St. Clair River

REMEDIAL ACTION PLAN

The St. Clair River Area of Concern Remedial Action Plan Progress Report

Volume 1 - Synthesis Report
Environmental Conditions and Implementation Actions
(1998-2003)

ST. CLAIR RIVER
RAP PROGRESS REPORT

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FOREWORD

This Progress Report serves to update the environmental conditions in the St. Clair River Area of Concern (AOC) as well as to summarize the actions taken to remediate the problems defined in the Stage 2-Recommended Plan. Specifically, it attempts to measure progress toward the recovery of identified beneficial use impairments (BUIs), identify information gaps and provide recommendations for further action. The information contained in this Report will ultimately be used to develop strategic work plans for the 'delisting' of the St. Clair River as one of the International Joint Commission's (IJC) 41 AOCs. While information as recent as 2003 is discussed, the majority of the data represent the period from 1998 to 2001. The source of most industrial contaminants entering the St. Clair River has and continues to originate from Canadian industries, and therefore much of the data in this report is from Canadian sources. However, significantly more environmental monitoring data, habitat restoration and non-point source pollution control information from both Canada and the U.S. should be incorporated into future update reports in order to present a more comprehensive picture of the environmental health of the St. Clair River AOC. Information gaps can be attributed to the lengthy time interval between monitoring and reporting by scientists, agencies and industrial facilities. This document has been reviewed by Provincial, State and Federal Agencies and the Binational Public Advisory Council (BPAC), resulting in a consensus-based report.

Although this Progress Report and its accompanying Technical Addendum detail the current conditions and temporal trends of contaminants in water, air, sediment and biota, progress should also be viewed in the larger sense of what has been accomplished and what remains to be done. Progress toward cleaning up the St. Clair River commenced prior to the current RAP process. The IJC first recognized that the River contained elevated concentrations of metals and nutrients due to human activities as early as the 1940s. Since then, governments, industries, municipalities, and public interest groups in both the United States and Canada have undertaken a wide range of remedial action plans (RAPs) and programs aimed at cleaning-up and rehabilitating the AOC. These actions have included the collection and analysis of environmental data, development of public awareness and environmental educational programs, and the implementation of site-specific and AOC-wide remedial measures.

Such actions and programs have resulted in tremendous improvements in the environmental conditions of the St. Clair River, its tributaries and associated fish and wildlife habitats. The 1997 St. Clair River Remedial Action Plan - Stage 1 Update documented these improvements, and highlighted downward trends in industrial loadings, environmental contaminant concentrations and the frequency of chemical spills. Consequently, it was recommended that the status of four of the 10 specific BUIs be redesignated as either "not impaired" or "requiring further assessment on a St. Clair River AOC basis". While the status of these particular BUIs has indeed improved relative to pre-implementation of remedial action plans, the process for redesignating a particular BUI will now follow the agreed upon formal binational process as outlined in the Four Agency Letter of Commitment signed in 1998. This process involves the provision of supporting documentation and data to validate the change in status, peer review of the documentation by a Technical Review Team, open discussion with local RAP committees and the public, and a decision by a Four Agency Management Team. The process will ensure that transparency, credibility and scientifically defensible decisions are achieved in the St. Clair River AOC. Consequently, tainting of fish and wildlife flavour, restrictions on drinking water consumption or taste and odour problems and, added cost to agriculture or industry, require evaluation under this process to determine their current status. Additional study is required in order to assess bird or animal deformities or reproductive problems in the St. Clair River AOC.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 EXECUTIVE SUMMARY

Many of the municipal and industrial point sources in the St. Clair River AOC have implemented significant corrective measures to improve air and water effluent quality, reduce waste generation, reduce or eliminate spills, and improve plant efficiency since the 1995 Stage 2 Recommended Plan. These remedial actions have been significant in addressing the original environmental concerns identified for the St. Clair River AOC. As a result, there have been significant reductions in loadings of persistent, bioaccumulative and non-bioaccumulative contaminants to the St. Clair River. The elimination of numerous combined sewer overflows (CSOs) has reduced pollutant loads, and the remediation of contaminated sediments in the Cole Drain and offshore of Dow Chemical Canada Inc. has reduced the risk of downstream movement. Significant progress has also been achieved on the restoration or enhancement of upland, riparian and wetland habitats on both the Ontario and Michigan sides of the AOC.

Many of these improvements directly address one or more of the 45 recommended actions identified in the 1995 Stage 2 Report that were proposed as remedial and preventative measures for the eventual restoration of beneficial use impairments (BUIs) and the delisting of the St. Clair River as an AOC. Yet, information gaps exist and finding solutions to remove impairments and to move forward in the delisting process requires the results of several recently completed or ongoing studies. The information gaps and actions include: point and non-point source pollution data; sediment characterization and remediation strategies; recent habitat inventories for both Canada and the United States; a focus on public education and outreach; a greater emphasis on monitoring and research needs, and the formation of a Remedial Action Plan Implementation Committee (RIC).

Status of Beneficial Use Impairments

- Restrictions on Fish and Wildlife Consumption
    - Restrictions on Fish Consumption (Impaired)
    - Consumption of Wildlife (Requires further assessment)
- Tainting of Fish and Wildlife Flavour (Requires further assessment)
- Degradation of Fish and Wildlife Populations
    - Dynamics of Fish Populations (Not Impaired)
    - Dynamics of Wildlife Populations (Requires further assessments)
    - Body Burdens of Fish and Wildlife (Requires further assessment)
- Fish Tumours and Other Deformities (Requires further assessment)
- Bird or Animal Deformities or Reproductive Problems (Requires further assessment)
- Degradation of Benthos
    - Dynamics of Benthic Populations/Communities (Impaired)
    - Body Burdens of Benthic Organisms (Requires further assessment)
- Restrictions on Dredging Activities (Impaired)
- Eutrophication or Undesirable Algae (Not Impaired)
- Restrictions on Drinking Water Consumption or Taste and Odour Problems (Impaired)
- Beach Closings (Impaired)
- Degradation of Aesthetics (Impaired)
- Added Cost to Agriculture or Industry (Impaired)
- Degradation of Phytoplankton and Zooplankton Populations (Not Impaired)
- Loss of Fish and Wildlife Habitat (Impaired)

Restrictions on Fish and Wildlife Consumption

The 2003-2004 Guide to Eating Ontario Sport Fish (OMOE, 2003) and the Michigan Fish Advisory (MDEQ, 2001) indicate that consumption restrictions remain in place for various fish species due to mercury, polychlorinated biphenyls (PCBs), mirex/photomirex, and pesticides. Consumption advice is provided for the upper, middle and lower zones of the St. Clair River, reflecting the differences in fish tissue contaminant burdens. However, the decreasing trend in environmental concentrations of certain chlorinated organic compounds in water (1986-2000) reported by Environment Canada's Head and Mouth survey, and the removal of contaminated sediment by Dow Chemical Canada Inc. should contribute to improved health and quality of wild fish.

To this date, there are currently no numeric guidelines directly applicable to the St. Clair River regarding human consumption of wildlife. However, concentrations of polychlorinated biphenyls (PCBs) in snapping turtles as well as octachlorostryene (OCS), hexachlorobenzene (HCB) and PCBs in mallards and redhead ducks highlight the need for these guidelines. The Ministry of Natural Resources has issued a warning for people to use caution with respect to the regular consumption of these species from some areas of the Delta.

Degradation of Fish and Wildlife Populations

Contaminant concentrations in snapping turtles, terns and mink remain above RAP contaminant yardstick values (numerical environmental objectives) for biota; however, the effects on "Dynamics of Wildlife Populations" is unknown and requires further study in the AOC.

Tainting of Fish and Wildlife Flavour

Aboriginal traditional knowledge of fish tainting reported by Walpole Island First Nation was the impetus for a 1995 controlled subjective olfactory sensory evaluation of walleye caught from the St. Clair River. Results revealed that no identifiable tainting was detected by a panel of BPAC members and the public. It was then recommended that the status of this BUI be changed from "requires further study on a site-specific basis" to "not impaired". The change in status was to be based on further confirmation by results of an extensive angler survey in late 1997. However, the results of an angler survey (1996 – 1997) funded by Health Canada's Great Lakes Health Effects Program revealed that just under half of St. Clair fish consumers (291) had concerns about the fish they caught. Of these, 4% reported fish tainting and provided specific descriptions such as "didn't smell/taste right" and odours and flavours like "oil", "crude", "petrochemicals" and "gasoline" (Dawson, 2000). Given that these reports were derived from experiences in the early to mid 1990s, and the study did not include Walpole Island First Nation residents or the U.S. shore, this BUI "requires further study on a St. Clair River AOC basis".

Fish Tumours and other Deformities

Liver samples from 63 fish representing 17 species from different trophic levels were evaluated using histopathologic criteria by the University of Guelph (Hayes, 2002). No neoplasms were found in any of the liver samples examined. One carp assessed from the Sarnia Bay station had several altered foci of the type observed in some fish species from locations where liver cancers occur. Thus, there is a possibility that these lesions might have been generated by exposure to mutagenic insult. Many of the fish may have been too young to develop neoplasms. Further assessment on older fish was recommended (Hayes, 2002).

Bird or Animal Deformities or Reproductive Problems

One study on snapping turtle contaminant concentrations in eggs and frequency of deformities has addressed this BUI in sufficient detail. Although PCB concentrations exceeded the RAP yardstick value, concentrations were below that of other southern Ontario AOCs (Detroit River and Hamilton Harbour).

Hatching success and the frequency of deformities were no different than that of a reference site located in Algonquin Park. Contaminant concentrations in eggs of black and Forster's terns and livers of wild mink are also provided in this Progress Report. The recommendation that this BUI be changed from "impaired" to "requires further study" was based on a re-assignment of evidence of chironomid mouthpart deformities to the BUI category “degradation of benthos” (dynamics of benthic populations/communities). There is insufficient evidence for a full characterization of this BUI and delisting criteria are required.

Degradation of Benthos

Numerous studies have examined benthic community structure and contaminant body burdens. Benthic communities in the three Priority 1 zones remain impacted and significant relationships were found between contaminant body burdens (mercury (Hg), hexachlorobutadiene (HCBD), HCB, OCS, PCBs) in invertebrates (oligochaetes, chironomids and mayflies) and sediment contaminant concentrations, demonstrating the extent of bioaccumulation. Sediment mercury contamination also impacts tubificid (a type of worm found in sediments) population density.

A BEnthic Assessment of SedimenT (*Beast*) methodology is currently being applied to 16 sampling sites adjacent to industrial sites in the St. Clair River and Stag Island, as well as upstream and downstream sites. The *Beast* methodology will further address the concern over mercury biomagnification and involves the assessment of sediment quality based on the physical and chemical attributes of the sediment and overlying water, benthic invertebrate community structure, sediment toxicity tests and invertebrate body burdens. The results from this study are pending further analysis. In addition, further research is needed to address chironomid mouth-part deformities.

Restrictions on Dredging Activities

Results from analyses of sediment samples collected from the Southeast Bend Cutoff Channel in 2000 indicate that mercury, total PCBs, TKN (total Kjeldahl nitrogen - nitrogen in the form of organic proteins or their decomposition product ammonia), HCB, manganese and phosphorus exceeded RAP yardstick levels and provincial sediment quality guidelines (PSQG) lowest effect levels.

Sediment samples (surficial and core samples) collected in 2001 by the OMOE from just south of the Dow Chemical Canada Inc. property line (zone A) and from sites adjacent to and downstream of Suncor and opposite Stag Island (zone B) were tested to assess sediment management options. Approximately 5% of zone A had surficial mercury (Hg) concentrations exceeding the 1 mg/kg MOE-recommended sediment clean-up target and 30% of zone B had Hg concentrations ranging from 2 to 9.30 mg/kg. Hexachlorobenzene (HCB) concentrations exceeded the recommended target of 220 ug/kg approximately over 43% of zone A and about 4% of zone B.

To date, approximately 13,370 m^3 of bottom sediment historically contaminated with mercury has been removed from the highest priority area offshore of Dow Chemical Canada Inc. A complete update on activities in 2004 will be provided in a future report.

Restrictions on Drinking Water Consumption or Taste and Odour Problems

The 1997 Stage 1 Update recommended that the status of this BUI be changed from "impaired" to "not impaired”, based on the significant reduction in the frequency and quantities of chemical spills to the St. Clair River. There had been no OMOE-issued drinking water advisories or mandatory water treatment plant shutdowns resulting from spills to the St. Clair between 1994 and 1997. However, the OMOE responded to a spill to the St. Clair River in August 2003 from Royal Polymers in Sarnia and to a spill of methyl ethyl ketone and methyl iso-butyl ketone into the St. Clair River in February 2004 from Imperial Oil Ltd. in Sarnia. As a result of these incidents, the status of this BUI is under review.

Beach Closures

Signs warning of possible intermittent pollution are to remain in place at four Ontario parks (Willow, Seager, Lambton, Cundick, Brander) until bacterial levels are below Ontario Ministry of Health guidelines. Combined sewer overflows, storm sewer outfall discharges and discharges from the Sarnia Water Pollution Control Centre (WPCC) and the Port Huron Waste Water Treatment Plant (WWTP) still constitute major sources of pollution to the St. Clair River and contribute to beach closures. Additional research is needed to determine the role of non-point source pollution relative to local point source from treatment plants in beach closures.

Degradation of Aesthetics

This BUI is impaired as a result of oily surface films, spills and combined sewer overflow (CSO) events from both Port Huron and Sarnia. However, five CSOs had been eliminated in the City of Port Huron and two CSOs in Sarnia have been replaced while two others require additional funding. On-going and planned improvements to sewage treatment and storm water systems in Ontario and Michigan, improvements in the St. Clair WWTP relating to mercury losses, continued sediment remediation offshore of the Sarnia Industrial Complex and the maintenance of habitat restoration programs should significantly contribute to the delisting of the BUIs.

Added Cost to Agriculture or Industry

Because there had been no water treatment plant closures or associated interruptions in water supply to industrial users between 1994 and 1997, it was recommended that the status of this BUI be changed from “impaired" to "not impaired”. However, this beneficial use impairment also requires current review based on recent chemical spills to the St. Clair River.

Loss of Fish and Wildlife Habitat

The 1997 Stage 1 Update reported that restoration targets were not fully accomplished and that clearing/draining of marsh and woodland by private landowners continues. Habitat loss is one of the most serious BUIs and affects fish and wildlife populations and degradation of benthos. Restoration and enhancement projects are ongoing in both Ontario and Michigan. Multi-agency partnerships have resulted in habitat restoration and stream bank erosion programs. Thirty percent of the target area of the Darcy McKeough Floodway has been enhanced and a total of 500 hectares of habitat has been enhanced in the St. Clair region since 1992. The current status of fish and wildlife habitat in the AOC will be evaluated and reported on in the next update.

2.0 INTRODUCTION

2.1 Background

This Progress Report is one in a series which began in 1991 with the release of the Stage 1 Report "Environmental Conditions and Problem Definitions". The first 'update' to the Stage 1 Report was released in 1993 as an Addendum Report, summarizing data which were not available at the time of the Stage 1 Report.

In 1995, the Stage 2 Recommended Plan – "Water Use Goals, Remedial Measures and Implementation Strategy" was released following extensive public consultation and review by task team members through facilitated workshops and meetings. It was a joint effort involving local citizens as well as Agency representatives. The 1995 document established RAP goals and objectives as well as numerical environmental objectives (yardsticks) by which concentrations of contaminants in sediment, water or biota would be assessed and progress measured. It also established 45 specific actions which required implementation to address point and non-point pollution sources, sediment, habitat, public education and outreach and monitoring/research, in order to ultimately restore each of the identified BUIs.

In 1997, an additional Stage 1 Update report was prepared along with an Implementation Annex. The former updated data on water, sediment and biota quality along with point and non-point source data to assess trends and conditions in the AOC. The Implementation Annex provided an update on the implementation measures carried out, the progress on the action recommended in the Stage 2 document, and summarized the commitments to further actions within the AOC. These have been further updated for several Michigan and Ontario facilities (see reference list for list of respondents).

Information summarized within the 1997 Update was based on data and information released following the 1993 Addendum Report, up to and including 1996. Most of the ambient data were from 1994 to 1996; however, the period of record for point source data (e.g., MISA monitoring data) was highly variable from facility to facility. At the time of the Update Report, there was very little non-point source data to report. Also, work on habitat acquisition and/or restoration was very preliminary. The following lists the recommended changes to the status of impairments to beneficial uses which were documented in the 1997 Update Report.

The Recommended Changes in the Status of Beneficial Use Impairments (1997 Update Report)

The 1997 Stage 1 Update identified significant improvement in environmental conditions within the St. Clair River AOC relating to water, sediment and biota quality, as well as loading reductions originating from industrial discharges. Consequently, a change in status was recommended for the following BUIs:

- Tainting of fish and wildlife flavour: "requiring site-specific studies" to "not impaired", based on the results of a subjective olfactory-sensory evaluation of St. Clair River Walleye;
- Bird or animal deformities or reproductive problems : "impaired" to "requires further study on a St. Clair River AOC basis", based on a re-assignment of evidence of chironomid mouthpart deformities to the impairment "degradation of benthos-dynamics of benthic populations/communities";
- Restrictions on drinking water consumption or taste and odour problems: "impaired" to "not impaired" ;
- Added cost to agriculture or industry: "impaired" to "not impaired"

Although Provincial, State and both Federal Agencies recognize the improvements in environmental conditions in the St. Clair River AOC, certain process steps still require action before a redesignation of BUI status is possible. In 1998, a formal binational process for redesignating beneficial use impairments was outlined in a Four Agency Letter of Commitment and signed by Environment Canada, Michigan Department of Environmental Quality, Ontario Ministry of the Environment, and the United States Environmental Protection Agency. The process requires that the local RAP implementation committee(s) recommend a change of status accompanied by a rationale, supporting documentation and data in order to substantiate that the status of the BUI be redesignated. The Four Agency Working Group designates a Technical Review Team to review the request. The lead Agencies will convene a review meeting, at which the implementation committee presents the request for redesignation with supporting data and documentation to the Technical Review Team. The meeting shall be open to the RAP committees, interest groups, community members and the general public. The Four Agency Management Team then issues a decision on whether to support the recommendation. This process will ensure that transparency, credibility and scientifically defensible decisions are achieved and consensus attained. Consequently, the abovementioned BUIs must undergo this process before a change in status can be approved.

A summary of the assessment and status of each of the 14 beneficial use impairments up to the 1997 St. Clair River Remedial Action Plan Stage 1 Update is provided in Table 1.

Table 1. Summarized comparison of the 1991 Stage 1 RAP, the 1995 Stage 2- Recommended Plan and the 1997 RAP Stage 1 Update regarding the assessment and status of beneficial use impairments.
Impairment status is defined as impaired (I), not impaired (NI) or requires further assessment on a site specific basis (A) or on a Great Lakes Basin basis (B).

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Restrictions on Fish and Wildlife Consumption			
Restrictions on Fish Consumption *Restrictions on Wildlife Consumption*	"I" Mercury and/or PCBs in fish exceeded Health and Welfare Canada Limits (0.5ug/g). "B" No guidelines are applicable to the St. Clair regarding human consumption of wildlife. Ontario MNR issued warnings with respect to regular consumption of turtle meat from some areas including Walpole Island due to PCBs.	"I" Fish Consumption advisories in effect for Ontario and Michigan for consumption of fish due to mercury, PCBs, dioxins and furans. "B" Elevated concentrations of PCBs in snapping turtles as well as octachlorostyrene, hexachlorobenzene and PCBs in mallards and redheads highlight the need for guidelines for the consumption of wildlife. Warnings on regular consumption of turtle meat.	"I" Fish consumption guidelines are currently in effect for walleye, drum, yellow perch, gizzard shad, blue gill and white sucker. "B" Health Canada advises that consumption of waterfowl poses no health hazards, although additional study of the common merganser in the River and hooded merganser in Lake St. Clair is recommended (CWS 1997).
Tainting of Fish and Wildlife Flavour	"A". Aboriginal traditional knowledge of tainting has been provided by residents of Walpole Island First Nation.	"A". There have been Aboriginal traditional knowledge reports of tainting.	"NI" *(Recommended change in status)* No identifiable tainting in walleye from the St. Clair River as confirmed by a controlled study (Mylloja and Johnson, 1995). Change in status to be further confirmed by results of an angler survey.
Degradation of Fish and Wildlife Populations			
Dynamics of Fish Populations	"NI" The fish community in the River is diverse. A return to an historic fish community structure is not possible. Goals and objectives support the current fish community structure.	"NI" The fish fauna of the River are considered well-balanced. The RAP will assess quantitative fish community goals being prepared by OMNR to determine further improvements.	"NI"
Body Burdens in Fish	"B". Various metals, organic chemicals and other contaminants were found in sport fish exposed to discharges on the Ontario side of the River.	"B" Several contaminants including mercury, PCBs, hexachlorobenzene and octachlorostyrene were found in fish on the Ontario side of the St. Clair delta.	"B"

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Dynamics of Wildlife Populations	**"A"** Waterfowl populations are low due to physical and biological constraints. Use of wetlands by true marsh-dwelling species declined by 79% (spring surveys) and 41% (fall surveys) between 1968 and 1982. Octachlorostyrene in young-of-year shiners downstream of Lambton is greater than the 0.02 ug/g guideline for protection of fish-eating wildlife.	**"A"** Use of wetlands by true marsh-dwelling species declined between 1968 and 1982 due to loss of wetlands. Guidelines for the protection of fish-eating wildlife have been exceeded in shiners, gizzard shad, carp and walleye for PCBs and in shiners for octachlorostyrene. Effects of these exceedences are unknown.	**"A"** Preliminary study of waterfowl and amphibian populations in wetlands indicates no statistically significant differences between AOC and non-AOC sites (4 AOCs including St. Clair compared) except in the case of 2 amphibian species, which were less frequent in AOCs; significant additional study is required (Chabot, 1996).
Body Burdens of Wildlife	"B" Contaminant burdens of some organic compounds have been measured in turtles, muskrats, and ducks on Walpole Island. Non-migratory ducks (mallards and redheads) generally contain higher concentrations of organic chemicals than did migrating individuals. The impact on wildlife is unknown.	"B" Contaminants such organic chemicals and pesticides such as DDT have been found in snapping turtles, muskrats and ducks in the St. Clair Delta. The effects of these chemicals on wildlife are not fully understood. Research on body burdens and associated effects in wildlife is required for the Great Lakes.	**"B"** Contaminants in snapping turtle, mudpuppy, Forster's tern, black-crowned night heron, and herring gull eggs and tissue remain above RAP contaminant yardstick levels for biota (CWS, 1997).
Fish Tumours and Other Deformities	"A" Existing data on external tumours or skin lesions (lymphocytosis and dermal sarcoma) for walleye from the AOC do not suggest a link to anthropogenic factors, but rather natural factors.	"A" There is growing consensus that there is sufficient evidence to suggest liver tumours are caused by chemical factors. For this reason additional studies are required. Results are pending.	"A"
Bird or Animal Deformities or Reproductive Problems	**"I"** An abnormally high number of mouth-part deformities in chironomid species along the Ontario side of the river below the Sarnia industrial complex. No wildlife evidence of reproductive problems or deformities.	**"I"** Mouth part anomalies occur in some chironomid species but no evidence of bird or other animal deformities or reproductive problems has been reported.	"A" *(Recommended change in status)* Chironomid mouth-part deformity issues have been moved to "degradation of benthos". Contaminant levels in snapping turtles, terns and mink are not suspected of having reproductive impacts (Martin et al, 2004; Weseloh and Jermyn, unpublished).

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Degradation of Benthos			
Dynamics of Benthic Populations	"I" Benthic community health is good on the Michigan shore. In Ontario, data up to 1985 reveal that community structure is impacted beginning at 7km downstream from the Sarnia industrial complex and the impairment zone extends about 12km. The most severely degraded portion occurred at a 1km reach of the river beginning offshore of Dow Chemical. Bioassay studies undertaken in 1986 identified Cole Drain sediments as acutely lethal to minnows and mayflies.	"I" Benthic community health is good on the Michigan side of the river but, as of 1990, was "degraded" in several short segments along the Ontario shore for about half the distance identified from the 1985 survey. The "severely degraded" zone was not found in the 1990 survey.	"I" An increasing downstream invertebrate diversity density observed, reaching a steady state 20 km downstream of Sarnia; diversity higher in Ontario and densities higher in Michigan. (Harris, 1996). Benthic communities remain moderately to slightly impaired (LIS 1997). Additional studies (Beak int. Inc. 1996) confirm that benthic communities in these zones remain impaired and observed no improvement in these areas since 1985.
Body Burdens in Benthic Organisms	"B" Organic chemical concentrations were elevated in caged mussels exposed to Ontario shoreline discharges during 1986 relative to upstream locations. Uptake greatest between Dow Chemical and Suncor Inc. Contaminant body burdens found in macrobenthos and heavy metals in oligochaetes near Stag Island in 1983. Bioaccumulation of some organic chemicals in mayfly from sediments in 1986. Effects unknown.	"B" Several types of benthic organisms, including native clams, mayflies, aquatic worms (Oligochaetes) have been found to bioaccumulate various organic and inorganic chemicals. The effects of these chemicals on benthic organisms are required for the entire Great Lakes ecosystem.	"B" Chironomids mouthpart deformities require further study on species and contaminant specific dose-response (OMOE, 1997). Bioassay and sediment toxicity studies report contaminant levels above RAP yardsticks and PSQG lower and severe effect levels in priority 1 zones downstream of Sarnia industrial area (LIS 1997). Mortality, growth, and reproduction were adversely impacted.

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Restrictions on Dredging Activities	"I" Concentrations of certain metals, total PCBs, total Phosphorus, and oil/grease along the Ontario shoreline exceed PSQG and/or U.S.EPA guidelines for the Open Water Disposal of Great Lakes Harbour Sediments. Most exceedences occur along the Sarnia industrial waterfront to the Lambton Generating Station, and the mouths of Talfourd and Baby Creeks and the Murphy Drain. U.S. EPA guidelines for disposal of harbour sediments were exceeded for oil, grease, and certain metals.	"I" Similar to what was described in the Stage 1 document. Concentrations of total Kjeldahl nitrogen, oil and grease, and metals from the Michigan shore are considered moderately or heavily polluted by U.S. EPA guidelines and exceed OMOEE disposal guidelines of PSQG.	"I" Contaminant levels in sediment from Sarnia Harbour and the southeast bend cutoff channel in March 1996 exceeded RAP yardstick levels and PSQG lowest effect levels (Ecologistics Limited, 1996). Contaminant levels above sediment yardstick values continue to be recorded for certain metals total PCBs, total PAHs, TKN, total Phosphorus, and oil and grease.
Eutrophication or Undesirable Algae	"NI" Little work has been done on smaller phytoplankton; larger species are typical of oligotrophic waters.	"NI" The waters of the St. Clair river are mesotrophic and algae do not occur at nuisance levels.	"NI"
Restrictions on Drinking Water Consumption or Taste and Odour Problems			
Consumption	"I" Numerous closures have been reported for the Wallaceburg and Walpole Island WTPs and the City of Marysville, East China Township, Marine City, Algonac, and Old Club Water Filtration Plants in Michigan. Spill-related closures of WT/WF plants in Ontario and Michigan increase the costs to municipalities.	"I" Periodic closing of WT/WF plants in Michigan and Ontario as a result of chemical spills at upstream locations.	" NI" *(Recommended change in status)* There have been no OMOE-issued drinking water advisories or water treatment plant shutdowns on the SCR since November of 1994 (OMOEE, 1997). Similarly, there have been no mandatory plant closures issued by the Michigan department of Environmental Quality "for the last several years" (MDEQ, 1997).

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Taste and Odour	"I" Elevated heterotrophic bacterial populations in the river water and sediments may adversely affect drinking water via taste and odour problems (OMOEE, 1990). The 1990 spill of ethylbenzene from Dow exceeded the Health and Welfare Canada objective for taste and odour at the Wallaceburg intake. Wallaceburg WWTP closures during chemical spills are associated with taste and odour.	"I" The Health and Welfare Canada taste and odour aesthetic objective for taste and odour for ethylbenzene was exceeded at the Wallaceburg WWTP during start-up following a spill in October 1990. Closures of the Wallaceburg WWTP intakes based on level II responses are based on factors including taste and odour concerns.	" NI" *(Recommended change in status)* The delisting criteria are as that for the consumption impairment; there have been no water treatment plant shutdowns along the river since 1994.
Beach Closings	"I" Swimming advisories lasting up to two months in duration were placed on at least five bathing areas on the Ontario side of the SCR during 1990 due to bacterial contamination in excess of the PWQO of 100 fecal coliforms/100ml. There are no reports of beach closings in Michigan.	"I" No beach closings occurred in Michigan in 1992-93, but several in 1994. Areas downstream of Michigan CSOs are impaired due to periodic discharge of inadequately treated sewage. In Ontario, five beaches were closed in 1990 for up to two months due to coliform bacteria levels which exceeded both Ontario and Michigan standards. Caution signs have been posted on Ontario beaches along the SCR.	"I" Bacterial levels above the RAP yardstick at several sites between Sarnia and the southern edge of Lambton County, in the mid 1990s, and on the Michigan side from 1993-97 (Harris, 1994; 1995, 1997; St. Clair County, 1997). Clay, Talfourd, Bowen and Baby Creeks are a significant source of contamination to the River, reaching levels above yardstick (LHU-OMOE 1994, 1995; MacKenzie, 1996).
Degradation of Aesthetics	"I" On occasion, floating scums, slicks, periodic spills, and objectionable odours are reported, mainly adjacent to and downstream from Sarnia on the Ontario side.	"I" Floating scums, oil slicks, spills and odours have been periodically reported.	"I" Some of the floating foam on the St. Clair River is bio-geologically derived (F. Kemp, City of Port Huron, personal communication, 1997). Objectionable surface films, foams, etc are still reported.

Use Impairment	1991 Stage 1 RAP	1995 Stage 2- Recommended Plan	1997 RAP Stage 1 Update
Added Cost to Agriculture and Industry	"I" Akzo Salt in Michigan and food processors in Ontario temporarily shut down their water intake from the St. Clair River due to a spills resulting in additional costs. There are also costs related to the confined disposal of contaminated sediments dredged for marine and construction purposes.	"I" Similar to the 1991 Stage 1 report.	" NI" *(Recommended change in status)* There have been no water treatment plant closures or associated interruptions in water supplies to industrial users since 1994 (OMOE 1997; MDEQ, 1997).
Degradation of Phyto and Zooplankton Populations	" NI" Phyto-and zooplankton populations are typical of southern Lake Huron.	" NI" Phyto-and zooplankton populations are typical of southern Lake Huron.	" NI" Phyto-and zooplankton populations are typical of southern Lake Huron.
Loss of Fish and Wildlife Habitat	"I" Wetland loss from Lake St. Clair including portions of the AOC lying within the delta (at least 5,252 ha in Michigan and 1,064 ha in Ontario). Much of the original shoreline has been filled and bulk headed, eliminated and/or altering the littoral zone resulting in loss of fish and wildlife habitat. Present day development pressures continue to threaten and impacts as a consequence of sediment quality issues have not been well documented. Fish and wildlife management goals are needed to help determine the degree of impairment and guide rehabilitation strategies.	"I" Habitat has been lost due to filling, draining, dredging, and bulk heading for industrial, urban, agricultural and navigational uses. Significant losses of wetlands have occurred particularly in the delta region of the AOC.	"I" Restoration targets have not been fully accomplished. There have been reports of clearing/draining of marsh and woodland by private landowners (Kanter, 1996).

2.2 Progress Report Data Coverage

The current "St. Clair River AOC-RAP Progress Report" consists of two parts, this Synthesis Volume (Volume 1) and an accompanying Technical Addendum (Volume 2). Together, these volumes provide an update on data and other information relating to progress toward the delisting of the St. Clair River and its major tributaries as an "Area of Concern". The data and information summarized in this Progress Report represent the period from the 1997 Stage 1 Update through to 2003, with some data extending back before 1997.

Information on industrial implementation actions for both Ontario and Michigan include the period from the last update report (1997) through 2003.

The point source effluent loadings data for Ontario represent the period from as far back as 1995 to 2001. Information pertaining to compliance of municipal and industrial sources in Michigan relates to the period up to and including 1999. In Ontario, the most recent compliance information (MISA) is for 2001.

Information on biota quality consists principally of data from Canadian Wildlife Service (CWS) studies conducted on snapping turtles, terns and mink in the St. Clair Delta during the 1990s and more recently in 2001. Tissue contaminant concentrations for walleye and white sucker were provided by the Ontario Ministry of the Environment. The 2003/2004 Guide to Eating Ontario Sport Fish and the 2001 Michigan Fish Advisory pamphlets were referenced for consumption advisories on sport fish species.

The sediment quality section includes some dredge spoil analyses from samples collected in the South East Bend Cutoff Channel in the Delta in 2000, and the 2001 OMOE St. Clair River sediment core data. The recent removal of contaminated bottom sediments offshore from Dow Chemical Canada Inc. is one of the major steps taken in remediation of the highly contaminated sediment zones offshore of the Sarnia Industrial Complex. Environment Canada spatial data on mercury and PCB concentrations in suspended and bottom sediments is provided for the entire Huron-Erie Corridor.

Water quality data includes results from Environment Canada's on-going head (Point Edward) and mouth (Port Lambton) surveys up to the year 2001 and ambient water quality data from the Michigan Department of Environmental Quality (MDEQ). The Sarnia-Lambton Environmental Association (SLEA, formerly Lambton Industrial Society) provided data for the on-going automated volatiles monitoring program for years 1997 through 2001. Spills data from Ontario Ministry of the Environment Spills Action Centre (SAC) are updated to 2002 with reference to the largest spills in 2003 and 2004.

Air Quality data include emissions data from Canada's National Pollutant Release Inventory (NPRI) and the ambient air monitoring results as reported by the Sarnia-Lambton Environmental Association. U.S. Toxic Release Inventory information for Michigan is also provided.

3.0 OVERVIEW OF THE ST. CLAIR RIVER AREA OF CONCERN

The St. Clair River serves as a strait connecting Lake Huron with Lake St. Clair. It flows in a southerly direction from Lake Huron and, prior to entering Lake St. Clair, the River divides into several channels creating an extensive delta known as the St. Clair Delta or St. Clair Flats. The Area of Concern (AOC) is comprised of a unique ecosystem with some of the richest and most diverse wetlands in the entire Great Lakes basin. The Stage 1 Remedial Action Plan defined the AOC as the entire river from the Blue Water Bridge to the southern tip of Seaway Island, west to St. John's Marsh and east to include the north shore of Mitchell's Bay on Lake St. Clair. This area encompasses Walpole Island First Nation's Territory, which is comprised of St. Anne Island, Walpole Island, Pottawatomie Island, Squirrel Island, Bassett Island, and Seaway Island, which is a man-made island created from dredge spoils. Dickinson Island and Harsens Island are located on the U.S. side of the Delta.

The Stage 2 Recommended Plan for the St. Clair River RAP identified the need to expand the scope of the RAP to encompass the immediate drainage basin of the St. Clair River in order to more comprehensively address the environmental problems defined in the Stage 1 RAP. For purposes of the RAP, the Stage 2 Recommended Plan broadened the study area to include St. Clair County in Michigan and the watershed areas of several tributary creeks on the Ontario side (Figure 1). The municipalities and major point source dischargers in Ontario and Michigan are illustrated in Figure 2.

In Ontario, 78% of the immediate drainage area of the St. Clair AOC is agricultural and in Michigan, 68% is dedicated to agriculture. While urban areas such as Sarnia and Port Huron are home to a large number of people, a significant portion of the population remains in rural areas. A relatively small portion of the land bordering the St. Clair River is forested. There is a concentration of industry in the upper portion of the River between Lake Huron and Fawn Island, including petroleum refineries, organic and inorganic chemical manufacturers, paper companies, salt producers and thermal electric generating facilities. Two First Nations are situated along the Canadian shore – the Aamjiwaang First Nation (formerly referred to as the Chippewas of Sarnia) and the Walpole Island First Nation.

The St. Clair River serves as a shipping channel for a number of industries and the broader Great Lakes Seaway system. It is also a source of cooling and process water for industry and thermal generating stations. It serves as drinking water for a population of approximately 170,000. The wetlands and associated open waters of the lower St. Clair River and Lake St. Clair comprise one of the most important wetland areas in the Great Lakes Region . The AOC supports 91 fish species, 20 species of amphibians, 25 species of reptiles, 250 species of birds and 60 mammal species (Stage 2 RAP Report). Currently, commercial fishing within the St. Clair River is considered negligible. Sport fishing, however, is popular on the St. Clair River, and hunting and trapping are significant uses, particularly for First Nations people living on the River. The River also supports a number of parks and areas affording recreational opportunities including swimming, boating and naturalist activities.

Figure 1. The St. Clair River Area of Concern comprised by the river proper, Walpole Island First Nation Territory, and United States and Canadian watershed basins.

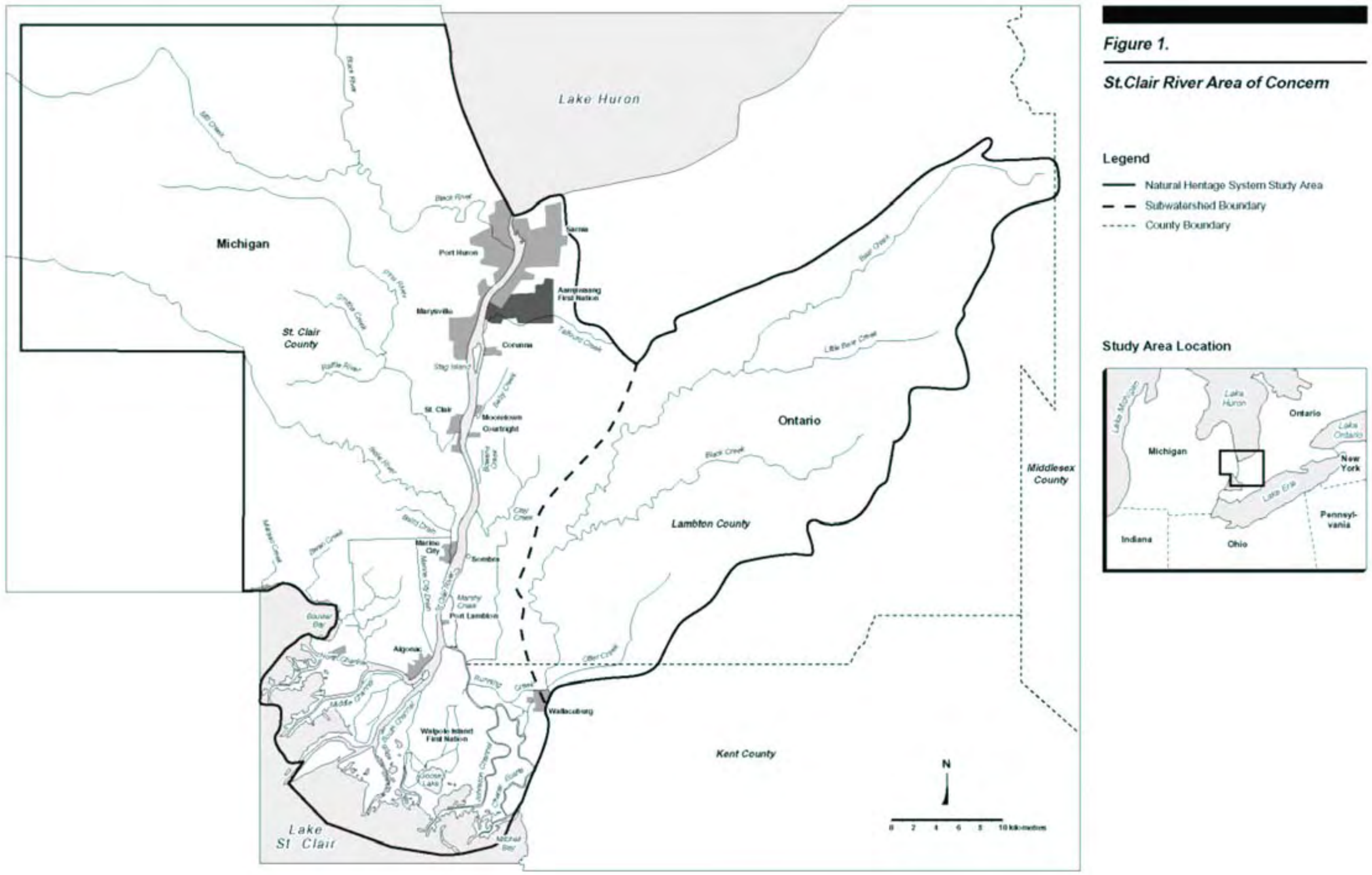
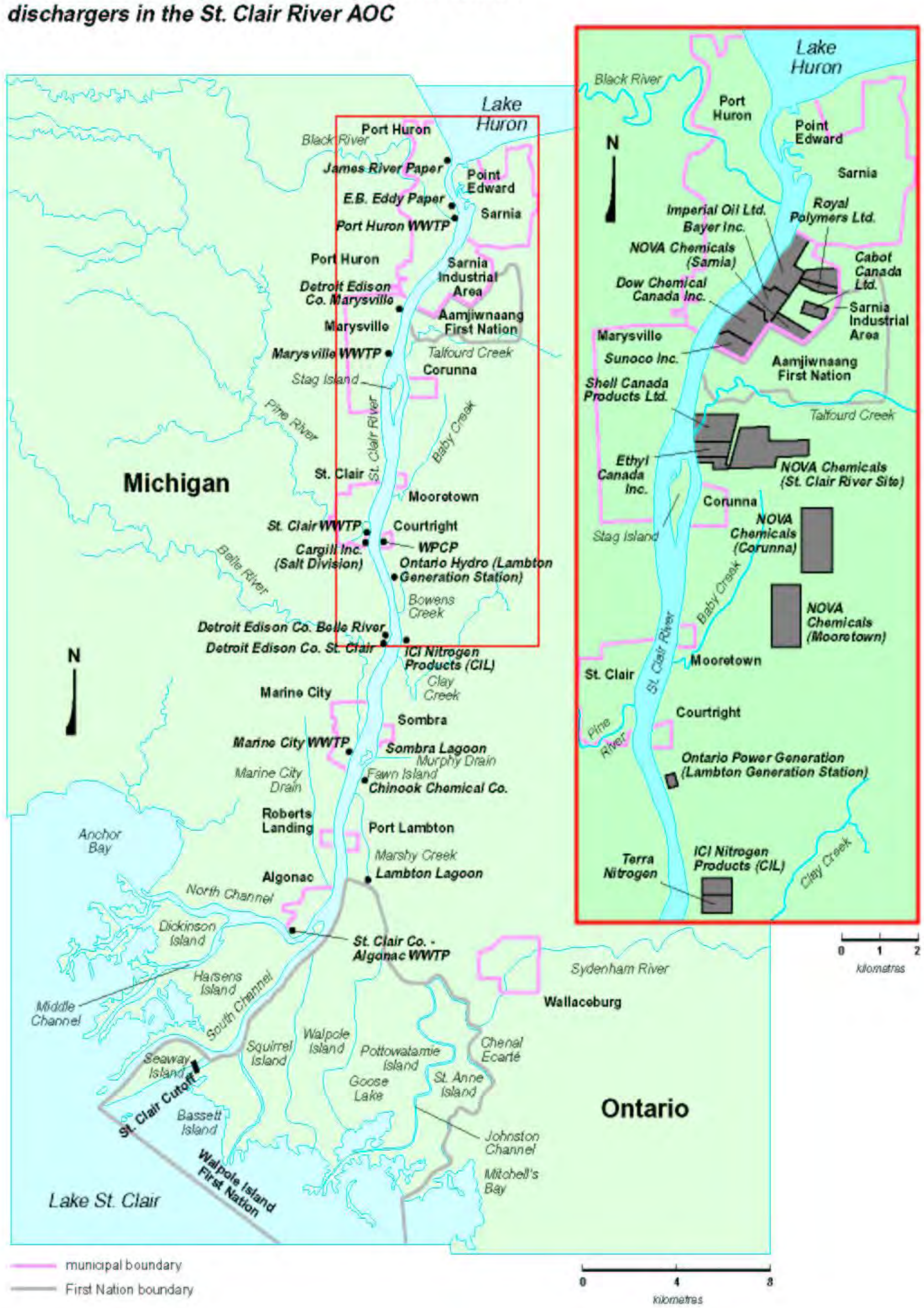


Figure 2. Location of municipalities and major point source dischargers in the St. Clair River AOC.

Figure 2

Location of municipalities and major point source dischargers in the St. Clair River AOC



4.0 OVERVIEW OF THE ST. CLAIR RIVER MANAGEMENT PROCESSES

The United States and Canada have pledged their cooperation to restore the shared upper connecting channel AOCs and Lake St. Clair under the terms of the Great Lakes Water Quality Agreement (GLWQA). The following section provides information on the Binational Governance Structure under the Four Agency Letter of Commitment that was signed on April 17, 1998, by Environment Canada, Michigan Department of Environmental Quality, Ontario Ministry of the Environment, and the United States Environmental Protection Agency.

4.1 Four Agency Framework of Roles and Responsibilities

The Letter of Commitment identifies the roles and responsibilities of the Four Agencies for the three shared AOCs (St. Clair River, St. Mary's River and Detroit River), details commitments and strategies and highlights the importance of leadership. Specifically, the Four Agencies will demonstrate their leadership through visibility, by empowering local leadership, by contributing to and facilitating implementation activities by recognizing successes, actively pursuing solutions to problems, helping to define research needs and gaps and facilitating the transfer of information and methodologies.

The Four Agencies have developed a Compendium of Position Papers to explain how commitments made under the Letter of Commitment and the GLWQA will be applied to the shared AOCs. This compendium contains the 1998 Four Agency Letter of Commitment, the position papers, and the appendices (Compendium of Position Papers, 2000).

The following administrative roles and responsibilities detail the commitments of the Four Agencies, while recognizing the national, provincial and state regulatory systems already in place.

- Individual agencies will focus their existing and new programs and resources to restore the shared Areas of Concern (AOCs) and will encourage other organizations to do likewise.
- To achieve the goals outlined in each shared AOC, the Four Agencies will cooperate on issues such as:
    - data sharing and consistency
    - promoting standardization of environmental criteria
    - binational delisting criteria – including a binational process for delisting and a peer review of the redesignation of beneficial uses and delisting of an AOC. This will ensure that the process is credible and scientifically defensible.
    - monitoring – coordinate monitoring programs to maximize consistency and effectiveness, facilitate monitoring efforts to establish baseline conditions and track progress toward the restoration of beneficial uses.
    - public involvement – maintain public interest in and awareness of local environmental quality issues, provide a continuing basis for broader community support for RAP implementation, and facilitate funding and partnership opportunities to restore AOCs.
    - research
    - reporting progress – progress reports will focus on progress in implementation, update technical information, assess progress towards achieving the delisting criteria, as well as highlighting progress towards achieving priorities.
    - pooling resources

4.2 Four Agency Letter of Commitment Structure

To facilitate cooperation, the Four Agencies established a Four Agency Management Committee to ensure that the RAP proceeds in a timely, consistent manner and binational tasks are completed. A Four Agency Working Group ensures that technical issues are addressed, disputes are mediated, that state, provincial and federal resources are coordinated among the shared AOCs and that progress reports are issued in a timely manner. Ad-Hoc Technical Teams resolve technical issues and review RAP documents.

The roles and responsibilities of the Four Agencies involve working in conjunction with stakeholders and lead agencies on activities such as:

- preparation, printing and distribution of Progress Reports;
- support for and convening the biennial meeting;
- binational communication;
- binational public involvement and outreach;
- coordinating development and review of binational delisting criteria, and
- coordinating and facilitating monitoring to track progress toward delisting..

4.3 Role of Binational Public Advisory Council (BPAC)

The BPAC continues to schedule regular meetings and functions to audit the implementation of the RAP, evaluate progress towards goals, objectives, and delisting, review the environmental monitoring results, provide advice on priorities and directions to the RAP Implementation Committee and its subcommittees, and to issue reports to the public which assesses progress on the RAP. This committee includes representatives from each of the sectors and a representative from the First Nations.

4.4 Remedial Action Plan (RAP) Implementation Structure

The overall strategy for implementation of the St. Clair River RAP is to have recommended actions carried out directly by agencies, facilities, other organizations involved in development of the RAP and/or committed to specific actions, and the general public. To do this, a RAP Implementation Committees (RIC) will be established to complement the already existing BPAC. The RAP Implementation Committee will function as the focal point for coordination and implementation of the remaining actions in the St. Clair River AOC.

The RAP Implementation Committee will:

- coordinate and facilitate RAP implementation activities, update problem definitions and restoration of impaired beneficial uses;
- initiate and respond to monitoring and research results/activities;
- undertake data assessment and make remedial decisions/recommendations;
- track progress and schedules relating to implementing remedial actions;
- undertake educational activities;
- produce short biennial reports, including update of problems, progress of remedial actions, further recommendations, progress towards goals and objectives;
- review and track agency programs, activities, regulations, and lobby, accordingly;
- coordinative activities with all parties responsible for remediation, agencies and other stakeholders, and
- provide meeting minutes, data, updates, etc. to the BPAC and 4 Agency Management Committee regularly and upon request.

5.0 SUMMARY OF RAP IMPLEMENTATION MEASURES TO 2003

This section summarizes the actions taken by Industry, agencies and municipalities to further restore the BUIs within the St. Clair River AOC as outlined in the 1995 Stage 2 - Recommended Plan and the 1997 Stage 1 Update. The information is presented according to point source (industrial and municipal) and sediment/habitat actions, with Ontario listed first followed by actions in Michigan.

5.1 Industrial Point Source

Numerous Ontario and Michigan industries have implemented measures that address the recommended point source actions as detailed in the 1995 Stage 2 Recommended Plan. These actions include: reduced air emissions; significant upgrades to facilities; sophisticated monitoring systems; Environmental Management Systems; installation of River Separation Programs; and improved control over process water. Appendix 1 provides greater detail on the following Ontario and Michigan industries:

ONTARIO: Basell Canada Inc. (formerly Montell Canada Inc.), Ontario LANXESS Inc. (formerly Bayer.), Cabot Canada Ltd., Dow Chemical Canada Inc., DuPont Canada Inc., Ethyl Canada Inc., Fibrex Insulation Inc., Imperial Oil Ltd., Ontario Power Generation Lambton Generating Station., NOVA Chemicals, Shell Canada Products, Sunoco Inc., and Terra Nitrogen.

MICHIGAN: Crown Paper-Port Huron, Cargill Salt, Domtar (formerly E.B. Eddy), DECO St. Clair Plant, Marysville and Belle River.

5.2 Municipal Point Source

ONTARIO

Water Pollution Control Plants (WPCPs) in Ontario which discharge directly to the St. Clair River AOC are the Point Edward, Sarnia, Corunna and Courtright facilities. The Sombra and Port Lambton Lagoons also discharge treated sewage into the St. Clair River. Current updates on infrastructure improvements, plant upgrades, and improved operating practices are required for these plants. Data on effluent quality is also required for a full assessment of any improvements and to assess the biological, metallic and organic pollutant load to the River.

City of Sarnia

In 1997, the City of Sarnia replaced the Devine St. and Wellington St. combined sewer overflows (CSOs) with holding tanks to allow containment of runoff from most storm events for routing through the Sewage Treatment Plant (STP). In 2001, the City completed $30 million in STP upgrades to secondary treatment and upgrades and retrofitting of storm water management infrastructure are on-going. Current plans are in-place to replace two CSOs (Cromwell and Exmouth Streets) and are waiting funding. Future project includes installing sanitary sewers on Exmouth Street, East Street, Nelson Street and Collingwood Avenue, installing storm sewers on East Street and Nelson Street, installing a sanitary forcemain along Exmouth Street, and replacing watermains on Exmouth Street, East Street and Collingwood Avenue.

Township of St. Clair

The Township of St. Clair (formerly the townships of Moore and Sombra) located in the County of Lambton also completed a sewage collection system with primary treatment. Investments made under the Canada-Ontario Municipal Rural Infrastructure Fund (COMRIF), are expected to improve wastewater infrastructure. Work includes improvements to the plants raw water pumping station, pre-treatment facility, aeration tanks and blowers, ultra-violet disinfection system and dewatering facilities.

MICHIGAN

There are five major Waste Water Treatment Plants (WWTPs) discharging to the St. Clair River form Michigan. These include the Port Huron, Marysville, St. Clair, Marine City and St. Clair County-Algonac WWTPs.

City of Port Huron

In 1995, Port Huron replaced and upgraded the computer control system in the WWTP and the outfall was deflected up off the bottom to reduce toxicity. In 1996, the City initiated a $185 million project involving accelerated sewer separation, water distribution and lift stations. As of 1996, 57% of the City had full sewer separation between storm sewers and sanitary sewers. The WWTP facility installed two rotary screen thickeners in 1998, and subsequent to December 1, 1999, a new National Pollutant Discharge Elimination System (NPDES) permit required only monitoring for copper and zinc without setting discharge limits. By the end of 2001, five CSOs had been eliminated, with projected reductions in annual flows to the river down from 309 to 163 million U.S. gallons. The WWTP is currently undergoing $10 million in upgrades (over 5 to 6 years) which will include an additional 4 million gallon capacity to sludge storage tanks, which will replace sludge incineration with land application. Upgrades for the grit handling system and new odor control equipment are also being installed.

City of Marysville

The City WWTP installed variable frequency drives in the raw sewage and the re-circulation pump area. Programmable logic controls were installed in the raw sewage pump control system and the re-circulation pump control system for the WWTP. In 2000, the WWTP was converted from chlorine gas to sodium hypochlorite in order to reduce the risk of accidental release to the community and environment. Additional upgrades to the WWTP are planned over the next 5 to 20 years, including the addition of underground sludge storage capacity and additional treatment units (primary clarifier, trickling filter and secondary clarifier). The WWTP underwent a sewer separation project. This resulted in the elimination of untreated combined sewage discharge from three outfalls to the St. Clair River.

City of St. Clair

In 1996, the City of St. Clair completed a sewer separation project resulting in the elimination of untreated combined sewage discharge from 12 outfalls to the St. Clair River. Raw sewage pumps and controls were upgraded in 2001 and a sewer system evaluation survey was completed. The City replaced the Spring Street Pump Station with a higher capacity unit, and in 2002-03, added a 3.0 million gallon detention tank and an additional relief sewer and wet weather pumping station.

Marine City WWTP

In 1992, a new secondary treatment facility with a concentric ring oxidation ditch with sludge thickening tanks went on-line for half of the plant; the remainder went on-line in 1993. The WWTP was converted from chlorine gas to liquid sodium hypochlorite in order to reduce the risk of accidental release to the community and environment.

St. Clair River SA WWTP (East China/China Twp.)

Chlorine gas was replaced with liquid sodium hypochlorite in order to reduce the risk of accidental release to the community and environment. The Township also replaced most CSOs with retention tanks.

St. Clair County WWTP

A total of $2.0 million U.S. was spent on improvements in 2000, including the extension of a 700 ft outfall into the main channel of the St. Clair River to provide adequate discharge mixing to meet water quality standards. The WWTP increased capacity and redesigned and reconstructed two main interceptor lift stations with increased capacity. In 2002, over $800,000 U.S. in upgrades were implemented, including construction of an additional 1.1 million gallon sludge storage tank and installation of emergency generators for interceptor lift stations. In 2003, a secondary treatment system was changed to a trickling filter process with added capacity ($2.7 million U.S.).

5.3 Non-Point Source/Habitat Actions

Non-point source (NPS) pollution and habitat restoration programs are discussed jointly as these programs are funded and reported jointly and certain NPS programs also address habitat issues (i.e., riparian buffers). Actions related to terrestrial habitat restoration include ecological restoration of public and private lands through planting of native species, the purchase of degraded and natural habitats by public agencies and improvements to tributaries via naturalization and bank stabilization. Such actions have been the focus in the AOC since the release of the 1997 Update Report. The loss of aquatic and terrestrial habitat in the AOC is a key Beneficial Use Impairment with little or no improvement up to 1997. However, today successful stewardship programs for the restoration of terrestrial habitat, supported by both private and public funds, are active in Ontario. Much less information is available for Michigan non-point source control and habitat restoration programs and this gap in knowledge requires updating.

ONTARIO

In Ontario, much of the NPS and habitat improvement work has been performed by the Rural Lambton Stewardship Network (RLSN) and the St. Clair Region Conservation Authority (SCRCA) through funding from Environment Canada’s Great Lakes Sustainability Fund (formerly the Great Lakes Clean-up Fund) and from Dow Chemical Canada Inc.

The RLSN has been active since 1999 in soliciting projects from local landowners. Proposed projects are reviewed by a committee of the St. Clair Stewardship Initiative which includes representatives of landowners, the Ontario Ministry of Natural Resources and the Conservation Authority. Habitat and non-point source control projects are funded 50% and 30%; the landowner contributes the remaining funds.

Non-point source control projects funded to date include the conversion of leaking septic systems to bio-filter systems, proper manure storage, fencing of streams to prohibit livestock use, conservation tillage, soil testing, benthic monitoring (tributary streams), and conversion of road and drain sides to natural corridors using native and prairie species.

Wetland rehabilitation/enhancement, tree planting, riparian, prairie/meadow and forest habitat restoration and protection have been a major focus in priority areas of the watershed. Between 1990 and 2000, the Great Lakes Sustainability Fund has funded a total of 26 projects within the Ontario side of the AOC for a total of $1,382,580.00 (CDN). This value includes approximately CDN$345,000 in support funding to the St. Clair Stewardship Initiative. By the end of the 2002/2003 fiscal year, the following estimates in habitat-related projects had been achieved:

- Wetland rehabilitation (40.3 ha; 99.6 acres)
- Prairie/meadow (77.1; 190.52 acres)
- Forest Habitat (50.0 ha; 123.5 acres)
- Riparian habitat (42.4; 104.8 acres)

One of the largest projects funded through the Great Lakes Sustainability Fund is the McKeough Floodway Naturalization project. The floodway consists of a 610m earthen dam and a 7 km long by 68 m wide channel. The St. Clair Region Conservation Authority is converting land least suitable for agriculture to different types of wildlife habitat, including upland deciduous forest, Tallgrass Prairie, wetland, and old field. Although the project takes its name from the McKeough Floodway, planting has also been done on nearby public and private lands. The rehabilitation of 445 hectares (1,100 acres) of the Darcy McKeough Floodway is scheduled as one of the delisting criteria in the Stage 2 Recommended Plan for the restoration of “loss of fish and wildlife habitat”. At the end of 2003, a total of 135 ha (333 acres) were restored or enhanced at a cost of $291,300 CDN.

Bickford Oak Woods in Lambton County, also known as Clay Creek Woodland, is a 308 ha (761 acres) Clay Plain upland/lowland forest complex with scattered wetland pockets representing swamp and slough characteristics. The woodland provides critical interior forest habitat for a diversity of Carolinian flora and fauna, some of which are rare and endangered. The Nature Conservancy of Canada and the Ontario Ministry of Natural Resources, with funding support from several partners (including the St. Clair River RAP) and individuals acquired this site in 2002. The purchase and long-term management of the Bickford Oak Woods will ensure that this habitat is protected in perpetuity.

In 1999/2000, the Canada Wildlife Service, Ontario Ministry of Natural Resources and Ducks Unlimited Canada as lead agencies in the Eastern Habitat Joint Venture partnership, were instrumental in protecting 67.9 ha (168 acres) of wetland adjacent to the Chenal Ecarté and the CWS Bear Creek lands. Approximately 23.8 ha (59 acres) were already dyked and managed as wetland but required significant restoration work. The purchase also included 44.1 ha (109 acres) of farmed land. Of the farmed land, 25.1 ha (62 acres) land has been restored as managed wetland and much of the balance is planted with native grasses and used as a nursery for native grass seed production. The CWS owns the land and the lead partners cooperate on management issues. Restoration of this property was completed in 2001.

Cooperative wildlife habitat initiatives with Industries have also been a focus, including the restoration of 3 ha of prairie at the Lambton Generating Station in 1998 (Ontario Power Generation). Dow Chemical Canada Inc. constructed new wetlands adjacent to Talfourd Creek. Clean clay fill was required to cap their Scott Road Landfill site. Rather than scraping soil from various sites, Dow employees, working with environmental consultants, designed an artificial wetland consisting of deep and shallow water areas and upland islands. Water is directed to the complex from Talfourd Creek and the filtered overflow water is redirected to the creek from the wetlands. The area has successfully attracted a wide range of wildlife including nesting birds, ducks, geese, turtles, raptors, and small mammals.

Additional restoration activities undertaken in the AOC include: 8 ha (19.7 acres) tallgrass prairie restoration on Stag Island in1998/99 (also one of the delisting criteria in the Stage 2 Recommended Plan); 8 ha (19.7 acres) of re-naturalization along utility and rail corridors in the City of Sarnia (Wellington Prairie Project); forest, wetland and prairie restoration on 13.2 ha (32.6 acres) along County Road 31(Wilkesport Habitat Restoration); and a 9 ha (22.2 acres) restoration of a formerly drained wetland in the City of Sarnia (Brigden Road Wet Meadow).

MICHIGAN

There have also been actions that have addressed the loss of habitat in the Michigan portion of the AOC. These have been conducted under the auspices of the St. Clair Waterways for Wildlife Project, Friends of St. Clair River, and the St. Clair County Drain Commissioner's office.

The Waterways for Wildlife Project has worked to coordinate wildlife habitat enhancement, restoration and protection activities on private lands in both the U.S. and Canada since 1995. Efforts include organizing workshops, coordinating River Day activities, assisting schools with naturalization projects, facilitating partnerships to conduct habitat enhancement activities and organizing the Environmental Stewardship Awards recognizing outstanding habitat enhancement projects. Specific projects within the AOC include:

- Purchase of the Pine River Nature Center property in December 1998 includes over 32 ha (80 acres) of habitat along the Pine River. The project received a US$25,000 grant from the EPA to write a wildlife habitat management plan, conduct a plant and animal inventory, design and layout nature trails and prioritize stream banks for protection.
- Palms Elementary School in Fair Haven, restored 2.8 ha (7 acres) of tall grass prairie in 1999 (~US$2,000).
- Restoration of 12.1 ha (30 acres) of prairie at St. John's Marsh in partnership with the MDNR and EPA's Coastal Environmental Management Program completed in 1999 (~US$20,000).
- Designation of Indian Trail Park preserves over 12.1 ha (30 acres) of habitat in East China Township.
- BP St. Clair created a 2.0 ha (5 acres) wetland at its St. Clair terminal in partnership with the US Fish and Wildlife Service and Ducks Unlimited Canada.

The Friends of St. Clair is a volunteer organization developed to promote conservation, beautification and other environmental activities including assisting in the development and implementation of the St. Clair River RAP. A Steering Committee was formed in 1999 to administer a US$30,000 grant from the United States Environmental Protection Agency's Coastal Environmental Management program. The committee received grant applications from 24 land owners to undertake nine projects. A total of US$25,000 has been allocated to these projects which have a total value of over US$70,000. Projects include the installation of four experimental wetland septic systems, three stream bank erosion control projects, development of a conservation buffer and wetland enlargement around a failing pond, and dike stabilization and water control measures to mitigate declining water levels in a marsh. The latter project was undertaken in Kent County in Ontario.

The Blue Water Task Force on Water Quality was formed in 1998 to address beach closings and other water quality problems in St. Clair County. It was a collaboration of county agencies, civic leaders and citizens, inspired by Macomb County's Blue Ribbon Commission for Lake St. Clair. The Task Force was an outgrowth of the Macomb-St. Clair Intercounty Watershed Advisory Group, which began meeting in 1998 to work on water quality problems in Lake St. Clair. In 2001, the Blue Water Task Force disbanded after issuing a "Report and Recommendations". Following one of its recommendations, the St. Clair County Board of Commissioners appointed a permanent Water Quality Board modeled on Macomb County's Water Quality Board.

The Macomb-St. Clair Advisory Group helped initiate a large number of grants from Clean Michigan Initiative and Section 319 federal funds. The following grants were awarded in 2000-2002:

1. Drain Commissioner's Office: $297,629 for Illicit Connection Elimination Project to inspect county drains in the Anchor Bay and Pine River Watersheds to eliminate pollution outfalls (mainly failing septic systems).

2. County Health Department: $297,718 for Illicit Connection Elimination Project to inspect road ditches, natural watercourses and perform enforcement in the same watersheds.
3. County Health Department: $25,000 to monitor St. Clair and Sanilac County beaches.
4. Drain Commissioner's Office: $91,252 to develop an Anchor Bay Watershed Management Plan jointly with Macomb County. The St. Clair River delta on the U.S. side of the AOC was included in the plan.
5. Drain Commissioner's Office: $7,123 for the Mill Creek Volunteer Monitoring Project to study benthic macro-invertebrates in dredged versus natural parts of the creek.
6. Drain Commissioner's Office: $12,500 to study the problem of failing septic systems in the Village of Emmett.
7. Drain Commissioner's Office: $411,329 to design and construct an innovative wetlands wastewater treatment system for the Village of Avoca, which has a combined sewer system that discharges to Mill Creek without any treatment.
8. Drain Commissioner's Office: $28,933 to fix erosion problems caused by cattle in the headwaters of the Pine River Watershed.
9. Drain Commissioner's Office: $125,000 to study the effects of land use and hydrology on erosion and the geomorphology of the Pine River and its tributaries.

In 1997, the St. Clair County Drain Commissioner began working with the MDEQ to improve wetland protection enforcement in the county, which had been relatively weak. In 1999, the MDEQ provided more staff and resources for wetland protection in St. Clair and Macomb Counties.

In 2000, the St. Clair County Metropolitan Planning Commission published a new County Master Plan based on extensive public input. It strongly advocates managing growth to protect the rural character, green corridors, natural features and environmental quality of the county.

In 2001, the St. Clair County Department of Public Works, after an audit by the MDEQ, revived its Soil Erosion and Sedimentation Control program and began devoting several full-time employees to enforcement and permit review.

In 2002, the St. Clair County Health Department hired a full-time Storm Water Permit Coordinator. The Coordinator helped the county apply for a Watershed-Based Voluntary Storm Water Discharge Permit as an optional way to comply with new Federal Clean Water Act Phase II regulations, which require all medium-sized urban municipalities to obtain storm water discharge permits. The coordinator helps county agencies, townships and cities comply with permit requirements that include development of sub-watershed management plans throughout the county, public education programs, illicit connection elimination programs and Storm Water Pollution Prevention Initiatives.

5.4 Implementation Action Progress Summary

The 1995 Stage 2 Recommended Plan identified contaminant sources associated with eight of the nine specific beneficial use impairment categories for the St. Clair River AOC and proposed 45 remedial actions related to water, sediment, biota, air, and habitat that were considered necessary to implement remedial actions leading toward delisting of the AOC. The federal, provincial and state governments supported the goals and objectives set forth and agreed that the recommendations accurately identified the remedial actions necessary for restoring the impaired beneficial uses. The implementation of recommended actions was supported by all stakeholders to enhance the success of remediation and cleanup efforts. It also identified agencies, industries and organizations responsible for the implementation as well as a proposed time frame.

A summary of significant actions taken in the St. Clair River AOC as of mid-2003 and which relate to each of the recommended issues/actions are summarized in Table 2. Actions taken at industrial and municipal point sources are only listed for those facilities which were identified in the Stage 2 document as requiring remedial actions.

The following codes indicate the "implementation status" found in Table 2:

P	partial implementation of remedial measures
C	full implementation of measures and attainment of RAP-identified goals
AA	measures carried out as part of another issue/action, as part of overall pollution reduction strategy, or outside scope of RAP Stage 2 document
D	status as stated in RAP Stage 2 document is questioned
NF	attainment of RAP-identified goals not feasible due to incorrect classification, insufficiently developed technology, excessive cost, or other
NA	not applicable

Table 2. Significant actions, responsible agencies or facilities, proposed completion dates, and implementation status since the 1995 Stage 2 Document.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
POINT SOURCE				
Persistent and Bioaccumulative Substances	Cole Drain; Dow; Ethyl; Corunna WPCP Port Huron WWTP; Sarnia WPCP; St. Clair WWTP	1995 - determine whether meet or exceed yardstick 2000 - meet yardstick 2004 - virtually eliminate from discharge	City Of Port Huron WWTP * (D) City of St. Clair (C) City of St. Clair (P) Nova Chemical Canada Inc. (P) Dow Chemical Canada Inc. (P) Ethyl Canada Inc. (C)	LANXESS Inc. – isolated chemicals from river and diverted process and rainwater to BIOX Cole Drain remediation (C) Dow River – separation project (C) Dow - Scott Road discharge (C) Ethyl - eliminated one wastewater effluent Sarnia WPCP - secondary treatment (C) Port Huron WWTP - upgrades (P) St. Clair WWTP - mercury (P) MISA - control regulations in place for all Ontario industrial sectors.
Persistent, (Potentially Bioaccumulative) Substances	Dow; Ethyl; Corunna WPCP; Imperial Oil Refinery; Novacor (Corunna); Sarnia WPCP; Shell Canada; Suncor	1995 - determine whether meet or exceed yardstick 2000 - meet yardstick at end of pipe	City of St. Clair (C) Shell Canada (Information not available) Suncor Inc. (D, NF) Eso Imperial Oil (NF) Dow Chemical Canada Inc. (P) Ethyl Canada Inc. (C)	LANXESS Inc. – isolated chemicals from river and diverted process and rainwater to BIOX Cole Drain remediation (C) Dow River – separation project (C) Dow - Scott Road discharge (C) Ethyl - eliminated one wastewater effluent. Sarnia WPCP - secondary treatment (C) St. Clair WWTP - Hg minimization (P) MISA - control regulations for all Ontario industrial sectors.
Persistent Parameters (Not Bioaccumulative)	Sarnia WPCP	2000 - meet yardstick at edge of mixing zone	Dow Chemical Canada Inc. (P)	LANXESS Inc. – isolated chemicals from river and diverted process and rainwater to BIOX Sarnia WPCP - secondary treatment (C) MISA - control regulations in place for all Ontario industrial sectors.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Non Persistent, and Non-Bioaccumulative Substances	Ethyl; Imperial Oil Refinery; Marysville WWTP; Polysar; Port Huron WWTP; Sarnia WWTP	2000 - meet yardstick at edge of mixing zone	Shell Canada Products Limited (C) Esso Imperial Oil (C) Chinook Group (C) Dow Chemical Canada Inc. (P) Ethyl Canada Inc. (P) LANXESS Inc. (C) LANXESS Inc. (NF)	Ethyl - eliminated 1 wastewater effluent stream. MISA - control regulations in place for all Ontario industrial sectors.
Source Discharges of Coliform Bacteria	MDNR (CSOs). All WPCP & WWTP; Municipalities	2005 - 50% reduction from Sarnia WPCP 2000 - all WPCP/WWTP effluents disinfected 2005 - completely eliminate from Sarnia WPCP	City of St. Clair * (P) Sombra Township (P) Government of Canada (AA)	Sarnia WPCP – secondary treatment (C) Sarnia WPCP - improved storm water management system (P) St. Clair Township – Sewage collection and primary treatment extended to Township.
CSO Elimination	Port Huron; Marysville; Sarnia	2001 - Marysville 2005 - Port Huron and Sarnia	City of Sarnia WPCP (P) City of Port Huron WWTP (P) City of St. Clair (P) Suncor Inc. (AA) Montell Canada Inc. (C) Fibrex Insulation Inc. (P) City of Marysville (P) Government of Canada (AA)	Sarnia – two of four CSOs replaced Port Huron – five of 19 CSOs eliminated St. Clair – sewer separation has eliminated combined outflows to 12. Marysville - sewer separation has eliminated combined outflows to 3. St. Clair County Storm Water Permit Coordinator to facilitate county agencies, townships and cities comply with permit under Federal Clean Water Act Phase II regulations.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Point Source Discharges to Air	RIC; All Sources; EPA	1994/95 - Inventory of atmospheric releases for all yardstick substances 1996 - develop means to define impacts	Esso Imperial Oil (C) Montell Canada Inc. (C) Detroit Edison (P) Lambton Gen. Station (C) Crown Vantage Mill (AA) Shell Canada Ltd. (AA) Amoco Canada Petroleum Ltd. (AA) Suncor Inc. (AA) Laidlaw Environmental Services (AA) DOW Chemical Inc. (AA) LANXESS Inc. (AA) Fibrex Insulations Inc. (AA) E.B. Eddy Paper Inc. (AA)	In 2001, Imperial Oil Products and Chemicals division, Sarnia Refinery, and Suncor Inc. (Sunoco Division) exceeded the legal allowable limits for hydrogen sulphide and gaseous Fluorides respectively. In 2002, there were no non-compliant facilities in the area.
Eliminate Spills	All point sources	2000	All facilities (C) Government of Canada (AA)	Spill prevention and containment actions have reduced the spill frequency in the AOC. However, spills to the River have not been eliminated and two Sarnia area companies were fined in 2005 as the result of spills to the St. Clair River in 2003 and 2004. (P)
Pollution Prevention/Toxics Release Plan	All point sources not meeting yardsticks	December 1995	City of Sarnia WPCP (P) Esso Imperial Oil Other pollution abatement measures undertaken by: Shell Canada Products Limited; Suncor Inc.; Chinook Group; Dupont Canada Inc.; Montell Canada Inc.; Ethyl Canada Inc.; LANXESS Inc.; Fibrex Insulations Inc.; E.B. Eddy Paper Inc.; Lambton Gen. Station; Detroit Edison; Townships of Dover, Sombra; Lambton County (C)	The City of Sarnia has developed a comprehensive pollution prevention and control strategy that will reduce loads to the Sarnia waterfront and the St. Clair River from municipal outfalls.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Setting new yardsticks and adjusting existing	MNDR; OMOEE	ongoing	No Action	Existing yardsticks continue to be utilized and require updating
Develop discharge permits on the basis of discharges already approved or under application and assess total mass loadings to the river.	MNDR; OMOEE	ongoing	Crown Vantage Mill (C)	MISA monitoring guidelines in place for all Ontario point sources Mass loading calculations not complete
Develop whole plant permitting system	MNDR; OMOEE	1994 and ongoing	No Action	Information not available
Elimination of discharges/ leachate to Cole Drain	All relevant point sources	2004	Amoco Canada Petroleum Limited (P) Dow Chemical Canada Inc. (P) Fiberglass Canada (P) LANXESS Inc. (P)	Cole Drain remediation (C)
Small business toxic reduction education	MNDR; OMOEE, Environment Canada	1993 and ongoing	NIL	Education programs have been conducted in the AOC although small businesses were not specifically targeted. (P)
Assess storm water impacts	All facilities; MDNR; EPA	1997/99 - Ontario 1995/96 - Michigan	City of Sarnia WPCP (NIL) Esso Imperial Oil (AA) ICI Canada Inc. (AA) E.B. Eddy Paper Inc. (AA) Lambton Generating Station (C) Detroit Edison (Marysville, St. Clair, Belle River Plants) (C) *	Storm water at industrial facilities has been assessed as part of the spill containment and prevention program.
Zero discharge	All point sources	To be determined - ongoing	Crown Vantage Mill (NF) Esso Imperial Oil (C) Cabot Canada Inc. (P) ICI Canada Inc. (C) E.B. Eddy Paper Inc. (NF) Lambton Generating Station (p) Detroit Edison (Marysville, St. Clair, Belle River Plants) (NF)	Not achieved; however, declining concentrations and load reductions of numerous contaminants at facilities due to improved source controls.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
NON-POINT SOURCE				
Watershed/Subwatershed Management Plans	MDNR; OMOE; OMNR; EPA; Environment Canada	1997-Draft Ontario and Michigan watershed plans	RIC Non-Point Source Steering Committee, Watershed Improvement Plan	Habitat management, stormwater control, septic upgrades and agricultural programs are ongoing in Lambton County. St. Clair County -Storm Water Permit Coordinator to help county agencies, townships and cities comply with permit requirements that include development of sub-watershed management plans. St. Clair County Drain Commissioner's Office initiated an Anchor Bay Watershed Management Plan jointly with Macomb County. The St. Clair River delta was included in the plan.
Urban runoff for new developments	Municipalities; Developers	1994 – enforce bylaws re: on-site pollution control 1995 – maintain natural areas 2000 – maintain hydrology	City of Port Huron (C) Lambton County (P) RIC Non-Point Source Steering Committee (P)	Information not available.
Urban runoff for existing developments	Municipalities; Developers	2000 - construct on-site controls to remove pollutants	City of Port Huron (P)	Information not available.
Link Urban/Rural storm water control through subwatershed plans	Municipalities; Conservation Authorities	1994 and on going	Kent County (No Action)	Subwatershed planning proposed for St. Clair County Michigan. (P)

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Reduce use of road salt and seek alternatives	Ontario and Michigan Transport Agencies; MDNR; OMOEE; Municipalities/Local Govt's	1994 and ongoing	Kent County (No Action) Sombra Township (NF)	A Code of Practice for the Environmental Management of Road Salts published under the *Canadian Environmental Protection Act, 1999*. The Code is designed to help municipalities manage use of road salts that reduces harm to the environment while maintaining road safety. Michigan: Information not available.
Reduce use of lawn fertilizers and pesticides	Residents; Municipalities	1994 and ongoing	Kent County (No Action) Sombra Township (NF)	Programs (inside and outside AOC) have increased awareness of residents.
Promote agricultural programs and technology to reduce contamination to rural runoff	OMAFRA; MDNR; Agriculture Canada; MDA; USDA/SCS	ongoing since 1993	Agriculture Canada (P) RIC Non-Point Source Steering Committee (P)	Habitat improvement programs target stream bank stabilization and the creation of vegetated buffer strips along streams and drains in Ontario. St. Clair County - Drain Commissioner's Office provided funding to fix erosion problems caused by cattle in the headwaters of the Pine River Watershed.
Protect existing natural areas and undertake remedial measures	OMOEE; OMNR; MDNR; Local Govt's; Conservation Authorities	1993 and ongoing	RIC Non-Point Source Steering Committee (P)	Habitat restoration programs exist for Ontario and Michigan. In 1999, the MDEQ provided more staff and resources for wetland protection in St. Clair and Macomb Counties.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Improved waste site planning and management	OMOEE; MDNR; Municipalities	5 year phase in – incentives for waste disposal; implement pollution prevention measures 1993 and ongoing – sites only accept waste designed to handle; secure monies to avoid abandonment; ensure proper closing of all bore holes and wells 1994 – BAT for new waste sites; up-to-date inventory of sites and site condition; licensed/insured/ bonded haulers 1995 and ongoing – improved accountability of waste disposal practices; properly cap closed sites determine extent of contamination of existing sites; monitor site conditions and shallow groundwater 2000 and ongoing – mitigate and remediate contaminated groundwater	RIC Non-Point Source Steering Committee (P)	Dow – undertook remedial work in capping Scott Road Landfill and adding wetland filter. Sarnia Michigan Ave. landfill has been capped. Surface water sampling in the Ladney disposal site drainage ditch, Parker Drain and Marsh Creek was conducted as recently as November, 2003. Samples taken in the vicinity of the site and in Marsh Creek, both upstream and downstream of the site, revealed no detection of PCBs in the surface water. The results from a follow-up study that assessed the Canatara Landfill Site are required to determine the area, extent and degree of contamination.
Identify problems relating to domestic sanitary sources and ensure proper maintenance/repair	Municipalities; Residents; Public Health Authorities	1993 and ongoing	Moore Township (P) Sombra Township (P) RIC Non-Point Source Steering Committee (P)	Individual septic systems are being repaired, upgraded or connected to local collection systems in Ontario.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Correct direct discharges of untreated grey water	Municipalities; OMOEE; MDNR; U.S. and Canadian Coast Guards	1994 and ongoing	No action	It is legal for boats to discharge grey water. Rural U.S. and Canadian programs address bacterial contamination due to septic leaks.
Proper use and disposal of household hazardous wastes and product substitution / education	Municipalities; Residents	1994 and ongoing	NIL	Lambton and St. Clair Counties have established hazard waste depots.
SEDIMENT				
Complete sediment characterization studies	OMOWW; LIS; Environment Canada; Geological Survey of Canada; EPA; SEMI; MDNR; USACE	1994 – OMOE/LIS sediment characterization study 1995 – Priority 1 Zones follow-on sediment characterization studies 1995- review sediment transport mechanisms	LIS/OMOE and RIC Sediment Subcommittee (P) Government of Canada (AA)	Sediment characterization studies have been completed for all three impaired zones. Additional research (Benthic Assessment of Sediment) is being conducted by Environment Canada to supplement existing data.
Undertake in-situ pilot scale remediation	OMOE; LIS; Environment Canada; USACE	1996 – begin pilot studies	Dow Chemical Canada Inc. (C)	Pilot-scale remediation and downstream impact modelling has been completed.
Develop final remedial strategy	OMOE; LIS; Environment Canada; USACE	1998	RIC Sediment Subcommittee (P)	Dow Chemical Canada Inc. - remediation of Cole Drain sediment and 13,370 m^3 of contaminated sediment completed.
HABITAT				
Develop and implement communications/education program and appropriate landowner guidelines	RIC; BPAC; EPA; MDNR; Environment Canada; EPA	1995 and ongoing	OMNR, Lambton Stewardship Network,RIC Habitat Subcommittee, BPAC (P)	Lambton Stewardship Network, Friends of St. Clair, The St. Clair County Drain Commissioner's Office, Waterways of Wildlife Project, and the St. Clair Region Conservation Authority – Implemented various educational programs and landowner contact.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Strengthen wetland protection measures	Ontario and Michigan Legislatures; Environment Canada. EPA	1995 and ongoing	Township of Dover (AA)	Michigan – passed Marine Safety Act which disallowed the use of personal watercraft in the marshy areas of Lake St. Clair Flats. The Flats are the largest deltaic wetland system in the Great Lakes. St. Clair County Drain Commissioner began working with the MDEQ to improve wetland protection enforcement in the county. In 1999, the MDEQ provided more staff and resources for wetland protection in St. Clair and Macomb Counties. St. Clair County Metropolitan Planning Commission's Master Plan advocates managing growth to protect the rural character, green corridors, natural features and environmental quality of the county. Ontario – Natural Heritage Policies issued as a Provincial Policy Statement under Section 3 of the Planning Act (1997) requiring municipalities to "have regard to " the protection of "significant wetlands: designated Provincially Significant Wetlands.
Reduce ship wakes and surges and minimize impacts from winter shipping	U.S. and Canadian Coast Guards; MDNR; USACOE; USFWS	1994 and ongoing	Coast Guard of Canada concluded that more stringent regulations were not required (NF).	Signage added to portions of the seaway channels through the St. Clair Delta

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Ensure protection of shorelines from erosion and protect/enhance /restore other natural habitats in watershed	MDNR; USDA Natural Resource Conservation Service (Soil Conservation Service); OMNR; Landowners; Conservation Agencies	1994 and ongoing	Crown Vantage Mill (AA) ICI Canada Inc. (AA) E.B.Eddy Paper Inc. (AA) Lambton Generating Station (AA) Detroit Edison (Marysville, St. Clair, Belle River plants) (AA) Kent County (no information) Township of Dover (AA) City of Marysville (P)	Over $2 million (Can) have been spent since 1990 on the development of habitat restoration and stream bank erosion programs.
Control/eradicate exotic species	OMNR; MDNR	1994 and ongoing	Government of Canada (P) U.S. Federal Government (P)	Intake chlorine treatment to kill zebra mussels. Needs basin wide actions for most species.
Undertake habitat restoration and enhancement measures	OMNR; OMOEE; MDNR; RIC; Conservation Agencies; Environment Canada; EPA	1994-Stag Island; develop compatible mapping for Ontario and Michigan. 1994 and ongoing- maximize fish use of the delta; encourage maintenance/enhancement of riparian vegetation; implement and expand candidate site projects; acquire Harsens Island property; improve coordination among conservation/protection agencies; expand list of special status species.	IC Canada Inc.(AA) Lambton Generating Station (AA) Detroit Edison (Marysville, St. Clair, Belle River plants (AA) Sombra Township (AA) • MDEQ (AA)Rural Lambton Stewardship Network (AA) • St. Clair Region Conservation Authority (AA) • Walpole Island First Nation Heritage Centre (AA) Government of Canada (AA)	Environment Canada contributes funding to Conservation Authorities and Stewardship Initiatives for restoration programs. Funding contributed t the approximately 29% of the 440 ha (1087 acres) target for rehabilitation of the Darcy McKeough Floodway. Approximately 209 ha (516 acres) target for rehabilitation of upland and riparian habitat in Ontario achieved (however, this does not factor additional habitat which may have been lost)

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Develop long term habitat management plan and GAP analysis.	RIC; BPAC	2000 – Develop a long term habitat management plan for both Ontario and Michigan. Plan includes a GAP analysis that assesses needs related to maintain wildlife diversity.	Lambton County (AA) Government of Canada (AA)	Long-term habitat management plan developed and recommendations made for Ontario and Michigan. The plan ensures continuity, protection and rehabilitation of fish and wildlife habitat beyond the life of the RAP. The Management Plan requires implementation.
PUBLIC EDUCATION AND OUTREACH				
Develop and implement Public involvement program	RIC; BPAC	1994 and ongoing	Information not available	BPAC volunteers have organized a clean-up of Stag Island, helped sponsor a storm drain marking program by Girl Guides in Ontario and Girl Scouts in Michigan. Friends of St. Clair River/BPAC have involved the public through Eco days, St. Clair River Week, Envirofest, River Day, St. Clair River photo contest, logo contest, Environment Achievement Recognition Awards, SPAC conference.
Develop and implement public outreach and education program	RIC; BPAC	1994 and ongoing	Information not available	Environmental education programs established to put RAP information in the hands of teachers and students, creation of an interactive computer game about the St. Clair River RAP, sponsorship of an annual St. Clair River photo contest, and presentation of yearly environmental achievement awards and ongoing outreach through brochures, pamphlets, posters and presentations.
MONITORING AND RESEARCH				
Develop monitoring plans	RIC; BPAC	1995	Information not available	ongoing
Complete GIS Analytical spatial database	RIC	1994	Information not available	GIS database exists for watershed bordering Ontario side of St. Clair River.

ISSUE	AGENCY/FACILITY	1995 STAGE 2 RECOMMENDED ACTIONS	1997 STAGE 2 IMPLEMENTATION STATUS	PROGRESS 0N IMPLEMENTATION UP TO 2003
Implement monitoring Programs and update GIS database	RIC; LIS; All Agencies	1994 and ongoing	Information not available	Environment Canada Head and Mouth Surveys ongoing. SLEA monitoring also ongoing. GIS currently updated.
Acquire additional Information to Improve modelling accuracy	OMOEE; MDNR	1994 and ongoing	Information not available	ongoing
RAP IMPLEMENTATION				
Establish RAP Implementation Committee and PBAC	RAP Team; BPAC; OMOEE;OMNR; MDNR; Environment Canada; EPA	1994	BPAC formed in 1988 and continues to meet quarterly.	RAP Team formed in 1987; RAP BPAC formed in 1988 and continues to meet quarterly. Plans to re-establish a RAP Implementation are underway.
Complete implementation work plan	RIC	1995	Information not available	To be completed by newly established RIC.

5.5 Gap Analysis

Point Source

It is apparent from Table 2 that while many of the 16 actions that address point source discharge to the St. Clair River have been acted upon in some way, several actions have yet to be fully addressed and need further consideration.

- Current reports detailing facility upgrades, in situ monitoring and water quality conditions that reflect yardstick objectives are required from industry facilities and municipal WPCPs, WWTPs and CSOs in order to make further recommendations;
- A review of the current science and further discussion on open water quantitative yardstick values and how they reflect specific water use goals and objectives are required to establish new yardsticks or adjust existing yardsticks. Where yardsticks do not exist for current contaminants of concern, experts should be involved in the determination of a suitable means for setting a yardstick;
- Total mass loading to the St. Clair River is absent from this report and requires further comment from the respective scientists;
- The development of whole plant permitting system requires consideration;
- "Discharge" is defined as the introduction of polluting substances into receiving waters and includes any spilling, leaking, pumping, pouring, emitting or dumping. A current report from each industry relating to their policies, goals and attainment of zero discharge is necessary in order to fully address this action item. Zero discharge was identified as the ultimate goal in the Stage 2 RAP document. This goal has not been achieved due to the discharge of metal and organic contaminants by industrial/municipal facilities and occasional spills to the river.

Non-point Source

In regards to the actions that address non-point source contamination, a greater understanding of the types and extent of watershed and subwatershed management plans for both Ontario and St. Clair County in Michigan is required. Current information on municipal programs designed to reduce the use of lawn fertilizers and pesticides and control discharges of untreated grey water and suspended solids is required.

The Stage 2 Recommended Plan identified two Ontario waste disposal sites as potential problem areas. The Ladney site, located in St. Clair Township at Highway 40 and Hill Street, was used up until the early 1960s for the disposal of industrial waste. The second site, located in Point Edward at Michigan Avenue and Front Street, was operated in the 1930s and 1940s for the disposal of industrial waste and is presently owned by the City of Sarnia. Both sites were used for waste disposal prior to the requirement to obtain approval under the Environmental Protection Act.

Reports of oil like substances seeping from the Ladney Site into a drainage ditch that is connected to Baby and Talfourd Creeks prompted a hydrogeologic investigation of PCB contamination by Golder and Associates in 1994. Remedial actions were carried out in the 1980s and early 1990s to deal with seepage of oily substances. Action was taken by the Ministry of the Environment in 1994 to clean-up and secure PCB waste that was found on-site. An area in the southern portion of the site had been used by an undetermined party to deposit PCB contaminated capacitors and those materials and approximately 90 tonnes of soils from a localized area were excavated and securely contained on site. Surface water sampling in the site drainage ditch, Parker Drain and Marsh Creek was conducted as recently as November, 2003. Samples taken in the vicinity of the site and in Marsh Creek, both upstream and downstream of the site, revealed no detection of PCBs in the surface water.

The Point Edward site is a closed and covered landfill site and is part of Canatara Park. In 1992, a site assessment by the City of Sarnia revealed the presence of diesel fuel below the surface of the ground, migrating along the south and west sides of the property. Remedial work was performed by the City of Sarnia and it is recommended that the City be contacted to provide information on the current status of these sites.

Sediment

Contaminants in bottom sediments are derived from point and non-point sources. In turn, contaminated sediments act as a source to biota through re-suspension and bioaccumulation. A complete assessment of zones 2 and 3 is required in order to initiate the Canada – Ontario Agreement Sediment Framework Assessment and develop management strategies.

Habitat

Many of the recommended actions pertaining to the BUI "loss of fish and wildlife habitat" have been addressed in some manner, ranging from the publication of educational brochures, to habitat enhancement, restoration and stream bank erosion programs. A current net quantification of habitat gained through these efforts is considered necessary in order to fully realize the progress made and to measure this against the established delisting criteria outline in the Stage 2 Recommended Plan. A quantitative analysis of habitat lost versus habitat restored or protected is also required.

Although a binational habitat management plan was produced (Dutz, 1998), the author indicated that the area estimates for wetlands and riparian cover were not exact. This was due to the LANDSAT imagery ability to define the difference between "forest cover" and treed wetlands" and the true quality of many habitats are unknown until on the ground evaluations occur. Furthermore, the protection status on many areas is unknown and thus the degree to which biodiversity is represented is uncertain. Both short- term and long-term recommendations for habitat management were provided in the plan; however, many of these require implementation. The loss of fish and wildlife habitat, including wetland and nearshore habitat within the AOC, was summarized in the 1991 Stage 1 document. As such, consideration should also be given to developing an aquatic habitat management plan.

Emphasis is lacking in the control of exotic species and although a long-term habitat management plan has been developed, its implementation status is unclear. Further habitat related information is required from both Michigan and Ontario watersheds.

RAP Implementation

The St. Clair River Binational Public Advisory Council (BPAC) has had broad community representation and has worked cooperatively with government, industry, municipalities and all interested community groups in addressing environmental issues in the river. The BPAC has recently expressed concern about their declining base of community representation and the emphasis on public outreach is deemed necessary to increase public participation. There is currently no RAP implementation committee (RIC) for the St. Clair River AOC; however, plans are underway for the re-establishment of a Canadian committee.

6.0 TRENDS AND CONDITIONS

This section provides a summary of recent trends and conditions within the AOC pertaining to water, sediment, biota, air, and effluent quality. This information is critical to determine the Beneficial Uses Impairments status within the AOC in Section 7.0. The following is a review of the key findings and results presented from a variety of studies and monitoring programs. The Technical Addendum (Volume 2) to this synthesis report provides more detailed summaries of many of the studies or programs along with key data tables and graphs.

6.1 Water Quality

The principal information sources pertaining to water quality in the St. Clair River or its tributaries are the volatile organic compounds (VOCs) monitoring station (Courtright) maintained by the Sarnia-Lambton Environmental Association (SLEA, formerly Lambton Industrial Society), the head (Point Edward) and mouth (Port Lambton) surveys and the spatial contaminant trends monitoring in the St. Clair/Detroit River Corridor of Environment Canada (Chan, 2001), and the temporal and spatial trend monitoring in the St. Clair River (and other connecting channels) done by Michigan Department of Environmental Quality.

Sarnia-Lambton Environmental Association Organic Volatiles Monitoring

The water quality monitoring station maintained by SLEA (see Ortech 1998, 1999, 2000 and 2001) collects between 8,526 and 8,642 hourly samples each year. With the measurement of 20 different compounds (primarily VOCs), this results in over 175,000 analyses annually.

It is not possible to directly compare the number of results greater than the method detection limits (MDLs) for all the years of operation due to the implementation of lower MDLs in May 1991 and September 1995. In spite of this, the total number of detections has remained relatively low given the total number of samples collected and analyzed. In recent years, only about 1 to 1.7% of analyses had concentrations above their respective MDLs. The highest frequency of detections is found with toluene and benzene. Some or most of the toluene is believed to be derived from pleasure boating as the concentrations generally peak during weekends.

SLEA has established limits for individual parameters which, if exceeded, would trigger a notification being issued to OMOE. During 1997, no result equaled or exceeded trigger levels; perchloroethylene exceeded its trigger level in 1998, but no parameters exceeded trigger levels in 1999 or 2000. In 2001, the limit was exceeded in 28 samples but all during two specific events. Xylene peaked to 1.2 ppb during a rainfall episode in late October. In late November, benzene peaked at 2.83 ppb due to the discharge of hydrocarbons from a cooling system. Peak values for both parameters were below applicable drinking water standards and no downstream water treatment plant closures were necessitated.

Temporal Trend Data for the St. Clair River (Head and Mouth Survey) – Environment Canada

One of the most complete and continuous contaminant data sets for the St. Clair River has been collected by Environment Canada. Water and suspended sediment samples are collected at two stations, one upstream (Point Edward) of the Sarnia industrial complex and the other downstream (Port Lambton) at the mouth of the river. Samples have been collected up to two times per month (approximately 20/year) since 1986/87 and analyses include a wide range of nutrients, metals and organic contaminants.

Graphical results are provided for water concentrations of three metals (copper, cadmium, lead and zinc) collected from the St. Clair River from the beginning of the program through to 2000 (Figure 3). Over this period, method detection limits have remained constant and all values less than the detection limit were assigned a value of zero and plotted on the graphs. While Environment Canada continues to monitor water quality parameters at both stations, information is presented up to 2000 as data past this date are not comparable with earlier data due to differences in analytical methodology.

The temporal trend in copper concentrations (Figure 3a) shows greater variability at Point Edward than at Port Lambton, with concentrations at Port Lambton occasionally exceeding the 5 ug/L yardstick. Only five values for cadmium were above the detection limit at the downstream station in the early 1990s; however, concentrations were below the 0.5 ug/L yardstick value (Figure 3b). Lead concentrations (Figure 3c) in St. Clair River water show little difference between sampling stations with no apparent temporal trend. Lead concentrations frequently have been above the 2.9 ug/L yardstick. In contrast, zinc concentrations in water have no exceeded the 30 ug/L yardstick value and are near the method detection limit

Mean concentrations of hexachlorobenzene (HCB), hexachlorobutadiene (HCBD) and octachlorostyrene (OCS) are presented in Figures 4a through 4c and represent concentration trends over time (1984-2000). Dissolved phase hexachlorobenzene concentrations (Figure 4a) tend to be higher at Port Lambton relative to Point Edward indicating sources along the St. Clair River. Concentrations of HCB have decreased with time, with larger decreases observed at Port Lambton. The most recent sampling results indicate that concentrations are near the 0.04 ng/L method detection limits.

Mean dissolved phase HCBD concentrations (Figure 4b) at Port Lambton were as much as two orders of magnitude higher than at Point Edward at the beginning of the sampling period, suggesting inputs from sources along the River. There is no discernable downward trend at Point Edward, but concentrations have decreased over time at Port Lambton. Octachlorostyrene is not readily detectable in the dissolved phase, thus suspended sediment data is presented (Figure 4c). Octachlorostyrene concentrations were detected only at Port Lambton, indicating continued inputs. Concentrations have decreased over time but remain above the 2.7 ng/g detection limit.

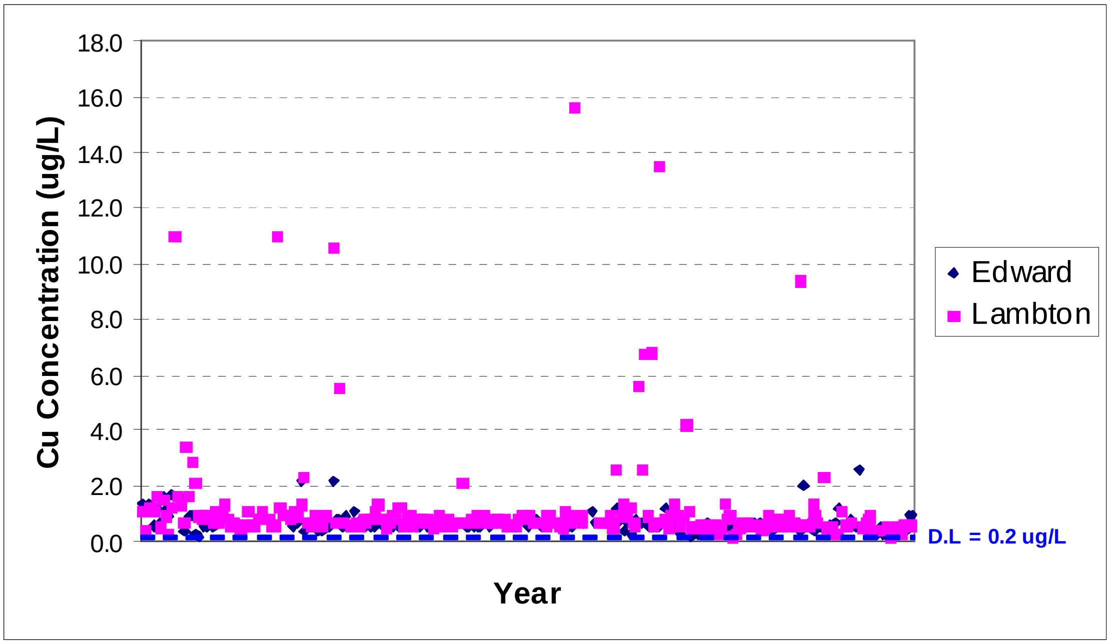


Figure 3a. Copper concentrations in water collected from head (Pt. Edward) and mouth (Port Lambton) of the St. Clair River (source: C.H.Chan, 1998-2000).

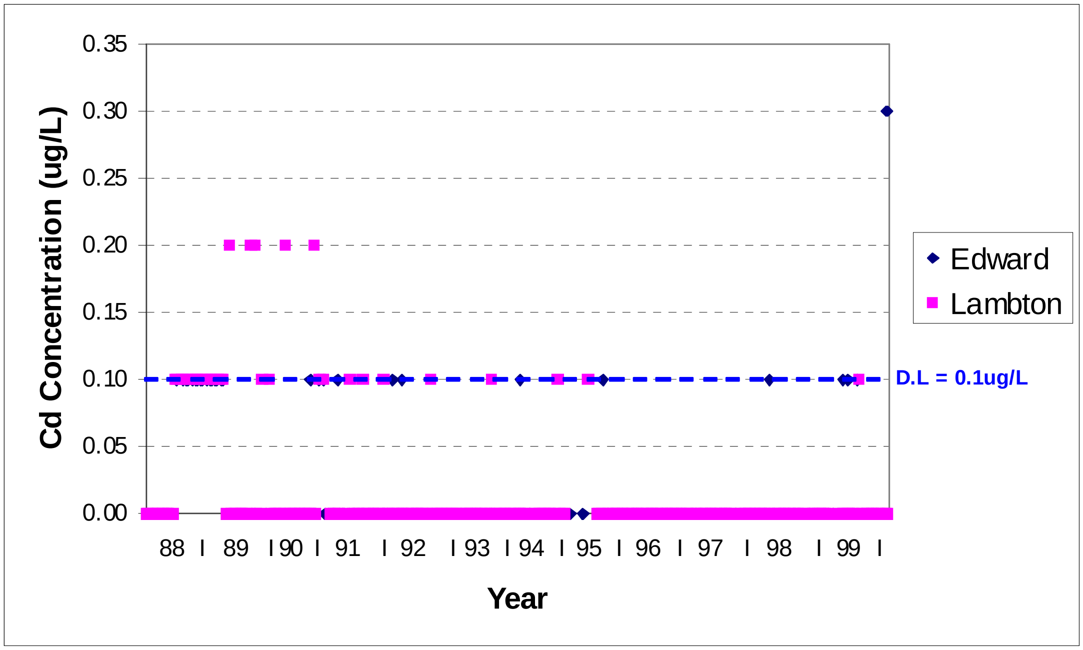


Figure 3b. Cadmium concentrations in water samples collected from the head (Pt. Edward) and mouth (Port Lambton) of the St. Clair River (source; C.H. Chan, 1988-2000).

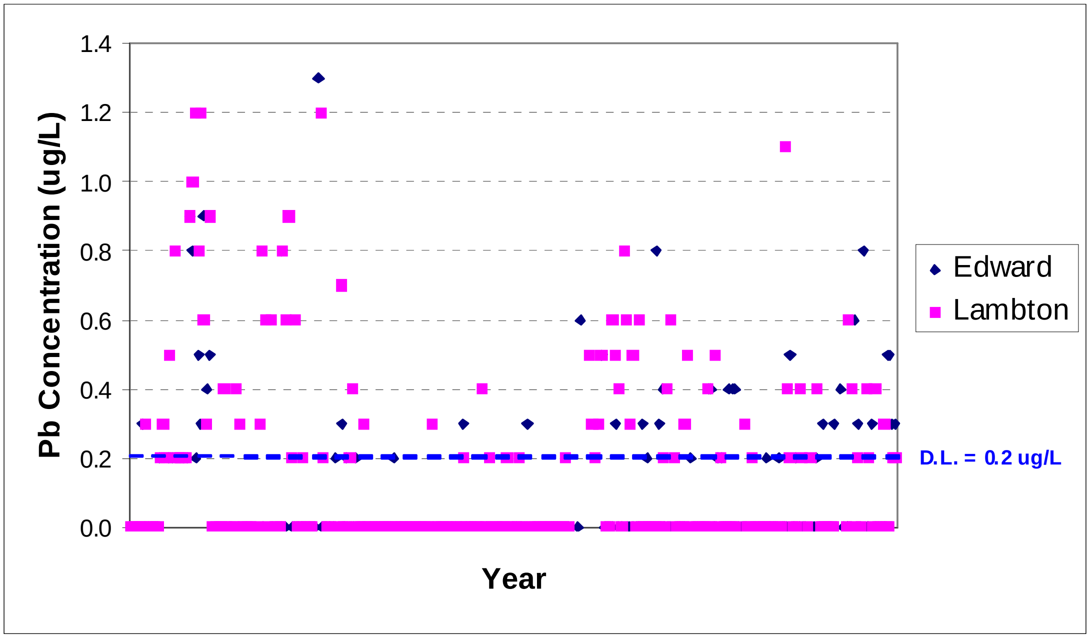


Figure 3c. Lead concentrations in water samples collected from the head (Pt. Edward) and mouth (Port Lambton) of the St. Clair River (source; C.H. Chan, 1988-2000).

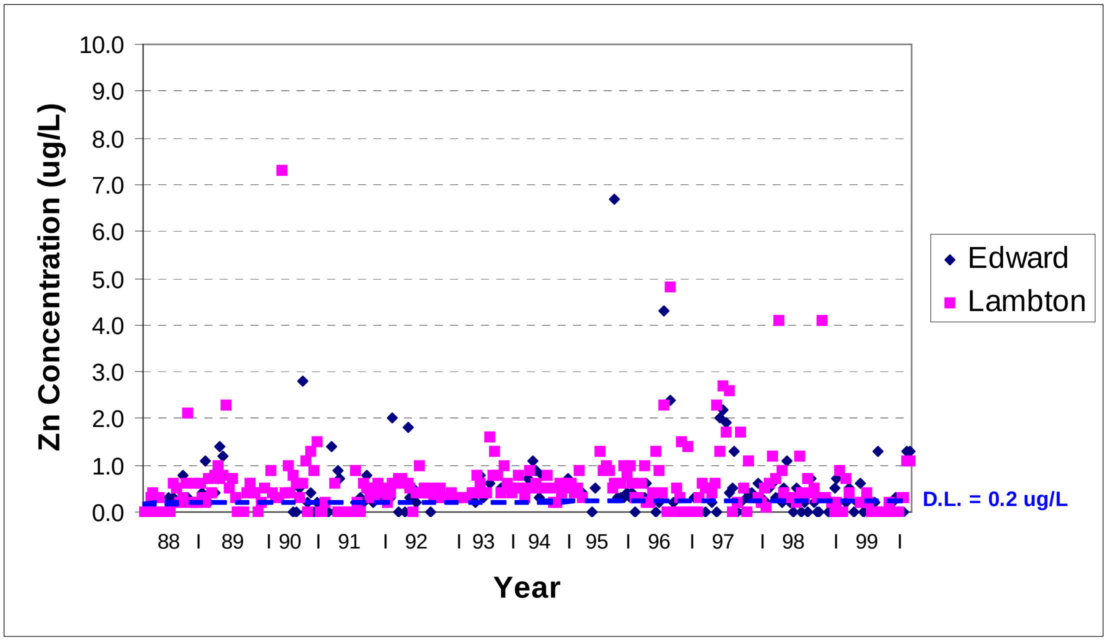
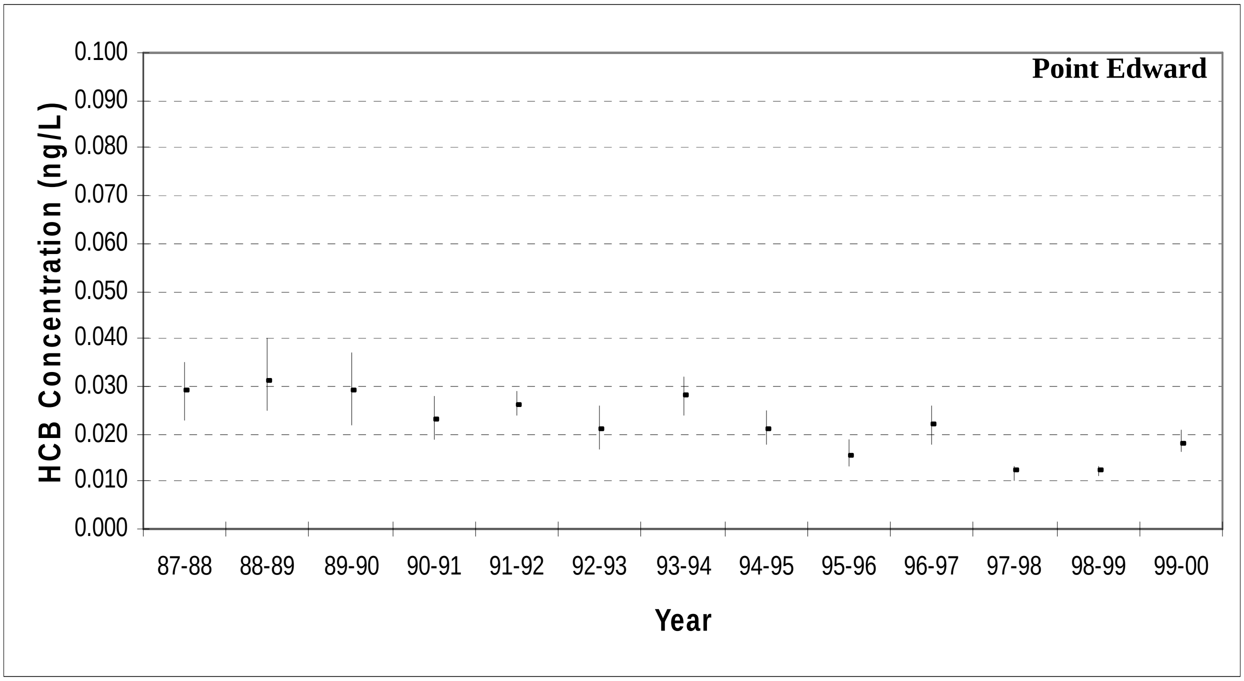


Figure 3d. Zinc concentrations in water samples collected from the head (Pt. Edward) and mouth (Port Lambton) of the St. Clair River (source; C.H. Chan, 1988-2000).



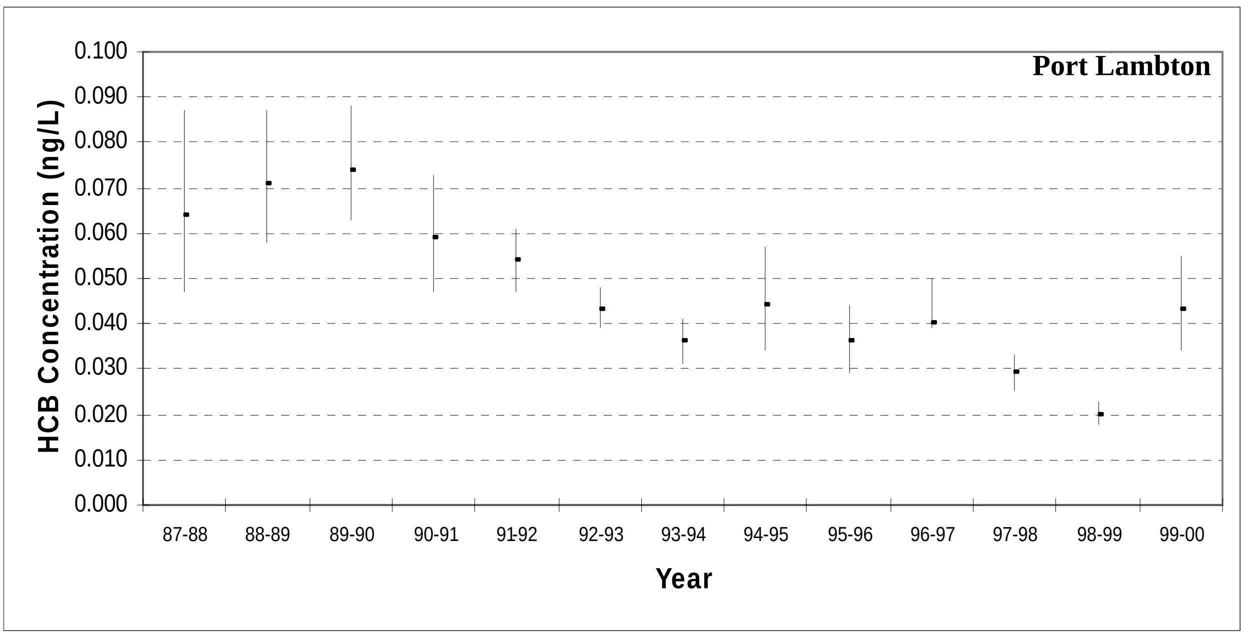
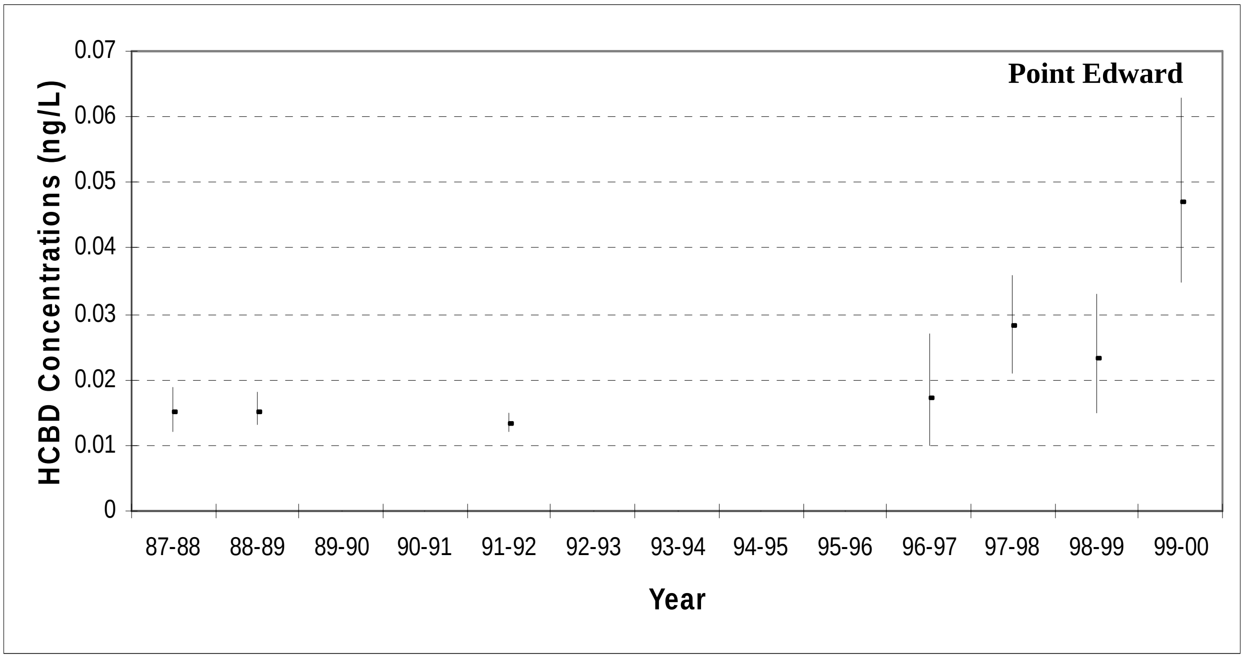


Figure 4a. Hexachlorobenzene in water samples collected from the head (Point Edward) and mouth (Port Lambton) of the St. Clair River.
Mean (Maximum Likelihood Estimate ± 90% Confidence Interval) dissolved phase concentrations (ng/L) of hexachlorobenzene (HCB) at the head (Point Edward) and mouth (Port Lambton) of the St. Clair River (from C.H. Chan; April 1987 – March 2000; detection limit = 0.04 ng/L).



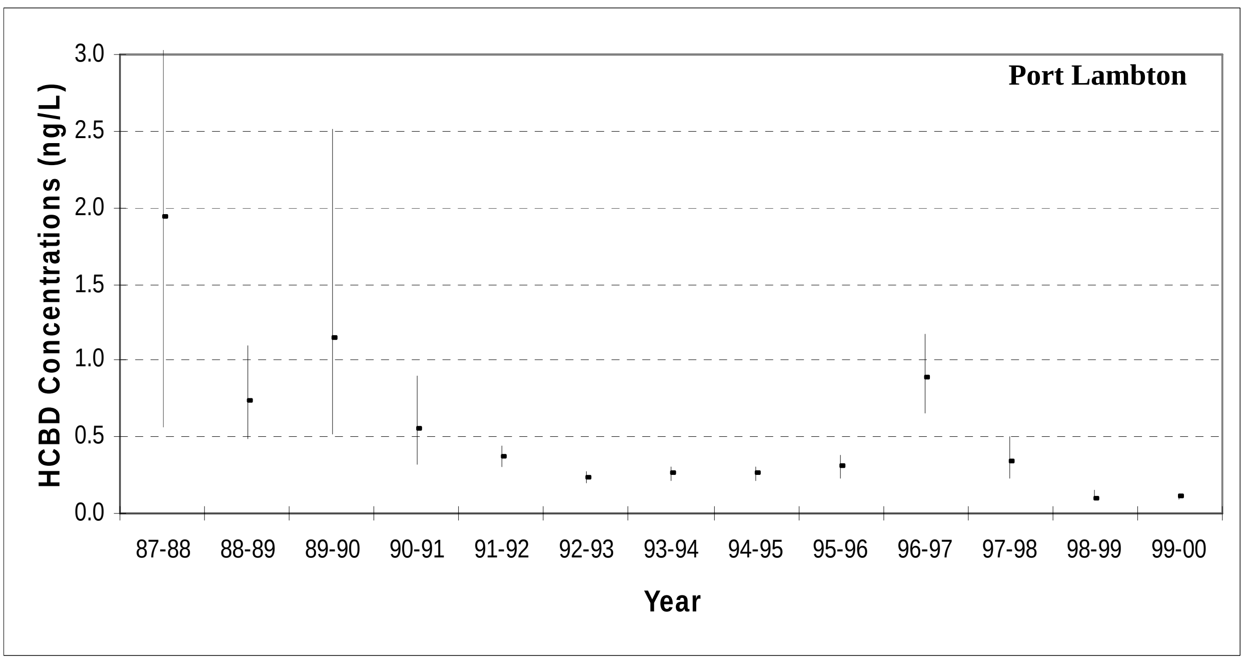


Figure 4b. Hexachlorobutadiene in water samples collected from the head (Point Edward) and mouth (Port Lambton) of the St. Clair River.

Mean (Maximum Likelihood Estimate ± 90% Confidence Interval) dissolved phase concentrations (ng/L) of hexachlorobutadiene (HCBD) at the head (Point Edward) and mouth (Port Lambton) of the St. Clair River (from C.H. Chan; April 1987 – March 2000; detection limit = 0.04 ng/L).

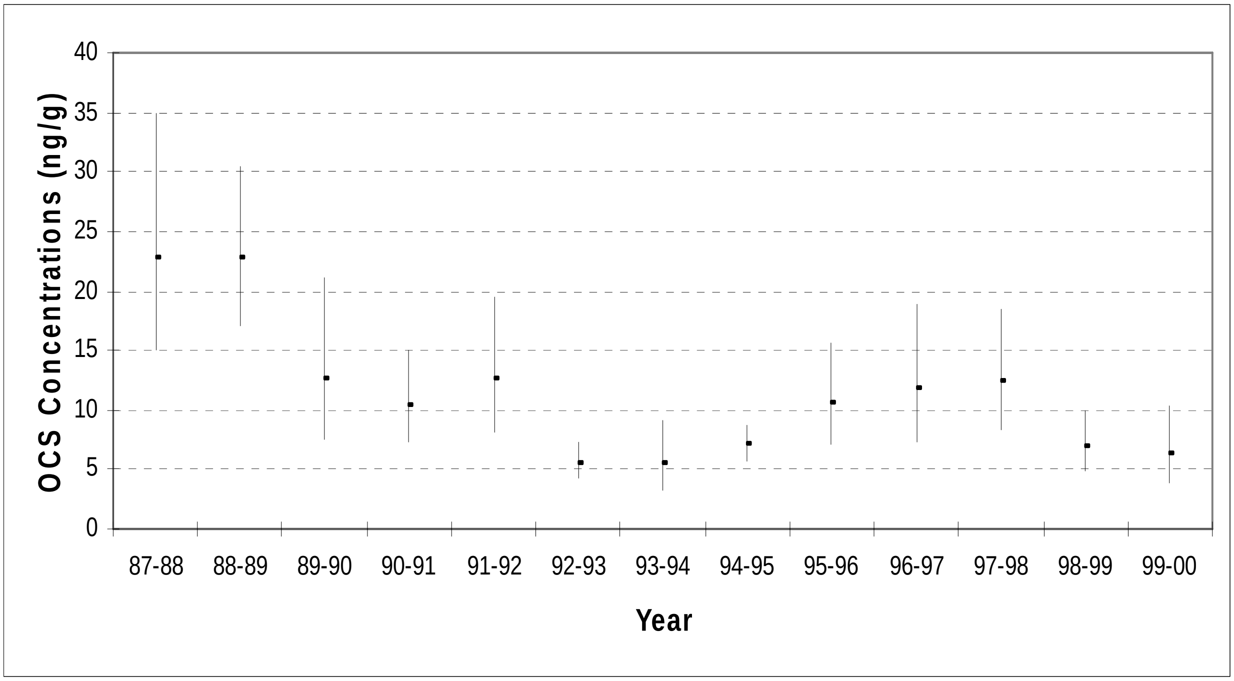


Figure 4c. Octachlorostyrene in suspended sediment collected from the head (Point Edward) and mouth (Port Lambton) of the St. Clair River.
Mean (MLE ± 90% CI) suspended sediment phase concentrations (ng/g) of octachlorostyrene (OCS) at Port Lambton (from C.H. Chan; April 1987 – March 2000; detection limit = 2.7 ng/g). OCS was not detected in the suspended sediment phase at Point Edward.

Spatial Contaminant Trends in Water from the St. Clair/Detroit River Corridor – Environment Canada

In addition to the Head and Mouth survey data, Environment Canada has collected whole-water samples from sites throughout the St. Clair/Detroit River Corridor. These samples were analyzed for metals including mercury and organic compounds such as PCBs. Mercury concentrations in the St. Clair River-Detroit River corridor, based on 2001 and 2002 data from the above studies are illustrated in Figure 5. Whole-water mercury concentrations in the upper portion of the St. Clair River were below the most stringent guidelines for protection of wildlife. In the lower portion of the river, concentrations were consistently above the guidelines on the Canadian side and intermittently above the guidelines on the U.S. side. Concentrations at the outlet of Lake St. Clair were higher than those found at the St. Clair River downstream sites. In the St. Clair River – Detroit River corridor overall, the highest mercury concentrations were found in the lower Detroit River with concentrations increasing 12-fold, when compared to levels found at the Lake Huron outlet. Whole water total PCB concentrations (Figure 6) increased from Sarnia to Port Lambton (119 pg/L to 207 pg/L), but were much lower than the 6670 pg/L measured in water from the lower Detroit River.

Temporal and Spatial Trend Monitoring in the St. Clair River Corridor – Michigan Department of Environmental Quality

The Michigan Department of Environmental Quality has monitored ambient water quality conditions in the St. Clair River since 1998, in order to assess spatial and temporal trends of toxic and conventional pollutants. Water quality samples have been collected at the head and mouth of the river on a monthly basis during the period of April to November each year.

Michigan's recently released report on water quality monitoring in the connecting channels provides the following summary of spatial and temporal water quality trends in the St. Clair River:

"Total phosphorus concentrations have declined from concentrations measured in the 1980s. Recent data indicate no trend in most nutrient parameters, with the exception of a decreasing trend in total phosphorus concentrations. Total phosphorus, orthophosphate, ammonia, and nitrite concentrations were higher at the downstream station. Seasonal fluctuations were apparent in most of the nutrient parameters.

Due to seasonal fluctuations, the dissolved oxygen concentration in the St. Clair River ranged between 7.4 and 13.4 mg/L, and demonstrated an increasing trend with time. No statistically significant difference between upstream and downstream concentrations was observed." (Great Lakes Environmental Center and Limno Tech, 2005).

There was a definite increase (similar to Detroit River) in most metals concentrations analyzed in the St. Clair River in the latter part of 1999. Metals concentrations generally decreased in 2000, and then were variable between 2001 and 2003. The elevated metals concentrations measured throughout the study appear to be related to elevated suspended solids concentrations. Review of the data and other information about dredging activity or other possible sources of sediment disruption, and point and non-point source loadings, could provide insight as to why metals concentrations were elevated. Most metals concentrations had a decreasing trend with time, except zinc, which had an increasing trend in concentration. Several of the metals, including chromium, copper, lead, nickel and zinc showed a statistically significant increase in concentration downstream compared to the concentrations measured upstream.

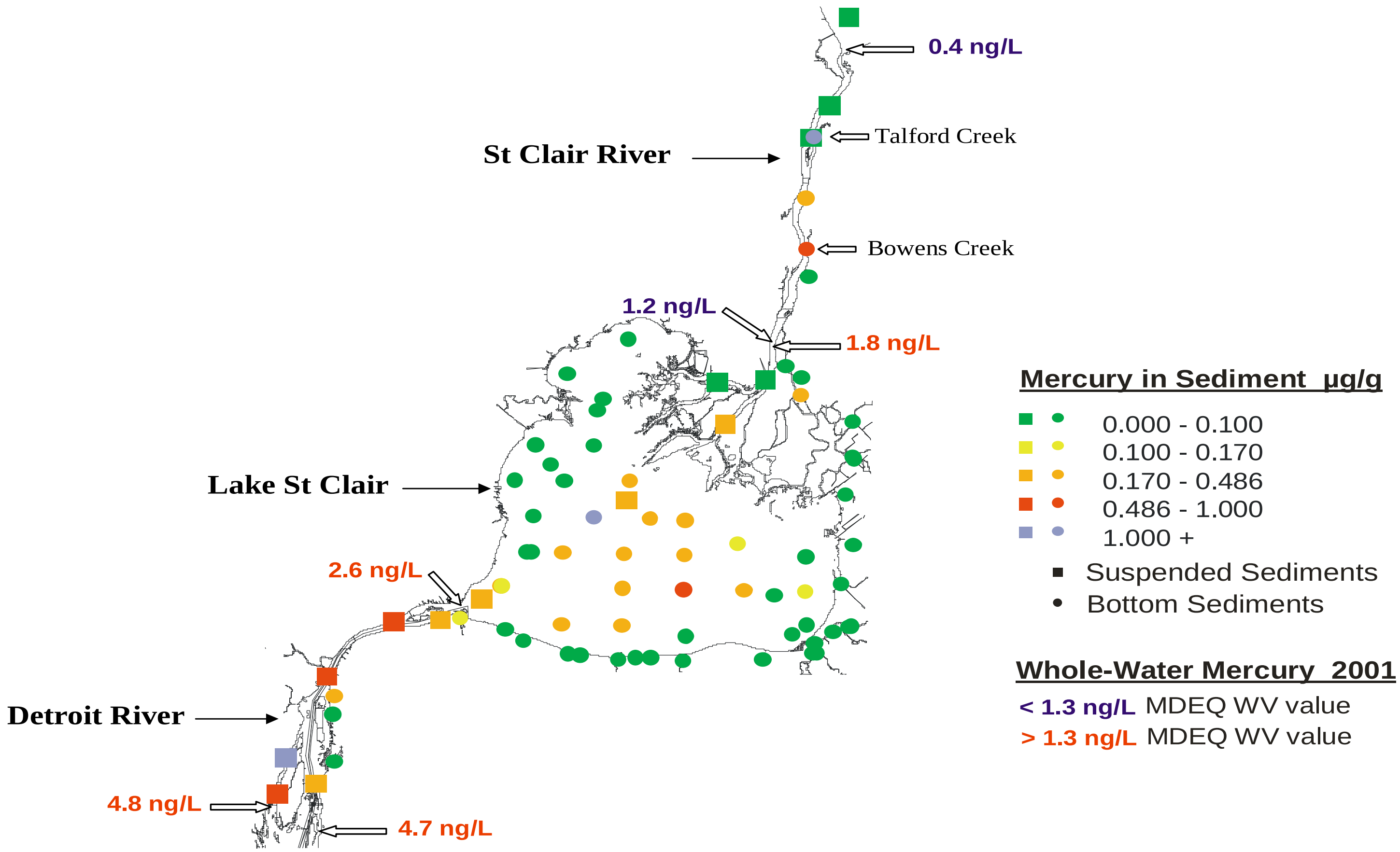


Figure 5. Mercury concentrations in sediments and water in the St. Clair/Detroit Corridor. (Source: Environment Canada)

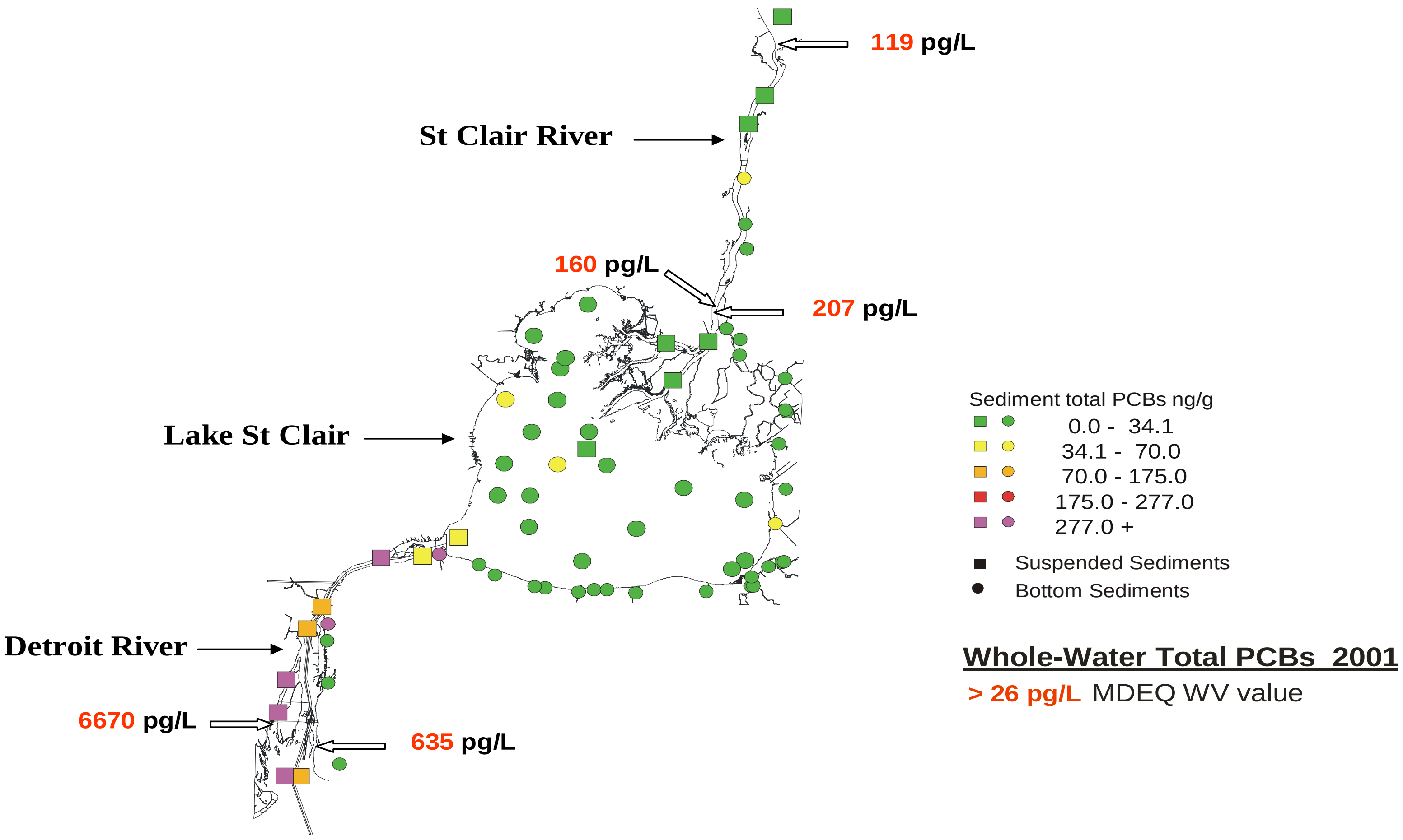


Figure 6. Total PCB concentrations in sediment and whole water in the St. Clair/Detroit Corridor. (Source: Environment Canada)

6.2 Sediment Quality

Since the 1997 Update Report, much of the bottom sediment and benthic quality work has focused on sediment characterization of the known contaminated zones offshore of the Sarnia industrial complex. This work has focused on three activities, 1) sediment toxicity testing, 2) the development of an integrated sediment quality index, and 3) physical sediment studies and modeling. Additional data have been obtained relating to dredge spoil (bottom sediment removed to improve navigation) characterization of samples collected in the Southeast Bend Cutoff Channel in 2000. Current consumption restrictions for St. Clair River fish and consumption advisories on wildlife species are a result of the elevated mercury, total PCBs, octachlorostryene (OCS) and hexachlorobenzene (HCB). Elevated contaminant concentrations in sediment can also have negative effects associated with fish tumours and deformities and restrictions on dredging. Sediment survey results for metal and organic contaminants from the Michigan shore were not available at the time of this report.

Sediment Characterization Offshore Sarnia Industrial Complex

A RAP Sediment Committee comprised of agency and BPAC members and invited experts prepared an integrated sediment assessment approach for the St. Clair River in 1993 (Farara and Burt, 1997). The approach was intended to facilitate decisions respecting the most appropriate means to deal with the contaminated sediments. Studies by the Ministry of the Environment, Environment Canada, the University of Windsor's Great Lakes Institute for Environmental Research and the Sarnia Lambton Environmental Association were designed to assess and integrate findings from the physical, chemical and biological monitoring, to establish priorities for remediation, and to evaluate remedial options including natural recovery (do nothing), in-situ treatment, capping, and removal. This approach was intended to provide a better understanding of the size and extent of the zones of contamination, local effects on biota, sediment dynamics and, through modelling, the effects of contaminated sediments on down river water quality.

Although all participants shared the objectives of the RAP Sediment Committee, different perspectives concerning the decision-making process being followed and the interpretation of data resulted in difficulties in achieving consensus on the final approach to remediation. In order to advance the goal toward remediation, the Ministry of the Environment and Environment Canada (EC) undertook direct discussions at senior levels among the regulatory, approving, and implementing agencies outside the RAP process. This approach had also been utilized for other contaminated sediment projects. In June 2000, at Dow Chemical Canada Inc.'s initiative, MOE senior management met with Dow representatives to discuss a proposed work plan for addressing sediments contaminated by historical operations at Dow. In March of 2001, Dow formally announced that it would undertake a sediment remediation program of sediments contaminated by historical operations at Dow.

The area of highest priority for remediation included an area roughly the size of a city block located directly adjacent to the company's former First Street outfalls. Dow closed these outfalls between 1986 and 1993 as part of the larger program to eliminate the potential for any adverse impact on the environment. During 2001, Dow gathered additional information to determine the possible remedial options that would result in minimal impact on downriver water quality and could be implemented safely. A team of independent technical experts were assembled. Additional investigations of lower priority zones were undertaken in 2001 and remediation work in high priority zones commenced in 2002.

In 2003, Dow Chemical Canada Inc. completed the first two phases of sediment removal from the St. Clair River in the area adjacent to its Sarnia plant site. Upon completion, 13,370 m^3 of bottom sediment contaminated with mercury was removed. In the process, about 60 million gallons of river water was collected, treated to drinking water quality and discharged back to the St. Clair. Through laboratory analysis, the sediment was characterized as non-hazardous material and is being removed to a landfill. A portion of the sediment was left on site to form a dividing berm in the sediment holding pond. Water quality monitoring, as approved by the Ministry of Environment, was ongoing throughout the project, detecting no adverse impact on river drinking water quality or clarity. A comprehensive communications program supported project planning and operations, enabling local community and downstream stakeholders on both sides of the St. Clair River to be informed and consulted. The third and final phase was completed in 2004 and addressed the sediments contaminated with chlorinated organic compounds. With the completion of this third phase, sediment contamination within the highest priority area of the river has been addressed.

Dredge Spoil Contaminant Concentrations

Public Works and Government Services Canada (PWGSC) released a maintenance dredging report relating to works in the Southeast Bend Cutoff Channel located in the lower Walpole Island delta (PWGSC, 2001). This report focused on environmental protection measures and general procedures utilized in their on-going maintenance dredging program for the channel. The report also included the results of contaminant concentrations in dredge spoil samples in May and July of 2000.

In the May 2000 survey, a total of 16 samples were analyzed for metals and nutrients (silver, arsenic, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, zinc, phosphorus, total organic carbon, total Kjeldahl nitrogen (TKN- nitrogen in the form of organic proteins or their decomposition product ammonia), oil and grease, NH3-N and CN) as well as a wide range of pesticides, total PCBs and industrial compounds hexachlorobenzene (HCB) and octachorostyrene (OCS). Ten samples were also analyzed for a range of polycyclic aromatic hydrocarbons (PAHs). In the July survey, a total of 12 samples were analyzed for the same suite of parameters.

There were few exceedences of either the Ontario Sediment Quality Guidelines or the St. Clair River RAP yardsticks. Samples collected in the May survey exceeded RAP yardstick values for mercury (one sample), TKN (four samples), HCB (three samples), manganese (one sample), and phosphorus (one sample). Organochlorine pesticides and PAHs were below detection limits. Low concentrations of some PAHs were detected (phenanthrene, pyrene, chrysene). Hexachlorobenzene and octachlorostyrene were detected in few samples.

Fewer detections and exceedences were recorded in results of analyses of the July 2000 survey. There were no detections of octachlorostyrene or hexachlorobenzene and only two PAHs were detected in one sample (phenanthrene and pyrene). Exceedences were found for mercury (1 sample), TKN (1 sample), and total PCBs (two samples).

St. Clair River Sediment Core Results

Sediment samples (surficial and core samples) collected in 2001 by the OMOE from just south of the Dow Chemical Canada Inc. property line (zone A) and sites adjacent to and downstream of Suncor and opposite Stag Island (zone B) were tested in order to assess sediment management options.

Results showed that approximately 5% of zone A had surficial mercury (Hg) concentrations exceeding the 1 mg/kg MOE-recommended sediment clean-up target and 30% of zone B had Hg concentrations ranging from 2 to 9.30 mg/kg. Hexachlorobenzene (HCB) concentrations exceeded the recommended target of 220 ng/g over 43% of zone A and about 4% of zone B. Hexachlorobutadiene (HCBD) concentrations were lower than the established criteria of 3500 ng/g within both assessed zones. Their values ranged from 52 to 1600 ng/g within zone A, and from 7 to 610 ng/g within zone B.

Octachlorostyrene concentrations ranged from 14 to 160 ng/g within zone A and from 3 to 150 ng/g within zone B. Octachlorostyrene concentrations exceeded the 20 ng/g target throughout 91% of zone A and 80% of zone B (OMOE, 2003).

Spatial Assessment of Sediment Contaminant Concentrations in the St. Clair River

Several Environment Canada studies that assess contaminants in sediments have been initiated and include suspended sediment sampling in the St. Clair River-Detroit River corridor, bottom sediment surveys in Lake St. Clair and bottom sediment sampling of tributaries that drain directly into the Canadian shoreline of the St. Clair River, Lake St. Clair and the Detroit River.

Mercury contamination in the aquatic environment of the corridor is a major concern. Bacteria and chemical reactions in lakes and wetlands change the mercury into a much more toxic form known as methyl mercury. Fish become contaminated with methyl mercury by eating plankton and smaller fish which have accumulated methyl mercury. Concentrations in suspended and bottom sediments collected from the St. Clair-Detroit River corridor are based on a composite of 2001 and 2002 data (Figure 5). Mercury concentrations in suspended sediment appear to be relatively constant throughout the St. Clair River but higher in the South Channel. By contrast, mercury concentrations in surficial bottom sediment collected at the mouths of tributaries ranged from 0.170 ug/g to greater than 1.0 ug/g between Bowens and Talfourd Creeks. These data are more representative of inputs from upstream sources rather than the St. Clair River.

Polychlorinated biphenyls can also be taken up by fish and wildlife from the St. Clair River AOC. Concentrations of total PCBs were detected in suspended and bottom sediments of the St. Clair River and delta up to 70.0 ng/g. No trend in concentration was observed from the upper to lower reaches of the AOC. Suspended sediment and bottom sediment concentrations in the St. Clair River and Lake St. Clair were modest in comparison to levels in the Trenton Channel (lower Detroit River) (Figure 6).

Industrial organic and mercury concentrations in surficial sediment samples collected from tributaries of the St. Clair River that exceeded provincial or federal sediment quality guidelines (Appendix 2) are provided in Table 3.

Table 3. Organic chemical and mercury concentrations (ng/g) in surficial sediment samples collected from St. Clair River tributaries that exceeded sediment quality guidelines.

	p,p'-DDE	γ -HCH	PCB	OCS	HCB	Total PAHs	Hg
Talfourd Creek			40 (>TEL)	8	14	4363 (>LEL)	1180 (>PEL)
Clay Creek							
Baby Creek			50 (>TEL)	5	6		296 (>TEL)
Bowens Creek				14	23 (>LEL)		915 (>PEL)
Running Creek				11	13		315 (>TEL)

LEL, lowest effect level; PEL, probable effect level; TEL, threshold effect level

6.3 Biota Quality

Since the 1997 Update Report, research and monitoring of biota quality has been focused on benthic communities as they reflect sediment contamination zones, the Ontario and Michigan sport fish contaminant monitoring programs and on studies of selected wildlife species on Walpole Island. The degradation of benthos, specifically "dynamics of benthic populations" is listed as impaired, and "body burdens in benthic organisms" requires further assessment on a site-specific basis. Several contaminants including mercury, PCBs, HCBs, and OCS contribute to the need for further assessment on a Great Lakes or a St. Clair River basis for both “body burdens in fish” and “restriction on wildlife consumption”. Elevated contaminant body burdens may also result in fish tumours and other deformities and bird and animal deformities or reproductive problems.

Sediment Effect Studies on Benthos and Fish

An assessment of the biological effects of sediment contaminant loads is necessary in any potential remediation strategy and also addresses the BUI “degradation of benthos”. The available data which quantifies the relationship between biological and sediment chemistry data for the St. Clair River includes sediment chemistry from cores (Farara and Burt, 1997), laboratory sediment bioassay results for juvenile fish and invertebrates (Bedard and Petro, 1997), benthic invertebrate community assessment (Farara and Burt, 1997), bioaccumulation data for in-situ invertebrates (Kauss, 1997), laboratory bioassays for fish (Bedard and Petro, 1997) and caged mussels (Kauss, 1999).

The above studies integrated a range of organisms at different trophic levels of the St. Clair River aquatic ecosystem and examined effects at the individual and community level. The most significant relationships were found between invertebrate (oligochaetes, chironomids, and mayflies) and fish (juvenile fathead minnows) contaminants and surficial sediment contaminants (Hg, HCBD, HCB, OCS, PCBs) demonstrating the extent of bioaccumulation. Sediment mercury contamination also impacted tubificid (a type of worm inhabiting bottom sediments) population density. The relationship between concentrations in caged mussels and sediments was weak owing to the route of contaminant exposure through water and the high proportion of plankton in their diets. Sediments from many sampling stations were toxic to test organisms in laboratory experiments; however, mortality was not correlated with sediment contaminant concentrations, except for a sub-set of stations along the Dow nearshore (Bedard and Petro, 1997).

A BEnthic Assessment of SedimenT (*BEAST*) methodology is currently being applied by Environment Canada scientists to 16 upstream and downstream locations adjacent to industrial sites in the St. Clair River. The *BEAST* methodology will further address the concern over mercury biomagnification and involves the assessment of sediment quality based on the physical and chemical attributes of sediment and overlying water, benthic invertebrate community structure, sediment toxicity tests and invertebrate body burdens. Contaminant concentrations in biota provide evidence of bioavailability and can be used to assess the risk to higher trophic levels due to biomagnification. Integration of these lines of evidence and study results are pending further analyses and will be used to address sediment characterization/remediation.

Sport Fish Contaminant Monitoring Programs

The Michigan Guide (2001 Fish Advisory) is prepared by the Michigan Department of Community Health (MDCH). It reports fish advisories due to mercury and PCBs in carp, freshwater drum, and gizzard shad, and due to levels of PCBs in walleye. The Guide to Eating Ontario Sport Fish (2003-2004) is prepared jointly by the Ontario Ministry of Natural Resources and the Ontario Ministry of the Environment. Consumption advice for each species is based on health protection guidelines developed by Health Canada. Information on the St. Clair River in the guide is based on 1999 fish collections. It advises against consumption of several fish species in the upper, middle and lower St. Clair River as a result of concentrations of mercury, PCBs, dioxins and furans, chlorinated benzenes, pesticides, and/or mirex. Species include walleye, northern pike, rock bass, carp, white sucker, and redhorse sucker throughout the river as well as lake trout, chinook, freshwater drum, yellow perch, and gizzard shad in some locations. Concentrations of PCBs in walleye and white sucker exceeded the 2.5 ng/g yardstick.

Elevated mercury concentrations continue to be found in walleye sampled from the St. Clair River, with larger fish containing the highest body burdens (Figure 7). The data also reveals that St. Clair River walleye have exceeded the 0.5 ug/g RAP biota yardstick as recent as 1999. Walleye sampled from the upper and middle sections did not exceed the RAP yardstick in 2003; however, data were not available for the lower River.

Trend information on mercury in St. Clair River walleye (39-51 cm) indicates a high degree of variability (Figure 8). While walleye sampled from the upper River have experienced a general reduction in tissue concentration between 1985 and 1999, a slight increase was found in 2003. Mercury concentrations in walleye from the middle and lower portion of the River are variable and show not trend over time. In general, the temporal data for the entire St. Clair River suggest that mercury concentrations in walleye have not decreased significantly. Consumption advisories continue to be placed on most of the above mentioned fish species from other areas of the Great Lakes Basin including fish from open water; so advisories are not unique to the St. Clair River. Additional contaminants information is provided in Appendix 5 of the Technical Addendum.

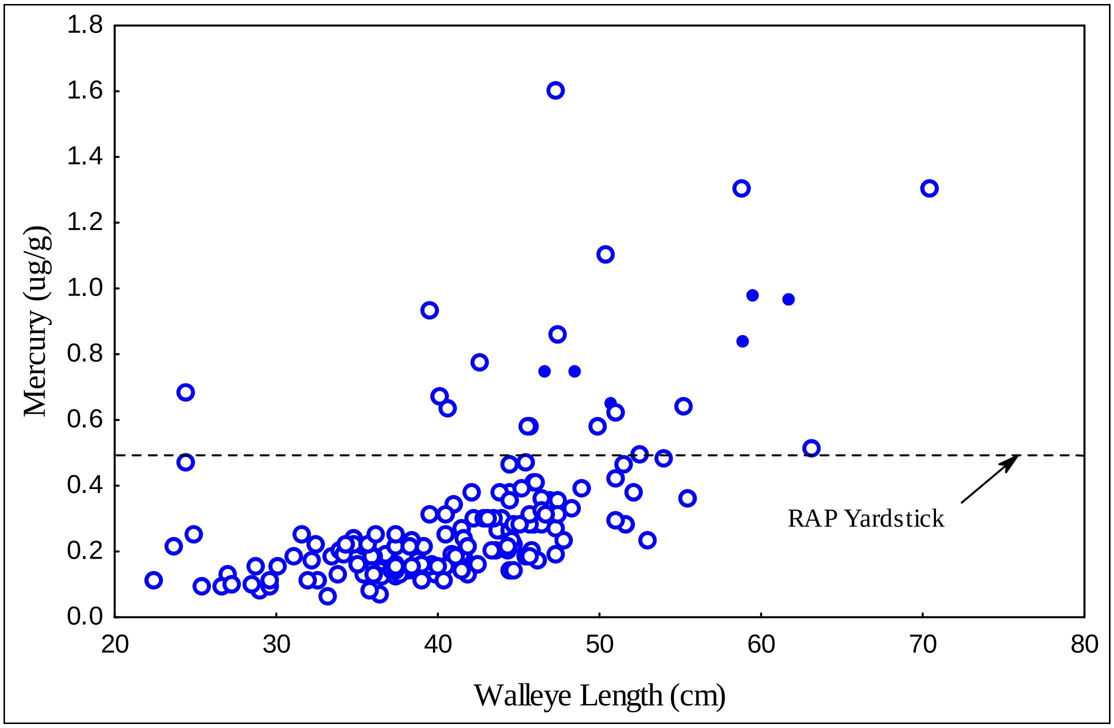


Figure 7. Association between mercury concentrations in walleye tissue and body length. Solid data points represent walleye sampled in 1999 that exceeded the RAP yardstick.

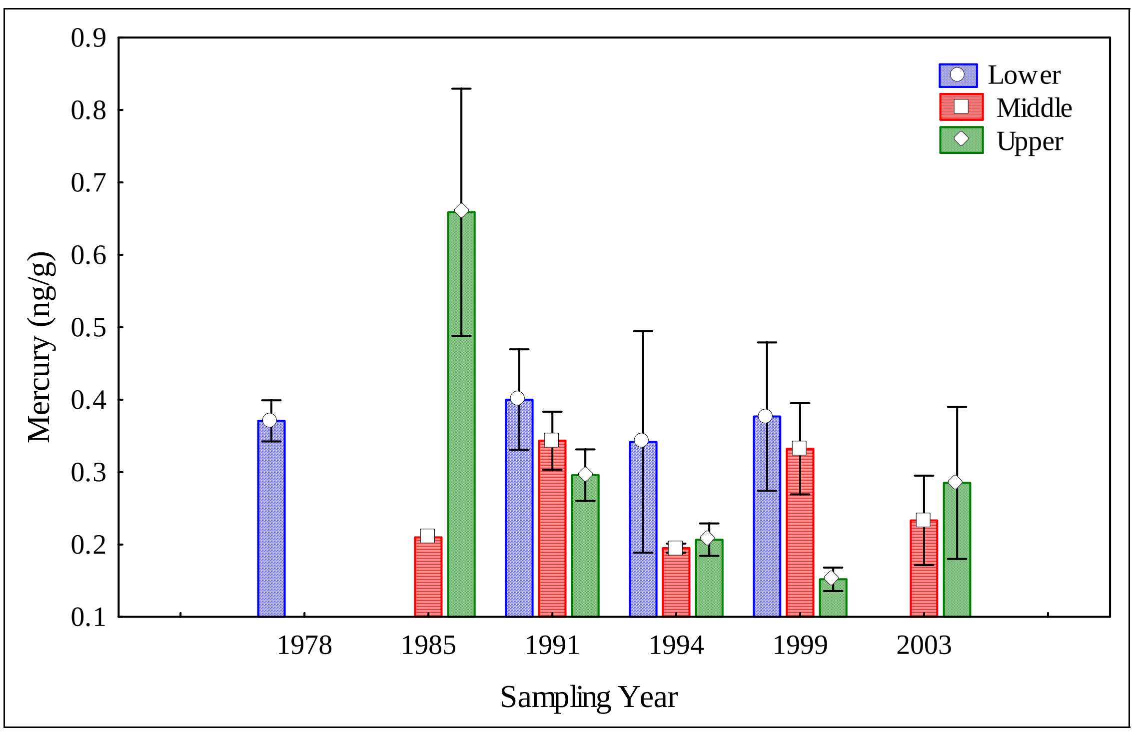


Figure 8. Temporal trend in total mercury concentrations in walleye (39-51 cm) sampled from the St. Clair River between 1976 and 2003.
Lines indicate standard error. (Source: OMOE)

Histology of Fish Livers

An elevated prevalence of liver cancer in fish populations from Great Lakes tributaries caused tumors to be among the BUIs in Appendix One of the 1987 Protocol Amending the Great Lakes Water Quality Agreement of 1978. Liver samples from 63 fish representing 17 species from different trophic levels were evaluated using histopathological criteria by the University of Guelph (Hayes, 2002). This beneficial use is considered impaired when "the incidence rates of fish tumors or other deformities exceed rates at control sites". No neoplasms were found in any of the liver samples examined. One carp assessed from the Sarnia Bay station had several altered foci of the type observed in some fish species from locations where liver cancers occur; liver neoplasms are rare in carp in other surveys. Thus, there is a possibility that these lesions might have been generated by exposure to mutagenic insult. In some species such as walleye, however, these lesions occur spontaneously regardless of habitat. Several fish had small granulomas often with various larval parasites. Some of these might have appeared grossly as tumours; however, these are all common inflammatory lesions that are not neoplastic. Many of the fish may have been too young for development of neoplasms. It was recommended that older fish be used in future surveys (Hayes, 2002).

Survey of Fish and Wildlife Consumption in the St. Clair River Area

The 1997 Stage 1 Update reported on a controlled study involving a subjective olfactory sensory evaluation of fish tainting (Myllyoja and Johnson, 1995). The study results revealed that no noticeable odour could be detected in walleye caught from the Bluewater Bridge or from the vicinity of the main industrial point sources. It was then suggested that the status of 'tainting of fish and wildlife flavour' be changed from "requiring site-specific studies" to "not impaired" with additional confirmation from an extensive angler survey. The following is a summary of findings from the St. Clair River shoreline fishing and fish and wildlife consumption survey (Dawson, 2000).

The study was conducted over two seasons from 1996 to 1997 and involved a multidisciplinary research team. Data was collected using structured questionnaires, semi-structured tape recorded conversations and field notes taken by research assistants. Research assistants drove the length of the St. Clair River from the Bluewater Bridge to Mitchell's Bay daily in search of interviewees. In addition to fish consumption, researchers also collected data on aquatic wildlife (waterfowl, furbearers and turtles) consumption from September 25th until December 12th in 1996.

Of the 1295 St. Clair anglers approached, 126 refused to participate and another 245 were previously surveyed. Thus, the statistics for the report were generated from the responses of 924 participants. One hundred and six of the 924 St. Clair River anglers had also eaten aquatic wildlife in the 12 months prior to being interviewed. Their responses provided information on the consumption of aquatic wildlife.

Although 15 locations were surveyed along the River, the majority of fishermen were typically found at the Lambton Generating Station (21%), the grain elevators/government docks south of Point Edward (16%) and in the vicinity of the Bluewater Bridge (15%). Other popular fishing spots were Sarnia Bay, Suncor/Chippewa's Reserve and Talfourd Creek (8% each), Mitchell's Bay (6%), Chenal Ecarté (4%) and Sombra locations and Port Lambton (3%) (Figures 1 and 2). The top five species of St. Clair River fish consumed – in terms of greatest number of participants reporting- were (1) walleye, (2) yellow perch, (3) rainbow trout, (4) coho salmon and (5) smallmouth bass.

Just over a third (316) of St. Clair interviewees had not eaten fish from the River over the 12 months prior to the interview. When asked why, nine percent of the 'non-eaters' responded that the fish were dirty/contaminated and that they had concerns about contamination from historical and current industrial practices and spills to the River. Two percent gave as a reason, a “bad smell or taste” as to why they prefer not to eat fish.

Just over half (51%) of the fish consumers (591), when asked if they had any ‘concerns’ about the fish from the River, answered ‘no’. Many felt that there had been significant improvement in environmental quality since the 1960s and 1970s. The migration of fish and the small quantity of fish consumed were also cited as reasons why fishermen felt it was safe to consume St. Clair River fish. The author of the report also emphasized that many in this group disregarded media reports, public opinion and judgments of others in defense of value-oriented values.

In contrast, forty-nine percent (291) of St. Clair Fish consumers had concerns about the fish they caught. Of these, 48% said that the water was polluted/dirty, 40% were concerned that the fish were dirty/contaminated, and 17% indicated concern about fish tumours and deformities.
Tainting of fish was also reported as a concern by 4% of interviewees. Tape recorded interviews and field notes included references to fish tainting with non-specific descriptions such as “smelled bad”, “didn’t smell/taste right”, and had an “indescribable” smell - to specific references to a “urine” or “chemical” smell, or petrochemical odours and flavours like “oil”, “crude”, “petrochemicals” and “gasoline”. Although anglers included locations like “the grain elevator” and “Bluewater Bridge” where fish had a tainted smell, it was usually Talfourd Creek and the Lambton Generating Station which received most concern due to previous experiences. While most interviewees referred to tainting incidents as isolated, several indicated that fish caught at the Generating Station regularly smelled or tasted “oily”, especially during particular times of the year.

There were 106 St. Clair Participants who had eaten and reported on the quality of aquatic wildlife. In decreasing order, mallard ducks, Canada geese, wood duck, teal, canvasback, bufflehead, redhead, black duck, gadwall, goldeneye and lesser scaup were eaten with the greatest frequency. Five participants (5%) reported meals of turtle, four (4%) reported eating frogs and one participant reported consuming duck/goose eggs. No interviewee raised the issue of chemical contamination of wildlife and most claimed not to eat enough aquatic wildlife to warrant worrying. There was no mention of tainting of wildlife flavour.

Given the contrasting results between the sensory evaluation and the Angler study, and the fact that these studies were conducted in the mid- to-late 19902, it is recommended that this BUI undergo further assessment in the St. Clair River and Delta to reflect current conditions. Participation from First Nations, U.S. and Canadian residents is necessary to reflect all interests.

Canadian Wildlife Service Contaminant and Reproductive Parameters

There is no systematic monitoring program that examines environmental contaminant exposure and the associated health effects in wildlife inhabiting the St. Clair AOC. Reasons for this are associated with the quality and quantity of wildlife habitat. Much of the shoreline on both sides of the Upper St. Clair River is urbanized/industrialized, and construction of bulkheads along the riverbanks further reduces the amount of suitable wildlife habitat. By contrast, the lower St. Clair River is shallow and slow-moving, and the extensive St. Clair Flats and associated wetlands provide more opportunity for wildlife monitoring. In the 1991 Stage 1 - Environmental Conditions and Problem Definitions, “bird and animal deformities or reproductive problems” was listed as impaired due to chironomid mouth part deformities. No wildlife evidence was provided; however, the document stated that studies specifically examining this issue had never been completed.

The following provides a summary of the available information on contaminant exposure and reproductive outcomes for snapping turtles, black and Forster’s terns and mink. These studies were conducted in the vicinity of the Walpole Island First Nations' Territory. Contaminant levels of PCBs measured in snapping turtles, terns and mink exceeded the environmental yardstick value of 2.5ng/g. Refer to Appendix 6 for a comparison of contaminant concentrations among wildlife indicators.

Snapping Turtles

Contaminant concentrations in snapping turtle eggs from Walpole Island have been measured on three separate occasions during the 1990s. Results from the 1999 study indicate that the mean total PCB concentration (240 ng/g) has not changed markedly from concentrations measured in 1995 or 1992 (Ashpole, 2003; CWS database). The mean total PCB concentration in Walpole Island eggs is low relative to the St. Lawrence River AOC, Hamilton Harbour AOC, Wheatley Harbour AOC, the Detroit River AOC, but higher than the St. Clair National Wildlife Area (NWA) (74.2 ng/g) (de Solla and Fernie, 2004) (Figure 9, appendix 6).

Turtle eggs from Walpole Island had a higher mean p,p'DDE concentration (8.8 ng/g) than eggs from an inland reference site at Algonquin Park (6.4 ng/g), but an approximate 8-fold lower concentration than eggs from Hamilton Harbour (69.0 ng/g). Additional values are presented in Appendix 6.

The total mercury concentration (110 ng/g dry weight) measured in eggs was two-fold greater than eggs from the Hamilton Harbour AOC (50 ng/g), but lower than concentrations (720 ng/g) measured in eggs from the Akwesasne Territory located within the St. Lawrence River AOC (Ashpole, 2003; CWS database).

Of most importance to the assessment of the BUI "bird and animal deformities and reproductive problems" was the assessment of 20 snapping turtle eggs from each clutch to determine hatching success and deformity rates. The results demonstrated that the frequency of egg mortality varied widely within and among several different study sites. No difference was found between Walpole Island turtle eggs (8.4 – 17.4 %) and eggs from the Algonquin Park reference site (0.04 – 26.0 %) or Hamilton Harbour (14.0 – 17.0 %). The frequency of hatchling deformity in individuals from Walpole Island (17.0 to 26.7 %) was similar to the Algonquin Park reference site (19.1 to 38.4 %) and Hamilton Harbour (7.05 -23.0) and lower than rates observed in turtles from the Raquette River/Turtle Creek sites (40.0 to 70.0 %) in the St. Lawrence River AOC.

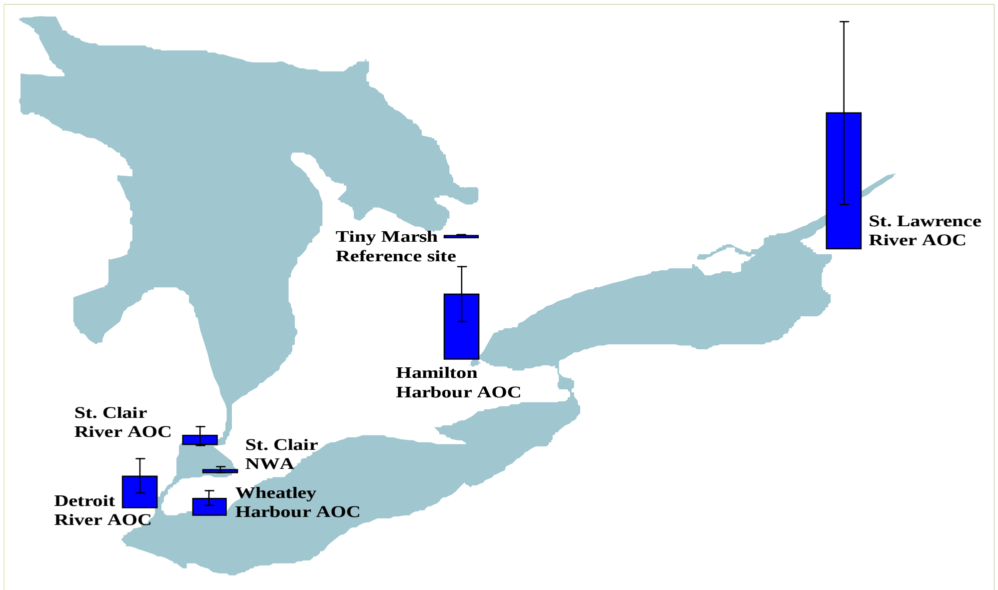


Figure 9. Comparison of the mean total PCB concentrations in turtle eggs collected from Areas of Concern within the Great Lakes – St. Lawrence basin (1999-2001).

Black and Forster's Terns

Colonial marsh-nesting black and Forster's terns were monitored from May to August in 1999 to determine egg contaminant concentrations, assess the potential for contaminant-induced reproductive impairment and to assess the utility of these species as indicators of marsh quality. Eggs of black and Forster's terns were collected from the Snye Channel and St. Anne's areas of Walpole Island First Nation, as well as from Tiny Marsh (an inland reference site near the southern extent of Georgian Bay) and Lake Simcoe, Ontario. Black tern eggs from Walpole Island had higher PCB (1.86 ug/g) and p,p'DDE (0.18 ug/g) concentrations than eggs from Tiny Marsh (PCBs, 0.23 ug/g; p,p'DDE, 0.08 ug/g). The mercury concentration in eggs from Walpole Island 0.16µg/g was similar to for Tiny Marsh (0.17µg/g).

The total PCB concentration in Forster's tern eggs from Walpole Island First Nation has remained fairly constant, with a mean PCB concentration of 4.53 ug/g in 1992 and 4.40 ug/g in 1999. Eggs collected from Walpole Island First Nation had an almost two-fold greater PCB concentration than eggs from Lake Simcoe (2.41 ug/g). The mean p,p'-DDE concentration (0.62 ug/g) in Forster's Tern eggs has decreased 58% from the level measured in 1986 (1.47 ug/g). The results of the most recent p,p"-DDE analysis is similar to egg concentrations from Lake Simcoe (0.82 ug/g).

Fifty-one black tern nests and 32 Forster's tern nests were marked at Walpole Island and at the reference sites in order to assess hatching and fledging success. Black Terns from Walpole Island had a minimum hatching success of 34 %. While this is low, it is not unusual for this species; however, many nests were flooded out as a result of naturally occurring high water levels during the summer of 1999. A comparison with the reference site at Tiny Marsh (11%) was difficult as predation by northern water snakes at Tiny Marsh may have been a factor. Forster's Terns at Walpole Island had a minimum hatching success of only 22 % while 58 % of all nests were washed out or otherwise destroyed by high water, winds and boat wake.

Wild Mink
Mink are top mammalian carnivores in the Great Lakes ecosystem and can accumulate high concentrations of persistent contaminants. Mink have small home ranges and provide a sensitive biological indication of PCB contamination for upper trophic levels of the Great Lakes ecosystem. This study examined contaminant burdens in liver tissue from trapped mink. Thus, no reproductive endpoints were assessed.

The mean total PCB concentration in livers of mink did not differ significantly from inland mink or from non-AOC sites (range = 82 – 84 ng/g w.w.). The mean total PCB concentration was significantly lower when compared to the mean concentration found in mink from the western basin of Lake Erie (1,692 ng/g). Concentrations of p,p'-DDE (12.1 ng/g), dieldrin (3.4 ng/g) and mirex (0.4 ng/g) in livers of mink from Walpole Island, although higher than mink from the inland sites, where lower than concentrations measured in livers of mink from Lake St. Clair and the Western Basin of Lake Erie (see Appendix 6).

Of noteworthy mention, is that the mean mercury concentration was highest in mink livers from the St. Clair AOC (2200 ng/g dry weight), but that this concentration did not approach the 92,000 ng/g biological effect level (Wolfe et al. 1998). Refer to Appendix 6 of the Technical Addendum for detail on wildlife contaminant concentrations and comparisons among Canadian AOCs of the Great Lakes - St. Lawrence basin.

In conclusion, evidence from snapping turtle research reveals that environmental contaminant concentrations are not negatively impacting upon the rate of deformities and reproductive success. Canadian Wildlife Service biologists also speculate that the low egg contaminant concentrations in black and Forster's terns are not likely to impact on the reproductive success and that other environmental factors may be causing the variation between sites. Although PCB and mercury concentrations exceeded the yardstick established for biota (2.5 ng/g and 500 ng/g respectively), concentrations in livers of Walpole Island mink did not exceed reproductive thresholds (980 and 220 ng/g ww for kit growth and survival) as defined by Wren et al. (1987) and Restum et al. (1998).

6.4 Effluent Quality

ONTARIO

Data on effluent quality for each of the four primary industrial sectors on the Ontario side of the AOC are derived from the Ontario Ministry of the Environment's monitoring requirements under the Clean Water Regulations. The data for each discharger are presented in Appendix 1, Volume 2. Guideline limits are established under the Municipal Industrial Strategy for Abatement (MISA) for selected parameters (average daily and monthly loadings) in process effluent on a facility-by-facility basis.

Petroleum Sector

The petroleum sector in the St. Clair River AOC is represented by the Imperial Oil Refinery (Sarnia), Shell Canada Products (Corunna), and by Suncor Inc. (Sarnia). Average monthly and average annual flows and gross loadings for the period 1994 through 2001 are provided in Appendix 1a in the Technical Addendum (Volume 2) for most facilities. All effluent guidelines noted in the tables are MISA regulatory limits established in January 1996.

Average annual effluent flows at the Imperial Oil Refinery were between 135,485.7 and 185,956.67 m^3/day with no distinct trend from 1994 through 1998. However, decreasing loading trends over this period are noted for benzene, total ammonium, phenolics, sulphide, and toluene, whereas, increasing average annual loading trends are observed for dissolved organic carbon, total phosphorus, and solvent extractables. No limits were approached or exceeded for any controlled parameter in any of the three years including dissolved organic carbon, total ammonium, phenolics, total phosphorus, particulate residue, solvent extractables, or sulphide.

Average annual effluent flows in the process effluent stream at the Shell Canada Products Refinery increased between 1999 and 2001 from 15,163.3 to 15,820.8 m^3/day; which amounts to about a 4% increase. However, decreasing loadings over the full period were noted for dissolved organic carbon, benzene, ammonium, total phosphorus, solvent extractables (oil content)), sulphide (total effluent – CP1000), and toluene (CP1000), whereas, variable to stable average annual loadings were observed for the other parameters. As in the case of Imperial Oil, no regulatory limits were approached or exceeded for any controlled parameter in any of the six years.

Average annual process effluent flows at the Suncor Inc. Refinery increased between 1999 and 2001 from 8,506.3 to 9,726.7 m^3/day; an increase of 14%. Decreases in loadings over the full period were noted for ammonium and sulphide. Benzene loadings decreased over the period of record except in 2001, during which average annual loading increased by about 1.5 orders of magnitude. This was due to high discharges during the month of November. The remainder showed variable loadings from year to year. During the eight years of record, only one limit exceedence was reported. The guideline for phenolics was exceeded in one month in 1998.

Organic Chemical Sector

A total of 8 direct dischargers represent the organic chemical sector in the St. Clair River AOC. These include: Amoco Canada Resources Ltd. (Sarnia), LANXESS Inc. Inc. (Sarnia), Chinook Group Ltd. (Sombra), Dow Chemical Canada Ltd. (Sarnia), Ethyl Canada Inc. (Corunna), Imperial Oil Chemicals Division (Sarnia), and Novacor Chemicals (Canada) Ltd. (Corunna and Mooretown). Average monthly and average annual data on flows and loadings are provided for each facility in Appendix 1b of the Technical Addendum (Volume 2). All effluent limits noted in the tables are MISA regulatory limits established in February 1998.

At Amoco Canada Resources Ltd., average annual effluent flows show little change from 1977 through 2001, although flows in the latest year were the highest during the period of record. The high average flows in 2001 were also reflected in the highest average annual loadings of aluminum, arsenic, benzene, copper and zinc in the same year. In contrast, loadings of mercury and dichlorobenzene were completely eliminated in the last year and loadings of dissolved organic carbon, sulphide, and particulate residue declined over the period of record. During 1998, exceedences of monthly average loading limits were recorded in 6 of 10 months for dissolved organic carbon (3 kg/day), in only one month for phenolics (0.0023 kg/day), in two months for total phosphorus (0.41 kg/day), and for one month for particulate residue (3.7 kg/day). Exceedences were also observed in 1999 for total phosphorus (2 months), in 2000 for dissolved organic carbon (4 months), and in 2001 for benzene (1 month), dissolved organic carbon (4 months), phenolics (2 months), and particulate residue (1 month).

From 1995 through 2001, average annual loadings from LANXESS Inc. Inc. tended to increase for total ammonium, however benzene loadings were eliminated in 2001 and marked reductions over the period of record were reported for aluminum, cobalt, dissolved organic carbon, phenolics, total phosphorus, solvent extractables, bromoform, chloromethane, chloroform, and methylene chloride. MISA limits were exceeded for total cobalt in six months in 1998, nine months in 1999, ten months in 2000, and six months in 2001. The limit for total kjeldahl nitrogen was exceeded in only one month during the entire period of record (in 1999).

Average annual effluent flows at Chinook Group Limited ranged between 309.05 and 356.61 m^3/day with no specific trends observable from 1997 through 2001. During this period, notable loadings decreases were observed for dissolved organic carbon, ammonium, total Kjeldahl nitrogen and solvent extractables (particularly in the 1999 to 2001 period). Increasing average annual loadings were recorded for chromium and zinc. Of particular note at this facility is the relatively high number of exceedences of MISA limits throughout the period of record which consisted of a total of 43 months with data (see Appendix 1b). These included during each of the 43 months for dissolved organic carbon and particulate residue; 42 months for total Kjeldahl nitrogen; 38 months for solvent extractables; 37 months for total phosphorus; 35 months for total ammonium; and 13 months for zinc (all occurring during 2000 and 2001).

Average gross effluent flows and contaminant loadings for Dow Chemical Canada Inc. are presented for only the Vidal Street Sewer as the Scott Road Sewer was shut down in 1998. From 1999 through 2001, average annual effluent flows at the Vidal Street control point varied between 4155.9 m^3/day and 6103.3 m^3/day, increasing throughout the 3 years, particularly from 2000 to 2001. This flow increase was also reflected in 2001 increased average annual loadings for aluminum, ethylbenzene, dissolved organic carbon, total ammonium, total Kjeldahl nitrogen, phenolics, total phosphorus, particulate residue, trichlorobenzene, hexachloroethane, and triclhlorotoluene. Notable loading decreases were noted for bis-2chloroisopropyl ether, dichloroethane, and dichloropropane, the latter of which was not present in effluent during 2001. This effluent stream has established MISA regulatory limits for 19 parameters and it is notable that during the entire period of record, only one exceedence was recorded (total phosphorus).

Ethyl Canada Inc.'s final effluent average annual flows have declined over the 1999 to 2001 period, from 5835.4 m^3/day to 3412.0 m^3/day. As noted above (section 4.1), Ethyl Canada has reduced its effluent flows, including process effluent, significantly. This is reflected in decreased loadings of most parameters monitored. There are no MISA regulatory limits on any parameters in the plant's final effluent. MISA limits are in place for a small process stream (Appendix 1b); however, there have been no discharges from this stream since 1998.

Average annual effluent flows at Imperial Oil Chemicals Division have declined from 1995 (34,402.5 m^3.day) through 2001 (29,798.4 m^3/day). This is reflected in significant average annual loadings reductions over this period for all parameters monitored including dissolved organic carbon, phenolics, particulate residue, solvent extractables, and vinyl chloride. In addition, loadings of benzene, toluene, total phosphorus, and hexachlorobutadiene were eliminated. No MISA regulatory limits were exceeded.

Effluent data are provided for both the Mooretown and Corunna facilities of Novacor Chemicals Ltd. At the Corunna facility, average annual flows and contaminant loadings have been variable over the 1997 through 2001 period with few distinct trends. Slight overall decreases in loadings of dissolved organic carbon (Mooretown) and phenolics (Corunna) have been recorded. MISA regulatory limits were exceeded on only one occasion for dissolved organic carbon at Mooretown, however, exceedences at Corunna include solvent extractables (once each in 1999 and 2000), and residue particulate (twice in 2000).

Inorganic Chemical Sector

The inorganic sector is represented by four direct dischargers: Cabot Canada Ltd, Sarnia; Praxair Canada Inc, Mooretown and Sarnia; and Terra International (Canada) Inc, Courtright. Average monthly and average annual flow and loadings data for each source are provided in appendix 1c of Volume 2. Guideline loading values are MISA regulatory limits established in February of 1998.

At Cabot Canada Ltd, flows generally decreased between 1997 and 2001, as did average gross loadings of aluminum, dissolved organic carbon, particulate residue, and solvent extractables. Phosphorus and zinc average annual loadings were quite variable from year to year and nitrate loadings tended to increase. Cabot Canada Ltd. reported no limit exceedences in any year for aluminum; however, the guideline for dissolved organic carbon was exceeded on a monthly average basis on four occasions in 1998; six occasions in 1999, and once each in 2000 and 2001. The MISA regulation limit for particulate residue was exceeded during two months in 1999 and one month in 2000.

Average annual gross effluent flow at Praxair Canada Inc. (Mooretown) was variable until 2001 when flows decreased significantly to 0.556 m^3/day from 7.16 m^3/day during the previous year. Significant reductions in all parameters monitored (copper, dissolved organic carbon, total phosphorus, particulate residue, solvent extractables, and zinc) were also recorded during the last 2 or 3 years of record. There were no exceedences for any parameter in from 1997 to 2001.

Praxair Canada Inc. (Sarnia) reported no exceedences for dissolved organic carbon, total phosphorus or solvent extractables; however, exceedences on a monthly average basis occurred for all other parameters monitored. In 1998 exceedences occurred in one month only for aluminum, in four months for copper, in seven months for particulate residue (0.46 kg/day), and in three months for zinc.

Although average annual gross effluent flow did not change much between 1999 and 2001, Terra International (Canada) Inc. (Courtright), reported increasing loadings of aluminum, fluoride, sulphate, and zinc. Nitrates tended to decrease on an average annual basis and all other parameters were variable from year to year. MISA exceedences occurred for dissolved organic carbon during one month in 1999 and for particulate residue during three months in 1999, one month in 2000 and two months in 2001. The monthly limit for total Kjeldahl N was exceeded once in 2000 only.

Thermal Generating Sector

Only one facility – Ontario Power Generation's Lambton Generating Station – represents this sector in the AOC. Appendix 1d in the Technical Addendum (Volume 2) provides monthly and average annual data on effluent flow volume as well as gross loadings of Al, Fe, particulate residue, and solvent extractables for the 1995 through 2001 period.

Average annual flows have almost tripled over this period (4,342.2 to 12,632.2 m^3/day) and the gross loadings of all parameters have increased as well. Average annual gross loadings for aluminum increased from 1.1577 kg/day to 5.7249 kg/day; iron from 0.16951 to 1.0129 kg/day; particulate residue from 9.84 to 128.06 kg/day (reaching 301.907 kg/day in 1999); and solvent extractables from 1.245 to 3.727 kg/day. There are no reported compliance guidelines for any of these parameters.

Spills

The 1991 Stage 1 Report of the St. Clair River RAP identified "restrictions on drinking water consumption" and "added cost to agriculture or industry" as beneficial use impairments. The primary cause was chemical spills to the river which affected downstream water supplies, resulting in mandated closures to water treatment plants. The Stage 2 RAP criterion for removal of this BUI is "no treatment plant shutdowns due to exceedences of drinking water guidelines over a two year period". As reported in the 1997 Update Report, this criterion had been met, with the last mandated closure occurring in 1994. It was then recommended that the status of these BUIs be changed to "not impaired".

The data for spills from Ontario sources from 1998 through 2002 as reported to the OMOE Spills Action Centre (SAC) are provided in Table 4. Over this period, the number of spills has remained low and no Water Treatment/Filtration Plant shutdowns have been ordered by public agencies. The number of reported spills is well below those reported between 1986 and 1989 (70 to 135 total spills annually) and less than half reported in 1996.

Table 4. Summary of reported spills to the St. Clair River from Ontario Sources 1998 – 2002.

Year	Chemical	Petroleum	Total
1998	5	3	8
1999	1	7	8
2000	3	6	9
2001	0	2	2
2002	1	2	3

One of the largest spills reported in 2000 occurred in December at Nova Chemicals (Corunna). The spill entered the storm water pond which discharges to Talfourd Creek. Approximately 4,600 to 4,700 barrels of product containing 30 to 35% benzene escaped from two lines at the DPG unit. The Ontario Drinking Water Standard for benzene is 5.0 ppb and the maximum concentration recorded at the storm water pond overflow was much less than the standard at 0.7 ppb. In January 2001, the Nova Chemicals Styrene Plant in Sarnia experienced a spill of about 300 to 400 barrels of product. The spill occurred over a large area of open field from a long section of 6 inch pipe. No material escaped to the river. Neither of these incidents resulted in water treatment plant intake closures.

However, despite the significant reduction in the number of spill from Ontario point sources to the St. Clair River highlighted in Table 2, large spills were again reported in 2003. In August 2003, the OMOE responded to two vinyl chloride spills into the St. Clair River from Royal Polymers in Sarnia that occurred during the “blackout”. As a precaution, down-river water users as well as local health agencies were notified of the spills. The results from water samples taken after the spills showed that vinyl chloride was not detected in the treated drinking water supplies. The Ministry issued an Order to the Company on August 28, 2003. In response to the order, the company implemented a number of safeguards aimed at reducing the potential for future spills to the St. Clair River. Following an investigation into the spill by the Ministry of the Environment, charges were laid against Royal Polymers. On May 19, 2005, the company pleaded guilty to three counts under the OWRA. For discharging, or causing or permitting the discharge of a material into a watercourse that may impair the quality of the water the company received a $100,000 fine. For failing to immediately notify the Ministry of the discharge, the company received a $105,000 fine. For operating a sewage works other than in accordance with its Certificate of Approval, the company received an additional $50,000 fine for a total of $255,000 in fines plus a 25 per cent victim fine surcharge.

In February 2004, the OMOE responded to a spill of methyl ethyl ketone and methyl iso-butyl ketone into the St. Clair River from Imperial Oil Ltd. in Sarnia. As per established notification procedures, the downstream water users were notified along with local health agencies. The water intakes were subsequently shut down at Walpole Island and Wallaceburg. The OMOE issued an Order to the company requiring the submission of a report on the cause of the spill and the submission of a spill prevention plan to prevent a similar re-occurrence. The company complied with the order. The spill incident was referred to the Ministry's Investigations and Enforcement Branch and charges were subsequently laid against Imperial Oil Limited for permitting the deposit of a deleterious substance into the St. Clair River which is frequented by fish contrary the Fisheries Act. On August 16, 2005 the company was fined $300,000 after pleading guilty to one count under the Fisheries Act.

In view of the recent spill events and intake closures at Walpole Island and Wallaceburg, the proposed redesignation in status of “restrictions on drinking water consumption” and “added cost to agriculture or industry" requires consideration. The redesignation of these BUIs will be considered by the Four Party Agencies in accordance with the steps described in section 2.1.

MICHIGAN

Data on effluent quality for the industrial and municipal sectors on the Michigan side of the AOC are derived from the NPDES Permit Compliance System. The data, presented as total annual flows and loadings from 1995 through 1998 for each discharger, is presented in Volume 2, Appendix 2. Table 5 presents the combined annual flow and loadings data representing all Michigan sources to the St. Clair River from 1995 through 1998. These loadings are not restricted to the area of the AOC (St. Clair County) but include all sources within the drainage basin of the St. Clair River including the Black and Belle Rivers (including parts of Sanilac, Lapeer and Macomb counties).The highest loadings of total phosphorus and zinc to the St. Clair River from Michigan point sources occurred in 1995 with subsequent years being one-half to one-third less. In general, however there are no distinct trends over the four years of record with regard to flow volumes or total annual loadings of the parameters monitored.

Table 5. Annual total point source loadings for St. Clair River 1995 to 1998 from all Michigan point sources (all parameter loadings in kg/year).

Parameter	Year				
	1995	1996	1997	1998	TOTALS
Total Phosphorus	123,685.70	63,991.79	76,769.12	60,988.29	**325,434.82**
Arsenic	0.71	1.20	1.38	0.54	**3.83**
Cadmium	0.97	2.53	2.13	3.04	**8.67**
Copper	1,946.92	606.10	18,912.69	1,059.24	**22,524.95**
Nickel	19.65	43.79	62.22	51.59	**177.25**
Zinc	148,799.90	58,238.47	43,061.55	43,874.42	**293,974.34**
Chloroform	0.10	0	0.21	0	**0.31**
Toluene	0.21	3.04	3.99	1.49	**8.73**
Benzene	0	0	0	0	**0**
Mercury	2.11	2.24	0.66	1.21	**6.21**

Michigan Industrial Point Sources

Total annual loadings and flow data for major Michigan industries are provided in Appendix 2a of Volume 2. Data are provided for DECO (Detroit-Edison) (Greenwood, St. Clair, Marysville and Belle River), E.B. Eddy Paper, Crown Paper (Port Huron), and Cargill Salt.

The DECO plants represent the Thermal Electric Generation Sector, with three of the plants coal fired and one plant (DECO Greenwood) oil/gas fired. Parameters monitored at the facilities include phosphorus and copper (Greenwood and St. Clair Plants), phosphorus only (Marysville), and arsenic and cadmium (Belle River). Loadings of arsenic and cadmium at the Belle River Plant were significantly reduced over the period of record with both parameters eliminated in the 1997 and 1998. Loadings of total phosphorus were also eliminated in the final two years of record at both the St. Clair and Marysville Plants. Total phosphorus at the Greenwood facility was more variable from year to year with the largest loading discharged during 1998. Copper monitored at the Greenwood and St. Clair Plants generally show a strong decline over the period of record, however, loadings at the latter plant increased significantly from 1997 to 1998. As of 1999, all four DECO plants were fully in compliance with their NPDES permits.

The permit for Crown Paper (Port Huron) requires monitoring only for copper. Copper loadings did not display any particular trends over the period of record. As of 1999, this facility was out of compliance due to paper coating losses, solids loadings violations and turbidity releases to the river. As noted in Section 4.1 (above), this company has been making upgrades to their wastewater treatment system to respond to these problems.

Domtar's (formerly E.B. Eddy Paper) NPDES permit requires monitoring for total phosphorus, cadmium, and copper. Annual flow volumes increased over the period of record, but no trends in total phosphorus, cadmium, or copper loadings were apparent. As of 1999, the plant was considered to be generally in compliance with its permit but occasionally has overflows to the Black River.

The NPDES permit for Cargill Salt Division requires monitoring for total phosphorus, copper, and zinc. Total phosphorus loadings decreased significantly over the four year period of record, however, no discernable trends are apparent for the other two parameters. As of 1999, Cargill Salt was noted as having a history of conductivity problems but is currently taking measures to correct this (Section 4.1).

Michigan Municipal Point Sources

Total annual loadings and flow data for major Michigan Waste Water Treatment Plants (WWTP) and Sewage Lagoons (WWSL) in St. Clair County are provided in Appendix 2b of Volume 2. Data are provided for Algonac WWTP, Capac WWSL, Marine City WWTP, Marysville WWTP, Port Huron WWTP, St. Clair WWTP, and St. Clair River SA WWTP.

All facilities monitor total phosphorus loadings. In addition to total phosphorus, the St. Clair River SA, monitors copper and mercury, and St. Clair WWTPs monitors mercury. Zinc is monitored at the Marine City, Marysville, Port Huron, and St. Clair WWTPs and cadmium is monitored at the St. Clair WWTP. Phosphorus loadings from these seven St. Clair County WWTPs and WWSL contribute 32% of the total phosphorus loadings to the St. Clair River from all Michigan sources (Table 4). The largest single source is the Port Huron WWTP (18.5% of the total Michigan sources), followed by the Capac WWSL, and the Marysville WWTP. Annual total phosphorus loadings from these facilities were relatively constant over the four year period of record (1995 to 1998). Cadmium loadings at the St. Clair WWTP decreased significantly over the period of record from 0.52 kg/year in 1995 to 0kg/year in 1998.

These facilities account for only about 7.7% of the copper loading from all Michigan sources to the St. Clair River. The Port Huron WWTP is the largest municipal source, contributing about 90% of all municipal loadings (1,568.50 kg over the four years of record). In general there are no distinct trends over the four years with the exception of the St. Clair WWTP where copper loadings steadily decreased from 11.33 kg/year in 1995 to 7.3 kg/year in 1998.

Zinc loadings from all municipal sources are less than 5% of all Michigan sources. The largest source is Port Huron which contributed over 95% of the municipal loadings. Again, only the St. Clair WWTP showed any trend over the period of record with zinc loadings decreasing from 219.28 kg/year in 1996 to 24.06 kg/year in 1998.

Virtually all the mercury loadings from Michigan sources were derived from the St. Clair and St. Clair River SA WWTPs over the 1995 to 1998 period. The former WWTP was the largest single contributor with over 97% (6.04 kg total over 4 years) of the total Michigan loadings. Loadings at the St. Clair WWTP did not show a distinct trend; however loadings in 1997 and 1998, combined, were less than half of those in 1995 and 1996, combined. As of 1999, the Port Huron, Marysville, Marine City, and St. Clair SA WWTPs were in compliance with their NPDES permits. The St. Clair WWTP has experienced a mercury violation which is being addressed as part of a mercury minimization plan. The Algonac WWTP was also not in compliance as of 1999, and MDEQ has pursued action against the facility.

6.5 Air Quality

The actions for point source discharges to air listed in the 1995 Stage 2 Recommended Plan include an inventory of atmospheric releases so that contribution of air pollutants to the AOC can be assessed and to determine the impact of air emissions on the St. Clair River. The primary data available for air quality in the St. Clair River AOC includes the local area air quality monitoring network maintained by the Sarnia Lambton Environmental Association (SLEA) and emissions data from Environment Canada's National Pollution Release Inventory (NPRI). In addition, the U.S. EPA and State of Michigan maintain data on toxic chemical releases and ambient air quality. Additional information was taken from the report "Air Quality in Selected Binational Great Lakes Urban Regions" (IJC, 2004).

NPRI Emissions Release Data

The National Pollutant Release Inventory (NPRI) provides Canadians with access to information on the releases of key pollutants in their communities. It is the only national, legislated, publicly web-accessible inventory of its kind in Canada. This level of transparency compels industry to reduce pollutant releases. It also helps the Government of Canada track progress in pollution prevention, evaluate releases and transfers of substances of concern, identify and take action on environmental priorities, and implement policy initiatives and risk management measures.

Tabulated results for air emissions for compounds such as ammonia, benzene, butadiene, ethylene, methanol, propylene and toluene, are found in Appendix 4 of the Technical Addendum.
Available data indicate that air emissions of most of these compounds have decreased between 1994 and 2002. However, the NPRI recorded increased emissions of methanol for Bayer (now LANXESS Inc.) and Dow Chemical Canada Inc. Emissions of ammonia have increased at Dow Chemical Canada Inc. and Imperial Oil (Sarnia Refinery), while data for Suncor Energy Products Inc. indicate increases in propylene and toluene in the 2002 data.

SLEA Ambient Air Monitoring

SLEA has operated an ambient air monitoring network for more than 40 years; the OMOE has operated additional monitoring sites in the area. The monitoring network consists of six air stations located along the St. Clair River from Sarnia to Courtright. A mobile monitor was introduced in 2000 that increases the range of the air monitoring system. The network analyzes air samples and records hourly averages of air contaminants such as sulphur dioxide, ozone, nitrogen oxides, volatile organic compounds, respirable particulate matter, and total reduced sulphur. Temporal trend data are available to the public via a website managed by SLEA.

Long-term sulphur dioxide (SO_2) concentrations in the Sarnia- Corunna area have changed little between the years 1988 and 2002, and are approximately one-half of the acceptable annual average concentration of 20 parts per billion. Government regulations are designed to maintain daily average SO_2 concentrations below the Ontario Ambient Air Quality Objective of 100 parts per billion (ppb). In 2003, there were five Lambton Industry Meteorological Alert (LIMA) alerts; during one of these, on October 20, the 24-hour criterion of 100 ppb was exceeded. The average SO_2 concentration was 106 ppb.

Ozone is continuously measured and hourly averages are recorded at monitoring stations in Corunna and Sarnia. In 2003, Ontario's Criteria of 80 parts per billion was exceeded during 41 hours in Sarnia and 38 hours in Corunna. However, these exceedances occurred during the summer months, when production of ozone is powered by the photochemical process. Long-term annual data collected between 1976 and 2002 indicate reductions in the yearly peak reductions for ozone levels.

Levels of total nitrogen oxides (NO_x) in the Sarnia-Lambton area declined significantly through the 1980s but they have remained relatively constant since 1990. Efforts are now underway to reduce industrial emissions of NO_x which will hopefully result in a downward trend in levels over the next few years.

Air samples are analyzed by SLEA on an hourly basis and records concentrations for each of the 50 volatile organic compounds (VOCs). Data collected between 1989 and 1999 show that the average annual concentration of all VOCs has declined from approximately 120 mg/m3 to 58 mg/m3 at Sarnia, and from approximately 84 mg/m3 to 30 mg/m3 at Corunna.

Particulate matter in the atmosphere of most concern to ambient air quality and human health are less than10 microns. Particles less than 2.5 microns ($PM_{2.5}$) have been added to the Ontario Air Quality Index program. The Ontario Ambient Air Quality Criterion for $PM_{2.5}$ is set at 30 $\mu g/m^3$, averaged over 24 hours. Although the annual averages in 2002 were 7 $\mu g/m^3$ for Sarnia, and 9 $\mu g/m^3$ for the Moore Line station, the 24-hour objective was exceeded at the Sarnia station on eleven occasions and at Moore Line on seven occasions. All of these incidents occurred during smog alerts on days when ozone concentrations were elevated, or southerly winds brought smog and its precursors into the region from distant heavily populated areas.

U.S. Toxic Release Inventory and Ambient Air Quality

The U.S. EPA's Toxic Release Inventory (TRI) is a database containing detailed information on nearly 650 chemicals and chemical categories that over 23,000 industrial and federal facilities manage through disposal or other releases, and waste management for recycling, energy recovery, or treatment. The 2003 TRI was released by EPA on May 11, 2005. The 2003 report indicates that total releases of toxic pollutants declined in Michigan by 23%. The searchable database, located at: http://www.epa.gov/tri/tridata/tri03/index.htm, provides information on fugitive and point source airborne emissions of chemical pollutants at both the state and county level.

In addition, the U.S. EPA and State of Michigan both maintain databases of ambient air quality in the state to ensure compliance with state and federal air quality standards. Information on statewide and county emissions of criteria air pollutants is available at www.epa.gov and www.michigan.gov/deq.

6.6 Summary of Trends and Conditions

It is difficult to statistically confirm contaminant trends in the AOC over this period compared to previous periods. Differences in data reporting, MISA/NPDES permit requirements, and locations of sampling methodologies make this problematic. However, it appears that concentrations of most contaminants in sediment (dredge spoils), air, water, effluent, biota and sport fish, are either the same as or less than those reported in previous periods. Few, if any contaminants in any media have been found to be increasing over the current period of record.

It would appear that the significant actions undertaken to address point and non-point source issues defined in the Stage 2 Report (see Table 2) have contributed to improving the overall environmental condition within the AOC. This is reflected in some respects in the relatively few compliance problems recorded in Ontario and Michigan, and by effluent loadings data which reveal either no strong trends or strong declining loadings. MISA loadings data did not indicate any significant increasing trends between 1994 and 2001 nor did the Michigan NPDES data through 1998/1999.

In addition, long-term monitoring data such as Environment Canada's head and mouth surveys of metals and industrial organics, the SLEA volatile organic monitoring station, the Ontario sport fish monitoring data, and the dredge spoil sampling by PWGSC in the lower delta; all indicate decreasing or static concentration trends and fewer exceedences of guidelines. In the case of the dredge spoil data, fewer than 5% of samples exceeded sediment guidelines and those which did, did so by narrow margins. The 2003/2004 Ontario Guide to Eating Sport Fish in Ontario continues to reveal exceedences of fish consumption advisories, but most exceedences recorded were at or near the lower guideline, well below the 'total restriction' levels.

Some key trends and conditions since the 1997 Update report are listed below.

- The frequency of detection of volatile organic compounds at Courtright is about half that reported in 1997 and fewer were above the SLEA voluntary advisory levels;
- Declining concentrations of industrial organics (OCS, HCB, HCBD) at Port Lambton and a spatial variation in mercury and total PCBs were measured in water and sediment;
- Average annual gross loadings were variable over the period of record. Across all facilities, however, decreasing trends were more common than increasing, notably for benzene, ammonium, toluene, dissolved organic carbon, solvent extractables, and other selected chlorinated organics;
- Generally, Ontario industrial facilities were well within most of their applicable MISA regulatory limits with the exception of Chinook Group Limited, which had the highest frequency of exceedences and number of parameters exceeding guidelines;
- Spill frequency continued to decline from 19 in 1996 to 3 in 2002. A spill of methyl ethyl ketone and methyl iso-butyl ketone into the River from Imperial Oil Ltd. in February 2004 resulted in the first water treatment plant intake closures since 1994;
- Total loadings of TP and zinc from all Michigan point sources decreased by one-half to one-third from 1995 to 1998;
- Loadings of arsenic, cadmium, and total phosphorus decreased significantly at some Michigan industrial facilities from 1995 through 1998;
- Michigan sources out of compliance included Crown Paper due to losses of paper coating material to its discharge, Cargill Salt was out of compliance due to elevated conductivity, St. Clair WWTP (mercury losses) and Algonac WWTP (location of outfall); and
- Loadings of individual contaminants from Michigan municipal sources generally did not show any major trends with the exception of the St. Clair WWTP which had significant reductions in cadmium, copper and zinc.

7.0 STATUS OF BENEFICIAL USE IMPAIRMENTS

Although the preceding sections identify significant remedial actions that have been undertaken in the AOC which have resulted in reduced loadings of many parameters to air and water, exceedences of yardstick values continue to occur. The data collected and reviewed since the 1997 Stage 1 Update does not provide sufficient evidence that any of the impairments to beneficial uses in the AOC may be delisted at this time (see the 1995 Recommended Plan for delisting criteria). A summary of the current status (based on data as recent as 2003) and information pertaining to each of the BUIs as defined in the St. Clair River AOC is provided in Table 6.

Research and monitoring, and/or additional data are required for the following BUIs:

- Restrictions on Fish Consumption continue to be classified as impaired based on the 1999 Ontario data for the upper, middle and lower river. More recent data is required from both Ontario and Michigan fish contaminant surveys;
- While a controlled olfactory sensory evaluation (1995) indicated no detectable tainting in walleye, an extensive survey of St. Clair River Anglers on the Canadian shoreline conducted in 1996-1997 reported tainting (taste and odour) in fish caught from various locations. As both reports were conducted in the mid to late -1990s, and were not inclusive of U.S. and First Nation residents, consideration must be given to further study;
- Bird and Animal Deformities or Reproductive Problems requires further investigation within areas of the St. Clair River and Delta to conclusively show that this beneficial use in not impaired;
- Dynamics of Benthic Populations/Communities (based on measured concentrations offshore Chemical Valley in Ontario) continue to be classed as impaired;
- Restrictions on Dredging Activities remains impaired due to sediment yardstick values being exceeded by mercury, various metals, total PCBs, HCB and nutrients;
- The frequency of chemical spills to the river has decreased dramatically since the Stage 1 RAP; however, due to recent spills and water treatment plant shutdowns, a review of the BUIs "Restrictions on Drinking Water Consumption or Taste and Odour Problems" and "Added Cost to Agriculture or Industry" is required;
- Beach Closings and Degradation of Aesthetics continues to be classified as impaired based on reports from the public and continuing CSO discharges in both Michigan and Ontario; however significant actions have taken place resulting in the extension of primary treatment facilities and the reduction of CSO discharges in both Ontario and Michigan;
- Loss of Fish and Wildlife Habitat continues to be classified as impaired and habitat loss continues; however actions toward delisting are ongoing through both non-point pollution control and habitat restoration programs. Supplementary information on programs in Michigan is required to fully evaluate the progress towards delisting.

Table 6. Summary of Great Lakes Water Quality Agreement (GLWQA) beneficial use impairments within the St. Clair River AOC.
Impairment abbreviations: I = impaired, NI = not impaired, A = requires further study on a site-specific basis, B = requires further study on a Great Lakes Basin-wide basis. Abbreviations qualified by an asterix (*) are those which a change in status was recommended in the 1997 Stage 1 Update and which require review.

GLWQA IMPAIRMENT OF BENEFICIAL USE	STATUS	CURRENT CONDITIONS IN THE ST. CLAIR RIVER
1) Restrictions on Fish and Wildlife Consumption		
Restrictions on Fish Consumption	I	Fish consumption guidelines are exceeded for lake trout, chinook salmon, smallmouth bass, rock bass, yellow perch, carp, walleye, freshwater drum, white and redhorse sucker, gizzard shad, and northern pike (MOE 2003; MDCH 2001). The role of exposure of fish to contaminants originating outside the St. Clair River relative to local sources is considered essential for a comprehensive evaluation. Additional monitoring is required for all three River sections simultaneously.
Consumption of Wildlife	B	Health Canada advises that consumption of commonly hunted Ontario waterfowl poses no health hazards. Additional study of the common merganser in the St. Clair river and the hooded merganser in Lake St. Clair is recommended (CWS 1997).
2) Tainting of Fish and Wildlife Flavour	A*	No tainting in walleye was found in a controlled study involving a subjective sensory evaluation (Myllyoja and Johnson, 1995. A subsequent intensive angler survey of the St. Clair River revealed reports of fish tainting along with references to specific tastes and smells from fish caught at various locations (Dawson, 2000). Given that the above studies were conducted in the mid-1990s, a more current evaluation should be considered.
3) Degradation of Fish and Wildlife Populations		
Dynamics of Fish Populations	NI	The fish community is considered diverse and fish community goals and objectives support the current fish community structure.
Body Burdens of Fish	B	The role of exposure of fish to contaminants originating from outside the St. Clair River relative to local sources is considered essential for a comprehensive evaluation.
Dynamics of Wildlife Populations	A	Preliminary study of waterfowl and amphibian populations in wetlands indicates no statistically significant differences between AOC and non-AOC sites (four AOCs including St. Clair were compared) except in the case of two amphibian species, which were less frequent in AOCs; significant additional study is required (Chabot 1996). Additional study is required to understand wildlife population trends.
Body Burdens of Wildlife	B	PCBs in eggs of the snapping turtle, Forster's tern and black-tern, and PCBs and mercury in mink livers are above RAP contaminant yardstick levels for biota (Ashpole, 2004; Weseloh, unpublished; Martin, 2004).

GLWQA IMPAIRMENT OF BENEFICIAL USE	STATUS	CURRENT CONDITIONS IN THE ST. CLAIR RIVER
4) Fish Tumours and Other Deformities	A	Analyses of 62 fish livers do not indicate abnormal incidence of tumour formation (Hayes, 2002). An assessment of older fish may be required to verify the results of the previous study.
5) Bird or Animal Deformities or Reproductive Problems	A*	The issue of chironomid mouthpart deformities has been assigned to the BUI category "degradation of benthos". A study on snapping turtles indicates that, while PCB concentrations exceed the environmental yardstick value, no deformities or reproductive problems were associated with contaminant exposure (Ashpole, 2004). Additional studies on wildlife contaminant exposure effects are required and delisting criteria developed for this BUI.
6) Degradation of Benthos		
Dynamics of Benthic Populations/ Communities	I	An increase in the number of taxa was noted in the 3 "priority 1" zones offshore of the Sarnia industrial area noted in the Stage 1 report, as compared to previous reports. A study (Beak International Incorporated, 1997) confirms that benthic communities in these zones remain impaired with no improvement since 1985. Current benthic community dynamic studies are required to assess present conditions in both the River and Delta areas.
Body Burdens of Benthic Organisms	B	Bioassay and sediment toxicity studies based on 1994 and 1995 sampling report RAP yardstick exceedences and PSQG lowest and severe effect level exceedences in the "priority 1" zones downstream of the Sarnia industrial area (Pollutech Enviroquatics Limited 1997). Test species mortality, growth, and reproduction were adversely impacted during sediment toxicity testing. Additional 1994 studies of sites offshore of the Sarnia industrial area reported sediment contaminant levels in excess of RAP yardstick and PSQG lowest effect levels, and moderate to high toxicity to test species (OMEE 1996c). Current studies that evaluate contaminant exposure and bioaccumulation are required to assess present conditions in both the River and Delta areas.
7) Restrictions on Dredging Activities	I	Exceedences of sediment yardstick values were recorded in the Southeast Bend Cutoff Channel for manganese, mercury, HCB, total PCBs, TKN, and total phosphorus, however, exceedences were less than 5% of samples collected and values were only slightly above yardstick (PWGSC 2001).
8) Eutrophication or Undesirable Algae	NI	The waters of the St. Clair river are mesotrophic and algae do not occur at nuisance levels.
9) Restrictions on Drinking Water Consumption or Taste and Odour Problems		
Consumption	I*	There were no OMOE or MDEQ-issued drinking water advisories or mandated water treatment shutdowns for several years prior to 2000, thus meeting the delisting criteria for this BUI. The status of this BUI requires re-assessment given reports that a number of facilities in the Sarnia industrial sector had allowed potentially harmful chemicals to spill into the St. Clair River since 2000.

GLWQA IMPAIRMENT OF BENEFICIAL USE	STATUS	CURRENT CONDITIONS IN THE ST. CLAIR RIVER
Taste and Odour Problems	I*	See above comment.
10) Beach Closings	I	Permanent signs warning of possible intermittent pollution of water are posted at 4 Ontario parks (Willow, Seager, Lambton Cundick and Brander). It has been recommended that postings remain until surveying indicates that water quality has significantly improved to a point where bacterial levels are consistently below Ministry of Health guideline (LHU--OMEE 1994, 1995). It has been recommended that public be made aware of effects of heavy rains on bacterial levels and that the role of non-point source pollution is investigated.
11) Degradation of Aesthetics	I	CSO overflow events continue in both Port Huron and Sarnia.
12) Added Cost to Agriculture or Industry	I*	There were no water treatment plant closures or associated interruptions in water supplies to industrial users between 1994 and 1997 (OMOE 1997; MDEQ 1997. The status of this BUI requires re-assessment given reports that a number of facilities in the Sarnia industrial sector had allowed potentially harmful chemicals to spill into the St. Clair River since 2000.
13) Degradation of Phytoplankton and Zooplankton Populations	NI	The species composition of phytoplankton and zooplankton reflect the oligotrophic to mesotrophic conditions of lower Lake Huron (Stage 1 RAP, 1991).
14) Loss of Fish and Wildlife Habitat	I	Michigan passed the Marine Safety Act which disallowed the use of personal watercraft in the marshy areas of Lake St. Clair Flats. The flats are the largest deltaic wetland system in the Great Lakes. Ontario – Natural Heritage Policies issued as a Provincial Policy Statement under Section 3 of the Planning Act (1997) requiring municipalities to “have regard to “ the protection of “significant wetlands: designated Provincially Significant Wetlands Natural Heritage System was completed for RAP (Geomatics International, 1998). Binational habitat management completed (Dutz, 1998). Much of the 240 ha target for rehabilitation of upland and riparian habitat on the Ontario side has been achieved, but no estimates of continuing habitat loss is available. Approximately 30% of the 440 ha target for rehabilitation of the Darcy McKeough Floodway has been achieved.

8.0 CONCLUSION

The restoration of beneficial uses is the cornerstone of Annex 2 of the Great Lakes Water Quality Agreement. Of the 14 BUIs defined by the International Joint Commission, nine were considered "impaired", two were considered to "require additional study on a site-specific basis" and three were considered "not impaired". The 1997 Stage 1 Update recommended a redesignation of four BUIs from "impaired" or "requiring further assessment on a site specific basis" to "not impaired". The change in status was based on the reduction in chemical spill frequency to the River from industrial facilities in Ontario and Michigan, partial results for fish tainting studies and a re-assignment of deformity evidence between BUI categories. While improvements in water quality have been achieved, delisting criteria requires updating and a formal binational process for the redesignation of BUIs must be followed to ensure consensus among agencies, the BPAC, stakeholders and the general public. Thus, the summary of impairments in the current Progress Report reflects the need for additional information and BUI redesignation process steps to be followed.

Although eight BUIs remain impaired, there have clearly been reductions in industrial and municipal loadings and in water contaminant concentrations from the mid 1990s to 2002. In fact, many industrial and municipal facilities are currently within established Ontario MISA or Michigan National Pollutant Discharge Elimination System (NPDES) permit regulatory limits. Hence, further reductions below these limits will be the result of further improvements in best management practices which individual facilities may implement.

Fish consumption advisories do not reflect the documented reductions in contaminant loadings to the river. However, many of these species are not year-round residents of the river and long-term trend data for whole water mercury is considered necessary for a complete evaluation. Further, such advisories are found for fish from throughout the Great Lakes, including the open water areas of southern Lake Huron, immediately upstream of the AOC. The relative role of basin-wide sources, local on-going sources, and local in-place sources (*i.e.*, historical sediment contamination) is not well understood. Likewise, the BUIs "degradation of benthos" and "restrictions on dredging" can in part be related to sources of historical contamination which have been remediated to some degree. The determination of the most cost-effective means of further remediation by dredging, and the assessment of cost/benefit of further removal vs. natural remediation should also be examined.

Further study that reflects current conditions is required in order to make a sound judgment on "tainting of fish and wildlife flavour". Similarly, supplementary investigation is required within the St. Clair River AOC to elucidate possible contaminant-induced biological responses relating to the BUIs "fish tumours and other deformities" and "bird and animal deformities or reproductive problems". Delisting criteria need to be established for the latter BUI as none currently exist. In regards to the "consumption of wildlife" and "body burdens of wildlife", additional monitoring studies should be conducted to determine current tissue contaminant concentrations in over wintering waterfowl and other local game species.

Beach closings continue, but clearly the actions taken by all communities to eliminate CSOs, illegal sewer connections, leaking septics, as well as treatment plant upgrades must be recognized. At some point we must evaluate the role of non-point sources of pollution, and whether the cost of further remediation to ensure that no beach is closed at any point during the recreational season is warranted to delist this BUI.

Aesthetic degradation is more easily assessed and may be on the verge of being delisted. The reduction in spills to the river since the early and mid 1970's contributes to the improving condition of this BUI but reevaluation is necessary.

Habitat continues to be lost despite restoration and enhancement actions taken by land stewardship initiatives, non-profit groups and agencies from all levels of government in both the United States and Canada. Although substantial effort has been made to restore terrestrial habitat and control non-point sources of pollution, an endeavor to quantify the current habitat status within the entire AOC, followed by an evaluation against the established delisting criteria are crucial for both sides of the St. Clair River AOC. Current information is required from both Michigan and Ontario initiatives to properly evaluate progress.

It would seem that the primary message from this update report is that we are seeing improvements in the environmental quality of the St. Clair River AOC. Nonetheless, all 45 implementation actions summarized in the 1995 Stage 2 Recommended Plan have yet to be completed and a full accounting of pollutant loadings is required for both U.S. and Canadian watersheds. It is also clear that all parties involved in the St. Clair River RAP process should undertake an objective evaluation of all assumptions and delisting criteria for each BUI based on knowledge gained and the current science. With this in mind, development of a clear and practical program for further remedial actions necessary to restore and delist the AOC will be possible.

9.0 SUMMARY OF RECOMMENDATIONS

1. A remedial action plan (RAP) implementation committee (RIC) is needed to function as the focal point for coordination, implementation and tracking of remedial actions in the St. Clair River AOC.
2. Monitoring of long-term trends in metals and organic compounds in water, sediment, fish and wildlife should continue in order to track the effectiveness of industry and municipal implementation actions as well as the removal and remediation of contaminated sediment in the St. Clair River.
3. In regards to "restrictions on fish consumption", the relative role of contaminants originating from the Great Lakes basin, local on-going and local in-place sources (*i.e.*, historical sediment contamination) is not well understood. A greater effort to determine contaminant sources is required.
4. Biennial fish collections and contaminant analysis for the upper, middle and lower St. Clair River is necessary to establish contaminant trends and to determine the effects of sediment remediation.
5. Given the contrasting results between the 1995 olfactory sensory evaluation of tainting of walleye flesh and the 1996-97 Angler survey, further assessment is recommended in order to reflect current conditions in the AOC. Furthermore, participation from First Nations and U.S. Anglers is a requisite for future studies in order to represent all stakeholders.
6. An investigation of older fish is suggested for the St. Clair River AOC to further examine "fish tumors and other deformities".
7. Additional monitoring studies are required to determine the extent to which contaminant exposure and uptake occurs in mergansers, over-wintering waterfowl and other game species to address the BUIs "consumption of wildlife" and "body burdens of wildlife". Wildlife contaminant monitoring is required within the Delta areas of WIFN territory to characterize north-south portions of different channels i.e., Chenal Ecarté, Johnston, Chematogan and Bassett Channels.
8. A review of the BUI "bird and animal deformities and reproductive problems" is essential and delisting criteria need to be developed for the St. Clair AOC. Because observations of elevated contaminant burdens in wildlife alone are not indications of ecological degradation, additional research is needed to investigate possible contaminant-induced effects.
9. The BUIs "degradation of benthos" and "restrictions to dredging" may be related to both current and historical contaminant discharges which have been reduced or eliminated. The determination of the most cost-effective means for further remediation by dredging, and the assessment of cost/benefit in further removal vs. natural recovery should be re-visited. The BEnthic Assessment of SedimenT (*Beast*) methodology will further address the concern over mercury biomagnification. At this point in time it may be necessary to decide how best to have cooperation from all parties, including industry. Further research is needed to address chironomid mouth-part deformities.
10. The delisting criteria for "restrictions on drinking water consumption or taste and odour problems" and "added cost to agriculture or industry" require reassessment given the recent spills to the St. Clair River. Further information is needed regarding spill prevention, notification and reporting mechanisms.
11. The re-establishment of a Habitat Work Group is required for the AOC. This will facilitate development of an updated inventory of aquatic and terrestrial habitats on both the U.S. and Canadian sides of the St. Clair River AOC and to determine the status of the BUI "loss of fish and wildlife habitat".

12. With increasing budget constraints faced by many agencies involved in the remediation processes, efforts to coordinate and integrate studies should be made in order to concomitantly address multiple BUIs i.e., “tainting of fish flavour”, “restrictions on fish consumption”, “body burdens in fish” and fish tumours and other deformities”. Standardized sample collections, standardized pathology diagnosis, and determining numbers for statistical confidence should be considered in the study design.

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ACRONYMS

AOC: Area of Concern
BATEA: Best Available Technology Economically Achievable
BEC: Binational Executive Committee
BPAC: Binational Public Advisory Council
BTEX: benzene, toluene, ethylbenzene, xylenes
CCG: Canadian Coast Guard
COA: Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem
C of A: Certificates of Approval
CSO: combined sewer overflows
CURB: Clean Up Rural Beaches
CWS: Canadian Wildlife Service
DDT: dichlorodiphenyltrichloroethane
DFO: Fisheries and Oceans Canada
EAA: *Ontario Environmental Assessment Act*
EBR: *Environmental Bill of Rights*
EC: Environment Canada
EPA: *Environmental Assessment Act*
GLWQA: *Great Lakes Water Quality Agreement*
HCB: hexachlorobenzene
HCBD: hexachlorobutadiene
IJC: International Joint Commission
LaMP: Lakewide Management Plan
MDEQ: Michigan Department of Environmental Quality
MISA: Municipal-Industrial Strategy for Abatement
OCS: octachlorostyrene
ODWS: Ontario Drinking Water Standards (formerly the Ontario Drinking Water Objectives)
OMAF: Ontario Ministry of Agriculture and Food
OMNR: Ontario Ministry of Natural Resources
OMOE: Ontario Ministry of Environment
PAH: polycyclic aromatic hydrocarbons
PCB: polychlorinated biphenyls
PEL: Probable Effects Level
PWGSC: Public Works and Government Services Canada
PWQMN: Provincial Water Quality Monitoring Network
PWQO: Provincial Water Quality Objectives
RAP: Remedial Action Plan
RIC: Remedial Action Plan Implementation Committee
SLEA: Sarnia-Lambton Environmental Association (formerly the Lambton Industrial Society)
TDI: Tolerable Daily Intake
TOC: total organic carbon
USEPA: U.S. Environmental Protection Agency
UTRCA: Upper Thames River Conservation Authority
VOC: volatile organic compounds
WIFN: Walpole Island First Nation
WPCP: Wastewater pollution control plants

APPENDIX 1. SUMMARY OF RAP IMPLEMENTATION MEASURES

ONTARIO

Basell Canada Inc. (formerly Montell Canada Inc.)

- reduced air emissions by 10 % in 1997
- completed characterization step of the Leak Detection and Repair program at the Sarnia Plant in 1998

LANXESS Inc.

- Instituted an employee Household Hazardous Waste Day in 1997
- Instituted operational measures to remove residual ammonia from the area of the Ammonia Refrigeration Unit during shutdowns resulting in the elimination of atmospheric releases
- In 1997, completed a process change at the rubber plant in which less toxic cyclohexane replaces benzene in the reactor feed
- Between 2000 and 2003 spent over $3 million on several projects including:
  - Installation of a secondary cooling loop water system the Butyl 1 facility to prevent process chemicals from leaking into river cooling water
  - Diversion of all process water and rainwater from processing areas to the BIOX plant
  - Treatment of all landfill rainwater at the BIOX plant
  - Installation of a secondary cooling loop system for oil from the compressor system at one operating facility
  - Institution of a spill prevention plan including construction of containment areas to divert spills and rainwater to the BIOX plant
  - Installation of a sophisticated monitoring system for all once through cooling water for selected chemicals
  - Upgrading of the pre-treatment area of the wastewater treatment plant
  - Replacement of sewer effluent monitoring analyzers

Cabot Canada Ltd.

- Installed bin vent filters on all finished product storage tanks to prevent release of fine particulates

Dow Chemical Canada Inc.

- River Separation Program (RSP) – a series of projects to eliminate spills and harmful discharges to the St. Clair River from operations was initiated in 1990
- The RSP included installation of new cooling tower at the Sarnia Site Polystyrene unit to eliminate the risk of hydrocarbons being released to the river
- In 1996, Dow removed the most contaminated sediments in the St. Clair River at the discharge of the Cole Drain
- In 1998 the RSP included the closing of the final two sewers
- Between 1994 and 1999 Dow has eliminated the area around the Scott Road landfill as a source of chlorinated organic chemicals to the river
- Remediation of contaminated sediments in the bottom of the Cole Drain (1998-99) has eliminated a residual source of contaminants to the river
- The Scott Road effluent discharge was eliminated in late 1999

- In June, 2001 the final phase of Dow's River Separation program was completed – this program has contributed to the prevention of all spills to the river since 1998
- The most highly contaminated sediments in the river offshore of the facility are undergoing remediation with 9,300 cubic yards removed in 2003

DuPont Canada Inc.

- in 1997 and 1998 reduced volumes of solid waste by 12.7% and 13% resulting in a total reduction of 81% since 1991

Ethyl Canada Inc.

- continuing efforts to ensure double containment at all unmonitored process outlets
- upgraded hydrocarbon monitoring system on plant's outfall to enhance reliability
- in 1998 eliminated the only remaining wastewater stream from final combined effluent resulting in occasional controlled batch discharges (rather than continuous) as the only process wastewater from the facility
- since 2000 have reduced total water use per unit of production by >70% (>90% since 1994) and have reduced total effluent volume by >65% (>85% since 1994)

Fibrex Insulations Inc.

- in 1997, installed insulation scrap recycler for off-specification product (5% landfill reduction)
- between 1993 and 1999, reduced coke consumption in plant's coke-fired cupola to one-fifth (2 million kg) by consistent measurement, reporting and improved process control

Imperial Oil Limited

- in 1996/97, over 400 leaking valves were restored with state-of-the-art technology resulting in air emission reductions of 300 to 350 tonnes per year
- in 1998, benzene emissions declined from 59 to 14 tonnes through the elimination of process vents, installation of floating tank roofs, installation of an on-line analyzer, and implementation of an annual leak detection and repair program (reduced by 85% between 1993 and 1998)

Ontario Power Generation Lambton Generating Station

- upgraded particulate collection equipment and stack emission monitoring instrumentation with technology which reduces energy consumption by 30 % for the particulate collection system
- in 1998, opened new $10 million effluent treatment system consisting of two clarifiers and other equipment allowing separation of suspended solids in wastewater from the boiler prior to discharge
- in 1999, installed Artificial Intelligence software on all four generating units resulting in a 15% reduction in NO_x and 0.5% improvement in heat rate

NOVA Chemicals

- upgraded Styrene facility in Sarnia to eliminate use of aluminum chloride as a catalyst resulting in elimination of potential for accidental hydrogen chloride gas releases and site waste reduction of approximately 750 tonnes per year
- in 1998, installed new $13 million state-of-the-art stripping tower which captures virtually 100% of the cyclohexane used in the A-Line process

- in 1999 implemented the EB Upgrade Project at an estimated cost of about $130 million which resulted in the reduction or elimination of hazardous waste streams (spent caustic waste, clarifier sludge waste, 1-4 emulsion waste) and reduced styrene air emissions by about 5 tonnes/yr
- following December 2000 spill at its DPG plant in Corunna, Nova undertook retrofitting of pipes and valves in order to prevent future occurrences
- storm water mitigation projects at Corunna have eliminated all discharges since December 2000(US$659,000)
- instituted groundwater monitoring project at the Corunna site to reduce the potential of off site migration of contaminants
- at the St. Clair River site, process improvements have resulted in a reduction of cyclohexane to the river by 74%
- several projects resulting in air emission reductions of styrene, naphthalene, hydrocarbons, and cyclohexane at various facilities (total costs >$1.9 million)

Shell Canada Products

- in 1998 constructed concrete viaducts under the St. Clair Parkway to protect piping of liquid hydrocarbon fuels and solvents from road salt corrosion
- developed an Environmental Management System which has achieved and maintained ISO 14001 certification

Sunoco Inc.

- on-going pollution control efforts resulted in 1997 benzene emissions being reduced by 80% over 1990 levels (10 versus 49 tonnes)
- in 1999 the refinery achieved certification under ISO 14001

Terra Nitrogen

- - completed second phase of $1.4 million water separation project in 1997

MICHIGAN

Crown Paper – Port Huron

- facility switched to a process additive at the screw presses (dewatering of solids) that has significantly reduced toxicity levels in effluent
- in the early 1990s, the plant installed spill containment structures; installed lamella for improved solids removal; and trained staff for the separation of coating waste from the paper machine process waste
- during 1999, upgraded clarifiers and developed an operational change to allow operators to divert heavy coating losses from specific areas in the mill to the dump chest.

Cargill Salt

- installed two 50,000 gallon tanks for the collection of process water overflow which is then injected back into wells (salt caverns) instead of overflowing to river
- installed conductivity alarms for condensers for discharge from multiple effect evaporators and installed remote pH and conductivity indicators to monitor the wastewater at the boiler house and the Alberger (flake salt evaporator)

- installed recirculation systems for the dust collectors (reusing process water for dust collection) along with a small well pump that cuts back intake of brine from the caverns.

Domtar (formerly E.B. Eddy)

- installed neutralization/equalization tank to equalize flow of process water and provide process isolation capability for up to 4 hours of process water flow
- in 1995, started wastewater treatment facility for Blue Water Fiber including primary and secondary treatment
- in 1997, added indirect heat exchanger/cooling tower system to Blue Water Fiber waste treatment system
- in 1999, added a dissolved air floatation clarifier to the Blue Water Fiber system and added additional air capabilities to Blue Water Fiber's secondary treatment system
- since early 1990s, added computer upgrades throughout E.B. Eddy Plant for better for treatment plant optimization
- replaced lift station pumps for better control of process water throughout the E.B. Eddy plant
- switched from chlorine gas to calcium hypochlorite (solid) to chlorinate effluent.

DECO St. Clair Plant

- no changes since 1990

DECO Marysville

- no changes since 1990

DECO Belle River

- installed an extra surge basin in the bottom ash transport system that discharges the treated wastewater to the St. Clair River (formerly discharged to the Belle River).

APPENDIX 2. PROVINCIAL AND FEDERAL SEDIMENT QUALITY GUIDELINES (ng/g) FOR SELECTED ORGANIC CHEMICALS AND MERCURY

Chemical	Federal TEL[a]	Federal PEL[b]	Provincial LEL	Provincial SEL[d]
Total PCBs	34.1	277	70	530,000
OCS	NA			
HCB	NA	NA	20	24,000
Total PAHS	NA	NA	4,000	
Mercury	170	486	200	2,000

NA, not available
[a] TEL = threshold effects level
[b] PEL = probable effects level
[c] LEL = lowest effects level
[d] SEL = severe effects level

APPENDIX 3. SUMMARY OF RAP DELISTING CRITERIA

Beneficial Use Impairments	Delisting Criteria
Restrictions on Fish and Wildlife Consumption	When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines, and no public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed.
Tainting of Fish and Wildlife Flavour	When survey results confirm no tainting of fish or wildlife flavor (IJC delisting criteria).
Fish Tumours and other Deformities	When the incidence rates of fish tumors or other deformities do not exceed rates at unimpacted control sites and when survey data confirm the absence of neoplastic or preneoplastic liver tumors in bullheads or suckers (IJC delisting criteria).
Bird or Animal Deformities or Reproductive Problems	No specific delisting criteria are developed for bird and animal deformities or reproductive problems.
Degradation of Benthos	When invertebrate community structure can be documented as unimpaired or intermediate as defined by recent OMOEE benthic investigations.
Restrictions on Dredging Activities	No limitations on disposal of dredging spoils.
Restrictions on Drinking Water Consumption or Taste and Odour Problems	No treatment plant shutsdowns due to exceedences of drinking water guidelines over a two year period
Beach Closings	Zero beach closings based on fecal coliform standards regulating beach closings over a two year period.
Degradation of Aesthetics	When over a two year period there is/are no, objectionable deposits, unnatural colour or turbidity, unnatural odour or unnatural scum/floating materials.
Added Cost to Agriculture or Industry	No plant shutdowns attributable to water quality over a two year period. No added costs for the disposal of contaminated sediments.

Beneficial Use Impairments	Delisting Criteria
Loss of Fish and Wildlife Habitat	Protection: 1. Ensure that sufficient enforceable mechanisms are in place to protect existing aquatic and wetland habitat from cultural destruction or degradation, including filling, dredging, adversely affecting the hydrology, cutting or removing vegetation required for habitat, and allowing pollutants such as sediment, excess nutrients or toxic substances to enter aquatic or wetland habitat. 2. Acquisition: Acquire into public ownership an additional 800 acres (324 ha) of wetland habitat in Michigan by the year 2000. 3. Protect existing habitat in Ontario. Restoration and Enhancement: 1. Of the 5200 ha (12,844 acres) identified as Candidate Sites in Ontario, complete the following habitat rehabilitation projects by the year 2000: - Chenal Ecarte Wetland Creation (155 ha) (384 acres) - Stag Island (80 ha) (198 acres) - Darcy McKeough Floodway (445 ha) (1,100 acres) 2. Reclaim and restore 200 acres (81 ha) of Michigan state-owned public bottomlands currently in private use by the year 2000. 3. Restore an additional 150 acres (61 ha) of wet prairie/meadow habitat in Michigan by the year 2000 4. Enhance 2000 acres (809 ha) or wildlife habitat in Michigan by the year 2000 5. A long term habitat management plan for both Michigan and Ontario, including an assessment of needs (GAP analysis) relating to wildlife diversity and integrity, will be completed to ensure continued habitat restoration and protection beyond RAP delisting.

ST. CLAIR RIVER RAP
PROGRESS REPORT

Volume 2 – Technical Addendum

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March 2005

FOREWORD

This volume provides a summary of reports and key data pertaining to sediment, water, biota and air since the 1997 Update Report. For each data report, a full citation is provided along with a short annotated description of the report contents. Full data tables of MISA loadings and Michigan NPDES Permit results are provided in the appendices. These data tables support the descriptions and interpretations provided in Volume 1 but are too large to include in the summary volume. Other data and information provided by individual government scientists, government agencies and industry are referenced only in Volume 1 with the exception of the head and mouth survey data provided by C.H. Chan of Environment Canada.

The reports and data described in this volume are synthesized and interpreted with regard to their implications on the implementation of remedial actions within the AOC and the resulting status of Impairments to Beneficial Uses in the companion volume (Volume 1) of this St. Clair River RAP Progress Report.

TABLE OF CONTENTS

SUMMARY OF REPORTS

A. Water Quality

1997 Annual Report, Water Quality Assessment Program

Source: Ortech Corporation 1998
Where: Courtright pumphouse station on the St. Clair River
What: continuous (once per hour) water monitoring for target compounds

Data Available: Tables summarizing method detection limits, historical episodes with concentrations greater than 1 ppb for select contaminants (note: the parameters have changed over the period summarized), monthly summaries of results for 17 contaminants (expressed in terms of guideline exceedence--not absolute values.

Prepared by the Ortech Corporation for the Sarnia-Lambton Environmental Association (formerly Lambton Industrial Society), this report summarizes the 1997 sampling program. In 1997, 8,642 samples were analyzed for 20 different compounds (primarily volatile organics) resulting in 172,840 separate results. Only 1968 of the results showed values higher than or equal to the method detection limit (MDL--minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the concentration is greater than zero). No results equaled or exceeded the MOEE advisory levels. It is not possible to directly compare the number of results greater than the MDLs for all the years of operation due to the implementation of lower MDLs in May 1991 and September 1995. The resulting trend shows that while the total number of detections has remained constant, the number of results greater than advisory levels has declined substantially with the exception of 1996. In 1996, results that exceeded advisory levels were attributed to a non-industrial source. As expected, pH levels did not fluctuate notably during 1997, and the temperature of the river was comparable to that of previous years with the exception of May and June which were seen to be the coldest since 1990.

1998 Annual Report, Water Quality Assessment Program

Source: Ortech Corporation 1999
Where: Courtright pumphouse station on the St. Clair River
What: continuous (once per hour) water monitoring for target compounds

Data Available: Tables summarizing method detection limits, historical episodes with concentrations greater than 1 ppb for select contaminants (note: the parameters have changed over the period summarized), monthly summaries of results for 17 contaminants (expressed in terms of guideline exceedence--not absolute values.

Prepared by the Ortech Corporation for the Sarnia-Lambton Environmental Association (formerly Lambton Industrial Society), this report summarizes the 1998 sampling program. In 1998, 8,526 samples were analyzed for 20 different compounds (primarily volatile organics) resulting in 170,520 separate results. Only 2468 of the results showed values higher than or equal to the method detection limit (MDL--minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the concentration is greater than zero). Only one result equaled or exceeded the MOEE advisory levels. It is not possible to directly compare the number of results greater than the MDLs for all the years of operation due to the implementation of lower MDLs in May 1991 and September 1995. The resulting trend shows that while the total number of detections has remained constant, the number of results greater than advisory levels has declined substantially with the exception of 1996. In 1996, results that exceeded advisory levels were attributed to a non-industrial source. As expected, pH levels did not fluctuate notably during 1998, and the temperature of the river was comparable to that of previous years with the exception of February, September, October and December which were seen to be the warmest since 1990.

1999 Annual Report, Water Quality Assessment Program

Source: Ortech Corporation 2000
Where: Courtright pumphouse station on the St. Clair River
What: continuous (once per hour) water monitoring for target compounds

Data Available: Tables summarizing method detection limits, historical episodes with concentrations greater than 1 ppb for select contaminants (note: the parameters have changed over the period summarized), monthly summaries of results for 17 contaminants (expressed in terms of guideline exceedence--not absolute values.

Prepared by the Ortech Corporation for the Sarnia-Lambton Environmental Association (formerly Lambton Industrial Society), this report summarizes the 1999 sampling program. In 1999, 8,567 samples were analyzed for 20 different compounds (primarily volatile organics) resulting in 171,340 separate results. Only 2910 of the results showed values higher than or equal to the method detection limit (MDL--minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the concentration is greater than zero). No results equaled or exceeded the MOEE advisory levels. It is not possible to directly compare the number of results greater than the MDLs for all the years of operation due to the implementation of lower MDLs in May 1991 and September 1995. The resulting trend shows that while the total number of detections has remained constant, the number of results greater than advisory levels has declined substantially with the exception of 1996. In 1996, results that exceeded advisory levels were attributed to a non-industrial source. As expected, pH levels did not fluctuate notably during 1999, and the temperature of the river was comparable to that of previous years, although January was seen to be the coldest month since 1990.

1986 to 2001 St. Clair River Head and Mouth Surveys

Source: C.H. Chan, Ecosystem Health Division, Environment Canada
Where: St. Clair River at Point Edward (head) and Port Lambton (mouth)
What: Monthly sampling of suspended sediments and water for selected metals, OC's, PAH's

Data Available: Data files listing annual results at Point Edward and Port Lambton for metals (Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sr, V, Zn) and organic contaminants (OCS, HCBD, HCB, Fluorene, Phenanthrene, Pyrene, Fluoranthene).

The data consist of Excel files only and there is recent technical summary or report available. Graphs have been prepared for selected metals (Cd, Cu, Fe, Pb, and Zn) and organic contaminants (OCS, HCBD and HCB) in water. These are presented in the companion synthesis report (Volume 1).

1996 to 2001 MISA Monitoring Data for Ontario Point Source Dischargers

Source: Ontario Ministry of Environment (source self-monitoring data)
Where: All industrial and thermal-electric effluent discharge points
What: Monthly loading data for controlled parameters

The data have been provided from MOE in Excel spreadsheet format. The data are provided in Appendix 1 of this volume in tabular format by sector.

B. Sediment Quality

2000 Lower St. Clair River Dredge Spoil Monitoring Study

Source:	Public Works and Government Services Canada (PWGSC)
Where:	South East Bend Cutoff Channel, St. Clair Delta
What:	Nutrients, Metals, Pesticides, and Industrial Organics in sediment (see Volume 1)

C. Biota Quality

Binational Habitat Management Plan

Source:	Dutz 1998
Where:	St. Clair Area of Concern
What:	Preliminary development of a long-term binational habitat management plan including a gap analysis
Data available:	A comparison of historical vegetation (amount and type) versus current vegetation (amount and type) for Ontario and Michigan. In addition, there is a brief review of current natural area protection mechanisms in both Ontario and Michigan. Provides both short and long-term recommendations for habitat conservation and restoration.

This report is a first step in the completion of a gap analysis for the St. Clair AOC. A gap analysis attempts to determine species representation (vegetation and/or wildlife) and protection in a particular study area (in this case the AOC) and attempts to determine gaps in biodiversity representation. This gap analysis is a continuation of the Natural Heritage System (NHS) mapped for the St. Clair Area of Concern (Geomatics 1997). The NHS identified upland forest, wetland and riparian areas for the AOC. In addition, areas for restoration and rehabilitation were mapped. The NHS also examined historical vegetation in both Ontario and Michigan using early surveyor maps and journals.

Limitations to the conclusions provided in this report are mainly due to the discrepancies between historical and current datasets. To allow for an accurate comparison of historical and current biodiversity the representation of current vegetation types must be determined using similar classifications as the historical data. Information is also required on the current amount of vegetation classes with protection. When all of this information is assembled it can be used to set goals to attempt to retain representation similar to historical conditions in the AOC. The interim goals of the habitat plan are to retain 10% wetland cover, 20% forest cover, and 50% riparian cover in the AOC.

The Effects of Dredging versus the Effects of River Restoration on Mill Creek

Source:	Mill Creek Volunteer Monitoring Project 2000
Where:	Mill Creek, Michigan
What:	Comparison of data collected on different reaches of Mill Creek prior to and after dredging and stream rehabilitation projects.
Data Available:	Water and benthic macroinvertebrate sampling at seven sites along Mill Creek in the spring and fall of 1999 as well as the spring of 2000. Sites were chosen to represent natural stream channels, stream channels that had been dredged 50 years ago and channels to be dredged in 1999. Data collected included stream width, depth, surface water velocity, erosion, fish presence and benthic macroinvertebrates. From this data a water quality score was assigned to each sampling site.

To compare 1.75 miles of Mill Creek that were dredged and 15.25 miles that were restored data was collected on a core set of parameters using standard methods and forms (Save Our Streams). The data was verified by a DEQ biologist and entered into a State database. Seven sites along Mill Creek were sampled in the spring and fall of 1999 before the projects were initiated and sampled again in spring of 2000 after projects were completed.

Findings indicated that only the sites that had never been dredged received the highest quality score of excellent. Water quality scores generally decreased in the fall for five of the seven sites sampled. The two sites that were dredged decreased their scores from good to fair after dredging was completed. In addition dredged sites had to have their banks reshaped four months after project completion due to erosion. A recommendation was made to apply restoration practices instead of dredging on all reaches of Mill Creek.

Benthic Macroinvertebrate Survey

Source:	Zaranko Environmental Assessment Services 1998
Where:	Tributaries of the St. Clair River, Detroit River and Wheatley Harbour
What:	A survey of benthic macroinvertebrates to establish baseline water quality conditions in the rivers surveyed.
Data Available:	Summary of sampling protocols, location of sites sampled, and detailed inventory of benthic macroinvertebrates summarized by total organism density and total number of taxa for each sample. Water quality metrics determined using the Biological Monitoring and Assessment Program (BioMAP) protocols.

This report provides the results of a spring 1998 benthic macroinvertebrate survey on five tributaries of the St. Clair River (Talfourd Creek, Baby Creek, Bowens Creek, Clay Creek and Grape Run), a tributary of the Detroit River (Turkey Creek) and two watercourses associated with Wheatley Harbour (Muddy Creek and Two Creeks). The samples were processed according to the BioMAP protocols. This baseline data will be used to determine if water quality is different between benchmark and reclamation areas as well as establishing current conditions for future monitoring. Data were used to determine Water Quality Index (WQI) for each sampling site.

WQI for all sampling sites was well below the unimpaired water values for creeks (WQI $\geq$ 14), streams (WQI $\geq$ 12), and rivers (WQI $\geq$ 10). However, trends in the total number of taxa and EPT index (number of mayfly, stonefly and caddis fly taxa) were not evident between sites sampled. This finding did not corroborate findings of the WQI. Rehabilitation target WQIs were proposed for the tributaries sampled as follows: 5.9 to > 6.5 (creeks) and 5.0 to > 5.9 (streams). No rehabilitation target was proposed for rivers.

Sport Fish Contaminant Monitoring

Source:	Ontario Ministry of the Environment
Where:	The Upper, Middle and Lower St. Clair River
What:	A survey of fish contaminant concentration to establish consumption guidelines the St. Clair River.
Data Available:	A summary of years (1979-2001) and location of sites sampled, and contaminant concentrations (total PCBs and mercury) in walleye and white sucker tissues.

The Ontario Sport Fish Monitoring Program is carried out jointly by the Ontario Ministry of Natural Resources and the Ontario Ministry of the Environment. The data collected by the two agencies is summarized in the form of a Guide to Eating Ontario Sport Fish. The data used in this report reflect their findings. Additional data was provided in order to present graphical and tabular data which depicts the temporal and spatial contaminant patterns for mercury and PCBs in the tissue of walleye and white sucker.

The results for walleye reveal that mercury concentrations are highly variable, but that the Upper and Lower portions of the St. Clair River show a non-significant decreasing trend. When considering the entire River together, the high variability in the results indicates that mercury concentrations are not decreasing substantially.

Wildlife Contaminants Monitoring

Source:	Environment Canada, Canadian Wildlife Service
Where:	The Lower St. Clair River in the vicinity of Walpole Island First Nation's Territory
What:	A comparison among AOCs and other sites with regard to contaminant concentrations in eggs of snapping turtle, terns and livers if mink
Data Available:	A summary of multiple contaminant results in various species studied on Walpole Island First Nation Territory collected throughout the 1990s and as recent as 2002.

There is no systematic monitoring program that examines environmental contaminant exposure and health effects in wildlife inhabiting the St. Clair AOC. Reasons for this are associated with the quality and quantity of wildlife habitat. Much of the shoreline on both sides of the Upper St. Clair River is urbanized/industrialized, and construction of bulkheads along the riverbanks further reduces the amount of suitable wildlife habitat. By contrast, the lower St. Clair River is shallow and slow-moving, and the extensive St. Clair Flats and the associated wetlands of Walpole Island First Nation have provided more opportunity for wildlife contaminant monitoring.

PCB concentration in snapping turtles, terns and mink are lower than many other AOCs but still exceed the RAP yardstick of 2.5 ng/g. In contrast, mink and snapping turtles had higher mercury concentrations than AOC and reference sites. Reproductive parameters measured for snapping turtles did not differ significantly from the inland reference site at Algonquin Provincial Park.

D. Air Quality

National Pollutant Release Inventory (NPRI), Environment Canada

Source:	National Pollutant Release Inventory (NPRI) (www.npri-inrp.com)
Where:	St. Clair River corridor from Pt. Edward to Walpole Island
What:	On site pollutant releases to the air (temporal trend data) from Ontario industries located on the shores of the St. Clair River.
Data available:	Data is provided in the web page on a facility by facility basis with each parameter tabulated separately.

The National Pollutant Release Inventory (NPRI) provides Canadians with access to information on the releases and transfers of key pollutants in their communities. It is the only national, legislated, publicly accessible inventory of its kind in Canada. The NPRI is a starting point for identifying and monitoring sources of pollution in Canada. It is an important in monitoring indicators for the quality of our air, land, and water. It is also emerging as an indicator for corporate environmental performance.

Statistics from Environment Canada's NPRI concerning the amount of air releases, in tones, of various chemical substances from 23 facilities located in Sarnia, Corunna, Courtright, and Sombra Ontario, from 1994-2002 were reviewed. The most prevalent organic chemical substances were chosen for presentation in table format. This does not indicate the extent of chemical releases and the reader is referred to the website for further statistical data.

DATA APPENDIX 1. MISA MONITORING DATA FOR ONTARIO POINT SOURCE DISCHARGES

Data Appendix 1a. Petroleum Sector

Gross average 1994 to 1998 flows and loadings for Imperial Oil Products and Chemicals Division, Sarnia.

Facility: Imperial Oil Refinery, Sarnia [0000070102]							Control Points: 1400 (also 1500 where noted)							
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)*	1994	129280	119640	132930	124100	129160	132520	150570	160900	154430	132140	129850	130330	135487.5
	1995	128450	137490	144130	147130	149930	153120	164390	171940	144880	181750	169470	149840	153543.33
	1996	188480	182690	179570	181600	195300	205100	187810	169620	176320	202410	180920	181660	185956.67
	1997	163680	164900	157480	168190	166950	189460	200040	190000	189680	n/a	n/a	n/a	176708.89
	1998	152020	148130	153380	159030	167950	182710	n/a	n/a	n/a	n/a	n/a	n/a	160536.67
Benzene (kg/day)	1994	0.5876	0.3264	0.3162	0.2548	0.1461	0.3347	0.1724	0.1863	0.3398	0.1737	0.2103	0.1936	0.27016
	1995	0.3286	0.1423	0.327	0.4341	0.4102	0.2861	0.4007	0.5522	0.09287	0.4768	0.6019	1.03	0.42356
	1996	0.4963	0.3867	0.3137	0.3569	0.4586	0.1686	0.1097	0.1254	0.09816	0.5245	0.1473	0.3082	0.29117
	1997	0.07315	0.08588	0.049	0.0766	0.1354	0.1171	0.06605	0.1984	0.1483	n/a	n/a	n/a	0.10554
	1998	0.1178	0.1704	0.1645	0.3609	0.1197	0.07889	0.1131	0.075	0.1811	0.1502	0.0805	0.2095	0.1518
C dissolved organic (kg/day)	1994	160.1	187.1	220.8	280.1	132.8	144	88.73	73.82	75.08	133.2	85.11	148.6	144.12
Guideline** = 859 kg/day	1995	75.29	79.05	101.7	97.72	167	121.2	239.3	94.38	65.4	104.2	307.3	262.2	142.9
	1996	249.8	324.5	305.9	368.9	318.2	344.9	294.4	209.4	279.4	287.1	242.4	301.7	293.88
	1997	294.3	190.9	400.9	219.6	291.8	300.3	310.3	326.4	311.8	n/a	n/a	n/a	294.03
	1998	280.7	246.7	260.5	317.7	221.8	205.5	298.118	262.856	240.449	274.882	230.362	288.225	260.65
Total Ammonium (kg/day)	1994	5.816	7.679	7.461	12.78	3.186	9.456	18.34	3.279	3.168	57.56	19.05	13.25	13.419
Guideline** = 219 kg/day	1995	2.824	11.99	33.87	67.39	60.07	20.88	24.49	2.683	1.369	3.826	8.191	5.276	20.238
	1996	6.009	23.76	10.52	11.1	7.611	22.7	9.151	8.424	8.422	0.8534	1.62	31.7	11.823
	1997	1.21	3.045	1.189	1.603	20.34	23.28	1.092	1.232	2.058	n/a	n/a	n/a	6.1166
	1998	2.459	0.5421	0.9933	4.696	0.674	0.5062	4.8122	0.2485	0.9338	74.059	2.8944	18.0615	9.24
Phenolics (kg/day)	1994	0.06061	0.06853	0.07984	0.1037	0.09508	0.08082	0.07198	0.06179	0.06575	0.0865	0.1001	0.1002	0.081242
Guideline** = 0.65 kg/day	1995	0.07347	0.08393	0.1153	0.1221	0.1391	0.09902	0.08646	0.06556	0.04032	0.08148	0.1446	0.04556	0.091408
	1996	0.05126	0.06283	0.07667	0.06051	0.0732	0.05004	0.05519	0.05151	0.04811	0.03508	0.04666	0.5116	0.093555
	1997	0.06822	0.04212	0.03116	0.02984	0.06727	0.08626	0.06168	0.06243	0.08777	n/a	n/a	n/a	0.059639
	1998	0.04162	0.04781	0.04078	0.05238	0.03096	0.04214	0.03482	0.05896	0.07122	0.07895	0.06078	0.05535	0.051314
Phenolics (kg/day) (CP 1500)	1994	0.2329	0.2	0.2181	0.2116	0.2111	0.2592	0.2811	0.2876	0.2737	0.1996	0.2282	0.1975	0.23338
	1995	0.134	0.1424	0.2856	0.245	0.6265	0.2716	0.2589	0.2287	0.1751	0.3482	0.313	0.18	0.26742

Facility: Imperial Oil Refinery, Sarnia [0000070102]										**Control Points: 1400 (also 1500 where noted)**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1996	0.1858	0.08015	0.2251	0.2464	0.3206	0.2238	0.1732	0.1317	0.1819	0.1375	0.2358	0.1796	0.19346
	1997	0.188	0.1745	0.04013	0.05125	0.08591	0.1481	0.148	0.1111	0.07623	n/a	n/a	n/a	0.11369
	1998	0.07823	0.1061	0.1613	0.1529	0.1003	0.1156	0.15707	0.08583	0.06253	0.03365	0.88915	0.09566	0.16986
Total Phosphorus (kg/day)	1994	14.33	12.19	18.61	23.21	13.11	14.94	9.62	10.77	7.315	15.01	8.904	8.095	13.009
Guideline** = 41 kg/day	1995	5.871	6.278	6.601	10.53	6.766	9.444	11.58	10.78	6.991	5.274	10.12	19.45	9.1404
	1996	11.8	28.68	20.26	35.14	17.01	22.82	27.32	23.74	26.36	13.92	25.45	16.13	22.386
	1997	20.29	15.82	20.1	29.86	13.9	23.2	25.19	22.08	13.35	n/a	n/a	n/a	20.421
	1998	23.05	33.04	39.9	21.46	24.62	15.8	12.8718	22.4537	14.4796	23.517	13.4579	14.9111	21.63
Particulate Residue [RSP] (kg/day)	1994	241.3	346.5	472.7	418.9	424.7	355.2	119.1	110.5	72.58	200.9	170.1	98.08	252.55
Guideline** = 947 kg/day	1995	116.6	115.7	119.3	119.4	150	166.6	153.1	177.4	135	131.7	499.1	360.4	187.03
	1996	435.7	557.5	406.7	532.4	483.2	442.1	291.6	316.6	501.8	333.2	617.4	579.8	458.17
	1997	461.7	315.9	215	305.7	493.2	441.3	507.2	465.7	570	n/a	n/a	n/a	419.52
	1998	475.3	409.1	403.2	380.9	315.1	274.5	670.402	386.492	397.484	464.148	392.891	450.277	418.32
Particulate Residue [RSPLOI] (kg/day)	1994	200.7	320.3	417.4	406.6	292.4	383.4	308.9	245.6	202.8	211.2	304.7	264.1	296.51
Guideline** = 738 kg/day	1995	397.7	380.6	336.7	346.5	294	311.4	368.8	297.7	286.5	346.9	389.2	418.6	347.88
	1996	398.6	416.5	364.8	350.8	424.5	406.6	267.3	284.2	365.9	333.2	515.2	474.7	383.53
	1997	451.4	340.5	305.9	274.5	389.2	344.1	406.9	418.2	459	n/a	n/a	n/a	376.63
	1998	455.6	380.5	415.9	355.4	280.5	224.5	296.168	345.463	325.453	398.865	448.658	438.455	363.79
Solvent Extractables (kg/day)	1994	20.7	40.14	42.01	33.04	42.51	31.9	22.1	22.93	19.18	58.25	7.656	7.148	28.964
Guideline** = 316 kg/day	1995	5.1	7.671	16.82	13.87	11.75	10.98	13.36	16.92	11.5	15.51	49.23	32.99	17.142
	1996	18.23	56.45	24.98	56.51	21.91	10.97	19.44	12.32	77.64	38.19	36.22	52.97	35.486
	1997	82.07	53.54	37.1	67.19	74.34	53.2	82.69	32.12	110.1	n/a	n/a	n/a	65.817
	1998	74.39	106.4	107	85.08	50.31	40.35	39.0485	54.4334	52.2938	49.7805	59.3183	89.7355	67.345
Sulphide (kg/day)	1994	0.4142	0.6388	0.5014	0.513	0.9482	0.4456	0.4317	0.4986	0.2643	0.5243	1.329	0.7963	0.60878
Guideline** = 6.3 kg/day	1995	1.412	0.6913	0.458	0.5742	1.752	0.4979	1.514	0.653	0.1069	0.2939	0.771	1.654	0.86485
	1996	1.509	3.557	2.776	2.365	2.521	2.975	1.509	0.7648	1.998	0.1519	0.212	0.3799	1.7266
	1997	0.3607	0.3557	0.3512	0.2044	0.1945	0.4554	0.05044	0.04916	0.1641	n/a	n/a	n/a	0.24284
	1998	0.04157	0.9236	0.04343	0.04505	0.04001	0.08107	0.2139	0.0478	0.1127	0.3877	0.039	0.0438	0.1683
Sulphide (kg/day) (CP 1500)	1994	3.315	1.923	2.169	1.978	2.111	2.213	2.45	4.276	4.119	0	0	2.177	2.2276
	1995	0	0.08221	0	0.6234	3.236	0.9463	4.848	6.594	1.683	2.994	0.721	2.98	2.059
	1996	1.871	0.8025	1.745	0.7825	1.068	2.55	1.16	0.7397	0.7554	0.9039	0.8873	1.341	1.2172
	1997	2.293	1.607	3.782	0.8625	0.5653	1.249	0.3502	0.3316	0.3287	n/a	n/a	n/a	1.2633
	1998	0.2616	0.504	0.2622	0.2722	0.2963	0.3286	0.3425	0.3363	0.3457	3.976	0.2977	3.4451	0.88902

Facility: Imperial Oil Refinery, Sarnia [0000070102]							Control Points: 1400 (also 1500 where noted)							
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Facility: Imperial Oil Refinery, Sarnia [0000070102]								**Control Points: 1400, 1500**						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Toluene (kg/day)	1994	0.7124	0.344	0.4362	0.3298	0.3076	0.4588	0.141	0.2051	0.144	0.2605	0.1828	0.1501	0.30603
	1995	0.2613	0.1084	0.347	0.4672	0.3259	0.2577	0.3177	1.679	0.391	0.5172	0.5648	0.7316	0.4974
	1996	0.5032	0.3301	0.2932	0.3041	0.3148	0.2217	0.1629	0.1489	0.1414	0.9704	0.1993	0.4076	0.33313
	1997	0.08013	0.07229	0.03125	0.08331	0.1276	0.08937	0.04791	0.1372	0.2796	n/a	n/a	n/a	0.10541
	1998	0.1157	0.1927	0.1033	0.3436	0.102	0.05772	0.0769	0.1133	0.1834	0.1056	0.0631	0.2003	0.13813

* Total of Average Monthly Flows for CP 1400 and 1500
** Guidelines established January 01, 1996

Gross average flows and loadings for Shell Canada Products, Corunna.

Facility: Shell Canada Products Limited, Corunna [0000510107]										**Control Points: 0900, 1000**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow* m^3/day	1999	15500	14620	14430	14290	15360	15560	17210	15250	14250	n/a	n/a	n/a	15163.3
	2000	13020	14000	13260	13270	16230	17310	17320	17330	16830	14670	14410	15780	15285.8
	2001	15100	16040	15120	14300	14630	16650	17830	17850	17280	15670	14870	14510	15820.8
C dissolved organic (kg/day)	1994	53.98	80.33	129.90	113.10	85.78	87.06	70.50	52.41	75.62	76.68	118.50	96.27	86.68
Guideline** = 214 kg/day	1995	83.55	125.20	141.00	129.80	195.60	99.01	143.50	131.90	63.49	52.61	141.20	61.98	114.07
	1996	151.40	159.70	123.30	163.90	150.10	136.20	55.18	82.40	133.70	146.70	128.60	103.30	127.87
	1997	124.70	164.30	161.10	116.60	111.30	118.70	162.90	100.10	112.60	147.60	115.00	121.50	129.70
	1998	131.49	104.46	138.03	95.18	103.32	100.70	113.89	95.25	108.62	89.47	85.26	69.14	102.90
	1999	144.36	111.42	107.25	104.68	127.68	84.80	97.29	89.76	103.80	n/a	n/a	n/a	107.89
	2000	64.70	99.90	76.90	72.90	133.10	99.50	62.80	100.40	139.80	86.50	86.48	109.24	94.35
	2001	78.45	76.16	97.71	75.57	57.80	76.78	95.82	128.50	110.30	86.97	105.70	83.50	89.44
Ammonium (kg/day)	1994	9.978	70.180	0.785	0.782	0.507	6.029	3.652	0.247	0.347	15.390	5.284	0.610	9.483
Guideline** = 55 kg/day	1995	1.029	12.880	0.764	64.040	1.907	3.392	0	0.855	0	2.260	0.398	5.209	7.728
	1996	0.898	0.767	0.500	2.283	16.250	0.684	0.695	6.548	0.603	1.284	1.264	1.972	2.812
	1997	1.233	30.950	1.465	0.875	1.258	0.457	1.038	0.735	0.320	0.603	0.258	0.489	3.307
	1998	1.448	1.748	10.227	1.802	0.639	0.690	0.881	0.480	0.647	0.576	0.608	1.717	1.789
	1999	39.569	5.283	0.915	6.920	1.535	1.244	1.312	1.386	0.831	n/a	n/a	n/a	6.555
	2000	2.131	3.663	0.589	0.605	1.280	0.881	0.735	0.745	0.626	1.219	4.090	1.190	1.480
	2001	11.270	4.720	1.520	0.750	0.700	1.640	1.830	0.750	0.890	1.060	1.370	0.710	2.268
Benzene (kg/day) (CP1000)	1994	0.14900	0.08833	0.15220	0.11860	0.12200	0.09715	0.05796	0.04940	0.12700	0.03549	0.04833	0.08237	0.09399
	1995	0	0.09572	0.07832	0.04808	0	0.14380	0.25570	0.02202	0.10200	0.11200	0.04258	0.31090	0.10093
	1996	0.49750	0.21510	0.11650	0.13010	0.12260	0.02925	0.00610	0.05135	0.07335	0.02688	0.07649	0.07539	0.11838
	1997	0.07916	0.01034	0.01232	0.05634	0.01705	0.05882	0.05018	0.01003	0.01875	0.01666	0	0.00382	0.02779
	1998	0.11000	0.03000	0.02000	0.02000	0.04000	0.05	0.03000	0.02000	0.08000	0.03000	0.01000	0.01000	0.03750
	1999	0.07000	0.07000	0.01000	0.03000	0.05000	0.02000	0.02000	0.01000	0.02000	n/a	n/a	n/a	0.03333
	2000	0.03000	0.10000	0.07000	0.03000	0.05000	0.02000	0.02000	0.11000	0.19000	0.04000	0.06000	0.02000	0.06167
	2001	0.13000	0.06000	0.04000	0.09000	0.06000	0.04000	0.02000	0.02000	0.06000	0.04929	0.10000	0	0.05577
Phenolics (kg/day)	1994	0.0382	0.0490	0.0987	0.0636	0.0780	0.0986	0.0595	0.0172	0.0436	0.0271	0.0355	0.0308	0.0533
Guideline** = 0.16 kg/day	1995	0.0417	0.0741	0.1022	0.1013	0.0513	0.0664	0.0467	0.0733	0.0386	0.0378	0.0440	0.0485	0.0605
	1996	0.0423	0.0638	0.0654	0.0810	0.0898	0.1172	0.1076	0.1044	0.1090	0.1081	0.0455	0.0563	0.0825
	1997	0.0530	0.0580	0.0726	0.0594	0.0533	0.0689	0.0825	0.0470	0.0369	0.0431	0.0300	0.0455	0.0542

Facility: Shell Canada Products Limited, Corunna [0000510107]										**Control Points: 0900, 1000**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1998	0.0407	0.0606	0.0700	0.0641	0.0987	0.0848	0.1385	0.1114	0.1352	0.0925	0.0874	0.1166	0.0917
	1999	0.1302	0.1177	0.1357	0.1202	0.1329	0.1109	0.1589	0.1461	0.1166	n/a	n/a	n/a	0.1299
	2000	0.1217	0.1039	0.0907	0.0706	0.0868	0.1219	0.1290	0.1069	0.1147	0.0782	0.0835	0.0753	0.0986
	2001	0.1445	0.1232	0.1151	0.0927	0.0873	0.0942	0.1279	0.0705	0.0643	0.0480	0.0574	0.0385	0.0886
Phenolics (kg/day) (CP 1000)	1994	0.2173	0	0.1153	0	0.1413	0.8220	0.8333	0.2790	0.4536	0.0767	0.1113	0	0.2542
	1995	0.1177	0.1101	0	0.1140	0.0361	0.1085	0.1636	0.2483	0.0902	0.0502	0.1082	0	0.0956
	1996	0	0.0975	8.7340	0.1313	0.1548	0	0.0752	0	0	0.0207	0.0364	0.0542	0.7753
	1997	0	0.0710	0.0165	0.0118	0.0216	0.0517	0	0	0.0163	0	0.0190	0.0506	0.0215
	1998	0.0236	0.0231	0.0373	0.0157	0.0179	0.0229	0.0276	0.2715	0.1598	0.0736	0.1259	0.0674	0.0722
	1999	0.0708	0.2497	0.0410	0.0995	0.0469	0.1057	0.1770	0.0257	0.2205	n/a	n/a	n/a	0.1152
	2000	0.0220	0.07210	0.0195	0.0214	0.1197	0.0679	0.1205	0.2528	0.1178	0.0311	0.1346	0.0165	0.0830
	2001	0.0328	0.01690	0.0169	0.0170	0.0187	0.0202	0.0617	0.0294	0.0272	0.0515	0.0166	0.00980	0.0266
Phosphorus (kg/day)	1994	0.6010	0.8351	12.5000	6.1130	11.7700	0.9752	15.7600	5.3690	2.8040	8.3910	14.6200	2.3440	6.8402
Guideline** = 10 kg/day	1995	3.4170	1.2540	2.4740	12.5600	6.2930	6.2650	5.2360	3.0820	4.5580	12.0600	5.1810	4.7570	5.5948
	1996	3.0950	0.9521	0.9651	0.2256	0.4129	0.8191	2.1720	6.3920	3.3880	1.2980	0.7411	0.6988	1.7633
	1997	0.5609	1.4880	3.3220	1.3060	0.9915	0.6228	1.1840	1.4430	4.0890	0.4206	0.9623	1.5660	1.4963
	1998	1.0080	1.1900	2.8770	2.7340	0.8460	0.9940	1.9720	1.4080	1.5960	3.3450	2.6820	0.5400	1.7660
	1999	0.5480	0.8580	0.9250	1.6560	2.0450	1.7740	3.1570	1.3220	4.2600	n/a	n/a	n/a	1.8383
	2000	0.4800	0.9500	0.4900	2.9800	2.0100	1.9600	1.5600	1.6100	0.5600	0.4900	0.5050	0.5090	1.1753
	2001	1.2420	1.1500	3.2810	1.7590	1.5460	2.3200	0.8370	1.4050	1.3980	0.6837	1.0000	1.4000	1.5018
Particulate Residue [RSP] (kg/day)	1994	469.90	152.50	110.20	34.55	46.80	531.10	53.96	174.90	100.50	83.40	112.80	121.30	165.99
Guideline** = 236 kg/day	1995	98.16	166.60	110.70	143.20	226.70	203.40	233.00	168.40	85.910	89.24	125.90	80.54	144.31
	1996	181.20	160.90	153.30	87.31	123.40	147.90	83.68	108.70	135.50	148.60	210.80	173.60	142.91
	1997	161.50	161.00	182.70	100.60	158.40	92.63	132.50	139.40	123.90	151.10	181.50	202.90	149.01
	1998	167.80	162.50	191.30	121.50	176.10	105.50	111.80	99.80	148.80	164.50	143.20	132.80	143.80
	1999	190.10	151.40	91.20	117.00	139.00	118.20	156.60	118.00	71.30	n/a	n/a	n/a	128.09
	2000	142.00	57.00	76.00	94.00	96.00	83.00	101.00	511.00	107.00	119.00	134.80	160.70	140.13
	2001	157.00	178.60	97.40	135.50	139.10	108.90	140.70	115.60	129.80	137.30	86.90	121.90	129.06
Particulate Residue [RSPLOI] (kg/day)	1994	148.40	46.64	26.64	32.24	93.32	64.37	57.15	88.97	127.30	55.01	52.03	54.09	70.51
Guideline** = 184 kg/day	1995	84.94	95.60	74.33	70.95	99.98	103.70	93.79	81.75	72.52	57.58	64.08	36.08	77.94
	1996	132.90	125.10	162.90	78.06	91.24	97.39	47.90	70.21	109.40	82.92	108.50	91.16	99.81
	1998	107.40	161.70	145.40	87.58	99.89	83.99	90.00	69.01	109.10	91.22	153.70	154.80	112.82
	1998	133.30	106.50	100.00	101.90	109.30	95.20	99.00	95.20	107.40	104.50	121.90	106.20	106.70

Facility: Shell Canada Products Limited, Corunna [0000510107]										Control Points: 0900, 1000				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	98.20	81.60	64.50	90.60	100.60	80.80	86.00	84.40	59.50	n/a	n/a	n/a	82.91
	2000	92.00	66.00	55.00	78.00	96.00	84.00	79.00	120.00	98.00	61.00	92.20	123.80	87.08
	2001	103.90	112.40	109.80	102.20	82.10	75.60	97.70	81.80	89.50	74.90	73.70	89.00	91.05
Solvent Extractables (kg/day)	1994	35.34	42.05	10.32	11.03	7.13	8.15	10.08	14.21	25.07	16.41	10.02	19.10	17.41
Guideline** = 79 kg/day	1995	26.88	22.31	30.44	18.52	5.28	14.78	6.56	16.83	3.317	14.40	25.59	2.81	15.64
	1996	18.08	8.58	52.43	8.36	7.49	15.24	9.38	13.76	19.18	20.48	13.25	18.21	17.04
	1997	16.99	12.53	8.98	6.21	19.17	12.22	19.44	7.55	19.36	15.77	9.48	15.28	13.58
	1998	14.80	13.90	16.80	16.30	13.80	14.00	18.80	15.80	14.50	10.60	12.80	12.80	14.58
	1999	18.00	15.20	18.70	12.50	13.90	21.90	21.50	15.70	9.60	n/a	n/a	n/a	16.33
	2000	29.10	19.70	22.10	11.10	24.80	37.80	15.50	13.70	14.70	7.90	7.40	23.10	18.91
	2001	15.70	14.40	17.20	12.50	12.40	20.50	20.20	31.50	9.300	19.69	10.79	21.91	17.17
Sulphide (kg/day)	1994	0.331	0.146	0.165	0.227	0.113	0.134	0.146	0.120	0.209	0.125	0.143	0.138	0.167
Guideline** = 1.6 kg/day	1995	0.131	0.174	0.160	0.158	0.140	0.134	0.160	0.557	0.112	0.123	0.138	0.117	0.175
	1996	0.123	0.142	0.131	0.129	0.126	0.170	0.152	0.152	0.300	0.186	0.124	0.165	0.158
	1997	0.139	0.131	0.140	0.127	0.145	0.156	0.169	0.172	0.149	0.153	0.136	0.143	0.147
	1998	0.014	0.014	0.015	0.011	0.012	0.014	0.018	0.015	0.113	0.015	0.014	0.013	0.022
	1999	0.016	0.015	0.112	0.013	0.046	0.066	0.016	0.015	0.014	n/a	n/a	n/a	0.035
	2000	0.014	0.014	0.012	0.013	0.017	0.018	0.018	0.018	0.016	0.015	0.133	0.217	0.042
	2001	0.016	0.017	0.016	0.085	0.045	0.052	0.018	0.448	0.106	0.185	0.130	0.420	0.128
Sulphide (kg/day) (CP1000)	1994	2.378	2.449	2.409	2.182	2.166	3.344	3.273	3.124	4.209	3.019	2.829	2.626	2.834
	1995	2.965	2.355	2.337	2.264	3.053	2.401	2.667	2.826	2.784	2.709	2.514	2.501	2.615
	1996	2.451	4.467	1.794	2.037	2.267	2.223	3.249	2.687	2.776	3.067	2.346	2.292	2.638
	1997	2.032	1.972	2.046	1.804	1.884	1.862	2.237	2.699	2.557	2.358	2.329	2.364	2.179
	1998	0.236	0.231	0.227	0.157	0.179	0.229	0.276	0.287	0.264	0.235	0.208	0.209	0.228
	1999	0.18600	0.204	0.219	0.191	0.232	0.255	0.281	0.257	0.269	n/a	n/a	n/a	0.233
	2000	0.22000	0.220	0.195	0.214	0.228	0.240	0.251	0.271	0.250	0.192	1.880	0.330	0.374
	2001	0.14300	0.154	0.153	0.155	0.170	0.184	0.232	3.400	0.247	0	1.800	3.330	0.831
Toluene (kg/day) (CP1000)	1994	0.13600	0.15940	0.07851	0.08152	0.06449	0.13690	0.06486	0.11200	0.26190	0.06843	0.07504	0.10100	0.11167
	1995	0	0.14200	0.04080	0.05627	0.07262	0.48170	0.29450	0.04791	0.15570	0.11310	0.10390	0.14540	0.13783
	1996	1.41700	0.12480	0.05940	0.13390	0.03954	0.04514	0.01219	0.14320	0.01409	0.04271	0.16260	0.08766	0.19019
	1997	0.07692	0.03873	0.01751	0.04905	0.03616	0.07284	0.03264	0.03762	0.07635	0.02738	0.03736	0.06472	0.04727
	1998	0.08000	0.31000	0.03000	0.02000	0.08000	0.11000	0.05000	0.06000	0.04000	0.01000	0.02000	0.04000	0.07083
	1999	0.07000	0.07000	0.03000	0.02000	0.06000	0.02000	0.03000	0.02000	0.02000	n/a	n/a	n/a	0.03778

Facility: Shell Canada Products Limited, Corunna [0000510107]								Control Points: 0900, 1000					
Flow/Loading Parameters	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
2000	0.03000	0.07000	0.11000	0.04000	0.04000	0.03000	0.03000	0.04000	0.22000	0.08000	0.06000	0.03000	0.06500
2001	0.05000	0.03000	0.03000	0.11000	0.09000	0.03000	0.03000	0.03000	0.19000	0.09516	0.20000	0	0.07376

* Flows for CP 0900 - process water only. ** Guidelines established January 01, 1996

Gross average flows and loadings for Suncor Inc. (Sunoco Division), Sarnia.

Facility: Suncor Inc. (Sunoco Division), Sarnia [0000490102]									**Control Points: 0700, 0800**					
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)*	1999	8519	7580	8133	7821	7619	7803	8393	10550	10130	n/a	n/a	n/a	8505.3
	2000	7956	9479	9365	8960	9829	9990	8066	7500	6322	9216	9056	9822	8796.8
	2001	10040	11110	10480	9357	8307	8828	10490	10620	10640	9682	8168	8998	9726.7
C dissolved organic (kg/day)	1994	310.70	110.30	63.05	55.31	40.03	54.31	59.09	50.71	47.10	46.75	94.59	117.70	87.47
Guideline** = 214 kg/day	1995	63.18	41.69	39.67	64.98	51.12	150.60	89.18	135.70	53.75	381.40	45.23	49.43	97.16
	1996	52.81	64.85	54.16	42.97	46.50	82.32	104.20	71.29	166.60	67.94	44.33	46.48	70.37
	1997	45.69	82.66	44.53	38.35	42.63	41.17	46.86	40.82	55.05	43.93	41.41	36.11	46.60
	1998	38.91	68.14	150.50	101.10	31.56	28.02	46.88	54.79	83.06	79.46	40.60	591.20	109.52
	1999	93.78	77.78	52.57	49.59	41.37	39.26	43.13	58.23	72.76	n/a	n/a	n/a	58.72
	2000	154.10	51.76	46.38	55.39	50.45	60.90	47.42	35.46	39.73	55.10	70.29	170.40	69.78
	2001	168.20	56.78	75.11	54.90	37.57	34.75	124.40	74.59	61.50	144.40	71.15	98.71	83.47
Ammonium (kg/day)	1994	57.050	7.341	3.312	3.156	1.781	2.125	10.550	3.105	3.318	2.534	11.560	90.190	16.335
Guideline** = 55 kg/day	1995	3.129	1.520	22.19	12.120	2.239	5.673	4.264	44.720	3.096	7.593	1.984	3.471	9.333
	1996	2.530	12.140	1.837	2.681	79.710	5.999	20.900	4.651	21.960	30.540	4.834	7.423	16.267
	1997	10.140	10.170	1.468	1.102	2.235	2.809	2.109	2.118	1.964	2.205	1.206	1.266	3.233
	1998	3.661	2.889	12.300	24.800	12.760	1.863	1.817	2.598	20.980	44.640	47.470	26.520	16.858
	1999	22.310	46.800	34.540	43.040	3.330	3.480	2.075	10.290	3.680	n/a	n/a	n/a	18.838
	2000	15.930	18.980	35.100	1.684	28.120	11.190	1.422	2.133	3.378	7.039	1.772	1.921	10.722
	2001	31.600	3.543	3.159	1.837	10.380	2.535	10.080	3.739	11.290	18.880	1.520	8.349	8.909
Benzene (kg/day) (CP 0800)	1994	0.02052	0.01420	0.02380	0.01460	0.01858	0.01892	0.01330	0.01272	0.01385	9.12E-03	0.01093	0.00637	0.01474
	1995	5.89E-03	2.31E-03	3.49E-03	6.68E-03	7.03E-03	7.25E-03	0.01636	0.02055	8.41E-03	9.61E-03	5.72E-03	0.03328	0.01055
	1996	0.02145	5.93E-03	3.20E-03	0	2.20E-03	3.27E-03	5.89E-03	7.63E-03	4.90E-03	1.45E-03	0	0	4.66E-03
	1997	1.11E-03	1.80E-03	0	2.35E-03	2.37E-03	3.14E-03	2.20E-03	5.42E-03	3.71E-03	2.50E-03	2.09E-03	3.17E-03	2.49E-03
	1998	3.83E-03	2.71E-03	0	4.15E-03	4.32E-03	4.39E-03	4.82E-03	4.33E-03	4.89E-03	4.40E-03	4.14E-03	4.18E-03	3.85E-03
	1999	0.00375	0.00317	0.00387	0.00396	0.00405	0.00458	0.00476	0.00508	0.00505	n/a	n/a	n/a	0.00425
	2000	0.00415	0.00411	0.00385	0.00335	0.00336	0.00451	0.00451	0.00461	0.00480	0.00467	0.00450	0.00425	0.00674
	2001	0.00421	0.00424	0.00405	0.00412	0.00427	0.00451	0.00498	0.00504	0.00519	0.00412	4.409	0.00406	0.37148
Phenolics (kg/day)	1994	0.0966	0.0905	0.0923	0.0709	0.0571	0.0631	0.0387	0.0680	0.0425	0.0254	0.0455	0.1099	0.0667
Guideline** = 0.16 kg/day	1995	0.0490	0.0257	0.0357	0.0779	0.0293	0.0304	0.0657	0.0940	0.0425	0.0497	0.0416	0.0258	0.0473
	1996	0.0639	0.0766	0.0960	0.0521	0.0763	0.1015	0.1049	0.0706	0.2089	0.1035	0.0681	0.1250	0.0956
	1997	0.0824	0.1355	0.0644	0.0708	0.0667	0.0447	0.0747	0.0430	0.0986	0.0504	0.0508	0.0655	0.0706

Facility: Suncor Inc. (Sunoco Division), Sarnia [0000490102]										Control Points: 0700, 0800				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1998	0.0880	0.1135	0.1561	0.1590	0.0918	0.0601	0.0558	0.0862	0.1068	0.1256	0.1104	0.1852	0.1116
	1999	0.1197	0.1095	0.0798	0.0724	0.0714	0.0455	0.0384	0.0442	0.0350	n/a	n/a	n/a	0.0684
	2000	0.0455	0.0540	0.0516	0.0684	0.0441	0.1002	0.0785	0.0566	0.0228	0.0286	0.0302	0.1108	0.0576
	2001	0.1316	0.0805	0.0271	0.0094	0.0083	0.0097	0.0105	0.0127	0.0140	0.0164	0.00951	0.0115	0.0284
Phenolics (kg/day) (CP0800)	1994	0.1064	0.1470	0.1551	0.1661	0.1694	0.1665	0.1790	0.1815	0.1839	0.1723	0.1548	0.1588	0.16173
	1995	0.1514	0.1332	0.1488	0.1577	0.1688	0.1799	0.1937	0.2039	0.1598	0.1422	0.1314	0.1302	0.15842
	1996	0.1189	0.1345	0.1472	0.1551	0.1783	0.1763	0.1888	0.1912	0.1192	0.1748	0.1279	0.1302	0.15353
	1997	0.1176	0.0585	0.0699	0.1596	0.0762	0.0882	0.2783	0.0992	0.0986	0.0948	0.0851	0.1167	0.11189
	1998	0.0851	0.0719	19.9800	0.0831	0.0864	0.0877	0.0932	19.2400	0.0979	0.0880	0.0828	0.0836	3.34000
	1999	20.4800	0.0633	0.0774	79.1900	0.0810	18.1900	0.0953	0.1016	20.6600	n/a	n/a	n/a	15.4380
	2000	0.0830	0.0822	0.0771	0.0671	0.0846	0.0901	0.0920	0.1646	0.0959	0.0934	0.0900	0.3414	0.1133
	2001	0.2173	0.0847	0.0810	0.0825	0.0854	0.0902	0.0995	0.1007	0.1037	0.0824	0.0605	0.0812	0.0974
Phosphorus (kg/day)	1994	1.2650	0.8267	0.8251	3.6090	0.5573	2.0830	1.6290	1.4320	0.8073	0.7504	1.0370	2.6150	1.4531
Guideline** = 10 kg/day	1995	0.9507	1.2320	1.3440	0.8481	0.8727	2.2660	1.7210	1.2790	2.5210	0.9578	0.9472	0.3699	1.2758
	1996	1.7600	0.4006	1.9390	1.2600	1.6760	1.8930	1.0370	0.6828	0.5789	0.4801	0.6768	0.5527	1.0781
	1997	1.0040	0.8572	0.4839	1.1740	0.5361	0.9068	1.3370	1.6880	0.8842	0.6884	0.2667	0.4620	0.8574
	1998	1.0760	1.1170	1.6990	0.4156	0.5508	0.4937	0.8320	1.3730	2.8690	0.4385	0.5420	0.6100	1.0014
	1999	0.9785	1.5200	0.5053	0.5001	1.3650	0	0.9969	0.8787	1.1080	n/a	n/a	n/a	0.8725
	2000	0.6313	0.5277	1.6610	0.5319	1.2230	0.9923	1.0780	2.6250	0.9096	1.5190	0.4615	0.6325	1.0661
	2001	0.6809	1.6010	0.5695	0.4843	1.7990	0.9431	0.6132	0.9181	0.9706	0.8271	0.4137	0.6017	0.8685
Particulate Residue [RSP] (kg/day)	1994	120.50	53.40	100.20	68.77	39.27	65.36	63.82	47.38	44.13	21.19	54.14	74.08	62.69
Guideline** = 236 kg/day	1995	39.72	38.75	81.27	61.50	40.77	55.79	76.29	63.85	50.36	37.00	52.99	58.45	54.73
	1996	38.07	52.38	54.43	47.41	43.72	53.53	35.78	41.10	134.60	57.59	37.59	54.83	54.25
	1997	41.13	79.05	41.86	70.11	63.78	46.86	59.46	40.75	49.43	55.11	55.25	40.80	53.63
	1998	114.30	171.00	76.13	126.40	87.91	54.58	67.57	60.37	61.22	126.60	59.89	142.60	95.71
	1999	120.40	121.00	89.37	79.03	33.33	59.13	112.60	94.15	86.50	n/a	n/a	n/a	88.39
	2000	49.05	44.34	50.12	62.28	53.65	67.34	30.14	32.57	33.67	27.19	26.63	43.70	43.39
	2001	66.10	72.96	54.35	32.13	32.10	48.52	40.10	40.33	52.20	61.24	33.03	49.21	48.52
Particulate Residue [RSPLOI] (kg/day)	1994	53.04	29.91	40.04	45.53	41.74	45.30	52.45	34.34	28.99	22.94	40.52	56.57	40.947
Guideline** = 184 kg/day	1995	30.43	36.07	35.46	61.83	29.32	17.81	19.48	23.88	36.35	36.00	31.81	31.75	32.516
	1996	30.71	39.56	33.39	25.96	27.07	48.31	35.69	53.43	139.00	38.76	32.96	67.57	47.701
	1997	48.57	40.68	36.55	47.39	40.68	41.76	43.57	41.39	49.73	25.54	41.88	25.80	40.295
	1998	41.22	82.97	61.15	73.63	46.85	44.83	43.96	62.78	47.28	93.07	45.96	140.40	65.342

Facility: Suncor Inc. (Sunoco Division), Sarnia [0000490102]										Control Points: 0700, 0800				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	111.50	120.50	48.65	34.34	36.45	50.33	49.23	57.55	59.02	n/a	n/a	n/a	63.063
	2000	39.07	31.73	34.26	26.13	34.16	28.48	20.64	23.64	26.58	24.29	18.69	31.49	28.263
	2001	28.75	33.58	20.63	27.40	20.44	20.59	21.69	30.23	28.60	41.60	16.09	28.99	26.538
Solvent Extractables (kg/day)	1994	42.60	21.93	26.15	16.82	9.61	9.98	16.98	15.09	9.32	13.05	8.66	41.04	19.27
Guideline** = 79 kg/day	1995	25.66	18.28	11.05	15.63	30.33	21.75	30.98	16.08	16.10	10.26	19.52	11.52	18.93
	1996	9.54	13.87	5.30	8.34	11.05	24.59	28.41	26.09	28.27	13.05	19.25	19.31	17.26
	1997	16.04	40.65	12.70	22.50	16.93	23.71	22.81	19.37	19.90	14.79	15.25	11.74	19.70
	1998	20.25	27.45	10.04	38.26	18.10	13.27	13.15	15.76	28.71	50.18	16.54	35.44	23.93
	1999	31.13	16.21	19.13	12.01	6.66	20.20	38.81	48.87	25.61	n/a	n/a	n/a	24.29
	2000	19.40	11.69	9.66	13.54	11.94	15.99	7.92	8.42	6.81	11.54	10.13	6.58	11.14
	2001	8.30	11.77	6.48	5.48	5.88	5.92	6.60	6.13	18.61	18.44	7.12	15.39	9.68
Sulphide (kg/day)	1994	0.519	0.449	0.525	0.404	0.235	0.204	0.662	0.688	0.346	0.359	0.167	0.328	0.407
Guideline** = 1.6 kg/day	1995	0.213	0.182	0.210	0.201	0.195	0.155	0.232	0.293	0.225	0.130	0.189	0.296	0.210
	1996	0.134	0.205	0.357	0.103	0.156	0.264	0.313	0.221	0.594	0.395	0.159	0.444	0.279
	1997	0.219	0.348	0.132	0.287	0.21	0.259	0.386	0.424	0.133	0.306	0.314	0.196	0.267
	1998	0.307	0.552	0.397	0.491	0.301	0.175	0.439	0.590	0.274	0.347	0.323	0.224	0.368
	1999	0.240	0.384	0.368	0.265	0.202	0	0.182	0.297	0.141	n/a	n/a	n/a	0.231
	2000	0.240	0.113	0.135	0.152	0.140	0.151	0.124	0.105	0.102	0.117	0.089	0.097	0.130
	2001	0.135	0.190	0.161	0.092	0.102	0.087	0.100	0.128	0.531	0.244	0.077	0.109	0.163
Sulphide (kg/day) (CP 0800)	1994	0.650	0.710	0.980	0.845	1.334	1.060	0.890	1.818	0.925	0.852	1.862	1.782	1.142
	1995	4.046	2.630	1.117	16.870	1.421	2.029	1.379	1.027	1.372	2.417	1.601	1.228	3.095
	1996	0.715	1.185	1.570	0.776	1.062	0.874	2.629	7.211	1.029	1.048	1.369	0.651	1.677
	1997	1.185	0.858	1.400	0.977	1.771	1.554	3.501	1.482	1.231	1.324	1.066	0.829	1.432
	1998	1.287	0.719	2.602	1.332	1.280	0.877	1.414	1.087	0.978	2.680	1.041	4.643	1.662

Facility: Suncor Inc. (Sunoco Division), Sarnia [0000490102]								Control Points: 0700, 0800					
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	0	0	1.395	0.792	0	1.288	3.034	1.016	1.215	n/a	n/a	n/a	0.971
	2000	1.660	1.031	0.771	1.160	0.846	1.129	0.902	19.860	0.959	1.162	0.900	1.920	2.692
	2001	0.843	0.847	1.218	0.825	0.854	0.902	0.995	1.007	0.881	1.237	0.605	0.812	0.91900
Toluene (kg/day) (CP 0800)	1994	0.01768	0.02680	0.02580	0.02727	0.04068	0.01895	0.04450	0.03630	0.02268	0.04116	0.05044	0.01480	0.03059
	1995	0.01027	0.01305	0.00837	0.01297	8.01E-03	0.01973	0.02597	0.05344	0.01117	0.00663	0.00656	0.03019	0.01720
	1996	0.01616	0.07140	0.02063	0.03078	0.01413	0.03152	0.14360	0.03978	0.08671	0.08844	0.01591	0.05473	0.05115
	1997	9.28E-03	0.01242	0.04603	0.02243	0.01684	0.02298	0.01904	0.02365	0.01489	0.01999	0.00721	0.01501	0.01915
	1998	0.01046	0.01155	7.69E-03	0.04334	1.25E-03	9.04E-03	0.02711	4.53E-03	46.43000	0.05724	0.02194	0.00298	3.88560
	1999	0.02254	0.02615	0	0	0	0	0.00284	0	0	n/a	n/a	n/a	0.00573
	2000	0	0	0	0	0.03734	0	0.00492	0	0	0	0	0	0.00352
	2001	0.00199	0	0	0	0	0	0	0	0	0	1.65900	0	0.13842

* Flows for CP 0700 (process effluent) only
** Guidelines established January 01, 1996

Data Appendix 1b. Organic Chemicals Sector

Gross average flows and loadings for Amoco Canada Resources Ltd., Sarnia.

Facility: Amoco Canada Resources Ltd., Sarnia [0104330204]													**Control Points: 0900**	
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m3/day)	1997	423.6	621	570.5	249.2	448.2	353.8	393.5	434.7	478.8	288	295.4	307.3	405.33
	1998	549.9	753.6	622.2	206.3	274.9	213.9	446.4	303.6	226	236.6	185.1	237	354.63
	1999	581.9	178.0	191.2	442.8	332.2	267.2	327.4	415.1	255.7	274.1	274.8	347.6	324.0
	2000	213.9	269.0	298.0	428.5	640.2	542.0	654.7	425.9	384.7	315.2	204.2	303.5	389.98
	2001	232.0	1425.0	378.9	218.1	210.0	204.6	255.8	395.2	454.7	1123.0	265.8	291.8	454.58
Aluminium (kg/day)	1997	0.05551	0	0	0.04565	0	0	1.184	0	0	0.1762	0	0	0.12178
	1998	0	0	7.26E-03	0.01382	7.22E-03	0.03825	0	0.02821	0	0	6.87E-03	0	8.47E-03
	1999	0	8.21E-03	0	0	0	0	0	1.52E-03	0	0	3.84E-03	0	2.27E-03
	2000	0	0.03132	0	0	0.02392	0	0	7.28E-03	0	0	0	0.02878	7.608E-03
	2001	0	0.86900	0	0	4.49E-03	0	0	0.03130	0	0	0.14300	0	76.59E-03
Arsenic (kg/day)	1997	2.87E-03	0	0	1.62E-03	0	0	0	0	0	1.87E-03	0	0	0.530E-03
	1998	0	0	0	1.30E-03	6.86E-04	2.06E-03	0	2.50E-03	0	0	1.04E-03	0	0.632E-03
	1999	0	1.32E-03	0	0	0	0	0	1.52E-03	0	0	1.31E-03	0	0.345E-03
	2000	0	2.40E-03	0	0	2.03E-03	0	0	7.77E-03	0	0	0	3.04E-03	1.27E-03
	2001	0	0.010040	0	0	1.28E-03	0	0	4.32E-03	0	0	2.86E-03	0	1.54E-03
Benzene (kg/day)	1997	9.24E-05	5.57E-04	6.79E-04	1.07E-03	6.77E-04	6.13E-05	0	7.91E-05	0	8.08E-03	5.19E-05	4.04E-05	9.49E-04
Guideline* = 0.0051 kg/day	1998	5.03E-05	1.70E-04	3.85E-04	0	0	0	0	0	0	0	0	0	5.04E-05
	1999	1.41E-04	0	0	0	0	0	8.98E-05	0	0	0	0	2.17E-05	2.10E-05
	2000	1.12E-05	1.50E-05	0	0	6.14E-05	0	0	0	3.68E-05	0	2.70E-05	2.73E-05	1.49E-05
	2001	1.20E-04	64.37E-04	1.64E-04	0	0	1.16E-05	0	0	1.47E-05	0	0	0	56.86E-05
Copper (kg/day)	1997	2.01E-03	0	0	0	0	0	3.23E-03	0	0	1.30E-03	0	0	5.45E-04
	1998	0	0	1.62E-03	8.92E-04	4.93E-04	2.17E-03	0	1.58E-03	0	0	0	0	5.63E-04
	1999	0	1.67E-03	0	0	2.80E-03	0	0	9.55E-04	0	0	2.51E-03	0	6.61E-04
	2000	0	2.40E-03	0	0	2.29E-03	0	0	6.69E-04	0	0	0	1.08E-03	5.36E-04
	2001	0	8.19E-03	0	0	2.29E-04	0	0	1.50E-03	0	0	0	0	8.27E-04
C dissolved organic (kg/day)	1997	13.17	10.79	7.28	4.653	8.108	4.539	4.659	4.657	3.573	6.04	3.73	6.602	6.4834
Guideline* = 3 kg/day	1998	4.889	6.436	6.792	2.872	3.548	4.17	4.169	3.378	2.814	3.320	2.414	2.686	3.9573
	1999	2.835	1.250	1.192	2.619	2.387	2.192	2.468	2.751	2.23	2.015	1.918	2.042	2.1577
	2000	1.776	1.801	2.218	3.152	3.518	3.955	4.089	2.988	2.253	1.903	1.460	2.070	2.5986
	2001	1.342	5.975	1.820	1.428	1.768	2.295	2.056	3.330	3.042	4.949	1.655	1.545	2.6004

Facility: Amoco Canada Resources Ltd., Sarnia [0104330204]											Control Points: 0900			
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Mercury (kg/day)	1997	2.72E-04	0	0	2.00E-04	0	0	0	0	0	0	0	0	3.93E-05
	1998	0	0	0	4.47E-05	5.10E-05	1.06E-04	0	2.91E-04	0	0	2.61E-05	0	4.32E-05
	1999	0	0	0	0	0	0	0	8.43E-06	0	0	0	0	0.07E-05
	2000	0	0	0	0	0	0	0	0	0	0	0	2.34E-05	0.195E-05
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Molybdenum (kg/day)	1997	4.32E-04	3.56E-03	1.64E-03	6.29E-04	8.28E-04	3.05E-03	4.31E-03	2.49E-03	1.57E-03	2.07E-03	1.14E-03	1.70E-03	1.95E-03
Guideline* = 0.16 kg/day	1998	1.92E-03	0	1.02E-03	8.52E-04	4.88E-04	1.36E-03	4.03E-03	1.79E-03	7.95E-04	6.52E-04	1.01E-03	1.39E-03	1.28E-03
	1999	8.73E-04	1.14E-03	4.13E-04	2.58E-03	9.46E-04	8.52E-04	2.51E-03	7.56E-03	1.40E-03	1.32E-03	1.12E-03	4.54E-04	1.76E-03
	2000	6.20E-04	1.16E-03	1.11E-03	1.40E-03	2.60E-03	6.71E-03	2.04E-03	1.96E-03	2.60E-03	2.18E-03	9.54E-04	1.05E-03	2.03E-03
	2001	7.48E-04	1.57E-03	2.97E-03	1.81E-04	1.01E-03	7.69E-04	1.34E-03	2.98E-04	2.52E-03	3.35E-03	1.36E-03	8.20E-04	1.41E-03
Phenolics (kg/day)	1997	1.94E-04	1.45E-03	7.51E-04	4.51E-04	7.04E-04	7.57E-04	7.37E-04	1.59E-03	1.72E-04	2.95E-04	2.28E-04	2.54E-04	6.33E-04
Guideline* = 0.0023 kg/day	1998	3.63E-04	0.02573	4.32E-03	8.35E-04	5.87E-04	4.59E-04	1.20E-03	8.11E-04	1.32E-04	9.43E-05	1.70E-04	3.55E-04	29.2E-04
	1999	3.55E-04	5.50E-04	3.15E-04	5.19E-04	1.95E-04	1.10E-04	8.02E-04	4.42E-04	1.67E-04	4.44E-04	3.19E-04	3.46E-04	3.80E-04
	2000	0.88E-04	2.44E-04	2.92E-04	3.39E-04	2.81E-04	9.78E-04	6.20E-04	1.66E-04	5.20E-04	8.68E-04	2.91E-04	10.9E-04	4.81E-04
	2001	2.59E-04	63.8E-04	15.2E-04	4.86E-03	2.22E-04	10.2E-04	16.4E-04	4.28E-04	13.5E-04	28.4E-04	10.0E-04	1.32E-04	14.4E-04
Phosphorus (kg/day)	1997	0.1863	0.4648	0.6194	0.231	0.3668	0.3927	0.3648	0.3757	0.1483	0.2756	0.2248	0.2537	0.32532
Guideline* = 0.41 kg/day	1998	0.2406	0.4547	0.2616	0.2377	0.2544	0.3886	0.4129	0.4156	0.2236	0.1895	0.2467	0.3046	0.30254
	1999	0.2016	0.2146	0.1744	0.2152	0.1982	0.2106	0.4324	0.4545	0.2594	0.2643	0.2775	0.2264	0.26076
	2000	0.2342	0.2324	0.2173	0.1802	0.2941	0.2364	0.2168	0.2385	0.1814	0.2605	0.1396	0.1774	0.21740
	2001	0.1117	0.2732	0.1861	0.1767	0.1986	0.1719	0.2476	0.4056	0.2863	0.2591	0.2524	0.1332	0.2252
Particulate Residue [RSP] (kg/day)	1997	9.382	17.13	9.943	3.774	13.96	11.61	18.42	16.01	14.34	7.599	2.334	4.148	10.721
Guideline* = 3.7 kg/day	1998	10.97	4.203	5.973	0.9809	1.09	1.298	3.427	1.643	0.6573	0.9231	1.477	1.7	2.8619
	1999	2.7750	0.2827	0.4418	1.6090	1.2100	2.1220	2.2810	1.9010	0.3754	0.7121	0.8438	1.4980	1.3360
	2000	0.8527	0.8875	0.4881	2.7660	2.9390	1.1020	2.6180	0.9816	1.7290	0.5605	0.3326	0.6461	1.3253
	2001	0.1226	10.730	0.7559	0.2892	0.2762	0.6725	0.3934	0.2778	0.2115	1.7450	0.6047	0.1620	1.3534
Solvent Extractables (kg/day)	1997	0.4373	1.8910	1.1290	0.7765	2.1500	0.6628	3.2890	2.0370	0.7299	0.8861	0.6278	0.9166	1.29440
Guideline* = 4.7 kg/day	1998	0.4353	1.8670	3.1440	0.7079	0.8743	0.9610	2.4670	2.2130	0.3000	0.3703	0.2783	0.7953	1.20110
	1999	0.8522	0.3521	0.3188	0.7393	0.6345	0.4725	3.2790	207850	0.5898	0.4054	0.4694	0.9495	0.98729
	2000	1.3940	0.5558	0.9985	0.6302	1.1120	0.8837	0.4956	0.7714	0.3740	1.2470	0.1963	1.0390	0.80813
	2001	0.4385	1.4850	0.6882	0.3844	0.3419	0.3816	2.8040	0.4862	1.0640	2.0920	0.4689	0.3366	0.91428
Sulphide (kg/day)	1997	2.56E-04	2.46E-03	5.07E-04	0.01291	3.86E-04	4.61E-03	2.95E-03	3.61E-03	5.60E-04	0.02208	8.52E-03	1.02E-03	4.99E-03
Guideline* = 0.044 kg/day	1998	0	0.0017	2.12E-03	2.10E-03	1.48E-03	3.57E-03	1.85E-03	1.57E-03	8.30E-04	4.47E-04	3.64E-04	6.79E-04	1.39E-03
	1999	2.60E-04	1.14E-04	0	0	0	0	0	0	0	7.33E-04	0	0	0.092E-03

Facility: Amoco Canada Resources Ltd., Sarnia [0104330204]													Control Points: 0900	
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	2000	5.43E-04	6.53E-04	0	1.19E-03	0	1.22E-03	1.72E-03	0	9.20E-04	0	6.54E-04	5.85E-04	0.623E-03
	2001	0	0	0	0	0	0	0	6.26E-04	0	0	4.54E-03	0	0.090E-03
Dichlorobenzene 1,2 (kg/day)	1997	1.52E-04	8.88E-04	2.29E-03	6.96E-05	0	3.05E-03	1.49E-04	5.99E-03	6.87E-05	7.20E-03	2.03E-04	8.24E-05	1.68E-03
Guideline* = 0.056 kg/day	1998	7.32E-05	2.93E-04	2.49E-04	0	0	0	3.32E-04	0	0	0	0	0	7.89E-05
	1999	0	0	0	0	0	0	4.19E-04	0	0	0	0	0	3.49E-05
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Zinc (kg/day)	1997	0.01749	0	0	5.66E-03	0	0	0.03933	0	0	0.0217	0	0	7.01E-03
	1998	0	0	8.54E-04	5.28E-03	3.34E-03	0.0127	0	0.01627	0	0	7.11E-03	0	3.80E-03
	1999	0	5.78E-03	0	0	10.4E-03	0	0	4.50E-03	0	0	14.8E-03	0	2.96E-03
	2000	0	10.7E-03	0	0	8.32E-03	0	0	2.33E-03	0	0	0	20.4E-03	3.47E-03
	2001	0	0.1191	0	0	2.55E-03	0	0	2.82E-03	0	0	9.76E-03	0	11.19E-03

* Guidelines established February 16, 1998

Gross average flows and loadings for Bayer Inc., Sarnia.

Facility: Bayer Inc., Sarnia [0000030007]						**Control Points: 3100, 3200, 3300**								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day) *	1999	20240	20010	19680	20480	19310	19180	21550	21860	23620	19090	18910	19460	20282.5
	2000	20120	20070	20320	21130	21250	24090	24420	24650	24070	22680	21580	21180	22130.0
	2001	21910	21380	20320	20410	19200	18470	20230	18610	21220	20580	17360	19870	19963.3
Total Aluminium (kg/day)	1995	n/a	n/a	n/a	n/a	51.41	16.29	30.22	52.78	42.48	19.87	59.1	25.11	37.157
Guideline** = 57 kg/day	1996	28.04	7.009	26.74	7.957	6.813	6.706	6.923	9.909	1.926	4.662	7.929	6.871	10.124
	1997	6.335	4.244	7.931	4.772	4.056	5.231	3.195	1.738	7.828	5.994	6.332	4.904	5.2133
	1998	5.06	7.16	6.813	8.57	10.01	3.803	8.927	5.852	3.193	3.634	1.68	1.805	5.5423
	1999	5.090	2.826	4.681	3.231	3.091	1.979	4.818	3.633	4.075	3.083	4.472	4.349	3.7773
	2000	6.098	5.151	3.767	4.675	4.300	6.860	6.140	5.831	4.843	6.400	4.023	3.373	5.1218
	2001	4.392	6.131	6.536	4.501	4.239	6.913	7.888	4.288	4.709	6.352	2.925	3.766	5.2199
Benzene (kg/day)	1995	n/a	n/a	n/a	n/a	0.01083	0.01001	0.009535	0.0108	0.009746	0.009199	0.01068	0.009407	0.010026
Guideline** = 0.14 kg/day	1996	0.009147	0.008997	0.009257	0.008639	0.008497	0.005364	0.005765	0.006514	0.005572	0.004212	0.004574	0.005107	0.006804
	1997	0.004881	0.004593	0.004066	0.003674	0.004527	0.004534	0.007933	0.009638	0.01018	0.01509	0.009598	0.008429	0.007262
	1998	0.008124	0.010050	0.005374	0.004746	0.004405	0.003495	0.005033	0.005022	0.005245	0.00393	0.004014	0.003341	0.005232
	1999	0.003987	0.004598	0.004821	0.003657	0.004084	0.003670	0.002033	0.002056	0.002296	0.001850	0.001831	0.001855	0.003062
	2000	0.002004	0.001919	0.001945	0.002039	0.002102	0.002229	0.002207	0.002854	0.003335	0.001975	0.001779	0.001828	0.0021847
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Cobalt (kg/day)	1995	n/a	n/a	n/a	n/a	1.562	0.643	0.8712	0.4775	0.4221	0.5043	0.6687	0.7821	0.74136
Guideline** = 0.28 kg/day	1996	0.3233	0.4143	0.7743	0.9344	1.538	2.371	4.615	0.7822	0.6044	1.017	0.9809	1.021	1.2813
	1997	1.201	1.48	0.664	0.6114	0.4883	0.2229	0.3116	0.3589	0.3982	0.3082	0.3164	0.428	0.56574
	1998	0.3354	0.5584	0.428	0.5987	0.3347	0.2423	0.2848	0.1549	0.2328	0.1855	0.3277	0.3081	0.33261
	1999	0.2703	0.2679	0.4174	0.3813	0.3647	0.4404	0.4568	0.3089	0.3539	0.2666	0.3573	0.2956	0.34843
	2000	0.2201	0.5851	0.6166	0.4511	0.4519	0.3424	0.3005	0.4100	0.3672	0.5388	0.3923	0.2384	0.40953
	2001	0.4521	0.5034	0.5189	0.4239	0.3940	0.1554	0.2082	0.2013	0.2096	0.2854	0.1991	0.2513	0.31688
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	270.7	445.8	266.7	290.1	287.8	293.9	376.8	298.5	316.29
(CP3100)	1996	326.8	317.2	291.6	221.3	241.8	210.6	226.4	242.9	236.8	197.8	164.9	192.6	239.23
Guideline** = 447 kg/day	1997	204.1	187.5	221.3	284.9	241.1	213	213.8	227.8	241.7	206.2	191.3	195.1	218.98
	1998	204.2	212.9	204.9	242.8	185.3	158.2	206.8	207.9	201.2	157.3	164.2	182.9	194.05
	1999	216.7	193.5	204.7	173.9	130.6	129.6	153.7	149.1	135.7	133.0	175.6	174.4	164.21
	2000	174.4	167.0	187.6	196.1	154.5	189.4	149.6	131.0	140.7	111.0	102.2	88.8	149.36
	2001	103.4	103.3	110.7	116.2	110.2	88.19	112.51	103.0	128.46	114.78	95.51	111.91	108.18

Facility: Bayer Inc., Sarnia [0000030007]						Control Points: 3100, 3200, 3300								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	361.3	283.9	411.3	728.8	866.6	418.4	439.4	504.1	501.73
(CP3200)	1996	499.9	447.4	372.5	437.1	401.4	428.5	415.2	304.9	471.5	583.6	707.8	738.7	484.04
	1997	555.4	431.4	590.9	442	472.2	513	554.4	499.3	487	362.3	391	364.8	471.98
	1998	300	394.7	413.6	375.3	360.7	222.4	323.1	347	395.8	269.4	194.3	224.2	318.38
	1999	280.5	335.6	340.3	254.8	212.7	216.7	204.9	252.5	210.9	210.3	417.6	549.5	290.53
	2000	601.5	501.8	406.1	470.6	436.3	280.7	290.0	223.0	322.2	253.0	227.5	247.0	354.98
	2001	222.5	204.0	167.7	180.0	189.6	240.5	246.4	170.5	228.0	212.5	187.68	184.58	202.83
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	1499	1461	1535	1631	1665	1114	1135	1128	1396
(CP3300)	1996	1233	1206	927	784.8	1124	1339	1185	1624	1639	1265	911.4	962.9	1183.4
	1997	1034	1059	1317	1069	961.7	1188	1365	1179	1236	1096	1162	1091	1146.5
	1998	972	1135	1304	1278	1042	1009	1485	1203	1150	1465	1690	1495	1269.0
	1999	1544	1223	1169	912	2634	891	992	925	924	1226	1517	1351	1275.7
	2000	1514	1319	1047	1179	1041	752	1067	730	1494	602	555	561	988.42
	2001	505	542	464	424	521	614	630	564	659	610	514	493	545.00
Total Ammonium (kg/day)	1995	n/a	n/a	n/a	n/a	12.28	4.06	2.908	2.342	4.332	2.406	3.031	3.109	4.3085
Guideline** = 92 kg/day	1996	2.843	2.465	2.056	2.283	4.546	7.438	5.63	3.615	4.877	1.889	3.348	3.398	3.699
	1997	4.181	3.402	2.515	3.682	2.495	2.849	2.882	2.516	3.736	3.05	2.473	2.456	3.0198
	1998	5.332	2.096	5.196	3.037	1.835	3.017	2.097	1.747	2.185	1.637	18.1	2.007	4.0238
	1999	20.460	9.237	2.587	2.683	3.693	12.960	2.033	2.911	2.329	1.850	3.571	9.666	6.165
	2000	6.034	5.536	4.432	2.039	2.954	3.639	5.723	7.942	2.780	4.511	1.978	2.142	4.1425
	2001	7.400	26.120	3.750	2.834	9.775	3.017	8.840	7.120	4.110	8.270	4.460	16.110	8.4838
Total Nitrates (kg/day)	1995	n/a	n/a	n/a	n/a	47.79	86.81	59.85	58.87	80.61	71.67	159.4	34.26	74.907
Guideline** = 142 kg/day	1996	151.4	136.8	125.7	45.72	72.37	86.49	83.96	95.48	35.02	18.1	39.28	33.18	76.958
	1997	87.50	42.27	90.49	37.37	67.07	60.15	35.93	97.55	56.24	62.89	49.30	67.04	62.817
	1998	29.12	56.72	77.92	78.3	51.10	130.80	64.19	43.57	82.45	48.44	29.56	61.83	62.833
	1999	31.67	55.53	72.92	46.00	16.14	30.92	63.60	125.30	70.16	70.96	99.53	47.91	60.887
	2000	61.53	87.31	119.20	96.01	107.20	96.78	77.66	108.70	100.5	73.81	79.41	31.28	86.616
	2001	28.53	23.25	37.38	55.37	94.26	63.93	80.62	125.66	64.24	49.45	71.36	75.05	64.092
Total Kjeldahl N (kg/day)	1995	n/a	n/a	n/a	n/a	42.71	33.15	36.44	63.28	42.98	41	53.47	26.96	42.499
Guideline** = 67 kg/day	1996	32.26	22.75	18.22	18.39	18.91	28.94	21.02	25.29	22.57	22.99	26.08	20.55	23.164
	1997	21.63	16.38	19.4	26.05	16.75	14.69	16.28	20.03	28.7	17.6	19.76	18.27	19.628
	1998	22.74	21.52	30.41	31.86	16.84	18.56	22.7	18.26	18.85	14	18.96	13.3	20.667

Facility: Bayer Inc., Sarnia [0000030007]							**Control Points: 3100, 3200, 3300**							
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	27.48	25.43	19.20	20.74	16.89	24.41	22.60	20.91	27.73	14.68	68.75	32.68	26.792
	2000	28.27	33.91	34.32	35.69	21.52	37.96	38.68	33.16	29.95	28.95	23.12	19.85	30.448
	2001	27.49	34.91	33.79	30.87	32.94	19.64	41.77	27.58	27.36	32.15	26.19	38.44	31.094
Phenolics (kg/day)	1995	n/a	n/a	n/a	n/a	28.81	0.1204	0.2325	0.1812	0.09344	0.113	0.1166	0.1037	3.7214
Guideline** = 0.27 kg/day	1996	0.1447	0.1209	0.08382	0.1003	0.07545	0.1078	0.08471	0.1078	0.05166	0.59000	0.07884	0.06105	0.37709
	1997	0.07208	0.03734	0.03916	0.07722	0.05899	0.04663	0.04468	0.05811	0.05301	0.03017	0.06683	0.03669	0.051742
	1998	0.05890	0.03730	0.03024	0.03983	0.04426	0.04125	0.10850	0.04697	0.04773	0.02948	0.02969	0.04091	0.046255
	1999	0.05572	0.06873	0.06507	0.07105	0.07095	0.09335	0.09843	0.12330	0.05085	0.08315	0.09467	0.06198	0.078104
	2000	0.08197	0.09536	0.10.10	0.14560	0.09341	0.10580	0.07762	0.10610	0.09240	0.13600	0.10880	0.12110	0.105610
	2001	0.17250	0.13750	0.12880	0.05377	0.10030	0.07027	0.08610	0.14980	0.07190	0.08470	0.02990	0.08590	0.097620
Total Phosphorus (kg/day)	1995	n/a	n/a	n/a	n/a	24.71	2.944	8.905	17.5	20.48	12.63	22.78	14.06	15.501
Guideline** = 26 kg/day	1996	22.44	13.71	9.983	14.26	13.27	23.31	13.17	11.04	10.29	8.92	8.205	13.02	13.468
	1997	11.84	9.134	8.314	10.03	8.263	7.239	8.675	17.96	15.94	10.5	10.77	11.13	10.816
	1998	11.76	8.826	10.02	10.57	4.814	4.858	7.55	3.596	7.602	2.939	5.328	6.726	7.0491
	1999	7.64	3.73	7.00	5.03	3.96	3.74	4.73	2.28	8.09	6.04	3.99	7.39	5.2989
	2000	6.49	9.14	8.00	8.79	8.48	10.59	7.97	8.69	10.90	8.54	6.48	8.14	8.5168
	2001	6.48	10.47	11.64	8.13	8.90	6.42	8.78	6.87	2.99	7.94	5.16	4.97	7.3958
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	594	283.3	340.5	550.5	515.9	484.6	698.8	310.7	472.29
(CP 3100)	1996	391.8	234	190.7	172.5	218.4	335	358.6	341.8	270.6	208.4	245.3	241.6	267.39
Guideline** = 540 kg/day	1997	223.9	163	210.8	306.8	183.3	147	136.9	179.9	390.3	264.2	307.1	179.4	224.38
	1998	159.1	207	231.9	378.5	168.8	124.6	210.3	168.4	169.4	124	81.9	110.3	177.85
	1999	191.6	190.6	227.3	230.7	134.6	117.5	182.2	154.4	215.0	168.3	298.9	322.1	202.77
	2000	256.9	247.3	268.4	386.3	305.4	377.4	326.0	478.1	410.7	345.6	253.3	155.4	317.57
	2001	211.8	236.4	274.9	275.1	227.4	246.2	273.0	241.8	275.9	273.3	193.3	287.5	251.38
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	622	683	2962	2530	2093	4134	3598	3761	2547.90
(CP 3200)	1996	1289	2372	1887	599	687.7	1615	1478	289.1	944.8	5994	3581	1839	1881.30
	1997	814.7	574.7	1072	2574	1344	1365	1621	596.4	2747	541.1	1936	1198	1365.30
	1998	726.3	1341	1634	718.5	932.5	960	938.3	1192	1044	153.9	153.9	185.9	831.69
	1999	347.8	480.4	1140.0	1401.0	1028.0	650.1	1266.0	498.4	920.6	745.3	947.7	1470.0	907.94
	2000	1636.0	1049.0	943.8	1936.0	2711.0	3018.0	2014.0	1049.0	2154.0	824.8	877.4	1005.0	1601.50
	2001	1177.0	1239.0	2945.0	1362.0	960.0	448.5	1268.4	1303.5	1974.0	2382.5	1349.1	635.8	1420.40
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	2811	12160	4589	1965	3666	7847	6157	2725	5240

Facility: Bayer Inc., Sarnia [0000030007]						Control Points: 3100, 3200, 3300								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
(CP 3300)	1996	3003	2956	1014	1581	4545	14460	3189	2107	4164	3919	2350	2084	3781
	1997	1361	779.8	1089	3789	1814	2985	4952	1599	1549	1278	2574	2876	2220.5
	1998	1402	1977	4541	1587	1671	1960	2706	3702	11730	1924	2852	2131	3181.9
	1999	3222	2020	4786	3332	4055	1968	4687	2517	3555	5013	5266	3549	3664.2
	2000	5950	3341	2222	6974	2647	3799	3990	2931	8566	3901	2270	2106	4058.1
	2001	1804	2506	10600	4981	2302	2202	3948	4108	8052	5379	2787	1985	4221.1
Solvent Extractables (kg/day)	1995	n/a	n/a	n/a	n/a	78.95	140.8	82.36	113.8	154.6	78.2	51.89	65.19	95.724
Guideline** = 126 kg/day	1996	76.34	102.2	205.3	62.71	55.13	104.5	71.37	156.2	96.75	108.90	83.06	95.78	101.520
	1997	68.70	38.13	26.82	43.65	49.49	24.24	16.77	64.79	119.7	92.53	67.71	52.75	55.440
	1998	52.07	51.62	47.70	82.06	38.60	17.30	44.31	76.54	52.60	31.98	20.06	43.08	46.493
	1999	41.81	50.18	37.02	30.43	16.80	14.45	30.26	44.62	31.26	41.47	72.39	62.03	39.393
	2000	34.14	27.64	36.45	46.37	24.57	27.59	26.00	58.40	65.93	46.96	32.53	32.86	38.287
	2001	22.63	30.23	26.45	28.50	52.59	36.68	37.50	32.00	29.60	16.60	14.20	28.50	29.623
Bromomethane (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.32 kg/day	1996	0.02504	0.02713	0.02585	0.02324	0.02337	0.02746	0.03138	0.03316	0.02973	0.02422	0.0244	0.02641	0.026783
	1997	0.02586	0.02431	0.02412	0.02425	0.03063	0.02535	0.01541	0.0177	0.01866	0.01866	0.01753	0.0173	0.021648
	1998	0.02205	0.01846	0.03877	0.05222	0.04186	0.03508	0.04449	0.05086	0.05105	0.04496	0.04151	0.01914	0.038371
	1999	0.05158	0.01350	0	0	0.01169	0.00394	0.01442	0.00646	0	0.00501	0.01159	0.01955	0.011478
	2000	0.01948	0.01926	0.01913	0.02050	0.02127	0.02086	0.02246	0.02276	0.02174	0.02155	0.01868	0.01821	0.020492
	2001	0.00836	0.00820	0.00779	0.00777	0.00734	0.00727	0.01000	0.0100	0.01000	0.01000	0.01000	0.01000	0.008895
Bromoform (kg/day)	1995	n/a	n/a	n/a	n/a	0.5698	0.01908	0	0.07284	0	0.118	0.175	0.2066	0.14516
Guideline** = 0.37 kg/day	1996	0.05256	0.1097	0.3542	0.4713	0.2913	0.3244	0.2793	0.2898	0.2698	0	0.1087	0.0426	0.21614
	1997	0.14250	0.09607	0.05492	0.04146	0	0	0.01708	0.08375	0.0287	0.02396	0.02399	0.02107	0.044458
	1998	0.01478	0.02701	0.01391	0.001958	0.006217	0.02199	0	0.0313	0	0	0	0.01297	0.010845
	1999	0.05158	0.01350	0	0	0.01169	0.00394	0.01442	0.00646	0	0.00501	0.0116	0.0196	0.011478
	2000	0.06328	0.01682	0.04128	0.04298	0.00842	0.02777	0.01504	0.04279	0.00826	0	0.04152	0.05466	0.0300235
	2001	0.02527	0.00835	0.02311	0.01612	0.03352	0	0.01000	0	0	0.01000	0.01000	0	0.011364
Chloromethane (kg/day)	1995	n/a	n/a	n/a	n/a	0.01669	0.01616	0.0156	0.01699	0.01558	0.01607	0.1497	0.01505	0.03273
Guideline** = 0.6 kg/day	1996	0.01442	0.01562	0.01489	0.01338	0.01346	0.01544	0.01765	0.01865	0.01672	0.01362	0.01372	0.01485	0.015202
	1997	0.01454	0.01367	0.01356	0.01363	0.01369	0.01426	0.01596	0.01888	0.0199	0.0199	0.0187	0.01846	0.016263
	1998	0.02274	0.02053	0.03761	0.05004	0.04012	0.03362	0.04283	0.04874	0.04892	0.04308	0.03978	0.009877	0.036491
	1999	0.00980	0.00947	0.00916	0.00969	0.02452	0.02876	0.01005	0.01042	0.01123	0.00948	0.00896	0.00903	0.012546

Facility: Bayer Inc., Sarnia [0000030007]								**Control Points: 3100, 3200, 3300**						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	2000	0.00974	0.00963	0.00957	0.01025	0.01063	0.00928	0.01060	0.01085	0.01006	0.00869	0.00830	0.00810	0.009642
	2001	0	0	0	0	0	0	0.01000	0.01000	0.01000	0.01000	0.01000	0.01000	0.005000
Chloroform (kg/day)	1995	n/a	n/a	n/a	n/a	0.07821	0.07924	0.009956	0.01403	0.01018	0.009607	0.05632	0.03625	0.036724
Guideline** = 0.39 kg/day	1996	0.06791	0.03754	0.02987	0.1942	0.104	0.01226	0.0368	0.05216	0.09689	0.114	0.01576	0.1158	0.073099
	1997	0.01546	0.09812	0.05986	0.0189	0.007015	0.02264	0.01055	0.01714	0.009822	0.01661	0.03484	0.02068	0.027636
	1998	0.03179	0.04457	0.03021	0.02803	0.01607	0.005827	0.008389	0.01659	0.01928	0.01321	0.006692	0.003974	0.018719
	1999	0.003480	0.005356	0.004824	0.015940	0.019210	0.005511	0.002033	0.004018	0.008174	0.001850	0.001831	0.007086	0.0066094
	2000	0.002004	0.001919	0.001945	0.002039	0.002102	0.011060	0.004398	0.002854	0.006019	0.004289	0.005908	0.014680	0.0049348
	2001	0.012840	0.006502	0.014650	0.003480	0.008218	0.003932	0.010000	0	0.010000	0.010000	0	0	0.0066352
Methylene Chloride (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
	1996	0.01036	0	0	0.009751	0	0	0.0206	0	0	0.01628	0	0	0.004749
	1997	0.0244	0	0	0.01616	0	0	0.01845	0	0	0.02591	0	0	0.007077
	1998	0.02381	0	0	0.006183	0	0	0.006549	0	0	0.004998	0	0	0.003462
	1999	0.004102	0	0	0.003858	0	0	0	0	0	0	0	0	0.000663
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0.007312	0	0	0	0	0	0	0	0	0	0	0	0.000914
Zn (kg/day)	1995	n/a	n/a	n/a	n/a	2.434	0.3519	0.5966	0.6741	1.769	0.7997	1.234	1.142	1.1252
Guideline** = 4.9 kg/day	1996	0.3780	0.2009	0.3812	0.5133	0.7973	0.8558	2.099	1.353	0.9457	1.1840	1.348	0.5531	0.88411
	1997	0.4933	0.8108	0.8119	0.4269	0.3271	0.3601	0.3474	0.2416	0.7452	1.0850	0.1021	0.04854	0.48333
	1998	0.0947	1.6110	1.2390	0.2725	0.8128	0.4193	1.1010	0.3826	0.2201	0.1050	0.05173	0.4091	0.5599
	1999	0.3262	0.3181	0.5326	0.2147	0.0167	0.5326	0.3240	0.6095	0.3366	0.5500	0.7728	0.9830	0.45973
	2000	0.2204	0.3664	0.3268	0.4339	0.6621	0.9564	0.6496	0.7576	0.9886	0.7138	0.3519	0.1283	0.54632
	2001	0.2799	0.4055	0.4974	0.3827	0.5988	0.2428	0.3511	0.2839	0.2948	0.5881	0.8123	0.4459	0.43193

* Flows for process effluent only (CP3100)
** Guidelines established February 16, 1998

Gross average flows and loadings for Chinook Group Ltd., Sombra.

Facility: Chinook Group Ltd., Sombra [0005600002]												Control Points: 0600		
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1997	247.6	418.9	462.9	347.3	444.8	376.1	399	335.8	344.6	283.9	362.2	322.6	362.14
	1998	377.5	405.8	416.4	361	241.6	273.6	380.5	309.3	266.5	235.8	200.9	239.7	309.05
	1999	277.5	285.0	281.2	382.3	388.0	356.0	N/A	N/A	N/A	329.3	312.5	281.9	321.52
	2000	241.3	233.7	396.4	362.8	403.0	383.5	394.5	478.5	409.2	408.8	297.7	269.9	356.61
	2001	280.7	391.7	374.8	351.2	323.1	253.0	311.9	275.1	342.6	309.3	312.6	253.7	314.98
Chromium (kg/day)	1997	4.50E-04	1.69E-03	1.78E-03	9.39E-04	8.17E-04	1.00E-03	8.34E-04	7.86E-04	1.28E-03	2.00E-03	8.55E-04	7.65E-04	1.10E-03
Guideline* = 7.90E-03 kg/day	1998	7.47E-04	2.22E-03	8.68E-04	6.23E-04	3.53E-04	1.54E-03	6.05E-04	6.77E-04	5.30E-04	5.24E-04	9.14E-04	8.51E-04	0.87E-03
	1999	5.99E-04	6.29E-03	5.96E-03	6.81E-03	7.22E-03	5.42E-03	N/A	N/A	N/A	2.92E-03	3.12E-03	2.64E-03	4.55E-03
	2000	2.99E-03	1.73E-03	7.83-E03	4.91E-03	4.00E-03	3.48E-03	4.44E-03	4.25E-03	3.59E-03	4.30E-03	3.79E-03	1.84E-03	3.93E-03
	2001	2.32E-03	3.98E-03	3.40E-03	5.75E-03	6.30E-03	4.35E-03	3.16E-03	2.45E-03	4.06E-03	3.29E-03	3.04E-03	2.49E-03	3.71E-03
C dissolved organic	1997	13.85	101.1	20.76	17.64	23.05	20.31	21.51	19.55	20.98	11.16	13.17	15.37	24.871
Guideline* = 3.2 kg/day	1998	16.85	21.42	21.4	20.75	20.91	29.31	38.09	23.88	21.65	30.94	26.56	22.51	24.522
	1999	18.57	19.93	19.23	27.02	24.93	22.09	N/A	N/A	N/A	12.01	13.99	13.75	19.058
	2000	36.67	20.20	21.26	24.26	17.79	14.19	13.73	16.45	14.94	14.80	11.07	18.75	18.676
	2001	32.46	16.04	12.36	12.40	10.69	7.45	7.15	6.51	8.19	13.95	6.18	4.01	11.449
Ammonium (kg/day)	1997	6.999	13.62	13.2	8.519	6.124	13.47	14.03	19.12	11.43	7.553	11.02	10.54	11.302
Guideline* = 0.48 kg/day	1998	12.76	19.39	19.62	5.863	0.9383	0.6002	14	1.66	0.3376	0.2419	0.9818	0.9902	6.4486
	1999	14.152	8.498	11.250	2.361	0.1641	0.8951	N/A	N/A	N/A	2.201	0.8506	2.1850	3.5279
	2000	4.244	6.996	5.263	0.9562	2.119	0.3479	41.280	0.8484	0.8228	1.613	7.223	3.845	6.2965
	2001	7.986	17.070	13.650	5.465	0.5731	0.5741	0.8585	0.3470	0.5946	1.329	0.2977	0.1501	4.0746
Total Kjeldahl N (kg/day)	1997	13.52	42.62	24.68	14.52	17.53	19.73	29.01	22.94	22.22	13.66	19.46	19.95	21.653
Guideline* = 1.1 kg/day	1998	25.30	33.55	28.92	15.65	8.86	10.63	25.77	10.76	8.19	12.02	9.11	9.593	16.529
	1999	10.03	12.60	14.64	7.02	5.46	3.97	N/A	N/A	N/A	2.90	2.72	6.89	7.3598
	2000	12.89	9.21	11.23	6.56	4.17	2.87	29.64	13.86	4.83	5.81	10.44	13.31	10.401
	2001	22.83	28.38	20.75	9.93	3.40	4.42	2.46	3.10	5.15	5.17	2.45	1.04	9.0898
Phosphorus (kg/day)	1997	0.2999	0.5044	0.4743	0.3411	0.4158	0.758	0.6432	0.5819	0.509	0.4066	0.3895	0.8404	0.51367
Guideline* = 0.2 kg/day	1998	0.3891	0.4444	0.3147	0.2618	0.1257	0.2157	0.3651	0.2513	0.441	0.2549	0.7482	0.402	0.35116
	1999	0.4544	0.4180	0.2732	0.3188	0.4471	0.4190	N/A	N/A	N/A	0.1709	0.2741	0.1188	0.32163
	2000	0.1415	0.1708	0.5817	0.4677	0.3068	0.3022	0.4334	0.4322	0.3882	0.4855	0.6291	0.3390	0.38984
	2001	0.5208	0.6685	0.4358	0.2406	0.2667	0.3015	0.2803	0.2668	0.4803	0.2922	0.3232	0.1692	0.35383
Particulate Residue [RSP] (kg/day)	1997	7.683	40.98	26.29	14.84	23.07	27.74	18.05	22.15	13.63	7.995	3.961	10.11	18.042

Facility: Chinook Group Ltd., Sombra [0005600002]												Control Points: 0600		
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Guideline* = 2.4 kg/day	1998	23.92	48.55	17.31	8.816	4.052	3.78	6.212	14.01	9.273	6.496	11.82	9.379	13.635
	1999	12.340	11.450	8.561	8.407	8.660	4.231	N/A	N/A	N/A	4.506	4.847	4.956	7.5509
	2000	4.763	10.050	21.660	73.540	14.610	8.499	13.160	20.450	11.970	11.350	9.436	11.060	17.546
	2001	20.920	20.870	9.362	12.610	12.390	8.407	9.140	8.853	11.030	8.853	9.524	6.835	11.566
Solvent Extractables (kg/day)	1997	0.8984	1.022	0.7981	1.162	0.6898	0.7298	0.913	0.4111	0.7163	0.5074	2.211	1.976	1.0029
Guideline* = 0.34 kg/day	1998	2.6440	3.907	1.768	0.7339	0.2676	0.3669	0.9392	0.3199	0.2649	0.2618	0.2305	0.2801	0.99865
	1999	0.8443	1.6880	0.7198	0.3405	0.3610	0.3900	N/A	N/A	N/A	0.4081	0.3116	0.3991	0.60693
	2000	0.3075	0.3567	1.4580	1.2450	1.7860	0.4016	0.5711	0.6419	0.3589	0.5497	0.4555	0.6172	0.72909
	2001	0.2318	0.8933	0.4024	0.4580	0.3969	0.2345	0.3161	0.2452	0.4062	0.3285	0.3037	0.2478	0.37203
Zinc (kg/day)	1997	5.15E-03	0.01891	0.0148	5.88E-03	8.85E-03	0.01056	0.01292	9.54E-03	0.01405	0.01609	0.0185	0.01512	12.53E-03
Guideline* = 0.023 kg/day	1998	0.01157	0.01615	0.01268	7.51E-03	3.57E-03	8.40E-03	2.81E-03	7.70E-03	0.011	0.01385	0.01067	8.48E-03	9.53E-03
	1999	8.89E-03	0.01582	0.02221	0.01139	0.01345	6.60E-03	N/A	N/A	N/A	0.02098	0.1419	0.1404	14.17E-03
	2000	8.98E-03	6.05E-03	0.03054	0.02334	0.02663	0.01097	0.03664	0.02348	0.02176	0.02642	0.01422	9.21E-03	19.85E-03
	2001	0.01271	0.02788	0.01941	0.02395	0.023520	0.02632	0.03075	0.02639	0.05670	0.02288	9.80E-03	8.83E-03	24.09E-03

* Guidelines established February 16, 1998

Gross average lows and loadings for Dow Chemical Canada Inc., Sarnia.

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]						**Control Points: 3000, 3100, 3200**								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)*	1999	6580	6750	5890	4742	3220	3095	3150	3377	3117	2916	3170	3864	4155.9
	2000	4931	3499	4610	4051	5016	4706	4078	4645	4647	5463	4079	5664	4615.8
	2001	6354	7802	6427	5335	5005	5323	4725	5573	6873	9139	5367	5317	6103.3
Aluminium (kg/day)	1995	n/a	n/a	n/a	n/a	4.69E-03	2.00E-03	0	0	0	1.156	2.06	1.269	0.56146
Guideline** = 8.9 kg/day	1996	1.149	1.888	1.042	1.239	2.904	5.835	1.824	1	0.7777	1.912	2.354	1.207	1.9276
	1997	2.088	6.906	6.911	2.961	4.161	3.35	2.489	1.619	3.328	2.331	1.715	2.076	3.3279
	1998	5.09	4.901	7.559	2.166	2.689	1.779	2.805	0.7776	3.393	1.758	1.258	1.531	2.9756
	1999	1.7010	0.7134	2.2020	0.7129	0.2536	0.4947	0.3029	0.9547	1.1080	2.1640	0.9148	1.2230	1.0621
	2000	1.5250	1.8570	0.9653	1.7300	1.1800	1.0120	1.1520	0.7876	0.7442	0.7140	1.0440	1.1490	1.1550
	2001	2.1770	2.5890	1.8950	0.9532	1.6660	1.5180	0.6258	0.9668	1.4930	3.0220	1.5700	0.8336	1.6091
Ethylbenzene (kg/day)	1995	n/a	n/a	n/a	n/a	2.09E-04	0	1.23E-04	0	0	1.90E-03	0	0	27.9E-05
	1996	2.36E-04	0	0	2.18E-04	0	0	2.17E-04	0	0	2.71E-04	0	0	7.84E-05
	1997	1.83E-04	0	0	2.67E-04	0	0	0	0	0	0	0	0	3.75E-05
	1998	0	0	0	0	0	0	1.03E-04	0	0	1.32E-04	0	0	1.96E-05
	1999	0.88E-04	0	0	0.99E-04	0	0	0	0	0	0	0	0	1.56E-05
	2000	0.98E-04	0	0	0.67E-04	0	0	1.41E-04	0	0	2.70E-04	0	0	4.81E-05
	2001	2.43E-04	0	0	2.94E-04	0	0	1.85E-04	0	0	2.44E-04	0	0	8.06E-05
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	13.62	12.27	10.89	13.4	10.43	22.17	23.84	19.17	15.724
Guideline** = 73 kg/day	1996	10.43	28.79	23.31	20.35	16.54	15.95	17.7	22.52	23.15	22.01	32.78	29.29	21.902
	1997	26.55	30.64	32	35.47	24.41	18.61	21.03	22.4	21.96	20.04	23.38	16.61	24.425
	1998	28.57	32.27	18.54	21.15	18.12	15.69	18.71	20	17.74	18.99	20.96	23.34	21.173
	1999	23.22	23.56	17.93	13.06	10.17	9.33	9.04	8.80	9.23	9.65	7.03	9.97	12.582
	2000	25.75	10.76	12.59	10.56	13.89	11.01	10.62	16.01	10.95	11.87	10.21	15.92	13.345
	2001	32.72	38.79	26.98	22.11	13.67	12.39	11.60	13.24	16.25	38.81	24.11	29.16	23.319
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	264.4	389.6	502.1	450.3	314.9	306.1	299	226.7	344.14
(CP 3100)	1996	175.4	291.9	293.9	189	251.2	266.1	272.4	363.5	280.4	218.6	305.1	343.5	270.92
	1997	225.1	248.2	271.1	322.1	224.5	287.3	297.6	291.7	272.6	302.2	228.8	209.1	265.02
	1998	298.7	296.8	205.8	349.4	265.6	268.6	326.3	244.9	207.8	226.1	198.5	221	259.12
	1999	214.2	314.0	191.2	205.9	194.3	226.0	304.1	246.6	203.8	233.5	204.8	213.3	229.31
	2000	220.5	208.2	149.0	140.7	207.7	205.3	249.9	275.9	272.0	273.4	316.4	214.9	227.83
	2001	224.0	220.4	213.0	250.6	324.7	230.7	205.7	202.3	194.3	242.2	218.2	164.7	224.23
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	263.6	295.9	388.5	356.8	289.5	494.4	324.4	259.5	334.07
(CP 3200)	1996	233.5	298.3	170.4	159.8	159.8	174.8	190.3	312.8	190.1	135.4	235.3	265.6	210.51

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]						Control Points: 3000, 3100, 3200								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1997	181.5	204.3	249.1	360	290.8	344.6	266.2	304.4	263.4	260.1	235.8	204.8	263.75
	1998	287.1	266.3	184.9	520.8	257.7	182.7	277.2	215.4	107.5	n/a	n/a	n/a	255.51
Ammonium (kg/day)	1995	n/a	n/a	n/a	n/a	5.022	10.24	5.393	4.827	3.82	5.864	2.589	2.167	4.9902
Guideline** = 43 kg/day	1996	0.6882	0.7038	0.834	3.7	6.336	6.438	3.027	5.015	4.847	2.626	1.162	0.7532	3.0109
	1997	1.589	1.85	3.124	8.94	7.117	10.97	11.08	10.31	4.841	5.236	1.04	1.481	5.6315
	1998	2.426	0.4379	0.6496	0.9148	0.1646	0.09157	0.03042	0.1163	0.02692	0.07666	0.02192	0.0278	0.41537
	1999	0.02735	1.1080	0.02366	0.08256	0.03406	0.09370	0.00718	0.04616	2.7830	0	0.02793	0.04158	0.35627
	2000	0.04757	0.03175	0.03771	0.05050	0.08870	0.1249	0.1690	0.09336	0.1388	0.1278	0.09175	0.1592	0.096753
	2001	0.1278	0.4418	0.4786	0.3182	1.0870	0.1410	0.2373	0.2186	0.2354	0.2815	0.9909	1.6910	0.52076
Nitrates (kg/day)	1995	n/a	n/a	n/a	n/a	2.044	2.907	2.432	2.295	2.898	2325	2969	3776	1135.3
	1996	2.904	2.607	3.622	4.137	4.299	2.164	2.699	4.632	3.991	3.622	4.22	4.139	3.5863
	1997	4.574	5.284	4.953	4.01	3.15	4.394	3.31	3.509	3.873	4.935	3.757	3.533	4.1068
	1998	4.399	4.378	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4.3885
Total Kjeldahl N (kg/day)	1995	n/a	n/a	n/a	n/a	6.159	9.383	6.82	4.241	3.627	6.563	4.029	2.804	5.4533
Guideline** = 22 kg/day	1996	1.614	1.859	2.15	4.073	7.039	6.729	4.851	5.77	6.292	4.271	2.311	1.553	4.0427
	1997	2.352	3.144	4.648	10.47	10.6	14.42	13.45	14.2	7.884	5.761	2.026	2.482	7.6197
	1998	3.841	1.126	1.277	1.32	0.8326	0.868	1.096	0.8769	0.6753	0.8043	0.3143	0.8286	1.1550
	1999	1.591	2.195	10746	10449	1.128	1.389	0.8596	0.7729	3.645	1.169	0.8767	1.435	1.5214
	2000	1.133	0.9707	1.063	1.747	1.412	1.168	1.185	1.741	1.758	1.731	1.496	1.915	1.4433
	2001	2.381	3.163	2.976	2.356	1.805	1.547	1.304	1.432	2.223	3.919	2.153	4.018	2.4398
Phenolics (kg/day)	1995					0.01877	3.60E-03	3.27E-03	5.82E-03	8.54E-03	0.02696	0.09114	0.005014	0.020389
Guideline** = 0.3 kg/day	1996	0.04094	5.22E-03	8.16E-03	0.01983	0.01003	0.03252	0.01094	7.31E-03	0.01294	3.72E-03	4.33E-03	0.005496	0.013453
	1997	4.62E-03	6.81E-03	8.98E-03	0.01024	6.33E-03	0.0172	0.01033	0.01256	0.0102	0.01103	0.01049	0.006842	0.009640
	1998	0.01384	9.71E-03	0.01701	0.01085	0.01155	6.96E-03	0.03862	0.01467	9.63E-03	0.01016	0.01877	0.01311	0.014573
	1999	0.01907	0.01715	0.01481	0.01248	0.00878	0.00488	0.00377	0.00376	0.00378	0.00615	0.00270	0.00383	0.008430
	2000	0.00316	0.00165	0.00696	0.00913	0.00861	0.00908	0.00540	0.01103	0.00738	0.00725	0.00452	0.00769	0.006821
	2001	0.00668	0.01508	0.01600	0.01308	0.01056	0.01383	0.01373	0.00988	0.00412	0.01532	0.01063	0.00604	0.011246
Phenolics (kg/day)	1995	n/a	n/a	n/a	n/a	0.1623	0.08406	0.6382	0.48	0.3686	0.1232	0.1896	0.03125	0.25965
(CP 3100)	1996	0.06417	0.06022	0.08182	0.09075	0.05757	0.1466	0.09868	0.05835	0.1715	0.05264	0.08311	0.1067	0.089343
	1997	0.05981	0.06086	0.1274	0.1756	0.1433	0.1023	0.0833	0.1659	0.06546	0.1319	0.0799	0.08764	0.10695
	1998	0.08855	0.07441	0.04377	0.02426	0.04573	0.05993	0.05932	0.04671	0.05776	0.06369	0.05079	0.06146	0.056365
Phenolics (kg/day)	1995	n/a	n/a	n/a	n/a	0.3136	0.1961	0.1481	0.1697	0.2602	0.09478	0.2336	0.04795	0.183
(CP3200)	1996	0.1012	0.1023	0.118	0.0881	0.06515	0.1158	0.07943	0.07212	0.1801	0.04236	0.05267	0.07041	0.090637
	1997	0.04468	0.03911	0.1488	0.1925	0.1084	0.1417	0.1865	0.188	0.08319	0.09921	0.03753	0.07906	0.112390

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]												Control Points: 3000, 3100, 3200		
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1998	0.08331	0.09086	0.05223	0.06188	0.04521	0.0572	0.1236	0.06923	0.04455	n/a	n/a	n/a	0.069786
	1999	0.07421	0.04559	0.03375	0.03975	0.08935	0.09907	0.08278	0.11350	0.15470	0.20170	0.08668	0.07439	0.091289
	2000	0.06304	0.05986	0.09650	0.09584	0.08992	0.02126	0.08488	0.16500	0.16140	0.18080	0.11700	0.15490	0.107530
	2001	0.06967	0.07460	0.17380	0.59870	0.20770	0.22300	0.18110	0.13650	0.08388	0.13350	0.09520	0.04868	0.168860
BIS-2-Chloroisopropyl Ether (kg/day)	1995	n/a	n/a	n/a	n/a	0.01464	0	2.47E-03	0	0	9.49E-04	0	0	2.26E-03
	1996	1.18E-03	0	0	0.03393	0	0	1.08E-03	0	0	6.77E-03	0	0	3.58E-03
	1997	0.01665	0	0	0.03277	0	0	7.80E-04	0	0	1.19E-03	0	0	4.28E-03
	1998	1.68E-03	0	0	1.68E-03	0	0	1.03E-03	0	0	1.32E-03	0	0	0.476E-03
	1999	0.882E-03	0	0	0.989E-03	0	0	1.399E-03	0	0	1.173E-03	0	0	0.370E-03
	2000	0.983E-03	0	0	0.674E-03	0	0	1.407E-03	0	0	1.351E-03	0	0	0.368E-03
	2001	1.216E-03	0	0	1.472E-03	0	0	0	0	0	0	0	0	0.224E-03
Phosphorus (kg/day)	1995	n/a	n/a	n/a	n/a	0.4822	0.5056	0	0	0	0.7574	0.545	0.5434	0.3542
Guideline** = 7 kg/day	1996	0.4838	0.447	0.4679	1.024	0.4609	1.589	0.3715	0.5561	0.527	0.5863	0.7222	0.8534	0.67409
	1997	0.7703	0.8498	0.9001	0.8589	0.6224	0.6201	0.4057	0.5096	2.289	0.5688	0.8842	0.9627	0.85347
	1998	1.051	1.613	1.263	1.105	1.166	1.071	1.526	1.714	1.032	1.131	1.206	1.201	1.2566
	1999	1.251	1.175	1.353	0.7521	0.4382	0.6899	0.5347	2.052	0.5392	0.4944	0.4345	0.7950	0.87575
	2000	1.005	0.4838	20262	0.6071	0.6179	0.5502	0.4637	0.4371	0.3230	0.3771	0.4937	0.6915	0.69268
	2001	1.090	1.217	0.6091	0.6546	1.075	1.040	10994	0.3367	0.5190	42.91	0.6301	2.110	4.5155
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	60.8	61.42	65.83	48.79	55.87	45.24	51.59	34.02	52.945
Guideline** = 230 kg/day	1996	30.42	59.97	47.45	33.01	33.81	50.30	47.92	47.72	61.37	66.63	43.77	67.46	49.153
	1997	50.41	80.95	90.15	71.54	52.37	59.49	34.10	33.41	51.92	35.67	55.40	49.04	55.371
	1998	77.24	55.19	75.18	51.05	23.40	17.25	31.15	26.78	33.18	31.29	35.50	51.60	42.401
	1999	91.30	37.09	58.50	38.58	19.77	20.21	19.55	17.97	37.97	51.21	31.43	29.57	37.763
	2000	35.07	30.11	30.99	67.97	41.26	32.51	24.81	22.91	37.33	49.72	27.81	62.01	38.542
	2001	53.20	63.81	52.73	24.29	22.73	29.37	35.76	24.33	32.54	133.10	61.73	25.65	46.603
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	782.3	563.9	1612	1106	1428	825.6	865.6	830.2	1001.7
(CP 3100)	1996	457.9	574.1	354.0	250.9	662.6	819.3	1032.0	277.6	494.5	1153.0	353.5	172.4	550.15
	1997	216.0	293.5	924.7	461.4	299.2	214.0	292.3	623.4	1175	1002.0	1062	925.5	624.08
	1998	601.8	939.8	1476.0	406.7	381.6	265.2	924.8	373.4	434.5	647.7	424.4	411.0	607.24
	1999	701.5	451.0	973.7	525.0	282.0	185.8	733.1	940.6	404.1	2314.0	663.6	747.2	743.47
	2000	682.0	498.1	813.7	1303.0	670.9	419.2	483.7	615.0	979.9	977.2	605.5	573.6	718.48
	2001	528.5	633.2	474.9	452.6	252.1	784.4	485.6	375.3	730.0	744.1	421.6	176.5	504.90
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	641.5	387.6	915.6	1045	1670	1579	749	1082	1008.7
(CP 3200)	1996	2715	780.7	253.9	242.7	531.1	478.5	372.9	251.7	401.9	927.3	103.8	144.4	600.32

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]										Control Points: 3000, 3100, 3200			
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1997	103	186.8	405.7	105.3	605.8	630.2	315.5	498.9	1011	987	921.3	649.4	534.99
	1998	424.8	306.7	946	410.5	267.5	181.9	369	275	130.3	n/a	n/a	n/a	367.97
Solvent Extractables (kg/day)	1995	n/a	n/a	n/a	n/a	12.13	4.041	5.202	5.818	5.804	13.17	7.066	4.371	7.2003
Guideline** = 76 kg/day	1996	3.905	12.520	10.450	19.380	7.944	7.534	6.415	4.057	7.280	5.780	8.998	7.358	8.4684
	1997	15.420	13.760	8.706	30.140	12.580	5.502	6.441	6.231	15.930	5.458	9.837	5.718	11.31
	1998	8.778	6.278	8.874	8.290	6.637	4.167	5.382	3.878	6.018	1.724	1.287	1.274	5.2156
	1999	1.290	2.121	1.221	0.8594	1.702	1.920	0.6411	1.991	0.5849	4.766	2.423	4.991	2.0427
	2000	6.424	5.869	7.737	36.800	15.770	16.710	12.290	1.329	0.9472	2.526	0.8331	1.046	9.0234
	2001	1.273	2.731	1.285	1.028	1.200	1.159	0.9838	1.128	1.362	1.734	1.135	0.9785	1.3331
Dichloroethane 1,2 (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.18 kg/day	1996	2.03E-04	0.01316	4.08E-03	8.66E-03	4.36E-03	0.01063	0.01245	5.54E-03	1.66E-03	0.02375	6.78E-03	0.01992	9.27E-03
	1997	3.55E-03	0.01718	6.52E-03	2.26E-04	2.13E-03	6.36E-04	2.02E-04	2.27E-04	3.64E-04	2.14E-04	4.78E-04	8.77E-04	2.72E-03
	1998	0.01216	4.94E-03	6.33E-03	1.40E-03	4.46E-04	6.06E-04	2.35E-04	2.25E-04	1.60E-04	2.38E-04	1.77E-04	1.07E-03	2.33E-03
	1999	0.23E-03	1.04E-03	0.20E-03	0.26E-03	1.15E-03	1.14E-03	0.18E-03	0.18E-03	0.18E-03	1.19E-03	1.34E-03	3.30E-03	0.864E-03
	2000	0.16E-03	2.14E-03	0.16E-03	0.50E-03	0.63E-01	0.23E-01	0.24E-03	0.20E-03	0	2.04E-03	0.59E-03	2.22E-03	0.759E-03
	2001	0.69E-03	0.62E-03	0	0	0	0.29E-03	0.03E-03	1.08E-03	1.02E-03	4.11E-03	0.92E-03	1.59E-03	0.861E-03
Dichloropropane 1,2 (kg/day)	1995	n/a	n/a	n/a	n/a	7.35E-04	3.18E-03	1.93E-04	6.96E-04	1.57E-04	2.19E-04	6.19E-03	2.04E-04	14.5E-04
Guideline** = 0.62 kg/day	1996	8.12E-04	1.92E-04	1.84E-04	1.10E-03	3.99E-03	6.07E-04	9.48E-04	1.88E-04	2.33E-04	2.36E-04	9.61E-05	1.81E-04	7.30E-04
	1997	2.00E-04	2.57E-04	2.54E-04	2.26E-04	1.54E-04	2.06E-04	0	0	0	0	0	0	1.08E-04
	1998	3.25E-04	2.67E-04	3.22E-04	2.53E-04	1.70E-04	1.64E-04	2.35E-04	1.88E-04	1.60E-04	2.38E-04	1.77E-04	2.25E-04	2.27E-04
	1999	2.29E-04	2.62E-04	2.00E-04	2.55E-04	1.62E-04	1.79E-04	1.83E-04	1.78E-04	1.76E-04	1.63E-04	1.48E-04	2.40E-04	1.98E-04
	2000	1.57E-04	1.89E-04	1.56E-04	2.04E-04	2.27E-04	2.31E-04	2.35E-04	2.01E-04	0	2.59E-04	1.98E-04	3.04E-04	1.97E-04
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Methylene Chloride (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
	1996	0	0	0	0	0	0	0	0	0	0.01598	0	0	13.3E-04
	1997	0	0	0	0	0	0	0	0	0	0	0	0	0
	1998	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	5.89E-04	0	0	0	0	0	0	0	0	0.491E-04
Tetrachloroethylene (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.041 kg/day	1996	0	0	0	0	0	0	0	0	0	1.24E-04	0	0	1.04E-05
	1997	0	8.13E-04	0	0	0	0	0	0	0	0	0	0	6.78E-05
	1998	4.23E-04	2.56E-04	0	0	0	0	0	0	0	0	0	0	5.65E-05

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]									Control Points: 3000, 3100, 3200					
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	0	0	0	0	0	8.34E-04	0	0	0	0	0	0	6.95E-05
	2000	0	3.40E-04	0	0	0	0	0	0	0	0	0	0	2.83E-05
	2001	1.20E-04	4.13E-04	0	0	0	0	0	0	0	0	0	0	4.44E-05
Trichloroethylene (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
	1996	0	0	0	0	0	0	0	0	0	0	0	0	0
	1997	0	0	0	0	0	0	0	0	0	0	0	0	0
	1998	0	0	0	0	0	0	4.14E-04	0	0	5.26E-04	0	0	7.83E-05
	1999	3.53E-04	0	0	3.96E-04	0	0	0	0	0	0	0	0	6.24E-05
	2000	3.93E-04	0	0	2.69E-04	0	0	5.63E-04	0	0	0	0	0	10.21E-05
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
	1996	0	0	0	0	0	0	0	0	0	0	0	0	0
	1997	0	0	0	0	0	0	0	0	0	0	0	0	0
	1998	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichlorobenzene 1,2,4 (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.0056 kg/day	1996	2.23E-06	1.91E-06	1.83E-06	2.77E-06	2.08E-06	2.29E-06	2.48E-06	1.88E-06	2.33E-06	2.35E-06	2.30E-06	2.26E-06	2.23E-06
	1997	1.99E-06	2.57E-06	2.54E-06	2.25E-06	2.48E-06	2.06E-06	2.01E-06	2.27E-06	2.97E-06	2.13E-06	2.23E-06	4.27E-06	2.49E-06
	1998	3.24E-06	2.67E-06	3.22E-06	2.53E-06	1.70E-06	1.64E-06	5.16E-06	1.88E-06	1.59E-06	2.37E-06	1.77E-06	2.24E-06	2.50E-06
	1999	2.29E-06	2.62E-06	2.00E-06	2.55E-06	1.62E-06	1.79E-06	1.83E-06	1.78E-06	1.76E-06	1.63E-06	1.48E-06	2.40E-06	1.98E-06
	2000	1.57E-06	1.89E-06	1.56E-06	2.04E-06	2.27E-06	2.31E-06	2.35E-06	2.01E-06	3.10E-06	2.59E-06	1.98E-06	3.04E-06	2.23E-06
	2001	2.78E-06	4.84E-06	3.62E-06	2.55E-06	3.16E-06	3.16E-06	2.00E-06	3.05E-06	3.97E-06	4.72E-06	2.71E-06	2.80E-06	3.28E-06
Tetrachlorobenzene 1,2,4,5 (kg/day)	1995	n/a	n/a	n/a	n/a	3.00E-06	2.00E-06	3.00E-06	4.00E-06	3.00E-06	4.00E-06	5.00E-06	4.00E-06	3.50E-06
Guideline** = 0.00075 kg/day	1996	4.47E-06	3.83E-06	3.67E-06	5.06E-06	4.17E-06	4.58E-06	4.97E-06	3.76E-06	4.66E-06	4.71E-06	4.20E-06	4.52E-06	4.39E-06
	1997	3.99E-06	5.14E-06	5.08E-06	0	0	0	0	0	0	0	0	0	1.18E-06
	1998	0	0	0	0	0	0	1.82E-06	0	0	0	0	0	0.15E-06
	1999	0	0	0	0	1.05E-06	0	0	0	0	0.48E-06	0.49E-06	0	0.17E-06
	2000	3.03E-06	3.73E-06	0	0	0	0	4.71E-06	0	0	7.67E-06	2.00E-06	0	1.76E-06
	2001	1.17E-06	3.10E-06	0	0	0	0	0	0	0	0	0	0	0.36E-06
Hexachlorobenzene (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0.00E+00	0	0	0
	1996	1.18E-05	0	0	0	0	0	0	0	0	9.48E-06	0	0	1.77E-06
	1997	0	0	0	1.15E-05	0	0	8.67E-06	0	0	4.05E-05	0	0	5.06E-06

Facility: Dow Chemical Canada Inc., Sarnia [0000910109]											Control Points: 3000, 3100, 3200			
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1998	0	0	0	0	0	0	9.09E-06	0	0	0	0	0	0.76E-06
	1999	9.17E-06	0	0	7.71E-06	0	0	11.19E-06	0	0	0	0	0	2.34E-06
	2000	5.90E-06	0	0	2.29E-06	0	0	17.17E-06	0	0	15.7E-06	0	0	3.42E-06
	2001	22.62E-06	0	0	0	0	0	0	0	0	10.3E-06	0	0	2.74E-06
Hexachloroethane (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.00033 kg/day	1996	1.12E-05	9.58E-06	9.19E-06	2.72E-06	0	0	2.74E-06	0	0	0	0	0	2.95E-06
	1997	0	0	0	4.51E-06	4.97E-06	4.12E-06	4.03E-06	4.54E-06	3.87E-06	4.27E-06	4.47E-06	5.01E-06	3.32E-06
	1998	5.56E-06	5.34E-06	6.44E-06	5.06E-06	3.40E-06	3.28E-06	4.55E-06	9.60E-06	3.19E-06	4.75E-06	3.54E-06	4.49E-06	4.94E-06
	1999	4.58E-06	5.24E-06	4.00E-06	5.10E-06	3.24E-06	3.58E-06	3.67E-06	3.56E-06	3.51E-06	3.26E-06	2.96E-06	4.79E-06	3.96E-06
	2000	3.14E-06	3.79E-06	3.12E-06	4.09E-06	4.54E-06	4.62E-06	0	4.02E-06	6.20E-06	5.18E-06	3.96E-06	6.09E-06	4.06E-06
	2001	5.56E-06	9.68E-06	7.24E-06	5.09E-06	6.32E-06	6.33E-06	4.00E-06	6.09E-06	7.93E-06	9.44E-06	5.42E-06	5.60E-06	6.56E-06
Trichlorotoluene 2,4,5 (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
Guideline** = 0.0016 kg/day	1996	1.12E-05	1.01E-05	9.19E-06	0	0	0	0	0	0	0	0	0	2.54E-06
	1997	0	0	0	2.25E-06	2.48E-06	1.57E-06	2.01E-06	2.27E-06	1.93E-06	2.13E-06	2.23E-06	2.50E-06	1.62E-06
	1998	3.24E-06	2.67E-06	3.22E-06	2.53E-06	1.70E-06	1.64E-06	2.35E-06	1.88E-06	1.59E-06	2.37E-06	1.77E-06	2.24E-06	2.27E-06
	1999	2.29E-06	2.62E-06	2.00E-06	2.55E-06	1.62E-06	1.79E-06	1.83E-06	1.78E-06	1.76E-06	1.63E-06	1.48E-06	2.40E-06	1.98E-06
	2000	1.57E-06	1.89E-06	1.56E-06	2.04E-06	2.27E-06	2.31E-06	0	2.01E-06	3.10E-06	2.59E-06	1.98E-06	3.04E-06	2.03E-06
	2001	2.78E-06	4.84E-06	3.62E-06	2.55E-06	3.16E-06	3.16E-06	2.00E-06	3.05E-06	3.97E-06	4.72E-06	2.71E-06	2.80E-06	3.28E-06

* Flows for CP 3000 (process effluent) only.

** Guidelines established February 16, 1998

Gross average flows and loadings for Ethyl Canada Inc., Corunna.

Facility: Ethyl Canada Inc., Corunna [0000120006]										**Control Points: 0200, 1000**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1999	n/a	n/a	n/a	9667	10830	4866	2302	3694	4035	2331	8304	6490	5835.4
	2000	3852	4245	4199	5975	7354	4724	4185	3968	3699	3477	3160	3649	4373.9
	2001	6327	5598	4048	3438	3898	3763	3613	3183	2199	1984	1596	1297	3412.0
Toluene (kg/day)	1997	0	0	0	0	0	0	0	0	1.74E-05	3.74E-06	0	1.40E-04	1.341E-05
Guideline** = 0.0001 kg/day)	1998	4.96E-05	1.16E-05	0	0	0	0	0	0	n/a	n/a	n/a	n/a	0.076E-05
Chromium (kg/day)	1997	0	0	2.94E-04	0	0	6.48E-04	0	0	0	6.15E-04	0	0	1.30E-04
	1998	2.86E-04	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	0.36E-04
(CP 0200)***	1997	n/a		2.94E-04	n/a	n/a	6.48E-04	n/a	n/a	n/a	n/a	n/a	n/a	4.71E-04
	1998	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
C dissolved organic (kg/day)	1997	2.633	2.741	2.994	1.536	1.891	3.902	3.652	1.67	2.216	2.848	1.787	1.467	2.4447
Guideline** = 0.087 kg/day	1998	1.458	1.102	0.02235	0.04022	0.04569	0.05106	0.0069	0	n/a	n/a	n/a	n/a	0.34078
(CP 1000 – no MISA guideline)	1997	35.97	26.74	27.86	815.50	31.71	170.80	22.36	18.21	34.90	32.29	30.43	24.35	105.93
	1998	29.41	24.06	24.02	18.56	18.87	17.21	10.26	6.76	13.15	8.49	6.32	9.57	15.557
	1999	8.83	11.68	13.95	15.87	19.86	8.43	4.47	4.97	5.13	3.30	8.80	8.90	9.5152
	2000	5.67	6.60	5.59	8.47	8.88	9.70	7.36	6.55	5.77	7.56	4.90	4.29	6.7780
	2001	8.86	5.98	6.07	5.56	6.10	5.50	3.87	4.55	3.57	3.43	2.34	2.18	4.8342
Mercury (kg/day)	1997	0	0	5.60E-07	0	0	1.56E-06	0	0	0	7.20E-06	0	0	7.8E-07
	1998	3.30E-07	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	4E-08
(CP 0200)***	1997	n/a	n/a	5.60E-07	n/a	n/a	1.56E-06	n/a	n/a	n/a	n/a	n/a	n/a	1.06E-06
	1998	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Nitrates (kg/day)	1997	94.43	107.8	134.1	58.44	74.32	61.83	57.67	67.83	64.64	90.04	58.97	47.16	76.436
Guideline** = 0.15 kg/day	1998	72.4	42.94	0.2692	0.7053	0.4953	0.469	0	0	n/a	n/a	n/a	n/a	14.66
Lead (kg/day)	1997	9.96E-05	2.34E-04	1.37E-04	1.11E-04	1.04E-04	3.43E-04	9.11E-04	2.14E-04	2.52E-04	9.351E-05	3.713E-05	6.912E-05	2.17E-04
Guideline** = 0.0035 kg/day	1998	7.10E-05	9.55E-05	5.81E-05	8.31E-05	1.07E-04	7.77E-05	1.26E-04	0	n/a	n/a	n/a	n/a	7.73E-05
Phenolics (kg/day)	1997	1.62E-05	2.01E-05	4.00E-05	1.35E-05	9.20E-06	2.58E-05	3.17E-05	1.98E-04	6.28E-05	6.728E-05	1.56E-05	2.476E-05	4.369E-05
Guideline** = 0.000078 kg/day	1998	2.03E-05	1.76E-05	8.00E-07	8.80E-06	8.70E-06	1.21E-05	0	0	n/a	n/a	n/a	n/a	8.55E-06
(CP 1000 – no MISA guideline)	1997	3.80E-03	6.61E-03	0.00531	0.01597	3.98E-03	6.11E-03	6.34E-03	5.45E-03	5.99E-03	4.95E-03	6.09E-03	4.74E-03	6.28E-03
	1998	0.01144	0.00721	1.44E-03	2.37E-03	5.96E-03	0.01363	0.00211	2.48E-03	1.26E-03	1.70E-03	1.81E-03	4.35E-03	4.65E-03
	1999	8.90E-04	6.13E-04	8.56E-04	43.98E-04	13.27E-04	6.96E-04	9.28E-04	1.79E-04	5.35E-04	17.81E-04	55.65E-04	44.11E-04	1.85E-03
	2000	9.25E-04	23.83E-04	14.10E-04	8.53E-04	16.65E-04	57.82E-04	99.75E-04	16.00E-04	16.14E-04	14.13E-04	10.05E-04	0.021120	4.15E-03
	2001	3.21E-03	5.04E-03	10.01E-03	0.97E-03	7.45E-03	0.82E-03	3.48E-03	3.25E-03	2.90E-03	1.42E-03	0.79E-03	1.44E-03	3.40E-03
Phosphorus (kg/day)	1997	0	0	4.34E-04	0	0	0	0	1.90E-04	0	7.65E-04	0	0	1.16E-04
	1998	5.61E-04	0	0	3.36E-04	0	0	0	0	n/a	n/a	n/a	n/a	1.12E-04

Facility: Ethyl Canada Inc., Corunna [0000120006]						Control Points: 0200, 1000								
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
(CP 0200)***	1997	n/a	n/a	4.34E-04	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	2.17E-04
	1998	n/a	n/a	n/a	3.36E-04	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3.36E-04
Particulate Residue [RSP] (kg/day)	1997	0.3882	0.4321	0.3084	0.2813	0.2342	0.642	0.4371	0.1931	0.3108	0.6332	0.2333	0.2135	0.35893
Guideline** = 0.1 kg/day	1998	0.1883	0.1645	0.01683	0.01282	0.01522	5.01E-03	0.028	0	n/a	n/a	n/a	n/a	5.38E-02
(CP 1000 – no guideline)	1997	20.13	19.54	27.54	27.34	30.46	14.93	21.83	20.11	39.03	19.84	9.63	10.44	21.735
	1998	42.18	38.36	0	16.31	13.41	7.766	2.45	3.504	7.572	5.01	5.367	7.636	12.464
	1999	3.56	6.14	4.18	4.41	4.49	1.46	1.26	0.75	4.49	0.90	7.16	2.88	3.4720
	2000	11.48	5.58	9.83	26.09	9.49	9.49	4.49	5.00	6.32	3.41	2.15	11.55	8.7403
	2001	2.90	3.40	6.40	3.10	0.90	3.60	0.70	4.20	0.60	6.20	2.90	0.10	2.9167
Solvent Extractables (kg/day)	1997	0.4733	0.2313	0.3092	0.2373	0.3219	0.2392	0.4974	0.7382	0.3819	0.7561	0.2077	0.174	0.38063
Guideline** = 0.13 kg/day	1998	0.04358	0.05456	0.01101	0.03379	0.02443	0.0206	0	0	n/a	n/a	n/a	n/a	0.023496
(CP 1000 – no MISA guideline)	1997	21.81	17.04	8.113	7.186	12.17	10.53	6.272	2.172	10.98	59.31	11.21	5.166	14.33
	1998	7.501	0	7.589	6.3	2.867	3.336	1.469	2.234	2.23	1.593	1.412	6.789	3.6100
	1999	3.563	6.139	4.179	4.408	4.487	1.461	1.255	0.751	4.489	0.901	7.155	2.875	3.4720
	2000	0.897	6.373	5.309	3.300	1.859	1.295	1.664	2.444	1.611	0.869	2.846	4.853	2.7767
	2001	2.420	1.750	0.650	1.740	1.980	4.630	1.540	2.160	0.770	0.680	0.610	0.660	1.6325
Dichloroethane 1,2 (kg/day)	1997	0	1.00E-05	2.19E-05	1.42E-05	0	0	5.72E-06	0	1.40E-05	0	0	4.88E-06	5.89E-06
Guideline** = 0.0028 kg/day	1998	6.50E-06	4.57E-06	4.72E-06	3.12E-06	1.12E-05	5.20E-07	0	0	n/a	n/a	n/a	n/a	3.82E-06
Ethylene Dibromide (kg/day)	1997	0	0	0	0	0	1.56E-05	0	0	0	0	0	0	1.30E-06
	1998	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	0
(CP 0200)***	1997	n/a	n/a	0	n/a	n/a	1.56E-05	n/a	n/a	n/a	n/a	n/a	n/a	7.80E-06
	1998	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0

* Flows for CP 1000 only.

** MISA Regulatory Limits established February 16, 1998

*** These data are based on single measurements

Gross average flows and loadings for Imperial Oil Chemicals Division, Sarnia.

Facility: Imperial Oils Chemicals Division, Sarnia [0000070201]													**Control Points: 0500 (also 0200, 0700 where noted)**	
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1995	n/a	n/a	n/a	n/a	33860	33880	38020	37300	36400	35680	30010	30070	34402.5
	1996	30130	30090	34960	35310	33890	34710	35410	35790	35270	31830	32040	34390	33651.7
	1997	28650	28180	29100	28500	31950	35160	36410	37580	35730	30430	30360	30520	31880.8
	1998	29980	31040	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30510.0
	1999	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	30211	29181	26703	28698.3
	2000	n/a	n/a	n/a	25876	28482	25228	28328	28991	30384	26729	29198	28091	27923.0
	2001	27336	28108	29115	27801	26994	28488	30932	32985	31736	30303	30225	33558	29798.4
Benzene (kg/day)	1995	n/a	n/a	n/a	n/a	0.0373	0.04729	0.03246	0.04773	0.02015	0.01712	0.02562	0.02726	0.031866
Guideline** = 0.09 kg/day	1996	0.02103	0.03896	0.4594	0.07208	0.06173	0.03017	0.02762	0.01896	0.01862	0.01481	0.06324	0.02955	0.071347
	1997	0.01907	0.114	0.02373	0.02257	0.0224	0.4484	0.02416	0.03467	0.0188	0.01691	0.02589	0.03304	0.06697
	1998	0.09882	0	0	0	0	0	0	0	0	0.0164	0	0	0.0096017
	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	0	0	0	0	0	0	0	0	0	0
Toluene (kg/day)	1995	n/a	n/a	n/a	n/a	0	0.1932	0	0.0135	0	0	0	0.009318	0.027002
	1996	0	0	0.01171	0	0.07461	0	0	0	0.004056	0	0.006138	0	0.0080428
	1997	0	0.03596	0	0	0.01446	0	0	0.01671	0	0.01548	0.01549	0	0.008175
	1998	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
C dissolved organic (kg/day)	1995	n/a	n/a	n/a	n/a	430.3	362	439.2	355.8	347.7	373	281.4	352.6	367.75
Guideline** = 40 kg/day	1996	345.8	357.9	394.3	374	371.3	373.1	376.7	382.7	361.6	338	329.4	392.7	366.46
	1997	346.2	331.6	417.8	403.2	381.8	432.2	465	430.2	453.6	396.7	412	404	406.19
	1998	319.1	6.834	10.465	12.424	8.764	12.157	14.427	15.011	9.91	14.306	12.361	9.345	37.092
	1999	18.866	14.147	21.959	16.793	12.972	15.139	10.146	11.516	11.204	8.364	6.461	9.335	13.075
	2000	n/a	n/a	n/a	5.198	10.718	15.488	7.742	6.575	6.383	11.072	8.738	6.726	8.7378
	2001	7.293	6.790	8.365	6.593	5.581	6.938	8.216	11.243	19.987	15.980	11.121	9.007	9.7595
Phenolics (kg/day)	1995	n/a	n/a	n/a	n/a	0.1329	0.1547	0.1118	0.1883	0.1379	0.1648	0.1435	0.1291	0.14538
	1996	0.1271	0.114	0.1522	0.1378	0.1128	0.06545	0.07889	0.06141	0.07344	0.04341	0.09222	0.09494	0.096138
	1997	0.09721	0.1847	0.103	0.08531	0.05525	0.05888	0.08429	0.07032	0.07795	0.1331	0.1177	0.1566	0.10203
	1998	0.07153	0.06294	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.067235
Total Phosphorus (kg/day)	1995	n/a	n/a	n/a	n/a	0	5.522	0	11.18	0	0	0	6.777	2.9349
	1996	0	0	2.157	0	4.775	0	0	0	5.304	0	1.395	0	1.1359
	1997	0	6.916	0	0	0	0	0	1.071	0	0	4.029	0	1.0013

Facility: Imperial Oils Chemicals Division, Sarnia [0000070201]														Control Points: 0500 (also 0200, 0700 where noted)
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1998	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	112.3	220.9	175.8	302.3	144.8	234.4	239.6	159.1	198.65
Guideline** = 60.7 kg/day	1996	172.3	224.5	129.9	211.6	238.5	421.9	180.9	184	214	247.2	156.1	221.9	216.9
	1997	129.6	312.9	234.2	273.9	351	156.6	706.4	254.6	331.8	222.2	234.4	192.6	283.35
	1998	260.8	13.242	21.443	3.444	1.804	2.803	4.65	2.992	2.119	4.701	2.121	2.605	26.894
	1999	7.522	2.737	2.070	4.256	6.562	5.656	0	1.942	3.419	1.915	2.040	8.136	3.8546
	2000	n/a	n/a	n/a	7.170	8.623	11.123	1.218	6.794	3.645	2.478	3.063	7.859	5.7748
	2001	2.926	8.753	4.092	0.307	2.025	0	3.543	1.482	14.606	15.288	4.132	3.009	5.0136
Solvent Extractables (kg/day)	1995					33.34	48.73	25.55	47.05	53.67	50.96	14.65	8.724	35.334
Guideline** = 8 kg/day	1996	44.84	34.08	33.23	37.16	49.66	9.208	12.59	19.11	29.15	38.07	28.64	41.15	31.407
	1997	49.87	27.59	14.52	51.54	28.05	29.85	41.27	31.97	18.39	19.4	47.61	30.09	32.512
	1998	60.08	1.3216	1.1039	2.4556	0.5865	2.2706	1.7037	0.5414	1.2376	0.4398	0.4885	0.5526	6.0652
	1999	0.7839	0.3327	0.4398	0.4954	6.0405	1.3782	1.7915	2.1509	1.3148	1.7049	1.1221	2.0063	1.6301
	2000	n/a	n/a	n/a	3.3175	1.2195	3.3910	0.8748	2.0723	1.2095	1.4400	1.2785	0.5010	1.7005
	2001	0.7371	0.36570	0.8829	0.3016	0.4566	2.7282	0.6449	1.0672	1.7190	2.4484	0.7816	0.9654	1.0916
Hexachlorobutadiene (kg/day)	1995	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0
	1996	0	0	0.0002312	0	5.7E-05	0	0	0.0002141	0	0	0	0	0.00004183
	1997	0	0	0	0	0.00051	0	0	0.0001468	0	0	0.00009299	0	0.00006217
	1998	0	0	0	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	0
	1999		0			0			0			0		0
	2000	n/a	n/a	n/a		0			0			0		0
	2001		0			0			0			0		0
(CP 0200)*	1998	n/a	n/a	0	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	0
(CP 0700)*	1998	n/a	n/a	0	n/a	0.00023	n/a	n/a	0.0000629	n/a	n/a	0	n/a	0.00007332
Vinyl Chloride (kg/day)	1995	n/a	n/a	n/a	n/a	0.2295	0.4906	0.2007	0.2202	0.1893	0.1558	0.3	0.378	0.27051
Guideline** = 2.4 kg/day	1996	0.2401	0.3331	0.3191	0.2802	0.5044	0.3812	0.3636	0.2082	0.3255	0.3753	0.3523	0.6094	0.3577
	1997	0.3464	0.5602	0.4308	0.2691	0.4702	0.2463	2.415	0.3726	0.2678	0.3501	0.2497	0.4471	0.53544
	1998	0.3034	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.1	0.1	0.3	0.18362
	1999	0.2	0.1	0.2	0.1	0.1	0.1	0.6	0.1	0.1	0.1	0.1	0.1	0.15833
	2000	n/a	n/a	n/a	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1	0.08889
	2001	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.13333

* These data are based on single measurements.
**Guidelines established February 16, 1998

Gross average flows and loadings for Novacor Chemicals (Canada) Ltd., Corunna.

Facility: Novacor Chemicals (Canada) Ltd., Corunna [0000080309]										**Control Points: 0700 (also 0200 where noted)**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Flow (m^3/day)	1997	35520	34320	37520	35360	25820	60000	60480	64650	55740				45490
	1998	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0
	1999	58220	53850	54090	59070	62670	67520	n/a	n/a	n/a	56180	58620	56490	58523
	2000	52670	51170	54870	58510	60120	64180	71910	74730	58630	50120	60000	55680	59383
	2001	50280	45940	39170	45280	46810	54880	62770	64810	47270	40390	44990	38050	48387
(CP 0200)*	1998	n/a	44680	47030	n/a	n/a	67600	n/a	n/a	68200	n/a	n/a	n/a	56877.5
Total Aluminium (kg/day)	1997	0	2.402	0	0	2.415	0	0	4.717	0	n/a	n/a	n/a	1.0593
	1998	n/a	60.77	3.669	n/a	n/a	3.448	n/a	n/a	5.047	0	0	0	10.419
	1999			6.9560		3.1020		n/a	n/a	n/a	5.502			5.1867
	2000			1.8420		4.5360			4.7930		4.8700			3.9895
	2001		5.7370			0.5099			4.6580		19.5100			7.6037
(CP 0200)*	1998	n/a	60.77	3.669	n/a	n/a	3.448	n/a	n/a	5.047	n/a	n/a	n/a	18.233
Toluene (kg/day)	1997	0	0	0	0	0.0035	0	0	0.003165	0	n/a	n/a	n/a	0.00074
	1998	n/a	0.02681	0.03763	n/a	n/a	0	n/a	n/a	0	0	0	0	0.00921
	1999			0.05477		0		n/a	n/a	n/a	0.02456			0.02644
	2000			0.03453		0			0		0.03234			0.01672
	2001		0			0			0		0.00927			0.00232
(CP 0200)*	1998	n/a	0.02681	0.03763	n/a	n/a	0	n/a	n/a	0	n/a	n/a	n/a	0.01611
C dissolved organic (kg/day)	1997	72.03	64.26	69.67	69.38	63.6	139.7	147.8	96.79	80.43	n/a	n/a	n/a	89.296
Guideline** = 220 kg/day	1998	79.36	91.51	96.08	96.81	93.5	144.9	153.4	132.7	146.6	0	0	0	86.238
	1999	124.50	98.68	115.40	115.20	113.20	130.50	n/a	n/a	n/a	94.92	114.70	118.30	113.93
	2000	131.30	108.70	121.00	130.40	119.10	156.50	162.80	159.20	139.50	138.30	115.00	126.90	134.06
	2001	113.90	102.10	75.53	88.49	96.59	104.50	105.80	121.80	109.50	94.99	93.54	74.92	98.47
Phenolics (kg/day)	1997	0.1036	0.0771	0.1031	0.1451	0.1289	0.3138	0.4732	0.1616	0.1713	n/a	n/a	n/a	0.18641
Guideline** = 0.34 kg/day	1998	0.08845	0.1142	0.1148	0.1599	0.214	0.3135	0.322	0.1776	0.2647	0	0	0	0.147430
	1999	0.1384	0.1314	0.1326	0.0649	0.1088	0.1913	n/a	n/a	n/a	0.2829	0.0945	0.0774	0.135800
	2000	0.0504	0.0183	0.0289	0.0141	0.05996	0.06861	0.1313	0.08782	0.07824	0.1495	0.1431	0.1451	0.081276
	2001	0.07327	0.1030	0.03173	0.03472	0.08893	0.04479	0.1898	0.04691	0.08782	0.07808	0.06665	0.03260	0.073192
Total Phosphorus (kg/day)	1997	0	1.123	0	0	0	0	0	0.8652	0	n/a	n/a	n/a	0.22091
	1998	n/a	2.726	2.352	n/a	n/a	2.231	n/a	n/a	1.91	0	0	0	1.317
	1999			6.409		11.440		n/a	n/a	n/a	6.533			8.1273
	2000			6.445		6.803			0		0			3.3120

Facility: Novacor Chemicals (Canada) Ltd., Corunna [0000080309]										Control Points: 0700 (also 0200 where noted)				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	2001		0.6146			0			0		2.7800			0.84865
(CP 0200)*	1998	N/a	2.726	2.352	n/a	n/a	2.231	n/a	n/a	1.91	n/a	n/a	n/a	2.3047
Particulate Residue [RSP] (kg/day)	1997	216.4	169.8	152.1	88.85	98.95	124.2	120.9	322.6	166.9	n/a	n/a	n/a	162.3
Guideline** = 570 kg/day	1998	378.6	412.9	311.6	106.4	503.4	283.5	398.8	505.1	429.6	0	0	0	277.49
	1999	488.7	211.7	378.0	136.5	118.2	62.16	n/a	n/a	n/a	152.0	148.7	306.8	222.53
	2000	238.9	84.86	116.5	163.6	247.3	349.1	86.3	94.0	620.8	108.0	69.1	649.4	235.65
	2001	181.8	110.5	187.3	40.6	29.1	10.0	95.2	26.5	274.6	159.9	114.1	119.3	112.41
Solvent Extractables (kg/day)	1997	27.6	43.15	30.88	19.05	24.25	41.06	51.86	25.2	38.25	n/a	n/a	n/a	33.478
Guideline** = 170 kg/day	1998	44.43	46.62	30.27	22.48	39.91	55.39	153	54.08	104.6	0	0	0	45.898
	1999	14.35	70.66	80.93	0	18.63	171.70	n/a	n/a	n/a	43.86	66.48	21.95	54.284
	2000	55.77	49.22	190.00	110.40	44.70	18.75	70.50	107.30	65.26	49.27	18.38	52.02	69.298
	2001	94.02	11.27	51.09	54.99	35.30	13.73	37.70	30.92	48.91	19.58	44.87	45.35	40.640

* These data are based on single measurements.
** Guidelines established February 16, 1998

Gross average flows and loadings for Novacor Chemicals (Canada) Ltd., Mooretown.

Facility: Novacor Chemicals (Canada) Ltd., Mooretown [0000380105]									Control Points: 0700 (also 0100 where noted)					
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1997	1247	1281	1182	1278	1274	1410	n/a	n/a	n/a	n/a	n/a	n/a	1278.7
	1998	1177	1129	1054	1144	1232	1194	1289	1198	1207	1245	1075	1183	1177.3
	1999	1216	1299	1337	1306	1159	1232	1151	1181	1117	1103	1034	1036	1180.9
	2000	915	995	868	991	1000	982	1086	994	1036	1174	1240	1311	1049.3
	2001	1369	1324	1305	1242	1190	1157	1267	1280	1236	1293	1247	1346	1271.3
(CP 0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1361	n/a	n/a	1361.0
	1998	n/a	n/a	921	n/a	1412	n/a	n/a	887	n/a	1409	n/a	n/a	1157.3
Total Aluminium (kg/day)	1997	0	0	0.7840	0	1.056	0	n/a	n/a	n/a	0.7138	n/a	n/a	0.3648
	1998	n/a	n/a	0.6908	n/a	0.3248	n/a	n/a	0.6209	n/a	0.8031	n/a	n/a	0.6099
(CP0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.7138	n/a	n/a	0.7138
	1998	n/a	n/a	0.6908	n/a	0.3248	n/a	n/a	0.6209	n/a	0.8031	n/a	n/a	0.6099
C dissolved organic (kg/day)	1997	8.40	8.12	9.05	13.13	8.24	12.09	n/a	n/a	n/a	9.17	11.70	10.03	9.99
Guideline** = 11 kg/day	1998	7.98	8.54	7.46	6.20	10.88	8.59	10.16	8.60	6.57	6.73	7.57	9.20	8.21
	1999	8.08	7.18	7.61	11.49	9.90	8.75	8.33	8.15	7.15	7.54	4.88	5.12	7.85
	2000	7.89	6.19	7.09	8.67	7.63	7.19	7.45	5.56	7.55	5.09	4.92	5.94	6.76
	2001	5.61	5.48	4.75	8.32	5.48	7.51	7.51	7.95	5.50	5.39	7.04	8.32	6.57
Phenolics (kg/day)	1997	0.0021	0.0026	0.0014	0.0039	0.0021	0.0019	n/a	n/a	n/a	0.0011	0.0018	0.001	0.0020
Guideline** = 0.007 kg/day	1998	0.0013	0.0012	0.0033	0.0015	0.0016	0.0019	0.0014	0.0010	0.0007	0.0006	0.0020	0.0016	0.0015
	1999	0.0032	0.0016	0.0015	0.0012	0.0034	0.0020	0.0025	0.0023	0.0030	0.0042	0.0028	0.0013	0.0024
	2000	0.0024	0.0024	0.0029	0.0022	0.0018	0.0015	0.0024	0.0017	0.0012	0.0014	0.0015	0.0009	0.0019
	2001	0.0020	0.0012	0.0022	0.0017	0.0015	0.0010	0.0027	0.0029	0.0019	0.0010	0.0006	0.0010	0.0016
Total Phosphorus (kg/day)	1997	0.2018	0.2121	0.2360	0.2902	0.3477	0.3064	n/a	n/a	n/a	0.1991	0.1317	0.1743	0.2333
Guideline** = 1.1 kg/day	1998	0.1847	0.2389	0.2347	0.1822	0.2250	0.3582	0.3477	0.2376	0.2387	0.2226	0.1590	0.2502	0.2400
	1999	0.2257	0.2674	0.2096	0.1552	0.2914	0.2293	0.3155	0.2050	0.2546	0.3295	0.2273	0.2704	0.2484
	2000	0.3042	0.2944	0.2787	0.3712	0.2605	0.3187	0.2954	0.2518	0.4422	0.2643	0.2544	0.2407	0.2980
	2001	0.2618	0.2721	0.3434	0.2044	0.2322	0.4218	0.4015	0.3625	0.2471	0.2417	0.2952	0.3920	0.3063
Particulate Residue [RSP] (kg/day)	1997	18.59	28.02	15.71	19.20	22.98	16.58	n/a	n/a	n/a	22.26	18.86	10.87	19.23
Guideline** = 34 kg/day	1998	18.06	19.22	16.78	25.79	19.31	26.23	20.92	23.91	30.77	26.05	14.09	14.36	21.29
	1999	9.03	14.66	21.70	15.17	16.40	21.43	33.76	23.89	25.59	24.52	19.68	26.95	21.07
	2000	19.08	16.19	17.43	18.26	19.58	18.33	23.93	18.09	21.78	19.94	22.19	13.02	18.99
	2001	13.35	13.01	13.97	12.98	14.74	17.64	14.42	15.95	22.41	23.89	31.77	26.04	18.35
Solvent Extractables (kg/day)	1997	1.548	1.531	2.333	2.721	1.860	1.746	n/a	n/a	n/a	10.930	1.818	1.828	2.924
Guideline** = 3.3 kg/day	1998	1.052	1.856	1.504	0.788	2.322	0.573	1.595	2.198	3.115	1.399	1.738	0.929	1.589

Facility: Novacor Chemicals (Canada) Ltd., Mooretown [0000380105]										Control Points: 0700 (also 0100 where noted)				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	1.647	0.692	0.675	1.441	0.421	1.740	2.425	1.435	1.8660	0.307	0.844	0.768	1.188
	2000	1.599	1.621	0.587	0.657	1.006	0.598	0.907	0.720	1.0570	1.005	1.388	1.155	1.025
	2001	1.348	2.231	1.464	1.672	0.736	0.686	0.602	1.196	1.5880	1.758	1.255	1.724	1.355
Zn (kg/day)	1997	0	0	0.3920	0	0.0604	0	n/a	n/a	n/a	0.0260	n/a	n/a	0.0683
	1998	n/a	n/a	0.0461	n/a	0.0706	n/a	n/a	0.0444	n/a	0.0564	n/a	n/a	0.0543
(CP 0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0260	n/a	n/a	0.0260
	1998	n/a	n/a	0.0461	n/a	0.0706	n/a	n/a	0.04435	n/a	0.0564	n/a	n/a	0.0543

* This data is based on single measurements.

** Guidelines established February 16, 1998

Gross average flows and loadings for Novacor Chemicals (Canada) Ltd., Mooretown.

Facility: Novacor Chemicals (Canada) Ltd., Mooretown [0000380105]								**Control Points: 0700 (also 0100 where noted)**						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1997	1247	1281	1182	1278	1274	1410	n/a	n/a	n/a	n/a	n/a	n/a	1278.7
	1998	1177	1129	1054	1144	1232	1194	1289	1198	1207	1245	1075	1183	1177.3
	1999	1216	1299	1337	1306	1159	1232	1151	1181	1117	1103	1034	1036	1180.9
	2000	915	995	868	991	1000	982	1086	994	1036	1174	1240	1311	1049.3
	2001	1369	1324	1305	1242	1190	1157	1267	1280	1236	1293	1247	1346	1271.3
(CP 0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1361	n/a	n/a	1361.0
	1998	n/a	n/a	921	n/a	1412	n/a	n/a	887	n/a	1409	n/a	n/a	1157.3
Total Aluminium (kg/day)	1997	0	0	0.7840	0	1.056	0	n/a	n/a	n/a	0.7138	n/a	n/a	0.3648
	1998	n/a	n/a	0.6908	n/a	0.3248	n/a	n/a	0.6209	n/a	0.8031	n/a	n/a	0.6099
(CP0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.7138	n/a	n/a	0.7138
	1998	n/a	n/a	0.6908	n/a	0.3248	n/a	n/a	0.6209	n/a	0.8031	n/a	n/a	0.6099
C dissolved organic (kg/day)	1997	8.40	8.12	9.05	13.13	8.24	12.09	n/a	n/a	n/a	9.17	11.70	10.03	9.99
Guideline** = 11 kg/day	1998	7.98	8.54	7.46	6.20	10.88	8.59	10.16	8.60	6.57	6.73	7.57	9.20	8.21
	1999	8.08	7.18	7.61	11.49	9.90	8.75	8.33	8.15	7.15	7.54	4.88	5.12	7.85
	2000	7.89	6.19	7.09	8.67	7.63	7.19	7.45	5.56	7.55	5.09	4.92	5.94	6.76
	2001	5.61	5.48	4.75	8.32	5.48	7.51	7.51	7.95	5.50	5.39	7.04	8.32	6.57
Phenolics (kg/day)	1997	0.0021	0.0026	0.0014	0.0039	0.0021	0.0019	n/a	n/a	n/a	0.0011	0.0018	0.001	0.0020
Guideline** = 0.007 kg/day	1998	0.0013	0.0012	0.0033	0.0015	0.0016	0.0019	0.0014	0.0010	0.0007	0.0006	0.0020	0.0016	0.0015
	1999	0.0032	0.0016	0.0015	0.0012	0.0034	0.0020	0.0025	0.0023	0.0030	0.0042	0.0028	0.0013	0.0024
	2000	0.0024	0.0024	0.0029	0.0022	0.0018	0.0015	0.0024	0.0017	0.0012	0.0014	0.0015	0.0009	0.0019
	2001	0.0020	0.0012	0.0022	0.0017	0.0015	0.0010	0.0027	0.0029	0.0019	0.0010	0.0006	0.0010	0.0016
Total Phosphorus (kg/day)	1997	0.2018	0.2121	0.2360	0.2902	0.3477	0.3064	n/a	n/a	n/a	0.1991	0.1317	0.1743	0.2333
Guideline** = 1.1 kg/day	1998	0.1847	0.2389	0.2347	0.1822	0.2250	0.3582	0.3477	0.2376	0.2387	0.2226	0.1590	0.2502	0.2400
	1999	0.2257	0.2674	0.2096	0.1552	0.2914	0.2293	0.3155	0.2050	0.2546	0.3295	0.2273	0.2704	0.2484
	2000	0.3042	0.2944	0.2787	0.3712	0.2605	0.3187	0.2954	0.2518	0.4422	0.2643	0.2544	0.2407	0.2980
	2001	0.2618	0.2721	0.3434	0.2044	0.2322	0.4218	0.4015	0.3625	0.2471	0.2417	0.2952	0.3920	0.3063
Particulate Residue [RSP] (kg/day)	1997	18.59	28.02	15.71	19.20	22.98	16.58	n/a	n/a	n/a	22.26	18.86	10.87	19.23
Guideline** = 34 kg/day	1998	18.06	19.22	16.78	25.79	19.31	26.23	20.92	23.91	30.77	26.05	14.09	14.36	21.29
	1999	9.03	14.66	21.70	15.17	16.40	21.43	33.76	23.89	25.59	24.52	19.68	26.95	21.07
	2000	19.08	16.19	17.43	18.26	19.58	18.33	23.93	18.09	21.78	19.94	22.19	13.02	18.99
	2001	13.35	13.01	13.97	12.98	14.74	17.64	14.42	15.95	22.41	23.89	31.77	26.04	18.35
Solvent Extractables (kg/day)	1997	1.548	1.531	2.333	2.721	1.860	1.746	n/a	n/a	n/a	10.930	1.818	1.828	2.924
Guideline** = 3.3 kg/day	1998	1.052	1.856	1.504	0.788	2.322	0.573	1.595	2.198	3.115	1.399	1.738	0.929	1.589

Facility: Novacor Chemicals (Canada) Ltd., Mooretown [0000380105]										Control Points: 0700 (also 0100 where noted)				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	1999	1.647	0.692	0.675	1.441	0.421	1.740	2.425	1.435	1.8660	0.307	0.844	0.768	1.188
	2000	1.599	1.621	0.587	0.657	1.006	0.598	0.907	0.720	1.0570	1.005	1.388	1.155	1.025
	2001	1.348	2.231	1.464	1.672	0.736	0.686	0.602	1.196	1.5880	1.758	1.255	1.724	1.355
Zn (kg/day)	1997	0	0	0.3920	0	0.0604	0	n/a	n/a	n/a	0.0260	n/a	n/a	0.0683
	1998	n/a	n/a	0.0461	n/a	0.0706	n/a	n/a	0.0444	n/a	0.0564	n/a	n/a	0.0543
(CP 0100)*	1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.0260	n/a	n/a	0.0260
	1998	n/a	n/a	0.0461	n/a	0.0706	n/a	n/a	0.04435	n/a	0.0564	n/a	n/a	0.0543

* These data are based on single measurements.

** Guidelines established February 16, 1998

Data Appendix 1c. Inorganic Chemicals Sector

Gross average flows and loadings for Cabot Canada Ltd., Sarnia.

Facility: Cabot Canada Ltd., Sarnia [0004260006]										Control Points: 0500				
Flow/Loading Parameters		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Av.
Flow (m^3/day)	1997	1291	1342	1357	1017	1272	1429	1847	2744	2979	1846	1378	1287	1649.1
	1998	1370	1362	1630	1690	1583	1989	n/a	n/a	n/a	n/a	n/a	n/a	1604.0
	1999	1538	1084	964	1372	1296	1548	1676	1841	1672	1047	765	740	1295.2
	2000	581	557	492	705	903	1070	1689	1062	1048	801	745	773	868.7
	2001	1009	1075	768	762	1086	926	993	1213	1028	n/a	n/a	n/a	984.6
Aluminium (kg/day)	1997	1.401	2.449	0.7973	0.4786	0.2866	0.4949	0.4409	0.4513	2.837	0.5713	0.2745	0.3677	0.90417
Guideline* = 2.2 kg/day	1998	0.3835	0.6807	0.886	0.5348	0.2873	0.482	n/a	n/a	n/a	n/a	n/a	n/a	0.54238
	1999	1.3760	0.7966	0.7584	0.5921	0.6130	0.6972	0.5756	0.8525	0.7830	0.3479	0.1583	0.2785	0.65243
	2000	0.2560	0.3382	0.2373	0.2359	0.2455	0.3359	0.9117	0.3498	0.2055	0.3025	0.2473	0.2524	0.32650
	2001	0.9941	0.3590	0.2740	0.1973	0.2109	0.1300	0.3993	0.2007	0.3053	n/a	n/a	n/a	0.34128
C dissolved organic (kg/day)	1997	11.47	10.93	9.99	4.22	4.68	5.44	5.14	13.16	14.59	13.75	11.64	7.20	9.3517
Guideline* = 10 kg/day	1998	11.70	24.09	10.57	28.66	28.35	7.87	n/a	n/a	n/a	n/a	n/a	n/a	18.540
	1999	13.09	15.72	8.22	6.75	8.68	7.99	6.01	11.43	10.39	17.13	3.48	13.34	10.186
	2000	5.05	6.33	5.16	8.93	3.84	7.41	16.11	7.30	5.96	5.87	4.76	3.84	6.7130
	2001	9.02	5.57	3.43	5.45	5.51	3.17	12.76	7.05	7.72	n/a	n/a	n/a	6.6314
Nitrates (kg/day)	1997	0.9443	0	0	0	0	0	0	0	0	0	0	0	0.078692
	1998	0	0.396	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	0.06600
	1999	0	0	1.5200	0	0	1.4220	0	0	0.2006	0	0.8500	0	0.33272
	2000	0	0	0	0	0.6984	0	0	0.09746	0	0	0.4132	0	0.10076
	2001	0	0.5796	0	0	0.3977	0	0	0.1594	0	n/a	n/a	n/a	0.12630
Phosphorus (kg/day)	1997	0.05396	0	0	0	0	0	0	0	0	0	0.1225	0	0.014705
	1998	0	0.132	0	0	0.229	0	n/a	n/a	n/a	n/a	n/a	n/a	0.060167
	1999	0	0	0	0	0	0.1248	0	0	0.2006	0	0.0085	0	0.027825
	2000	0	0.0141	0	0	0.01204	0	0	0.02241	0	0	0.016520	0	0.005423
	2001	0	0.3817	0	0	0.01767	0	0	0.09569	0	n/a	n/a	n/a	0.055007
Particulate Residue [RSP] (kg/day)	1997	5.53	7.615	7.58	2.588	4.73	5.395	8.146	12.9	9.203	5.773	3.871	7.353	6.7237
Guideline* = 15 kg/day	1998	11.98	7.157	11.14	10.43	11.58	11.3	n/a	n/a	n/a	n/a	n/a	n/a	10.598
	1999	11.80	31.40	5.40	12.39	6.36	7.24	11.34	22.06	8.14	6.26	1.98	3.68	10.671
	2000	5.05	2.55	1.13	18.37	6.07	4.83	3.66	3.55	3.21	2.27	1.98	6.08	4.8945

Facility: Cabot Canada Ltd., Sarnia [0004260006]										Control Points: 0500				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
	2001	3.70	7.07	2.07	1.43	9.86	4.07	2.54	1.84	3.28	n/a	n/a	n/a	3.9849
Solvent Extractables (kg/day)	1997	5.665	0	0	0	0	0	0	0	0	0	0	0	0.47208
	1998	0	0.66	0	0	3.599	0	n/a	n/a	n/a	n/a	n/a	n/a	0.70983
	1999	0	0	0	0	0	1.248	0	0	2.006	0	0.425	0	0.30658
	2000	0	0.1763	0	0	0.1204	0	0	1.559	0	0	0.5206	0	0.19803
	2001	0	0.1413	0	0	0.5303	0	0	0.9569	n/a	n/a	n/a	n/a	0.18094
Zinc (kg/day)	1997	0.02698	0	0	0	0	0	0	0	0	0	0.01225	0	0.0032692
	1998	0	0.1478	0	0	0.2094	0	n/a	n/a	n/a	n/a	n/a	n/a	0.0595330
	1999	0	0	0.02185	0	0	0.02496	0	0	0.01404	0	0.017850	0	0.0065583
	2000	0	0.006171	0	0	0.02287	0	0	0.06237	0	0	0.03553	0	0.0105780
	2001	0	0.02120	0	0	0.1060	0	0	0.11640	0	n/a	n/a	n/a	0.027067

* Guidelines established February 16, 1998

Gross average flows and loadings for Praxair Canada Inc., Mooretown.

Facility: Praxair Canada Inc., Mooretown [0000381608]										**Control Points: 0400**				
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow m^3/day	1997	4	4	4	2.93	4.574	5.116	5.119	5.509	4.306	2.974	4	4	4.2107
	1998	1.761	1.482	2.387	3.109	2.806	3.188	3.995	3.664	1.088	0.04778	2.212	4.9	2.5533
	1999	14.000	1.675	2.308	6.275	6.665	5.981	9.028	9.253	6.920	5.376	5.907	6.595	6.6653
	2000	2.016	4.830	6.138	9.042	15.210	11.220	10.220	6.008	6.333	13.280	1.596	0.02466	7.1598
	2001	0.04750	0.07416	0.02035	0.01853	0.06500	0.12760	0.92250	0.03615	0.15500	5.2000	0	0	0.55557
Aluminium (kg/day)	1997	1.11E-03	8.88E-04	8.22E-04	6.38E-04	1.02E-03	8.03E-04	2.01E-03	3.20E-03	2.23E-03	1.31E-03	1.58E-03	7.04E-04	13.6E-04
Guideline = 0.0052 kg/day	1998	5.39E-04	3.51E-04	3.99E-04	1.32E-04	1.81E-03	1.48E-03	1.48E-03	1.94E-03	4.69E-04	9.89E-06	6.43E-04	1.32E-03	8.81E-04
	1999	1.49E-04	1.48E-04	4.86E-03	0	0	0	0	0	0	0	0	0	0.652E-04
	2000	0	4.62E-04	0	0	0	0	20.68E-04	0	0	0	0	0	2.10E-04
	2001	0	0	0	0	0	0	5.44E-04	0	0	23.29E-04	0	0	2.39E-04
Copper (kg/day)	1997	0	0	9.20E-05	1.01E-04	0	0	1.64E-04	0	0	2.70E-04	0	0	5.23E-05
	1998	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	0	0	0	0	0	0	3.64E-04	0	0	0.30E-04
C dissolved organic	1997	0.044	0.0466	0.03304	0.02417	0.03798	0.0298	0.05602	0.05829	0.05744	0.03357	0.0496	0.03672	0.042269
Guideline = 0.17 kg/day	1998	0.01203	0.0157	0.02172	7.31E-03	0.03164	0.07908	0.04041	0.04028	8.31E-03	2.42E-04	0.01719	0.04364	0.026462
	1999	6.63E-03	7.50E-03	7.51E-03	0	0	0	0	0	0	0	0	0	0.001803
	2000	0	35.82E-03	0	0	0	0	0.1029	0	0	0	0	0	0.011560
	2001	0	0	0	0	0	0	00.01360	0	0	0.05969	0	0	0.006108
Phosphorus (kg/day)	1997	2.54E-03	2.63E-03	1.09E-03	1.19E-03	1.80E-03	1.55E-03	2.77E-03	3.53E-03	2.80E-03	1.68E-03	2.99E-03	1.96E-03	2.21E-03
Guideline = 0.015 kg/day	1998	1.02E-03	7.66E-04	1.04E-03	4.65E-04	2.59E-03	2.90E-03	2.34E-03	2.13E-03	5.55E-04	1.93E-05	6.47E-04	1.39E-03	1.32E-03
	1999	2.29E-04	2.59E-04	2.44E-04	0	0	0	0	0	0	0	0	0	0.061E-03
	2000	0	13.2E-04	0	0	0	0	55.86E-04	0	0	0	0	0	0.576E-03
	2001	0	0	0	0	0	0	016.9E-04	0	0	48.7E-04	0	0	0.546E-03
Particulate Residue [RSP] (kg/day)	1997	0.01109	0.01897	0.0109	6.77E-03	0.01063	0.01354	0.02079	0.02083	0.02597	0.01913	0.0111	0.01214	0.015155
Guideline = 0.14 kg/day	1998	6.46E-03	4.63E-03	5.09E-03	9.43E-03	0.0138	0.01037	0.01242	9.21E-03	5.08E-03	1.10E-04	3.73E-03	0.04977	0.010842
	1999	0.02709	0.008971	0.01389	0.06235	0.04089	0.02461	0.09765	0.03572	0.04279	0.01279	0.01598	0.03214	0.034573
	2000	0.00604	0.02512	0.02991	0.02827	0.06246	0.02961	0.05548	0.02746	0.03660	0.02555	0.00444	0.00015	0.027590
	2001	1.6E-04	3.96E-04	0.45E-04	0.62E-04	2.22E-04	9.11E-04	95.7E-04	1.29E-04	7.37E-04	0.02383	0	0	0.003005

Facility: Praxair Canada Inc., Mooretown [0000381608]								Control Points: 0400						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Solvent Extractables (kg/day)	1997	3.97E-03	3.97E-03	3.97E-03	2.56E-03	6.02E-03	8.99E-03	6.61E-03	5.58E-03	4.69E-03	6.24E-03	3.96E-03	3.96E-03	5.04E-03
Guideline = 0.047 kg/day	1998	2.03E-03	1.68E-03	2.82E-03	8.53E-04	3.93E-03	0.004	2.95E-03	7.60E-03	8.60E-04	2.30E-05	2.07E-03	5.50E-03	2.86E-03
	1999	2.48E-03	1.97E-03	3.14E-03	0	0	0	0	0	0	0	0	0	0.63E-03
	2000	0	3.00E-03	0	0	0	0	9.80E-03	0	0	0	0	0	1.07E-03
	2001	0	0	0	0	0	0	1.36E-03	0	0	5.20E-03	0	0	0.547E-03
Zinc (kg/day)	1997	8.06E-04	7.60E-04	6.74E-04	3.57E-04	6.84E-04	3.98E-04	2.68E-04	5.95E-04	2.83E-04	5.15E-04	3.90E-04	5.28E-04	5.22E-04
Guideline = 0.0066 kg/day	1998	3.92E-04	5.65E-04	1.35E-03	1.06E-04	1.03E-03	3.44E-04	1.01E-04	1.52E-04	5.61E-05	4.60E-07	7.09E-05	3.00E-04	3.73E-04
	1999	0.62E-04	4.67E-04	14.13E-04	0	0	0	0	0	0	0	0	0	1.62E-04
	2000	0	4.02E-04	0	0	0	0	17.64E-04	0	0	0	0	0	1.81E-04
	2001	0	0	0	0	0	0	01.09E-04	0	0	10.29E-04	0	0	0.95E-04

* Guidelines established February 16, 1998

Gross average 1997 to 1998 flows and loadings for Praxair Canada Inc., Mooretown.

Facility: Praxair Canada Inc., Mooretown [0000381608]							Control Points: 0400							
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow m^3/day	1997	4	4	4	2.93	4.574	5.116	5.119	5.509	4.306	2.974	4	4	4.2107
	1998	1.761	1.482	2.387	3.109	2.806	3.188	3.995	3.664	1.088	0.04778	2.212	4.9	2.5533
	1999	14.000	1.675	2.308	6.275	6.665	5.981	9.028	9.253	6.920	5.376	5.907	6.595	6.6653
	2000	2.016	4.830	6.138	9.042	15.210	11.220	10.220	6.008	6.333	13.280	1.596	0.02466	7.1598
	2001	0.04750	0.07416	0.02035	0.01853	0.06500	0.12760	0.92250	0.03615	0.15500	5.2000	0	0	0.55557
Aluminium (kg/day)	1997	1.11E-03	8.88E-04	8.22E-04	6.38E-04	1.02E-03	8.03E-04	2.01E-03	3.20E-03	2.23E-03	1.31E-03	1.58E-03	7.04E-04	13.6E-04
Guideline = 0.0052 kg/day	1998	5.39E-04	3.51E-04	3.99E-04	1.32E-04	1.81E-03	1.48E-03	1.48E-03	1.94E-03	4.69E-04	9.89E-06	6.43E-04	1.32E-03	8.81E-04
	1999	1.49E-04	1.48E-04	4.86E-03	0	0	0	0	0	0	0	0	0	0.652E-04
	2000	0	4.62E-04	0	0	0	0	20.68E-04	0	0	0	0	0	2.10E-04
	2001	0	0	0	0	0	0	5.44E-04	0	0	23.29E-04	0	0	2.39E-04
Copper (kg/day)	1997	0	0	9.20E-05	1.01E-04	0	0	1.64E-04	0	0	2.70E-04	0	0	5.23E-05
	1998	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	0	0	0	0	0	0	0	0	0	3.64E-04	0	0	0.30E-04
C dissolved organic	1997	0.044	0.0466	0.03304	0.02417	0.03798	0.0298	0.05602	0.05829	0.05744	0.03357	0.0496	0.03672	0.042269
Guideline = 0.17 kg/day	1998	0.01203	0.0157	0.02172	7.31E-03	0.03164	0.07908	0.04041	0.04028	8.31E-03	2.42E-04	0.01719	0.04364	0.026462
	1999	6.63E-03	7.50E-03	7.51E-03	0	0	0	0	0	0	0	0	0	0.001803
	2000	0	35.82E-03	0	0	0	0	0.1029	0	0	0	0	0	0.011560
	2001	0	0	0	0	0	0	00.01360	0	0	0.05969	0	0	0.006108
Phosphorus (kg/day)	1997	2.54E-03	2.63E-03	1.09E-03	1.19E-03	1.80E-03	1.55E-03	2.77E-03	3.53E-03	2.80E-03	1.68E-03	2.99E-03	1.96E-03	2.21E-03
Guideline = 0.015 kg/day	1998	1.02E-03	7.66E-04	1.04E-03	4.65E-04	2.59E-03	2.90E-03	2.34E-03	2.13E-03	5.55E-04	1.93E-05	6.47E-04	1.39E-03	1.32E-03
	1999	2.29E-04	2.59E-04	2.44E-04	0	0	0	0	0	0	0	0	0	0.061E-03
	2000	0	13.2E-04	0	0	0	0	55.86E-04	0	0	0	0	0	0.576E-03
	2001	0	0	0	0	0	0	016.9E-04	0	0	48.7E-04	0	0	0.546E-03
Particulate Residue [RSP] (kg/day)	1997	0.01109	0.01897	0.0109	6.77E-03	0.01063	0.01354	0.02079	0.02083	0.02597	0.01913	0.0111	0.01214	0.015155
Guideline = 0.14 kg/day	1998	6.46E-03	4.63E-03	5.09E-03	9.43E-03	0.0138	0.01037	0.01242	9.21E-03	5.08E-03	1.10E-04	3.73E-03	0.04977	0.010842
	1999	0.02709	0.008971	0.01389	0.06235	0.04089	0.02461	0.09765	0.03572	0.04279	0.01279	0.01598	0.03214	0.034573
	2000	0.00604	0.02512	0.02991	0.02827	0.06246	0.02961	0.05548	0.02746	0.03660	0.02555	0.00444	0.00015	0.027590
	2001	1.6E-04	3.96E-04	0.45E-04	0.62E-04	2.22E-04	9.11E-04	95.7E-04	1.29E-04	7.37E-04	0.02383	0	0	0.003005

Facility: Praxair Canada Inc., Mooretown [0000381608]							Control Points: 0400						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Solvent Extractables (kg/day)	1997	3.97E-03	3.97E-03	3.97E-03	2.56E-03	6.02E-03	8.99E-03	6.61E-03	5.58E-03	4.69E-03	6.24E-03	3.96E-03	3.96E-03	5.04E-03
Guideline = 0.047 kg/day	1998	2.03E-03	1.68E-03	2.82E-03	8.53E-04	3.93E-03	0.004	2.95E-03	7.60E-03	8.60E-04	2.30E-05	2.07E-03	5.50E-03	2.86E-03
	1999	2.48E-03	1.97E-03	3.14E-03	0	0	0	0	0	0	0	0	0	0.63E-03
	2000	0	3.00E-03	0	0	0	0	9.80E-03	0	0	0	0	0	1.07E-03
	2001	0	0	0	0	0	0	1.36E-03	0	0	5.20E-03	0	0	0.547E-03
Zinc (kg/day)	1997	8.06E-04	7.60E-04	6.74E-04	3.57E-04	6.84E-04	3.98E-04	2.68E-04	5.95E-04	2.83E-04	5.15E-04	3.90E-04	5.28E-04	5.22E-04
Guideline = 0.0066 kg/day	1998	3.92E-04	5.65E-04	1.35E-03	1.06E-04	1.03E-03	3.44E-04	1.01E-04	1.52E-04	5.61E-05	4.60E-07	7.09E-05	3.00E-04	3.73E-04
	1999	0.62E-04	4.67E-04	14.13E-04	0	0	0	0	0	0	0	0	0	1.62E-04
	2000	0	4.02E-04	0	0	0	0	17.64E-04	0	0	0	0	0	1.81E-04
	2001	0	0	0	0	0	0	01.09E-04	0	0	10.29E-04	0	0	0.95E-04

* Guidelines established February 16, 1998

Data Appendix 1d. Thermal Generating Sector

Gross average flows and loadings for Ontario Power Generation Lambton TGS, Courtright.

Facility: Lambton TGS, Courtright [0001841204]									**Control Points: 3200 (also 3400 where noted)**					
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
Flow (m^3/day)	1995	n/a	n/a	n/a	n/a	n/a	n/a	4643	5363	4168	3240	4477	4162	4342.2
	1996	4599	4861	3238	4905	4850	5827	5139	5656	5362	5097	4281	4354	4847.4
	1997	5950	6033	4274	2866	3949	6580	5666	5987	6483	5011	5432	5437	5305.7
	1998	6387	4787	4499	14010	n/a	n/a	723.6	670.3	822.1	19280	16510	12110	7979.9
	1999	12120	11580	13810	16800	15460	13940	16530	16270	15330	14060	14110	13560	14464.2
	2000	14890	13190	12170	11450	9949	12490	13460	14620	14850	14650	16230	15660	13634.1
	2001	13750	15880	12010	n/a	n/a	n/a	10010.0	11610	10970	11390	13920	14150	12632.2
Aluminium (kg/day)	1996	0.2821	1.7360	1.1500	1.1890	1.3650	1.3630	1.2180	1.0510	1.5890	1.2800	0.8507	0.8181	1.1577
	1995	n/a	n/a	n/a	n/a	n/a	n/a	0.5172	0.6422	0.5506	0.2334	0.2458	0.5505	0.4566
	1997	0.9183	0.6731	0.3901	1.9890	0.3128	1.0790	0.4995	1.5630	2.8440	9.0530	2.2500	2.8060	2.0315
	1998	3.5640	5.9660	0.3927	6.4330	n/a	n/a	0.3604	0.0589	0.2720	7.9460	6.7110	2.9120	3.4616
	1999	3.9800	6.9420	4.8390	3.2440	4.0660	7.2930	10.250	6.7120	7.4540	5.3860	5.0370	3.6170	5.7350
	2000	2.8350	2.7020	1.8170	0.8829	2.3240	0.1277	0.6514	0.5623	1.7730	0.6250	0.3076	2.1120	1.3936
	2001	1.7650	6.7050	3.5780	n/a	n/a	n/a	8.8300	7.2480	6.4180	6.3920	5.7240	4.8640	5.7249
Iron (kg/day)	1995	n/a	n/a	n/a	n/a	n/a	n/a	0.0896	0.2470	0.1803	0.1115	0.1872	0.2015	0.1695
	1996	0.1774	0.4196	0.2837	0.4576	0.9404	0.4448	0.5514	0.2297	0.6814	0.4074	0.4624	0.2943	0.4458
	1997	1.1100	0.9036	0.8142	0.1173	0.4461	1.4700	0.6728	1.0340	0.6706	0.8232	0.4365	0.6959	0.7662
	1998	0.6454	0.7905	0.0884	2.2670	n/a	n/a	0.0848	0.0045	0.0846	10.6900	3.7230	1.3570	1.9735
	1999	2.6150	1.7030	2.7340	4.5820	1.2780	1.2650	2.1750	2.0080	3.3180	1.0550	2.0430	1.7040	2.2067
	2000	1.2320	1.0220	1.4590	0.9956	1.0000	1.4930	1.1250	1.0290	3.1140	0.5079	0.4439	0.2463	1.1390
	2001	0.9800	1.1540	0.6731	n/a	n/a	n/a	1.0800	2.1640	0.6878	0.7728	1.0250	0.5798	1.0129
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	n/a	n/a	4.52	9.56	5.43	4.97	9.47	25.10	9.84
	1996	24.50	41.06	32.69	51.41	33.71	37.69	29.63	21.01	12.39	18.04	19.32	22.12	28.63
	1997	31.19	27.05	49.68	24.55	28.41	44.41	26.69	31.40	33.50	28.69	31.56	198.00	46.26
	1998	263.40	272.00	308.70	372.00	n/a	n/a	65.52	10.86	16.36	486.40	489.00	480.50	276.5
	1999	251.40	284.50	211.30	402.50	280.70	289.50	473.70	272.20	485.70	193.30	330.20	341.60	318.05
	2000	318.50	188.50	162.50	221.50	182.50	244.70	110.00	107.40	96.37	93.79	267.00	223.60	184.70
	2001	106.20	232.40	128.20	n/a	n/a	n/a	105.90	179.40	140.50	49.16	90.65	120.10	128.06
Particulate Residue [RSP] (kg/day)	1995	n/a	n/a	n/a	n/a	n/a	n/a	0	0	27.510	24.390	0	0	8.650

Facility: Lambton TGS, Courtright [0001841204]								Control Points: 3200 (also 3400 where noted)						
Flow/Loading Parameters		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Annual Av.**
(CP 3400)	1996	0	0	14.920	0	0	28.540	37.350	0	0	0	28.220	0	9.086
	1997	0	0	13.620	0	0	31.310	0	0	21.080	0	0	120.700	15.559
	1998	0	0	139.700	0	n/a	n/a	29.970	22.650	31.710	30.340	0	0	25.437
	1999	0.605	0	0	0.166	0	0	0.005	0	43.050	0.043	0	161.000	17.072
	2000	1.444	0	28.800	1.185	0	271.100	0.006	0	57.750	53.560	0	0	34.487
	2001	0	0.330	104.500	n/a	n/a	n/a	0	0.002	26.710	0	21.540	38.380	21.274
Solvent Extractables (kg/day)	1995	n/a	n/a	n/a	n/a	n/a	n/a	6.956	0	0.255	0.257	0	0	1.245
(CP 3400)	1996	0	0	6	0	0	1.339	1.828	0	0	0	0.233	0	0.289
	1997	0	0	0.748	0	0	2.172	0	0	1.476	0	0	10.260	1.221
	1998	0	0	4.757	0	n/a	n/a	9.507	12.11	8.723	10.170	0	0	4.527
	1999	0.112	0	0	0.249	0	0	0.002	0	16.030	0.018	0	16.730	2.762
	2000	0.258	0	9.516	0.056	0	14.120	0.001	0	13.030	17.270	0	0	4.521
	2001	0	0.110	6.845	n/a	n/a	n/a	0	0.001	13.240	0	0.949	12.400	3.727

DATA APPENDIX 2. NPDES PERMIT COMPLIANCE SYSTEM MONITORING DATA FOR MICHIGAN POINT SOURCES 1995 TO 1998

Data Appendix 2a. Annual point source loads for St. Clair River 1995 to 1998 for industrial facilities

Facility	Year	Flow (conduit or million gal)	Phosphorus (total kg)	Arsenic (total kg)	Cadmium (total kg)	Copper (total kg)	Zinc (total kg)	Toluene (kg)
DECO - Greenwood Energy Center	1995	1,337.43	227.67	-	-	63.07	-	-
	1996	1,522.64	979.46	-	-	50.02	-	-
	1997	889.91	107.91	-	-	34.84	-	-
	1998	922.56	1,303.55	-	-	21.29	-	-
	TOTALS	**4,672.54**	**2,618.59**	**-**	**-**	**169.22**	**-**	**-**
DECO - St. Clair Plant	1995	357,955.94	302.82	-	-	1,312.66	-	-
	1996	343,487.46	0.00	-	-	1.79	-	-
	1997	357,417.96	0.00	-	-	0.00	-	-
	1998	351,842.91	0.00	-	-	592.21	-	-
	TOTALS	**1,410,703.60**	**302.82**	**-**	**-**	**1,906.66**	**-**	**-**
DECO - Marysville Plant	1995	4,946.83	0.42	-	-	-	-	-
	1996	6,113.87	2.14	-	-	-	-	-
	1997	9,242.95	0.00	-	-	-	-	-
	1998	17,262.65	0.00	-	-	-	-	-
	TOTALS	**37,566.30**	**2.56**	**-**	**-**	**-**	**-**	**-**
DECO - Belle River Plant	1995	223,098.45	-	0.13	0.0069		-	-
	1996	188,369.10	-	0.29	0.01		-	-
	1997	194,329.77	-	0.00	0.00		-	-
	1998	215,005.83	-	0.00	0.00		-	-
	TOTALS	**820,803.15**	**-**	**0.43**	**0.02**		**-**	**-**
Crown Paper - Port Huron	1995	917.40	-	-	-	37.61	-	-
	1996	1,092.00	-	-	-	72.37	-	-
	1997	918.30	-	-	-	68.14	-	-
	1998	929.40	-	-	-	37.25	-	-
	TOTALS	**3,857.10**	**-**	**-**	**-**	**215.37**	**-**	**-**
EB Eddy Paper Inc.	1995	3,382.38	690.76	-	0.35	223.89		
	1996	3,976.11	2,625.85	-	1.93	204.12		
	1997	4,069.20	4,016.33	-	1.57	207.88		
	1998	4,156.68	3,065.31	-	3.00	150.49		
	TOTALS	**15,584.37**	**10,398.24**	**-**	**6.85**	**786.39**		
Cargill Salt Division - St. Clair	1995	1,137.00	533.69	-	-	16.29	5.70	-
	1996	1,464.00	1,247.12	-	-	22.73	47.90	-
	1997	1,335.00	782.02	-	-	17,622.39	98.11	-
	1998	1,290.00	58.36	-	-	0.02	11.87	-
	TOTALS	**5,226.00**	**2,621.19**	**-**	**-**	**17,661.44**	**163.57**	**-**

Data Appendix 2b. Annual point source loads for St. Clair River 1995 to 1998 for Waste Water Sewage Lagoons and Waste Water Treatment Plants

Facility	Year	Flow (conduit or million gal)	Phosphorus (total kg)	Cadmium (total kg)	Copper (total kg)	Zinc (total kg)	Mercury (total kg)
Algonac WWTP	1995	656.67	1,072.43	-	6.01	-	-
	1996	739.05	893.91	-	5.51	-	-
	1997	807.42	896.20	-	0.00	-	-
	1998	704.61	1,201.80	-	8.37	-	-
	TOTALS	**2,907.75**	**4,064.34**	**-**	**19.89**	**-**	**-**
Capac WWSL	1995	180.00	1,465.98	-	-	-	-
	1996	353.40	7,609.78	-	-	-	-
	1997	382.20	5,831.38	-	-	-	-
	1998	382.20	5,992.22	-	-	-	-
	TOTALS	**1,297.80**	**20,899.35**	**-**	**-**	**-**	**-**
Marine City WWTP	1995	303.42	596.82	-	13.23	22.14	-
	1996	356.25	459.14	-	7.52	15.84	-
	1997	365.97	381.43	-	6.25	14.04	-
	1998	321.15	344.08	-	8.20	18.33	-
	TOTALS	**1,346.79**	**1,781.47**	**-**	**35.20**	**70.35**	**-**
Marysville WWTP	1995	1,085.40	2,868.22	-	24.83	25.28	-
	1996	1,151.40	3,397.23	-	16.92	0.00	-
	1997	1,128.00	2,960.26	-	13.50	19.19	-
	1998	967.20	2,910.72	-	12.92	13.90	-
	TOTALS	**4,332.00**	**12,136.43**	**-**	**68.17**	**58.36**	**-**
Port Huron WWTP	1995	4,440.00	10,339.64	-	230.33	2,119.87	-
	1996	4,730.40	9,298.04	-	199.77	1,528.73	-
	1997	15,581.70	29,419.78	-	934.92	4,746.01	-
	1998	3,945.60	11,148.91	-	203.48	2,068.39	-
	TOTALS	**28,697.70**	**60,206.36**	**-**	**1,568.50**	**10,463.01**	**-**
St. Clair WWTP	1995	452.55	1,008.04	0.52	11.33	95.36	2.06
	1996	523.44	909.72	0.49	16.63	219.28	2.18
	1997	438.24	892.51	0.39	8.21	23.68	0.63
	1998	421.77	1,005.62	0.00	7.30	24.06	1.17
	TOTALS	**1,836.00**	**3,815.89**	**1.40**	**43.47**	**362.37**	**6.04**
St. Clair River SA WWTP	1995	178.14	437.01	-	-	-	0.00
	1996	212.46	448.92	-	-	-	0.04
	1997	207.00	436.68	-	-	-	0.03
	1998	182.88	383.38	-	-	-	0.03
	TOTALS	**780.48**	**1,705.99**	**-**	**-**	**-**	**0.10**

DATA APPENDIX 3. ENVIRONMENT CANADA HEAD AND MOUTH RESULTS FOR METALS AND ORGANIC CHEMICALS IN WHOLE WATER

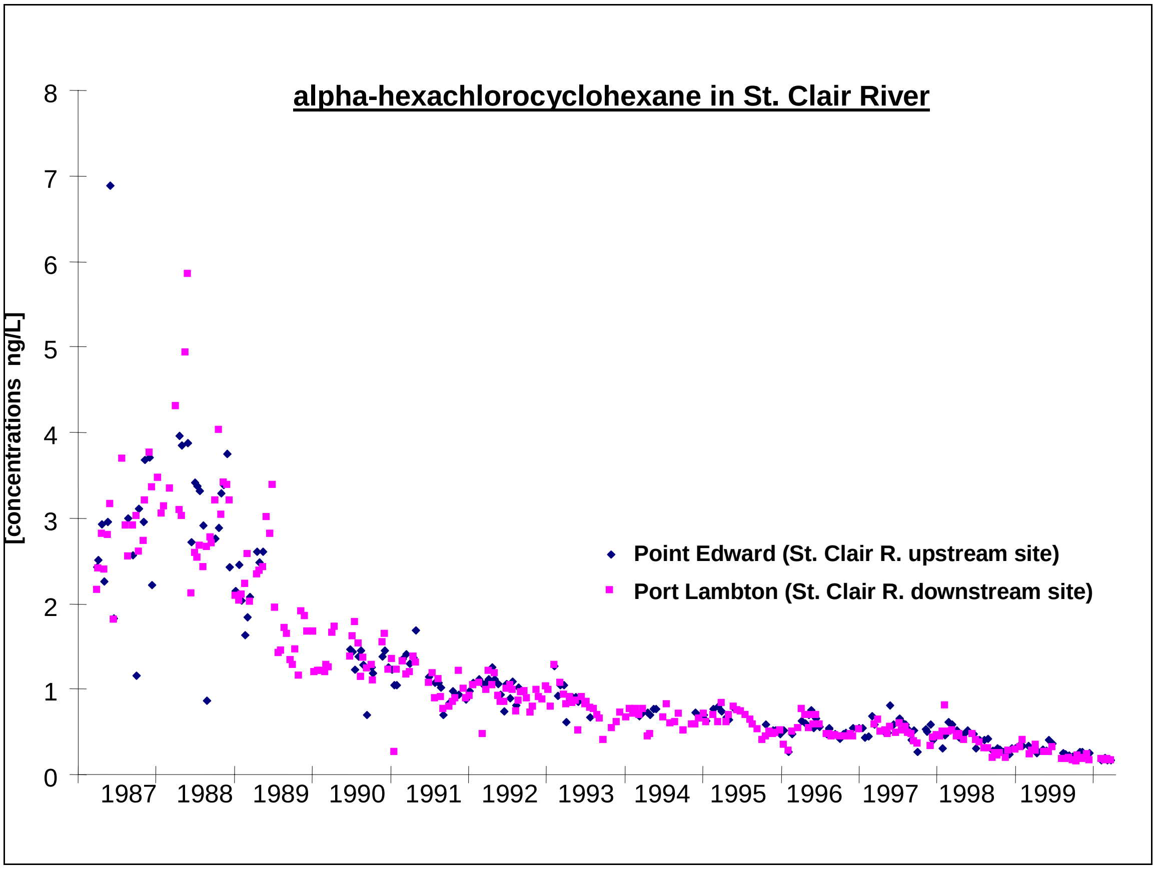
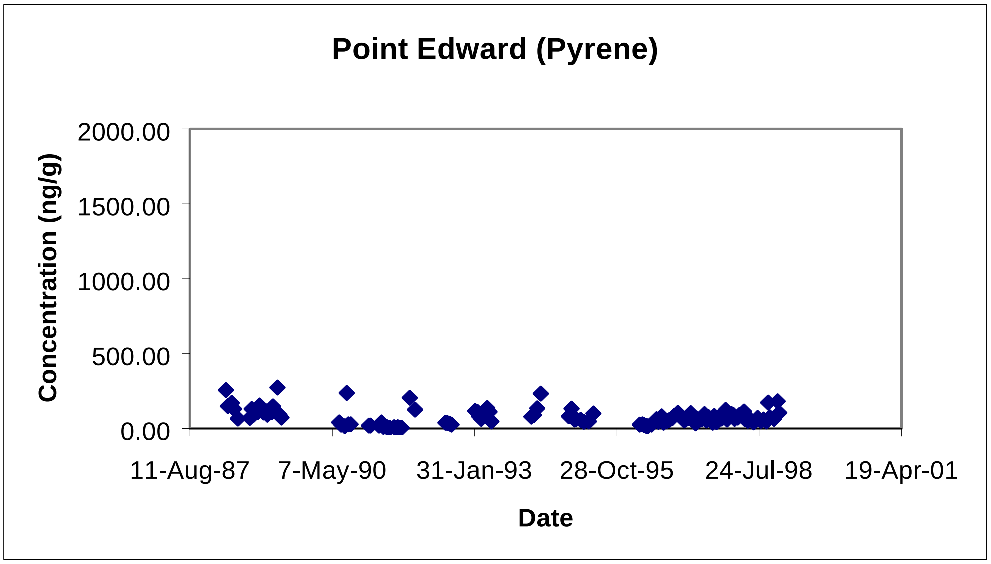


Figure 1. Alpha-hexachlorocyclohexane in whole water samples collected from head (Pt Edward) and mouth (Port Lambton) of the St. Clair River (from Environment Canada; 1987 to March 1999).



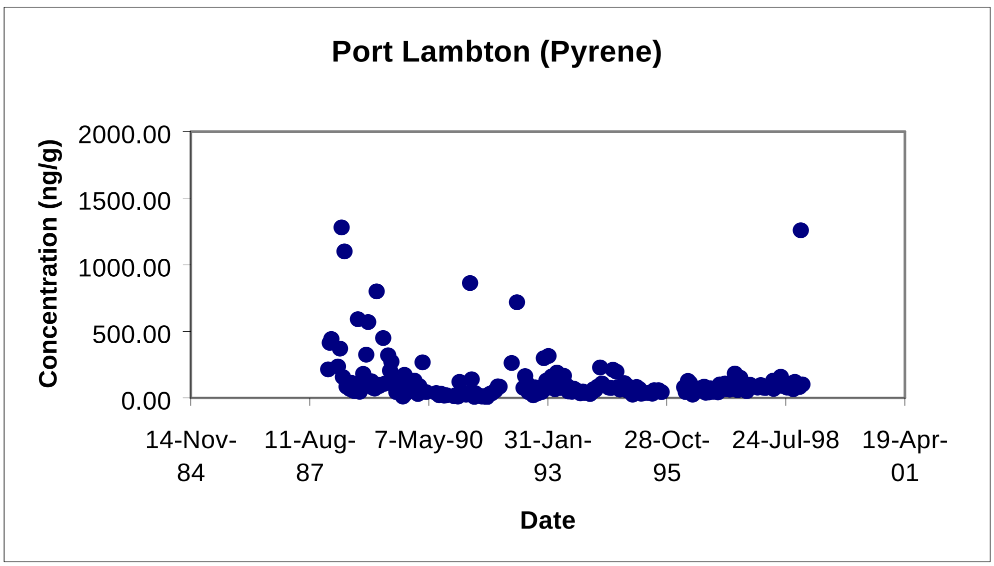
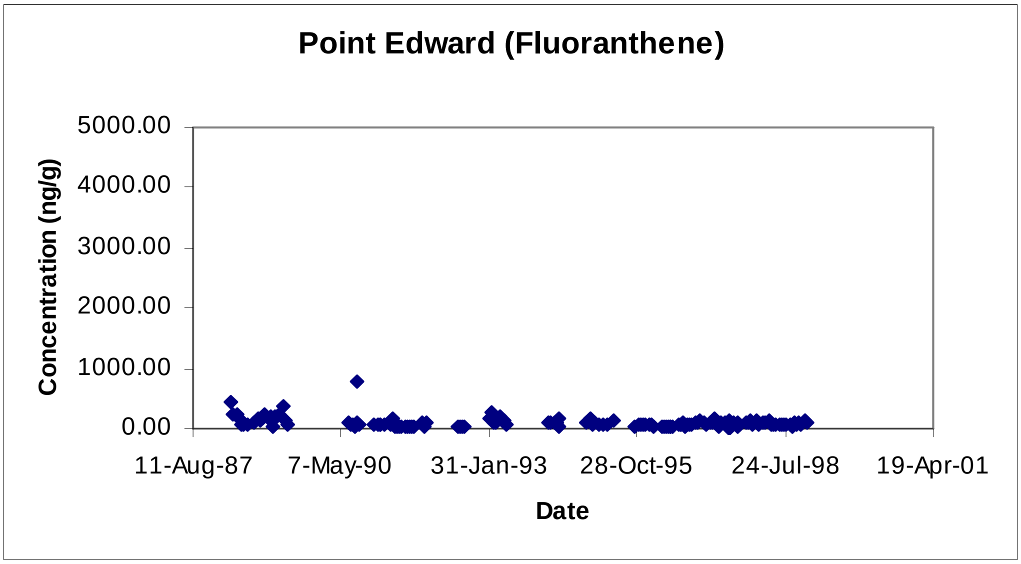


Figure 2. Pyrene in whole water samples collected from head (Pt Edward) and mouth (Port Lambton) of St. Clair River (from C.H. Chan; January 1988 to March 2001; detection limit before 2000 = 0.0002 mg/L – lower afterward).



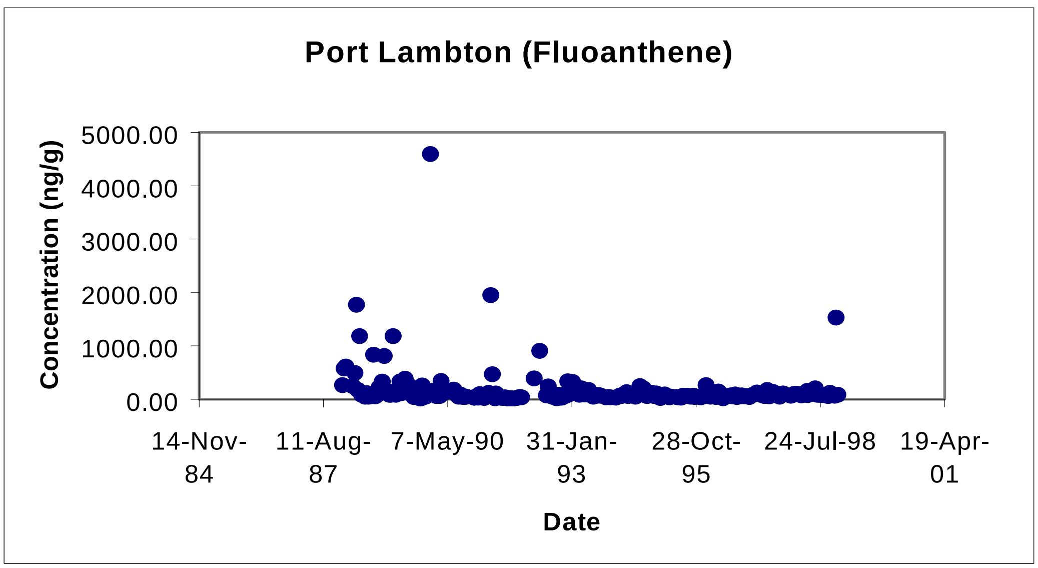


Figure 3. Fluoranthene in whole water samples collected from head (Pt Edward) and mouth (Port Lambton) of St. Clair River (from C.H. Chan; January 1988 to March 2001; detection limit before 2000 = 0.0002 mg/L – lower afterward).

DATA APPENDIX 4. AIR EMISSIONS DATA FOR SELECTED CHEMICALS AND INDUSTRIES LOCATED ON THE SHORES OF THE ONTARIO SIDE OF THE ST. CLAIR RIVER

Table 1. Historical substance reports for air emissions (tonnes) data for selected chemicals and industries on the Ontario side of the St. Clair River.

Facility	Year	Emissions of chemicals to the air in tonnes									
		Ammonia	Acetonitrile	Benzene	1,3-Butadiene	Cyclohexane	Ethylene	Methanol	Styrene		
Bayer Inc. NPRI ID: 1944 Bayer Inc. Sarnia Site 1265 Vidal Street South Sarnia, ON N7T 7M2	2002	67.2	6.037	NA	45.2	119.8	29.9	195.3	0		
	2001	97.97	6.03	NA	59.865	293.926	39.882	103.394	0.354		
	2000	71.86	6.005	NA	40.388	460.735	40.587	13.65	2.094		
	1999	69.39	7.52	NA	60.068	458.2	45.65	10.883	1.118		
	1998	70.64	8.167	NA	64.77	549.682	43.071	11.473	0.77		
	1997	73.465	11.182	9.24	67.473	602.709	54.85	11.595	0.92		
	1996	53.668	23.7	71.66	81.27	528.2	54.65	NA	1.483		
	1995	77.03	79.055	167.131	179.887	468.843	37.17	NA	1.63		
	1994	NA	79.13	319.075	247.458	270.5	46	NA	NA		
Dow Chemical Canada Inc. NPRI ID: 3146 Dow Chemical Canada Inc. - Sarnia 1425 Vidal Street South Sarnia, ON N7T 8C6		Ammonia	Benzene	Ethylene	Ethyl benzene	Ethylene oxide	Methanol	Styrene	Toluene	Vinyl chloride	
	2002	0.17	NA	114.531	2.827	0.343	0.165	6.141	0.169	NA	
	2001	0.164	NA	126.364	2.743	0.442	0.152	7.246	0.376	NA	
	2000	0.575	NA	148.932	2.84	1.067	0.086	6.757	0.375	NA	
	1999	0.012	0.148	237.509	2.942	0.593	0.102	9.143	1.695	0.075	
	1998	0.004	11.319	129.737	7.707	0.937	0.092	14.771	1.459	0.259	
	1997	0.027	18.744	218.54	10.887	0.425	0.032	18.131	3.73	8.875	
	1996	0.051	36.449	188.419	7.885	0.241	0.075	23.207	0.751	0	
	1995	0.063	48.13	218.403	14.737	1.578	0.093	16.003	0.892	0.007	
	1994	NA	64.645	253.98	14.27	4.66	0.08	15.31	1.4	0.03	
Ethyl Canada Inc. NPRI ID: 2734 Ethyl Canada Inc.- Corunna Site 220 St. Clair Parkway Corunna, ON N0N 1G0		1,2-dichloro ethane	Dichloro methane	Cyclohexane	Toluene						
	2002	0.005	1.16	1.37	0.176						
	2001	0.086	1.26		0.057						
	2000	0.311	0.63	0.076	0.071						
	1999	0.028	0	0.094	0.048						
	1998	0.032	0	0.2	0.043						
	1997	0.037	0	NA	0.06						
	1996	0.044	NA	NA	0.09						
	1995	0.06	NA	NA	0.01						
	1994	1.132	NA	NA	0.13						

Imperial Oil		1,3- butadiene	Cyclo hexane	Ethyl benzene	Ethylene	Methanol	Propylene	Toluene	1,2,4-Trimethylbenzene	Vinyl chloride	
NPRI ID: 1464	2002	0.027	2.736	0.623	159.899	0.052	17.162	7.532	0.554	NA	
Sarnia Chemical Plant	2001	0.066	4.059	0.9	277.103	0.146	22.144	7.513	1.385	NA	
602 South Christina Street	2000	0.03	0.842	1.907	303.83	0.177	23.124	3.769	4.635	NA	
Sarnia, ON	1999	0.044	1.73	0.708	299.1	0.087	18.8	3.94	3.882	0.166	
N7T 7M5	1998	0.047	1.643	1.088	186.242	0.285	23.24	5.079	7.654	0.166	
	1997	0.061	2.311	1.198	101.11	0.241	35.35	8.956	7.51	11.43	
	1996	0.039	1.972	1.229	175.22	0.2	46.53	7.485	7.403	5.456	
	1995	0.17	1.66	1.156	250.655	0.2	129.56	7.2	5.443	5.606	
	1994	1.6	2.9	1.2	303.5	0.2	88.9	26.605	10.4	9.76	
Imperial Oil		Ammonia	Benzene	1,3-Butadiene	Ethylene	Methanol	Methyl ethyl ketone	Methly isobutyl ketone	Napthalene	Propylene	Toluene
NPRI ID: 3704	2002	8.578	11.077	0.06	2.551	9.474	44.903	65.003	0.846	92.439	17.907
Sarnia Refinery Plant	2001	1.528	10.811	0.068	3.421	30.609	50.6	72.49	0.85	31.642	19.11
602 South Christina Street	2000	2.907	16.787	0.101	16.245	82.096	51.799	74.195	1.05	34.015	21.63
Sarnia, ON	1999	2.718	15.678	0.251	15.459	66.291	49.98	48.58	1.161	33.522	19.138
N7T 7M5	1998	5.576	16.259	0.884	22.769	68.705	29.89	72.66	2.813	38.602	26.934
	1997	2.888	19.247	0.976	19.152	75.007	59.15	68.39	2.959	35.759	32.139
	1996	5.535	25.165	1.266	34	0.036	61.165	95.286	3.29	27.482	47.87
	1995	19.54	28.13	1.29	41.16	0.51	89	71.5	4.171	13.62	54.06
	1994	1.4	32.39	1.4	30.712	1.29	74.19	71.02	4.366	20.48	56.98
Nova Chemicals (Canada) Ltd.		Benzene	1,3-Butadiene	Ethylene	Ethyl benzene	Napthalene	Propylene	Styrene	Toluene		
NPRI ID:1776	2002	56.429	17.907	50.98	5.89	3.734	28.45	3.842	24.792		
Corunna Site	2001	46.835	19.11	80.007	5.048	1.44	46.484	2.461	22.835		
785 Petrolia Line	2000	47.059	21.63	118.447	7.7	2.124	76.657	3.03	26.71		
Corunna, ON	1999	26.951	19.138	63	NA	2.654	37.9	1.35	22.191		
N0N 1G0	1998	35.093	26.934	70	NA	5.199	42.38	NA	22.916		
	1997	44.07	32.139	152.3	NA	1.028	68.65	NA	27.051		
	1996	62.363	47.87	122	NA	2.25	56.15	NA	32.759		
	1995	39.38	54.06	81	NA	NA	124	NA	15.14		
	1994	51.095	56.98	169	NA	NA	41.2	NA	14.456		

Nova Chemicals (Canada) Ltd. NPRI ID: 1785 Sarnia Site 872 Tashmoo Ave Sarnia, ON N7T 8A3		Ethylene	Ethyl benzene	Styrene	Toluene						
	2002	1.043	17.217	11.401	7.146						
	2001	16.23	24.02	20.983	7						
	2000	4.63	19.04	18.01	6.18						
	1999	17	20.703	15.19	7.87						
	1998	4	41.11	25.647	5.505						
	1997	4.1	44.4	28.5	5.5						
	1996	1.5	25.8	18.9	6.2						
	1995	1	19.8	14.59	6						
	1994	NA	136.1	43.7	45.7						
Nova Chemicals Corporation NPRI ID: 1788 Moore Site P. O. Box 3042 510 Moore Line Road Sarnia, ON N7T 8C9		Ethylene	Ethylene glycol	Isopropyl alchohol	Propylene						
	2002	325.19	NA	17.064	4.191						
	2001	288.552	NA	15.402	4.979						
	2000	316.07	NA	10.451	10.45						
	1999	213.871	0.318	4.806	2.556						
	1998	285.6	0.613	7.47	6.02						
	1997	211.22	0.112	5.94	2.9						
	1996	229	0.136	9.5	3.65						
	1995	218.1	0.136	9.55	3.57						
	1994	206	0.034	8.85	2.24						
Nova Chemicals Corporation NPRI ID: 4700 St. Clair River Site 285 Albert Street Corunna, ON N0N 1G0		Biphenyl	Cyclo hexane	Ethylene	Toluene						
	2002	3.6	455.816	9.91	6.574						
	2001	3	517.877	17.818	11.895						
	2000	3	518.247	8.9	19.723						
	1999	2.072	527.118	12.77	27.153						
	1998	3.95	1057.8	17	56.027						
	1997	2.9	1960.47	27	56.01						
	1996	1.1	2100.81	23	62.01						
	1995	4	2010.76	34	107.03						
	1994	5	1960.5	40	64.15						

Royal Polymers Ltd. NPRI ID: 5728 Sarnia PVC Plant 1 Esso Chemical Drive Sarnia, ON N7T 8G1		Methanol	Hexa chloro benzene	Hydro chloric acid	Vinyl chloride						
	2002	19.25	3.847	118.3	6.164						
	2001	21.791	3.24	99.5	4.761						
	2000	23.09	3	92.2	8.749						
	1999	20.729	NA	144	5.313						
	1998	0.055	NA	145.602	8.614						
	1997										
	1996										
	1995										
	1994										
Shell Canada Products NPRI ID: 3962 Sarnia Manufacturing Centre 150 St. Clair Parkway Corunna, ON N0N 1G0		Ammonia	Benzene	Cyclo hexane	Ethylene	Ethyl benzene	Methanol	Napthalene	Propylene	1,2,4-Trimethyl benzene	Toluene
	2002	0.538	12.876	5.577	5.864	6.36	0.157	0.297	8.811	1.845	37.23
	2001	0.605	32.7	7.37	9.171	9.878	2.099	0.694	24.313	3.66	55.011
	2000	1.233	23.934	6.929	5.853	8.749	1.014	0.619	19.123	7.413	42.602
	1999	3.842	34.672	8.47	5.055	11.686	0.698	2.281	25.68	8.168	57.522
	1998	1.635	36.515	10.356	8.125	11.286	0.746	2.228	28.835	8.138	59.124
	1997	2.601	41.739	11.801	8.87	13.047	2.027	2.565	38.52	11.351	65.289
	1996	1.648	68.223	16.644	8.685	11.093	2.131	2.534	46.061	11.281	69.904
	1995	8.314	70.281	8.679	10.449	13.935	3.117	2.083	48.144	12.963	68.301
	1994	13.48	92.761	16.3	9.54	13.399	17.2	2.123	45.07	13.48	97.826
Suncor Energy Products Inc. NPRI ID: 3071 Sarnia Refinery 1900 River Road P.O. Box 307 Sarnia, ON N7T 7J3		Ammonia	Benzene	Chlorine	Ethyl benzene	Methanol	Napthalene	Propylene	Toluene	1,2,4-Trimethyl benzene	Xylenes
	2002	5.024	11.838	0.1	15.161	15.161	0.465	14.248	51.617	3.64	67.103
	2001	3.25	22.3	0.1	22.258	22.258	0.53	2.259	48.729	3.653	92.746
	2000	3.914	10.661	0.1	19.288	19.288	0.606	0.886	36.262	3.088	73.156
	1999	6.44	27.766	0.1	24.359	24.359	0.097	16.5	73.463	4.723	98.3
	1998	6.153	17.097	0.1	20.762	20.762	0.43	17.188	64.416	0.483	81.82
	1997	1.68	17.978	0.1	17.826	17.826	0.003	17.188	80.404	0.669	80.684
	1996	5.996	26.468	0.1	23.015	23.015	0.003	NA	104.051	5.281	115.607
	1995	3.461	30.617	0.063	15.23	15.23	1.753	NA	105.312	2.37	65.66
	1994	NA	49.765	0.063	6.87	6.87	NA	NA	102.238	0.8	36.186

DATA APPENDIX 5. CONTAMINANT MONITORING RESULTS FOR WHITE SUCKER AND WALLEYE FROM THE ST. CLAIR RIVER

Table 1. Mean (SE) mercury and total PCB concentrations in walleye and white suckers from the Upper, Middle and Lower St. Clair River between 1978 and 2003.

Site/Species		Jan-1978 (20)	Jun-1991 (6)	Aug-1994 (9)	Oct-1999 (3)	Sep-2003 (4)
Lower / White Sucker	Weight (g)	NM	NM	126.95 (126.95)	819.66 (185.66)	515.50 (213.90)
	Length (cm)	NM	NM	42.44 (2.74)	42.26 (3.66)	34.00 (5.48)
	Hg (ug/g)	NM	NM	0.34 (0.06)	0.30 (0.12)	0.11 (0.06)
	PCB (ng/g)	NM	NM	20.00 (0.0)	NM	53.67 (19.87)
		May-1985 (19)	**Jun-1991 (3)**	**Aug-1994 (3)**	**Oct-1999 (2)**	**Sep-2003 (10)**
Middle / White Sucker	Weight (g)	830.00 (102.14)	NM	1053.33 (164.98)	715.00 (154.00)	801.90 (111.29)
	Length (cm)	41.72 (1.52)	NM	46.80 (2.64)	41.65 (2.95)	40.25 (2.66)
	Hg (ug/g)	0.22 (0.04)	NM	0.26 (0.04)	0.29 (0.05)	0.21 (0.05)
	PCB (ng/g)	NM	NM	20.00 (0.00)	NM	122.4 ()
		Jan-1985 (20)	**Jun-1991 (13)**	**Aug-1994 (8)**	**Oct-1999 (2)**	**Sep-2003 (9)**
Upper / White Sucker	Weight (g)	841.50 (65.62)	576.92 (76.15)	739.62 (124.26)	786.00 (60.00)	477.33 (122.84)
	Length (cm)	40.76 (1.40)	36.35 (1.73)	40.26 (2.91)	43.10 (3.60)	32.71 (3.31)
	Hg (ug/g)	0.22 (0.04)	0.22 (0.03)	0.38 (0.8)	0.26 (0.17)	0.07 (0.01)
	PCB (ng/g)	NM	69.62 ()	92.00 ()	NM	26.60 ()

Site/Species		Jan-1978 (20)	Jun-1991 (6)	Aug-1994 (7)	Oct-1999 (15)	Sep-2003 (0)
Lower / Walleye	Weight (g)	755.00 (116.22)	1255.83 (155.32)	844.86 (118.96)	908.53 (165.62)	NM
	Length (cm)	41.42 (2.30)	48.052 (1.65)	45.4 (2.13)	44.00 (2.29)	NM
	Hg (ug/g)	0.446 (0.06)	0.400 (0.07)	0.384 (0.14)	0.362 (0.08)	NM
	PCB (ng/g)	269.58 (65.87)	142.50 (32.52)	120.00 (80.11)	NM	NM
		Jan-1985 (15)	**Jun-1991 (20)**	**Aug-1994 (6)**	**Oct-1999 (14)**	**Sep-2003 (4)**
Middle / Walleye	Weight (g)	450.33 (29.57)	850.75 (85.48)	651.67 (116.63)	691.71 (78.65)	951.00 (191.87)
	Length (cm)	34.92 (0.69)	42.07 (1.72)	41.12 (3.08)	40.64 (1.67)	46.63 (3.26)
	Hg (ug/g)	0.182 (0.01)	0.302 (0.04)	0.180 (0.01)	0.268 (0.05)	0.233 (0.04)
	PCB (ng/g)	325.75 (42.04)	20.00 (0.00)	80.00 (NA)	32.50 (4.33)	
		Jan-1985 (20)	**Jun-1991 (10)**	**Aug-1994 (10)**	**Oct-1999 (8)**	**Sep-2003 (7)**
Upper / Walleye	Weight (g)	698.65 (120.25)	986.50 (174.07)	598.10 (106.25)	529.36 (75.27)	740.43 (159.24)
	Length (cm)	40.05 (1.96)	45.53 (2.45)	39.10 (2.58)	37.50 (1.96)	42.49 (2.93)
	Hg (ug/g)	0.43 (0.10)	0.27 (0.05)	0.17 (0.02)	0.14 (0.01)	0.22 (0.04)
	PCB (ng/g)	191.00 (54.88)	36.00 (7.48)	60.00 ()	60.14 (14.32)	NM

DATA APPENDIX 6. COMPARATIVE WILDLIFE CONTAMINANT TISSUE BURDENS

Table 1. A comparison of the mean contaminant concentrations (ng/g, standard deviation) in eggs of snapping turtles and terns, and livers of mink collected from the vicinity of Walpole Island First Nations territory, reference sites, and other areas of concern (1992-2002).

Study Site	Year	N	PCBs*	HCB	OCS	Dieldrin	Mirex	p,p'-DDE	Non-Ortho PCBs	Dioxins	Furans	Hg	Reference
Snapping turtle eggs													
Walpole	1992	5	191	NM	NM	NM	NM	NM	NM	NM	NM	NM	CWS database
Walpole	1995	3	263	NM	NM	NM	NM	NM	NM	NM	NM	NM	CWS database
Walpole	1999	10	240 (270)	1.1(0.10)	1.5 (.002)	15 (39)	1.0 (1.8)	8.8 (5.1)	0.12	0.0024	0.0012	110	Ashpole et al., 2004
Mitchell Bay	1984	2	1,400	130	NM	20	10	180	NM	NM	NM	NM	Struger et al., 1993
St. Clair NWA	1984	2	660	5	NM	10	NM	50	NM	NM	NM	NM	Struger et al., 1993
St. Clair NWA	2001	6	74.2 (90.1)	0.66 (0.67)	0.39 (0.36)	1.16 (0.83)	0.24 (8.6)	5.93 (1.6)	NM	NM	NM	NM	De Solla and Fernie, 2004
Hamilton Harbour AOC	1999	9	1900(810)	0.83 (0.25)	3.3 (0.25)	4.2 (1.1)	27 (14)	69 (19)	0.51	0.0078	0.0052	50	Ashpole et al.
St. Lawrence River AOC	1999	5	5200 (2400)	1.3 (1.2)	6.9 (0.6)	7.5 (3.4)	75 (45)	51 (29)	3.4 (1.4)	0.027 (0.009)	0.006 (0.00006)	720	Ashpole et al.
Tiny Marsh	2001	9	41.1 (27.3)	0.25 (0.18)	ND	.59 (0.28)	2.08 (2.91)	4.92 (198)	0.12	0.0022	0.0007		
Mink													
Walpole	2002	10	82 (20)	NM	2.3 (0.7)	3.4 (1.0)	0.4 (0.01)	12.1	0.353	0.096	0.010	2200 (320)	Martin et al. 2004
Inland (reference)	1999	4	84 (20.2)	NM	ND	ND	ND	7 (5.8)	NM	NM	NM	193 (520)	
Lake Erie (west basin)	2002	16	1,692 (557)	NM	3.4 (1.2)	42.3 (10.9)	1.2 (0.16)	48.4 (80.8)	4.553	0.1948	0.0318	350.6 (260)	
Black terns													
Walpole	1999	6-10	1861	11	5	33	1	176	0.787	0.0200	0.0070	530	Weseloh (unpubl.)
Tiny Marsh	1999	6-10	226	1	0.05 (ND)	4	2	82	0.253	0.0069	0.0024	670	
Forster's terns													
Walpole	1986	NA	NM	44	NM	133	37	1470	NM	NM	NM	NM	
Walpole	1992	NA	4531	20.6	45.7	63.9	22.5	1067.2	NM	NM	NM	NM	
Walpole	1999	6-10	4404	7	33	16	14	621	1.008	0.0200	0.0020	2570	
Lake Simcoe	1999	6-10	2407	4	0.5 (TR)	11	6	818	0.669	0.0137	0.0023	2210	

Sum PCBs and pesticides, dioxins, furans and non-ortho PCBs ng/g wet weight. Total mercury (Hg) ng/g dry weight.
NM, not measured; ND, not detected; NA, not available; N, number of samples; TR, trace
Walpole = Walpole Island First Nation Territory; St. Clair NWA = National Wildlife Area; St. Lawrence River AOC = south shore at Raquette River
Concentrations of non-ortho PCBs, dioxins and furans in pooled livers of mink are reported with associated TEQs (ng/g wet weight)
Mean contaminant concentrations without associated standard deviations represent pooled values