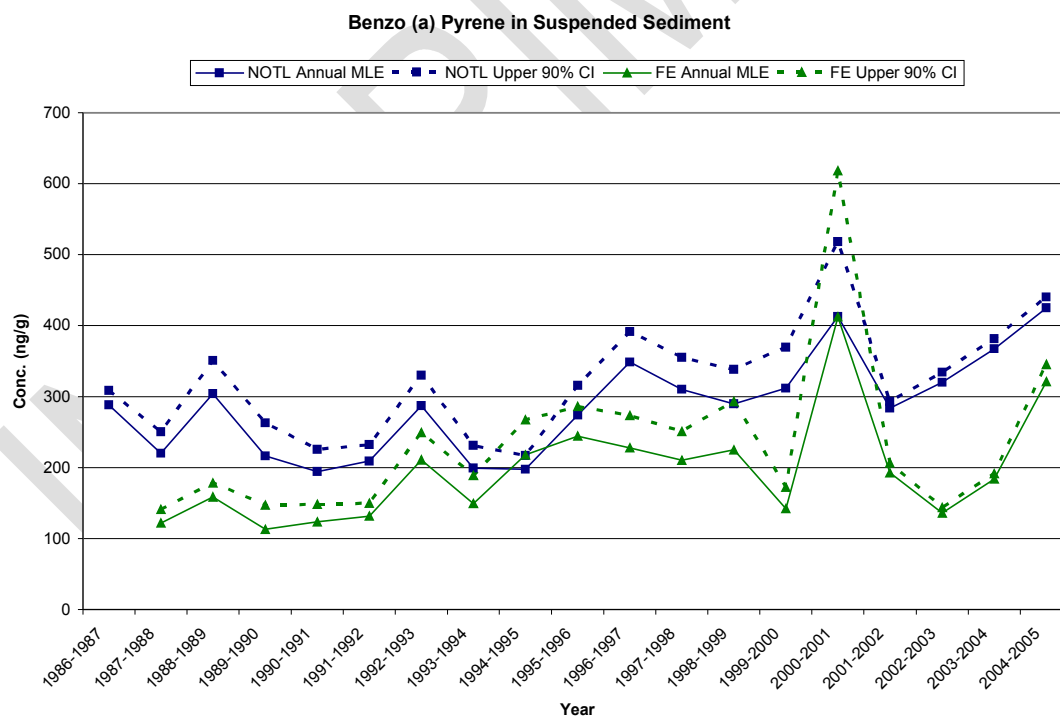


Figure 6 Annual Suspend Sediment MLE and Upper 90% CI of Benzo(a)Pyrene from 86/87 to 04/05

The trend analysis for Arsenic in Table 4 was done for the period of 86/87 to 02/03. An analytical methodological change beginning in 03/04 does not allow for a meaningful comparison with earlier data. The new method reports whole water concentrations that are approximately 2X higher than the old method. The new method provides better sensitivity and which should improve our ability to determine upstream/downstream differences in concentration. Concentrations are still well below the NYSDEC criterion of 5.0 ug/L (see Figure 7). The analysis indicates no significant trend at FE, however the results at NOTL show a significant decreasing trend of concentration of 31%.

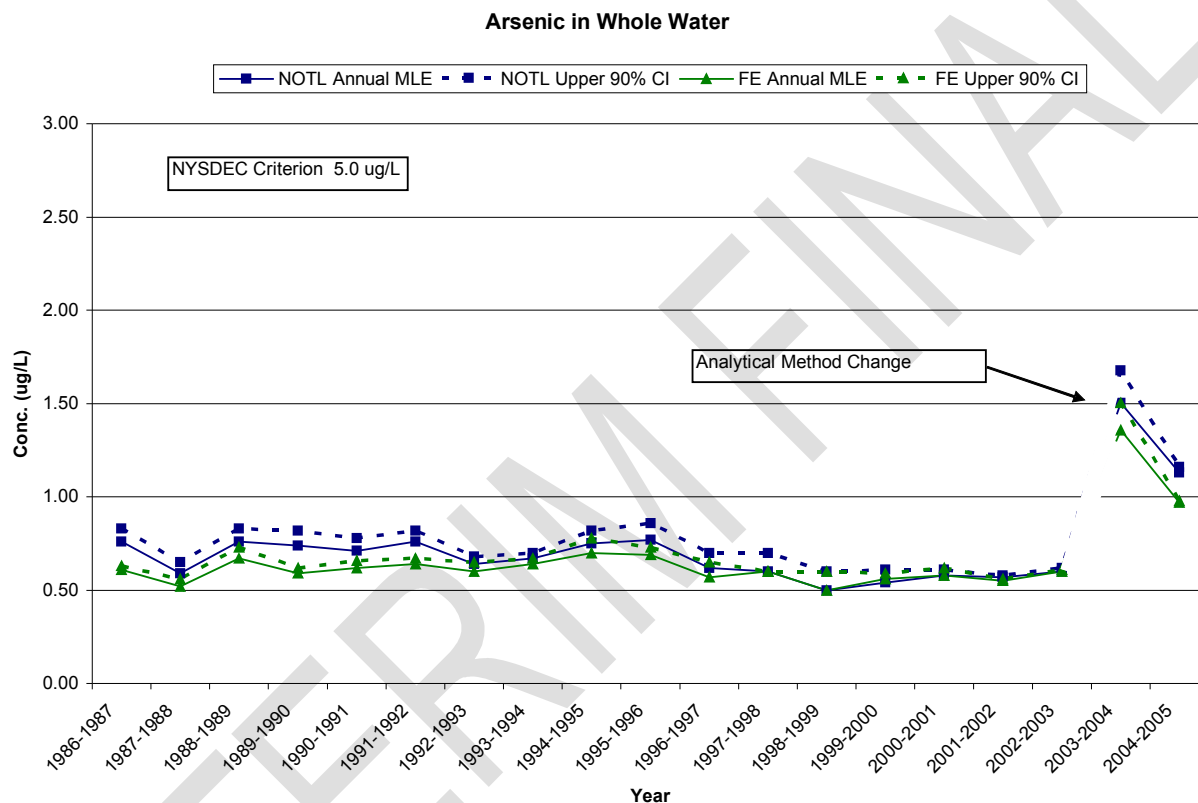


Figure 7 Annual Whole Water MLE and Upper 90% CI of Arsenic from 86/87 to 04/05

A statistical analysis was done to determine if there is a significant difference in concentrations between NOTL and FE. The results are presented in Table 5. These results do not allow for the interpretation of any trend information, rather they are a snapshot of the most recent available data. The Table shows the downstream-upstream ratio of the annual MLE ($\frac{[MLE]_{notl}}{[MLE]_{fe}}$) for the RWW concentrations and the ratio of the 90% confidence interval. MLE ratios greater than one indicate a higher concentration of the analyte at the downstream (NOTL) site while, conversely, ratios less than one indicate a higher concentration at the upstream site (FE). The significance of the annual MLE ratio is determined by the ratio of the 90% CI. If the 90% CI ratio includes unity then the upstream/downstream difference is not considered to be significant.

Based on the analysis of 2004/05 data for the Priority Toxics, the results indicate that hexachlorobenzene, o,p-DDT, dieldrin, PCBs, all (4) PAHs, lead, arsenic and mercury have significantly higher concentrations at the downstream site. Two of the DDT metabolites, pp-DDT and pp-TDE, have significantly higher concentrations at the upstream station; this is consistent with previous findings that our upstream station at Fort Erie is influenced by local DDT contamination from a nearby source (Dove, A. et al, 2003). No ratio was determined for mirex or OCS as they are not detected at FE indicating that they originate from Niagara River sources. Further analysis of this information will be provided in the 2001/02-2004/05 Niagara River Upstream/Downstream report.

Table 5 Statistical Confirmation of U/D Differences for 2004/2005

Analyte	MLE Ratio	90% CI Ratio
<i>Chlorobenzenes (CBs)</i>		
Hexachlorobenzene**	4.279	3.906 - 4.689
<i>Organochlorine Pesticides (OCs) & PCBS</i>		
a-chlordane	1.004	0.908 - 1.109
g-chlordane ¹	1.044	0.927 - 1.176
p,p'-DDT**	0.611	0.540 - 0.691
o,p'-DDT ¹	1.613	1.338 - 1.944
p,p'-TDE (DDD) ¹	0.442	0.412 - 0.475
p,p'-DDE**	0.959	0.843 - 1.090
Dieldrin**	1.165	1.147 - 1.183
Mirex**	-	-
PCBs ¹ **	1.634	1.558 - 1.714
<i>Polynuclear Aromatic Hydrocarbons (PAHs)</i>		
Benz(a)anthracene	2.206	1.900 - 2.561
Benzo(a)pyrene**	2.427	2.128 - 2.768
Benzo(b/k)fluoranthene**	2.353	2.077 - 2.667
Chrysene-triphenylene**	2.507	2.210 - 2.842
<i>Industrial By-products</i>		
Octachlorostyrene	-	-
<i>Trace Metals in Whole Water</i>		
Lead	2.222	1.911 - 2.584
Arsenic	1.168	1.139 - 1.198
Mercury ^{1**}	1.380	1.328 - 1.435

¹Calculated using the sediment fraction only.

**Priority Toxics that exceed the most stringent criteria at either the FE or NOTL station (See Table 3)

1.4 Biomonitoring

The NRTMP uses biomonitoring to compliment the Upstream/Downstream program, and as a means of determining the presence and relative concentrations of contaminants in various areas of the river and their bioavailability to fish, mussels and other wildlife.

3.1.4 Mussels

Since 1980, the Ontario Ministry of Environment (MOE) has been committed to both routine and specialized biomonitoring of contaminants in the Niagara River using caged mussels (*Elliptio complanata*) in support of the Niagara River Toxics Management Plan. Mussels were deployed on the American as well as the Canadian side of the river. These studies have provided information on suspected contaminant sources and source areas in the river between FE and NOTL (Richman L., 2006).

The freshwater mussel, *Elliptio complanata*, is a good biomonitor because it is a filter feeder feeding on plankton and organic detritus thereby accumulating contaminants directly from the water column and from particulate matter. Mussels are abundant and easily collected and transported. They are sedentary organisms which are responsive to their environment by integrating short term fluctuations in water column contaminant levels. Conversely, because the sampling design is limited to a particular deployment period, results only reflect the exposure during that period and cannot be extrapolated to yearly loadings from sources.

In 2003, caged mussels were deployed at five stations on the Canadian side of the river and 29 sites on the American side of the river for 21 days of exposure. Mussels were retrieved after the designated period of deployment from all but two stations on the American side of the river. Cages at these two sites were lost from the point of deployment. Additional cages were deployed at one of these sites (Bloody Run Creek) in 2004. All samples were analysed for organochlorine pesticides, total polychlorinated biphenyls (PCBs), chlorinated benzenes, and polycyclic aromatic hydrocarbons (PAHs). Samples from selected sites were analysed for polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans (PCDD/PCDF) and polybrominated diphenyl ethers (PBDEs).

The contaminant p,p'-DDE was detected in mussels at a few stations on both sides of the river at low concentrations indicating that historic contamination with this compound is persistent and widespread. p,p'-DDE was only detected above trace levels in mussels deployed in Lyons Creek where concentrations ranged from 12 to 26 ng/g. Hexachlorocyclohexanes (HCH) were detected at two sites on the U.S. side of the river at concentrations previously detected in other Niagara River mussel surveys. HCH concentrations were typically low.

Ongoing remediation projects have likely contributed to an overall reduction of PCB loadings to the Niagara River and hence, to Lake Ontario. However, the data do suggest that PCB exposure is pervasive in the Niagara River and that PCBs will likely continue to be bioavailable in the future, similar to the continued bioavailability of DDT and its metabolites. Trace concentrations of total PCBs were present in mussels deployed at almost all stations in the survey. These data were consistent with results from the 2000 survey. One control mussel from Balsam Lake also had trace concentrations of total PCBs. Based on Balsam Lake data from the past 25 years of monitoring this was likely an anomaly due to sample contamination during processing.

The highest total PCB concentrations (250 to 650 ng/g) detected in the 2003 survey were observed in mussels deployed in Lyons Creek which is a site located in Ontario known to be contaminated with PCBs. Remedial actions to clean up contaminated sediment in Lyons Creek are presently being investigated by MOE and are pending the completion of an environmental risk assessment. Lyons Creek flows into the Welland River which discharges to the Niagara River. Previous surveys have not detected PCBs in the Welland River.

The chlorinated compound that is also a priority toxic, most frequently detected in mussel tissue was hexachlorobenzene (HCB) which was identified at 15 sites but only at trace concentrations. High concentrations of pentachlorobenzene were associated with Bloody Run Creek. Data from Bloody Run Creek suggested that this area was a source of chlorinated benzenes in general to the Niagara River. Other non-priority chlorinated compounds found were hexachlorobutadiene (HCBd) at the Occidental Chemical facility, Gill Creek and Bloody Run Creek locations; 1,2,3,5-tetrachlorobenzene at the Occidental Chemical Company, Pettit Flume, Erie Canal, Bloody Run Creek, and Two Mile Creek locations; and 2,3,6-trichlorotoluene at Pettit Flume, Gratwick Riverside Park and the mouth of Gill Creek.

Trichlorobenzenes and octachlorostyrene were not detected at all in 2003, but have been detected sporadically in previous surveys typically at trace concentrations. In general, 2,3,6- and/or 2,4,5-trichlorotoluene were detected in mussel tissue at several stations although these compounds were not present in earlier surveys; [e.g. Pettit Flume, Gratwick Riverside Park (upstream and downstream), and mouth of Gill Creek]. The results were confirmed with laboratory analysts. Presently, it is unclear if they represent an episodic release of the contaminant into the Tonawanda Channel during the period of mussel deployment. Further monitoring is required to identify whether these results were an anomaly for the 2003 survey.

The highest concentrations of PAHs in mussel tissue were present in mussels deployed at the mouths of storm sewers and urban creeks (Cayuga Creek, Two Mile Creek, Pettit Flume, mouth of the sewer discharging to the Niagara River downstream of Superior Lubricant). Concentrations of total PAHs ranged from 620 ng/g to 1,200 ng/g at these sites. Since the sampling sites were located alongside roads and high traffic areas the likely sources of PAHs would be road and surface runoff to storm sewers.

Toxic Equivalents, or TEQs, are used to report the *toxicity-weighted masses* of mixtures of dioxins. Within the TEQ method, each dioxin compound is assigned a Toxic Equivalency Factor, or TEF relative to 2,3,7,8-TCDD, which is assigned the maximum toxicity designation of one. Other dioxin compounds are given equal or lower numbers, with each number roughly proportional to its toxicity relative to that of 2,3,7,8-TCDD. Developed by the World Health Organization, TEFs are used extensively by scientists and governments around the world (Van den Berg, *et al.*, 1998). To obtain the number of grams-TEQ of a dioxin mixture, one simply multiplies the mass of each compound in the mixture by its TEF and then totals them.

Sediment concentrations of dioxins and furans at NOTL were low (9 pg/g TEQ), and were similar to concentrations measured in 1993 and 1995 (TEQ:14.8 and 14.2 pg/g respectively). The TEQs for the sediment samples from Cayuga Creek and Two Mile Creek were 70 and 81 pg/g, respectively, in 2003 which suggested that the sediments in these areas were contaminated with dioxins and furans. The sediment collected from Gill Creek is of particular interest. In 2000 (the first time the sediment was analysed for dioxins), the TEQ was 103 pg/g similar to concentrations measured in 2003 (119 pg/g). Since the area was remediated (i.e., dredged) in 1998 due to PCB contamination, these data suggested residual contamination, re-contamination due to back flows within the creek, or the possibility of a recent source of dioxins and furans. Although sediment TEQ concentrations indicated some dioxin/furan contamination, TEQ concentrations in caged mussels were low for Cayuga Creek and Gill Creek (data for Two Mile Creek were unavailable).

In 2003, sediment collected from the shoreline (bank) of the Niagara River in the vicinity of Bloody Run Creek had extremely high concentrations of dioxins and furans (TEQ; 121,725 pg/g), similar to concentrations measured in 1993. Mussels deployed in the area also had high TEQ concentrations (42 pg/g and 48 pg/g) suggesting that the contaminants were bioavailable and that the area is a source of dioxins to the river. Benchmarks for comparison are the 0.71pg/g and 4.75pg/g TEQs for tissue for the protection of fish eating mammals and birds respectively.

High concentrations of dioxins and furans were detected in mussels (66 pg/g wet wt.) and sediment (TEQ of 11,383 pg/g dry wt.) collected from the Pettit Flume cove. High concentrations of dioxins and furans were also present in sediment collected from a station in the river, just downstream of the cove (TEQ: 2,078 pg/g), suggesting sediment transport from the cove. A benchmark for sediment is the CCME probable effect level of 21.5 pg/g TEQ. The contamination outside the cove in 2003 was four times higher than in 2000 (502 pg/g TEQ) implicating the cove as a source of dioxins to the Niagara River. However, the TEQ for mussels deployed outside the cove was low (0.47 pg/g). In addition to the "Priority Toxics", the mussel program also measured PBDE's. This discussion of this can be found in section 4.1.1 Brominated Flame Retardants.

3.1.5 Fish Monitoring

Besides caged mussels, biomonitoring includes fish contaminant monitoring programs conducted by MOE and NYSDEC. These programs include Young-of-the-Year (YOY) fish and common recreational sportfish. The YOY program is intended to provide information on toxic, persistent and bioaccumulative chemicals within a relatively localized area. The sportfish monitoring program is conducted with the intention of providing consumption guidelines to protect human health, however, it also provides information regarding toxic, persistent and bioaccumulative chemicals.

3.2.2.1 Young-of-Year

YOY fish are excellent bio-monitors because they are ubiquitous, relatively abundant, are localized and have a limited exposure period of only 4 - 6 months at Fall sampling. For these reasons YOY fish are helpful to find localized problems, determine temporal contaminant trends and are also useful to help determine the efficacy of cleanup efforts for hazardous waste sites.

The NYSDEC and the MOE have used YOY fish for monitoring persistent organic contaminants in the Great Lakes Basin dating back into the 1970s (Preddice et al 2006).

YOY fish are not normally consumed by humans living around the Great Lakes Basin but they can be a significant pathway for persistent contaminants such as PCBs and OC pesticides to bioaccumulate in many species of piscivorous wildlife and birds. Among these are mink, river otter and several water birds such as belted kingfisher, merganser, loon, various gulls and terns, and herons. For the NYSDEC study, contaminant levels in YOY fish are compared to protective non-carcinogenic wildlife criterion, the 1:100 dietary carcinogenic criterion for mink, and to levels designed to protect piscivorous wildlife.

The NYSDEC has conducted this monitoring on an approximate 5-year cycle. The latest report, *PCBs and Organochlorine Pesticides Residue in Young-of-Year Fish from Traditional Near-shore Sampling Areas, New York's Great Lakes Basin, 2003* published May, 2006 describes findings for the 2003 collections at 12 traditional near-shore sites in New York State's Great Lakes Basin - including three Niagara River sites. These three sites are Niagara River at Strawberry Island (calm protected area mid-island), downstream Little Niagara River (north side of river about 250 yds/230 m downstream from Cayuga Creek), and the Niagara River near Lewiston, NY (eastern side of river, downstream and within 0.25 mile/0.4 km of the Lewiston Boat Launch).

Initially, because of their great abundance, YOY spottail shiner, (*Notropis hudsonius*), was the primary target species collected in early monitoring years. However, since

1996 the NYSDEC has switched to the fairly abundant bluntnose minnow, (*Pimephales notatus*), because the abundance of spottail shiner has decreased significantly.

The study protocol required seven samples per site, each with 15 YOY fish of the same species. In a few instances, composites consisted of both species to obtain sufficient samples. Composites were analyzed by a commercial laboratory according to generally approved standard methods. However, due to changes in these methods since the YOY monitoring program began, NYSDEC also analyzed 32 extra composites at its own Wildlife Pathology Laboratory to compare composites from the same location and time between laboratories, and to better compare data from previous NYSDEC YOY studies.

Total PCB, mirex and photomirex (a mirex degradation product) were the only contaminants detected for this study to exceed criteria designed to protect sensitive wildlife species. For mirex and photomirex, the criterion is no measurable amount in fish is acceptable. Fish from the downstream Little Niagara River had 693 ng/g mean total PCB levels, approximately 4 times greater than the protective criterion. Mean total PCB for YOY fish from Lewiston was 82 ng/g, only slightly less than the criterion. Mean total PCB levels continue to be less than this criterion at the Strawberry Island location. In fact, both analytical facilities found fish from Strawberry Island, Niagara River to have the lowest total PCB and, none of the three PCB Aroclors (AR1248, AR1254 and AR1260) were detected at this site. PCB was also undetected in composites of bluntnose minnow and spottail shiner collected from this location in 1997.

Mirex and photomirex were detected in levels exceeding criterion only in composites from the downstream Little Niagara River location.

Trace levels of p,p'-DDE, a metabolite of DDT, were detected in all composites from downstream Little Niagara and Lewiston, and from only one composite at Strawberry Island. Less than trace levels of p,p'-DDD were detected at the Little Niagara River location.

Elevated levels of persistent contaminants in YOY fish can sometimes be linked to sources. Downstream Little Niagara River fish likely reflect residual contaminants in sediment originally from the nearby Love Canal and the 102nd Street Landfill. Prior to remediation both of these waste sites contributed a host of industrial waste chemicals to surface water and groundwater. The Niagara River, Little River and the Cayuga Creek-Bergholtz-Black Creek system were affected. Contaminated sediment in the Little Niagara River and in lower Cayuga Creek were not dredged during clean up operations. The 2003 YOY fish data for the downstream Little Niagara River site suggest that PCB, likely from one or both hazardous waste sites, is still bio-available as is mirex and photomirex which likely came from the 102nd Street Landfill. Any future remediation of contaminated sediment should focus on the Little Niagara River, lower Cayuga Creek and consider reaching upstream further into the Cayuga Creek system because sporadic elevated water levels in the Niagara River tend to push contaminated sediment into upstream areas once thought to have only background contaminant levels.

3.2.2.2 Sport Fish

In 2006, NYSDEC completed chemical residue monitoring of various sportfish in the upper and lower Niagara River. In the upper Niagara River, carp were sampled for PCB, organochlorine pesticides and mercury; in the lower Niagara River brown bullhead, American eel, carp, smallmouth bass, and white sucker were sampled for the same parameters. Data has been provided to the New York State Department of Health and have resulted in no changes in the New York State public health advisory for 2007/08.

The Ontario Sport Fish Contaminant Monitoring Program, which started in 1976, is the largest testing and advisory program of its kind in North America. Fish have been tested from approximately 1,700 locations in Ontario's inland lakes and rivers and Great Lakes. Between 4,000 and 6,000 fish per year are tested through the program. The program was initiated in response to concern over human health from consumption of fish contaminated with mercury.

Sport fish are collected by electrofishing from various locations in Ontario by the MOE and the Ministry of Natural Resources (MNR). The contaminant levels are used to calculate consumption advisories based on Health Canada Tolerable Daily Intakes (TDIs) which are published biennially in the *Guide to Eating Ontario Sport Fish*. The consumption advisories inform the public on the number of meals of sport fish they can safely consume in one month.

The Niagara River is separated into two blocks, the Upper Niagara River, which includes the Canadian waters from Fort Erie to above the falls, and the Lower Niagara River, which includes the Canadian waters from below the falls to Lake Ontario. The Sport Fish Contaminant Monitoring Program of the MOE collects sport fish from the Niagara River every 1 to 2 years.

Upper Niagara River

The species of fish collected were:

MOE - Northern pike, smallmouth bass, largemouth bass, freshwater drum, yellow perch, brown bullhead, carp and white sucker (2006)

MNR - carp and freshwater drum (2004)

Lower Niagara River

The species of fish collected were:

MOE – Rainbow trout, lake trout, northern pike, smallmouth bass, largemouth bass, yellow perch, rock bass, brown bullhead, carp, rainbow smelt, freshwater drum and smelt (2006)

MNR – carp and freshwater drum (2004)

The 2007-2008 Ontario Guide to Eating Sportfish indicated that for Lake Ontario and the Niagara River dioxins, furans and dioxin-like PCBs are the consumption-limiting contaminants in various species of trout and salmon while mercury is the consumption limiting contaminant in species such as walleye, pike, bass and perch.

Contaminant results from the MOE collection of the Upper and Lower Niagara River were used in the 2007-08 *Guide* advisory.

Current & Future Monitoring

Both the upper and lower blocks of the Niagara River were sampled in 2006. In the upper Niagara River, carp, white sucker, northern pike, yellow perch, largemouth bass, smallmouth bass, brown bullhead and freshwater drum were collected. In the lower Niagara River, rainbow trout, lake trout, smelt, carp, freshwater drum, largemouth bass, smallmouth bass, brown bullhead, yellow perch, rock bass and northern pike were collected. There are plans to sample both the upper and lower blocks of the Niagara River in 2007.

1.5 Source Trackdown: Sediment Investigations in Tributaries

One of the commitments in the Letter of Support is to track down new sources for control; to accomplish this, Environment Canada and NYSDEC/EPA have undertaken sediment investigations in tributaries to the Niagara River. For the Niagara River, water quality results are typically compared to the most stringent criteria amongst the Four Parties. A comparison of sediment criteria between the Four Parties presents a challenge due to differences between American and Canadian approaches. For the purpose of this report, sediment contaminant concentrations are compared to the relevant criteria of the agency that conducted the study.

3.1.6 Sediment Quality in Ontario Tributaries to the Niagara River

Environment Canada (EC), Ontario conducted a screening-level survey of sediment quality in Canadian tributaries to Lake Ontario including those feeding into the Niagara River during the summer of 2002 (Dove *et al.* 2003). The purpose of the sampling was to assess sediment quality in deposition zones in each tributary prior to discharge to Lake Ontario or the Niagara River in order to identify remaining sources of

contamination for subsequent follow-up work. It is not the intent at this stage to quantify the loadings of contaminants entering either the lake or the river. Instead, the results from this program will be combined with existing water quality, fisheries, benthic and sediment contaminant information, using a weight-of-evidence approach, to prioritize subsequent track-down efforts.

Targeted parameters for the sediment screening were those identified in the Lake Ontario Lakewide Management Plan (Lake Ontario LaMP) as impairing lake-wide beneficial uses. In addition, a suite of contaminants targeted for virtual elimination in the Canada-U.S. Binational Toxics Strategy (BTS) was considered in order to assess Canada's commitments towards that Strategy. Additional parameters (e.g., metals, pesticides, contaminants of emerging concern) were included to improve our understanding of the contaminant status of lake and river tributaries.

The sediment quality results were compared to the Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment (CCME), 2002). The CCME sediment quality guidelines provide scientific benchmarks, or reference points, for evaluating the potential for observing adverse biological effects in aquatic systems. The guidelines are derived from available toxicological information. A lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely. Fewer than 25% of adverse effects (in the Biological Effects Database for Sediments) occur below the TEL, and more than 50% of adverse effects occur above the probable effect level (PEL). The MOE lowest effects level corresponds approximately to a TEL.

A number of the tributaries sampled in 2002 had already been targeted for detailed assessment under the auspices of the Niagara River Remedial Action Plan (RAP). These include Frenchman's Creek, Black Creek and Lyons Creek (both East and West segments). As a result of the RAP investigations, Black Creek and Frenchman's Creek are no longer considered a potential source of contaminants to the Niagara River. The PCB-contaminated sediment in Lyons Creek east of the Welland Canal has recently been the subject of on going Ecological Risk Assessments (ERAs) and Human Health Risk Assessments (HHRAs). A management strategy for the contaminated sediments is under development. Results for the remaining tributaries sampled in 2002 will be reviewed by the MOE to flag those that require further assessment or action.

The persistence of DDT and metabolites in the Niagara River tributaries remains a concern. It is surmised that contamination from heavy legacy use is contributing to the continued presence in the Niagara River tributaries.

3.1.7 Sediment Quality in New York Tributaries to the Niagara River

In 2003, NYSDEC and USEPA synthesized sediment quality data and mussel biomonitoring data of the Niagara River and New York tributaries and concluded further investigation was needed of PCBs in Gill Creek, Two Mile Creek and upper Scajaquada Creek, as well as PAHs in the Cayuga Creek – Little Niagara River area (USEPA &

NYSDEC, 2001). In 2004, USEPA Region 2 provided funding for NYSDEC to investigate the four study areas. In conducting these four tributary sediment studies, historic and potential contamination sources were identified and considered as useful to the overall assessment of these tributaries and follow-up considerations.

Sediment chemistry results were compared to the MacDonald et al. (2000) sediment quality guidelines. The lower sediment quality guideline (Threshold effect concentration, TEC) indicates the level below which adverse effects to biota are expected to be rare, while the higher sediment quality guideline (Probable effect concentration, PEC) indicates the level above which adverse effects to biota are expected to be likely. These sediment quality guidelines are used for qualitative evaluation. They are not regulatory action levels, and their use does not imply official endorsement by NYSDEC.

Two Mile Creek

Six surficial sediment sites were sampled from the upper reach (near Sheridan Drive Bridge) to the mouth with the Niagara River in November 2004. The upper two sampling stations had metals and PCBs greater than the PEC sediment quality guideline. PCBs were found at the two golf course locations at concentrations greater than 1.7 ppm, predominantly Aroclor 1254, the highest of any locations in this study. Uranium also was sampled at Two Mile Creek due to historical use of material within the watershed. All six sediment results were below 10 pCi/g total uranium and are not considered a problem.

Scajaquada Creek

Eight surficial sediment samples were collected along a transect from near Transit Road in Depew to Forest Lawn Cemetery in November 2004. No patterns were detected among sampling stations for contaminants. Metals (copper and lead) exceeded the PEC guideline at two sites, while total PAHs exceeded the PEC guideline at three sites. The highest concentrations of PCBs were found at the upper-most and lower-most sites but they were all below the (PEC) guideline. One sampling site from the U-Crest Ditch near the former Westinghouse site, which was remediated in 2000, was sampled for volatile organic compounds (VOCs). Most VOCs formerly associated with this site were undetected and the five VOCs that were detected (benzene, toluene, o-xylene, m&p-xylene, and chloromethane) were found at low levels, indicating the effectiveness of the remediation.

Gill Creek

Surficial sediment samples were collected from three locations between Hyde Park Lake and the mouth of the creek in September 2005. From the lake to near the mouth, concentrations generally decreased. Mercury was found at a concentration above the PEC at the middle sampling station, upstream of Falls Street. PCBs and pesticides were all below the TEC guideline at all sites.

Cayuga Creek/Little Niagara River

Surficial sediment samples were collected from two sites in Cayuga Creek in September 2005. Surficial sediment was collected at one site and core samples were taken at another two sites in the Little Niagara River. All samples were analyzed for metals, dioxins/furans, PAHs, pesticides and PCBs. Within Cayuga Creek, concentrations of total PAHs exceeded the PEC guideline at the downstream site. Only zinc exceeded the PEC guideline at both Cayuga Creek locations. The highest concentration of contaminants exceeding the PEC (PCBs, lindane, lead and zinc) within the Little Niagara River were found in the top section of a core taken downstream of the confluence with Cayuga Creek. Mercury levels in this core sample exceeded the PEL and were the highest found at any site during this study. Most pesticides were below detection limits in both locations; only lindane and p,p'-DDE exceeded the PEC. Dioxin/Furan and D/F TQ values were elevated in most samples from both streams but no pattern was discernable indicating sources within the immediate area.

In summary, it appears that Cayuga Creek is not a source of dioxin/furans or pesticides to the Little Niagara River. The Little Niagara River may be contributing some of these contaminants in lower Cayuga Creek from the periodic backflows resulting from power generation downstream. However, Cayuga Creek may be a source of PAHs and PCBs to the Little Niagara River, though not the only source.

In Gill Creek, recent contaminant levels appear much lower than samples collected in 1995. The downstream sample, collected from the Olin Industrial Welding remediation site where creek sediments were removed in 1999, had the lowest levels of mercury and PCBs.

In Scajaquada Creek, no discernable patterns were seen in metals. The highest concentrations of PAHs were found downstream of the Walden Galleria Mall. Concentrations of PCB above the TEC guideline were found at the most upstream and downstream locations with trace levels at all locations in between.

Two Mile Creek was found to have the highest concentrations of PCBs and metals in the upper locations. Pesticides were not detected. Uranium was detected but at very low concentrations, well below levels of concern.

In general, although some sample analyses resulted in concentrations of surficial sediment contaminants that exceed the higher sediment quality guideline (PEC) used by the NYSDEC, these are likely attributed to pockets of residual contamination. The relatively low levels reflect the extensive remediation efforts that have occurred along the river. This study will be used by NYSDEC in considering possible follow-up action by the Department's regulatory programs.

4.0 ADDITIONAL ACTIVITIES RELEVANT TO NRTMP

In addition to the programs already described for reducing and monitoring chemicals in the river as a result of the DOI, there are a number of other agency activities that occur in the river and watershed that help to provide a more complete picture of the status of the river. These activities include monitoring for new and emerging chemicals, as well as efforts to improve information management.

1.6 New and Emerging Chemicals

There are currently significant efforts underway in the US and Canada to look at new and emerging chemicals. The NRTMP is including some of these contaminants in this report to highlight the breadth and scope of monitoring done in the River.

4.1.1 Brominated Flame Retardants

During the 1970s, production of brominated flame retardants (BFRs) increased due to growing demand for better fire retardants, due in part to more stringent fire safety standards and the phase out of PCBs. Polybrominated diphenyl ethers (PBDEs) constitute roughly a third of the BFRs manufactured. They are additives mixed into polymers and, as such, are not chemically bound and can leach into the surrounding environment. Because of their widespread use and persistence, PBDEs have been found in sewage sludge, sediment, biota and humans (Hites, 2004). There is limited toxicological evidence available but the effects of BFRs are expected to be similar to PCBs. Aquatic life exposed to PBDEs may exhibit thyroid impairment, problems with neurological development and cancer.

PBDEs are prepared as three commercial mixtures: Penta-BDE, Octa-BDE and Deca-BDE. Penta-BDE and Octa-BDE have been banned in Europe (Prevedouros et al., 2004). Many of the U.S. states have place restrictions/bans on the use and manufacturing of Penta-BDE and Octa-BDE (BSEF, November 2005 update). On July 1, 2006, Canada added tetra- to deca-BDEs to Schedule 1 of the Canadian Environmental Protection Act (CEPA 1999), requiring the Government to publish proposed regulations or preventive/control actions within a 2-year timeframe.

Archived suspended sediment samples, collected during spring (March-May) over the period 1980-2002 at Niagara-on-the-Lake (NOTL), were analyzed to assess historical trends in new and emerging chemicals, including PBDEs (Marvin et al., 2007). Over the period 1980 – 1988, although generally detected in the low-ng/g range, PBDEs (measured as the sum of 16 congeners, including deca-BDE) showed a trend toward increasing concentrations. After 1988, PBDE concentrations showed a more rapidly increasing trend, peaking (35 ng/g) in 1995, with deca-BDE as the predominant congener. Marvin et al. (2007) also analyzed samples collected at both the head (Fort Erie) and mouth (NOTL) of the river over the period February 2003 to March 2004.

These demonstrated higher concentrations at the mouth of the river, indicating sources of PBDEs along the length of the Niagara River. They concluded that concentrations in Niagara River suspended sediments were comparable to those found in bottom sediments in other industrialized/urbanized areas of the world, and suggested general PBDE contamination from local, regional and continental sources. For example, an assessment of Niagara River bottom sediments by Samara et al. (2006), indicated that wastewater treatment plants discharging to the river are an important source of PBDEs to Niagara River sediments.

Recent analytical method development within the MOE laboratory have allowed for the inclusion of PBDEs in the Niagara River mussel monitoring survey to assess their bioavailability in the river.

PBDEs were detected in mussels deployed in the Niagara River. Caged *Elliptio complanata* was a useful bioindicator of PBDEs. The highest concentrations (measured as the total sum of detectable individual PBDE congeners) were present in mussels deployed within tributaries to the American side of the Niagara River (Cayuga Creek 8.6 ng/g wet wt.; Gill Creek 7.2 ng/g; and Two Mile Creek - range 4.0 to 6.3 ng/g). In addition to contributions from the atmosphere (which should be fairly consistent among all sites within the survey), each of these tributaries have storm sewers, hazardous waste site, landfills and industries located nearby the sampling sites that could be potential sources of PBDEs. Total PBDE concentrations were also higher in mussels deployed at all sites in the Tonawanda Channel and Buffalo River (range: 1.7 to 3.3 ng/g) compared with mussels deployed on the Canadian side (Chippawa Channel) and in the lower Niagara (Bloody Run Creek and NOTL). This could be a reflection of the relatively higher degree of industrial activity and larger urban centres within the Tonawanda Channel compared with the other areas. The PBDE congener patterns were similar among the mussels, with BDE-47, -99 and -100 representing the highest concentrations relative to the other detectable congeners.

4.1.2 Fluorinated Compounds

Fluorinated surfactants (FSs) are an emerging class of contaminants widely distributed in the environment. They are persistent, bio-accumulative and potentially toxic and carcinogenic. Manufacturers have used these chemicals in soil and stain-resistant coatings for fabrics, carpets and leather and in grease and oil-repellent coatings for paper products. Since 1970, there has been a steady increase in the production of FSs as they are being used in an increasing number of industrial applications. Industrial uses include fire-fighting foams, mining and oil well surfactants, photographic film and insecticides. A large number of studies (Lucaciu 2006) have found perfluorinated compounds in surface water, human blood, tissues of wildlife (fish, birds, polar bears, bald eagles, etc.), sediments and house dust.

In 2000, 3M phased out the production of two forms of FSs (perfluorooctanesulfonate, PFOS and perfluorooctanoate, PFOA) because of concerns regarding their

environmental persistence. In July 2004, Canada was the first country to ban three fluorinated polymers that contain fluorinated telomer alcohols (believed to be precursors for PFOA) for a two-year period. Depending on the availability of new information the ban was to be reevaluated in 2006.

Archived suspended sediment samples, collected during spring (March-May) over the period 1980-2002 at Niagara-on-the-Lake (NOTL), were analyzed to assess historical trends in new and emerging chemicals, including nine fluorinated surfactants (Lucaciu, 2006). Maximum concentrations of PFOS and PFOA in suspended sediments from the Niagara River over that period were 1.1 ng/g and 0.29 ng/g dry wt respectively. Most fluorinated surfactants showed an increasing trend. PFOS levels in the suspended sediments from Niagara River tripled from the beginning of the 1980s to the early 2000s and the total FSs levels increased approximately 6 times during the same period of time.

4.1.3 Pharmaceuticals

Prescription and non-prescription drugs are produced and used in large quantities. The majority of these drugs and their metabolites are excreted by the users and make their way to sewage treatment plants (STPs). Depending on the type of treatment used at the STP varying degrees of removal efficiency are achieved. The remaining drugs are released into the environment via the STP effluent (Halling-Sorensen 1998).

In order to assess the concentration of selected pharmaceuticals in the ambient environment, Environment Canada initiated a pilot project. The purpose of the monitoring is to determine the ambient water concentrations of selected pharmaceuticals in the interconnecting channel. The results will be evaluated to determine the need for inclusion of these parameters into a routine monitoring program. The Niagara River is an ideal location for a project of this nature because of the established Upstream/Downstream monitoring program. Pharmaceuticals enter the waterway via sewer treatment plant (STP) discharge and the river has several STP discharges along its length. The Fort Erie (FE) location serves as a reference station against which the downstream Niagara-on-the-Lake (NOTL) station results can be compared.

The results in Table 6 indicate that the amount and concentration of several pharmaceuticals detected at NOTL is higher than at FE. This is not unexpected given the number of STPs discharging into the river. The reported concentrations are very low. There is limited information on the toxicity of pharmaceuticals to aquatic species however some studies indicate that toxic effects occur at concentrations several orders of magnitude higher than the ambient concentrations measured in the river (Dussault 2005).

Table 6 Pharmaceutical Concentrations in the Niagara River May 2004 - March 2005

Analyte	Detection Limit (ng/L)	Use and Origin	MLE (ng/L) (90%CI)	
			FE N=11	NOTL N=10
Clofibric Acid	0.37	Metabolite of lipid regulator, clofibrate, etofyllin clofibrate, etofibrate	IS	IS
Ibuprofen	0.45	Analgesic/anti-inflammatory	1.27 (0.88-2.02)	4.23 (3.28-5.69)
Gemfibrozil	0.13	Lipid regulator	2.64 (2.17-3.28)	5.25 (4.33-6.48)
Fenoprofen	0.03	Analgesic/antiphlogistic	IS	IS
Naproxen	0.45	Analgesic/anti-inflammatory	IS	2.95 (2.19-4.20)
Triclosan	0.22	Antimicrobial disinfectant	IS	0.94 (0.66-1.45)
Fenofibrate	0.30	Lipid regulator	IS	IS
Ketoprofen	0.17	Analgesic/anti-inflammatory	IS	IS
Diclofenac	0.21	Antiphlogistic	IS	IS
Indomethacin	0.06	Antiphlogistic	IS	IS
Bezafibrate	0.06	Lipid regulator	IS	IS

MLE-Maximum Likelihood Estimate

IS-insufficient data to calculate an MLE

4.1.4 Current Use Pesticides

Currently-used pesticides (CUPs) were analyzed in 2002 and 2003 from the Niagara River. The CUPs analyzed included triazine herbicides, metolachlor, phenoxy acid herbicides and organophosphorous insecticides and are typical of some of the major pesticides used to control plant and insect pests in agricultural and urban settings in Ontario. They were analyzed by Environment Canada's National Laboratory for Environmental Testing (NLET) in Burlington, ON and the analytical methodology is described in Struger et al. (2004). In 2002, 3 whole water samples were collected 4 times from May-November from the Fort Erie and NOTL stations. In 2003, 3 samples were collected 5 times from May-October from only the NOTL station.

There were low level detections of several herbicides including atrazine ranging from 79.8 - 88 ng/L, metolachlor from ND - 130 ng/L, 2,4-D from 1.69 - 22.8 ng/L and dicamba from ND - 3.9 ng/L. No organophosphorous insecticides were detected in any samples. There were no apparent differences in concentrations between NOTL and Fort Erie in 2002. These concentrations were very similar to the low levels of CUPs measured by Struger et al (2004) in the open surface waters of Lake Erie and Lake Ontario. No pesticide concentrations exceeded water quality guidelines for the protection of aquatic life or drinking water (Struger et al. 2004).

4.1.5 Methyl Mercury in Sediments

Methyl mercury (MeHg) is a more environmentally toxic form of mercury. The transformation of inorganic Hg by anaerobic sediment microorganisms in the water column produces MeHg, which bioaccumulates in the food chain. If fish eating birds and mammals ingest sufficient MeHg in prey and drinking water, mercury toxicoses, including damage to nervous, excretory and reproductive systems, may result. (Wolfe, 1998)

In 2004 and 2005 Environment Canada conducted a pilot study to determine the concentration of MeHg in suspended sediments from the Niagara River. The results for NOTL are shown in Figure 12 along with a comparison of the unbiased mean and the upper 90% CI to the CCME sediment quality guideline (4 ng/g). The average concentration of MeHg in the suspended sediment exceeded the guideline at both the FE (not shown on graph) and NOTL stations. There did not appear to be a significant upstream/downstream difference in the concentration of MeHg. Further study is required to determine the impact of these concentrations on the aquatic life in the river and to establish a trend in the concentration.

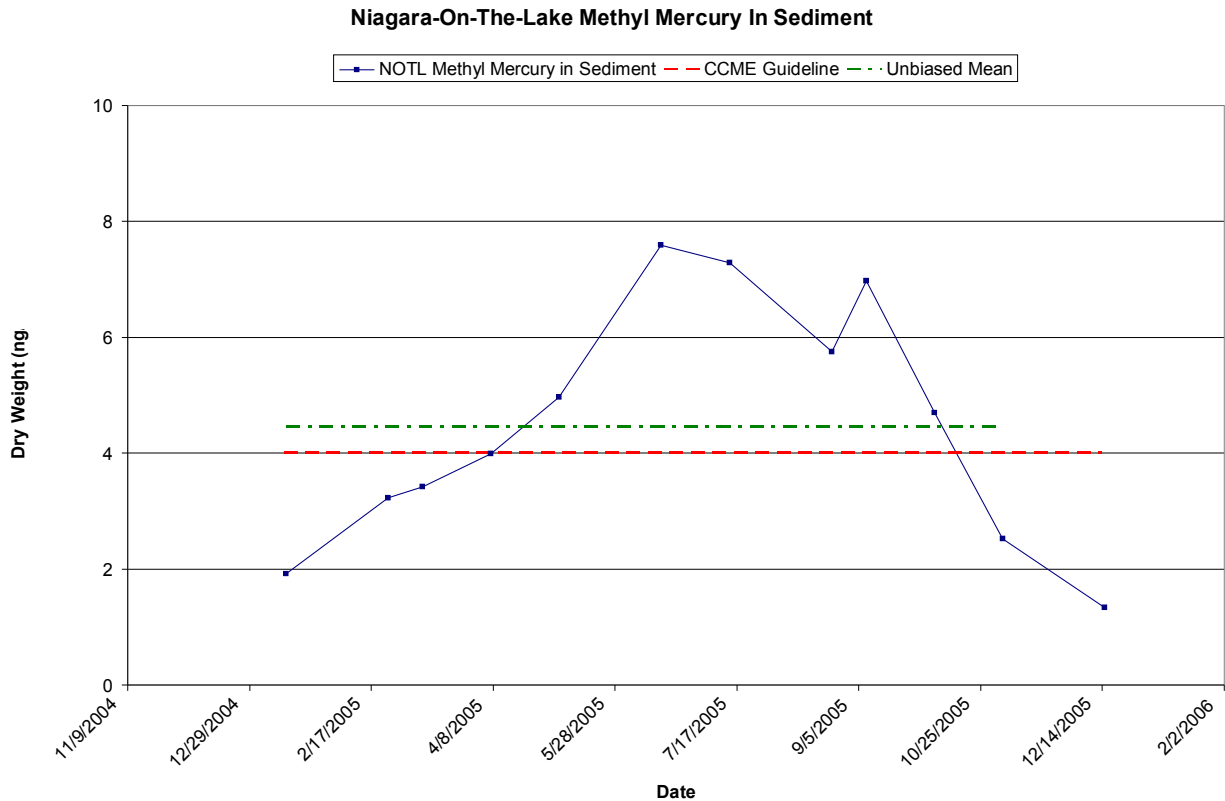


Figure 8 Concentration of Methyl Mercury in Suspended Sediment at Niagara-on-the-Lake

1.7 Information Management

Given the breadth of environmental programs in the Niagara River, the number of agencies involved, and the range of years these programs cover, it isn't difficult to imagine the volume of information that has been collected; however, accessing this information can be quite difficult for these reasons alone. This issue is not unique to the Niagara River; in fact, information management is quickly becoming a key issue for environmental programs on a much broader scale. Highlighted here are some initiatives undertaken by the Parties to improve information management.

4.1.6 Synthesis/Mapping Environmental Data of Niagara River Tributaries

A considerable amount of remediation work and monitoring has been done within the Niagara River watershed, generating a large volume of data on contaminants in general including the NRTMP 18 Priority Toxics. However, in the absence of a single repository for the reports and data generated during the past several decades, it became increasingly difficult to plan future trackdown and sampling investigations that built upon these efforts. In 2003, EPA issued a grant to SUNY at Buffalo (Buffalo State College) to collect, organize, and digitize sediment, water, and biological data related to the Niagara River and tributaries for the period 1979 to present. Past sample locations were mapped

in ArcView 3.2 and, to the extent possible, the sample locations and associated Excel data files were hot-linked. This work will help to provide documentation of past and current environmental conditions, as well as support the identification of potential priority areas for future investigations.

This study, which focused on the 18 priority toxic contaminants identified by the NRTMP, collected and digitized (into a pdf format) more than 175 reports. In addition, more than 150 databases were constructed in Excel from the collected reports. These databases were categorized as: river sediment (solid phase); sediment elutriate; sewer sediment (solid phase); sewer and stormwater runoff; surface water (rivers, ponds, and Niagara Gorge seeps); and biota (principally fish and mussels). The study did not include groundwater (well) monitoring results, surface soil sample results, or permitted direct discharges.

The pdf report files, Excel data files, pertinent digital layers (e.g. watershed boundaries, rivers, aquifers, wetlands, floodplain delineation, soils, land use, roads, NYSDOT planimetric maps), an inventory of historical industry location, digital orthoquads, metadata files, and ArcView shapefiles are included on a set of self-extracting CDs. The CDs also contain a brief summary of all data, as well as a comparison of sediment data with guidelines proposed by Ingersoll et al., 2000, *Prediction of Sediment Toxicity Using Consensus-based Freshwater Sediment Quality Guidelines*. EPA Report 905/R-00/007. The CD set for the project has been distributed to state and local agencies and stakeholders and is available from: Kim Irvine, Department of Geography/Planning, Buffalo State, 1300 Elmwood Avenue, Buffalo, NY 14222.

4.1.7 Lakeviews and the Great Lakes Monitoring Inventory

In their “11th Biennial Report on Great Lakes Water Quality”, the International Joint Commission issued a challenge to “improve public information and decision-making by increasing funding, technology and staff” for information management in order to support implementation of the Great Lakes Water Quality Agreement and, in more general terms, to provide easy and timely access by decision-makers, citizens, communities and the private sector to the reliable information they need to make informed decisions related to the environment.

In response, the The Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA) has included an Annex specifically dealing with information management that commits federal and provincial parties to provide access to accurate information regarding trends in environmental quality in the Great Lakes through an information management system.

Progress on the COA “Coordination of Monitoring, Research and Information Management” Annex has lead to the development of “Lakeviews”, an interoperable system of distributed databases linked by web services and mapping technologies that

serves as a discovery, access, visualization and decision support tool for information regarding trends in environmental quality.

"Lakeviews" is designed to provide easy access to environmental information using an interactive mapping tool and provides a snapshot of environmental programs. The application utilizes standards based open specifications and employs web services to dynamically pull information from distributed sources created by various government departments and partner organizations. Because of the flexibility offered by this design, the application is highly customizable in terms of form, content, and functionality. With the architecture already in place, the current focus is on content development - helping information custodians and their clients understand what web services are, how to develop them, how to use them and why they are so beneficial.

Similar to the IJC, the Binational Executive Committee (BEC) has identified the need for coordinated information management on a binational, multi-agency scale. In 2002, BEC approved a Binational Cooperative Monitoring Initiative to provide a mechanism to optimize monitoring activities underway in the Great Lakes. As part of the BEC Initiative, a basin-wide monitoring inventory was proposed as a necessary first step to improve knowledge sharing and coordination.

The Great Lakes Monitoring Inventory has been implemented on www.binational.net and is intended to raise awareness of current monitoring activities, promote knowledge sharing and collaboration, and help organizations identify monitoring gaps. Searchable by monitoring theme, location, and agency, the Inventory contains information about more than 1,000 monitoring programs currently conducted by Canadian and U.S. federal, provincial/state and municipal agencies, academia and non-governmental organizations.

In both of these cases, tools have been developed which are sure to have direct benefit for the Niagara River monitoring community. The Great Lakes Monitoring Inventory provides access to a larger community of practice that might assist in raising awareness of ongoing activities, promoting collaboration, and identifying monitoring gaps. At the same time, the "Lakeviews" initiative presents an opportunity to utilize new and emerging technology in order to not only deliver on reporting requirements, but to do so in a more effective and efficient means with a very strong possibility of reaching a much broader audience.

5.0 SUMMARY AND FUTURE DIRECTIONS

1.8 Summary

This report has summarized where we have come from, and where we are to date in terms of the 18 NRTMP “Priority Toxics” identified in the Niagara River Toxics Management Plan (NRTMP). The “Priority Toxics” which remain an issue in the Niagara River are:

mirex

Mirex levels in YOY fish exceed criterion at Little Niagara River. The U/D Program detected mirex in the suspended particulate fraction only at NOTL, indicating Niagara River sources. The concentration in the sediment still exceeds the strictest agency criterion at NOTL. Even though the concentration in the sediment decreased by ~50% over the period of record (Table 4), intermittent detections at NOTL suggest continuing inputs and indicate the need to conduct trackdown to identify continuing source(s) and implement further control measures at source(s).

HCB

HCB still exceeds its strictest agency criterion at NOTL. The concentrations are still much higher at NOTL than at FE suggesting continuing Niagara River inputs. Over the period of record, concentrations have decreased by >50%. The majority of this decrease in concentration occurred during the 1980's and early 1990's, but now the decreasing trend appears to have leveled off. This suggests that remedial actions implemented at sources are not effective in further reducing concentrations in the River and there is a need to conduct trackdown to identify source(s) and implement further control measures.

PAHs

Benzo(b/k)fluoranthene, chrysene/triphenylene and benzo(a)pyrene concentrations still exceed their respective criteria and statistical analysis suggest Niagara River sources may be responsible for about 50% of the input of the different PAHs to the river. The trends in concentration of the 4 PAHs have shown declines in the dissolved phase at both stations ranging from 17-78%, however, trends in the suspended particulate phase have varied widely with benzo(a)pyrene and benzo(b/k)fluoranthene increasing substantially, while chrysene/triphenylene showed no significant change, and benz(a)anthracene declined slightly at FE but showed no change at NOTL. Continued monitoring of the PAHs will be necessary to discern trends and possible sources.

dieldrin:

Concentrations at both sites continue to exceed strictest agency criterion even though concentrations have decreased by >70% over the period of record. The concentrations and trends measured at both sites are similar, suggesting sources are upstream of the River. The Four Parties need to consult with Lake Erie LaMP managers to address this chemical.

DDT & metabolites

Total DDT and two of the three metabolites still exceed strictest agency criteria at both sites. The trends show declining concentrations ranging from 42-85% with two of the DDT metabolites having significantly higher concentrations at the upstream station, likely due to local contamination. This suggests a need to conduct trackdown to identify continuing source(s) and implement further control measures at source(s).

PCBs

Focusing only on the suspended particulate phase (due to contamination of dissolved phase samples), PCBs exceed agency criterion at both stations, even though concentrations have declined by 45% (FE) and 54% (NOTL) between 1986 and 2005. Fish consumption advisories are in place for Lake Ontario and Niagara River for various species due to PCBs. PCB levels in YOY fish exceeded criteria designed to protect sensitive wildlife species at Little Niagara River. Statistical analysis of U/D data indicates continuing Niagara River sources and identifies the need for further trackdown efforts and control measures.

Mercury

Annual mean Hg concentrations in suspended sediment have declined by ~50% at both stations however fish consumption advisories are in place in Lake Ontario and Niagara River for selected species due to mercury. Mercury concentrations in water exceed criteria at the NOTL site, only. Results of the statistical analysis indicate Niagara River sources and suggest the need for further trackdown efforts and control measures.

Dioxin

Although not measured as part of the Upstream/Downstream program, dioxins and furans are measured in the Biomonitoring program and have been identified as consumption-limiting chemicals for some Lake Ontario and Niagara River sportfish species. The mussel biomonitoring program has identified Pettit Flume as a continuing source of dioxins to the Niagara River.

1.9 Future Directions

Clearly the NRTMP has achieved significant success improving the River's water quality. It is appropriate to ask, "Where does the NRTMP go from here?"

In keeping with the 1996 Letter of Support, the focus of future actions under the NRTMP should be on those chemicals which exceed their strictest agency criterion in water or sediment, or cause fish consumption advisories; those chemicals which do not show a downward trend in concentration; as well as those which have Niagara River sources. Additionally, the Four Parties need to review available ambient data in order to broaden the list of chemicals upon which progress is measured, beyond those meeting these criteria, including emerging chemicals.

Thus, the Four Parties commit to pursuing the following challenges over the next two years:

reviewing the list of NRTMP 18 “Priority Toxics” and consider a broader list of chemicals for measuring progress;

considering mechanism(s) for addressing upstream sources of chemicals which already exceed their strictest agency criteria in the water entering the River from Lake Erie (e.g. dieldrin);

exploring the future relationship between the NRTMP and the Lake Ontario and Lake Erie Lakewide Management Plans (LaMPs) and the Niagara River Remedial Action Plans (RAPs) in order to maximize efficient use of agency resources; and,

continuing and, where necessary, enhancing track down efforts to identify potential new sources of toxic chemicals.

1.10 Watch List

While the trend of the majority of legacy toxic pollutants has shown a significant decline, new chemicals used in commerce are routinely detected in the environment. Some of these new and emerging compounds show an increasing trend in the environment and have chemical properties similar to the legacy toxic pollutants while others are only now being detected due to advances in analytical technology. At present these chemicals do not have environmental criteria however, as the body of knowledge for these chemicals grows, criteria may be developed. As a precautionary measure the Secretariat is considering the development of a watch list which could include:

- Brominated Flame Retardants (PBDEs)
- Fluorinated Compounds (PFOS, PFOA)
- Selected pharmaceuticals and personal care products (Human and Veterinary drugs, Musks)
- Siloxanes
- Methyl Mercury
- Pigments and Dyes
- Platinum group metals

The NRTMP will work to establish baseline concentrations on these contaminants by developing cooperative binational partnerships with those actively involved in studying "watch list" chemicals and by promoting the inclusion of Niagara River samples as part of future research efforts.

6.0 REFERENCES

BSEF, Bromine Science and Environmental Forum. www.bsef.com.

Canadian Council of Ministers of the Environment, 1999, updated 2002
Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg, Manitoba, Canada

DOI. 1987. The Niagara River Declaration of Intent. Environment Canada, the United States Environmental Protection Agency II, Ontario Ministry of the Environment and the New York State Department of Environmental Conservation, February 4, 1987.

Dove, A., Painter, S., Kraft, J., 2003. Sediment Quality in Canadian Lake Ontario Tributaries: Part One, Report No. ECB/EHD-OR/103-01/I

Dussault, E., Balakrishnan, V., Sverko, E., Solomon, K., Sibley, P. (2005). Water and sediment toxicity of selected pharmaceuticals to benthic invertebrates. Paper at 10th Annual General Meeting & Conference of the Laurentian SETAC

El-Shaarawi, A.H., and D.J. Williams. 1989. Status of the Niagara River point source discharge information: sampling design and estimation of loading. *Environ. Monitor. Assess.* 32:331-341.

Halling-Sorensen B, Nors Nielsen S, Lanzky PF, Ingerslev F, Holten Lutzhoft HC, Jorgensen SE. Occurrence, fate and effects of pharmaceutical substances in the environment--a review. *Chemosphere*. 1998 Jan;36(2):357-93

Hites, R.A. (2004). Polybrominated diphenyl ethers in the environment and in people: a meta-analysis of concentrations. *Environ. Sci. Technol.* 38(4): 945-56.

Howell, E.T., C.H. Marvin, R.W. Bilyea, P.B. Kauss, and K. Somers. 1996. Changes in environmental conditions during *Dreissena* colonization of a monitoring station in eastern Lake Erie. *J. Great Lakes Res.* 22(3):744-756.

Lucaciu, C., 2006. "Time Trends of Persistent Organic Contaminants in Suspended Solids from the Niagara River." Masters Thesis. 86pp.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*. Archives of Environmental Contamination and Toxicology 39: 20-31.

Marvin, C.H., M.N. Charlton, G.A. Stern, E. Braekevelt, E.J. Reiner, E.J., and S. Painter. 2003. *J. Great Lakes Res.* 29(2): 317-331.

Marvin, C.H., S. Painter, D. Williams, V. Richardson, R. Rossman, and P Van Hoof. 2004. Spatial and temporal trends in surface water and sediment contamination in the Laurentian Great Lakes. *Environ. Poll.* 129:131-144.

Marvin, C., Williams, D., Kuntz, K., Klawunn, P., Backus, S., Kolic, T., Lucaciu, C., MacPherson, K., and Reiner, E. (2007). Temporal trends in polychlorinated dibenzo-p-dioxins and dibenzofurans, dioxin-like PCBs, and polybrominated diphenyl ethers in Niagara River suspended sediments. *Chemosphere* 67(9):1808-1815

NYSDEC, 2006. *Niagara River AOC Tributary Sediment Sampling Investigation*. New York State Department of Environmental Conservation, Division of Water. August 2006.

O'Connor, D.J., and J.P. Connolly. 1980. The effect of concentrations of adsorbing solids on the partition coefficient. *Water Res.* 14:1517-1523.

Preddice et al, 2006, PCBs and Organochlorine Pesticides Residue in Young of Year Fish from Traditional Near Shore Sampling Areas of New York State Great Lakes Basin.

Prevedouros, K.; Jones, K.C.; Sweetman, A.J. *Environ. Sci. Technol.* **2004**, *38*, 3224-3231.

Richman, L., 2006. Niagara River Mussel Biomonitoring Program, 2003. Ontario Ministry of the Environment

Samara, F., Tsai, C.W., and Aga, D.S. (2006) Determination of potential sources of PCBs and PBDEs in sediments of the Niagara River. *Environmental Pollution* 139: 489-497.

SAS. 1985. *The LIFEREG procedure*, In *SAS Institute Inc., SAS User's Guide: Statistics, Version 5 Edition*, pp. 507-528, Cary, N.C., SAS Institute Inc.

Struger, J., S.L'Italien and E. Sverko. 2004. In-use Pesticide Concentrations in surface Waters of the Laurentian Great Lakes, 1994-2000. *J. Great Lakes Res.* 30(3):435-450.

TAWG. 1994. A Report of the Technical Advisory Work Group (TAWG) to the Niagara River Secretariat. A Discussion Document prepared by R. Draper (NYSDEC), R. Hemmett (EPA II); R. McLarty (MOE) and D. Williams (EC), November, 1994.

USEPA, 2007. <http://www.epa.gov/glnpo/bns/baphcb/stepbap.html#sources>

USEPA & NYSDEC, 2001. *Characterization of NRTMP Priority Toxic Chemicals in Sediments, Biota and Water of the Niagara River and Tributaries*. U.S. Environmental Protection Agency, Region 2 and New York State Department of Environmental Conservation. March 30, 2001.

Van den Berg, *et al.*, 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife. *Env. Health Perspectives* 106(12)

Williams, D.J., and P. Klawunn. 2005. The NRTMP 18 Priority Toxics – An Update. Ecosystem Health Division, Environmental Conservation Branch-Ontario Region, Environment Canada, Report prepared for the Niagara River Secretariat, July 2005. 29p.

Wolfe, M.F. et al. Effects of Mercury on Wildlife: A Comprehensive Review, *Environ. Tox. Chem.*, 1998 17:146-60

BaP source <http://www.epa.gov/glnpo/bns/baphcb/stepbap.html#sources>

7.0 ACKNOWLEDGEMENTS

The Niagara River Secretariat wishes to thank the many members of the signatory agencies for their contributions to this report:

The Niagara River Secretariat members are:

Don Zelazny, New York State Department of Environmental Conservation
Mary Ellen Scanlon, Ontario Ministry of the Environment
Melanie Neilson, Environment Canada
Fred Luckey, United States Environmental Protection Agency
Paul Klawunn, Environment Canada

8.0 CONTACT INFORMATION

For further information please contact:

Marlene O'Brien
Environment Canada
Ontario Strategic Integration Division, Restoration Programs
867 Lakeshore Rd.
Burlington, ON L7R 4A6
Phone: 905 336 4552
Email: marlene.obrien@ec.gc.ca

Mike Basile
U.S. Environmental Protection Agency
Public Information Office
186 Exchange Street
Buffalo, New York 14204
Phone: 716 551 4410
Email: basile.michael@epa.gov

INTERIM FINAL

Part II: NRTMP ANNUAL WORK PLAN 2007

Controlling Point Sources
Controlling Non-Point Sources
Monitoring
Additional Actions to Reduce Toxic Chemical Inputs to the Niagara River
Public Involvement

INTERIM FINAL

NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) ANNUAL WORK PLAN 2007

The Four Parties: EPA =United States Environmental Protection Agency
 DEC =New York State Department of Environmental Conservation
 EC =Environment Canada
 MOE =Ontario Ministry of the Environment

ACTIVITY AND COMMENTS		E P A	D E C	E C	M O E	STATUS
Controlling Point Sources						
A.	Report on U.S. Point Sources		X			Ongoing; regulatory monitoring and reporting of all regulated facilities in the Niagara River basin for compliance with State Pollutant Discharge Elimination System (SPDES) permits will continue.
B.	Report on Canadian Point Sources				X	Ongoing; regulatory monitoring and reporting of Ontario point sources as required by Certificates of Approval and Clean Water regulations will continue.
C.	Report on actions to further address U.S. point sources discharging NRTMP Priority Toxics.	X	X			Ongoing; Permit reviews and revision occur routinely according to programmatic schedules. Non-regulatory and innovative voluntary pollution prevention activities have been implemented locally by DEC, Erie and Niagara counties, and various non-governmental organizations.
Controlling Non-Point Sources						
A.	Waste sites/landfills					
	1. Annual progress report on remediation of U. S. hazardous waste sites.	X	X			2007 update report completed
	2. Remediate DuPont, Necco Park site Complete Final Remedy		X			Completed; Final report pending EPA review.
	3. Hyde Park Site					
	a. Conduct annual survey of gorge-face seeps		X			Ongoing

ACTIVITY AND COMMENTS	E D E M P E C O A C E				STATUS
b. Conduct ecological risk screening of contamination at mouth of Bloody Run Creek	X				See comments
<i>Comments: Site construction was completed in June 2003 with all overburden groundwater being contained. EPA issued a Remedial Action Report in September 2004 which documented all the remedial actions taken to date on the site. Annual gorge face seep surveying continues to indicate no need for additional control or remediation of the area and studies performed by OCC indicate that the gorge-seep groundwater is not associated with the landfill since the landfill pumping system was implemented. Biomonitoring data from 2000 showed that concentrations of dioxins and furans in mussels at the mouth of Bloody Run Creek were lower than concentrations detected in 1994, 1995 and 1997. However, calculated TEQs were still considered high based on samples collected at uncontaminated sites. Samples from the 2003 sampling were lost due to vandalism and were redeployed in 2004. Risk screening of this contamination by EPA indicated human health risk to be within its acceptable risk range. The remedial action at Hyde Park has been completed with continued on-going performance monitoring. An ecological risk screening will be conducted at the mouth of Bloody Run Creek in spring 2008.</i>					
4. Remediate Buffalo Color Corporation (BCC) site					
a. Complete groundwater site investigation	X				See comments
d. Complete upland (Area A,B,C,E) site investigation	X				Draft RI/FS due Dec 2007
<i>Comments: Public notice and implementation of the final remedy was delayed due to BCC's Chapter 11 Bankruptcy filing in Oct 2002. Buffalo Color and Honeywell Corporation entered into an agreement regarding financial arrangements for future work at the site. On March 25, 2005 an Order on Consent between NYSDEC and Honeywell was issued to implement the interim remedy measure (IRM). The IRM design was approved in 2005 by DEC and construction completed in 2006 to address groundwater contamination at the site by installing a groundwater collection system. Concurrently, Honeywell voluntarily began a bulk chemical removal of remaining tanks, vats and drums at the facility that was completed during spring 2007. In June 2006 NYSDEC and Honeywell executed a second Order of Consent to conduct a RI/FS for Areas A, B, C and E. The fieldwork began in January 2007 with a draft report due later this year.</i>					

ACTIVITY AND COMMENTS		E P A	D E C	E C O	M O E	STATUS
5. Remediate Bethlehem Steel site						
a. Complete site investigation		X	X			Due to delays caused by several problems, the proposed schedule, and all target dates, were extended. DEC is currently negotiating a correction action order with Mittal Steel Company and their parent, Tecumseh, Inc.
b. Select site remedy		X	X			
c. Begin implementation of site remedy		X	X			
6. Occidental Chemical Durez - North Tonawanda						
a. Assess contamination in Pettit Flume Cove			X			See comments
b. Biomonitor effectiveness using caged mussels					X	Data analysis of 2006 ongoing
<i>Comments: After maintenance dredging by OCC in May 2000, the July 2000 and 2003 mussel biomonitoring study again detected high concentrations of dioxins and furans in deployed mussels and sediment collected from Pettit Flume. Pending the results of 2006 sampling, additional remediation measures may be required (e.g., toxic trackdown sampling; sediment trap deployment , etc.).</i>						
B. Contaminated Sediments						
Annual NY Great Lake Contaminated Sediment Inventory Update			X			Update completed for 2006 and submitted to EPA.
Monitoring						
A. Complete report on results of Upstream/Downstream sampling		X	X	X	X	Data through 2004-2005 included in NRTMP 2007 Progress Report. 2001/02-2004/05 Niagara River Upstream/Downstream Report to be released in 2007

ACTIVITY AND COMMENTS		E P A	D E C	E C O	M O E	STATUS
B.	Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan		X		X	DEC report completed. OMOE report completed.
	<i>Comments: In the fall of 2003 and 2004 MOE collected juvenile fish on both the Canadian and US sides of the Niagara River. In 2003, DEC sampled YOY fish from three locations in the Niagara River (Strawberry Island, Little Niagara River, and Lewiston). Reports released in 2006. Planning for future YOY sampling is underway.</i>					
C.	1. Track down toxic chemicals in tributaries and sewer systems to identify sources	X	X			See comments
	1. Perform post-remediation sediment sampling of Gill Creek.		X			Completed September 2006.
	2. Perform follow-up trackdown-related sampling in Two-Mile Creek		X			Ongoing. 2006 sampling indicates addition work required.
	3. Perform sediment sampling in Scajaquada Creek, Two Mile Creek, Cayuga Creek, and Little Niagara River		X			Completed September 2006.
	4. Perform water, sediment and insect sampling in tributaries	X				Sampling completed. Report by N.U. pending EPA review.
	<i>Comments: DEC and EPA are working cooperatively to oversee the implementation of New York State Great Lakes basin source trackdown work, including Lake Ontario, Lake Erie, and the Niagara River. Through DEC/EPA's assessment of past data collected in the Niagara River and U.S. tributaries, several priority areas were identified for follow-up sediment monitoring in 2004/2005 by DEC. DEC issued a report of findings in September 2006. Additional environmental sampling in the Niagara River was also funded through the Great Lakes National Program Office's FY 2004-2005 Request for Proposals. This grant to Niagara University funded the stratified sampling and analysis of water, sediment, and insects (chironomid larvae) in Cayuga Creek, Bergholtz Creek, Gill Creek, Pettit Plume, Gatwick Riverside Park Potential, Little Niagara River, and Black Rock Canal to locate potential pollutant hotspots that warrant more detailed investigation. Work has been completed and report submitted to EPA for approval.</i>					
D.	Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan. Evaluate effectiveness of waste site remedial actions.				X	Last deployment conducted in 2006, report in preparation. Next deployment scheduled for 2009.
E.	Study use of zebra and quagga mussels as biomonitors.				X	Results Published: Richman, L.A. and Somers K. 2005. Can we use zebra and quagga mussels for biomonitoring

ACTIVITY AND COMMENTS		E P A	D E C	E C O	M O E	STATUS
						contaminants in the Niagara River? Water Air Soil Pollution 167:155-178. Summary report on 1995 vs. 2003 Quagga Mussel data pending.
F.	Assess sport fishery in Niagara River, with contaminant analysis. <i>Comments: The 2007/08 Guide to Eating Ontario Sportfish has been released. In 2006 MOE collected rainbow trout, lake trout, northern pike, smallmouth bass, largemouth bass, yellow perch, rock bass, brown bullhead, carp, rainbow smelt, freshwater drum, white sucker and smelt from the Niagara River. In 2007 it is anticipated that lake trout, brown trout and Chinook salmon will be collected. Sportfish sampling is tentatively scheduled for 2008. In 2004-05, DEC collected carp from the Buffalo River and upper Niagara River, and in 2006 DEC collected American eel, bullhead, carp, smallmouth bass, and white sucker from the lower Niagara River. Data was used by the NYS Department of Health (DOH) for updating the 2007-2008 NYS DOH's Health Advisories: Chemicals in Game and Sportfish. No changes to either upper or lower Niagara River fish advisories were made.</i>	X		X		See comments
H	Develop plans for additional assessment of low-level contaminant discharges from Niagara River point sources. <i>Comments: DEC/EPA's 1999 assessment of recent available information on toxic contaminant discharges from Niagara River point sources indicated the potential value for additional assessment of low-level contaminant discharges from point sources in the Niagara River. The purpose would be to help determine future options for enhancing control of contaminant discharges from point sources that are meeting current effluent permit requirements. EPA started the systematic sampling of these point sources in 2005; the first facility sampled was the Bird Island Treatment Plant in Buffalo, NY in early May 2005. Influent and effluent waters at General Motor's Tonawanda Engine Plant facility were sampled for PCBs in September 2006. No significant differences between influent and effluent PCB concentrations were found. Another Niagara River point source will be sampled in 2007.</i>	X	X			See comments
Define Additional Actions to Reduce Toxic Chemical Inputs to the Niagara River						
A.	Develop additional materials relating information on Niagara River contamination and contaminant sources, and incorporate into NRTMP Progress Report/ Work Plan and Niagara River RAP updates.	X	X	X	X	Niagara River monitoring activities included in the BEC monitoring inventory found at www.binational.net

ACTIVITY AND COMMENTS		E P A	D E C	E C O	M O E	STATUS
B.	Develop plans addressing water-quality limiting chemicals. <i>Comments: Niagara River waters and tributaries have previously appeared on New York's annual list of water quality-impaired waters (i.e. the Clean Water Act Section 303(d) list) due to water quality standard exceedances of PCBs, dioxin, and mirex. In 2002 and 2004, the Niagara River was additionally listed under Part 3a of the New York State 303(d) list (Waterbody Segments Requiring Verification of Impairment) due to potential exceedances of the most stringent applicable NYS standards for PAHs. Total Maximum Daily Loads/Wasteload Allocations/Load Allocations (TMDLs/WLAs/LAs) may be developed, as necessary, for waters on the 303(d) list. Since monitoring data suggest several of these exceedances can be attributed to Lake Erie sources, DEC and EPA have communicated their priorities to the Lake Erie Lakewide Management Plan committee to ensure that their future strategy to address toxic contamination in Lake Erie be consistent with, and incorporate NRTMP concerns.</i>	X	X			See comments
Public Involvement						
B.	Present remediation progress for U.S. hazardous waste sites at a public meeting in Niagara Falls.	X	X	X	X	Progress on U.S. hazardous waste site remediation is summarized annually and presented at the NRTMP/LO LaMP public meeting in 2007.
C.	Make NRTMP information and reports available on the Internet. Develop a NRTMP web page. <i>Comments: Summaries of recent Four Party Upstream/Downstream Reports can be found on the GLIMR web site at http://www.on.ec.gc.ca/glimr/search.html (search "joint evaluation"). U.S. hazardous waste site reports (Reduction of Toxics Loadings to the Niagara River from Hazardous Waste Sites in the United States) from 1998 and NRTMP progress reports are at available at http://www.epa.gov/grtlakes/lakeont/nrtmp. Additional reports are added as they become available.</i>	X	X	X	X	See comments
D.	Produce a progress report on the condition of the Niagara River and NRTMP efforts to restore the river. Update annual work plan for future actions	X	X	X	X	Last full report released in 2003; interim reports issued in 2004 and 2005; no report issued in 2006.
E.	Hold a public meeting to present above progress and updated annual work plan	X	X	X	X	2007 meeting held on Grand Is. NY. <i>The next NRTMP public meeting will be scheduled for 2010 in Niagara Falls, Ontario</i>

Appendix

Declaration of Intent (1986)

Letter of Support (1996)

INTERIM FINAL

DECLARATION OF INTENT

BY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENT CANADA

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL
CONSERVATION

ONTARIO MINISTRY OF THE ENVIRONMENT

RELATING TO

THE NIAGARA RIVER TOXICS MANAGEMENT PLAN

INTRODUCTION

The problems of toxic chemical pollution in the Niagara River have been well documented. Major investigations have identified existing and potential sources of toxic pollution along the River, as has work undertaken by the Parties to this Declaration, the International Joint Commission and, more recently, through the Niagara River Toxics Committee (NRTC) report of October 1984.

Numerous studies and investigations undertaken over the years have contributed significantly to the understanding of the complex problems in the river. They have also led to the implementation by the jurisdictions of a wide range of control programs and other measures to reduce the burden of toxic chemicals in the River.

The United States Environmental Protection Agency (EPA), Environment Canada (DOE), the New York State Department of Environmental Conservation (NYSDEC) and the Ontario Ministry of the Environment (MOE) – herein referred to as the Parties – have each identified their respective various programs and activities underway or planned on the Niagara in their responses to the recommendations of the Niagara River Toxics Committee. The Parties continue to undertake activities leading to the reductions of toxic chemical pollutants in both countries in accordance with existing laws and regulations which continue to evolve and which may not be similar in approach.

Under Article II of the Great Lakes Water Quality Agreement of 1978, the governments of Canada and the United States agree to make a maximum effort to develop programs, practices and technology necessary to eliminate or reduce, to the maximum – extent practicable, the discharge of pollutants into the Great Lakes System. This Article also states the policy of the Parties that the discharge of toxic substances in toxic amounts be prohibited and that the discharge of any or all persistent toxic substances be virtually eliminated.

While there are other sources of contamination, the Niagara River is a major contributor of toxic chemical pollutants to Lake Ontario. Public concern over toxics problems in the international waters of the Niagara River and Lake Ontario calls for the unified and collective efforts and will of the four Parties to protect and improve the quality of this valuable resource. Complementary actions carried out in both countries to address these problems include:

- Remedial Action plans for Areas of Concern identified by the International Joint Commission (IJC);
- United States and Canadian Great Lakes Five Year Strategies;
- Canada-Ontario Agreement of Great Lakes Water Quality;
- Ongoing environmental programs in each jurisdiction.

PURPOSE

The purpose of this Declaration is to ensure that a management strategy is adopted which enables the Parties to move in a directed and coordinated manner toward the objective of achieving significant reductions of toxic chemical pollutants in the Niagara River in accordance with timetables and specific activities. The Parties commit themselves to using the authority provided by their domestic laws and regulations to this end. This is consistent with the goal of virtual elimination of toxic discharges, as agreed upon in 1978 by the Governments of the United States and Canada under the Great Lakes Water Quality Agreement.

In October 1986, the Parties released the first edition of a four-party Work Plan which establishes timetables and a set of specific activities to be undertaken. This Declaration in conjunction with that document, together form The U.S. – Canada Niagara River Toxics Management Plan, hereinafter referred to as The Plan. (See Appendix 1).

THE PARTIES DECLARE THEIR INTENT TO:

Adopt and implement The Plan as a dynamic and evolving framework within which the United States and Canadian agencies will cooperatively take appropriate steps leading to a significant reduction in toxic chemical pollutants from point and non-point sources to the Niagara River, in a manner consistent with federal, state and provincial laws.

In so doing, and in order to achieve the goals of The Plan as stated in this Declaration of Intent, the Parties will:

1. Jointly establish a common basis for identifying, assessing and quantifying toxic chemical loadings into the Niagara River:

Individually identifying and establish priorities for control measures to reduce loadings;

Individually implement chemical pollutant control activities in the Niagara River;

Individually and jointly monitor and evaluate the success of control activities.

2. Take into account applicable water quality and drinking water standards and set as a target a reduction level of 50% for persistent toxic chemicals of concern* from point sources in Ontario and New York by the year 1996. This achievement will depend on the progressive evolution of technologies, permits, standards, laws, and regulations in both countries.

3. Report by July 1987 and each year thereafter on progress made in identifying and quantifying loadings of toxic chemical pollutants originating from non-point sources in Ontario and New York. To this end, the Parties will work towards achieving a reduction of at least 50% of persistent toxic chemicals of concern* by the year 1996 taking into account siting issues, technology available, laws and regulations.
4. Establish an improved system of monitoring to ensure the effectiveness of all monitoring programs and schedules.
5. Enforce laws and regulations to ensure the maximum reductions in loadings. In general, point source control measures will be based upon the application of existing best available technology and the results of scientific evidence of environmental degradation. The Plan will be updated to reflect developments in these areas.
6. Use The Plan as a means of alerting the jurisdictions to those chemicals for which reductions are not occurring, so that appropriate corrective actions can be taken.
7. Review and update The Plan on an annual basis. As part of the review a progress report will be published and public input sought. The report will include an implementation schedule proposed for the coming year, the results of monitoring, a list of actions undertaken with respect to point and non-point sources, updated information on chemicals of concerns, and scientific evaluations of new and developing technologies relevant to the program.
8. In 1988 and annually thereafter, review and report in depth (based to the maximum extent possible on existing Parties' reporting requirements) on the state of new and emerging technologies applicable to hazardous waste landfill site remediation with particular emphasis on such techniques as the excavation, removal, and on-site destruction of contaminated material.

* A mutually agreed upon list of persistent toxic chemicals of concern will be developed from:

- 1) NRTC Group I and II lists of chemicals of concerns;
- 11) IJC Water Quality Board's 1985 list of "Critical Pollutants";
- 111) Results of point and non-point source monitoring activities underway.

9. Submit The Plan and progress reports to the International Joint Commission as part of the Commission's Action Plan program for the Great Lakes.

10. Adopt the following goals for each component of The Plan:

a) River Monitoring

- determine the toxic chemical loadings to the Niagara River from Lake Erie (input);
- determine toxic chemical loadings from the Niagara River to Lake Ontario (output);
- determine toxic chemical loadings from sources along the Niagara River by comparing the difference between the output from the river and input from the river from upstream sources (input-output differential river monitoring identified by the NRTC);

Attempts will be made to determine the loadings with sufficient confidence to measure the effectiveness of the control programs.

b) Point Sources

- determine toxic chemical loadings from industrial and municipal facilities;
- estimate allowable toxic chemical loadings from industrial and municipal sources as provided in regulatory specifications;
- estimate reduction of toxic chemical loadings as a result of implemented control measures and scheduled reductions based on planned control measures;
- implement remedial and control programs so as to achieve the maximum possible reduction of toxic chemical loadings to the Niagara River;

c) Non-Point Sources

- estimate toxic chemical loadings from tributaries and leaking hazardous waste disposal sites;
- estimate reductions in toxic chemical loadings as a result of implemented control measures, and schedule reductions based on planned control measures;
- implement remedial and control programs so as to achieve the maximum possible reduction of toxic chemical loadings to the Niagara River. In addition, on all sites, excavation, removal and destruction of contaminated material will be considered as a means of eliminating contaminants to the river.

d) Chemicals of Concern

- identify and maintain a list of chemicals of concern (as determined by the NRTC, with further monitoring, research and priorities established by the IJC Water Quality Board) within the Niagara River ecosystem and promote the establishment of uniform environmental and human health criteria for those chemicals.

e) Technical and Scientific Cooperation

- carry out research, technical and scientific programs to assist the four jurisdictions in addressing the problems of the Niagara Frontier.

f) Communication Plan

- present information and scientific reports to the public, and seek their input to The Plan.

g) Organization and Implementation

- establish and maintain a management structure to ensure that the implementation of The Plan is effectively monitored.

h) Reporting

- update The Plan annually and issue status reports at the beginning of each calendar year.

11. Initiate activity on a Lake Ontario Toxic Management Plan which will be similar in content and scope to the Niagara River Toxics Management Plan and compatible with IJC activities. The Lake Ontario document will be completed by January 1, 1988.

Executed this 4th day of February, 1987.

For the United States
Environmental Protection Agency

Signature on Original

Mr. Lee Thomas
Administrator

For Environment Canada

Signature on Original

The Honourable Tom McMillan
Minister

For the New York State Department
of Environmental Conservation

Signature on Original

Mr. Henry G. Williams
Commissioner

For the Ontario Ministry of the
Environment

Signature on Original

The Honourable Jim Bradley
Minister

INTERIM FINAL

NIAGARA RIVER TOXICS MANAGEMENT PLAN LETTER OF SUPPORT

In February 1987, the United States Environmental Protection Agency, Environment Canada, New York State Department of Environmental conservation, and the Ontario Ministry of Environment and Energy ("The Four Parties") signed the Niagara River Declaration of Intent to achieve significant reductions of toxic chemical pollutants in the Niagara River. The Declaration of Intent and a detailed workplan form of the Niagara River Toxics Management Plan.

There is no termination date written into the Declaration of Intent. 1996, however, is a significant year, because of the milestone in the Declaration of Intent of a 50% reduction in persistent toxic chemicals of concern from point and non-point sources in Ontario and New York by 1996. The Four Parties have worked together and individually to achieve significant reductions in inputs of toxic chemicals to the Niagara River. As the 1996 milestone date draws near, the Four Parties are taking the opportunity to reaffirm their commitment to the Niagara River Toxics Management Plan and to develop a post-1996 strategy for continued reduction of toxic pollutants.

With this Letter of Support, the Four Parties reaffirm their commitment to the Niagara River Toxics Management Plan and agree to make progress towards the following Goal:

To reduce toxic chemical concentrations in the Niagara River by reducing inputs from sources along the river. The purpose is to achieve ambient water quality that will protect human health, aquatic life, and wildlife, and while doing so, improve and protect water quality in Lake Ontario, as well.

The Four Parties intend to mark progress toward the Goal by reporting on measurable milestones in an annual Four-Party report:

Maintain downward trends in Concentrations of chemicals that exceed U.S. or Canadian water and sediment criteria, that cause fish consumption advisories, and that are detected in sediment cores. Each Criterion met or advisory removed is a milestone achieved.

Achieve downstream concentrations that are statistically equivalent to those upstream.

Maintain downward trends in concentrations of chemicals that are associated with particular sources, so that remediation program success can be demonstrated

The Four Parties agree to achieve the Goal and milestones through a Plan of Action:

Implement and report on effective point source control measures. Track down new sources for control

Remediate and monitor progress at hazardous waste sites.

Monitor the River through the Upstream-Downstream program.

Conduct biomonitoring and sediment coring in Niagara River and Lake Ontario.
Broaden the list of chemicals upon which progress is measured to include toxic chemicals other than those currently exceeding standards.
Relate, more effectively, the data from control measures and remedial activities to those on ambient conditions in the river.
Enhance public involvement in the current management structure by forming ad hoc public groups as issues arise and adopting a Public Involvement Plan.

Signed this 3rd day of December 1996

For the United States
Environmental Protection Agency

Signature on Original

Jeanne M. Fox

For Environment Canada

Signature on Original

R. John Mills

For the New York State Department
of Environmental Conservation

Signature on Original

Gary Speilmann

For the Ontario Ministry of
Environment and Energy

Signature on Original

Sheila Willis