NIAGARA RIVER
TOXICS MANAGEMENT PLAN

PROGRESS REPORT
AND
WORK PLAN

October 2001

BY THE NIAGARA RIVER SECRETARIAT

TABLE OF CONTENTS

Executive Summary....ii

PROGRESS REPORT

1.0 INTRODUCTION 1

2.0 THE UPSTREAM/DOWNSTREAM MONITORING PROGRAM 2

Chlorobenzenes (CBs).... 3
Organochlorines (OCs) 3
Polynuclear Aromatic Hydrocarbons (PAHs).... 4
Industrial By-Product Chemicals 4
Metals.... 4

Trend Graphs 4

3.0 STATUS AND TRENDS RELATIVE TO ENVIRONMENTAL OBJECTIVES.... 5

The Significance of Niagara River Sources.... 5
COMPARISON WITH WATER QUALITY CRITERIA 7
FISH CONSUMPTION ADVISORIES 9
New York State Advisories 9
Ontario Advisories 9
Upper Niagara River 9
Lower Niagara River 10

4.0 THE BIOMONITORING PROGRAM....10

Young-of-the-Year (YOY) Forage Fish Contaminant Monitoring....11

5.0 SYNTHESIS OF DATA FOR U.S. TRIBUTARIES AND POINT SOURCES....11

Contamination in Sediments, Biota and Water of U.S. Tributaries....12
Contamination in Point Sources....13

6.0 SUMMARY....14

7.0 REFERENCES 15

WORK PLAN

2001 NRTMP Annual Work Plan W-1

Niagara River Toxics Management Plan
Progress Report and Work Plan

October 2001

EXECUTIVE SUMMARY

The Niagara River flows 60 kilometres or 37 miles from Lake Erie to Lake Ontario. It serves as a source for drinking water, fishing grounds, and vacation spots. It generates electricity and provides employment to millions of people. Unfortunately, the River is also the recipient of toxic wastes that pollute its waters and prevent us from fully enjoying its beneficial uses.

Since 1987, the Niagara River has been the focus of attention for the four environmental agencies in Canada and the U.S. 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 a Declaration of Intent (DOI). 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, because they were thought to have significant Niagara River sources, were designated for 50% reduction by 1996. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions.

In December 1996, the Four Parties signed a “Letter of Support”, pledging their continued commitment to reduce toxic chemical inputs to the Niagara River, 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.

This Progress Report continues to focus on concerns related to water use in addition to presenting the results from the Upstream/Downstream and Biomonitoring Programs. Included are discussions on comparison of ambient water concentrations to water quality criteria, fish consumption advisories, contaminant concentrations in juvenile fish, and U.S. efforts to determine if there are sources of “priority toxics” to the Niagara River that may require further attention.

The Work Plan, also included as part of this Progress Report, outlines the activities to be undertaken by the Four Parties to achieve the goals expressed in the Letter of Support, and to monitor and report progress towards attainment of these goals.

The primary method of assessing progress is the Upstream/Downstream Program. This program collects water and suspended sediment samples once every two weeks from the head and mouth of the river to measure the changes in the concentrations and loads of about 70 chemicals. An advanced *statistical model* was used to determine trends for the eighteen "priority toxics" for the period 1986/87 to 1998/99, and to determine with more certainty, the effectiveness of reductions of chemical loads to the river.

The most recent results show continuing, statistically significant reductions in the concentrations/loads of most of the "priority toxics" for which there are data. The reductions since 1986/87 have, in many cases, been greater than 60%. For some chemicals, the reductions observed are due, in part, to the effectiveness of remedial activities at Niagara River sources in reducing chemical inputs to the river.

In 1998/99, the upper 90^{th} percentile concentrations of NRTMP "priority toxics" for which there are data at Niagara-on-the-Lake (NOTL), with the exception of the DDT metabolite TDE, arsenic (As) and lead (Pb), exceeded their most stringent agency criterion. At Fort Erie (FE), polynuclear aromatic hydrocarbons (PAHs), dieldrin, and some of the DDT metabolites exceeded their most stringent agency criteria. This can be contrasted with the information in last year's Progress Report which indicated that most of the "priority toxics", with the exception of hexachlorobenzene (HCB) and the PAHs, were below their relevant most stringent agency criteria.

The Four Parties have traditionally applied the most stringent surface water quality criteria as part of their assessment of water quality in the Niagara River. In February 1998, NYSDEC adopted new standards pursuant to the U.S. Great Lakes Initiative. For some chemicals, these new standards, in addition to being the most stringent of the Four-Party water quality criteria, are also more stringent than the NYSDEC standards existing prior to 1998. Now Upstream/Downstream Program data are available for the period for which the new standards were in effect. The increases in exceedences in 1998/99 are the result of comparing the data to the more stringent standards rather than significant increases in the water concentrations of these chemicals in the river. As noted above, the continuing decreasing trends in the concentrations/loads for most of the NRTMP "priority toxics" attest to the continuing improvement in Niagara River water quality.

While there were no changes to New York State fish consumption advisories, re-testing of several species of fish from the upper and lower Niagara River by Ontario (MOE) resulted in less restrictive consumption advisories for several species. It also resulted in a new consumption advisory for rock bass, and a more restrictive advisory for freshwater drum due to mercury levels exceeding guidelines.

PCB and DDT were detected in juvenile fish from all nine sites sampled by MOE in the upper and lower Niagara River in 1999. PCB concentrations have decreased at each of the sites since monitoring was started (around 1980). Concentrations at Fort Erie and Frenchman's Creek in the upper Niagara River are now less than the Great Lakes Water Quality Agreement (GLWQA) aquatic life guideline (100 ng/g). Concentrations at all four sites in the lower Niagara River were below or only slightly above the guideline.

As the Four Parties have previously reported, despite the successes to date and the continued improvements now being reported, more work needs to be done. With the adoption of new standards by NYSDEC, most of the NRTMP "priority toxics" now exceed their most stringent agency water quality criteria in the river. Advisories to limit consumption of sportfish caught in the Niagara River continue due to contamination by toxic substances. There is evidence of continuing sources of chemical contamination in the river. Inputs from Lake Erie are also important for some chemicals. In the past year, much work has been done to define the actions necessary to assure continued reductions of toxic chemicals in the Niagara River, and there are substantial new action commitments to address current concerns. For example, the U.S. parties have recently completed three assessments based on a variety of Niagara River data with the objective of identifying potential priorities for further action. The principal findings of these assessments have been summarized in this Progress Report, and specific actions are included in the Work Plan. The activities in the Work Plan reflect the commitment of the Four Parties to continue to reduce toxic chemical inputs to the River and to monitor the progress. This commitment includes:

- Completing the actions described in prior NRTMP Work Plans;
- Ensuring that these actions have been effective;
- Implementing additional actions to protect and restore the River; and
- Continuing and improving the public reporting of progress.

1.0 INTRODUCTION

In February, 1987, Environment Canada (EC), the U.S. Environmental Protection Agency Region II (EPA), the Ontario Ministry of the Environment (MOE) and the New York State Department of Environmental Conservation (NYSDEC)-- the “Four Parties”-- signed a "Declaration of Intent” (DOI). The purpose of this Declaration is to achieve significant reductions of toxic contaminants in the Niagara River. Eighteen “priority toxics” were specifically targeted for reduction (Table 1), ten of which, because they were thought to have significant Niagara River sources, were designated for 50% reduction from Canadian and U.S. point and non-point sources by 1996. The Niagara River Toxics Management Plan (NRTMP) is the program designed to achieve these reductions. The NRTMP Work Plan identifies activities taken by the Four Parties to remediate sources and to monitor progress toward protecting the River.

The Four Parties have used a variety of information to assess progress. For example, NYSDEC/EPA and MOE have presented point source daily load data showing greater than 50% reductions in the “priority toxics”. NYSDEC and EPA have presented information on progress in remediation of hazardous waste sites. Reductions in inputs of certain priority toxic chemicals to the river from Niagara River sources have also been corroborated by data from the Upstream/Downstream and Biomonitoring programs, and sediment core data from the Niagara River depositional zone in Lake Ontario.

The messages in the last few NRTMP Progress Reports have been clear and consistent:

- The concentrations/loads of many of the 18 NRTMP “priority toxics” in the Niagara River have decreased and the river is getting “cleaner”; and,

- The decreases since 1986/87 in nearly all cases have surpassed 50%.

The same reports, however, also acknowledged that more work still needs to be done.

The commitment to further reducing toxic chemical inputs to the Niagara River and to assessing the effectiveness of remedial activities at Niagara River sources in reducing the concentrations of these chemicals in water and biota was re-affirmed in a Letter of Support signed by the Four Parties in December, 1996. That Letter included the following revised goal statement:

> "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."

This goal statement clearly links the reason for reducing toxic chemicals in the river and uses of the water. Some of the current concerns related to use were noted in the two previous Progress Reports. These included, for example, exceedences of water quality criteria in the river and fish consumption advisories for fish from the river.

This Progress Report continues to focus on concerns related to water use in addition to presenting the results from the Upstream/Downstream and Biomonitoring Programs. Included are discussions on comparison of ambient water concentrations to water quality standards/objectives, fish consumption advisories and U.S efforts to determine if there are sources of priority toxics to the Niagara River that may require further attention.

The Work Plan, also included as part of this Progress Report, outlines the activities to be undertaken by the Four Parties to achieve the above goal, and to monitor and report progress.

2.0 THE UPSTREAM/DOWNSTREAM MONITORING PROGRAM

Since 1986, the Upstream/Downstream Program has collected both water and suspended sediment samples from the head (Fort Erie = FE), and mouth (Niagara-on-the-Lake = NOTL) of the Niagara River, once every two weeks[1], to measure the changes in the concentrations and loads of about 70 chemicals entering and leaving the river. Annual mean concentrations and loads with their 90% confidence limits have been estimated for each of the chemicals, in both phases, at both stations, and the results summarized and released in annual, Four Party Upstream/Downstream reports (e.g., NRDIG 1999). Using state-of-the-art sampling and analytical methodologies, the program has been able to detect chemicals at very low concentrations - much lower than those attainable at sources using source monitoring program detection limits.

Both seasonal and large, week to week, fluctuations in the Niagara River Upstream/Downstream data made discernment of trends in the concentrations and loads difficult. This difficulty was further exacerbated by concentrations of many chemicals, particularly organic chemicals, being below their analytical detection limits

[1] Prior to April 1997, sampling was done on a weekly basis.

(due to dilution by the river's high rate of flow), and the fact that the detection limits for some chemicals changed during the period of record. A statistical procedure (model) that dealt with "censored" and missing data, auto-correlation and seasonality, as well as changing analytical limits of detection was developed to determine reliable trends over time with known confidence for measured chemicals (El-Shaarawi and Al-Ibrahim 1996).

A detailed analysis of the Upstream/Downstream Program data collected over the eleven-year period 1986/87 to 1996/97 to determine trends was recently completed by Williams *et al* (2000). The model was run on each of the chemicals, in each phase individually [whole water for metals], at both stations *for the entire period of record.* The ratio of the means (expressed as a percent) for the end year (1996/97) to the base year[2] was used to calculate an index of change over the eleven-year period of record. This Progress Report updates this analysis to include the thirteen years up to 1998/99.

Table 2 shows the percent change in the annual[3] mean concentrations/loads *generated by the model* in both phases, at both stations, between the base year and 1998/99 for those NRTMP "priority toxics" for which there are data. A dashed line in the Table indicates that the chemical either had too few data to run the model (e.g., most values below detection), or insufficient data to have confidence in the model output. A positive number indicates a significant increase ($p<0.001$), and a negative number a significant decrease ($p<0.001$), in the model estimates of annual mean concentrations/loads over this time period. "NS" signifies no significant change. [**NOTE:** PCB estimates for the suspended sediment phase only are presented in the Table because of known laboratory contamination problems with the dissolved phase analyses.] The analytical protocol was changed in 1998/99 to measure PCB congeners rather than Aroclors. Analysis of congeners gives higher values than analysis of PCBs using the Aroclor method. This results in an increase in concentrations caused by the methodology change.

The results are consistent with those presented in previous Progress Reports. Briefly, they show the following:

Chlorobenzenes (CBs)

The reduction in both the dissolved and particulate phase concentrations and loads of hexachlorobenzene (HCB) at NOTL over the thirteen-year period was greater than

---

2 The base year varies for different chemicals; while the program was initiated in 1986 (identified base year in the NRTMP), additional chemicals were added to the Niagara River protocol as analytical methods became available.

3 Note that "annual" refers to April 1 to March 31, rather than calendar year.

60%. The decrease over the period up to 1998/99 only differs by a few percent from that estimated for the period up to 1996/97 reported in last year's Progress Report. At FE, the output from the model was discarded because significance was based almost entirely on "trace" (i.e., below the detection limit) values. As noted in previous Progress Reports, this clearly suggests that reductions at NOTL are due to reductions in the inputs of hexachlorobenzene to the Niagara River from Niagara River sources.

Organochlorines (OCs)

In general, both the concentrations and loads of nearly all the NRMTP OC "priority toxics" decreased significantly in one or both phases at both FE and NOTL. Decreases were often observed only in one phase because there were insufficient data in the other phase to determine change. This may be related to the partitioning of the chemical between the dissolved and particulate phases. The decreases (in concentrations or loads) ranged between 40.1% (p,p'-TDE) and 71.5% (dieldrin) and were, generally, of similar magnitude at both stations. α-chlordane exhibited no significant change at either station. Mirex concentration and load at NOTL has decreased by greater than 55%. Because it is only detected at NOTL, these reductions are due to the effectiveness of remedial activities at Niagara River sources.

Polynuclear Aromatic Hydrocarbons (PAHs)

Of all the chemicals analyzed in the Upstream/Downstream Program, results for the PAHs were the most variable. For those PAHs having sufficient data to run the model, the concentrations and/or loads between the base year and 1998/99 decreased for some, increased for others, and for yet others, exhibited no significant change. Depending on the PAH, these changes occurred only in the dissolved phase, only in the particulate phase, or in both. Furthermore, changes for some PAHs were significant at only one of the stations. For example, benzo(a)pyrene [B(a)P] exhibited a significant increase in concentration, but a significant decrease in load only at FE over the thirteen-year period. This reduction in B(a)P load is probably due to a decrease in the suspended particulate material (SPM) concentrations that have occurred over this time period**.** Benzo(b/k)fluoranthene showed no significant change in either phase at either station.

Industrial By-Product Chemicals

Octachlorostyrene (OCS) was detected only at NOTL. Its particulate phase concentration and load decreased significantly (greater than 80%) over the thirteen-year period up to 1998/99. There were insufficient data in the other phase to determine change. As noted for the OCs, this may be related to the different partitioning of these chemicals between the dissolved and particulate phases. These results clearly suggest success in controlling inputs of OCS from Niagara River sources.

Metals

The concentrations/loads of lead continued to exhibit a significant decrease ($p<0.001$). The trend for arsenic is no longer significant at either station. Analysis of mercury in water was discontinued in 1996/97 until a more sensitive detection limit is available. Analysis is scheduled to recommence in 2001/02.

Trend Graphs

In generating the output for Table 2, the model also generated time series plots (i.e., trends) of the dissolved and suspended sediment phase concentrations at both NOTL and FE for each of the "priority toxics" shown in the Table**.**

The plots for most of the chemicals continue to show a statistically significant ($p<0.001$) decreasing trend.[4] Figures 1 to 5 show the statistically significant trends for hexachlorobenzene, PCB, dieldrin, octachlorostyrene, and mirex respectively, over the period 1986/87 to 1998/99.

To recap, both the concentrations and loads of most of the NRTMP "priority toxics" shown in the Table continue to decrease.[5] The rate of change, however, has slowed considerably. For example, for many of the NRTMP "priority toxics", the decrease in concentrations/loads over the period base-year to 1998/99 is generally only slightly greater (about 10-15%) than that reported in last year's Progress Report for the period base-year to 1996/97. The reason for this is obvious from the trend graphs which show that the trends have flattened out considerably compared to the more rapid changes observed at the beginning of the Upstream/Downstream Program. For a number of the "priority toxics" (eg., HCB, OCS, mirex), the trend has almost become a horizontal straight line. Perhaps the notable exception is dieldrin which continues an almost linear decrease. Similar decreases have been noted in Lake Erie concentrations and are probably due to the "outgassing" of dieldrin from the Lake (Williams *et al* 2001).

Thus, while improvements are still occurring as evidenced by a continuing, significant downward trend in the Upstream/Downstream program data, the changes are occurring much more gradually. This means that significant changes in trends in the Upstream/Downstream Program data will not be as evident as in the past.

---

[4] The plot for B(a)P showed an increasing trend, while that for α-chlordane showed no significant change/trend.

[5] The exception is benzo(a)pyrene [B(a)P] for which the concentration at FE continues to increase.

3.0 STATUS AND TRENDS RELATIVE TO ENVIRONMENTAL OBJECTIVES

The Niagara River is the largest tributary to Lake Ontario, providing over 83% of all the tributary water that flows into the lake. Along with the contribution of water, the Niagara River also contributes contaminants to Lake Ontario originating from the waters of the upper Great Lakes and Lake Erie, and from sources along the river. There is, therefore, a critical link between the inputs of contaminants to the river from both upstream and Niagara River sources and the water quality of Lake Ontario. By inference, this means there is also a close link between the NRTMP and the Lake Erie and Lake Ontario Lakewide Management Plans (LaMPs). For example, the six critical pollutants identified in the Lake Ontario Lakewide Management Plan (Table 3) are also identified as “priority toxics” in the NRTMP. Critical pollutants are chemicals which are causing beneficial use impairments on a lakewide basis.

The Significance of Niagara River Sources

Inputs of chemicals to the Niagara River can impact both the river and Lake Ontario including, for example, contributing to the exceedences of water and sediment quality criteria, and issuance of fish consumption advisories. Surficial sediment chemical distribution patterns in Lake Ontario point to the Niagara as a major source of many chemicals to the lake (Thomas *et al* 1988). Similarly, depth distributions of chemicals in dated cores collected from Lake Ontario in the vicinity of the Niagara River mirror the production history of the chemicals (Durham and Oliver 1983) and the reduction of Niagara River inputs, either as a result of better control of sources along the length of the river, or reductions in inputs from Lake Erie/upstream (Mudroch 1983; Swart *et al* 1996).

Estimates of the relative significance of Niagara River versus upstream sources *vis a vis* Niagara River loads to Lake Ontario can be obtained for the various NRTMP “priority toxics” using the ratio,

$$\frac{(NOTL - FE)}{NOTL}$$

where, NOTL and FE represent the recombined whole water (RWW) loads (ie. dissolved + suspended sediment) at Niagara-on-the-Lake and Fort Erie, and (NOTL-FE), called the “differential load”, represents the load from sources along the river (Williams *et al* 2000). The value of the ratio will vary between zero and one. The higher the value, the greater the relative contribution of Niagara River sources to the total load entering Lake Ontario. A ratio of 1.0, for example, indicates that the load to the lake is due primarily to inputs from Niagara River sources.

For the chemicals shown in Table 2, the ratios were calculated for each of the years over the period 1986/87 to 1998/99.[6] Results are presented in Table 4, ordered by decreasing mean ratio. The ratio varies from 1.0 for mirex and octachlorostyrene (OCS), to negative values for DDT and its metabolites (because the differential loads are negative). This indicates that the loads of mirex and OCS entering Lake Ontario from the river are due principally to Niagara River sources, while the loads of DDT and its metabolites to the lake from the river originate primarily from sources upstream of the Niagara River. A study conducted in 1993 comparing the concentrations of NRTMP "priority toxics" at the Buffalo Water Intake and the FE station to determine the representativeness of the FE station *vis a vis* Lake Erie inputs to the Niagara River found that p,p'- and o,p'-DDT were detected at FE, but not at the Buffalo Water Intake (D.J. Williams, Environment Canada, personal communication). This finding corroborates that there is probably a Canadian nearshore source of DDT to the Niagara River from Lake Erie. A ratio of 0.8 for HCB suggests that the loads of HCB to Lake Ontario from the Niagara River are principally due to inputs from Niagara River sources. In contrast, ratios of 0.4 and 0.1 for total chlordane and dieldrin, respectively, suggest that Lake Ontario loads from the river originate primarily from sources upstream of the Niagara River. For the PAHs, about half the load to the lake appears to come from Niagara River sources, while the other half comes from sources upstream of the river. The other point of note in Table 4 is the consistency of the ratio over time for most of the "priority toxics". For example, since the inception of the Upstream/Downstream Program, Niagara River sources have always been implicated for mirex, OCS and HCB. Conversely, upsteam sources have always been implicated for DDT + metabolites and dieldrin. This consistency lends considerable credibility to these observations.

COMPARISON WITH WATER QUALITY CRITERIA

The 18 NRTMP "priority toxics" were selected based on their exceedence of water, fish or sediment criteria in the Niagara River or Lake Ontario (Categorization Committee 1990). The threat to aquatic life and the real or potential impairment of beneficial uses can be assessed by comparing the Niagara River Upstream/Downstream Program data to available water quality criteria. Such a comparison can also be used as an indicator of progress. Since its inception, the NRTMP has used the most stringent agency criteria of either Canada, the United States, Ontario, or New York State. It is important to note, that the increases in exceedences reported below are the result of comparing Upstream/Downstream Program data to more stringent criteria recently adopted rather than significant increases in concentrations.

The approach used by the Four Parties in their annual Niagara River Upstream/Downstream Reports (e.g., see NRDIG 1999) has been to compare the upper 90^{th} percentile recombined whole water (RWW) concentrations (i.e., dissolved +

---

[6] Ratios were not calculated for PCBs for the same reasons as stated previously.

particulate phases) of a chemical to the most stringent agency criterion for that chemical. Using the upper 90^{th} percentile, rather than the annual mean, provides a more protective estimate of criteria exceedences. This approach is also used in this report.

Table 5 compares the upper 90th percentile concentration from the 1997/98 and 1998/99 Upstream/Downstream Program data to the pre-1998 and 1998 most stringent agency water quality criteria. Table 5A summarizes the results for the NRTMP "priority toxics" contaminants, while Table 5B summarizes the results for other chemicals collected as part of the Upstream/Downstream Program. Briefly, the Table shows that in 1998/99, the upper 90^{th} percentile concentrations of all NRTMP "priority toxics" for which there are data at NOTL, with the exception of TDE [NOTE: TDE=DDD], As and Pb, exceeded their most stringent agency criterion.[7] At FE, the PAHs, dieldrin, and some of the DDT metabolites exceeded their most stringent agency criteria. Of the other chemicals measured in the Upstream/Downstream Program, only fluoranthene, anthracene, benzo(ghi)perylene and indeno(123cd)pyrene exceeded their most stringent agency criteria at NOTL. All but anthracene also exceeded their criteria at FE.

In February 1998, NYSDEC adopted new standards pursuant to the U.S. Great Lakes Initiative. For some chemicals, these new standards, in addition to being the most stringent of the Four-Party water quality criteria, are also more stringent than the NYSDEC standards existing prior to 1998. For example, the most stringent criterion for dieldrin was 0.9 ng/L and is now 0.0006 ng/L. Similarly, the most stringent criterion for mirex was 1.0 ng/L and is now 0.001 ng/L. Now Upstream/Downstream Program data are available for the period for which the new standards were in effect. The increases in exceedences in 1998/99 are the result of comparing the data to the more stringent standards rather than significant increases in concentrations. It is important to note that despite the apparent worsening of water quality when comparison is made to these more stringent standards, Niagara River water quality continues to improve. As indicated above, the decreasing trends for most of the NRTMP "priority toxics" continue, albeit at a much slower rate.

USEPA and NYSDEC have recently completed an assessment of water quality in the Niagara River against New York State's more stringent Water Quality Standards. Because NYSDEC standards are also the most stringent agency criteria for many chemicals, as indicated by Table 5, the U.S. assessment is similar to the Four-Party assessment presented here. The U.S assessment includes a number of specific actions to address the chemicals exceeding New York water quality standards in the

---

[7] The PCB data in the Table are based on particulate concentrations only because of the dissolved phase contamination problems noted previously. Notwithstanding this, the concentrations in the particulate phase alone are sufficient to exceed the strictest agency criterion.

Niagara River, including the development of TMDLs/WLAs/LAs[8]. These actions have been incorporated into the 2001 NRTMP Work Plan.

The most stringent NYSDEC criteria are generally based on human health. While the 1998/99 90th percentile concentrations for most of the NRTMP "priority toxics" exceed these criteria, it is also worth noting that ambient concentrations of these same chemicals are already below many of the most stringent agency criteria for other categories [e.g., protection of drinking water, protection of aquatic life] (Table 6).

Two additional points should be noted. First, despite the low concentrations of contaminants in the Niagara River, the high flow of the river (>5300 m^3/sec) means that it may still be contributing substantial loads of contaminants to Lake Ontario (Mudroch and Williams 1989). Given the persistence of many of these chemicals, this means that there may still be the potential for problems in Lake Ontario related to Niagara River inputs and other upstream sources for some time to come.

Lastly, it has been noted in previous Progress Reports, that some chemicals (particularly the PAHs), not currently considered "priority toxics", also exceeded their strictest agency criteria in the river. Figure 6, for example, shows that fluoranthene, anthracene, benzo(ghi)perylene and indeno(123cd)pyrene exceed their most stringent agency criteria at NOTL. More interestingly, the concentrations of these and some other PAHs are increasing. The reasons for this are speculative at this time. It may be due to atmospheric loads to Lake Erie and upstream. It may be due to changing sediment characteristics in Lake Erie (e.g., smaller particle size, higher organic carbon content) as a result of *Dreissena spp* invasion/colonization. For example, several principal investigators have documented the increases in bottom sediment PAH concentrations in Lake Erie related to mussel colonization of the eastern basin (Howell *et al* 1996; Marvin and Howell 1997). Regardless of the causes of the increases, chemicals exceeding criteria will continue to be a focus of Four Party action under the NRTMP.

FISH CONSUMPTION ADVISORIES

Both New York State and Ontario issue advice regarding consumption of sport fish caught in their waters.

New York State Advisories

The New York State Department of Health (NYSDOH) issues an annual booklet titled *Health Advisories: Chemicals in Game and Sportfish*. This booklet provides advisories on eating sportfish and game since some of these foods contain

[8] Total Maximum Daily Loads/Wasteload Allocations/Load Allocations

chemicals at levels that may be harmful to human health. The health advisories provide general advice on sportfish taken from the waters in New York State and on game species. The information is presented so that it is easy to understand the guidance for a particular species from a specific waterbody. The advisories explain how to minimize exposure to contaminants from sportfish and game and reduce whatever health risks are associated with them.

In New York State, the Department of Environmental Conservation (NYSDEC) monitors contaminant levels in fish and game. NYSDOH issues specific advisories (i.e., “eat none” or “eat no more than one meal per month”) when sportfish have contaminant levels greater than federal standards. NYSDOH also advises women of childbearing age, infants and children under the age of 15 to eat no fish from waters that have specific advisories for any fish species.

For 2000, there were no changes from the previous year in health advisories for fish taken from New York State waters. The most recent change for the Niagara River area occurred in 1999 when restrictions (all species, “eat none”) were removed for Gill Creek from the Hyde Park Dam downstream to its mouth on the Niagara River. The current advisories for fish taken from the Niagara River and its U.S. tributaries are summarized in Table 7. [**NOTE:** NYSDOH fish advisories for Lake Ontario also apply to the lower Niagara River, below Niagara Falls.]

Ontario Advisories

The Ontario Ministry of the Environment also issues advice regarding consumption of sport fish caught in their waters in the biennial *Guide to Eating Ontario Sport Fish*.

Upper Niagara River

Historically, thirteen species of sport fish from the Upper Niagara River have been tested for contaminants (Table 8). Seven of these have no advisory restrictions. Of the remaining six species, three (white bass, carp and rainbow smelt) are currently restricted because of PCBs and three (smallmouth bass, freshwater drum and redhorse suckers) are currently restricted because of mercury. [**NOTE:** The PCB restrictions on white bass and rainbow smelt are based on pre-1990 data and may not reflect current conditions].

In 2000, seven species (smallmouth, largemouth and rock bass, yellow perch, brown bullhead, carp and freshwater drum) were retested. This testing resulted in two changes in consumption advisories as follows. Freshwater drum were restricted at 35-45 cm because of mercury, whereas they were previously unrestricted. Lower PCB concentrations in carp resulted in much less stringent consumption restrictions for this species.

Lower Niagara River

Historically, eighteen species of sport fish from the Lower Niagara River have been tested for contaminants (Table 8). Three of these (largemouth bass, bluegill and freshwater drum) have no consumption restrictions. The remaining species are restricted because of PCBs (chinook salmon, white perch, white bass, brown bullhead, channel catfish, carp, white sucker, redhorse sucker and rainbow smelt), mirex (rainbow trout), photomirex (lake trout) and mercury (yellow perch and rock bass). In American eel, PCBs and mirex co-limit consumption, while mercury and PCBs co-limit the consumption of smallmouth bass.

In 2000, seven species (smallmouth, largemouth and rock bass, yellow perch, brown bullhead, carp and freshwater drum) were retested, and one species (bluegill) was tested for the first time. Several changes, mainly of a minor nature, resulted from this re-testing. Lower concentrations of PCBs and (or) mercury resulted in less restrictive consumption advice on smallmouth bass, freshwater drum and carp. Larger size rock bass (25-30 cm) were tested for the first time in 2000 and were restricted because of mercury.

4.0 THE BIOMONITORING PROGRAM

Many chemicals concentrate in the tissues of aquatic organisms to indicate the presence of contaminants that would not otherwise be directly detected in water because of their low concentrations. The Ontario Ministry of Environment (MOE), as part of Ontario's commitment to the NRTMP, has conducted both routine and specialized biomonitoring of contaminants in the Niagara River using caged mussels (*Elliptio complanata*). This program has provided information on suspected contaminant sources/source areas in the river between Fort Erie (FE) and Niagara-on-the-Lake (NOTL). Previous Progress Reports have relied on the results from this program to corroborate the reduction of contaminant inputs from these sites as a result of site-remediation activities. The most recent mussel collections were completed by MOE in July 2000. Unfortunately, the results were not available in time for inclusion in this report.

Collection of juvenile (young-of-the-year) forage fish, principally spottail shiners (*Notropis hudsonius*), has also been an integral component of the Biomonitoring Program. These fish have limited home ranges near shore and are of known age, making them useful indicators of local, recent chemical inputs to the aquatic ecosystem.

Both MOE and NYSDEC have collected indigenous, young-of-the-year (YOY) forage fish from several sites in the Niagara River and analyzed them for contaminants. MOE has collected YOY-fish from NOTL since 1975, and from several other Canadian and U.S. locations at least every other year since the early 1980s. NYSDEC has collected fish from locations on the U.S. side of the River annually between 1984 and 1987, and about every five years since. The following results are based on 1999 MOE data.

Young-of-the-Year (YOY) Forage Fish Contaminant Monitoring

In 1999, MOE collected spottail shiners *(Notropis hudsonius)* from nine locations in the upper and lower Niagara River and analyzed them for contaminants. Table 9 summarizes the results for PCB, DDT, mirex, OCS and HCB.

PCB and DDT were always detected at Fort Erie and Frenchman's Creek in the upper Niagara River, but mirex, OCS and HCB were not detected. PCB and DDT were also detected at Wheatfield, 102nd Street and Cayuga Creek in the upper river. Mirex was not detected at any of the sites, but OCS and HCB were also detected at two of the three sites (102nd Street and Cayuga Creek). PCB concentrations in YOY fish from Fort Erie and Frenchman's Creek were less than the Great Lakes Water Quality Agreement (GLWQA) Aquatic Life Guideline (100 ng/g). In contrast, PCB concentrations in fish collected from Wheatfield, 102nd Street and Cayuga Creek exceeded 200 ng/g.

In the Lower Niagara River, of the five contaminants, only PCB and DDT were detected at all four sites (Queenston, Niagara-on-the-Lake, Lewiston and Youngstown). Concentrations of both PCB and DDT were similar at all sites. PCB concentrations were near, or just above, the GLWQA Aquatic Life Guideline.

Figure 7 shows the trends in PCB concentrations for the nine sites. Briefly, the results show that PCB concentrations have decreased at all stations since monitoring was started. Concentrations in the mid- to late 90s have tended to level off or even increase at some stations (eg., Queenston, Lewiston).

5.0 SYNTHESIS OF DATA FOR U.S. TRIBUTARIES AND POINT SOURCES

As previously noted, USEPA and NYSDEC recently completed three assessments to synthesize a variety of Niagara River data with the objective of identifying potential priorities for further action. The assessments are:

- Assessment of Water Quality in the Niagara River with Regard to Toxic Chemicals and the Significance of Niagara River Sources.
- Characterization of NRTMP Priority Toxic Chemicals in Sediments, Biota and Water of the Niagara River and Tributaries.
- Summary of Information on Niagara River and Tributary Point Source Discharges of NRTMP Priority Toxic Chemicals.

It is important to recognize that these assessments were undertaken within a U.S. (vs. Four Party) context, primarily to help define additional U.S. actions in support of the NRTMP.[9] The content of the first assessment above has been included, in a Four Party context, in the discussion in Section 3.0 of this report. The principal findings of the latter two assessments are briefly summarized below. U.S. follow-up actions have been incorporated in the 2001 NRTMP Work Plan.

Contamination in Sediments, Biota and Water of U.S. Tributaries

USEPA and NYSDEC reviewed a number of recent data sets for ambient contamination by toxic substances in the Niagara River and its U.S. tributaries. The objective was to identify priority areas for further investigation which may lead to contaminant source identification, source trackdown, or remediation.

USEPA and NYSDEC recognized that comparisons and conclusions based on the synthesis of these data were subjective because much of the data was collected for different objectives, at different time periods, and using different methodologies.

The criteria used to identify priority areas were:

- contaminant levels were elevated relative to the prevailing contaminant levels in the Niagara River system;
- elevated contaminant levels were observed in more than one type of data set (eg., elevated levels in sediments corroborated by elevated levels in biota or water); and,
- there was indication of potential toxic effects on biota by comparison to available screening criteria.

In general, contaminant levels in sediments, biota and water were found to be consistent with the substantial improvements in the river that have been reported by NRTMP. For example, levels of contaminants in sediments seldom exceeded the "Severe Effect Levels" (i.e. the level at which toxic effects to most sediment-dwelling organisms are expected) in Ontario's Provincial Sediment Quality Guidelines (Persaud *et al* 1993). It appears that contaminant levels have decreased in several tributary areas, and contaminant levels at many sites were <u>not</u> elevated relative to the prevailing conditions in the river. However, contaminant levels were sometimes elevated, providing an indication of priority areas for further investigation. For example:

---

9 EC and MOE have not reviewed portions of the data summarized in these assessments.

- As first reported in the 2000 NRTMP Progress Report, USEPA and NYSDEC are taking follow-up actions to address dioxin contamination at the mouth of Bloody Run Creek and in Pettit Flume Cove. Hexachlorobenzene was also elevated at the mouth of Bloody Run Creek.
- In Gill Creek, monitoring has shown declines in contaminant levels below Buffalo Avenue, indicating the success of remedial actions in the area. The available data, however, also indicate the possible presence of mercury and PCB sources in the creek. The contamination sources may have been addressed by the remediations completed in 1992 below Buffalo Avenue, and in 1998-1999, above Buffalo Avenue to Falls Street. Further monitoring is recommended to assess this.
- Sediment concentrations of PCBs at one site in Two-Mile Creek were elevated, as were the concentrations in some water (passive samplers) and caged mussel samples. NYSDEC is conducting sampling to investigate potential sources. DDT was also elevated in a sediment sample in Two-Mile Creek.
- PAHs were elevated in some samples in Cayuga Creek (Niagara County). Dioxins in several sediment samples in the Little Niagara River above the Cayuga Creek mouth were around 1 ppb TEQ (Toxic Equivalency Quotient)[10].

It should be noted that the 1999 MOE young-of the-year fish contaminant monitoring data presented above were included in the U.S. assessment. The results helped to corroborate the identification of priority areas.

Contamination in Point Sources

USEPA and NYSDEC characterized recent information on discharges of NRTMP Priority Toxic Chemicals from point sources in the Niagara River and tributaries. The purpose was to help determine priorities for further actions to address discharges which may have chemical concentrations that are elevated relative to other point sources, and/or may contribute chemical loadings that are large relative to other point sources.[11]

The information available included a limited number of observations of chemical concentrations from self monitoring by permittees, and two studies carried out by

---

[10] TEQs are assigned to individual dioxins and furans on the basis of how toxic they are in comparison with the toxicity of 2,3,7,8-tetracholor-dibenzodioxin, which is assigned the value of 1.0. 2,3,7,8-TCDF is one tenth as toxic and has a toxic equivalent of 0.1.

[11] It is important to note that the U.S. Parties to the NRTMP have been focusing on reduction of toxic chemical inputs from point sources for many years. There is a high rate of compliance with existing New York State point source discharge permit conditions, and identification of a discharge containing toxic chemicals does not constitute a permit violation. The U.S. Parties have also been working with several dischargers in the Niagara River and Lake Ontario on a voluntary basis on contaminant trackdown programs.

NYSDEC and USEPA using special techniques designed to achieve very low detection levels (e.g. Trace Organics Platform Sampler [TOPS]).

The concentrations of contaminants found in point source discharges to the Niagara River and tributaries were very low (low parts per billion range and lower). Though the concentrations were low, the data suggested that the concentrations (and associated load estimates) vary considerably among discharges. It is USEPA's and NYSDEC's policy to address on a priority basis, discharges where there is evidence of elevated levels of toxic chemicals.

A retrieval of 1995-1998 effluent monitoring data for six NRTMP Priority Toxic Chemicals (dieldrin, mercury, PCBs, TDE, mirex, dioxin) was conducted for all facilities in the U.S. Niagara River Basin using USEPA's Permit Compliance System (PCS). The PCS is the U.S. national data base for tracking information on point source discharge permits. One or more detections were reported for five of these chemicals including mercury, PCBs, TDE, dioxin and mirex. Only four facilities had more than one reported detection for any of the chemicals. All detections were within allowable permit levels. The occasional detection of these chemicals suggests the need for follow-up on Niagara River point sources in general, including additional assessment of discharge concentrations and loads.

A small number of observations at low detection levels was available, through the special efforts of NYSDEC and USEPA noted above. In 1996, effluent discharges from two Niagara River basin POTWs[12] (Alden, Tonawanda) and three Lake Ontario basin POTWs (Carthage, Lockport, Rochester) were characterized. In 1999, the wet weather discharge from the Falls Street Tunnel was characterized. The information indicated the presence of certain NRTMP priority chemicals in point source discharges. Chemical concentrations ranged from the low parts per billion range to as low as the parts per quintillion range for dioxin found in some POTW effluents. Within this range, the concentrations of individual chemicals may vary over several orders of magnitude among discharges. The wet weather discharges from the Falls Street Tunnel (FST) had the highest concentrations of many chemicals. The final effluent from POTWs had lower concentrations.

Chemical concentrations in the POTW effluents were usually much higher than the most stringent ambient water quality criteria. Some of the concentrations, however, were below or only slightly above the most stringent criteria [e.g., total DDT (Tonawanda, Lockport), chlordane (Carthage, Lockport, Alden), and hexachlorobenzene (Lockport, Alden)].

6.0 SUMMARY

[12] Publicly Owned Treatment Works

This Progress Report reiterates the consistent messages of the past Progress Reports. Specifically, these are that:

- The concentrations/loads of many of the 18 NRTMP “priority toxics” in the Niagara River have decreased and the river is getting “cleaner”; and,

- The decreases in nearly all cases have exceeded 50% since 1986/87.

The “priority toxics” were selected based on their exceedence of water, fish or sediment criteria in the Niagara River or Lake Ontario (Categorization Committee 1990). Comparing the current concentrations of these “priority toxics” in the river to the 1998 most stringent agency criteria shows that all the chemicals for which there are data, with the exception of TDE, arsenic (As) and lead (Pb), now exceed these criteria. These exceedences are due to the much more stringent standards adopted by NYSDEC in 1998 rather than increases in the concentrations of these chemicals in the river. Indeed, the latest Upstream/Downstream data show that the downward trend in concentrations/loads continues, with the decreases for most chemicals over the thirteen-year period since 1986/87 now being greater than 60%. Re-testing of sport fish in 2000 by Ontario has resulted in less restrictive consumption advisories for several species from the upper and lower River. Data from the Biomonitoring Program show that PCB concentrations in juvenile fish from a number of sites in the river now meet or are very close to the Great Lakes Water Quality Agreement’s aquatic life guideline of 100ng/g. Furthermore, concentrations have decreased at most of these sites since monitoring first started in about 1980. These improvements are due, at least in part, to the beneficial remedial efforts at Niagara River sources.

As has been previously stated, despite the successes to date and the continued improvements now being reported, more work needs to be done. Perhaps the additional message in this Progress Report is that actions necessary to assure continued reductions of toxic chemicals in the Niagara River have been defined, and there are substantial new action commitments to address current concerns.

7.0 REFERENCES

Categorization Committee. 1990. Categorization of Toxic Substances in the Niagara River. A Joint Report of Environment Canada, the United States Environmental Protection Agency, Ontario Ministry of the Environment and New York State Department of Environmental Conservation.

Durham, R.W., and B.G. Oliver. 1983. History of Lake Ontario contamination from the Niagara River by sediment radiodating and chlorinated hydrocarbon analysis. *J. Great Lakes Res.* 9(2):160-168.

El-Shaarawi, A.H., and Al-Ibrahim. 1996. Trend Analysis and Maximum Likelihood Estimation of Niagara River Data (1986-1994). National Water Research Institute and McMaster University, Burlington, Ontario.

Howell, T.E., C.H. Marvin, R.W. Bilyea, P.B. Kauss, and K. Sommers. 1996. Changes in Environmental Conditions During *Dreissena* Colonization of a Monitoring Station in Eastern Lake Erie. J. Great Lakes Res. 22(3)744-756.

Marvin, C.H., and E.T. Howell. 1997. Contaminant burdens in sediments colonized by *Dreissena* at two nearshore sites in the lower Great Lakes. pp. 209-224. *in* D'Itri, F.M. [ed.] Zebra Mussels and Aquatic Nuisance Species. Ann Arbor Press Inc., Chelsea, Michigan.

MOE. 2001. Guide to Eating Ontario Sport Fish, 2001-2002. Ontario Ministry of the Environment, Toronto, Ontario.

Mudroch, A. 1983. Distribution of major elements and metals in sediment cores from the western basin of Lake Ontario. *J. Great Lakes Res.* 9(2):125-133.

Mudroch, A., and D. Williams. 1989. Suspended sediments and the distribution of bottom sediments in the Niagara River. *J. Great Lakes Res.* 15(3):427-436.

NRDIG. 1999. Joint Evaluation of Upstream/Downstream Niagara River Monitoring Data 1996-1997. Environment Canada, Ontario Ministry of the Environment, New York State Department of Environmental Conservation and the United States Environmental Protection Agency.

NYSDOH. 2001. Health Advisories, Chemicals in Sportfish and Game, 1998-1999. New York State Department of Health. Revised September 1998.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment, Toronto, Ontario.

Swart, J., F. Estabrooks, and R. Bopp. 1996. Lake Ontario Sediment Survey: 1995 Sediment Coring Results. Bureau of Watershed Management and Research, New York State Department of Environmental Conservation (November 1996).

Thomas, R.L., J.E. Gannon, J.H. Hartig, D.J. Williams, and D.M. Whittle. 1988. Contaminants in Lake Ontario - A Case Study. In Schmidtke, N.W. [ed.] *Toxic Contamination in Large Lakes. Vol III. Sources, Fate, and Controls of Toxic Contaminants.* Proceedings of the World Conference on Large Lakes, Lewis Publishers, Chelsea, Michigan, 1988, pp:327-387.

Williams, D.J., M.A.T. Neilson, J. Merriman, S. L'Italien, S. Painter, K. Kuntz and A.H. El-Shaarawi. 2000. The Niagara River Upstream/Downstream Program 1986/87 - 1996/97: Concentrations, Loads, Trends. Environment Canada, Environmental Conservation Branch - Ontario Region, Ecosystem Health Division, Report No. EHD/ECB-OR/00-01/I.

Williams, D.J., K.W. Kuntz, S. L'Italien, and V. Richardson. 2001. Great Lakes Surveillance Program: Organic Contaminants in the Great Lakes, 1992 to 1998. Intra- and Inter-lake Spatial Distributions and Temporal Trends. Environmental Conservation Branch - Ontario Region, Ecosystem Health Division, Environment Canada, Report No. EHD/ECB-OR/01-01/I.

Figure 1. Modelled Trend of Hexachlorobenzene in Water at NOTL, 1986/87 to 1998/99.

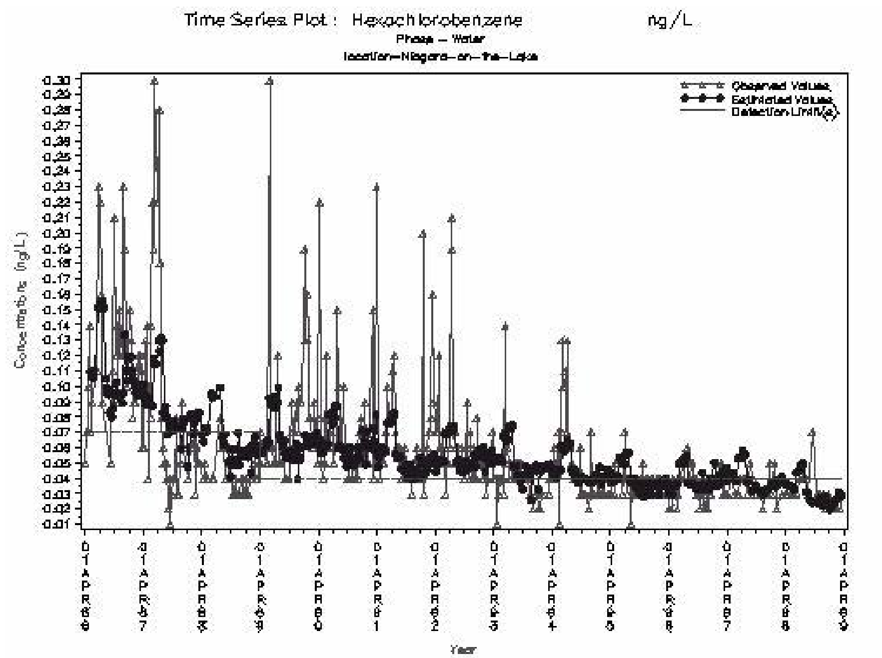


Figure 2. Modelled Trend of PCB in Suspended Solids at NOTL, 1986/87 to 1998/99.

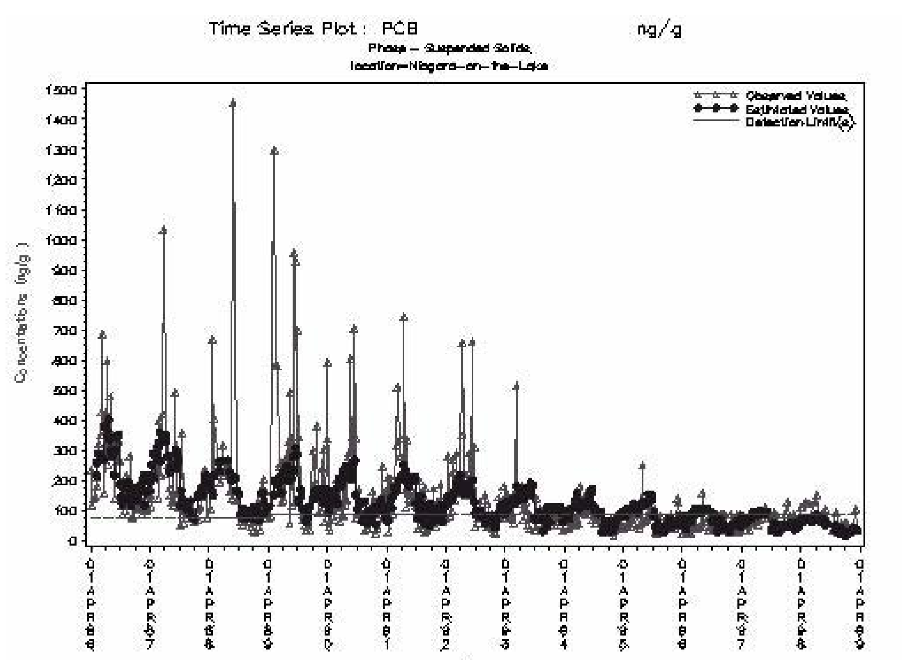


Figure 3. Modelled Trend of Dieldrin in Water at NOTL, 1986/87 to 1998/99.

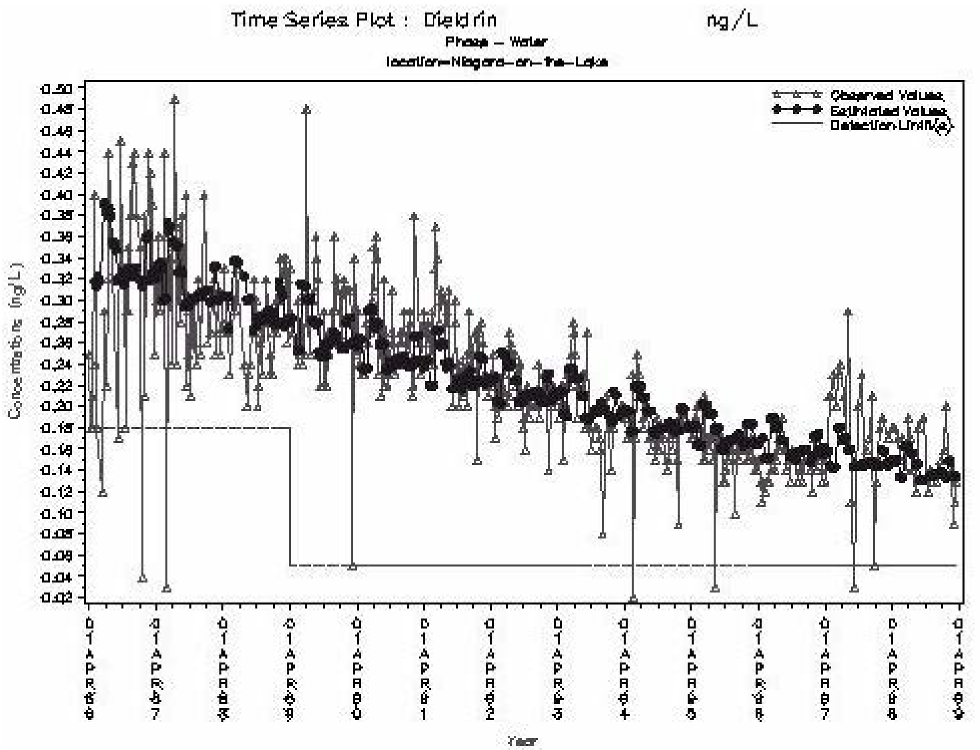


Figure 4. Modelled Trend of Octachlorostyrene (OCS) on Suspended Solids at NOTL, 1986/87 to 1998/99.

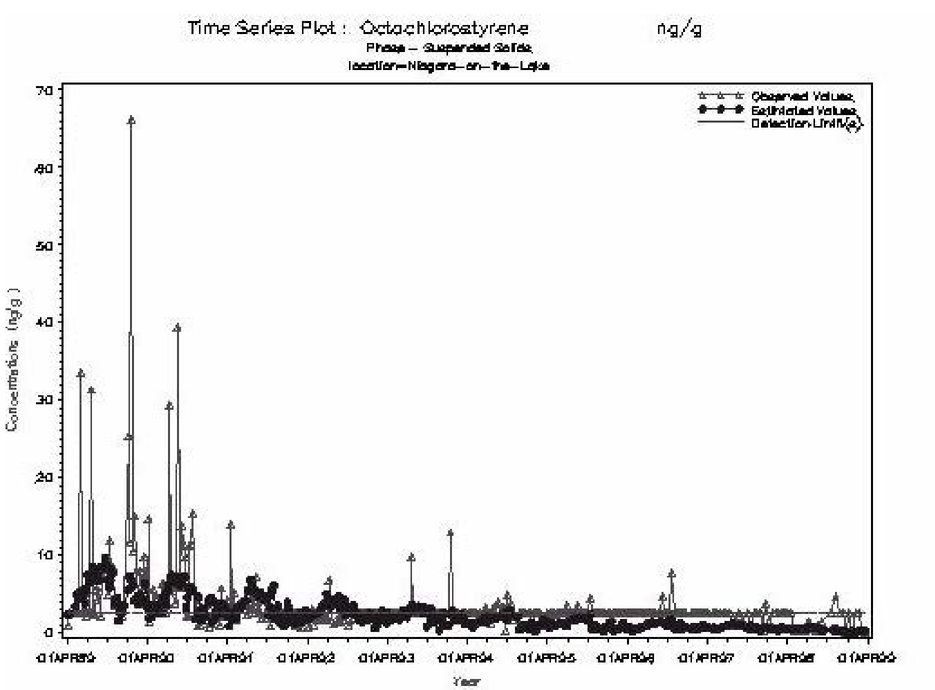


Figure 5. Modelled Trend of Mirex on Suspended Solids at NOTL, 1986/87 to 1998/99.

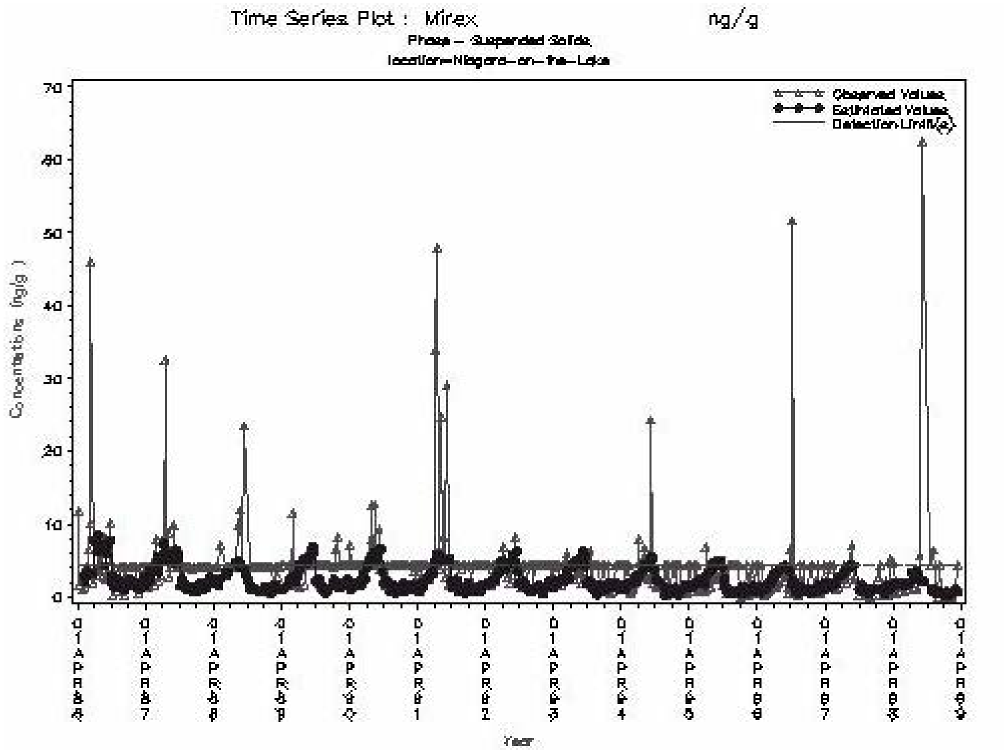
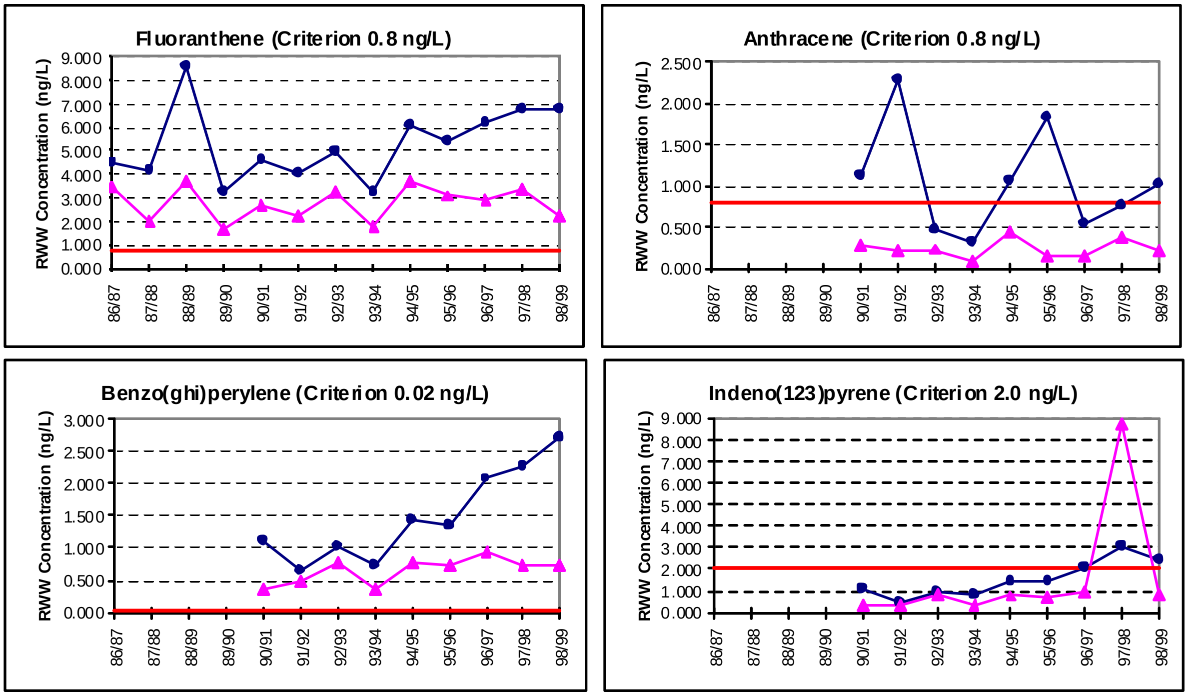


Figure 6. Additional PAHs Whose Upper 90th Percentile Recombined Whole Water (RWW) Concentrations at FE (▲) and NOTL (•) Exceed the Most Stringent Agency Water Quality Criteria, 1986/87 - 1998/99 (ng/L).*



Solid line represents criterion concentration

Figure 7. Trends in PCB Concentrations in Spottail Shiners (*Notropis hudsonius*) at Selected Sites in the Niagara River, 1975-1999.

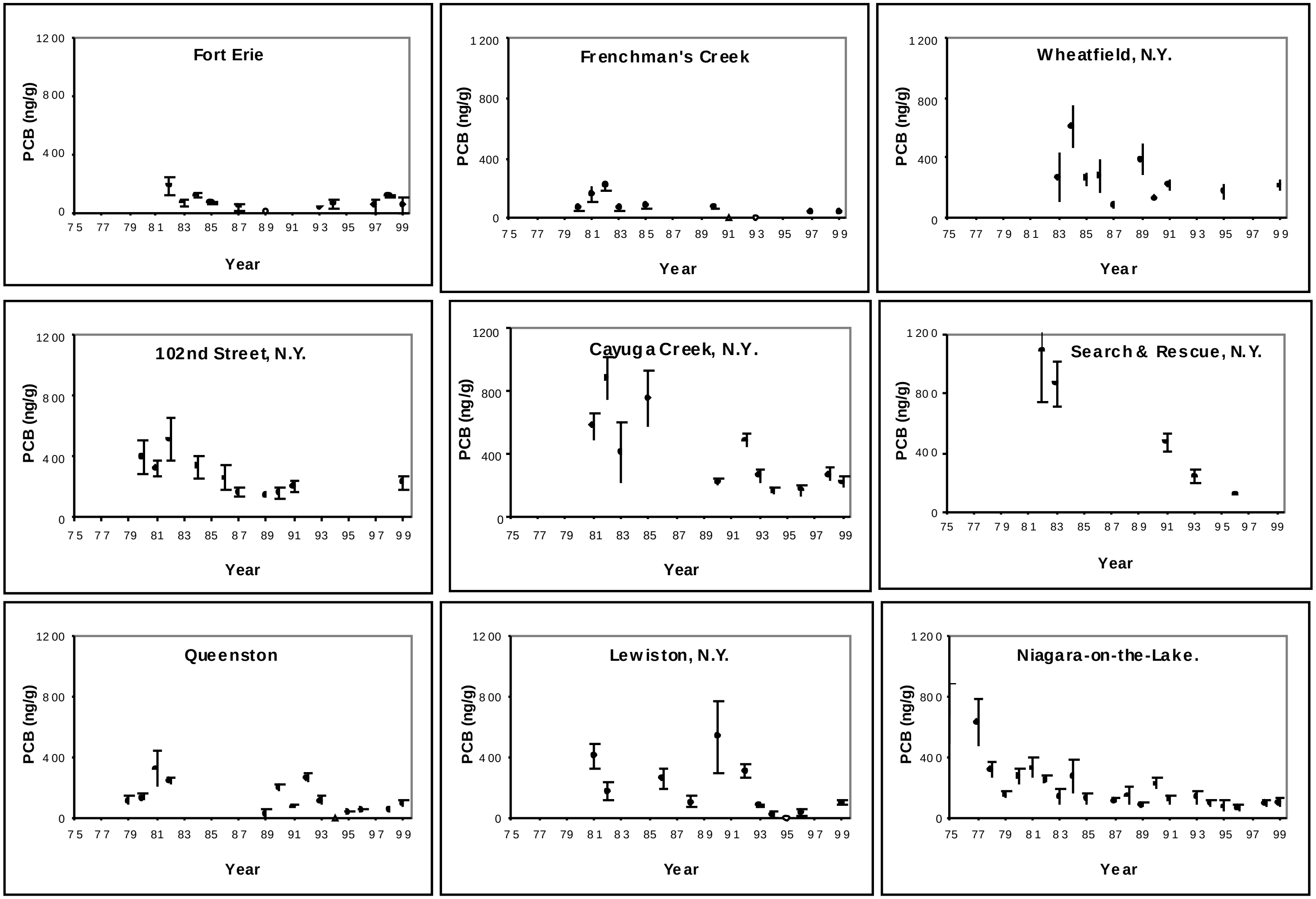


Table 1. NIAGARA RIVER TOXICS MANAGEMENT PLAN EIGHTEEN PRIORITY TOXIC CHEMICALS

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

* Chemicals designated for 50% reduction by 1996.

Table 2. Percent Change in Concentrations and Loads of Upstream/Downstream Program Chemicals between the Base Year and 1998/99.

		Fort Erie				Niagara-on-the-Lake			
Chemical	Period of record	Concentration % change		Load % change		Concentration % change		Load % change	
		Dissolved	Susp. Part.	Dissolved	Susp. Part.	Dissolved	Susp. Part.	Dissolved	Susp. Part.
Chlorobenzenes									
Hexachlorobenzene	1986-1999	--	--	--	--	-70.7	-60.9	-74.7	-62.4
Chlorinated Pesticides & PCBS									
a-chlordane	1986-1999	--	NS	--	NS	NS	NS	NS	NS
g-chlordane	1986-1999	--	--	--	--	--	--	--	--
p,p'-DDT	1986-1999	--	NS	--	NS	--	-46.4	--	-48.1
o,p'-DDT	1986-1999	--	--	--	--	--	--	--	--
p,p'-TDE	1986-1999	-46.7	NS	-53.6	NS	-40.1	-48.3	-48.2	-46.5
p,p'-DDE	1986-1999	NS	NS	NS	NS	NS	-32.2	NS	-34.8
Dieldrin	1986-1999	-64.2	-59.9	-68.8	-85.5	-57.7	-70.4	-63.4	-71.5
Mirex	1986-1999	--	--	--	--	--	-56.3	--	-58.0
PCBs	1986-1999	NC	-57.1	NC	-84.5	NC	-76.6	NC	-77.8
PAHs									
Benz(a)anthracene	1986-1999	-67.0	-25.4	-71.3	-73.1	-26.0	-38.7	-36.0	-41.0
Benzo(a)pyrene	1986-1999	--	+122.7	--	-19.5	NS	NS	NS	NS
Benzo(b/k)fluoranthene	1986-1999	NS	NS	NS	NS	NS	NS	NS	NS
Chrysene-triphenylene	1986-1999	-43.8	NS	-50.7	NS	NS	NS	NS	NS
Industrial By-products									
Octachlorostyrene	1989-1999	--	--	--	--	--	-85.1	--	-79.6
Trace Metals in Whole Water		Whole Water Concentration % Change		Whole Water Load % Change		Whole Water Concentration % Change		Whole Water Load % Change	
Lead	1986-1999	-79.5		-82.2		-72.2		-76.0	
Arsenic	1986-1999	NS		NS		NS		NS	
Mercury	1986-1997	*		*		*		*	

Notes:

NC	Dissolved phase concentrations and loads not calculated because of known contamination problems with dissolved phase data.
NS	No significant 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.

Table 3. LAKE ONTARIO LAKEWIDE MANAGEMENT PLAN CRITICAL POLLUTANTS

Chemical Name	Causes Lakewide Beneficial Use Impairments[1]	Likely to Cause Lakewide Beneficial Use Impairments[2]	Loading entering Lake from Niagara River[3]
PCBs	•		•
DDT/ metabolites	•		•
Mirex	•		•
Dieldrin		•	•
Dioxins	•		NE
Mercury		•	NE

1 Based on direct evidence that the chemical is causing lakewide use impairments.

2 Based on "indirect" evidence that the chemical is causing lakewide beneficial use impairments because the chemical exceeds the most stringent government standard, criteria, or guideline.

3 Based on Upstream/Downstream Monitoring Program, 1992/1993.

NE = Not estimated, because concentrations were below the analytical detection limit.

Table 4. Ratio of the "Differential Load" to the Load to Lake Ontario for NRTMP "Priority Toxics".

	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	Mean
Mirex	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.8	1.0	1.0
Octachlorostyrene (OCS)				1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Hexachlorobenzene (HCB)	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.6	0.8	0.8	0.8	0.8	0.8	0.8
Benzo(a)pyrene [B(a)P]	1.0	0.5	0.7	0.7	0.5	0.5	0.4	0.6	0.4	0.4	0.6	0.6	0.7	0.6
Benz(a)anthracene	0.2	0.5	0.6	0.6	0.4	0.5	0.5	0.6	0.4	0.5	0.6	0.6	0.8	0.5
Benzo(b/k)fluoranthene	0.6	0.5	0.6	0.6	0.5	0.5	0.4	0.5	0.4	0.5	0.6	0.7	0.7	0.5
Chrysene/Triphenylene	0.2	0.4	0.6	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.5
Total Chlordane (a- + g-)	0.0	0.5	0.9	0.3	0.0	0.3	0.4	0.4	0.4	1.0	0.8	0.4	-0.1	0.4
Dieldrin	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1
DDE	-3.8	-2.0	-0.4	-0.3	-0.4	-0.6	-0.8	-1.3	-0.4	-0.6	-0.2	-1.2	-0.7	-1.0
ppDDT	-2.2	-1.1	0.3	-5.5	-2.3	0.0	-0.4	-0.2	-0.6	-0.6	-3.4	-0.1	-0.3	-1.3
TDE	-1.9	-1.3	-2.9	-0.9	-0.6	-1.0	-1.1	-1.0	-0.7	-0.3	-3.1	-2.0	-0.6	-1.3
PCBs	**not calculated**													

Table 5. Comparison of the 1997/98 and 1998/99 Upstream/Downstream Program Upper 90th Percentile Data to the Most Stringent Agency Water Quality Criteria for Pre-1998 and 1998 (ng/L).

A. From the List of 18 "Priority Toxics"

Parameter	Pre-1998 Criteria	1998 Criteria	Agency	Upper 90% CI (RWW Concentrations - ng/L) 97/98n	97/98f	98/99n	98/99f
Total Chlordane	2	0.02	NYSDEC	0.048	0.025	**0.029**	0.018
Mirex	1.0	0.001	NYSDEC	0.010	ND	**0.027**	ND
Dieldrin	1	0.0006	NYSDEC	0.228	0.177	**0.166**	**0.134**
HCB	20	0.03	NYSDEC	0.082	0.036	**0.085**	0.018
ppDDT		0.01	NYSDEC	0.159	0.065	**0.021**	**0.024**
TDE		0.08	NYSDEC	0.145	0.248	0.051	0.080
DDE		0.007	NYSDEC	0.233	0.233	**0.056**	**0.092**
Total DDT	1.0		NYSDEC	0.621	0.577	0.251	0.225
PCBs*	0.0006	0.001	NYSDEC	**0.364**	**0.130**	**0.683**	**0.218**
OCS	None	0.006	NYSDEC	0.005	ND	**0.021**	ND
Benz(a)anthracene	0.4	0.4	MOE (proposed)	**2.605**	**0.857**	**2.245**	**0.482**
Benzo(b/k)fluoranthene	0.2	0.2	MOE (proposed)	**6.475**	**2.151**	**6.075**	**1.555**
Chrysene/Triphenylene	0.1	0.1	MOE (proposed)	**2.993**	**1.021**	**3.220**	**0.830**
B(a)P	1.2	1.2	NYSDEC	**2.662**	**1.224**	**2.646**	**0.629**
As (ug/L)	5	5	MOE (proposed)	0.684	0.580	0.580	0.580
Hg (ug/L)	0.02	0.02	NYSDEC	**NA**	**NA**	**NA**	**NA**
Pb (ug/L)	2.5	2.5	USEPA	0.784	0.635	0.784	1.493

B. Other Contaminants Measured in the Upstream/Downstream Program

Parameter	Pre-1998 Criteria	1998 Criteria	Agency	Upper 90% CI (RWW Concentrations - ng/L) 97/98n	97/98f	98/99n	98/99f
Methoxychlor	30	30	NYSDEC	ND	ND	ND	ND
Hep Epoxide	1.0	0.3	NYSDEC	0.076	0.075	0.061	0.053
Total Endosulfan (a- + -b)	3.0	3.0	MOE (proposed)	0.076	0.031	0.045	0.021
a-BHC	10	2.0	NYSDEC	0.627	0.486	0.553	0.404
g-BHC	10	8.0	NYSDEC	0.447	0.371	0.401	0.389
Aldrin	1.0	1.0	NYSDEC	ND	ND	ND	ND
Endrin	2.0	2.0	NYSDEC	ND	ND	0.039	0.026
HCCPD	450	450	NYSDEC	0.026	ND	0.015	ND
HCBD	500	10	NYSDEC	0.077	0.004	0.065	ND
Anthracene	0.8	0.8	MOE (proposed)	0.748	**0.857**	**1.011**	0.482
Fluoranthene	0.8	0.8	MOE (proposed)	**6.727**	**3.321**	**6.754**	**2.252**
Fluorene	200	200	MOE (proposed)	1.995	0.926	1.185	0.724
Pyrene	50000	4600	NYSDEC	5.999	2.740	5.620	1.603
Phenanthrene	30	30	MOE (proposed)	8.377	4.357	6.011	2.502
Indeno(123cd)pyrene	0.02	0.02	MOE (proposed)	**3.084**	**8.709**	**2.427**	**0.798**
Benzo(ghi)perylene	0.02	0.02	MOE (proposed)	**2.275**	**0.723**	**2.699**	**0.731**

bolded values represent Water Quality Criteria exceedences
n = NOTL; f = FE
ND = not detected
* only particulate data considered
NOTE: 98/99 data are for congeners which give higher results than total-PCBs
NA = not analyzed
HCCPD = Hexachlorocyclopentadiene
HCBD = Hexachlorbutadiene

Table 6. Surface Water Quality Criteria for Niagara River Toxics Management Plan "Priority Toxics and Lake Ontario LaMP Critical Pollutants (ppb).

Substance[a]	Protection of Human Health for Consumption of Fish			Protection of Aquatic Life (Acute Values)		Protection of Aquatic Life (Chronic Values)[b]				Protection of Human Health for Drinking Water Source			Protection of Piscivorous Wildlife
	NYS	EPA[c]	HC	NYS	EPA	NYS	EPA	OMOE[b]	IJC	NYS	HC	IJC	NYS
Arsenic		0.018		**340**[d]	340[d]	**150**[d]	150[d]	5(p)		**50**	50	50	
Benz(a)anthracene		0.0044		0.23		0.03		0.0004(p)		0.002			
Benzo(a)pyrene	0.0012	0.0044								0.002			
Benzo(b)fluoranthene		0.0044								0.002			
Benzo(k)fluoranthene		0.0044						0.0002(p)		0.002			
Chrysene		0.0044						0.0001(p)		0.002			
Chlordane	**2E-5**	2.1E-3	0.006		2.4		0.0043	0.06	0.06	**0.05**			
p,p'-TDE [=p,p'-DDD]	**8E-5**	8.3E-4	see DDT					see DDT	see DDT	**0.3**			see DDT
p,p'-DDE	**7E-6**	5.9E-4	see DDT					see DDT	see DDT	**0.2**			see DDT
p,p'-DDT	**1E-5**	5.9E-4	0.001[e]		1.1		0.001	0.003[e]	0.003[e]	**0.2**			**1.1E-5**[e]
Dieldrin	**6E-7**[f]	1.4E-4	0.004[f]	**0.24**	0.24	**0.056**	0.056	0.001[f]	0.001[f]	**0.004**			
Dioxins/dibenzofurans	**6E-10**[g]	1.3E-8[h]						2E-8(p)[g]		**7E-7**[g]			**3.1E-9**[h]
Hexachlorobenzene	**3E-5**	7.5E-4	0.0065					0.0065		**0.04**			
Lead				**see below**[i,d]	65[j,d]	**see below**[i,d]	2.5[j,d]	5(p)[j]	25	**50**	2		

Mercury	**7E-4**[d]	0.050		**1.4**[d]	1.4[d]	**0.77**[d]	0.77[d]	0.2[d]	0.2[d]	**0.7**	0.1[k]		**0.0026**[d]
Mirex	**1E-6**			**0.001**		**0.001**	0.001	0.001		**0.03**			
Octachlorostyrene	**6E-6**									**0.2**			
PCBs[l]	**1E-6**	1.7E-4	0.001				0.014	0.001		**0.09**			**1.2E-4**
Tetrachloroethylene	1	0.8						50		0.7			
Toxaphene	**6E-6**	7.3E-4		**1.6**	0.73	**0.005**	0.0002	0.008	0.008	**0.06**			

(New York State Standards are shown in boldface type)

Sources:

NY State: Division of Water Technical and Operational Guidance Series (1.1.1), June 1998. New York State Department of Environmental Conservation, Albany, NY.
U.S. EPA: National Recommended Water Quality Criteria. Office of Science and Technology, Washington, DC. May 21, 1999.
Ontario MOE: (1) Water Management Policies, Guidelines, Provincial Water Quality Objectives. July 1994. (2) Joint Evaluation of the Upstream/Downstream Monitoring Program, 1996-1997.
Health Canada: Joint Evaluation of the Upstream/Downstream Monitoring Program, 1996-1997.
IJC: (1) Specific Objectives. Annex 1 of the Great Lakes Water Quality Agreement of 1978, as amended 1987.

Footnotes:

a. All substances shown are NRTMP "priority toxics". Those in italics are also Lake Ontario LaMP critical pollutants.
b. Concentrations designed to be protective of all aquatic life in situations of long-term exposure. For Ontario, values shown are Provincial Water Quality
Obectives, or proposed PWQOs, denoted with (p).
c. Values for protection of human health for consumption of water + organisms.
d. Apples to dissolved form.
e. Applies to sum of pp-TDE, ppDDE and ppDDT
f. NY State Standard shown applies to dieldrin only. In addition, a NY State standard of 0.001 ppb applies to the sum of aldrin + dieldrin. Ontario PWQO, Health Canada, and IJC objectives apply to the sum of aldrin + dieldrin.
g. Value is for total dioxins/furans as 2,3,7,8 equivalents.
h. Applies only to 2,3,7,8-TCDD

i. Chronic value in ppb = {1.46203 - [ln (hardenss in ppm) (0.145712)]} exp (1.273[ln(hardness in ppm)] - 4.297).
Acute value in ppb = {1.46203 - [ln (hardness in ppm) (0.145712]} exp 1.273[ln(hardness in ppm)] - 1.052).

j. Hardness based criteria. For EPA criterion, 100 mg/L used. Ontario criteria apply at hardness > 80 mg/L.

k. Applies to inorganic mercury.

l. Values apply to sum of PCBs.

Table 7. New York State Advisories on the Consumption of Sportfish for Waters of the Niagara River and its U. S. tributaries (NYSDOH 2000-2001).

Water	Species	Recommendation*	Chemical of Concern
Niagara River, above Niagara Falls	Carp	Eat no more than one meal per month	PCBs
Niagara River, below Niagara Falls	American eel, channel catfish, carp, lake trout over 25", brown trout over 20", chinook salmon, white perch	Eat none	PCBs, mirex, dioxin
	Smallmouth bass, rainbow trout, white sucker, lake trout less than 25", brown trout less than 20", coho salmon over 25"	Eat no more than one meal per month	PCBs, mirex, dioxin
Tonawanda Creek, Lockport to Niagara River	Carp	Eat no more than one meal per month	PCBs
Buffalo River/Harbor	Carp	Eat none	PCBs
Cayuga Creek	All species	Eat none	Dioxin

* Note the additional advisories, applicable to the Niagara River and U. S. tributaries, recommended by the NYSDOH to minimize potential adverse health impacts:

- Eat no more than one meal (one-half pound) per week of fish from any New York fresh water.
- Women of childbearing age, infants and children under age 15 years should not eat any fish species from the waters listed above.
- Observe the above restrictions in tributaries of the above waters to the first impassable barrier impassable by fish.
- Follow trimming and cooking advice described in NYSDOH (2000-2001).

Table 8. Sport Fish Consumption Advisories for the Upper and Lower Niagara Rivers from the 2001-2002 Guide to Eating Ontario Sport Fish.

Location	Species	Fish Size in Centimetres (Inches)								
		15-20 (6-8)	20-25 (8-10)	25-30 (10-12)	30-35 (12-14)	35-45 (14-18)	45-55 (18-22)	55-65 (22-26)	65-75 (26-30)	>75 >(30)
Lake Ontario Upper Niagara River	Rainbow Trout[5]				X	X	X			
	Northern Pike[2]							X	X	X
	Smallmouth Bass[5,7]	X	X	X	X	4				
	Largemouth Bass[2]	X	X	X	X	X				
	Yellow Perch[5]	X	X	X						
	White Bass[5]	4								
	Rock Bass[5]	X	X							
	Brown Bullhead[2,7]	X	X	X	X					
	Carp[2,7]			X	X	X	X	X	4	4
	Freshwater Drum[5,7]		X	X	X	4	4			
	White Sucker[5]	X	X	X	X	X				
	Redhorse Sucker[1]	X	X	X	X	X	X	4		
	Rainbow Smelt[2]	4								
Lower Niagara River	Chinnook[5]						2	2	2	1
	Rainbow Trout[5,7,8,9]					X	X	4	4	4
	Lake Trout[5]							1	1	1
	Smallmouth Bass[5,7]	X	X	X	X	4	4			
	Largemouth Bass[2]		X	X	X	X				
	Yellow Perch[5,7]	X	X	4	4					
	White Perch[2]		2	1	Y					
	White Bass[5]	X	X	4	2					
	Rock Bass[2,7]	X	X	4						
	Bluegill[2]	X								
	Brown Bullhead[3,7]			X	X	4				
	Channel Catfish[5]				X	4	2	2	2	
	Freshwater Drum[5,7]	X	X	X	X	X				
	Carp[2,7]					X	4	4	2	2
	White Sucker[5]			X	X	4	4			
	Redhorse Sucker[5]				4	2	2			
	American Eel[5,7]							4	4	4
	Rainbow Smelt[2]	2								

X = Consumption of no more than eight meals per month for the general population. Women of childbearing age and children under 15 are advised to consume only the fish represented by this symbol and to consume no more than four meals per month

Y = None of these fish should be consumed in any amount by anyone.

1 - 4 = Number of advised meals per month. Women of child bearing age and children under 15 are advised not to consume these fish in any amount.

NOTE: A meal is considered to be 227 grams (8 ounces).

Contaminants Analyzed (Superscripts)

1 Mercury
2 Mercury, PCBs, mirex/photomirex and pesticides
3 PCBs, mirex/photomirex and pesticides
4 Mercury, PCBs and mirex
5 Mercury, other metals, PCBs mirex/photomirex and pesticides
6 Mercury and other mtals
7 Dioxins and furans
8 Mercury, PCBs, mirex/photomirex, pesticides chlorinated phenols and chlorinated benzenes
9 Polynuclear aromatic hydrocarbons (PAHs)

Table 9. Concentrations* of Selected Organochlorines in Spottail Shiners (*Notropis hudsonius*) from Canadian and U.S. Sites in the Upper and Lower Niagara River, 1999.

Sampling Site	Year	n	Total Length (mm)	Lipid (%)	PCB (ng/g)	DDT (ng/g)	Mirex (ng/g)	OCS (ng/g)	HCB (ng/g)
UPPER NIAGARA RIVER									
Canada									
Fort Erie	1999	5	54-5	1.1-0.5	44-9	8-3	ND	ND	ND
Frenchman's Creek	1999	5	55-6	0.9-0.2	36-9	8-5	ND	ND	ND
U.S.									
Wheatfield (NY)	1999	5	64-2	2.2-0.6	220-42	4-1	ND	ND	ND
102nd Street (NY)	1999	5	66-5	3.3-0.6	236-46	6-3	ND	2-0	2-0
Cayuga Creek (NY)	1999	5	57-5	2.7-0.6	216-36	8-3	ND	1-0	3-2
LOWER NIAGARA RIVER									
Canada									
Queenston	1999	5	61-4	1.6-0.2	92-22	10-5	ND	ND	ND
Niagara-on-the-Lake	1999	5	61-6	1.7-0.3	104-26	12-6	ND	ND	ND
U.S.									
Lewiston (NY)									

	1999	5	60-6	1.7-0.6	100-20	6-3	ND	ND	ND
Youngstown (NY)									
	1999	5	57-5	2.4-0.5	112-17	16-5	ND	ND	ND

*** X-Y = mean-standard deviation**

NIAGARA RIVER TOXICS MANAGEMENT PLAN (NRTMP) ANNUAL WORK PLAN [2001]

The "Four Parties"

EPA	=	U.S. Environmental Protection Agency
DEC	=	New York State Department of Environmental Conservation
EC	=	Environment Canada
MOE	=	Ontario Ministry of the Environment

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
I. Controlling Point Sources								
A. Report on U.S. Point Sources		*			Perio-dically		Perio-dically	See *Note A*
B. Report on Canadian Point Sources (1994/95)				*	- -	Completed Nov 96		See *Note B*
C. Report on actions to further address U.S. point sources discharging NRTMP Priority Toxic Chemicals	*	*			- -		Beginning 2002	*See Note C*

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
II.	**Controlling Non-Point Sources**								
A.	**Waste sites/landfills**								
1.	Update progress report on remediation of U.S. hazardous waste sites. [Progress at most significant sites summarized below.]	*	*			Oct 00	Completed Oct 00	2002	See “Public Involvement” section (V.B).
2.	Remediate Occidental Chemical-Buffalo Ave site								
a.	Complete overburden groundwater collection system.		*			----	Completed Dec 98	----	See *Note D*
b.	Enhance bedrock groundwater collection system.		*			----	Completed Dec 98	----	See *Note D*
c.	Complete remediation of contaminated soils and off-site groundwater		*			----	------------------------>	----	See *Note D*
d.	Issue Corrective Measures Implementation (CMI) Permit		*			----	Completed.	----	See *Note D*
e.	Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
3. Remediate Niagara County Refuse Disposal								
a. Complete construction of site remedy.	*				Sep 00	Completed Sep 00	---	Construction of the landfill cap was completed June 2000. A final inspection was conducted in September 2000. Operation and maintenance activities and monitoring have commenced.
4. Remediate DuPont, Necco Park site								

	ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
a.	Start construction of final site remedy	*				Jun 00	Delayed--------------->	Nov 01	See *Note E*
b.	Complete final remedy	*				Mar 03	Delayed--------------->	Oct 03	
5.	Remediate Hyde Park Site								
a.	Complete additional remedial measures as necessary to achieve hydraulic containment,	*				----		Jun 02	See *Note F*
b.	Optimize well pumping rates and evaluate the containment of contaminated groundwater. Monitor groundwater level and conduct chemical sampling	*				On-going		On-going	
c.	Complete all remedial systems.	*				Dec 00	Delayed -------------->	Jun 02	
d.	Conduct annual survey of gorge-face seeps.	*				Jul 00	Completed	Jul 01	See *Note F*

	ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
e.	Sample groundwater seeps coming from Niagara River Gorge face and analyze for toxic chemicals.	*				Dec 00	Completed. Sampling conducted annually in 1997, 1998, 1999. Results continue to indicate no need for additional control or remediation of the seep areas.	Jun 02	Results of 2001 sampling. See *Note F*
f.	Assess contamination at Bloody Run Creek mouth	*				2000	Completed	2001	Underway *See Note F*
g.	Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.
6.	Remediate 102nd Street								
a.	Complete containment system, including barrier wall, drainage system, landfill cap.	*				----	Completed	----	

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
b.	Complete leachate pumping system.	*				----	Completed Dec 98	----	Eliminates potential off-site loadings
c.	Complete site landscaping and optimization of the pump-and-treat system.	*				Jul 99	Completed Mar 99	----	
d.	Monitor groundwater level.	*				On-going		On-going	To ensure effectiveness of remedial systems.
e.	Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.

7.	Remediate Occidental Chemical, S-Area site								
a.	Finish building new City of Niagara Falls Drinking Water Treatment Plant (DWTP)	*				----	Completed Mar 97	----	Fully operational
b.	Demolish existing City of Niagara Falls DWTP.	*				----	Completed winter 98	----	

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
c. Construct eastern barrier wall	*				Jul 98	Completed May 98	----	Other three sides of site already enclosed by barrier walls.
d. Complete cap and overburden drain collection system for the old DWTP property.	*				----	Completed Sep 99	----	See *Note G*
e. Securement of the DWTP intake structures, including grouting of DWTP raw water intake.	*				Jul 00	Began Aug 00	----	Confirmatory tunnel borings 2001. See Note G.
f. Install final landfill cap.	*				Dec 00	Began Aug 00	Aug 01	See *Note G*
g. Optimize well pumping rates and make sure that contaminated groundwater is no longer flowing off site.	*				Apr 01	Evaluation report submitted Apr 01	2002	See *Note G*
h. Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.
8. Remediate Solvent Chemical site								

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
a. Complete remedial design		*			----	Completed	----	
b. Construct site remedy		*			----	On-going	----	See *Note H*
c. Complete remedial action	*				Jan 01	Delayed -------------->	Aug 01	
9. Remediate Olin plant site								
a. Monitor effectiveness of remedial systems.	*	*			On-going		On-going	Remedial system completed Oct 97
b. Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000	2003	Next field survey.

10. Remediate Buffalo Color Corporation site								
a. Complete site investigation		*			----	Completed Apr 99	----	See *Note J*
b. Select site remedy		*			Aug 00	Completed	----	See *Note J*
c. Implement site remedy.		*			Jul 01	Delayed	Jun 02	

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
11.	Remediate Bethlehem Steel site								
a.	Complete site investigation	*	*			Apr 01	Delayed -------------->	Mar 02	See *Note K*
b.	Select site remedy	*	*			Oct 02		Jun 03	
c.	Begin implementation of site remedy	*	*			Dec 03		Dec 03	
12.	Remediate Gratwick Riverside Park site								
a.	Start construction of site remedy.		*			----	Began Jun 99	----	
b.	Complete construction of site remedy		*			Comple-ted 2001	Construction completed Dec 00. Awaiting testing and verification.	----	
c.	Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.
13.	Remediate Occidental Chemical Durez - North Tonawanda Site								
a.	Complete construction of site remedy		*			----	Completed 1994. See *Note L*.		

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
b.	Assess contamination in Pettit Flume Cove		*			----			
c.	Biomonitor effectiveness of remediation using caged mussels				*	2000	Completed field survey in Aug 2000.	2003	Next field survey.
14.	Determine whether trace amounts of contaminants of concern found at 5 landfills are moving to groundwater off-site.			*	*	----	Completed. See *Note M.*	----	
B.	**Contaminated sediments**								
1.	Update NY Great Lakes Contaminated Sediments Inventory					Every 2 years	Data update completed Mar 2001 and submitted to national database.	Annually	Inventory of data on contaminated sediments is available to evaluate sampling and remediation actions.

III.	**Monitoring**

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
A. Complete report on results of Upstream/Downstream sampling.	*	*	*	*	Dec 98 (for 96-97 report)	Final report completed and distributed.	Dec 01	97-98 report. (Revised Format)
B. Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan. See *Note O*		*		*	MOE Apr 02 2000 DEC May 2000	MOE Technical summary of 1999 collection completed Apr. 2001 Spottail shiners were collected in Aug. 2000. DEC: Draft report on 1997 collections underway.	MOE Apr 02 Apr 02 DEC: Dec 2001	 Prepare technical summary of 2000 collection Spottails to be collected Final report on 1997 collections. Subsequent collections to follow on a five-year basis (next collection in 2002)

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
C.	Track down toxic chemicals in tributaries and sewer systems to identify sources.	*	*			Spring-Fall 2000	Monitoring completed in Two Mile Creek. Additional priority areas identified. *See Note P.*	Spring-Fall, 2000	Complete PCB trackdown in Two Mile Creek. See *Note P*
D.	Biomonitor using caged mussels and analyze for toxic chemicals, according to Monitoring Plan.				*	Every 3 years	Complete field survey in Aug 2002.	2003	Next field survey
E.	Study use of zebra and quagga mussels as biomonitors				*	Dec 02	Completed Abstract paper for 1997 Study		

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
F. Assess sport fishery in Niagara River, with contaminant analysis.				*	MOE:	MOE:	MOE:	
Complete the review of sport fish contaminant trends in the Niagara River/Western Lake Ontario from 1970-2000.					Apr 00	Delayed ------------->	Dec 01	
					Apr 00	Sport fish collected from the Niagara River.	Apr 00	
					Apr 01	Released 2001-2002 AA Guide to Eating Ontario Sport Fish in March 2001.	Apr 01	
							Apr 02	Prepare and Release 2003-2004 “Guide to Eating Ontario Sport Fish.”

	ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
G.	Collect sample of Falls Street Tunnel wet weather discharge and analyze for NRTMP priority chemicals using techniques to achieve low detection levels.		*			Jun 00	Sample collected fall 1999. Analysis and report completed Jan 01.	----	
H.	Develop plans for additional assessment of low-level contaminant discharges from Niagara River point sources.	*	*			----		2002	*See Note Q.*

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
IV. 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 and Work Plan.	*	*	*	*	May 01	Materials included in 2001 report	Oct 02	Update existing materials as necessary and add additional materials. See *Note R*
B. Develop plans addressing water-quality limiting chemicals.	*	*			- - -		Beginning 2002	*See Note S*

ACTIVITY		EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
V.	**Public Involvement**								
A.	Develop a reader-friendly brochure that gives an overview of the NRTMP and summarizes progress made on restoring the Niagara River.	*	*	*	*	Jun 99	Completed Feb 00	----	
B.	Present progress made in the remediation of U.S. hazardous waste sites at a public meeting in Niagara Falls.	*	*			Nov 00	Completed	2002	See "Controlling Non-Point Sources" section (II.A.1).
C.	1. Make NRTMP information and reports available on the Internet. 2. Develop a NRTMP web page	* *	* *	* *	* *	As available Sep 99	On-going. See *Note T* Delayed --------------	As availabl e Delayed until Jun 02	 NRTMP web page to be developed on EPA/GLNPO web site
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.	*	*	*	*	May 01	Delayed until Sep 01	No later than Sep 02	Annually.
E.	Hold a public meeting to present	*	*	*	*	Jun 00	Jun 00 completed	No later	Annually.

ACTIVITY	EPA	DEC	EC	MOE	2000 Commit-ment	Status/Comments	2001 Commit-ment	Status/Comments
above progress report and updated annual work plan.					Jun 01	Jun 01 delayed until Oct 01	than Oct 02.	

WORK PLAN NOTES

Note A. Report on U.S. Point Sources

DEC regularly monitors a suite of EPA priority pollutants in point sources as part of its State Permit Discharge Elimination System (SPDES) requirements. Of the 29 most significant point sources of toxic pollutants existing in 1986, 26 dischargers are still operating. New York reported an 80% drop in priority pollutants from its 29 significant point sources between 1981 and 1985. New York also reported a drop of 25% in the remaining load of "priority pollutants" between 1985 and 1994.

Note B. Report on Canadian Point Sources

In November 1996, MOE released a final report on NRTMP-specific monitoring of its point sources on the Niagara River.

From 1986 to 1995, MOE has seen an estimated 99% reduction in loadings of the 18 chemicals of concern (COC).

Provincial Water Quality Objectives (PWQO) have been set for 14 of the 18 COCs. Since 1993, effluent quality from these point sources has met all 14 PWQOs. This means that end-of-pipe concentrations are acceptable against the Standards that Ontario has set for all surface waters in the Province. As a result, MOE has discontinued NRTMP-specific monitoring of the Niagara River and focused resources towards Ontario's biomonitoring program on the River.

Regulatory monitoring and reporting of Ontario point sources required by Certificates of Approval and Clean Water regulations will continue.

Note C: Report on actions to further address U.S. point sources discharging NRTMP Priority Toxic Chemicals.

EPA and DEC have completed an assessment of recent information on discharges of NRTMP Priority Toxic Chemicals from point sources in the Niagara River and tributaries. The purpose is to help determine priorities for further actions to address discharges which may have chemical concentrations that are elevated relative to other point sources, and/or may contribute chemical loadings that are large relative to other point sources. In general, the levels of contaminants found in point source discharges to the Niagara River and tributaries are very low. The parties to the NRTMP have been focusing on reduction of toxic chemical inputs from point and non-point sources for many years, and these efforts have been very successful reducing contaminant inputs to the river. Though the concentrations of contaminants in U.S. point source discharges are generally low, there is evidence that the concentrations (and associated load estimates) vary considerably among discharges. It is EPA's and DEC's policy to address discharges where there is evidence of elevated levels of toxic chemicals on a priority basis. On this basis, EPA and DEC have identified several priority actions to address point source discharges in New York's Great Lakes basin. Among the priorities is to address contaminant discharges occurring due to wet-weather overflows from the Falls Street Tunnel (FST). DEC is currently reviewing the City of Niagara Falls Wastewater Treatment Plant (NFWWTP) SPDES permit under the Environmental Benefits Permit Strategy, which prioritizes the review of SPDES discharge permits. This permit currently includes conditions to control pollutants from CSOs including the FST. These conditions will be reviewed and revised as necessary. EPA and DEC will report further on the status of efforts to address the FST, including specific plans as they are developed, beginning in 2002. EPA and DEC also intend to develop voluntary programs to help address contamination appearing in Niagara River point source discharges, and will report further in 2002.

Note D. <u>Remediate Occidental Chemical-Buffalo Ave site</u>

The groundwater stabilization programs were completed in December 1998. Occidental enhanced its treatment plant for contaminated bedrock groundwater, and then increased the groundwater extraction rates. The overburden groundwater collection system was augmented by installation of a tile drain collection system. On December 27, 1999 New York State issued a final permit that incorporates these and other corrective measures currently in place as part of the Final Corrective Measures for the site. After a public comment period, the final permit became effective February 10, 2000.

Note E: <u>Remediate DuPont, Necco Park site.</u>

Remedial design is underway including the installation of additional groundwater wells, which began September 2000. The wells will serve as component parts of the hydraulic containmant portion of the final remedy. The completion date will allow time to address any complications that may arise in achieving effective hydraulic containment in the fractured bedrock beneath the site, and to allow the remedial systems to be tested and optimized.

Note F: Remediate Hyde Park site.

Most site construction is complete. All of the overburden groundwater is being contained, and in the three bedrock groundwater zones, at least 80% of contaminated groundwater is being contained. Remedial work to achieve full containment is continuing. A total of six pumping wells were installed in 1998 and 1999; one pumping well and five monitoring wells were installed in 2000. However, OCC still did not achieve all required inward hydraulic gradients. OCC completed a groundwater model, to better understand the groundwater flow in the vicinity of the site, in February 2001. The output of the model was used to design five additional extraction wells in the bedrock. The model predicts that 100% of the contaminated groundwater coming from the site will be captured when these wells are operational. OCC began installing the five new extraction wells and the associated monitoring wells in June and should be completed by December 2001.

To ensure that remediation of the groundwater seeps in the Niagara River Gorge face has been effective, a survey of the gorge face, and sampling of the seeps, is conducted annually. The survey is a physical inspection of the area, for example, to document whether any seepage is evident and ensure that physical barriers are sound. The seep sampling includes analysis of aqueous phase chemical contaminants. Results continue to indicate no need for additional control or remediation of the area.

Sediment sampling conducted by MOE in 1997 and EPA in 1999 at the mouth of Bloody Run Creek indicates possible continuing concerns due to dioxin contamination. EPA performed a human health risk screening of this contamination and found the human health risk to be within its acceptable risk range. EPA will perform an ecological risk screening this year.

Note G: Remediate Occidental Chemical S-area site.

The drain collection system and cap for the old Drinking Water Treatment Plant property were completed in 1999. Operation of the drain collection system for the landfill portion of the site began in 1996. However, a portion of the system was improperly installed and did not function as designed. The system was replaced in 1999-2000. This has delayed completion of the Remedial Action. Construction of the final landfill cap began in August 2000, was shut down for the winter, and is being completed in the Summer of 2001. Securement of the raw water intake structure from the old DWTP was completed in August 2000. The phase 3 evaluation of the bedrock pumping program indicated the need for additional bedrock wells. Additional wells will be installed. Completion of the Remedial Action is expected in 2002.

Note H: Remediate Solvent Chemical site.

Construction began in early 1998, but was delayed by lack of access agreements with adjacent property owners. Construction has now resumed. Construction of the groundwater remedial systems began in 1999 and will continue through summer 2001. The groundwater pre-treatment system is scheduled to go on-line in summer 2001.

Note J: Remediate Buffalo Color Corporation site.

The site RFI has been completed. A supplemental investigation was conducted during summer 1998. A revised RFI report was submitted in December 1998 and approved in April 1999. A Corrective Measures Work Plan was submitted in May 1999 and approved in July 1999. During July 1999, a pump test was performed to aid in the design of an Interim Corrective Measure for Plant Area A, to prevent the discharge of contaminated groundwater to the Buffalo River. The Corrective Measures Study Report was approved in July 2000. A Statement of Basis which will incorporate the final remedy (corrective measures) into the permit will be public noticed. The Statement of Basis was delayed in order to address additional coordination procedures with the local authorities. The proposed Corrective Measures alternative include an Area A groundwater extraction system, institutional controls, groundwater monitoring, the repair of a sheet piling breach in Area E and Area A bank erosion control.

Note K: Remediate Bethlehem Steel site

BSC has completed the field work for the site investigation, and is preparing RFI and human health risk assessment reports. However, these have been delayed due to negotiations over the scope and the need to collect additional data. The additional data needed to complete the Ecological Risk Assessment was collected spring 2001. In the interim, BSC is drafting the remaining portions of the RFI Report, including the SWMU assessment reports. Submittal of the Draft Final RFI report is anticipated by December 2001. BSC has also completed limited remedial technology studies for several SWMUs and for two areas that appear to be the primary sources of groundwater contamination (the Acid Tar Pits and Coke Oven Areas). BSC has submitted a

Pre-design Investigation Report for the remediation of the Benzol Plant Area (i.e., coke oven area), however a dispute over waste characterization has delayed implementation. BSC also submitted an application for two Corrective Action Management Units (CAMUs) to NYSDEC and EPA. NYSDEC determined that BSC's application was "substantially complete". This will allow the potential for CAMUs to be utilized as part of a future remedy at the facility. While the RFI activites are being completed, EPA has removed approximately 102 acres of the facility from the RFI Order to facilitate brownfields type redevelopment. This acreage is not believed to be significantly contaminated and may be suitable for redevelopement. BSC and NYSDEC are negotiating a Work Plan for the investigation of the 102 acre parcel. Any future CMS or CMI activities will require a new order, permit or other agreement.

Note L: <u>Remediate Occidental Chemical Durez - North Tonawanda site</u>

The remediation of this site was completed in 1994. The remedial action included construction of a ground water interceptor trench around the plant perimeter to collect groundwater for treatment at an on-site carbon treatment system; removal of contaminated sediments in 22,000 linear feet of sewers off site; and remediation of Pettit Creek Cove, including sediment and soil removal at the cove, pumping of DNAPL; and dredging of the Little Niagara River.

Biomonitoring sampling by the Ontario Ministry of the Environment in 1997, and recent water quality sampling by the NYSDEC, detected the possible release of OCC Durez contaminants of concern into the post-remedial Pettit Creek Cove. The extent of the sampling was limited to a very small area at the mouth of the Pettit Creek Flume storm sewer. As a result, OCC agreed to undertake a supplemental investigation of the Pettit Creek Cove to ascertain the cove=s current condition and to demonstrate the effectiveness of the completed remedial programs. Sampling of cove sediment, completed October 1999, found that low levels of Durez contaminants were present in recently deposited sediment emanating from the Pettit Flume storm sewer. OCC believes the contamination to be residual from the sewer cleaning project of 1994. In response, OCC completed maintenance dredging of 400 cubic yards of the recently deposited sediment in May 2000.

Note M: Determine whether trace amounts of contaminants of concern found at 5 landfills are moving to groundwater off-site.

During the Niagara River Toxics Committee Study (1981-84), four industrial and one municipal landfills were identified as having the potential to contribute contaminants to the River. Studies conducted in 1991 and 1993 showed that the landfills have minimal to no impact on the River. Groundwater monitoring at these sites has shown that contaminants are not moving to the groundwater and off-site. Further assessment is not required at this time.

Regulatory monitoring and reporting of these non-point sources as required by certificates of approval will continue.

Note O: Collect juvenile spottail shiners or other juvenile fish and analyze for toxic chemicals, according to Monitoring Plan

In 1997 and 1998, spottail shiner capture in the Niagara River was poor despite efforts of MOE and DEC on the Canadian and U.S. sides of the River. MOE collected emerald shiners as an alternate species at three locations in 1997 including Queenston, Lewiston, and Niagara-on-the-Lake. Technical summaries are currently in preparation. MOE collected juvenile fish from nine locations on both the Canadian and U.S. side of the Niagara River in 1998. The Canadian locations included Fort Erie (spottail shiners), Queenston (common shiners), and Niagara-on-the-Lake (spottail shiners). The U.S. locations included Wheatfield (common shiners), 102nd Street (common shiners), Cayuga Creek (common and spottail shiners), Search and Rescue (emerald shiners) and Lewiston (emerald shiners). In 1997, DEC completed collections of spottail shiners and other young-of-the-year fish at 35 stations throughout the Great Lakes basin in New York State, including 14 stations in the Niagara River basin. Analysis was expanded to include PCB congeners and dioxin and furans at several stations. A report is in preparation.

Note P: Track down toxic chemicals in tributaries and sewer systems to identify sources

Trackdown is a key program to identify continuing sources of toxic chemicals in the Niagara River and its tributaries. DEC and EPA are working cooperatively to oversee the implementation of New York State Great Lakes basin source trackdown work, including Lake Ontario, the Niagara River and Lake Erie. DEC and EPA are currently implementing certain plans for trackdown in the Great Lakes waters including the Niagara River. Trackdown work for Two-mile Creek was completed in 2000, and analysis of results is underway. Additional U.S. plans are being developed in consideration of available resources. DEC and EPA have completed an assessment of information collected over the past several years in the Niagara River and U.S. tributaries. This is helping to determine priorities for further monitoring efforts which may lead to identification of point and non-point sources impacting the river. For example, the DEC/EPA assessment indicates several priority areas for follow-up monitoring. Among these areas are Hyde Park/Bloody Run Creek, Cayuga Creek (Niagara County), and Gill Creek. DEC and EPA will be developing plans for follow-up monitoring efforts, and implementing additional efforts as feasible. DEC and EPA will report further in 2002.

Note Q: Develop plans for additional assessment of low-level contaminant discharges from Niagara River point sources.

DEC and EPA have completed an assessment of recent information on toxic contaminant discharges from Niagara River point sources. The information available indicates the need for additional assessment of low-level contaminant discharges from point sources in the Niagara River. The purpose would be to help determine additional priorities for control of contaminant discharges from point sources. EPA and DEC will develop plans for such an assessment, and intend to report further in 2002.

Note R: Develop additional materials relating information on Niagara River contamination and contaminant sources.

The goal of the December 1996 NRTMP Letter of Support is

> 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.

Though NRTMP has made much progress toward this goal, NRTMP set out in 1999 to determine what additional actions are necessary to improve water quality and reduce contamination of sediments, fish and wildlife. The task is to examine a variety of information sources on toxic contamination in the River water, biota, and sediments, toward the following objectives:

- Develop an improved description of contaminant status and trends in the Niagara River, and the relationship to the NRTMP;
- Determine the toxic chemicals that continue to exceed criteria or standards for the protection of human health, aquatic life, and wildlife in the Niagara River;
- Determine and describe the sources and loads of those chemicals;
- Where the above objectives cannot be fully achieved, describe the actions necessary to achieve them.

Key sources of information for the synthesis include: (1) Upstream/Downstream monitoring; (2) contaminant biomonitoring; (2) sportfish advisories and contamination; (5) contaminant source trackdown monitoring; (5) sediment quality data; (6) point source contaminant concentrations and loadings. The effort to develop the synthesis is underway. Some information was incorporated into the NRTMP 2000 Progress Report and Work Plan (e.g., fish advisory information, data comparison to water quality criteria). This information has been updated in the 2001 report, including the incorporation of Upstream/Downstream data for 1997/1998 and 1998/1999. In addition, the U.S. parties have completed several U.S. “Synthesis Papers”, which use a variety of data sources to help determine U.S. actions under the NRTMP toward the goals of the Letter of Support and the Declaration of Intent. The Synthesis Papers address (1) assessment of water quality for toxics in the Niagara River, and the significance of Niagara River sources; (2) point sources of toxics; and (3) toxic contamination in the sediments, biota and water of the river and tributaries. Information from the U.S. assessments is incorporated into the 2001 Progress Report and Work Plan. In the next year, NRTMP will update this information as necessary. Also, additional information is under development, including the preparation of a Four-Party technical interpretive report on the US/DS Program and Biomonitoring Program. NRTMP will report on the status of the Synthesis effort in 2002.

Note S: Develop plans addressing water-quality limiting chemicals.

DEC and EPA have completed a U.S. assessment of water quality in the Niagara River using US/DS Program data. The assessment indicates exceedances of New York water quality standards for some NRTMP Priority Toxic Chemicals. It is DEC’s and EPA’s intent to address sources of toxic substances determined to exceed water quality standards in the Niagara River. Niagara River segments determined to be water-quality limited will be added to New York’s 2002 list of impaired waterbodies (i.e. the Clean Water Act

Section 303(d) list). Total Maximum Daily Loads/Wasteload Allocations/Load Allocations (TMDLs/WLAs/LAs) will be developed for these segments. EPA and DEC, in coordination with the Four-Parties, will communicate priorities to the Lake Erie Lakewide Management Plan to help ensure implementation of programs that address water-quality limiting chemicals in the Niagara River.

Note T: Make NRTMP information and reports available on the Internet.

The Four Party Upstream/Downstream Reports for 1991/92, 1993/94, 1995/96, and 1996 /97 can be found on the GLIMR web site at http://www.cciw.ca/glimr/search.html (search “joint evaluation”). U.S. wastesite reports from 1998 through 2000 are at http://www.epa.gov/grtlakes/lakeont/nrtmp. Additional reports will be added as they become available.