ST. LAWRENCE
REMEDIAL ACTION PLAN
PLAN D'ASSAINISSEMENT
ST-LAURENT

Stage 1

Environmental Conditions and Problem Definitions

August 1992

Remedial Action Plan
Plan d'Assainissement

Canada Ontario

THE ST. LAWRENCE RIVER
AREA OF CONCERN

REMEDIAL ACTION PLAN FOR THE CORNWALL-LAKE ST. FRANCIS AREA

STAGE 1 REPORT: ENVIRONMENTAL CONDITIONS AND PROBLEM DEFINITIONS

ST. LAWRENCE RAP TEAM

AUGUST 1992

CATALOGUE #: EN40-218/1-1E
ISBN: 0-662-19958-8

MOHAWK COMMUNITY OF AKWESASNE

Words of Spiritual Communication

The Mohawk Nation is governed by the guiding principles, embodied in two words "Ohenton Kariwatekwen". Words of spiritual communication toward the natural environment, expressed before anything else. Whenever our people gather, a speaker is chosen to find the finest words of thanksgiving directed toward the earth mother and all of creation.

We encourage all people who may listen, to feel for the environment as we have felt since creation. We are living in turbulent times as ancient prophesies are being fulfilled. Indeed as has been foretold, the trees would start dying from its tops down. The waters would be dirtied and many fish and water life would die. Great destruction awaits our children and grandchildren if we fail to find answers needed to heal the environment. We encourage the best possible Remedial Action Plan for the clean-up of "Kaniatarowaneneh" St. Lawrence River be adopted.

The People

We who have gathered together see that our cycle continues. We have been given the duty to live in harmony with one another and with other living things. We are grateful and give thanks that this is true.

We also give greetings and thanks that our people still share the knowledge of our culture and ceremonies and still are able to pass it on.

We have our elders here and also the new faces are coming towards us, which is the cycle of our families; for all this we give thanks and greetings for mankind in mind, health and spirit.

Now our minds are one
Agreed

The Mother Earth

We give thanks and greetings to the earth; she is giving that which makes us strong and healthy. She supports our feet as we walk upon her. We are grateful that she continues to perform her duties as she was instructed. The women and Mother Earth are one; givers of life.

We are her colour, her flesh and her roots. Once we acknowledge and respect her role, then begins a true relationship, and all that is from her returns to her.

Now our minds are one
Agreed

The Three Sisters

Our people have been given three main foods from the plant world. They are known as the three sisters; corn, beans and squash. We acknowledge them for providing strength to mankind and also to many other forms of life.

For this we give thanks and greetings in the hope that they will continue to replenish Mother Earth with the necessities of the life cycle.

Now our minds are one
Agreed

Plant Life

We give greetings and thanks to the plant life. Within plants is the force of substance that sustains many life forms; among them are food, medicine and beauty.

From the time of creation we have seen the various forms of plant life work many wonders in areas deep below the many waters and the highest of mountains. We give greetings and thanks, and hope that we will continue to see plant life for generations to come.

Now our minds are one
Agreed

Medicinal Plants

We greet and give acknowledgment thanksgiving to the medicine plants of the world. They have been instructed by the Creator to cure disease and sickness.

Our people will always know their native names for this is the name we will use when we are weak and sick, for invested in the plants is the power to heal. They come in many forms and have many duties. It is said that because of this, our relationship is very close. Through the ones who have been vested with knowledge of the medicine plant, we give thanks.

Now our minds are one
Agreed

The Animals

We give thanks and greetings to all animals of which we know the names. They are still living in the forest and other hidden places, and we see them sometimes. Also from time to time they are still able to provide us with food, clothing, shelter and beauty.

This gives us happiness and peace of mind because we know that they are still carrying out their instructions as given by the Creator.

Therefore, let us give thanks and greetings to our animal brothers.

Now our minds are one
Agreed

Bodies of Water

We give thanks to the spirit of waters for our strength of well being. The waters of the world have provided to many; they quench thirst, provide food for plant life, and are the source of strength for many medicines we need. Once acknowledged, this too becomes a great power for those who seek its gift, for mankind himself is made from the waters.

Now our minds are one
Agreed

Trees

We acknowledge and give greetings to the trees of the forests. They continue to perform the instructions which they were given. The maple tree is symbolized as the head of the trees. It provides us with syrup, which is the first sign of the rebirth of spring. All the trees provide us with shelter and fruits of many varieties. The beauty of the trees is ever changing. Some of the trees stay the same throughout the cycle of the year.

Long ago our people were given a way of peace and strength and this way is symbolized by the everlasting tree of peace. The trees are standing firm toward the sky for which we give a thanksgiving.

Now our minds are one
Agreed

Birds

We now turn our thoughts toward the winged creatures that spread their wings just above our heads to as far upward as they can go. We know them as having certain names. We see them, and we are grateful.

They have songs which they sing to help us appreciate our own purpose in life. We are reminded to enjoy our life cycle. Some birds are available to us as food. We believe that they are carrying out their responsibilities.

To us the eagle is the symbol of strength. It is said that they fly the highest and can see the creation. It warns us if any great danger is coming. We show our gratitude for the fulfilment of his duties.

Now our minds are one
Agreed

The Four Winds

We listen, hear their voices as they blow above our heads. We are assured that they follow the instructions given them, sometimes bringing rain, and renewing the waters upon the earth. They always bring us strength. They come from the four directions.

The air and winds are still active in the changing of the seasons. Winter is the time when the earth is covered with snow and cold winds blow. Summer wind causes life to continue. In the fall season life matures and gets ready for the continuation of the cycle once more.

You refresh us and make us strong. For this we give greetings and thanksgiving.

Now our minds are one
Agreed

Our Grandfathers, The Thunderers

We call them our grandfathers. They are the Thunder People. We are of one mind that we should give them greetings and thanks.

Our grandfathers have been given certain responsibilities. We see them roaming the sky above, carrying with them water to renew life.

At certain times we hear our Grandfathers making loud noises. Our Elders tell us their voices are loud to suppress the powerful beings (not of his making) within the Mother Earth, from coming to the surface where the people dwell. Grandfathers, you are known to us as protective guardians and as medicine, so we now offer these words of thanksgiving.

Now our minds are one
Agreed

The Moon or Night Sun

In our world we have night time or darkness. During this time we see the moon reflects lights, so that there isn't complete darkness. We have been instructed to address her as our Grandmother. In her cycle she makes her face in harmony with other female life.

She is still following these instructions and we see her stages. Within these are the natural cycle of women. She determines the arrival of children on earth, causes the tides of the ocean, and she also helps us measure time.

We know that there are two sides to the natural flow, for day time there is night. They are on equal balance yet. Our Grandmother continues to lead us. We remain grateful, and we express our thanksgiving.

Now our minds are one
Agreed

The Day Sun

Our thoughts turn toward the sky. We see the day sun, the source of all life. We are instructed to call him our eldest brother. He comes from the east, travels across the sky, and sets in the west. With the sunshine we can see the perfect gifts which we are grateful for.

Brother sun nourishes Mother Earth and is the source of light and warmth. The cycle of the sun changes; during the winter months there is just enough heat and sunshine to allow Mother Earth to rest; we say "She wears a blanket of snow". As the cycle continues the sunshine and heat becomes stronger to allow all life forms to be reborn.

Our brother is the source of all fires of life. With every new sunrise is a new miracle; for this we are grateful.

Now our minds are one
Agreed

Stars

The stars are helpers of our Grandmother moon. They have spread themselves all across the sky. Our people knew their names and their messages of future happenings, even to helping mold individual character of mankind.

When we travel at night we lift our faces to the stars and are guided to our homes.

They bring dew to the gardens and all growing plants on Mother Earth.

When we look in the sky to the vast beauty of the Stars, we know they are following the way the Creator intended. For this we offer our greetings and Thanksgiving.

Now our minds are one
Agreed

The Sky Dwellers

The four powerful spirit beings who have been assigned by the Creator to guide us both by day and by night are called the Sky Dwellers. Our Creator directed these helpers to assist him in dealing with us when we are happy and of many minds during our journey on Mother Earth. They know and so our every act and they guide us with the teachings that the Creator established.

For the power of direction, we give greetings and Thanksgiving to these four beings, his helpers.

Now our minds are one
Agreed

The Creator

Now, we turn our thoughts to the Creator. We will choose our finest words to give thanks and greeting to Him. He has prepared all these things on earth for our peace of mind. Then he thought, "I will now prepare a place for myself where no one will know my face, but I will be listening and keeping watch on the people moving about on the earth."

And indeed, we see that all things are faithful to their duties as he has instructed them. We will therefore gather our minds into one and give thanks to the Creator.

Now our minds are one
Agreed

Closing Words

We have directed our voices toward our Creator in the best way that we will abide by his word so that we may yet be happy.

If we have left something out, or if there are more who have other needs or other words, let them send their voices to the Creator in their own ways. Let us be satisfied that we have gone as far as it was possible to fulfil our responsibility.

Now our minds are one
Agreed

ACKNOWLEDGEMENTS

This document was prepared by the St. Lawrence River Remedial Action Plan (RAP) Team under the guidance of the Canada-Ontario RAP Steering Committee. RAP Team membership during the preparation of this document has included:

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FOREWORD

This report constitutes the Stage 1 submission of the St. Lawrence River Remedial Action Plan (RAP), in accordance with the Canada-Ontario commitment to the Great Lakes Water Quality Agreement. It provides a summary of the environmental conditions and problem definitions in the St. Lawrence River area of concern (Cornwall-Lake St. Francis). A description of the public involvement program as it has developed to date is also included.

Background - What's a RAP?

The International Joint Commission (IJC) was established in 1909 by the Boundary Waters Treaty to deal with water and related issues along the Canada/United States border.

Since 1973, the Great Lakes Water Quality Board of the IJC has identified Areas of Concern throughout the Great Lakes and their connecting channels where Great Lakes Water Quality Agreement, provincial or state water quality objectives have been exceeded and uses of the areas have been impaired. Of the 42 areas of concern identified by the IJC, 12 are entirely within the Canadian Great Lakes Basin, while five are a shared Canadian/United States responsibility.

The Water Quality Board recommended that a Remedial Action Plan (RAP) be developed for each area of concern which would outline a "systematic and comprehensive approach to restoring beneficial uses . . . consistent with an 'ecosystem approach' to the protection of the Great Lakes" (IJC, 1985). When completed the RAP will provide: a description of the area; location and extent of environmental problems and use impairment; description of pollution sources leading to the problems; and the remedial actions proposed to restore beneficial uses, including scheduling and tracking procedures. The 1978 Great Lakes Water Quality Agreement (revised with 1987 Protocol) requires the RAP to be submitted to the IJC at three stages:

1. when the definition and description of the environmental problems and impaired beneficial uses are complete;
2. when remedial measures and implementation plans have been selected; and
3. when monitoring indicates that beneficial uses have been restored.

The St. Lawrence River Area of Concern

The St. Lawrence River area of concern includes the Maitland, Ontario area and the reach from Cornwall-Massena (Ontario and New York) downstream through Lake St. Francis (including the Quebec portion). It was identified as an area of concern by the IJC as a result of sediments contaminated with PCBs and excesses of water quality objectives for phenols and coliform bacteria (Cornwall-Massena), and elevated organolead concentrations in fish (Maitland) (IJC, 1985).

There are currently two Remedial Action Plan programs underway for the St. Lawrence area of concern, Cornwall/Lake St. Francis and Massena. The Maitland area has been addressed through ongoing agency programs and not through a specific RAP process primarily due to the closure of the organolead plant (Dupont) in 1985 and the subsequent improvement in environmental lead levels and the removal of fish consumption advisories for lead. This Stage 1 document has been prepared as part of the RAP process for the Cornwall-Lake St. Francis area in Ontario and Quebec. It is a joint effort by Canada and Ontario under the Canada/Ontario Agreement. New York state is proceeding with a separate Remedial Action Plan for Massena with provisions for Canadian involvement at critical stages.

A common definition of the geographic scope of the Area of Concern has, however, been agreed to by all parties as follows:

The St. Lawrence River Area of Concern (AOC) includes the waters from the Moses-Saunders power dam to the eastern outlet of Lake St. Francis adversely impacted by contaminants. This includes waters shared by the United States, Canada, and the Mohawks at Akwesasne.

For purposes of identifying water related sources of contaminants in New York State, the AOC includes the New York portion of the St. Lawrence River, including the area upstream of the Snell lock and power dam to the Massena public water supply intake, the Grasse River from the mouth upstream to the first dam, the Raquette River from the mouth upstream to the NYS Route 420 bridge and the St. Regis River from the mouth upstream to the dam at Hogansburg.

Recommendations of remedial measures will depend on the jurisdictions of the various governments involved.

Remedial actions will be identified for the Ontario portion of the area of concern and the identified sources in Cornwall. Remedial actions which may be required for the Quebec portion of Lake St. Francis due to Cornwall sources will also be written into the plan.

Maitland

Maitland is located approximately 88 km downstream of the outlet of Lake Ontario. The river at this point is about 1750 metres wide with a mid-channel depth of 20 m.

A 1975 Environment Ontario survey of water quality, sediment quality and benthos attributed adverse impacts to two industrial dischargers of effluent: Dupont and Genstar (Nitrochem Inc.).

In the Maitland area, elevated lead levels in fish and sediment have been partially resolved with the shutdown of Dupont's tetraethyl lead plant. Further activities in this section of the St. Lawrence River will be directed toward an Environment Ontario follow-up investigation of the continuing Nitrochem Inc. and Dupont monomer plant discharges. Extensive effluent monitoring is being done to comply with Ontario's Municipal and Industrial Strategy for Abatement (MISA) program regulation. A remedial action plan specific to the Maitland area of the St. Lawrence River will not be prepared at this time.

Dupont produced tetraethyl lead as a gasoline additive from 1965 to 1985 when the plant ceased operations. In 1985, Environment Ontario issued a fish consumption advisory in the Blue Church Bay/Maitland area based on lead levels in sport fish caught during 1983 and 1984. In 1987, the advisory based on lead was removed, however elevated mercury and PCB levels in older fish of some species still restricts fish consumption in this area.

A 1984 Environment Ontario survey showed that the sediment chemistry had not changed substantially since 1975. The Nitrochem plant outfall did not have any discernible impact on sediment chemistry in the 1984 survey. Dupont discharges created a 3 km plume of elevated lead levels and had a smaller impact on sediment levels of hexachlorobenzene (HCB), oil and grease, copper and possibly PCBs, cobalt and total Kjeldahl nitrogen (Wilkins, 1987). The 1984 survey also showed that less than 1 percent of the lead emitted during the plant's 20 year operation remained within the study area and estimated that some 400 tonnes had been transported downstream. The distribution in sediment of several inorganic contaminants including mercury and PCBs in the 1984 survey also indicated a pattern consistent with a major input upstream of the Maitland area (ie. Lake Ontario).

Elevated levels of HCBs, oil and grease and copper in Maitland area sediments may be associated with the continuing effluent from the Dupont monomer outfall. The need for further controls is being assessed through Environment Ontario's Municipal and Industrial Strategy for Abatement (MISA) program.

Public Involvement

Phase 1 of the public involvement program (information dissemination activities) ran from June to September 1988. This included an open house in June, the creation of a RAP display and slide show, production and distribution of a brochure, fact sheets and draft terms of reference for a Public Advisory Committee (PAC) and presentations by RAP Team members to potential PAC member groups. Public views on water quality issues and concerns were documented.

A Public Advisory Committee (PAC) was formed in November 1988 with members from the following sectors: Academia, Agriculture, Cottagers, Downstream (Quebec), Environmental Groups, Fishing, General Public, Health, Industry, Labour, Municipalities, Mohawk People, Power Generation, Shipping Recreation and Tourism and Small Business. In January 1989 the PAC struck a subcommittee to develop goal statements. Eight goals, along with an introductory 'perspective' statement, were tabled at the March 1989 meeting of the full committee.

The PAC meets monthly (every third Tuesday) and its subcommittees meet more frequently (some weekly). Three subcommittees (Technical, Public Outreach, and Remedial Options) are presently operating. Membership of the PAC has grown to approximately 40 members representing 17 sectors of the community.

Communication with the general public is continuing via open houses, trade shows and a RAP newsletter.

RAP Development

The RAP Team has been working since 1986 to analyze and complete the data base on environmental conditions and sources in the Cornwall-Lake St. Francis area. A report detailing environmental conditions and sources was prepared and submitted for public review in November 1988 (St. Lawrence River RAP Team, 1988). This work has included coordination with Environment Canada (Quebec Region), Environment Quebec, the United States Environmental Protection Agency, the New York State Department of Environmental Conservation (DEC) and the Mohawk Governments of Akwesasne.

RAP team efforts are presently being directed toward the completion of a remedial options discussion paper. Chapters of the paper have been reviewed in draft form by the Public Advisory Committee. Additions and suggestions from the committee are being incorporated as well as input from a remedial options technical workshop on feasibility and effectiveness of remedial options, held in March of 1991. Evaluation and selection of preferred options will follow with public review.

International Activities

Mechanisms for the involvement of Environment Quebec, New York State Department of Environmental Conservation and the Mohawk Governments of Akwesasne have been identified. In March 1988, the Mohawk Governments of Akwesasne were officially recognized by the Board of Review for the Canada-Ontario Agreement Respecting Great Lakes Water Quality (COA) and their direct participation in the RAP welcomed. In July 1988, the Canadian RAP Steering Committee also welcomed the contributions of Environment Quebec through liaison with the RAP Team.

The St. Lawrence River Restoration Council was formed in May 1989 with representation from the Cornwall Public Advisory Committee (PAC), the Massena Citizen's Advisory Committee (CAC) and the Mohawks Agree on Safe Health (MASH) group. The Council was supported by these groups as a forum for information exchange until 1991. The Cornwall PAC withdrew its support because of internal difficulties with representation on the council.

Although the IJC specifies the development of binational RAPs for areas of concern which are shared between the U.S.A. and Canada, New York State is developing a separate Remedial Action Plan for the Massena area of the St. Lawrence River area of concern. It continues to be COA's position that a binational RAP effort with New York State is required. The goal of such a joint RAP development process with DEC was partially achieved in May 1988 with an agreement between Environment Canada, Environment Ontario and The New York Department of Environmental Conservation (NYSDEC) to develop joint statements on environmental problems and goals for the Cornwall-Massena area of concern. Subsequent meetings between the Canadian and United States RAP Teams have outlined a process for the development of these joint statements which requires input from Environment Quebec, the Mohawk People of Akwesasne and the Canadian and United States publics. A joint goal statement (below) has received the approval of the Cornwall PAC, Massena CAC and the Mohawk People through the St. Lawrence River Restoration Council, as well as Environment Quebec and a joint statement of the problem in the form of a Cornwall-Massena Stage I summary report has been prepared.

Joint Goal Statement for the St. Lawrence River Area of Concern:

> The goal of the Cornwall and Massena Remedial Action Plans is to restore, protect, and maintain the chemical, physical and biological integrity of the St. Lawrence River ecosystem, and in particular, the Akwesasne, Cornwall-Lake St. Francis and Massena Area of Concern in accordance with the Great Lakes Water Quality Agreement.
>
> The goal of the Cornwall and Massena Remedial Action Plans includes protecting the downstream aquatic ecosystem from adverse impacts originating in the Akwesasne, Cornwall-Lake St. Francis and Massena Area of Concern.

In general, cooperation and coordination among and between the various groups and agencies involved in the Cornwall/Massena area of concern has improved, but much more remains to be done. There exists a unique opportunity in this multi-jurisdictional area to effectively share the benefits from recent initiatives such as the Canadian St. Lawrence River Action Plan in Quebec, the Canadian Great Lakes Action Plan in Ontario and the Superfund Investigations in New York. The presence of observers from the New York State Department of Environmental Conservation, the Massena Citizen's Advisory Committee (CAC) and Environment Quebec at PAC meetings has been useful in improving communications.

Canadian officials continue to monitor transboundary pollution from Massena sources on two fronts. First, staff of Environment Canada, Environment Ontario and Environnement Quebec are providing input to the EPA Superfund, State Superfund programs and the EPA 106 Order for the clean up of the three Massena industrial sites (General Motors, ALCOA, Reynolds) and river sediments. Secondly, the sharing and review of Canadian and American ambient data is occurring through the RAP process. Analysis of this data confirms that transboundary movement of PCBs from Massena is ongoing. An initiative to coordinate monitoring activities in this section of the St. Lawrence River has been supported by all agencies involved and plans are underway to begin discussions at an international workshop to be scheduled for February 1992 in Massena.

Human Health

Elevated levels of contaminants in the Great Lakes basin and the public and scientific concern about the associated effects on human health have motivated the Great Lakes Health Effects Program. A study of the effects on human health of consumption of contaminated in sport fish and wildlife has been designed by Health and Welfare Canada. The Cornwall area residents are no exception in their concern over human health and the relationships between consumption of fish and wildlife and human exposure to contaminants. Having consumption advisories on fish because of mercury and PCB contamination and being an area of high consumers of fish and wildlife, these residents may have a greater exposure to contaminants. Cornwall was chosen as one of two sites (Mississauga being the other) for a more detailed assessment of exposure to contaminants from the consumption of fish and wildlife. The study consists of two questionnaires in a mail-out package: The Great Lakes Basin Anglers Survey asks about fishing activities and consumption of sport fish from various Ontario locations and includes a few questions on health and lifestyle; the Fish and Waterfowl Consumption Survey for the Cornwall Area asks about consumption of fish and waterfowl from specific Cornwall area locations. A second stage of the study will collect information on the range and levels of contaminants found in humans consuming fish and wildlife from the Great Lakes basin by asking 100 volunteers to provide blood and hair samples and complete a more detailed dietary questionnaire.

The native people on the Akwesasne Reserve have been affected directly as a result of their concerns over human health and contaminant exposure through consuming fish and wildlife. Their subsistance lifestyle has been altered drastically and the Mohawk Councils have issued advisories to consume no fish from the St. Lawrence River of any size or species. Previous health studies have been inconclusive due to confounding factors, however, the Great Lakes Health Effects Program through the Assembly of First Nations are currently undertaking projects to address basin-wide and local native concerns.

Additional health concerns in the Cornwall area relate to the elevated incidence of: bladder cancer in men, pancreatic cancer in women; asthma and respiratory disease in men and; congenital anomalies. Although the incidences are statistically non-significant (Health & Welfare Canada, 1991), the possibility of disease trends that may be related to environmental contamination is suggested. Further study has been suggested and a recent updated report from the Eastern Ontario Health Unit is pending.

RAP Timetable

The approximate timetable for the St. Lawrence RAP is outlined below, with initiation and target completion dates given for major milestones.

Activity	Initiation-Target Completion Dates
Phase 1, Public Involvement Program	June-September 1988
Identification of Desired Use Goals	November 1988 - 4th quarter 1989
Identification of Remedial Options	2nd quarter 1990 - 2nd quarter 1991
Selection of Preferred Remedial Options	3rd quarter 1991 - 2nd quarter 1992
RAP (Stage 2) for Review	3rd quarter 1992 - 4th quarter 1992

Ongoing Studies

This document summarizes environmental conditions and identifies environmental problems in the Cornwall area of concern, based primarily on information and data collected prior to 1990. As the RAP progresses through Stage 2, this document will be supplemented with results of field work, analysis and the Public Involvement Program.

The following activities have been designed to support the development of remedial options. Results of these activities will also serve as a baseline against which to monitor the results of the implementation of remedial options.

1. Studies to further quantify contaminant loadings and transboundary movement in water and suspended sediment.

2. Surveys of sport fish, spottail shiners, waterfowl and mussels for contaminant analysis as well as the completion of an investigation of the physiological impact of contaminants on fish.

3. Additional studies of the environmental conditions of depositional zones in the Quebec waters of Lake St. Francis, including a variety of ecotoxicological studies.

4. Continuation of Phase 3 of the public involvement program which includes the review of a comprehensive set of remedial options for the river by the Cornwall Public Advisory Committee.

5. Monitoring of zebra mussels is underway to determine densities and distribution of this exotic species now present in the AOC.

6. Cornwall Waterfront sediment assessment to determine availability of contaminants to the biota and further define the need for sediment remediation.

7. Through the use of existing fish tainting threshold concentration data for Domtar's effluent, dispersion modelling and detailed review of Domtar's process and effluent treatment, the fish tainting issue will be further investigated in 1991.

8. A pilot fish and wildlife exposure study is underway in the Cornwall area in cooperation with Health and Welfare Canada's Great Lakes Health Effects Program. The local concerns on consumption rates and exposures will be addressed through questionnaires and hair and blood sampling for contaminants in volunteer participants. In addition about 140 personal interviews are being conducted by three local interviewers in the Lancaster area, near Cornwall. A separate project to address native concerns in the Great Lakes basin in also underway in cooperation with the Assembly of First Nations.

Comments from the Public Advisory Committee on the Stage I report were very thorough and provided the RAP team with useful insight into the concerns of the local community. Responses to the PAC on every individual comment were presented in written and verbal form. Changes/additions to the document as a result of their comments were included if the information was available. However, additional information to supplement the Stage I document is being collected and interpreted and will be presented in an addendum or included in the Stage II report. The major topic areas to be addressed in more detail include: shipping and industrial spill occurences and spill readiness, local and long-range air deposition of contaminants, up-to-date effluent loadings and a mass balance for the river, leachate and groundwater contamination and, the incidence and causes of fish tumours and tainting.

MISA

Environment Ontario is implementing a program called the Municipal-Industrial Strategy for Abatement (MISA), which will require, at a minimum, the application of Best Available Technology Economically Achievable by direct dischargers of effluent to the surface waters in Ontario. The goals of the MISA program is the virtual elimination of persistent toxic substances. Requirements for the pulp and paper (includes Domtar), organic chemicals (includes Courtaulds Fibres and Cornwall Chemicals), inorganic (ICI) and municipal (includes the Cornwall sewage treatment plant) sectors are currently being developed. The St. Lawrence River in the vicinity of Cornwall has also been selected as a MISA pilot project site. The goal of this study is to develop procedures for setting effluent requirements based on the more stringent option between Best Available Technology Economically Available and water quality based requirements.

MISA monitoring activities in the area of concern have been extensive. Recent data (post 1987-88) for municipal and industrial discharges is not yet available for most facilities in Cornwall with the exception of Domtar. The reports should be released in the coming months. Effluent data for the Domtar mill was issued by Environment Ontario in the summer of 1991 and subsequently in October. This information is not presented in this Stage I document because the report was in the final review stages at that time. All recent MISA monitoring information will be presented in a future addendum or included in the Stage II report.

MISA pilot site activities include the use of a model to simulate the hydrodynamics, dispersion characteristics and far-field transport of pollutants. This model is being applied for the entire width of the St. Lawrence River at Cornwall and will evaluate the water column dispersion pattern downstream of each of the point source discharges. Modelling the effects of point source discharges will aid in the selection of appropriate control options.

Impaired Uses

The St. Lawrence River in this area provides a wide array of beneficial uses, many of which are impaired to some degree. Table I outlines conditions for impaired use as outlined in Annex 2 of the Great Lakes Water Quality Agreement and their application to this area of concern. A summary of environmental conditions, problems and impaired uses is provided in Table 1-1 (see Summary of Environmental Conditions and Concerns).

Table I Conditions for Impaired Uses* and their Application to the St. Lawrence River at Cornwall-Lake St. Francis

CONDITION FOR IMPAIRED USE	APPLICATION TO ST. LAWRENCE RAP
1. Restrictions on fish and wildlife consumption	**Impaired.** In Lake St. Francis (from Glen Walter - Quebec Border) sport fish consumption is restricted: human consumption advisory for walleye (>45 cm), northern pike (>45 cm), white sucker (>45 cm), smallmouth bass (>35 cm) and black crappie (>15 cm) due to elevated mercury levels; sturgeon (>45 cm) and channel catfish (>30 cm) due to elevated PCB levels. In the North Channel i.e. Power Dam to Glen Walter: walleye (>35 cm), yellow Perch (>25 cm), northern pike (>45 cm). In the South Channel (Grasse River to Ile Jaune): walleye (>45 cm), northern pike (>45 cm), channel catfish (>55 cm), carp (>75 cm) and sturgeon (>45 cm). Children under 15 and women of child-bearing age are advised to eat only species which are fully unrestricted. Mohawk advisories restrict consumption of all fish species.
2. Tainting of fish and wildlife flavour	**Further study required.** Anecdotal evidence; previous reports of fish tainting may have been associated with Domtar effluent; Domtar study results; creel census survey of >900 anglers indicated no problem. 1990 survey inconclusive but is being reinvestigated in 1991.
3. Degradation of fish and wildlife populations	**Impaired.** Fish community probably shifted as a result of Seaway and dam construction. Impacts on sturgeon and walleye probable due to flooding of historical spawning areas. Exploitation (sport, commercial and subsistence) continues to be a major factor controlling fish population abundance. Information on other sport fish species does not include any recent changes in status of any significance (1984-1988) however data prior to 1984 are not available except for yellow perch. Perch populations have fluctuated since the mid-70s but no trend is apparent i.e. no significant increase or decrease in population size. Impact of recent zebra mussel invasion cannot be quantified at this early stage in the invasion. Incremental littoral zone habitat loss due to shoreline development activities is a problem. Impacts of contaminants on fish abundance is unknown. Waterfowl production has been reduced by wetland loss; impacts of contaminants unknown; use of the area by staging waterfowl is suspected to be down. Data on other wildlife species not available.
4. Fish tumours or other deformities	**Impaired.** Lip papillomas reported on white suckers; 1990 survey (preliminary) found liver tumours in walleye (close to 20% males, 50% females) and white suckers but no conclusions can be drawn from data prior to histopathological confirmation.
5. Bird or animal deformities or reproductive problems	**Further study required.** No impacts have been identified. The potential for such impairments exists given the levels of contaminants which are generally comparable to other areas in the Great Lakes where such impairments have been documented. The absence of colonies of nesting cormorants, gulls, and a substantial population of mink restrict study opportunities. Anecdotal evidence on the Akwesasne Reserve (New York) has been documented.
6. Degradation of benthos	**Impaired.** Benthic community structure impaired due to habitat restrictions; contaminant uptake documented, inorganic contaminant levels in sediments exceed Provincial Sediment Quality Guidelines to protect benthic community.
7. Restrictions on dredging	**Impaired.** Sediment contaminant levels (nutrients, oil and grease, metals and PCBs) in some areas exceed guidelines for open water disposal of dredged sediments.

(Table I cont'd)

Condition for Impaired Use	Application to St. Lawrence RAP
8. Eutrophication or undesirable algae	**Impaired.** Nutrient enriched conditions combine with low flows in nearshore areas of Lake St. Francis to produce algae and associated odours; algal growth on weed beds. Algal growth may be becoming more pronounced in some areas. Loss of emergent weed beds is a continuing problem. It is possible that a plant community shift is occurring with the exotic Eurasian milfoil being replaced by native species. Aquatic plant production is extensive due to combination of nutrient inputs and changes in system hydraulics due to Seaway/dam construction.
9. Restrictions on drinking water, or taste and odour problems	**Impaired.** No restrictions for the City of Cornwall; historic (early 1980s) taste and odour problems downstream of Cornwall caused by phenolic and other organic discharges from Domtar; additional treatment costs (for carbon filters) incurred for Glen Walter plant (1988) to protect against impact from transboundary movement of PCBs from Massena (and organics from Cornwall); potential impairment for private intakes where no treatment is employed.
10. Beach closings	**Impaired.** Several beach closures during 1986, 1988, and 1989; elevated bacteria levels downstream of Cornwall; No beach closures in Lake St. Francis, Quebec during 1987, 1988, 1989 or in Ontario during 1990, 1991.
11. Degradation of aesthetics	**Impaired.** Masses of uprooted aquatic weeds collect in embayments and create localized water quality, odour and aesthetic impairment and potential health hazard; odour of effluents in ambient water creates impairment.
12. Added costs to agriculture and industry	**Impaired.** Contaminant levels have adversely affected commercial fisheries by rendering some species unmarketable in some areas. Contaminant levels and general degradation of some sport fish species has probably adversely affected the local tourism industry.
13. Degradation of phytoplankton and zooplankton populations	**Further study required.** None documented, however; the healthy fish community is indicative of viable plankton community. Zebra mussel invasion may have major impact on plankton community.
14. Loss of fish and wildlife habitat	**Impaired.** Construction of the Seaway and dams had a major impact on fish and wildlife habitat in terms of physical alteration associated with dredging, change in habitat stability due to flooding and stabilization of water levels and stream channel morphometry have affected aquatic plant and wetland communities. Continual shoreline development has affected both wildlife and nearshore fish habitats.

* Impairment of beneficial use(s) means "a change in the chemical, physical or biological integrity of the Great Lakes System sufficient to cause any of the following": [14 conditions for impaired use] (Annex 2, Great Lakes Water Quality Agreement of 1978 as amended 1987).

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1.0 SUMMARY OF ENVIRONMENTAL CONDITIONS AND CONCERNS

The St. Lawrence Area of Concern (AOC) includes the waters from the Moses-Saunders power dam to the eastern outlet of Lake St. Francis. This includes waters shared by the United States, Canada, and the Mohawks at Akwesasne.

Three municipalities are located in the AOC, including: The City of Cornwall, and the muncipalities of Charlottenburg and Lancaster Township. Part of the Mohawk Community of Akwesasne is also located in the AOC. Each of these communities is dependent, to varying degrees, upon local industry, agriculture, commerce and tourism for employment.

The St. Lawrence River AOC provides a wide variety of industrial, municipal and recreational uses, including: boating, shipping, hydro-electric power generation, domestic and industrial water supplies, waste assimilation, sport and commercial fishing, hunting, nature appreciation, swimming and recreational water sports; however, many of these beneficial uses are impaired to some degree by contaminants. The primary contaminants of concern, i.e. those which cause negative effects locally and/or can be found at levels which exceed criteria or objectives established to protect human health, aquatic life or the beneficial uses of the water body, include polychlorinated biphenyls (PCBs) and mercury. Other contaminants of concern include: zinc, lead, chromium, polychlorinated dioxins and furans, polynuclear aromatic hydrocarbons (PAHs), phenols, and oils and grease. Many other organic chemicals and other metals can also be found in the AOC at low (trace) concentrations; however, dilution, media transfer and/or degradation of these contaminants is so great that there are no local or measureable effects. Causes of impairment other than chemical contamination include habitat loss, excessive growth of aquatic vegetation, and bacterial contamination.

Sources of these contaminants include: historic and ongoing point sources; non-point sources, including agricultural runoff, urban runoff, leachate from landfills, atmospheric emissions and upstream contaminant loadings; and transboundary sources from industrial facilities in Massena, New York.

The environmental impacts caused by these contaminants of concern, along with their sources, are summarized below and in Table 1-1.

HEAVY METALS AND TOXIC ORGANICS IN FISH AND WILDLIFE SPECIES

Fish

The two contaminants of concern in fish in the AOC are PCBs and mercury. Fish from Lake St. Francis contain higher concentrations of both chemicals, than fish upstream of the AOC, suggesting that the sources of contamination are either historical and/or ongoing local discharges including those from Massena, New York. Mercury levels are also higher in fish collected from the north channel of the St. Lawrence than elsewhere in the AOC. Conversely, PCB levels are higher in fish collected from the south channel (U.S. side) than they are elsewhere in the AOC.

Mercury is the major contaminant restricting consumption of most sport fish species, the only exceptions are yellow perch, bullhead and panfish. PCBs are responsible for consumption restrictions on sturgeon, channel catfish and most recently, walleye from the south channel of the St. Lawrence River and Lake St. Francis. PCBs in commercial and coarse fish species also exceed consumption guidelines, and result in the sporadic closure of commercial fisheries. Presently the carp and American eel fisheries are closed. PCB levels in young-of-the-year spottail shiners exceed the Great Lakes Water Quality Objective for the protection of fish and wildlife that consume the fish and increased dramatically in 1989 and 1990 at several sampling sites in the south channel.

Table 1-1 Summary of Environmental Problems and Sources

Environmental Problem	Current Conditions	Impaired Uses	Sources of Problem	Current Information Deficiencies
heavy metals and toxic organics in fish and wildlife species	contaminant levels exceed Health and Welfare Canada's consumption guidelines for mercury (0.5 ppm) and PCBs (2.0 ppm)	fish consumption by humans	Industrial Sources (ICI (formerly CIL), Courtaulds); sediments (mercury); Massena sources (PCBs); upstream loadings	
	PCB levels in young-of-the-year fish exceed the IJC guideline (0.1 ppm) for the protection of wildlife that consume fish	fish and wildlife health	Massena sources	
	PCB levels in waterfowl (local and staging) are high	waterfowl consumption	Massena sources	no health data available
fish population decline	historical impacts of Seaway and dams on whole fish community has resulted in some species declines (now stable)	fish reproduction and consumption	heavy fishing pressure, habitat loss (historically Seaway and dam construction; now shoreline development; zebra mussel impact expected in future)	
bacteria	bacterial densities exceed provincial requirements for safe swimming on occasion	swimming/body contact recreation	Domtar (*Klebsiella*), CSOs, cottage septic systems	study underway to determine concentration gradient and relative impacts of discharges
nuisance aquatic weed growth	Lake St. Francis has extensive beds of submergent and emergent aquatic vegetation; algal growth excessive in some summers	boating (nearshore access)	reduction in flow and velocity due primarily to Seaway & dam construction and continued nutrient inputs; algal growth probably due to climate conditions	
metals, oils & grease and toxic organics in sediments	sediments from some locations exceed provincial open water disposal guidelines; contaminant uptake documented in benthic invertebrates	open water disposal of sediments dredged for navigational purposes	historic and ongoing discharges and spills from municipal and industrial sources, spills from ships a potential source	significance of sediment contaminants to fish contamination
occasional unpleasant odour	localized unpleasant odours from effluents and decomposing uprooted aquatic weeds	aesthetics	Domtar effluent; storms and ship traffic uproot aquatic weeds	

The Mohawk Governments of Akwesasne also issued advisories in 1978 and again in 1986 to women of child bearing age, pregnant women and children under the age of 15 not to consume any fish species taken from the St. Lawrence River.

The impact of contaminants on the fish community has not been quantified, although PCB and mercury levels in fish do not appear to be high enough to cause direct chronic or acute lethal effects. Preliminary studies of liver tumour incidence rates in walleye and white suckers are under way, which show fairly high incidence rates (20% males, 50% females). In addition, lip papillomas were found on white suckers during a 1986 survey, and lesions on young-of-the-year fish were found in a 1987 survey; however, these reports could not be confirmed by additional sampling.

Wildlife

The levels of total chlordanes and PCBs in waterfowl collected in the AOC in 1988 exceeded Health and Welfare maximum residue limits in poultry. Metal analysis showed elevated levels (above other Great Lakes areas) of lead in breast muscle. While lead body burdens are not directly linked to biologically available lead, lead poisoning does occur and is of concern in this area. The major source of the lead, i.e. environmental versus lead shot, has not been determined.

Contaminants in other wildlife species have not been extensively studied; however, contaminants measured in three snapping turtles mirrored those found in waterfowl, but at levels substantially higher. The biological signficance of this data is unknown; however, both OMNR and the Mohawk Governments of Akwesasne have placed advisories against the consumption of turtles.

DEGRADATION OF FISH POPULATIONS

Historically, changes in the river brought on by the construction of the Beauharnois Dam (1930s) and the more recent construction of the St. Lawrence Seaway (late 1950's) impacted the fish community because of their effects on the physical habitat, water levels, and currents. Sturgeon, walleye, muskellunge and American eel were negatively affected, while yellow perch, bass and northern pike benefited from these changes. Despite continued heavy pressure from commercial, sport and subsistence fishing and habitat loss, the fish community appears to have reached some stability. The only exception is the sturgeon population, which has continued to decline considerably over the last several decades.

BACTERIA

Historically, the St. Lawrence River from the Thousand Islands to Cornwall, was bacterially contaminated primarily as a result of sewage from ships and communities along the river. Bacterial levels in the AOC more recently (1980's) often exceeded Provincial Water Quality Objectives until 1990, resulting in sporadic beach closings in the area. Fecal coliform densities in Domtar's pulp and paper mill effluent suggest that it is a major contributor, however speciation shows *Klebsiella pneumoniae* (not a human health concern) to be the dominant organism. Recent monitoring of the effluent has shown a decline in bacteria levels discharged due to operational changes. High fecal coliform densities in the vicinity of the Courtaulds Fibres/Courtaulds Film complex in 1982 indicated additional inputs from storm water or combined sewer overflows. Private shoreline septic systems downstream of Cornwall are also suspected sources of bacterial contamination. Upgrading of the Cornwall sewer system and expansion of Water Pollution Control Plant in 1988 has minimized the combined sewer overflow problem.

NUISANCE AQUATIC PLANTS

Lake St. Francis has extensive beds of submergent and emergent aquatic vegetation. The drastic reduction in velocity and increased sedimentation resulting from the construction of the St. Lawrence Seaway is believed to be the major contributing factor to the increased aquatic plant growth. The invasion of the exotic Eurasian milfoil and its subsequent expansion has also contributed to the proliferation of dense growth of aquatic vegetation.

Harvesting equipment is used by the Raisin Region Conservation Authority to harvest approximately 200 acres of aquatic vegetation each summer. Without the use of the harvesting equipment, access by small craft to and from marinas would be difficult. The accumulation of uprooted, decaying vegetation on the shores of Lake St. Francis has lead to localized, short-term impairment of water quality and aesthetic degradation, resulting in a loss of tourism and a drop in nearshore property values.

Lake St. Francis water quality also exceeds the Ontario phosphorus guidelines for the avoidance of nuisance algae in lake systems. As a result algal growth in the lake has been prolific in hot summers.

METALS AND TOXIC ORGANICS IN SEDIMENTS

Dredging

Dredging in the AOC is done to maintain the shipping channel through the Lancaster Bar in Lake St. Francis; however, concentrations of cadmium and chromium exceed Environment Ontario's open water dredging guidelines at this site. Environment Ontario's guidelines are also exceeded for chromium, copper, iron, nickel, mercury, lead and zinc at several sampling sites in both the north and south channels of the river. Except for iron, the mean values for all inorganic contaminants were higher in the north channel than the south.

Benthic Community

Provincial Sediment Quality Guidelines are set according to three levels of impact to the benthic community: (1) no-effect level; (2) lowest effect level; and (3) severe effect level. Within the AOC, zinc, lead, copper, chromium, nickel, arsenic, and cadmium all exceed the lowest effect level. Zinc, lead, mercury and copper samples taken near Courtaulds Fibres exceed the severe effect level.

Oils and greases also exceeded the Provincial dredging guidelines in 74% of samples collected in 1985 from the north shore and 33% of the samples from the south shore. The highest concentrations were present downstream of the Domtar/ICI/Cornwall Chemicals diffusers and around St. Regis Island. Benthic species richness at these sites were poor and only pollution tolerant species were common.

AESTHETICS

Aesthetic impacts in the AOC include: visual conditions, such as oily slicks, foams, scums, and floating debris; objectionable odour and/or taste of air and water; excessive aquatic weed growth; and objectionable colour and turbidity. These aesthetic impacts are caused by anthropogenic activities, such as spills and effluents, as well as naturally occurring phenomena such as algae blooms and microbiological activity.

A suspected aesthetic impact in the AOC is fish tainting. A 1986 fish survey detected several walleye with off-odours caught near the Domtar discharge; however a 1988 creel census showed no evidence of a tainting problem as determined from angler opinions of the taste of their catch. Results from a 1990 fish tainting survey were inconclusive. Differences in odour of indigenous perch collected upstream and downstream may be attributable to other factors and not Domtar's effluent. Further study is scheduled for 1991.

ZEBRA MUSSEL

An environmental problem which is likely to emerge in the next few years is the invasion of the zebra mussel. The first discovery of this species of mussel occured in late 1989 in the south channel of the St. Lawrence River and sampling in 1990 has confirmed mussel colonies at new locations in the south channel and on buoys in Lake St. Francis. No mussels have yet been found in the North Channel although their spread to this location is a certainty. Their prolific nature, feeding habits and colonization of hard substrates is likely to cause a major shift in the ecology of the AOC, and additional operating costs for local commerce and industry.

SOURCES

Point Sources

Prior to 1960, Ontario's industrial plants and municipalities did little to control the liquid waste discharges to the environment. There were no government agencies to develop and enforce pollution control policies, and few municipalities or companies had pollution control policies or strategies. As a result, BOD, suspended solids, mercury, zinc and sulphuric acid were discharged from local and upstream industries at concentrations far higher than today, with much of the contaminants remaining in sediments in the AOC.

Currently, there are three primary direct wastewater discharges into the St. Lawrence River at Cornwall: the Domtar Fine Papers and ICI (formerly CIL)/Cornwall Chemicals diffuser; the Courtaulds Fibres and Courtaulds Films (closed 1989) diffusers; and the City of Cornwall sewage treatment plant outfall. Marimac (closed 1990), a former direct discharger, was connected to the municipal sewer system in 1988.

Domtar

Domtar discharges the largest amount of effluent, which is relatively high in BOD_5 and suspended solids. The company has installed an additional clarifier to control spills within the plant. This clarifier has also served to improve the removal efficiency of suspended solids from Domtar's effluent. The soluble component of the effluent contains low concentrations of resin and fatty acids which can be toxic to fish if available at high enough concentrations and chlorinated and non-chlorinated phenolic compounds. A new Control Order has recently been served on Domtar. It requires the mill to control spills, BOD and adsorbable organic halogens (AOX, which is a measure of the concentration of chlorinated organic compounds) to at least a minimum standard set for all kraft pulp mills in Ontario.

ICI (formerly CIL)/Cornwall Chemicals

The effluent from ICI (formerly CIL) combines with the effluent from Cornwall Chemicals and discharges through a submerged diffuser which is shared with Domtar. ICI uses the mercury cell process to convert salt into sodium hydroxide and chlorine. Its liquid effluent is treated and concentrations of mercury meet the Federal Chlor-Alkali Regulation. The effluent has met this regulation for more than ten years.

Cornwall Chemicals produces inorganic and organic chemicals from the chlorine and sodium hydroxide produced at ICI. Its effluent is clarified prior to discharge but contains significant quantities of carbon tetrachloride and chloroform. The company has recently taken steps to reduce levels of these chemicals in its effluent.

Courtaulds Fibres/Courtaulds Films (closed 1989)

The Courtaulds Fibres and Courtaulds Films liquid process effluents are discharged through two diffusers - one acidic and the other alkaline. These effluents are characterized by extremes in pH, high BOD_5 and low suspended solids. The acidic effluent also contains high concentrations of zinc, to which elevated levels in sediments and biota have been attributed. Environment Ontario's toxicity studies in 1984 found Courtaulds' effluent extremely lethal to fish (LC_{50} normally between 2 and 10 percent), however, no in-stream zone of toxicity could be confirmed with sampling, due to dilution by the large volume of river water.

Non-point Sources

Non-Point sources of contaminants to the AOC includes: upstream inputs from the Great Lakes Basin and the upper St. Lawrence River; the Raisin River, which drains the largely agricultural area between Cornwall and Lancaster; urban runoff from the City of Cornwall; four active waste disposal sites (three municipally operated sanitary landfill sites located in Cornwall and Charlottenburg, and Domtar's waste disposal site); two closed waste disposal sites (the Old City of Cornwall landfill site, Courtaulds Fibres industrial waste disposal site); and atmospheric emissions, both from local Cornwall industry and from Massena, New York. Contaminants contributed from these sites are considered to be relatively minor. The type of contaminants vary, but in general include one or any combination of the following: nutrients, bacteria, inorganic and organic contaminants.

TRANSBOUNDARY SOURCES

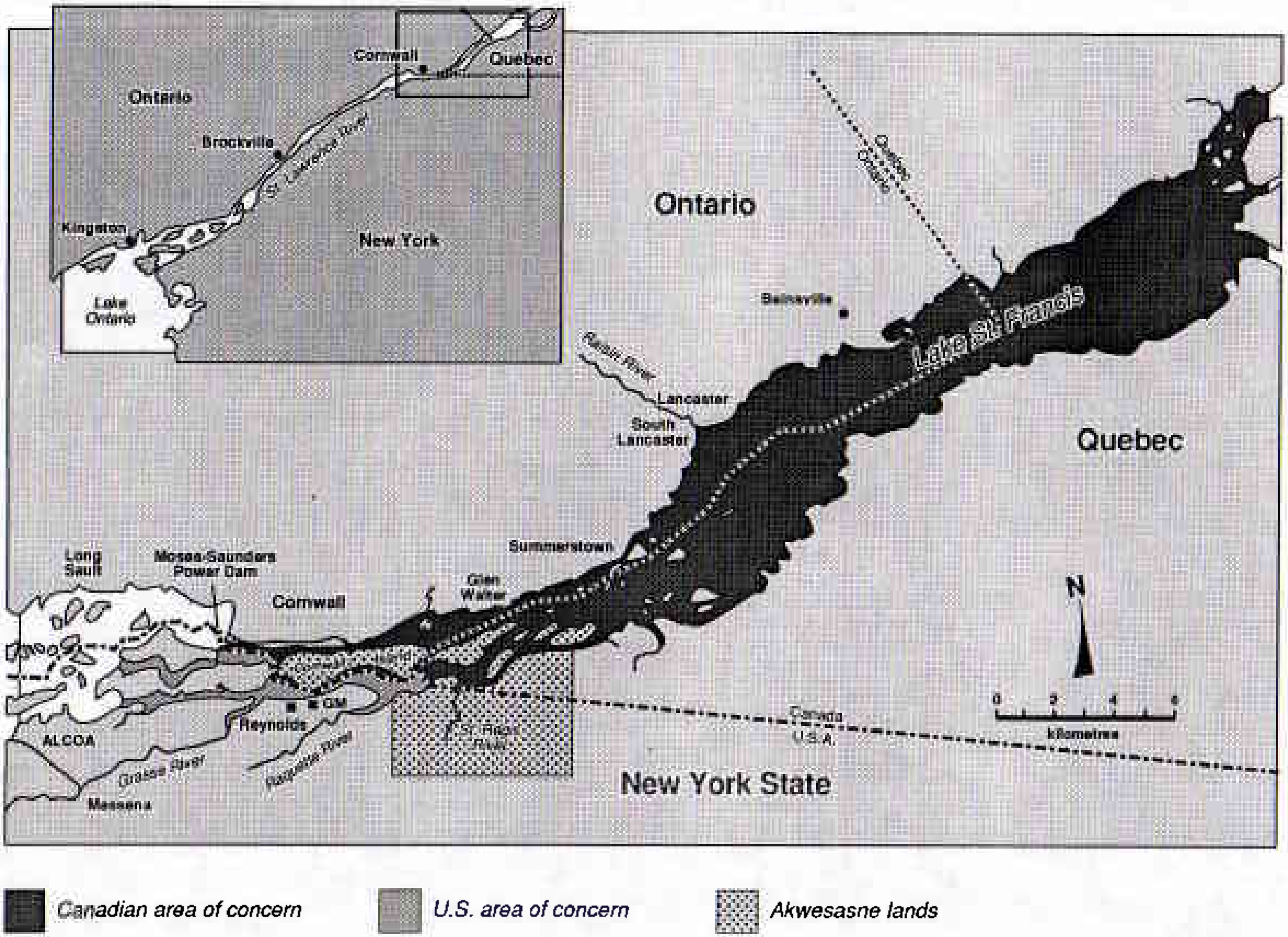
With the exception of potential impacts on migratory fish populations, pollutants originating from Cornwall sources do not have transboundary effects in New York State waters, due to the prevailing flow regime around Cornwall and St. Regis Islands; however, the Cornwall sources do impact on the Quebec waters of Lake St. Francis and downstream.

More than 25 studies that have been conducted in the Massena area by both U.S. and Canadian agencies since 1979 indicate that ALCOA, General Motors Central Foundry and Reynolds Metals have been and continue to be the largest source of PCB's to the St. Lawrence River between Lake Ontario and the Quebec border. Furthermore, these studies strongly suggest that PCBs are actively transported from Massena to depositional areas within Canada. Reynolds and ALCOA are known to be the major atmospheric dischargers of Polyaromatic Hydrocarbons (PAHs). Dioxins and furans exist on the Reynolds property, which borders the St. Lawrence River. Reynolds also emits fluoride to the atmosphere; however, the impact of the fluoride on the aquatic environment is expected to be negligible.

Contaminated sediments in the Grasse River and the St. Lawrence River adjacent to the industrial properties are subject to federal clean-up activities. EPA has designated a section of the river as a SUPERFUND site and other areas are subject to a 106 Order for remediation. Primary concerns are PCBs and PAHs in sediments, their potential to bioaccumulate in the aquatic ecosystem and resuspension both at present, because of wind, wave and shipping effects and also, during clean-up activities scheduled to begin in 1992.

Figure 2-1

ST. LAWRENCE AREA OF CONCERN



2.0 SOCIO-ECONOMIC PERSPECTIVE

2.1 Description and Geographic Extent

This document deals primarily with impacts and sources on the Canadian portion of the St. Lawrence River area of concern. The Canadian area of concern extends from the Moses-Saunders Power Dam in the west to the outlet of Lake St. Francis in the east (Figure 2-1). Although there are no direct discharges of contaminants into Lake St. Francis, it has been impacted by Cornwall sources and is thus addressed in the RAP. The Remedial Action Plan also includes the Ontario tributaries of this portion of the St. Lawrence River with respect to their role as sources to the area of concern. The largest of these, the Raisin River Watershed (Figure 2-1), discharges into the St. Lawrence River at Lancaster.

This chapter summarizes the demography and geography, social patterns, and wealth on the Ontario north shore of the St. Lawrence River including Lake St. Francis. The four municipalities represented in this outline include the city of Cornwall and Charlottenburg, Lancaster Village and Lancaster Township. Information sources for this section include personal communications (as identified below for each municipality), public information booklets published by the City of Cornwall and Revenue Canada (1988).

The area is in the eastern-most tip of the Province of Ontario and, in the east, borders the Province of Quebec. To the south, beyond Lake St. Francis, is again the Province of Quebec, the lands of the Mohawk People and New York State.

2.2 The Municipalities

2.2.1 Cornwall

Cornwall is located on the north shore of the St. Lawrence River at the western edge of the area of concern. It lies approximately 110 km upstream of Montreal, Quebec and 120 km southeast of Ottawa, Ontario. It is the home of several major industries (Section 4.0) and the seat of the Three United Counties (Stormont, Dundas, and Glengarry). Situated on the north end of the International Bridge to the United States of America, the city of Cornwall is the immediate northern neighbour of the Mohawks of Akwesasne. The Mohawks are an integral part of the social fabric of this part of eastern Ontario.

Having a total land area of 3,367 hectares, the municipality has a population of about 53,405 (Statistics Canada, 1986). The adult population is about 34,500 of whom approximately 7,000 are above pension age. The child (under twenty years) population numbers about 12,000.Information on the City of Cornwall has been drawn from the Cornwall Data Book, 1988; City of Cornwall Community Profile; Cornwall Parks and Recreation 1988/1989 Annual Activity Guide; and the Cornwall Chamber of Commerce Business and Industrial Guide.

The People and Their Economics

Although the population is largely English or French, close to 12 percent of the population have other ethnic origins. Cornwall can therefore be loosely described as multicultural. However, close to 40 percent of the population has a bilingual capability in English and French.

Of the 34,000 people of working age (15-64 years), as of the 1986 census, a little over 26,000 were in the labour force. This indicates a 9.9 percent rate of unemployment which is above the provincial average. The percentage of self-employed persons in Cornwall is below that of the province as a whole. More than 30 percent of the households in Cornwall have an annual income of less than $15,000.00 and the average weekly earnings, in Cornwall, have been consistently below the national average over the last decade. In fact, the average household income is $8,861.00 below the provincial average of $38,733.00.

Wages in the manufacturing sector tend to be in line with the provincial figures, however, incomes in Cornwall tend to be lower than the national average. This trend of low incomes in Cornwall may be due to the high incidence of minimum wage operations combined with above average numbers of part-time jobs. The city of Cornwall is, according to Revenue Canada (1988), ranked as the 99th poorest city in Canada. Only 66 percent of private dwellings are owned by the occupants which is 7 percent lower than the provincial average.

Industry

The city of Cornwall is considered to have a highly industrialized base with about 7,000 persons employed in manufacturing and related industries. Traditionally, the city's major industry has focused on the production of fine papers, textile and chemical products. However, there has been a recent diversification of considerable magnitude in the local manufacturing base.

There are currently 94 firms located in the city, producing a wide range of goods and materials for both local and external markets.

As means to attract and regulate viable industrial growth, the city of Cornwall maintains a large, fully serviced industrial park. Located in the east end of the city, the part has direct access to both Highways 401 and 2, is 3.2 km from Cornwall Harbour, 4.8 km from the International Bridge and has adjacent access to the C.N.R. mainline.

A comprehensive range of industrial uses is allowed and the entire park is provided with municipal water and sewer services, paved roads, fire hydrants, natural gas and heavy service hydro power.

Parks and Waterfront Recreation

The city of Cornwall has two waterfront parts, Guindon and Lamoureux. At the east end of Lamoureux Park is Marina 200 which is a municipally owned facility.

2.2.2 The Municipality of Charlottenburg

The Municipality of Charlottenburg, in the county of Glengarry, is the immediate eastern neighbour of the city of Cornwall. The southern boundary of the Township is the north shore of Lake St. Francis. The north western edge of Charlottenburg adjoins the suburban/rural municipality of Cornwall Township. To the west is the Village of Lancaster and Lancaster Township.

Information for this section has been provided through personal communications with Mr. M. Lapierre (Clerk-Treasurer), Mr. R. P. Stanton (Planner/Chief Building Official) and Mr. B. Daigle (Recreation Director).

The People and Their Economics

Having a total land area of 32,388 hectares, the Township has a population of 7,008 (1988 figures). It is the largest township in the Three United Counties, in terms of both population and land area. Over the last five years there has been a total population growth of 8.15 percent.

Population breakdown shows 1,140 children under ten years, 1,068 youths between ten and twenty years, 498 young adults between twenty and thirty five years, 2,855 adults between thirty five and sixty five years, and 698 senior citizens over sixty years.

On an economic level the people of Charlottenburg have been even more affected by the history of unemployment, which has adversely restricted the entire area.

The population of the municipality is dispersed into two large villages; Martintown and the historic Williamstown. There are also several smaller villages and communities along, or close to, the banks of Lake St. Francis. There are also several small rural communities.

The people of Charlottenburg tend to find their employment opportunities in the city of Cornwall although some commute to Montreal which is only a matter of approximately one hour by road. There is some employment found within the Township where industrial growth is beginning to occur.

Charlottenburg Township was one of the first in Ontario to be home to European settlers. Among the celebrated figures of Canadian history who were residents of this Township were Simon Fraser, David Thompson and Alexander McKenzie. The whole municipality is steeped in history. This was the settling place of Sir John Johnson and his band of United Empire Loyalists. The village of Williamstown was named for the father of Sir John Johnson.

The village of Williamstown, seat of the municipality, is also the home of the oldest Agricultural Fair in Ontario and one of the oldest in Canada.

Commerce and Industry

Commercial development might best be described as sparse, being limited to scattered shopping facilities throughout the entire Township.

As previously noted there is a growing industrial element in the Township although there is no industrial part as such. The only area in the municipality that could even remotely be considered as a Municipal Industrial Park, is the Richmond Road site. The Township owns approximately 130 acres of land, which has a potential for development. The potential for developing these lands, however, is severely restrained due to poor access and drainage. There is a need for major infrastructure improvement of road construction and servicing.

Furthermore, there is an additional 80 acres adjacent to the Township land that does not have drainage constraints. However, this acreage is in private ownership and also requires extensive infrastructural improvements. The municipality does not have the fiscal capability to undertake the infrastructural improvements necessary to convert these 210 acres into a Municipal Industrial Park.

A study of industrial development opportunities was recently undertaken. Within the Township, in 1987, there were two large to medium sized enterprises employing 100 to 125 persons, four medium sized firms employing 20 to 55 persons while the remaining firms employed 10 or fewer persons.

The land use survey identified 34 industrial firms. These include not only the more typical industrial enterprises such as manufacturing or metal fabrication, but also service-related activities such as long-distance trucking, tourism-related activities including marinas and boat repair services. Also in this category were small scale service industries such as welding establishments and contracting firms.

Other fairly extensive tracts of land have been designated for industrial or commercial related uses in the official plan of Charlottenburg. All of this land is in private ownership. No assessment of the number of vacant lots or size of each parcel has been undertaken. There is a brand new multi-tenant general industrial structure, approximately half of which is presently occupied.

Parks and Waterfront Recreation

Along the north shore of Lake St. Francis, in the municipality, there are seven privately owned marinas catering to large numbers of avid water-sports enthusiasts.

In Martintown is the Raisin Region Conservation Authority, responsible for the Raisin River which drains through the centre of the Township to Lake St. Francis.

Park areas include: the 107 acre Raisin Region Conservation Authority Marina and Conservation Area Complex; the Raisin River Provincial Park which consists of 84 acres of land along the Raisin River; Cooper Marsh Conservation Park including 361 acres of the Charlottenburg Marsh which is the largest underdeveloped area of natural wetland on the north shore of Lake St. Frances; and Charlottenburg Provincial Park.

2.2.3 The Municipality of Lancaster Township

Lancaster Township covers the area from its western boundaries with Charlottenburg Township and the village of Lancaster, through to the Ontario/Quebec Provincial border. The boundary to the south is the shoreline of Lake St. Francis.

Information for this section has been provided through personal communications with Mrs. Lebrun (Clerk-Treasurer, Village of Lancaster) and Mr. M. J. Samson (Clerk, Municipality of Lancaster Township).

The People and Their Economics

Lancaster Township has a land area of 25,036 hectares and a population of 3,360. This is a municipality which might be considered lean on population and tax base.

The economic base for the people of this rural municipality has fluctuated. The farming the farming community tends to be well established, in both dairy and corn production, however, the people of the villages in Lancaster Township have not fared well economically, being relatively far from the cities of Cornwall and Montreal.

Commerce and Industry

Commercial development follows a scatter pattern throughout the municipality consistent with rural settings.

A sense of the employment opportunities afforded the people of Lancaster Township will be seen in the sparse commercial and industrial development that has taken place in the municipality. At this time there are approximately thirty small industries and businesses, which would employ from two to ten people, in fact, of the 135 job opportunities available in the municipality, 40 jobs exist only because of two truck stops and service stations on Highway 401 which passes through the southern part of the Township.

The largest employer in Lancaster Township is Glengarry Aggregates employing 40 people. The Township does not have a Municipal Industrial Park.

Parks and Waterfront Recreation

Glengarry Park, a Provincial Park, alongside Lake St. Francis, together with privately owned Lancaster Trailer/Camping Park and a KOA facility at Bainsville, make up the parks in the Township. There is a privately owned marina at Bainsville, on Sutherland Creek, which is a tributary of the St. Lawrence River. This marina is close to the mouth of Sutherland Creek.

2.3 Akwesasne Mohawk Community

Akwesasne lies within the provinces of Quebec and Ontario as well as New York State. The Mohawk lands encompass several islands including Cornwall, Pilon, Coloquhoun, Yellow and Ile Saint-Regis as well as portions of the south shore of the St. Lawrence River. The people are governed by the Mohawk Council of Akwesasne.

Population

The present population of Akwesasne is approximately 6,000 registered on the "Canadian" membership roles and 4,200 on the "American" membership roles. Another 400 are not registered on either roles but consider themselves Mohawk Nation citizens. The total population is approximately 10,600.

The Mohawk people of Akwesasne are registered as Native peoples in both Canada and the United States. Approximately 34% of the population is absent from the community at any one time. They will be working and living in the surrounding area and all over the world. The growth rate of the population averages about 2% per year. The growth rate and the returning elderly has a serious effect on the social services.

Language

Approximately 70% of the Akwesasne's residents speak Mohawk as a first language and English second. Many of the elders speak only Mohawk. The Mohawk language is taught throughout the school system from kindergarten to high school.

Community Services

Community water systems take their water from the St. Lawrence River near the village of St. Regis. Only the village of St. regis and the American portion of the community are on a treated water system. Most of the other people in the community depend on wells.

The village of St. Regis has the only sewage treatment facility. The rest of the community depends upon septic systems to dispose of human waste.

Electricity is supplied by the St. Lawrence Power Company for Cornwall Island, Quebec Hydro for the Snye and St. Regis Village, and Niagara Mohawk for the United States.

Solid waste from the Canadian portion of the community goes to the Massena landfill site, while the American portion dumps in the Town of Bombay landfill site. A solid waste recycling plan is being prepared for implementation. Two abandoned landfill sites, one on Cornwall Island and one in the Snye are being capped and closed.

The Mohawk Governments of Akwesasne maintain their own education systems. Three school systems provide a "Canadian", "American" and a traditional education experience.

Police services are provided for the Canadian portion of the community. Fire protection services are provided by a volunteer fire department.

3.0 THE MOHAWK PERSPECTIVE

As Prepared by The Mohawk Community of Akwesasne

Introduction

A thousand years ago, the Great Lakes Basin and the St. Lawrence River System were home to many Native Nations. Each of these nations living within the context of their territories, each of these nations having a different perception of the whole, but all of them honouring the earth as their mother. This single over riding principle of family, was the power of these nations. All people, animals, plants and things had a place in the process of life. The spirits of the earth, sky and waters talk with all life and shared the beauty of the Creator's purpose. The native people formulated governments, religions and cultures which respect this whole and tried to preserve the dignity of all. Many centuries were needed to develop the complex co-operative world view, so that it was present in every aspect of human life.

Within the Great Lakes Basin and St. Lawrence River System, there are some 350,000 Canada/USA federally recognized native people and approximately 7,000,000 acres of Canada/USA federally recognized native lands. These lands are found in the most crucial areas of the system. Most of the connecting channels have associated native territories, and much of the Canadian shoreline is dotted with native communities. These native communities have special legal, cultural and political powers recognized by the governments of Canada and the United States.

Historical Review

The St. Lawrence River was called "Kaniataraowaneneh" which means "the majestic and magnificent river", by the Mohawk people of Akwesasne. The river has been a provider of fish, wildlife and other resource stocks. It has been the road which our people have travelled for trade with other nations and acted as a defence moat in times of war. The bounty of the river has made possible the growth of Akwesasne as a community of Mohawk Indians.

Archaeological evidence has shown a thriving population of Iroquoian peoples occupied this area for some 5000 years. Conflicts with the Huron and Algonquin Nations, strengthened the resolve of the Mohawk people to remain in this resource rich area. The remains of cornfields, longhouses and other structures can be found on the islands and mainland of the territory.

The earliest record of a Mohawk settlement in Akwesasne is 1746. The Jesuit priests of Montreal with a group of Mohawks from Kahnawake came down the river to establish a mission. At the present village of St. Regis, they were met by a group of Mohawk people who were occupying the current site. These two groups merged to form the present day Akwesasne community. A church was established and built in 1753.

In the 1800s after the war of 1812, the border between Canada and the united States was established. The border cut straight through the Mohawk Community of Akwesasne. This split the community into a "Canadian portion" and "American portion". By 1867 and the formation of the Dominion of Canada, border problems had begun to disrupt the Mohawk Nation Council of Chiefs. In the early 1900s, the St. Regis Band Council was established by the Canadian government, the St. Regis Mohawk Tribal Council was established by the United States government, but the Mohawk Nation Council of Chiefs was still the sovereign Council of the Mohawks. The complexity of the governments formed has made it almost impossible for the Mohawk people to mount a single co-ordination effort except in the environmental issues.

In 1834, the Mohawk Nation Council of Chiefs and their allies within the Seven Nations Treaty, called on Great Britain to stop the destruction of the St. Lawrence River due to the construction of the Beauharnois Barge structure near Valleyfield, Quebec. The Mohawk Nation Chiefs explained that the construction of these structures would cause the water levels to be affected upstream in the territories of Akwesasne. Marsh meadows used for agriculture and livestock would be affected, fishing grounds and spawning beds would decrease the fish stocks in the river. The officials of the British Governments believed that the compensation in the form of money was the only goal of the Mohawk Chiefs. The Mohawk Chiefs in several meetings made it clear that they were worried about the river's destruction. The British Government paid compensation to the Mohawk Chiefs for their losses, doing nothing about the river's destruction.

In 1949, the greatest engineering feat was about to be started, the construction of the St. Lawrence Seaway was to open up the starving markets and ports on the Great Lakes and increase the wealth of the whole region. The St. Lawrence Seaway was seen as the centre piece for this start. Problems great and small were swept aside in the maddening drive to complete the project. The Mohawk Chiefs of Akwesasne, however, saw their small lands being destroyed by earth movers. Their fields polluted by river dredging and their wetlands destroyed. Treaties and agreements which protected their place in Canada and the United States were being set aside by these governments in their insane haste to finish the Seaway. By 1959, the St. Lawrence Seaway was finished, the Mohawk lands at Akwesasne looked like a battle zone. Raw earth scars blemished the shorelines of the islands and the mainland. Vast spoils areas grew no vegetation. Spawning beds and wetlands were destroyed, and governmental indifference ignored calls by the Mohawk Nation Chiefs. To add injury to insult, the Canada and the united States governments wanted to charge a toll to the Mohawk people to help the governments pay for construction of the St. Lawrence Seaway.

By the 1970s however, another problem began to manifest itself. The construction of the St. Lawrence Seaway and associated power dams greatly increased the potential for industrialization. Existing industries increased their size and production and new industries moved into the area. This industrial expansion increased the flow of contaminants into the air, water and lands of the surrounding area. The people of Akwesasne who depended upon the natural resources of the area now found these resources contaminated and dangerous to their health and livelihood.

The vast array of contaminants and governmental indifference led the leaders of the Mohawk Council to start the St. Regis Environmental Division in 1976. This division was to protect and enhance the natural environmental of the community of Akwesasne and to act as an information, research and remedial facility to improve the environment as well as informing the Mohawk community concerning environmental issues. It was also to supply expertise and support to other native and non-native nations. These far reaching aims have been and are still the goals of the Environmental Division. The St. Regis Environmental Division was the first environmental division of its kind in both Canada and the United States. The St. Regis Mohawk Tribal Council established their Akwesasne Environmental Health Division in 1985 in response to the General Motors toxic waste site. The Mohawk people have also formed a public oversight and advisory group called Mohawks Agree on Safe Health (MASH).

Mohawk Governments of Akwesasne

Akwesasne, the traditional name meaning "Land Where the Partridge Drums" is a Mohawk territory which is situated on the shores of the St. Lawrence River and its territories are in Canada and the United States. The territory straddles the international border at the junction of Quebec, Ontario and New York State. The towns and cities in the immediate area are: Massena, New York to the west, Cornwall, Ontario to the north, and Huntington, Quebec to the east.

Presently, the territory of Akwesasne is governed by three Mohawk governments.

a. The Mohawk Nation Council of Chiefs.
   This Council is the historical and active government of all Mohawk citizens, comprised of nine life term chiefs and nine clan mothers. The Mohawk

Nation Council is responsible to a larger alliance called the Six Nations Confederacy (Iroquois Confederacy) which meets regularly at the Grand Council Fire in Onandaga near Syracuse, N.Y.. The Great Law of Peace is the ruling constitution of the confederacy and its member Nations.

b. The Mohawk Council of Akwesasne.
This council is a community government within the territory of Akwesasne. It is an elective council voted in every three years by the resident voting population of the "Canadian portion of the Mohawk territory". It is comprised of twelve (12) Chiefs, four chiefs from each of three electoral districts: Snye, Cornwall Island and St. Regis Village. A Grand Chief of the Council is elected by a simple majority from all electoral districts and acts as a chairperson to the Council for a three year term. It provides, through Indian and Northern Affairs Canada, various public service functions to meet the civil needs of the community (ie. Education, Health, Environment, Welfare, Land & Estates and Membership). The Mohawk Council of Akwesasne is recognized by the Canadian government as having special aboriginal rights according the Canadian constitution, Indian Act and various other acts passed by the Canadian government.

c. The St. Regis Mohawk Tribal Council.
This council is another community government within the territory of Akwesasne. There are three elected chiefs and three elected sub-chiefs each with a term of three years. The terms, however, are not served concurrently. The chiefs and sub-chiefs are elected from the electoral rolls kept for the "American portion of the Mohawk territory". It provides, through the United States Federal government and the Bureau of Indian Affairs, various public and civil services (ie. Education, Health, Land & Estates, Membership). The St. Regis Mohawk Tribal Council is recognized by the American government as having special rights and privileges according to the Clean Water, Clean Air and various other acts and laws.

Akwesasne Environmental Taskforce

These three governments work in co-operation from time to time on various issues. The Mohawk Governments of Akwesasne believe that the environment is one such issue. Through the Akwesasne Environmental Taskforce, the Mohawk Governments of Akwesasne are able to monitor and participate in all environmental activities within our territory. The Akwesasne Environmental Taskforce is composed of the environmental chiefs of the Mohawk governments, all Mohawk government environmental directors and technicians, plus representatives of Mohawks Agree on Safe Health and various non-native advisory groups.

St. Lawrence River Remedial Action Plan

The Mohawk Governments of Akwesasne in late 1987 and early 1988 began discussions with the United States, Canada, Quebec, Ontario, and New York State concerning the Mohawk governments involvement with the St. Lawrence River Remedial Action Plan for the Cornwall/Massena Area of Concern. On February 23, 1988, all the governments agreed that:

1. The Mohawk Governments of Akwesasne support the concept of an international remedial action plan for the Cornwall/Massena Area of Concern.

2. The Mohawk Governments of Akwesasne will participate directly in the preparation of the Remedial Action Plan. Personnel from the Councils will be mandated to fulfil this function to the State and Provincial governments,

3. The Mohawk Governments of Akwesasne will provide out expertise and information to the St. Lawrence River Remedial Action Plan on a reciprocal basis with the governments involved in the plan.

4. The Mohawk Governments of Akwesasne propose that the governments of Canada and the United States fund the activities of the Mohawk governments in support of the Remedial Action Plan.

5. The Mohawk Governments of Akwesasne will prepare for submission and approval as part of the St. Lawrence River Remedial Action Plan a Mohawk philosophical perspective of the St. Lawrence River.

6. The Mohawk Governments of Akwesasne will participate in the evaluation and implementation phase of the Remedial Action Plan.

The Mohawk Governments of Akwesasne and the other governments have been working diligently to fulfil the agreement.

4.0 THE PUBLIC INVOLVEMENT PROGRAM

4.1 Introduction

Input from the public is essential to the development of both the Canadian and American RAPs. The GLWQA recognizes this by requiring that the RAP process include citizen involvement: "The parties in cooperation with state and provincial governments shall ensure that the public is consulted in all actions pursuant to this Annex" (GLWQA, 1987).

Development of the RAP has two major components: technical information compilation and public participation. Public participation is an important and necessary component as it serves to inform the public, improve the plan by gaining information and advice from the public, gain support for plan implementation and provide a mechanism for accountability to the public. Public participation activities to date can be described by two phases:(1) public information and (2) the establishment of a Public Advisory Committee (PAC).

The various tools that have been used to communicate with the general public have included: brochures, newsletters, fact sheets, slide shows, newspaper inserts, articles in the local media, press releases, displays, open houses, public meetings/workshops and other public outreach activities and services such as dedicated telephone information lines and a RAP Resource Centre for Cornwall.

To establish the advisory committees, the lead agencies drew representatives from an array of community sectors including agriculture, education, elected and appointed government officials, environmental groups, industry, local municipal governments, native people, resident's groups, sport clubs and private citizens. These include both organizations that do and do not have an economic interest.

A citizen's group called the St. Lawrence River Restoration Council was formed in May 1989, and is comprised of members from the Cornwall PAC, the Massena CAC and the Mohawks Agree on Safe Health (MASH) group. Each of the above named organizations appointed four members to the Council. The Council is supported by these groups as a forum for information exchange.

The public has played a critical role in shaping the process and products of the RAP. They have mobilized community awareness and support, highlighted issues, contributed information, and added a great deal of individual and collective energy to the project.

4.2 Public Information

The goal of Phase 1 activities is "To inform and educate the public about the Remedial Action Plan Process, the existing environmental conditions and identify interested stakeholders".

During the period of the contract the major public involvement activities consisted of:

- Preparation and distribution of communications materials;
- Presentation of an Open House;
- Development of a St. Lawrence RAP mailing list; and
- Stakeholder presentations by RAP Team Members.

The communications materials consisted of two types: general information and media materials. The general information materials included a bilingual 4 panel brochure, a 20 minute slide show with speaker notes, and a portable, bilingual 4 panel display unit.

The above listed materials were complemented by a series of Fact Sheets and a Background Report on environmental conditions in the study area which had been previously prepared by the RAP Team.

Media materials included a newspaper advertisement, French and English newspaper inserts, a journalistically written article suitable for insertion in local community newspapers, a press release, and a media resource kit.

A St. Lawrence RAP logo was developed together with a graphic "family design" for newsletters, fact sheets, letterhead etc. A dedicated RAP telephone line was installed at Environment Ontario's Cornwall office and advertised in the above materials.

Public exposure to the St. Lawrence RAP process has been extensive within the study area. It included:

- 30,000 copies (English) and 1,100 copies (French) of the newspaper inserts distributed to area households. The inserts provided a brief overview of the RAP and announced the first RAP Open House. A "tear-off" coupon was also provided for those desiring additional information or wanting to be included in the RAP mailing list. The advertising inserts proved to be a highly effective means of advertising the Open House. In addition, approximately 120 persons returned the "tear-off" coupons.

- Fact Sheets have been distributed through the Open House and information packages mailed to those persons who returned the "tear-off" coupons.

- Newsletters have been distributed through mailing lists, the Cornwall Environment Resource Centre, mall displays, various local trade and sportsman shows.

- The portable display panels featuring both bilingual information and take-home materials were set up in local high traffic areas from July 1 to August 31, 1988. The portable display panels have also been successfully used by the Public Advisory Committee (PAC) in similar settings.

- Local newspapers have provided excellent coverage through numerous articles including an environmental supplement during Environment Week.

- The local radio station has provided excellent coverage of the RAP process and Public Advisory Committee (PAC) Meetings including taped interviews of RAP Team Members and the Chairman of the PAC.

The Open Houses and Displays in High Traffic Areas

The two RAP Open Houses and the displays in high traffic areas, held to date, have proved to be fairly good forums for contact with the general public. Completed Feedback Forms conveyed the views and concerns of a large proportion of those attending the Open Houses.

St. Lawrence RAP Mailing List

A computerized mailing list is now in place and it consists of:

- A master list containing all the records, listed in alphabetic order, by surname.

- A stakeholder listing, which presents the names of all individuals and organizations/firms identified as having a direct interest in the RAP. This is a subset of the Master list and is also presented in alphabetical order, by surname.

- A list of all Quebec records.

- A list of all U.S. records.

4.3 The Public Advisory Committee

A Public Advisory Committee (PAC) was formed and held its first meeting in November of 1988. Since that time there has been a meeting held on the third Tuesday of every month.

The PAC consists of more than forty members and the average attendance at meetings has been about half with mainly the same participants attending. Additionally, there tends to be an equal number of persons attending as observers, including participants in the Massena RAP.

Initially the PAC elected an interim Chairman for a period of three months. At the end of the three month period the Chairman was confirmed to his position for the duration of the RAP.

Since its formation, the PAC has elected a permanent chairman, worked with Environment Canada in hiring an executive assistant and public involvement program facilitator, established sub-committees, approved joint statements and established communication mechanisms with New York, the Mohawk people and Quebec, adopted use and source goals, carried out a public outreach program, and responded to a number of environmental issues and community concerns.

The PAC has initiated the formation of four subcommittees: Goals, Public Outreach, Technical and Remedial Options. In addition a Steering Committee consisting of the PAC Executive and RAP Team member exists to set the direction for the PAC.

The Public Outreach Subcommittee develops and implements both independent and joint projects with the RAP Team in support of the RAP public involvement program. It has effectively played the key role in creating and utilizing new public outreach mechanisms to inform, involve and get feedback from the local community in the RAP. Activities have included organizing and staffing displays at local malls and trade and sportsman's shows, making presentations to interested groups and clubs, investigating funding programs, and generally monitoring the pulse of the community. Of particular interest to this committee has been involving both elementary and secondary students in RAP activities. One of the major accomplishments of the PAC, through the Public Outreach Subcommittee, was the June 1990 opening of a St. Lawrence River Resource Centre in downtown Cornwall, through a federal grant. The centre has full time staff, provides information on the river and the RAP to the community, and provides office space for PAC activities.

The Goals Subcommittee developed the PAC goals, which are the cornerstone of the PAC's agenda and the development of the Stage 2 report. The committee led the PAC discussion on amendments to the goals and their final adoption, after which this committee was disbanded.

The Technical Subcommittee reviews and provides feedback on technical information prepared by the RAP Team or other agencies, for the PAC. A major review carried out on the RAP Stage 1 draft report generated an extensive list of comments for the RAP Team. In particular, concern expressed that the following areas were not adequately addressed: impacts from shipping, aesthetics, health concerns, aquatic weeds, spills, and fish tainting. The RAP Team made revisions to the Stage 1 report to address and reflect these concerns; some items will be addressed in the Remedial Options section of the Stage 2 report.

The Technical Subcommittee also carries out major reviews of proposed U.S. clean-up plans for the General Motors, ALCOA and Reynolds sites in Massena, and provides extensive briefs to Canadian and U.S. authorities. The committee has addressed many issues including spills and tanker safety, human health, fish tainting, aquatic weeds, and aesthetics.

The Remedial Options Subcommittee was formed to work with the RAP Team and the PAC throughout Stage 2 in developing remedial options.

The activities of the PAC, and each of the sub-committees, are being fully recorded and maintained in an archival form. These records are being held, and made available to the public, at the St. Lawrence College library in Cornwall.

Overview of Public Involvement to Date

There exists significant local interest in the RAP process. The involvement would appear to be the result of regularly held meetings and media coverage. It is anticipated this interest will be maintained through motivated actions of the PAC and its sub-committees, although the public still questions the strength of government commitment not only to developing the RAP but, in particular, to following through with implementation.

Underlying most of the public concern is a worry that pollution in the St. Lawrence River is having a negative effect on the quality of life including health, recreation and the local economy. With respect to specific water impairments, the issues identified to date by the public have, for the most part, been consistent with those previously identified by the RAP Team.

There are indications however, that the interest levels will increase as the committee and the media develop public motivation in the challenges created by the Remedial Action Plan.

5.0 ENVIRONMENTAL DATA BASE

5.1 Physical Characteristics of the St. Lawrence River

The St. Lawrence River is the outlet of the Laurentian Great Lakes, which have a drainage basin of 1,184,324 km^2 (Germain et Janson, 1984), of which 774,000 km^2 is located in Canada (Environment Canada, 1980). The St. Lawrence River originates as the outflow of Lake Ontario. It enters the Province of Quebec downstream of Cornwall and flows another 300 km before reaching the estuary at the eastern point of Ile d'Orleans.

Ninety-five percent of the flow in the St. Lawrence River at Cornwall is contributed by Lake Ontario. The remainder is supplied by a number of relatively small tributaries originating in New York State and Ontario. For the period of record from 1900 until 1986, mean annual outflows from Lake Ontario averaged 6853 m^3/sec (Environment Canada, 1989). The highest mean annual flows have occurred since 1972 due to higher than normal precipitation in the Great Lakes Basin. The highest recorded mean annual flow, 8948 m^3/sec, occurred in 1986.

There are several control structures on the St. Lawrence River. The Iroquois control dam is located about 50 km upstream of Cornwall. This dam can be operated to control and regulate the outflow from Lake Ontario, however, it is used only sporadically, mostly under low flow conditions in the river (International Great Lakes Levels Board, 1973). Immediately upstream of Cornwall are the Moses-Saunders Dam and the Long Sault Control Dam. These dams are the main control structures on the river between Lake Ontario and Cornwall. They impound Lake St. Lawrence with flows through the Moses-Saunders Dam adjusted to regulate the level of Lake Ontario. The Long Sault Dam has a sluiceway section which is operated to discharge flows in excess of requirements at the Moses-Saunders Power Plants. This dam can also be used to control river flows and levels within specified ranges if flows cannot be discharged through the power plants (International Great Lakes Levels Board, 1973).

Other, lesser, controlling structures which affect the flow distribution in the Cornwall area include the Wiley-Dondero Canal, the Cornwall Canal Dam and the Massena Canal. A small flow of water (0.7 m^3/sec) is sometimes diverted into the Raisin River from Lake St. Lawrence at Long Sault. This diversion allows improved flow conditions in the Raisin River during the summer months. The diversion is permitted for a maximum of only 100 days per year (IJC, 1985a).

Lake St. Francis is impounded by the Beauharnois Dam which is operated by Hydro-Quebec. This facility lies at the end of a 25 km navigation and power canal which serves as the main outlet to the lake (International Great Lakes Levels Board, 1973).

Water levels and discharges are controlled by the St. Lawrence River Control Board and are managed within the framework of an IJC approved management plan which sets out maximum and minimum levels and operating criteria.

River levels are elevated above 1930 levels for navigation and hydroelectric requirements (Sylvestre, 1989). The minimum levels for navigation and the required discharge for hydro-electric generation and flood control from Montreal to Lake Ontario are considered together to determine the discharge at Cornwall on a weekly basis. The power authorities adjust their operation at the Moses-Saunders Power Dam to achieve these discharges. Below certain flows (<7924 m^3/sec) the power authorities have the flexibility to peak and pond in Lake St. Lawrence on a daily basis within certain guidelines set by the Board. Another major factor controlling daily water level fluctuations in the upper river is wind-generated seiches on Lake Ontario.

The formation of Lake St. Lawrence vastly altered morphometric and hydrological features of the river as far upstream as Iroquois (Owen and Wile, 1975). Downstream of the Moses-Saunders Dam, the river divides into a north (Cornwall) and south (international) channel around Cornwall Island (see Figure 2-1). These channels carry approximately one-third and two-thirds, respectively, of the total flow in this reach of the river (7160 m^3/sec measured April 19-22nd, 1989) (Figure 5-1). Current speeds can reach 3 to 6 knots.

Downstream of Cornwall, the river widens into the long shallow reach known as Lake St. Francis where the current slows to less than 2 knots. Lake St. Francis appears as an enlargement of the St. Lawrence River, with a surface area of 233 km^2 and a mean depth of 6 metres, it has a volume of 2.8 km^3 (Allan, 1986). By agreement, the Quebec and Ontario authorities maintain water levels in Lake St. Francis within strict limits ($\pm$1 foot). This results in the outflow at Beauharnois (exit of Lake St. Francis) being adjusted to mirror changes in discharge at the Moses-Saunders dam at Cornwall. If more water is discharged into Lake St. Francis, more is let out at Beauharnois and vice versa. While this keeps water levels stable, flow rates and volumes fluctuate. The mean residence time for water in the lake is approximately 3 days (Sylvestre, 1989).

According to Allan (1986), Lake St. Francis is only a temporary sink for water and sediments and their associated contaminants. Similarly, Sloterdijk (1985) reports that sediment deposition in Lake St. Francis is minimal, with the exception of a potential sink at its eastern end (Sylvestre, 1989). Kaiser *et al.*, (1989) estimate that 93 percent of the PCB load entering Lake St. Francis passes through the lake.

The major tributaries entering the St. Lawrence River in the Cornwall-Massena area are all located on the south (New York State) side of the river. Several minor tributaries (Raisin, Beaudette, aux Saumons, a la Guerre) discharge around 27.5 m^3/sec to Lake St. Francis downstream of Cornwall (Sylvestre, 1989). The watershed area, average annual discharge and population for each tributary are shown below.

Table 5-1 Tributaries Entering the St. Lawrence River at Cornwall-Massena-Lake St. Francis

Tributary	Watershed (km^2)	Discharge (m^3/sec)	Population
Grasse	1667	31.9	36,060
Raquette	3257	59.7	32,800
St. Regis	2357	29.8	-
Raisin*	404	4.25	-
Beaudette †	189	3.3	-
aux Saumons†	1070	18.5	-
a la Guerre†	83	1.4	-

* Environment Canada (1985)
† Sylvestre (1989)

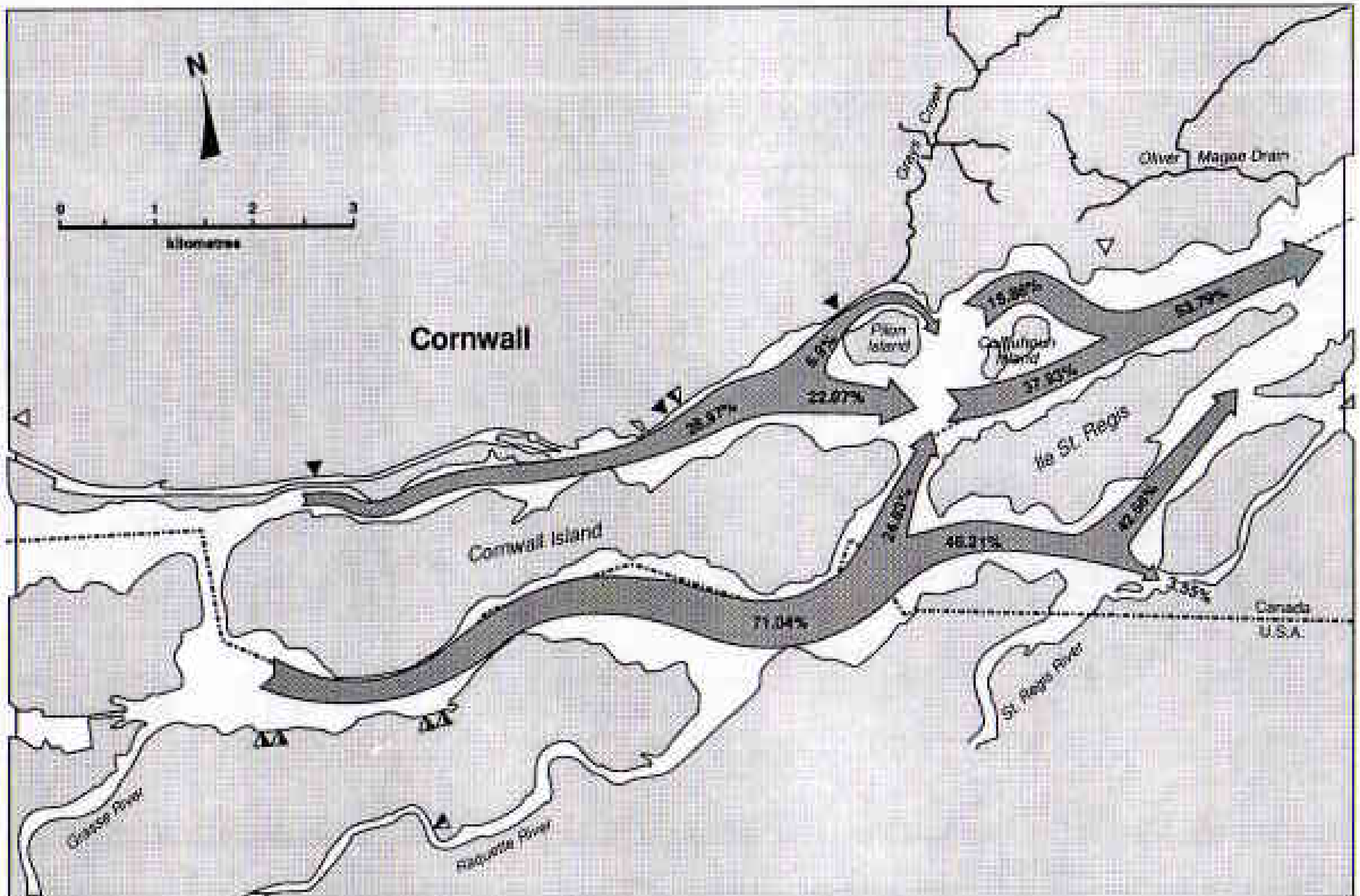
Cornwall, Ontario and Massena, New York (in the Grasse River watershed) are the major communities and industrial centres on the international section of the St. Lawrence River, with populations of 14,856 and 53,405, respectively (Kauss *et al.*, 1988; Statistics Canada, 1986). The combined population of the nine Quebec municipalities on Lake St. Francis, excluding Valleyfield, is approximately 12,000 (Sylvestre, 1989). The Mohawk population of Akwesasne is approximately 10,000.

Figure 5-1

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Percent flow distribution in the St. Lawrence River channels

(after Neilleton, 1989)



5.2 Water Uses

The Cornwall-Massena area of the St. Lawrence River supports a wide variety of industrial and recreational water uses. These include boating, shipping, hydro-electric power generation, domestic and industrial water supplies, waste assimilation, sport and commercial fishing, hunting, nature appreciation, swimming and recreational water sports. In addition, the river supports a diverse population of aquatic and terrestrial species.

In the Quebec portion of Lake St. Francis there are 11 beaches, 7 campgrounds and many small harbours which are used extensively for swimming, boating, sailing and other recreational activities (Sylvestre, 1989).

5.2.1 Water Supply

The two major industries in Cornwall, Domtar and Courtaulds Fibres/Courtaulds Films (Figure 5-2) use a considerable volume of water for processing and cooling. Cooling water does not contact the process and, hence, is discharged unchanged except for an increase in temperature. Wastes are added to water used directly in industrial processes and this water is discharged as effluent. The total amount of water used at Domtar is about 130,000 m^3/day while about 55,000 m^3/day is used at Courtaulds. These amounts, together with that used by the City of Cornwall, account for about 0.04 percent of the water flowing in the St. Lawrence River.

The water treatment plant (WTP) for the City of Cornwall averaged 52,000 m^3/day of intake water in 1987 (11.5 million gallons per day). It draws from Lake St. Lawrence located above the Moses-Saunders power dam (Figure 5-2). The plant has a capacity of 83,270 m^3/day (22 million gallons per day). Private dwellings in the Cornwall and Cornwall Island areas not serviced by the municipal water supply use ground water. However, many summer cottages and homes which occupy much of the downstream shore obtain their water untreated from the river (Sylvestre, 1989).

During 1987/88, a new municipal water treatment plant was installed downstream of Cornwall to service most of the Village of Glen Walter, including the Islamic Institute. The new water intake is downstream of Pilon Island and has a capacity of approximately 1,000 m^3/day.

In Quebec, four water intakes draw a total of 50,909 m^3/day to service Coteau-Landing, Coteau-Station, Coteau-du-lac, Saint-Zotique and Salaberry-de-Valleyfield (Sylvestre, 1989). The St. Lawrence River, in total, supplies drinking water for 40 percent of the population of Quebec.

There are no Quebec industrial discharges to Lake St. Francis; Valleyfield industries discharge downstream of the lake into the Beauharnois canal (Sylvestre, 1989).

The water treatment plant for the village of Massena and several Massena industries also draw water from the St. Lawrence. The Mohawk village of St. Regis water intake is located mid-river near the New York/Quebec border.

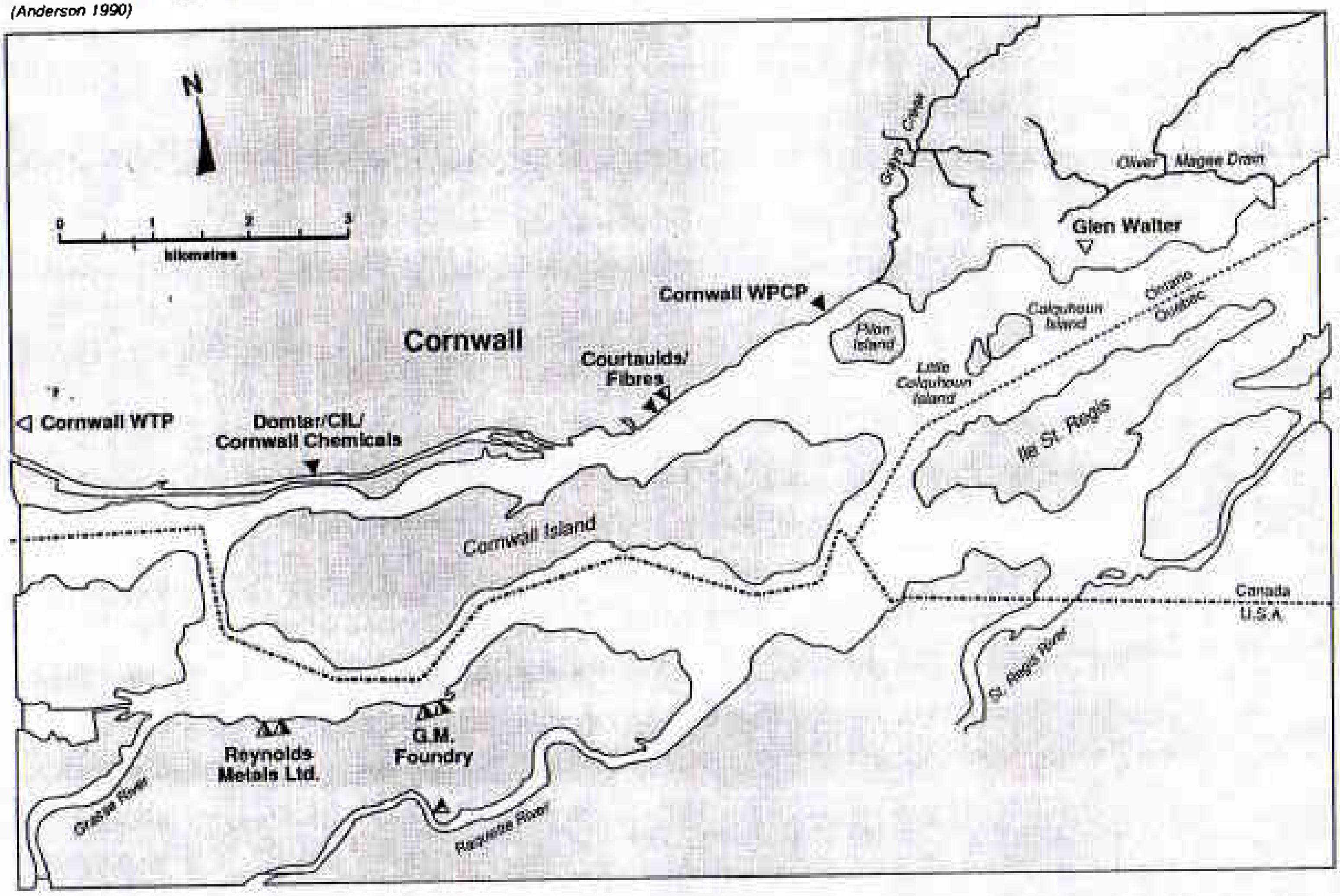
Concern has been expressed for potential drinking water impairment due to measured concentrations of volatile contaminants and PCBs in ambient water (Sylvestre, 1989). Treated drinking water supplies for Cornwall and Valleyfield are routinely sampled and, to date, have not been found to be impaired. The Cornwall intake is located upstream of Cornwall-Massena point sources. The intake for Glen Walter is located downstream of the major sources and has been fitted with additional treatment equipment (carbon filters) to protect against potential impairment as a result of upstream sources of PCBs (Massena sources) and other organics (Cornwall sources).

figure 5-2

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Location of major industries, intakes and outfalls

(Anderson 1990)



△ Intake
▲ Outfall (in pipe)
Δ Outfall (in river at shore)

5.2.2 Sport Fishing

A number of sport fishing assessments have been done for Lake St. Francis (Ontario waters) but only recent estimates are available for total fishing effort and harvest (Table 5-2). The two most recent surveys (1982 and 1988) have quite different effort estimates (373,000 angler-hours vs. 107,200 angler-hours). Despite being for different periods, there has been a large drop in the time spent angling on Lake St. Francis. Although fishing success (i.e. CUE) has remained the same or improved, the reduced angler effort has produced much lower total harvest estimates for all species. This reduction in harvest does not reflect, necessarily, a reduction in species abundance particularly given the maintenance of CUE levels and the results of the MNR Fisheries Assessment program, both of which indicate the sport fish populations are fairly stable. The drop in effort may be attributed to worse weather during the fishing period in 1988. It may not be a trend given there are only two sample years. It could also be attributed to public awareness of contaminant levels in fish. People may have quit fishing or not fished as much as they became aware of the consumption restrictions.

Using estimates from both years, the annual fishing recreation provided ranges from 29,000 to 101,000 angler-days, worth in direct economic value between $1 million and $3.5 million annually.

In Quebec, an estimated 200,000 angling days have a direct economic value of $6.5 million (Ouellette, 1989, in Sylvestre, 1989).

The Ontario harvest is predominantly yellow perch; 93.1 percent by number and 68.7 percent by weight. Walleye, pike and panfish are secondary in importance and are harvested at comparable rates (by number) and bass (largemouth and smallmouth) are fifth in importance. There is a strong spring fishery for bullhead but no creel data are available for this fishery.

Yellow perch is also the preferred target species with 64.6 percent of the anglers fishing exclusively for yellow perch and 74.5 percent of all anglers fishing for yellow perch either singly or in concert with other species. Walleye (16.3 percent), pike (14.2 percent) and bass (9.2 percent) are secondary target species. All other species are sought by less than 1 percent of the anglers but the spring bullhead fishery has not been censused.

In the Quebec portion of Lake St. Francis, yellow perch is caught most often (71.8 percent), followed by northern pike (14.5 percent). Rock Bass, walleye, brown bullhead, pumpkinseed and smallmouth bass are the next most often caught species (Fournier *et al.*, 1987, in Sylvestre, 1989).

The anglers using the Ontario waters of Lake St. Francis are predominantly local Ontario residents (75-80 percent) (Table 5-2). Anglers from Quebec (13-18 percent) form the next largest group and non-local Ontario residents (6 percent) and fishermen from the U.S. (1 percent) make up the remainder of the anglers. There are an estimated 30,000 resident and non-resident anglers who fish the Ontario portion of Lake St. Francis each year.

The reasons for the intense open-water angling pressure on Lake St. Francis are numerous. The system is productive, particularly for perch and supports a variety of desirable sport fish species. The fish are large and the success rate is high. Access is easy for anglers, either at provincial parks or at the numerous marinas along the shore. The large number of cottages and residences along the shore provide access to the lake for a great many local residents. There is also a certain tradition involved, a local history which places a high value on fishing in this waterbody. The reciprocal licensing agreement between Ontario and Quebec also removes the expense and trouble of acquiring a non-resident angling licence. Finally, there is an economic incentive to fish perch. The sale of angled fish is lucrative at a wholesale price of $8.50 to $11.00/kg of fillets and a large local market (restaurants and private individuals) has developed. This market absorbs about 25,000 kg of fillets annually, a substantial local industry worth between $212,500 and $275,000 annually.

Table 5-2 Estimates of Sport Fishing Effort and Harvest - Lake St. Francis (Ontario) (MNR, 1987a; MNR, 1990)

Species	CUE[a]		Harvest[b] (No. of fish)		Harvest[b] (kg)	
	1982	1988	1982 (All year)	1988 (April-Oct.)	1982 (All year)	1988 (April-Oct.)
Yellow perch	2.65	2.83	788,400	296,800	102,500	38,500
Walleye	0.01	0.023	16,200	3,200	19,400	3,800
Northern pike	0.053	0.060	14,200	1,500	21,300	2,200
Smallmouth bass	0.021	0.032	9,700	700	4,900	400
Panfish	0.11	0.23	18,000	38,000	1,800	3,800
Total	-	-	846,500	340,200	149,900	48,700

	1982	1988
Angler Effort		
Hours	373,000	107,200
Days	101,000	29,000
Angler Origin (%)		
Local residents	75	80
Non-local Ontario	6	6
Non-resident (Quebec)	18	13
Non-resident (U.S.)	1	1

[a] CUE = catch/unit effort, in this case, fish/angler hour

[b] The 1982 data are extrapolated for the entire year, the 1988 data are for the period late April to early October only.

Between 16 and 20 fish will produce 1 kg of fillets so the market absorbs between 400,000 and 500,000 perch annually. The exact proportion of this total that comes from Lake St. Francis is unknown but, in the absence of any other local major perch fishery it is probable that at least 80 percent of this harvest is from Lake St. Francis.

The perch fishery has been relatively stable since 1978 as measured by angler success rates (MNR, 1987). The angler effort and harvest of perch declined between 1982 and 1988 and while this may reflect a real trend, it may also be a product of differences in the two sample years only. The angling harvest of perch is thought to be near it maximum sustainable level (MNR, 1987).

The walleye and pike fisheries appear to be relatively stable and, based on the catch per unit effort data, there has been a recent increase in bass. There is a small fishery for muskellunge which is based on a reasonably abundant muskellunge population.

5.2.3 Commercial Fishing

Commercial fishing for species such as brown bullhead, white sucker, sunfish, black crappie, American eel and carp has occurred in Lake St. Francis for several decades (MNR, 1987a). Ontario catch data are available for the 1973-1985 period only. During that period 2-3 commercial fisherman harvested an average of 43,546 kg of commercial fish. A tabulation of catch by species (Table 5-3) indicates that bullhead, sunfish and eel continue to be the mainstays of the fishery although in certain years carp and white sucker have been important. The carp fishery is presently closed because of PCB contamination. The 1987 and 1988 landing (Table 5-3) are very close to the long-term average.

Table 5-3 Commercial Fish Harvest Statistics and Quotas; Lake St. Francis (Ontario)

Species	Harvest[a] (kg)		Quotas[b]
	1987	1988	
Brown bullhead	18,800	16,800	20,000
Carp	0[c]	0[c]	0[c]
Sunfish	10,800	8,300	15,000
American eel	12,900	13,300	15,000
White sucker	3,600	2,500	unlimited
Black crappie/Rock bass	1,300	1,000	1,500
Total	47,400	41,900	
Total Economic Value	$72,500	$66,600	

[a] Harvest is in kg of landed weight.

[b] Quotas are the maximum allowable annual catch by commercial fishermen.

[c] Carp fishery has been closed because of contaminant levels (PCBs)

In Quebec, seven commercial fishermen harvested a mean of 15,366 kg per year between 1970-77 (Mongeau, 1979, in Sylvestre, 1989) and 27,643 kg/yr between 1986-88 (Demers, 1989, in Sylvestre, 1989). Sturgeon, bait fish and yellow perch made up the 1970-77 harvest, while the present catch consists of American eel, brown bullhead, channel catfish, carp, rock bass, pumpkinseed, suckers, common/shorthead/silver redhorse and black crappie. Commercial fishing for lake sturgeon in Lake St. Francis (Quebec) was banned in 1987.

The 1987 and 1988 values of the Ontario fishery were $72,500 and $66,600 respectively. This does not include a capital investment by the fisherman of approximately $40,000. The 1970-77 Quebec catch was valued at $107,560 (Mongeau, 1979, in Sylvestre, 1989).

The bullhead, sunfish, eel and white sucker fisheries use impounding gear (hoop nets) while the carp fishery (when it operates) is a large-mesh gill net fishery. The fishing season runs from April until December with the spring and fall months being the most active periods. The area fished is from Pilon Island east to the Quebec border.

The two factors controlling the fishery are contaminants and market restrictions. The bullhead, sunfish, white sucker and crappie fisheries have not been influenced by contaminant restrictions but fluctuations in price result in the fishermen directing more or less effort at these species. All these species are currently saleable in Canada as they are not restricted due to contaminant levels (OMNR, 1987a). The carp and eel fisheries, however, have been subject to sporadic closures due to elevated levels of mercury and PCBs combined with the availability of foreign markets. All eels larger than 680 g have to be marketed outside North America due to PCB levels. Foreign markets for eel are volatile resulting in a fishery which fluctuates in effort. The carp fishery was closed in 1979, 1980, 1982 and from 1986 to the present due to mercury contamination (Ontario Ministry of Natural Resources, 1987a).

Commercial fisheries management is carried out independently by Quebec and Ontario for their respective portions of Lake St. Francis. Management in the Ontario portion currently consists of monitoring the catch contaminant levels by Fisheries and Oceans Canada and the collection of catch statistics by the Ontario Ministry of Natural Resources (harvest and effort data) and establishing annual harvest quotas. This long-term database will permit the Ontario Ministry of Natural Resources to adjust species quotas to protect the long-term viability of the resource. Quota management was recently instituted province-wide to prevent commercial fisheries from over-exploiting the resource. The species quotas for Lake St. Francis are provided in Table 5-3. The species quota is an upper limit for annual harvest which the fishermen cannot exceed.

The commercial fishery in Lake St. Francis is also regulated by setting the maximum number of fishermen at three, with limits on the number of hoop nets and yards of gill net. This regulation is for social reasons, to minimize any conflicts with other users and to ensure the long-term economic viability of the fishery.

The only potential conflict with sport fishermen is the brown bullhead fishery which conflicts with the spring brown bullhead angling fishery as anglers compete with commercial fishermen for spring bullheads. To date, the problems have been minimal.

The target species are also apparently able to withstand the allowable harvest (quota) without sustaining any long-term reduction in quality and quantity (OMNR, 1987a).

There is a small commercial bait fish operation on Lake St. Francis (Ontario waters) (OMNR, 1987a). Approximately 10,000 dozen bait fish are taken annually. There are several bait fishermen and baitfish dealers involved and the value of this industry exceeds $8,000 annually. The species taken include emerald shiner, white sucker, lake chub, bluntnose minnow and banded killifish.

5.2.4 Akwesasne Fishery

There is a subsistence fishery run by the Mohawk Council of Akwesasne in the Cornwall area (OMNR, 1987a). The fishery is for walleye, yellow perch and sturgeon although the sturgeon fishery has declined over the past 20 years, due to over-exploitation and habitat degradation. The perch and walleye fisheries are seine and gill net fisheries and estimated annual harvest in 1982 consisted of 8,000-10,000 kg of perch and 4,000 kg of walleye and the number of fishermen involved was 20-40 (H. Lickers, pers. comm.).

5.2.5 Waterfowl Hunting

Wetlands are common along the shores of the St. Lawrence River and Lake St. Francis. They are important components of the ecosystem and are heavily utilized by waterfowl and other wildlife species.

Waterfowl hunting on Lake St. Francis is an important recreational use. While no use or harvest data are available for the entire lake, the western portion of Lake St. Francis (Ontario and Quebec) provides 5,000-10,000 hunting days annually (Carreiro, CWS, pers. comm., 1989). The annual estimated harvest in this area is 7,500-15,000 waterfowl consisting primarily of mallard and lesser scaup. Redheads, black ducks, blue-winged teal, gadwall, wigeon, green-winged teal, goldeneye, bufflehead, Canada geese and mergansers also are taken. The St. Lawrence River and Lake St. Francis are major staging areas for migratory waterfowl in the Atlantic flyway and have been identified as significant waterfowl habitats requiring rehabilitation in the North American Waterfowl Management Plan.

5.2.6 Nature Appreciation

The wetlands and islands of Lake St. Francis also provide opportunities for various nature appreciation activities such as bird watching and hiking on nature trails. No estimates are available on the entire Area of Concern but several thousand recreation days are provided by the Cooper Marsh Conservation Area alone. A recreation survey by the Raisin Region Conservation Authority in 1980 found that 66% of Lake St. Francis shoreline residents participated in "enjoying the view", a nature-related recreational activity. The 1976 Ontario Recreation Survey found that 13.5% of residents in Eastern Ontario participated in nature appreciation activities, some of which would be done on Lake St. Francis. The four species heronry (the Great Blue, Black-crownded Night, and Green herons, and the Great Egret) on one of the islands in Lake St. Francis is another attraction for this kind of recreational activity.

5.2.7 Shipping, Navigation and Dredging

The St. Lawrence Seaway bisects the area of concern, entering Lake St. Francis from downstream through the Beauharnois canal and roughly following the Ontario-Quebec border to Cornwall Island and then the Canada-United States border to the Snell lock at the mouth of the Grasse River (Figure 2-1).

Shipping traffic at the Port of Cornwall amounts to approximately 10-12 ships per year. Cargo statistics are shown in Table 5-4.

Apart from the massive dredging of the Seaway during its construction, dredging has taken place only in Lake St. Francis since 1979. This occurred at the Lancaster Bar in 1979, 1981, 1984 and 1988; the Riviere Beaudette in 1978; Baie Saint-Francois in 1980; and Valleyfield Harbour in 1986 (Sylvestre, 1989). The volume of dredged sediments is shown in Table 5-5 (Duchesneau, 1989, as cited in Sylvestre, 1989).

5.3 Land Use

Land use within the drainage area of the Cornwall-Lake St. Francis section of the St. Lawrence area of concern is shown in Figure 5-3. This map illustrates the distribution of four major land use categories including intensive agriculture (row crops, market gardening and specialty crops), hay and pasture, woodland (forested, reforestation, pastured forest and idle agricultural land) and built-up (urban). The percent distribution of these classes, along with wetlands and recreation, are provided in Table 5-6. The information for the figure and table was taken from the maps and data summary sheets developed by the Ontario Ministry of Agriculture and Food (1978-80).

The watershed is primarily agricultural with the three agricultural classes accounting for approximately 86,000 ha or 57 percent of the total area (Table 5-6). The area east of Cornwall, particularly in Lochiel and Charlottenburg and Lancaster Townships, is largely agricultural (Figure 5-3). These three townships account for almost 53,000 ha of the three agricultural classes shown in Table 5-6. A variety of agricultural crops are grown, particularly corn. Dairy farming and hay and grain production are also major uses. In most cases, agricultural activities are indirectly associated with the river, the connection being the various rivers and municipal drains which flow into the St. Lawrence. Runoff into these drains and into rivers from intensive agricultural activities (particularly class A-1 in Table 5-6) contribute nutrients, bacteria and pesticides to the St. Lawrence River, although the flow are so small relative to the St. Lawrence River flows that loadings are low.

Woodland is the second largest land use class occupying approximately one-third of the total area (Figure 5-3 and Table 5-6). This land use is most common in Kenyon and Roxborough Townships. Woodland plus idle agricultural land also covers large portions of Cornwall and Osnabruck Townships.

Table 5-4 Port of Cornwall Cargo Statistics

Item	Year	Number	Quantity Unloaded	Quantity Loaded
			(Tonnes unless specified)	
Freighters	1985 1987	10 10		
Tankers	1985 1987	8 16		
General Cargo	1985 1987		321 211	559
Lumber	1987		357	
Aluminum Ingots	1987		727	
Pulpwood	1985		11,646	
Wood Pulp*	1985 1987			13,919 17,747
Newsprint	1987			1,800
Misc. Ores	1987			283
Gasoline	1987		18,180 kl†	
Other Petroleum Products	1987		12,978 kl	
Caustic Soda	1985 1987		39,933 kl 36,239 kl	
Miscellaneous Liquid Cargoes	1985			7,354 kl
Ethylhexanol	1987		3,197	
Ethylhexanol-2	1987		1,500	
Nonanol-N	1987		1,500	

* Partially manufactured paper
† kilolitres

Sources: Parsons, 1988 and Canada-U.S. Coast Guard, 1988

Table 5-5 Dredging Operations performed in Lake St. Francis (1979-1988)[*]

Area	Year	Surface/Volume	Metals Analysis
Lancaster Bar N/D 4501-2/LAC5	1979	63,000 m^2/50,000 m^3	Serodes, 1978
	1981	25,000 m^2/30,000 m^3	
	1984	25,000 m^2/50,000 m^3	
	1985	Work incomplete; reported in 1988	
	1988	25,000 m^2/50,000 m^3	
Beaudette River N/D 4501-2/RI5	1978	8,585 m^3	Report available
St. Francis Bay N/D 4501-2/V3	1980	No data available	No analysis done
Valleyfield Port N/D 4516-V24/NHB	1986	5,400 m^3 diluted in 150,000 m^3	

[*] Modified from Duchesneau, 1989; cited in Sylvestre, 1989.

Urban areas account for less than 7,000 ha (less than 5 percent), of which 5,200 ha is represented by the City of Cornwall which lies within the Township of Cornwall. It is home to all major industries on the Canadian side of the area of concern. Several of the principal industries, such as Domtar, ICI (formerly CIL) and BASF are located in the west-central part of the city near the St. Lawrence River. The large Courtaulds Fibres/Courtaulds Films complex, is situated in the east end of the city on the river. Most of the remaining industries are found in the industrial park located in the north-east end of the city.

The entire north shore of the St. Lawrence is developed to varying degrees. Between the larger communities, development consists primarily of year-round residences and seasonal-use cottages. There is also a liberal sprinkling of commercial establishments, such as marinas, hotels and other businesses, which take advantage of the number of people drawn by the recreational opportunities offered by Lake St. Francis.

The small communities of Glen Walter, Summerstown, Lancaster and Bainsville are spaced about 10 kilometres apart along this shore (Figure 2-1). The largest, the Village of Lancaster, serves as a commercial centre for the southeastern part of Glengarry County.

Recreation and wetland classes account for less than two percent of the whole area. Wetlands are most abundant in Kenyon Township whereas recreational land uses are most abundant in Cornwall Township. Large areas of eastern Ontario have been drained in order to improve land for intensive agricultural activities. Snell (1986) found that between 62 and 64 percent of the original wetlands in the two Ontario counties which encompass the Cornwall-Lake St. Francis area of concern (Stormont and Glengarry Counties) were converted to other uses. Up to 90 percent of the converted wetlands were lost as a result of agricultural activities. A survey of wetlands in the area of concern found only two major wetland areas in Lake St. Francis remain. Charlottenburg Marsh (also called Cooper Marsh) is a large Class 1 (provincially significant) wetland complex located along the north shore in Charlottenburg Township. Bainsville Bay Marsh is a Class 2 (provincially significant) wetland located in Lancaster Township along the north shore. It is presently being re-evaluated because a Ducks Unlimited project

Table 5-6 Distribution of Land Use in the Cornwall-Lake St. Francis Area of Concern (Summarized from Ontario Ministry of Agriculture and Food, 1978-80)

Land Use Category*	Township (percent)							Total Area (ha)
	Charlottenburg	Kenyon	Lancaster	Lochiel	Cornwall	Osnabruck	Roxborough	
Agricultural								
A1	28.00	15.00	55.00	14.00	9.00	28.00	20.00	40063
A2	26.00	21.00	20.00	54.00	19.00	17.00	10.00	33417
A3	6.00	4.00	6.00	7.00	14.00	13.00	6.00	12659
Woodland	33.00	50.00	16.00	22.00	34.00	33.00	60.00	48780
Built-up	4.00	1.00	1.00	3.00	14.00	2.00	1.00	6984
Wetland	1.00	3.00	0.00	0.00	1.00	2.00	0.00	1589
Recreational	1.00	1.00	1.00	0.00	2.00	1.00	0.00	1649
Total (%)†	99.00	95.00	99.00	100.00	93.00	96.00	97.00	
Total (ha)‡	38900	15800	28300	7800	30400	21100	7500	149800

* Agricultural: A1 – row cropping, mixed crops and speciality agriculture
A2 – hay and pasture
A3 – idle agricultural land
Woodland – forested, reforestation and pastures woodland
Built-up – urban related uses
Wetland – natural vegetation characteristic of poorly drained areas (i.e., swamp and marsh)
Recreational – parks, golf courses, campground, etc.
† classes not accounted for include open water and extactive
‡ total area based upon land use summaries prepared by Ontario Ministry of Agriculture and Food (1978-80)

has enhanced its value. There are numerous wetland areas inland, within the watersheds of the tributaries to Lake St. Francis. These areas serve to improve water quality in the tributaries and serve as important fish and wildlife habitats. They complement the Lake St. Francis wetlands by increasing the diversity of wetland habitats available to waterfowl staging in the area.

The Akwesasne Lands are primarily agricultural (Figure 5-3). These are shown primarily as hay and pasture. Woodland areas mapped on Cornwall Island are primarily idle agricultural lands. The largest built-up area is the Village of St. Regis on the south shore of the St. Lawrence River. Homes and cottages occur along the river both on the south shore and on the islands of Akwesasne.

6.0 DESCRIPTION OF ENVIRONMENTAL CONDITIONS AND CONCERNS

This section describing environmental conditions and concerns in the St. Lawrence area of concern is based on both original studies and literature reviews. Some of the data is presented using various measurement units. A table of measurement units and conversions is provided for the reader at the end of this document.

Water quality of the mainstream St. Lawrence River generally reflects that of its major source, Lake Ontario. However, inputs from point sources and tributaries have affected local conditions. The following summarizes past and present knowledge of environmental conditions in the Cornwall/Lake St. Francis area.

6.1 Water Quality

6.1.1 Bacteria

Monitoring data from as early as 1913 indicated that the St. Lawrence River was bacterially contaminated from the Thousand Islands to Cornwall. This was ascribed to the discharge of sewage from vessels and by communities along the river (IJC, 1914). Water quality data for the river since those early studies were collected following the development of the St. Lawrence Seaway. These included surveys to assess the status of municipal pollution control programs (Ontario Water Resources Commission 1964) and river water quality (Ontario Water Resources Commission, 1965). Water quality monitoring by Health and Welfare Canada from 1965 to 1967 indicated localized inputs of coliform bacteria and phosphorus in the Cornwall area; organic nitrogen (nitrite) in the Massena (Grasse River) area; and coliform bacteria in the Grasse River and St. Regis River areas (IJC, 1969).

A 1975 Environment Ontario study, undertaken to assess the effects of major Cornwall municipal and industrial dischargers, found high fecal coliform densities in the St. Lawrence River downstream of the Courtaulds outfalls (Experience, 1975). The sources of contamination were not identified at that time. Elevated total and fecal coliform densities also were found in the same area of the river in 1977 and 1985 during surveys conducted by Environment Canada (1978, 1985).

Fecal coliform bacterial levels found in a 1980 Environment Ontario survey exceeded the Provincial Water Quality Objective of 100 organisms/100 ml for the protection of waters used for body contact recreation such as swimming and water skiing (Environment Ontario, 1984, 1988). River water samples from stations as far as 8 km downstream of the Domtar/ICI (formerly CIL)/Cornwall Chemicals diffuser outfall were elevated during the July, September and October surveys (Table 6-1: see Figure 6-1 for station locations). Water samples collected from immediately downstream of Courtaulds were also found to be in excess of the Objective in November. Bacteria densities were high at the mouth of the Raisin River near South Lancaster as well. A 1982 survey confirmed the 1980 results (Table 6-2: Figure 6-1), with highest fecal coliform densities being observed downstream of the Domtar/ICI (formerly CIL)/Cornwall Chemicals discharge.

In general, fecal *Streptococcus* and *Pseudomonas aeruginosa* densities did not follow a similar distribution pattern to that noted for fecal coliforms during the 1980 and 1982 Environment Ontario surveys. Mean concentrations of these bacteria remained relatively low at all locations.

Fecal coliform densities in Domtar's effluent suggest that it was the major contributor of fecal coliforms to the waters of the St. Lawrence River at Cornwall during the two studies (Kauss *et al.*, 1988). As a result, a pilot plant study for the control of bacteria by ultraviolet disinfection was initiated at Domtar during 1984 and found to be effective in controlling bacteria. Subsequently, however, pH control has been found to be a more cost-effective method for controlling bacteria.

Table 6-1 Fecal Coliform Concentrations (organisms/100 ml) in St. Lawrence River Surface Water (1.5 m depth) During 1980 – Kauss *et al*, 1988

Date Sampled	Station Numbers										
	054A	054B	055	056A	056B	057	058	059	060	061A	061B
June 24-25-26											
Gm	11	7	7	10	4	6	9	8	42	70	<7
S.D.	15	6	6	5	0	8	8	3	87	33	-
July 29-30-31											
Gm	26,134	4,016	15,821	21,142	9,485	7,444	14,518	14,637	6,780	2,699	890
S.D.	35,351	3,297	19,726	99,829	2,262	11,954	5,558	1,173	9,771	102	1,925
Sept. 9-10-11											
Gm	>1,062	>612	>906	>944	648	≈134	239	268	454	449	<11
S.D.	-	-	-	-	993	-	313	-	283	648	-
Oct. 21-22-24											
Gm	21,647	17,775	5,768	18,290	19,766	>6,341	9,041	12,419	>7,612	6,109	≈766
S.D.	1,167	8,393	26,094	10,284	9,051	-	13,616	12,346	-	5,029	-
Nov. 25-26-27											
Gm	≤27	≤22	≤10	≤22	<22	<57	≈83	≤75	≈149	≈770	≤22
S.D.	-	-	-	-	-	-	-	-	-	-	-

Gm – Geometric mean
S.D. – Standard Deviation
- – No sample, no analysis, or S.D. could not be calculated
≈ – Approximately

Table 6-1 (cont'd) Fecal Coliform Concentrations (organisms/100 ml) in St. Lawrence River Surface Water (1.5 m depth) During 1980 - Kauss *et al.*, 1988

Date Sampled	Station Numbers									
	062A	062B	063A	063B	063C	064	065	066A	066B	022
June 24-25-26										
Gm	31	8	12	<6	<4	<4	<11	-	-	11
S.D.	31	0	60	-	-	-	-	-	-	-
July 29-30-31										
Gm	3,884	1,508	1,844	1,065	704	223	380	-	-	≈80
S.D.	4,366	4,892	8,923	308	253	311	458	-	-	-
Sept. 9-10-11										
Gm	489	≈85	424	218	≤18	72	≤20	-	-	≤22
S.D.	697	-	123	318	-	-	-	-	-	-
Oct. 21-22-24										
Gm	8,052	3,115	8,843	5,599	≈2,066	5,485	4,833	-	-	≤45
S.D.	7,593	5,132	18,151	1,194	-	8,885	19,434	-	-	-
Nov. 25-26-27										
Gm	≤94	≤34	≈67	≈41	≤54	≤45	≈63	≤20	≈18	≈315
S.D.	-	-	-	-	-	-	-	-	-	-

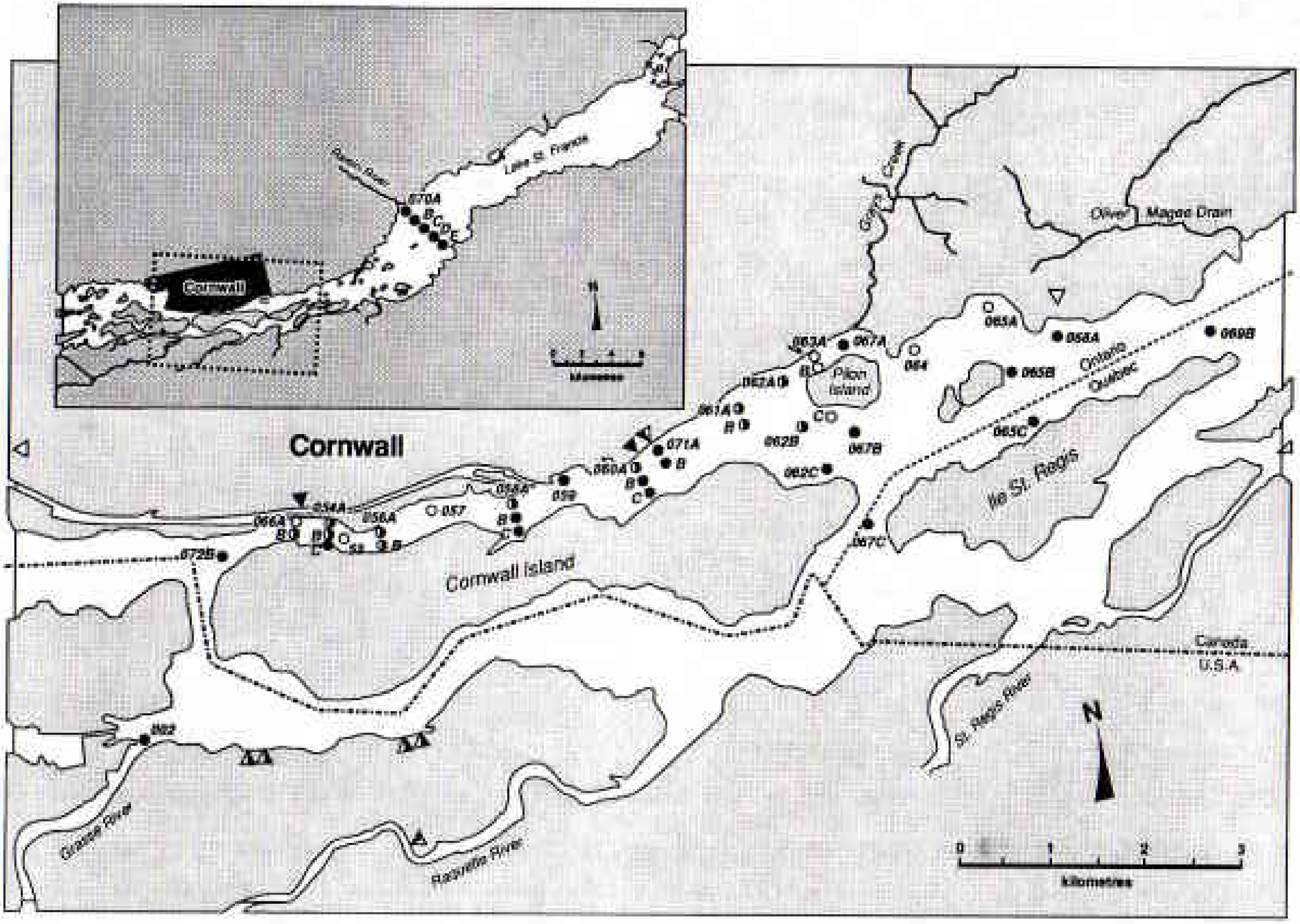
Gm – Geometric mean
S.D. – Standard Deviation
- – No sample, no analysis, or S.D. could not be calculated
≈ – Approximately

Figure 6-1

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Station locations for 1980 and 1982 surveys

(Kauss et al 1988)



△	Intake	○	1980
▲	Outfall (in pipe)	◑	1982
▲	Outfall (in river at shore)	●	1980 and 1982

Table 6-2 Fecal Coliform Concentrations (organisms/100 ml) in St. Lawrence River Surface Water (1.5 m depth) During 1982 – Kauss *et al*, 1988

Date Sampled	Station Numbers										
	072B	066B	054A	054B	054C	056A	056B	058A	058B	058C	059A
Aug. 6-7-8-9 Gm S.D.	 - -	 ≈137 -	 33,424 35,813	 ≈946 -	 <582 -	 12,328 10,681	 ≈61 -	 14,848 106,223	 ≤134 -	 ≤23 -	 - -
Sept. 28-29-30 Gm S.D.	 <18 -	 30 33	 48 19	 23 6	 26 33	 1,080 8,378	 43 54	 13,416 26,845	 200 546	 <20 -	 3,560 141,425
	067A	067B	067C	065B	065C	069B	070A	070E	070B	070D	070C
Aug. 6-7-8-9 Gm S.D.	 46,571 121,600	 ≤532 -	 ≈258 -	 ≈6,293 -	 ≤327 -	 <498 -	 ≈32 -	 - -	 2,449 -	 - -	 ≈300 -
Sept. 28-29-30 Gm S.D.	 775 -	 186 1,133	 <10 -	 268 4,597	 <13 -	 <17 -	 <16 -	 ≈154 -	 ≈225 -	 ≈49 -	 ≈56 -
	068A	060A	060B	060C	071A	071B	061A	061B	062A	062B	062C
Aug. 6-7-8-9 Gm S.D.	 12,599 22,604	 78,964 141,248	 - -	 - -	 - -	 - -	 - -	 882 1,121	 51,800 26,437	 7,654 41,733	 <47 -
Sept. 28-29-30 Gm S.D.	 944 4,326	 3,162 22,089	 465 1,955	 23 6	 7,294 55,450	 2,114 13,884	 3,405 16,516	 837 1,259	 1,277 26,873	 <302 -	 <10 -

Gm – Geometric mean
S.D. – Standard Deviation
- - No sample, no analysis, or S.D. could not be calculated
≈ – Approximately

Additional studies by Domtar have led to the conclusion that the main component detected in the fecal coliform test was *Klebsiella*, a bacteria which has been detected in high densities near other pulp and paper mill discharges. Speculation as to the health significance of *Klebsiella* led to the formation of an ad hoc committee to review this problem. A review produced for this group concluded that *Klebsiella* in the environment is not of human health significance (Duncan, 1988).

Other contributions of high fecal coliform densities were evident near the Courtaulds Fibres/Courtaulds Films (closed 1989) complex during the 1982 Environment Ontario study. These levels correlated well with rainfall events suggesting storm water or combined sewer overflows as sources (Kauss *et al.*, 1988).

Additional storage capacity was incorporated at the Cornwall Water Pollution Control Plants (WPCP) to reduce the number of bypasses to the St. Lawrence River. This expansion reached completion in mid-1988. As well, the Pitt St. and Amelia St. combined sewer overflows were stopped, which further reduced the inputs of bacteria to the Cornwall waterfront.

The Ontario Ministry of Health monitors the swimming areas downstream of Cornwall for bacterial contamination. Charlottenburg Park, Camerons Point, Lancaster Park and Lancaster Wharf are sampled weekly during the summer. Only these four are considered swimming areas, although the whole shoreline is used occasionally for swimming.

In the Quebec portion of Lake St. Francis, the public beaches (Plage premiere avenue, Plage camp Mont-Immacule, Plage camping St-Anicet, Parc Baie du Village, Camping a la Claire Fontaine, Plage Baie des Brises and Plage municipale de St-Zotique) are monitored by the Quebec environment ministry. No beach closings have been reported at these beaches since the program began in 1984.

For several years prior to 1986, none of the four swimming areas in the Ontario portion of Lake St. Francis was closed to swimmers but, in August 1986, the medical Officer of Health closed the Charlottenburg Park beach. The source of the contamination was suspected to be of local origin. No beaches were closed during the summer of 1987. However, in 1988 the Charlottenburg Park beach was closed again. This was likely due to unusually high summer temperatures and resultant high bacteria growth. High summer temperatures in 1989 also contributed to high fecal coliform counts (Table 6-3) which led to the posting of the Charlottenburg Park Beach from June 30 to August 2nd by the Medical Officer of Health (G. Dupuis, Eastern Ontario Health Unit, pers. comm., 1990). Three beaches (Lakeview Heights Park, Farran Park and Crysler Park) upstream of Cornwall on the St. Lawrence River in Lake St. Lawrence were also closed for most of the summer in 1989. Bacteria levels in 1990 and 1991 were consistently low and no beaches were closed.

Table 6-3 Fecal Coliform Bacterial Densities (geometric mean organisms/100 ml) at Eastern Health Unit Monitored Beaches, 1989

	May	June	July	August	September
Charlottenburg Park	2.08	2.27	1.42	1.50	2.51
Crysler Park	1.51	2.56	1.62	2.19	1.77
Farran Park	2.15	1.94	1.58	2.47	1.48
Lakeview Heights	2.26	2.49	2.22	1.12	1.61
Woodlands Beach	0.97	2.13	1.88	2.23	1.49

Note: Data is presented in logarithmic form - Provincial Water Quality Objective = 2 Gmean org/100 mL
G. Dupuis, 1989 pers. comm.

Table 6-4 summarizes results of fecal coliform counts from samples collected at several swimming areas within the Akwesasne Reserve (Figure 6-2). The St. Regis Village station (station 3) was consistently high in fecal coliform levels during July and August of 1987, 1988 and 1989. This site is most likely affected by the discharge from the St. Regis Village Sewage Treatment Plant. The plant is seriously overloaded and the inadequate capacity results in continual overflow problems. Replacement of the sewage system for St. Regis has been recommended (Greer Galloway & Associates and Simcoe Engineering Group, 1986), and construction began in 1990.

Mainstream St. Lawrence River water typically has bacterial densities of less than 10 organisms/100 ml of fecal coliforms (DWSP, 1987). Locally elevated densities which are above the Provincial Water Quality Objective (100 organisms/100 ml fecal coliform) occur as a result of bacteria contributed from many sources including; Domtar's effluent, sewage treatment plant discharges, combined sewer overflows from urban areas, private septic systems and other non-point sources (eg. agricultural). The bacteria contributed by Domtar is primarily *Klebsiella* which is not of concern with regard to health problems. Since the surveys of the early 1980s, two of the main combined sewer overflows in Cornwall, the Pitt St. and Amelia St. sewers, have been stopped and the sewage treatment plant has been upgraded. However, an improvement in the bacterial quality of the river has not followed, particularly with respect to beach closings. The St. Regis Sewage Treatment Plant remains a problem. In addition, the private septic inputs along Lake St. Francis will need to be considered in the Stage 2 Report: Remedial Action Plan with regard to their impact on beach closings.

A survey of bacterial conditions in the Area of Concern was undertaken (1990) to assist in determining appropriate remedial actions as well as future monitoring strategies for assessing the *Klebsiella* component in the fecal coliform count. Preliminary results indicate that total and fecal coliform levels meet Provincial Water Quality Objectives.

6.1.2 Nutrients

Eutrophication is the overproduction of microscopic plant life prompted by unnaturally abundant nutrient inputs. The control of phosphorus inputs is the primary means adopted under the Great Lakes Water Quality Agreement to reverse or prevent eutrophication in the Great Lakes. As a result of phosphorus removal from municipal and industrial point source discharges and detergent phosphorus controls, there have been significant reductions in total phosphorus loadings to all of the Great Lakes since the early 1970s. Since 1972 there has been a steady decrease in phosphorus loading to Lake Ontario and it appears that the lake is responding to the nutrient reduction effort.

The Cornwall Water Pollution Control Plant (WPCP) is a primary facility equipped with phosphorus removal. Poor removal efficiencies were experienced at this plant in the past and continued to be a problem until mid-1982, even after phosphorus removal became operational in 1979. This was due to industrial waste interference with the chemical precipitation process. However, improvement in the quality of contributing industrial discharges over the last few years has resulted in improved phosphorus removal at this facility. New York State does not require phosphorus treatment at their sewage treatment plants on the St. Lawrence River.

During effluent monitoring studies conducted by Environment Ontario in 1979, 1980 and 1982, the Cornwall WPCP and Domtar were found to discharge the largest loadings of phosphorus at 98 and 81 kg/day, respectively. While the Cornwall WPCP's final effluent concentration of total phosphorus was 2 mg/L during the 1979 study, the phosphorus concentration is now averaging less than 1 mg/L, due to improved removal efficiency. Domtar and the Cornwall WPCP also contributed the majority of total Kjeldahl nitrogen (TKN) loadings (372 and 588 kg/day, respectively) and the WPCP was the largest source of ammonia (315 kg/day).

Table 6-4 Fecal Coliform Concentrations (organisms/100 ml) in St. Lawrence River Surface Water Samples Offshore of St. Regis Akwesasne I.R. No. 15 During 1987, 1988, and 1989

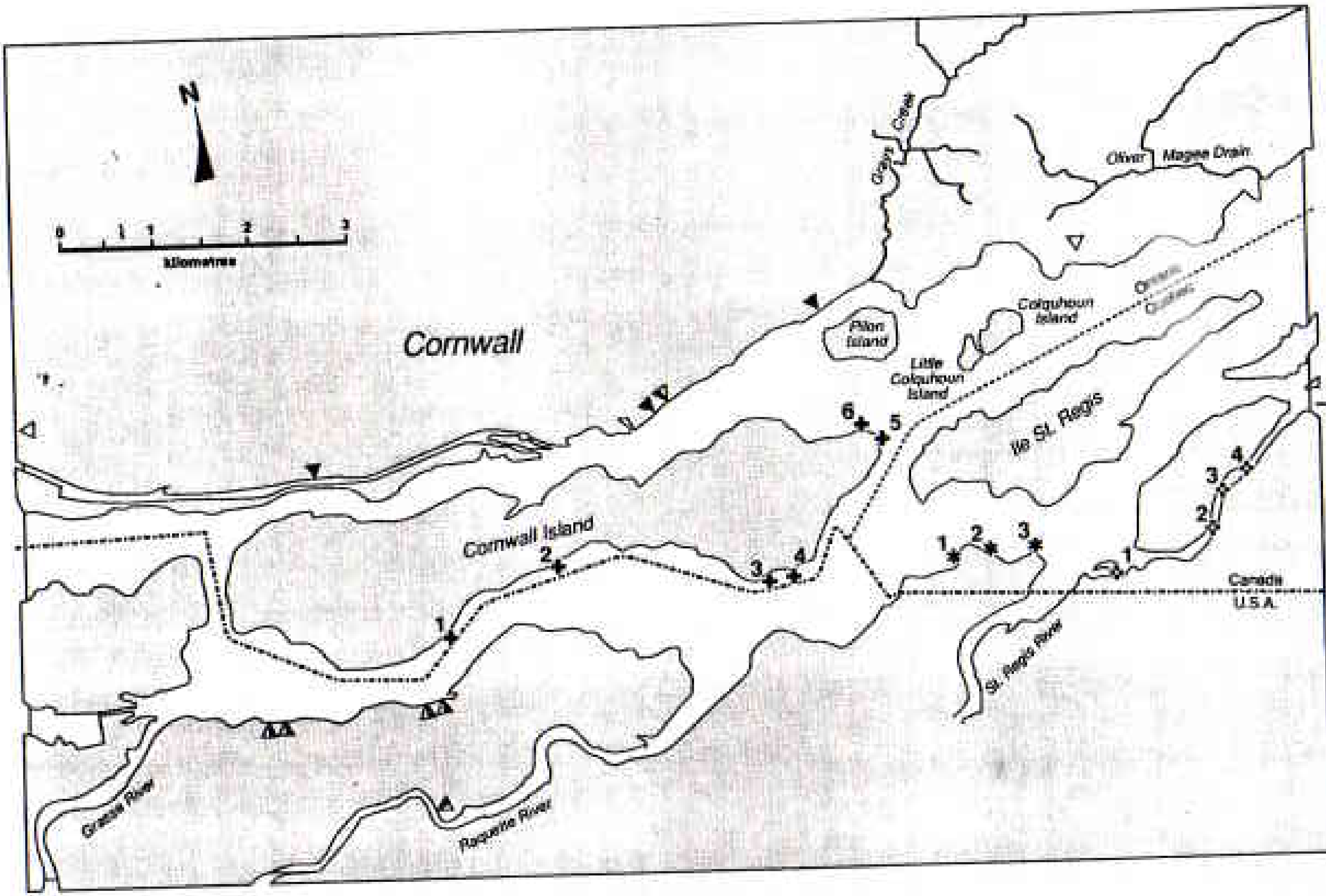
Date Sampled	Stations													
	Cornwall Island						St. Regis Village			Chenail Range				
	1	2	3	4	5	6	1	2	3	1	2	3	4	5
July 1987														
Gm	61.6	18.6	26.7	-	59.8	49	31.1	24.5	168.2	≈151.4	63.4	≈552.1	≈206.9	49.2
S.D.	-	15	103.9	-	34.6	-	15.3	28.9	224.5	198.5	61.8	2470.9	486.3	23.8
Aug. 1987														
Gm	15.7	34.2	20.3	91.6	110.3	91.5	119	≈72.6	>244.9	170	98.1	-	99.8	20
S.D.	9.6	106.9	80	254	57.4	75.7	156.9	56.3	228.8	155.9	121.7	-	125.7	33.7
July 1988														
Gm	15.7	10	20.8	≈101.1	16.4	>44.6	44.7	19.7	≈221	44.3	17.1	≈101.9	-	10.5
S.D.	9.6	0	46	514.2	14.2	40.4	34	18	249.3	74.1	23.1	940.5	-	8.3
Aug. 1988														
Gm	31.7	55.2	≈296.6	94.4	10	79.4	≈1147.2	20	347.6	31.7	34.6	92.5	-	41.6
S.D.	11.5	228.5	-	162	0	-	3125.4	40.4	92.9	35.1	-	225	-	15.3
July/Aug. 1989														
Gm	9.7	15.7	32	31.1	35.7	18.2	76.7	28.8	159.2	40	50.1	89.7	43.1	17.8
S.D.	0.58	9.6	25.8	78.1	32	10	333.4	25.2	109	0	20.8	195.8	41.6	18.9

Gm – Geometric mean
S.D. – Standard Deviation
- – No sample, or S.D. could not be calculated
≈ – Approximately

Figure 6-2

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Station locations, Akwesasne beaches



△ Intake
▲ Outfall (in pipe)
▲ Outfall (in river at shore)

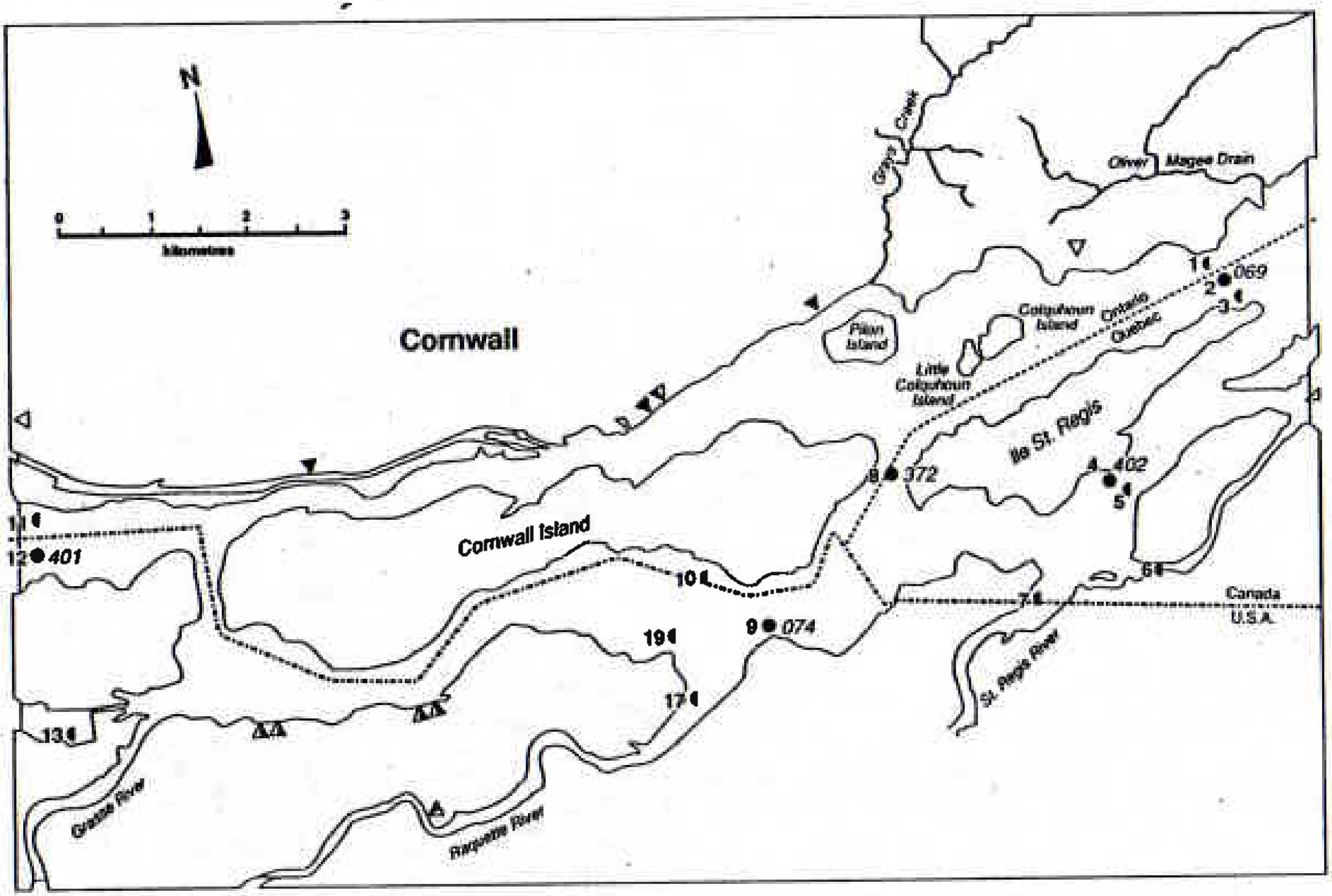
✚ Cornwall Island beach
✱ St. Regis Village beach
✧ Chenail Range beach

Table 6-6 Total Phosphorus Levels in St. Lawrence River Water at Cornwall-Massena, 1988 (Anderson & Biberhofer, (in press)).

Station ID	Total Phosphorus (mg/L)
Survey 1	
101	0.014
102	0.014
103	0.014
104	0.014
105	0.014
106	0.016
108	0.014
109	0.014
110	0.015
111	0.014
112	0.014
113	0.023
107	0.045
Survey 2	
201	0.015
202	0.015
203	0.017
204	0.015
205	0.015
206	0.016
208	0.015
209	0.016
210	0.015
211	0.016
212	0.016
213	0.031
207	0.029
Survey 3	
301	0.020
302	0.020
303	0.019
304	0.018
305	0.019
306	0.019
308	0.019
309	0.020
310	0.020
311	0.021
312	0.020
313	0.027
307	0.038
Survey 4	
401	0.019
402	0.018
403	0.017
404	0.018
405	0.019
406	0.019
408	0.018
409	0.018
410	0.020
411	0.019
412	0.018
413	0.024
417	0.011
Survey 5	
501	0.019
502	0.019
503	0.016
504	0.017
505	0.017
506	0.017
508	/
509	0.017
510	0.016
511	0.018
512	0.017
513	0.023
529	0.016
Survey 6	
601	0.011
602	0.011
603	0.011
604	0.011
605	0.011
606	0.012
608	0.011
619	0.011
610	0.011
611	0.011
612	0.011
613	0.025
617	0.008

Figure 6-3

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area
Station locations for 1988 surveys



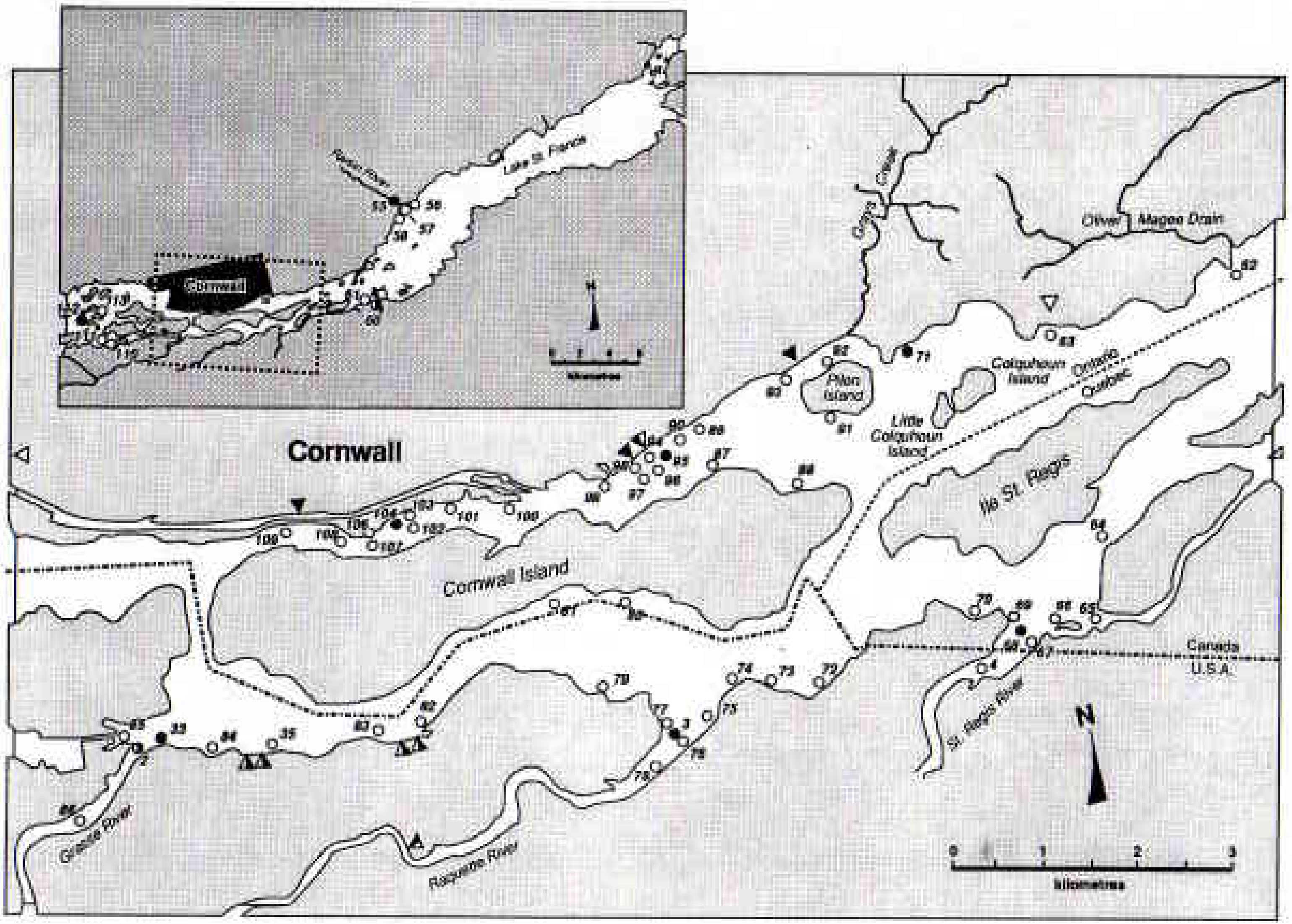
△	Intake	11◖	Environment Canada sampling location
▲	Outfall (in pipe)	9 ● *074*	Environment Canada/Environment Ontario sampling location
▲	Outfall (in river at shore)		

Figure 6-4

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Station locations for 1979 surveys

(Kauss et al. 1988)



△ Intake
▲ Outfall (in pipe)
Δ Outfall (in river at shore)

○ Sediment
◐ Sediment and water
● Sediment, suspended sediment, water and biota

the 1988 survey were also observed (Anderson & Biberhofer, (in press)). These levels were found at the two upstream (background) Stations 11 and 12 and once at Station 19 near the mouth of the Raquette River on the U.S. side and are not indicative of a major local source.

In the 1979 Environment Ontario survey, copper was detected at concentrations in excess of the Provincial Water Quality Objective of 0.005 mg/L in two of three samples (0.02 mg/L) near the Courtaulds Fibres/Courtaulds Films (closed 1989) complex (station 094). It was also found in excess of the objective in the channel south of Cornwall Island by Environment Canada (Quebec Region, Sylvestre, 1989).

One sample of raw water collected in 1979 at the Cornwall Water Treatment Plant contained 0.94 mg/L zinc (Provincial Water Quality Objective is 0.03 mg/L). The Objective also was exceeded near the Courtaulds Fibres/Courtaulds Films (closed 1989) complex where levels ranged from 0.08 mg/L to 0.18 mg/L in three samples (Kauss *et al.*, 1988). In 1985, of the 60 water samples collected in the immediate vicinity of the Courtaulds outfall, 32 percent contained concentrations in excess of the Objective for zinc (Table 6-7, Figure 6-5). The 1985 study was designed specifically to assess the dilution and dispersion capability of the river and many of the samples were taken in the immediate vicinity of the Courtaulds diffuser outfall which accounts for the higher than average (ambient river) levels. The maximum value observed was 0.440 mg/L (Anderson, 1990). In the 1988 water sampling the zinc levels were found to be within acceptable levels (i.e., below the PWQO).

In 1988, no Provincial water quality objectives for the protection of aquatic life were exceeded on a regular basis, except for concentrations of iron in the Snell lock where levels ranged from 0.4290 to 0.6970 mg/L or 429 to 697 μg/L. The Provincial Objective for the protection of aquatic life is 300 μg/L iron.

Mercury concentrations in the St. Lawrence River in 1988 were generally below the analytical detection limit of 0.01 μg/L (Anderson & Biberhofer, (in press)). Filtered mercury samples taken in 1979 were also at low levels (i.e., below the Provincial objective of 0.0002 mg/L) (Kauss *et al.*, 1988). Analysis of mercury from an additional 1988 sampling, indicates that mercury in the soluble form is present at levels which are typical of uncontaminated fresh water systems (G. Mierle, pers. comm.).

Mercury and zinc concentrations were high in both the whole and suspended solids portion of the effluent discharges from Courtaulds Fibres and Courtaulds Films (closed 1989) compared to the other discharges monitored in the 1988 study (Anderson & Biberhofer, (in press)). However, the flows average only about 1/10th of that from Domtar/ICI (formerly CIL)/Cornwall Chemicals suggesting that 75-80% of the mercury contribution from direct discharges in Cornwall originate from the Domtar/ICI (formerly CIL)/Cornwall Chemicals diffuser (Figure 6-6). Analysis of mercury from a sample taken near the Courtaulds' cooling water discharge sewer in 1988 for soluble mercury had levels which compare with effluent concentrations. The soluble fraction (0.08 μg/l) was analyzed separately due to the high content of particulate matter in the sample. The acid extractable mercury in the particulate fraction was recorded at 0.21 μg/L. Little dilution occurs in this area where the discharge enters the river and a visible plume is evident containing particles from the cooling water and condensate. The MISA program includes this discharge in the monitoring and effluent limit regulations (see Section 7.1).

The inundation of Lake St. Lawrence associated with the construction of the Seaway in the 1950's probably increased the mobilization of mercury from the sediments to the water. This would serve as an upstream source but the impact of the contribution would be felt more in Lake St. Lawrence than Lake St. Francis. The contribution of this mercury to the overall upstream load to the area of concern is unknown, however mercury levels in sediments and fish further upstream are similar to those found in Lake St. Lawrence.

Overall, because of the tremendous flow in the St. Lawrence River and the dilution capacity, the ambient concentrations of inorganic contaminants including the contaminants of concern, mercury and zinc, tend to be at

Table 6-7 Chemical Water Quality Results in the St. Lawrence River at Cornwall, 1985 (after Anderson, 1990)

Parameter	PWQO	MRA[†]	Upstream of Cornwall Max	Min	Mean[*]	S.D.	%>PWQO	%>MRA[‡]	0-1.4 km Downstream of International Bridge Max	Min	Mean[*]	S.D.	%>PWQO	%>MRA[‡]
Phenolics (µg/L) (4AAP Reactive)	1	0.2	3.4	0.6[§]	1.7	0.99	75	100	13.2	ND	2.9	1.95	92	98.6
Cond (umho/cm)	-		321	316	318.7	1.5	-	100	439	316	322.3	19.65	-	100
Fluorides (mg/L)	-		0.12	0.11	0.115	0.01	-	100	0.13	0.11	0.12	0.006	-	100
TR-1,2-Dichloro-ethylene (µg/L)	-	0	ND	ND	ND	-	-	100	2	ND	ND	-	-	8.3
Chloroform (µg/L)	1,200[¶~]	0	ND	ND	ND	-	-	0	11	ND	ND	-	0	8.3
1,1-Trichloroethane (µg/L)	5,300[††]	0	ND	ND	ND	-	0	0	4	ND	ND	-	-	8.3
Toluene (µg/L)	60[††]	0	ND	ND	ND	-	-	0	27	ND	ND	-	0	8.3
Tetrachloroethylene (µg/L)	310[††]	0	ND	ND	ND	-	0	0	3	ND	ND	-	-	16.7
Phenol (µg/L)	60	0	1	ND	ND	-	-	25	0.069	ND	0.004	-	0	57
Vanillin (ng/L)	-	0	Not Analyzed						8	ND	ND	-	-	43
Guaiacol (ng/L)	-	0	Not Analyzed						40,000	30	5,748	15,104	-	100
Acetovanillone (ng/L)		0	Not Analyzed						11	ND	7	-	-	71

Parameter	PWQO	MRA	3-5 km Downstream of International Bridge Max	Min	Mean[*]	S.D.	%>PWQO	%>MRA[‡]	6-14 km Downstream of International Bridge Max	Min	Mean[*]	S.D.	%>PWQO	%>MRA[‡]
Phenolics (µg/L) (4AAP Reactive)	1	0.2	18	1.8	4.01	1.99	100	100	23	0.8§	6.18	6.82	95	100
Cond (umho/cm)	-		447	316	324.9	16.1	-	100	322	315	318.2	1.97	-	100
Sulphates (mg/L)	-		107.86	25.25	30.37	11.48	-	100	Not Analyzed					
Fluorides (mg/L)			0.14	0.12	0.13	0.008	-	100	0.14	0.12	0.13	0.007	-	100
Zinc (mg/L)	0.03		0.44	0.001	0.049	0.083	32	100	Not Analyzed					
Carbon disulphide (µg/L)	1,000[~]	0.03	0.6	ND	0.13	-	-	86	Not Analyzed					
Dimethyl sulphide (µg/L)	-	0.03	0.09	ND	ND	-	-	33	Not Analyzed					

[*] Mean = median for parameters with NDs
[†] MRA = minimum reportable amount
[‡] % >MRA = % detected
[§] Result is tentative
[¶] Total trihalomethanes guide, 1 ppm
[~] Interim guideline
[††] EPA objective (24 hour average)

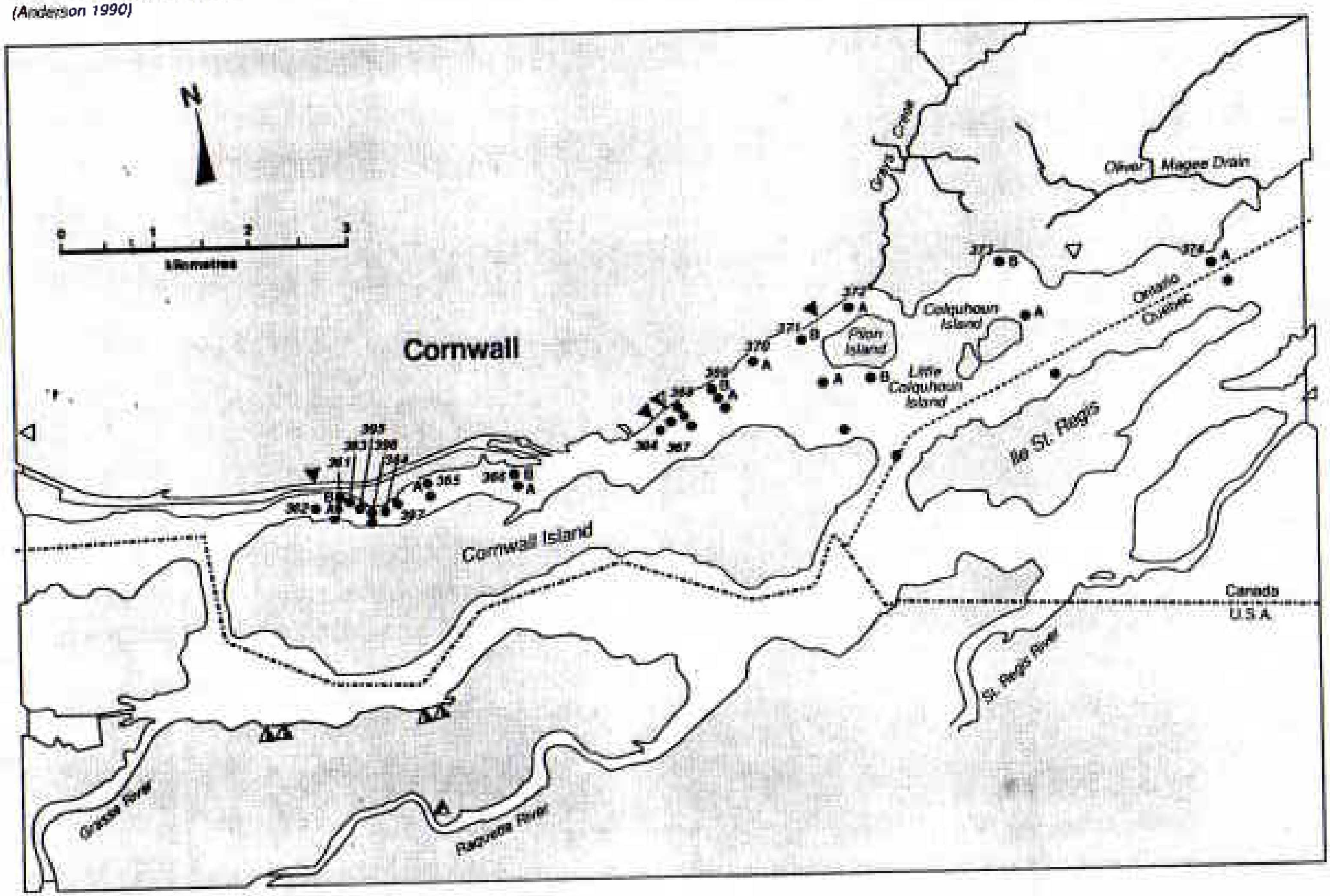
Note: For Phenolics with only one ND: ND set to MRA to calculate mean.
Stations (includes transect stations where applicable): upstream of Cornwall: 362
0-1.4 km downstream: 361, 363, 364, 365, 395, 396, 397, speciated phenolics analyzed for 361 only
3-5 km downstream: 367, 368, 369, 370, 394 (vicinity of Courtaulds)
6-14 km downstream: 371, 372, 373, 374

figure 6-5

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Station locations for 1985 surveys

(Anderson 1990)



△ Intake
▲ Outfall (in pipe)
Δ Outfall (in river at shore)

figure 6-6

St. Lawrence Remedial Action Plan

Mercury concentrations and estimated load from Cornwall effluent discharges, 1988

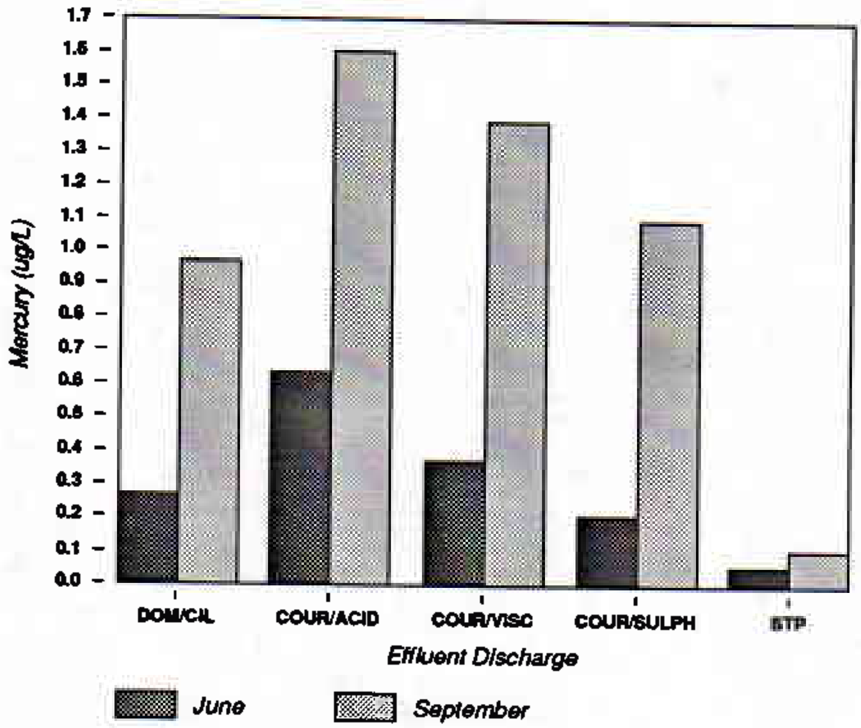
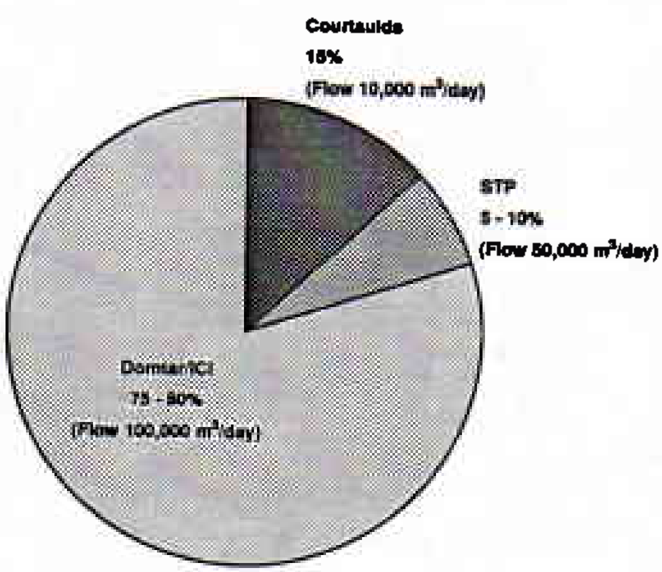


figure 6

Percentage estimated loading from Cornwall discharges, 1988



low levels. The exception to this is in the immediate vicinity of direct discharges, particularly the Courtaulds' diffuser and shore-based sewers.

6.1.4 Organic Contaminants

The PCB concentrations in this section of the St. Lawrence River are rarely below 1 ng/L, the Provincial Water Quality Objective (Environment Ontario, 1984) and the Canadian Council of Resource and Environment Ministers guideline for the protection of freshwater aquatic life (CCREM, 1987) (Anderson & Biberhofer, (in press)). The range of values observed from at the upstream stations over all seven surveys in 1988 was 0.89-4.215 ng/L. The stations on the U.S. side had the highest levels in the study with a maximum of 15.69 ng/L in survey 1 at Station 5 in the south channel closest to Yellow Island (Figure 6-7). This location is likely influenced more than the others on this transect by the industrial sources in Massena because of the flow regime. Industries (ALCOA, Reynolds, General Motors) discharging to the Grasse and Raquette Rivers and along the south shore of the St. Lawrence River are the main sources of PCBs in this area. All Cornwall industrial and municipal whole effluent samples in the 1988 investigation (Anderson & Biberhofer, (in press)) were below detection in both surveys although PCBs were detected twice in the suspended solids analysis of the effluent from Courtaulds Fibres and Courtaulds Films (closed 1989) (see Section 6.2.1).

PCB levels in this area of the St. Lawrence River have been a concern for over a decade. Water samples taken near the Grasse River mouth had PCBs at concentrations five times those found in the Domtar effluent in 1979 (Kauss *et al.*, 1988). The range of values found was similar to the range found in water samples collected during 1977 by Environment Canada (Chan, 1980). PCBs were not commonly detected in water along the north shore of the St. Lawrence River in the Cornwall area. Some concentrations in water of the north and south channels between 1977 and 1987 (Figures 6-7 to 6-10) above the detection limit (10 ng/L), however, have been reported by Sylvestre (1989). Both Domtar and the Cornwall WPCP have had very low levels in their discharges. Loadings from these two plants in 1979 ranged from 20 to 58 g/day and 1 to 9 g/day, respectively (Kauss *et al.*, 1988). A single detection of PCBs in water was observed at the Cornwall Water Treatment Plant in 1979 (0.090 μg/L raw water, Appendix I, Kauss *et al.*, 1988). Lake Ontario data (Neilson & Stevens, 1987) indicate that the upstream background level would be around 1 ng/L.

The 1988 survey number 5, which was conducted in August, had the highest levels of PCBs observed at many of the stations (3-6, 8-10 and 19) including the southern most station (3) on the transect in the north channel (Figure 6-3). This location would be influenced more than the others on this transect by the Massena PCB sources due to the flow regime. Dispersion modelling results from this reach of the St. Lawrence River have also shown a tendency for the U.S. sources of PCB contamination to impact this area of the river including the potential for an impact on the Glen Walter water treatment plant intake (Nettleton, 1988). Regular water quality monitoring of this section of the river by Environment Canada, Quebec Region has shown increases in PCB concentrations in August 1988 and other years as well (NAQUADAT, 1988). There are no apparent explanations for the observed higher levels during the month of August.

During the 1979 Environment Ontario investigation, organochlorine pesticides such as dieldrin, p,p'-DDD, o,p'-DDT, p,p'-DDT and endosulphan were detected, on at least one occasion, in the vicinity of all of the major tributaries, in the Cornwall Canal and near Reynolds Metals, General Motors and Courtaulds discharges at levels in excess of Provincial Water Quality Objectives and the Great Lakes Water Quality Agreement Specific Objectives (see Appendix I). Environment Canada (Quebec Region) measured concentrations of DDT and metabolites in excess of the Provincial Water Quality Objective (0.003 μg/L) in water samples from the St. Lawrence River in the channels north and south of Cornwall Island (Sylvestre, 1989).

Generally, the analyses for organochlorine pesticides were reported as non-detected or at very low levels in 1988. No results were found to be in excess of available Provincial Water Quality Objectives.

The 1988 observations (Anderson & Biberhofer, (in press)) the results from 1979, 1980, 1982 (Kauss *et al.),* 1985 studies (Table 6-7) indicate that the pesticide levels found throughout this reach of the river generally represent background St. Lawrence River levels. Occasional detections of organochlorine pesticides in water have been observed, however, they do not indicate a major source in the Cornwall-Massena area. Some detections of α, β and γ-BHC were observed in the liquid effluent from all sources in 1988. Heptachlorobenzene, Heptachlor, α and γ-Chlordane and Oxychlordane were also detected, however, these levels in effluent are low (see Section 7.1). Local sources of pesticides also include agricultural activities in the watersheds draining into the St. Lawrence River. This is shown, for example, by the relatively high concentrations of p,p'-DDD found at the stations within the lower channel of the Raisin River (Stations 55 and 57, Figure 6-4 and Appendix I).

Sampling during 1979 revealed the presence of total phenols (4AAP reactive) in Cornwall nearshore waters (range = 1 to 5 µg/L) occasionally above the Provincial Water Quality and Great Lakes Water Quality Agreement Objectives of 1 µg/L set to protect against fish tainting and taste and odour problems in water supplies. In Cornwall, sources of phenolic wastes have been attributed to discharges from Domtar and the WPCP.

In 1980, the highest concentration of total phenolics in river waters along the Ontario shoreline occurred at sampling sites near the Domtar/ICI (formerly CIL)/Cornwall Chemicals combined outfall with concentrations decreasing downriver (Kauss *et al.*, 1988). In a 1985 Environment Ontario investigation to measure effluent dispersion in the river, 94 percent of the samples were in excess of the total phenolic objective (range = not detected to 24 µg/L) (Nettleton, 1990; Anderson, 1990). These do not reflect ambient river conditions as the 1985 sampling program was designed to measure levels close to the actual source.

In response to questions regarding the application of the current Provincial Water Quality Objective for total phenols, Environment Ontario established an *ad hoc* working group. It's report, "The Significance of Phenolic Compounds in Ontario's Water" (de Barros, 1984) concluded that, depending on the nature of the individual phenolic compounds, the existing Provincial Water Quality objectives may be either too stringent or too lenient and it is therefore of limited value. The group recommended that new objectives be established for a number of individual phenolic compounds in place of the single 4AAP objective. The new guidelines are based on tainting thresholds (monochlorophenols, 7 µg/L; dichlorophenols, 0.2 µg/L) and on acute toxicity (trichlorophenols, 18 µg/L; tetrachlorophenols, 1 µg/L; and pentachlorophenol, 0.5 µg/L) (McKee *et al.*, 1984). Environment Ontario has since adopted these objectives.

Chlorinated phenols were found in river water samples in 1979 (Kauss *et al.*, 1988). As with total phenolics, levels were the highest downstream of the Domtar/ICI (formerly CIL)/Cornwall Chemicals outfall. The compounds identified were the same as those found in effluent samples: 2,3,6-trichlorophenol and pentachlorophenol. Concentrations of pentachlorophenol were in excess of the 0.5 µg/L Provincial Water Quality Objective. They note concentrations varying from 0.20 µg/L at the Cornwall Water Treatment Plant intake to 1.20 µg/L as far downstream as the mouth of the Raisin River. Concentrations in the same range were also found in some water samples from the mouths of the Grasse, Raquette and St. Regis Rivers and near the outfalls of Reynolds Metals and general motors in Massena (Kauss *et al.*, 1988).

In 1985, speciated phenolics (phenolic compounds) analysis were performed on river water samples taken in the vicinity of the Domtar/ICI (formerly CIL)/Cornwall Chemicals discharge and neither trichlorophenol or pentachlorophenol were detected. Vanillin, acetovanillone and phenol (hydroxybenzene) were detected in 3, 5 and 4 of seven samples, respectively. Guaiacol was measured in all of the seven samples with a maximum concentration of 40 µg/L (Table 6-7). There are presently no objectives set for guaiacol in water, however Shumway and Palensky (1973) reported a threshold level for fish tainting at 100 µg/L. The phenol concentrations (maximum 0.069 µg/L) were well below the United States Environmental Protection Agency's objective of 600 µg/L.

figure 6-7

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Total PCB concentrations (ng/L) in the St. Lawrence River, 1988

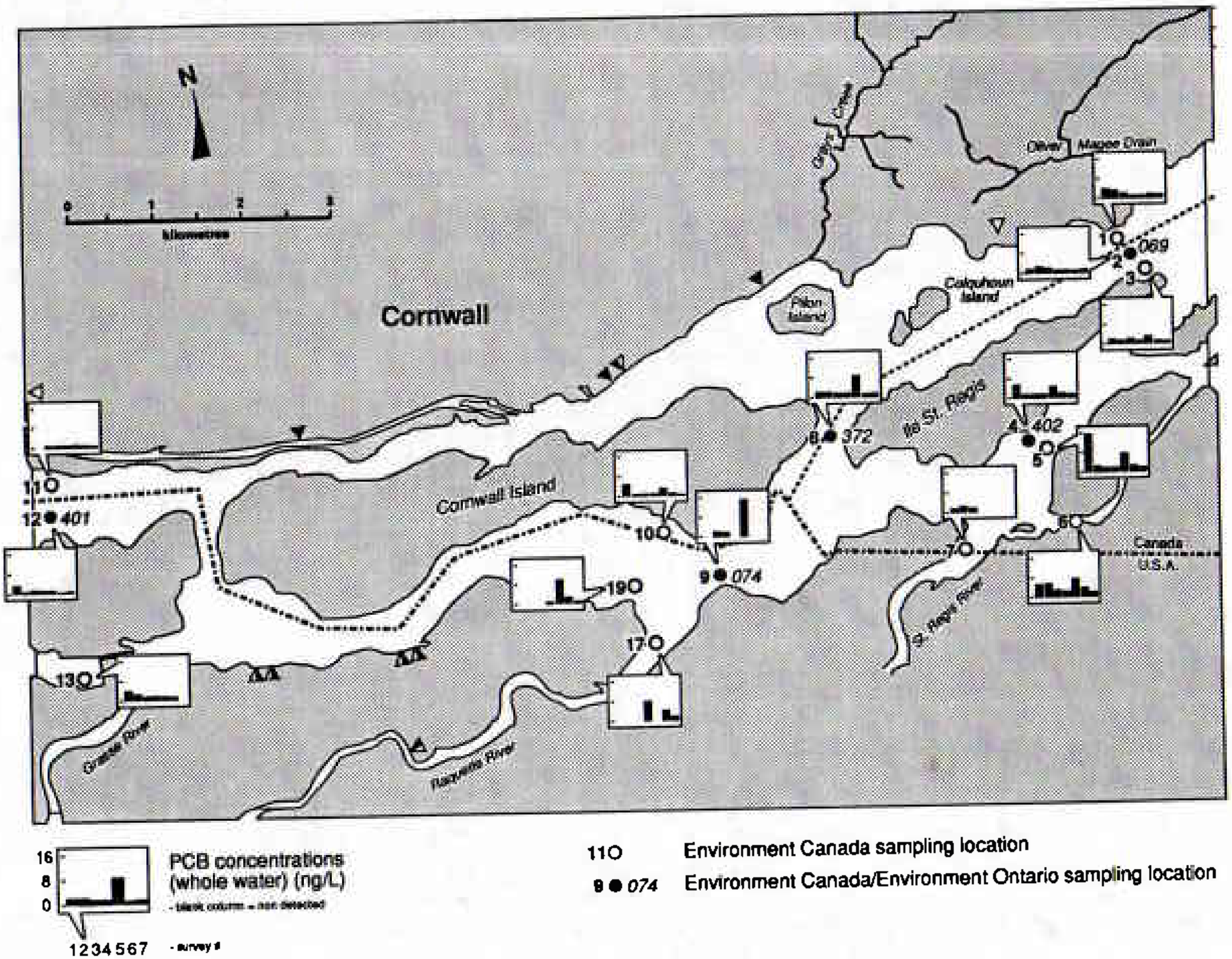
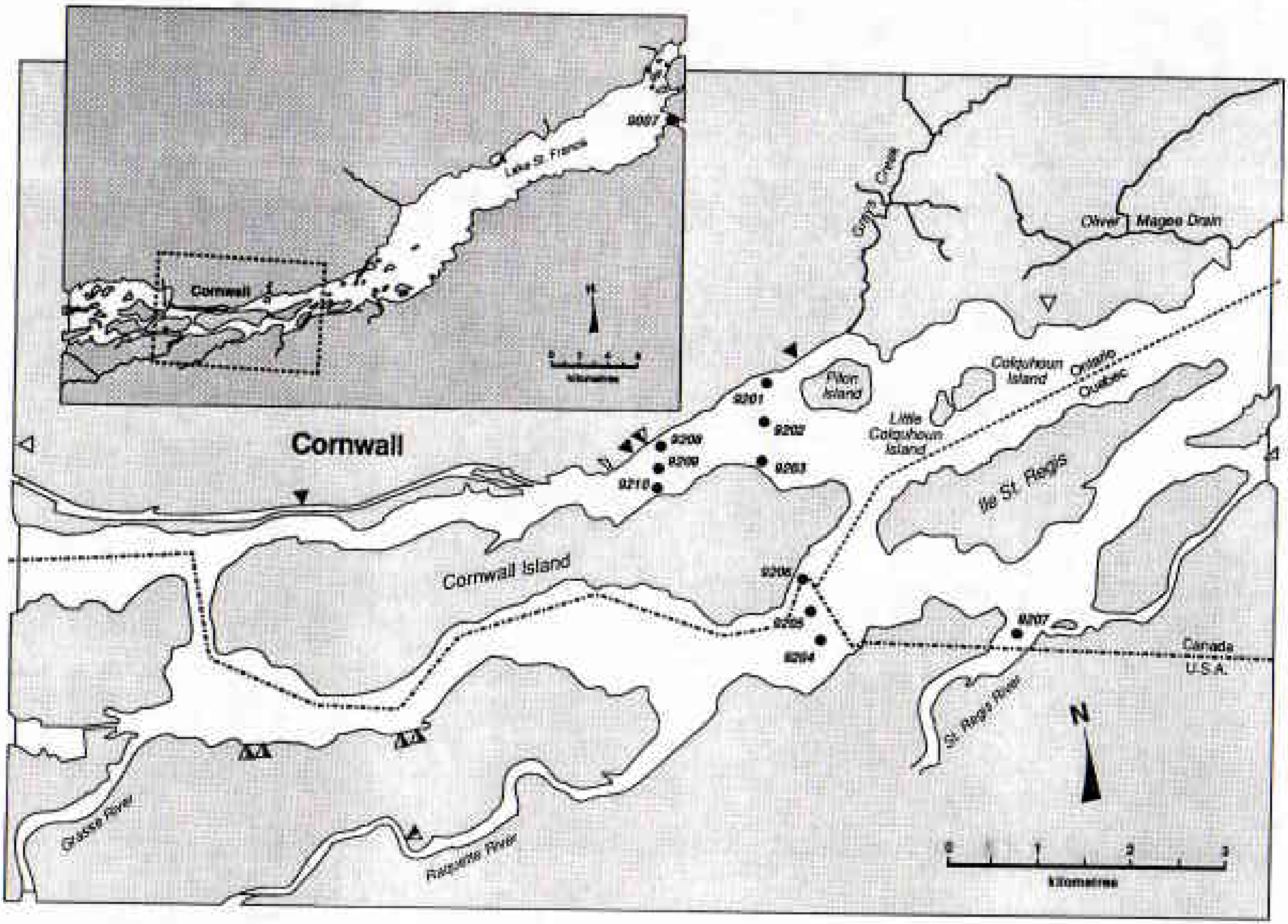


Figure 6-8

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Station locations for Inland Water's Directorate Quebec Region surveys

(cited in Sylvestre 1985)



△ Intake
▲ Outfall (in pipe)
▲ Outfall (in river at shore)

Figure 6-9

St. Lawrence Remedial Action Plan

PCB concentrations in water samples north of Cornwall Island

(after Sylvestre, 1989)

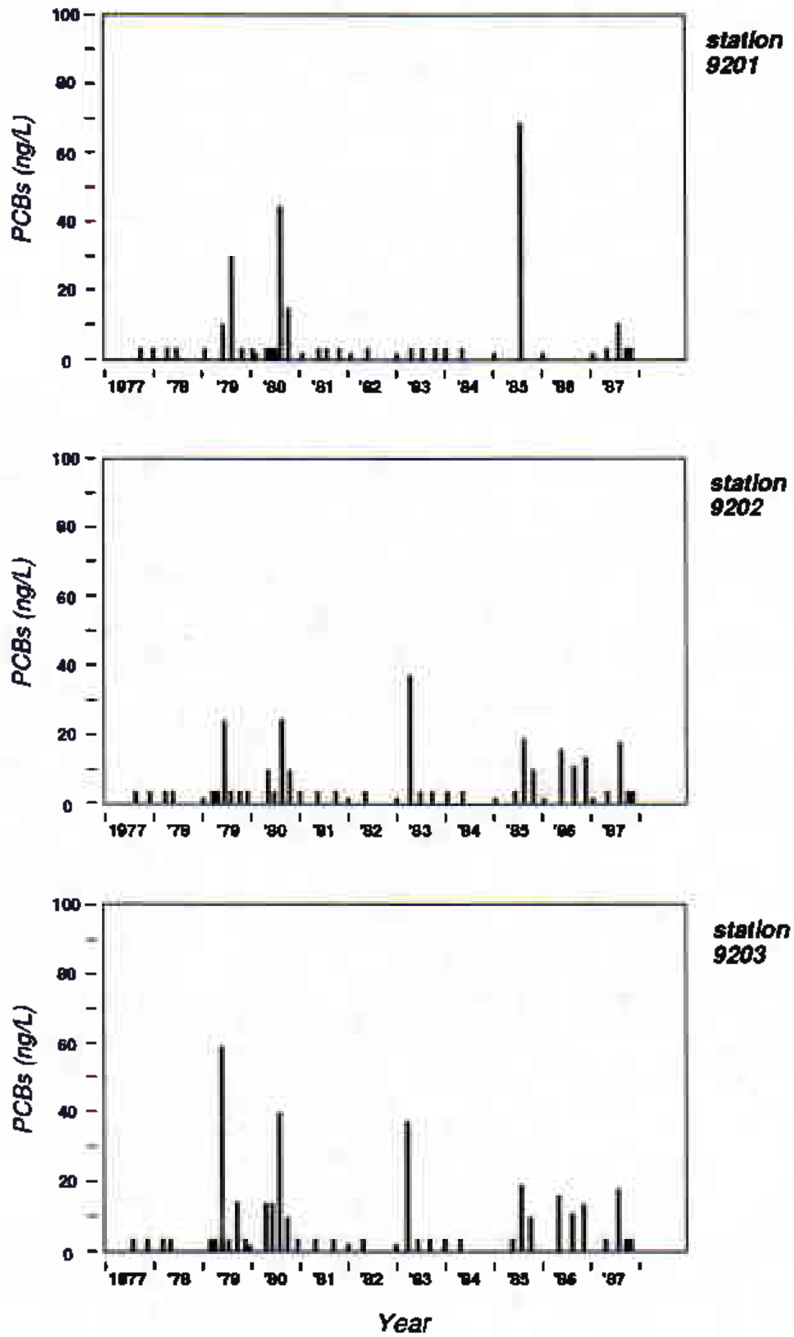
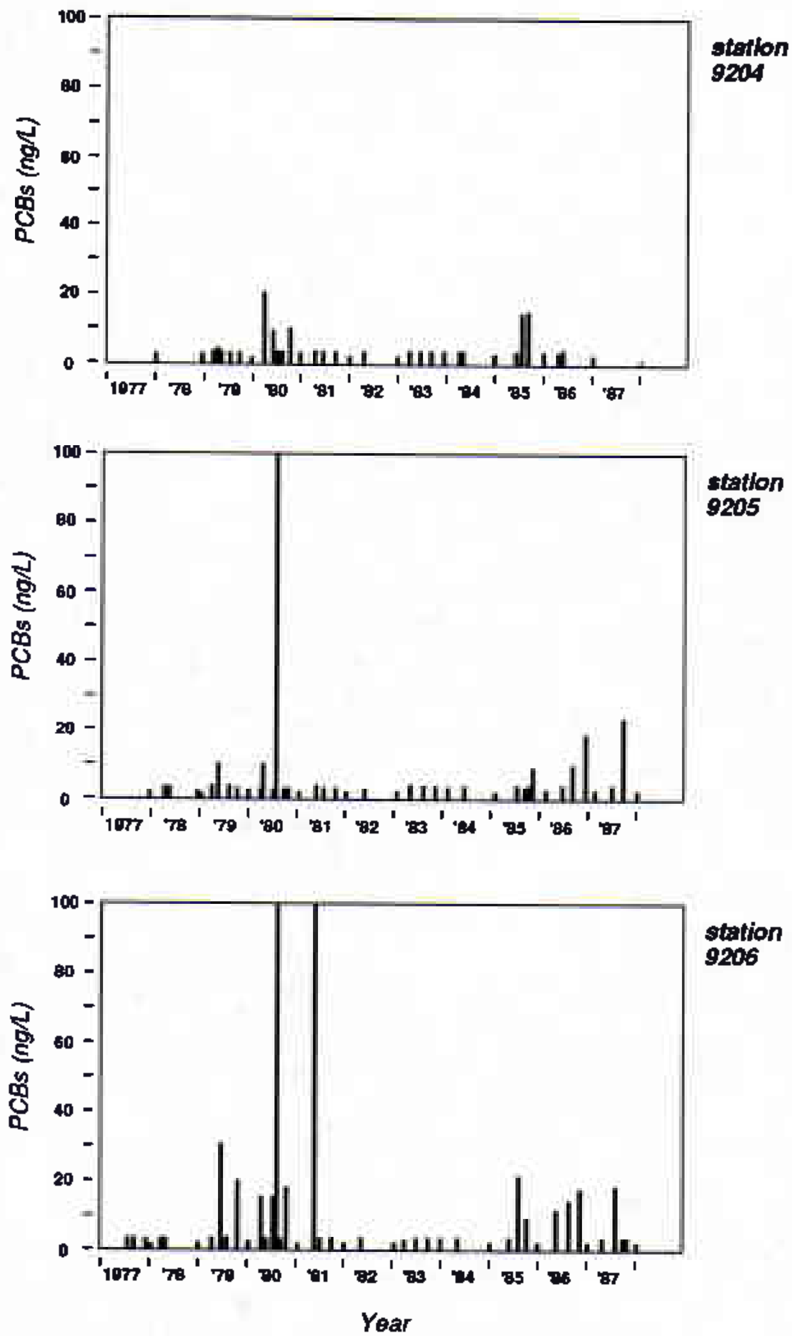


Figure 6-10

St. Lawrence Remedial Action Plan

PCB concentrations in water samples south of Cornwall Island

(after Sylvestre, 1989)



The majority of samples collected in the river for chlorophenol analysis in the 1988 study were non-detected and no PWQOs were exceeded. Station 1 often had the highest levels observed during some of the surveys. This location is not subject to any known direct discharges. 2,4,5 Trichlorophenol was detected only once at station 1 (survey 6) at 0.66 ng/L. Pentachlorophenol and phenol were detected most frequently during the surveys but no pattern in the sample results was apparent.

In both June and September 1988, 2,4,6 Trichlorophenol was found in the Domtar/ICI (formerly CIL)/Cornwall Chemicals whole effluent at 160 and 439 ng/L respectively. This effluent also represented a source of Pentachlorophenol as did the STP at levels of 225 ng/L. The STP effluent also contained concentrations of 2,4,6 Trichlorophenol and 2,4,5 Trichlorophenol. Courtaulds discharges contained lesser amounts of all of the above compounds (see Section 7.1 for a full discussion of effluent characteristics).

The toxicity of phenolics varies with the type of compound and they may taint the flavour of fish at levels that do not appear to adversely affect fish health. Currently, there is some evidence of tainted fish from this area of the St. Lawrence. A large portion of the reactive phenols present in Cornwall effluents (specifically Domtar) however, tend to be non-tainting in nature.

In 1985, analysis of water in the area of concern for volatile hydrocarbons showed carbon tetrachloride levels of 10-330 ng/L tetrachloroethylene at 65 and 190,000 ng/L, fluorotrichloromethane levels between 22 and 3500 ng/L, 1,1,1-trichloroethane between 14 and 18,000 ng/L and chloroform levels of 14 to 200 ng/L (Lum and Kaiser, 1986). There are few guidelines or objectives for these parameters. The Canadian Council of Resource and Environment Ministers (CCREM, 1987) has established a tentative guideline for tetrachloroethylene of 260,000 ng/L for the protection of aquatic life. This guideline was not exceeded in the samples collected by Lum and Kaiser (1986). The Quebec human health criteria for tetrachloroethylene, however, is 800 ng/L (Ministere de l'Environnement, 1989). Quebec has also established a human health guideline of 190 ng/L for fluorotrichloromethane. New York State has established a surface water guideline for chloroform 200 ng/L (New York State Department of Environmental Conservation, 1987) which is at the upper concentration determined by Lum and Kaiser (1986).

Carbon tetrachloride levels in 1988 were within the range observed in 1985 with the exception of one measurement at 17,800 ng/L (Anderson & Biberhofer, (in press)). All volatile analysis test results for the above sample were abnormally high, were not confirmed in the duplicate analysis of this station and are therefore regarded as questionable. The remaining results were within the ranges found by Lum & Kaiser with many below the detection limits. Chloroform was found at station 1 (Figure 6-3) at levels frequently above the 200 ng/L New York guideline. As with the chlorophenol results at the same station (1), there are no known sources in this area of the river. Overall, the levels of volatiles in the St. Lawrence River were low or not detected. Benzene was found frequently at levels ranging from not detected to 1430 ng/L (the questionable sample result from station 8, survey 2 of 16,600 ng/L was disregarded). Benzene is moderately toxic to fish and has an 96hr LC50 at <100 mg/L (100,000,000 ng/L). The observed levels do not represent a concern for aquatic life.

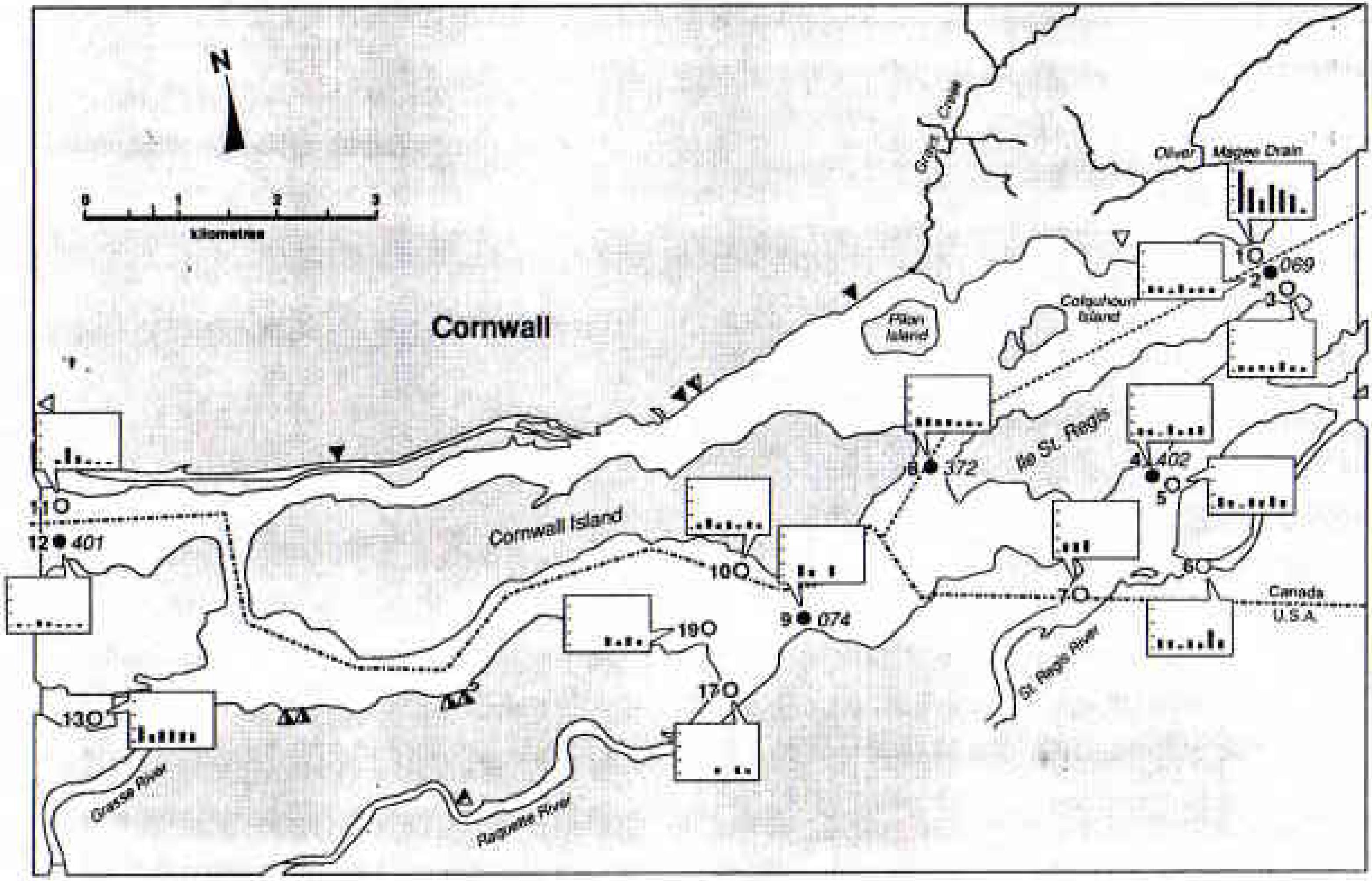
Levels of chlorinated benzenes were typically non-detected or less than 1.5 ng/L in river water in 1988. Of those compounds detected, 1,2 and 1,4-Dichlorobenzene were most frequently found. No spatial or temporal patterns in the sample results were apparent and the values reported were consistent with upstream concentrations. Most of the 1988 liquid effluent results for chlorinated benzenes were also non-detected. All detections of chlorinated benzenes were under 65 ng/L and no pentachlorobenzene was detected in either June or September.

Station 1 was consistently high in Polycyclic Aromatic Hydrocarbon (PAH) levels during the 1988 surveys (Figure 6-11). The main compounds observed were Fluoranthene, Pyrene, Chrysene, and benzo(a)anthracene with high levels particularly during survey 1. There are presently no Water Quality Objectives established for these compounds in water. The pattern of results do not indicate any substantial input from the U.S. side of the

figure 6-11

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Total PAH concentrations (ng/L) in the St. Lawrence River, 1988



30
20
10
0
1 2 3 4 5 6 7 - survey

PAH concentrations (whole water) (ng/L)

- blank column = non detected

11O Environment Canada sampling location

9 ● 074 Environment Canada/Environment Ontario sampling location

river although the Massena industrial sites have been documented as sites of PAH contamination (refer to Massena RAP Stage I Report, NYDEC, 1990). One compound, Bis (2-eh)phthalate was detected in concentrations ranging from 9.84 to 797.74 ng/L with no particular pattern. The Provincial Objective based on current toxicity data for this compound is set at 600 ng/L (Environment Ontario, 1984). As a plasticizer with common usage in consumer products (eg. Armorall), this phthalate tends to be ubiquitous in the environment. Occasional levels in excess of this objective are not of concern.

When the liquid (24 hr composite) effluents were sampled, the majority of the test results were non-detected or at trace levels. In the June survey when the analyses were performed however, using a lower limit of detection, the combined Domtar/ICI (formerly CIL)/Cornwall Chemicals effluent was found to contain levels of Anthracene, Fluoranthene, Pyrene and Benzo(e)pyrene in the 400 to 700 ng/L range and levels of Benzo(a)anthracene, Benzo(k)fluoranthene and Benzo(a)pyrene at lower levels. Trace levels of a number of other PAH compounds were also detected.

6.1.5 Drinking Water

Results (1987) from Environment Ontario's Drinking Water Surveillance Program (DWSP) show that the quality of treated water at Cornwall is not impaired. Analytical results were consistent with those obtained from other areas of the Great Lakes; occasional detections of organics occurred, and some deterioration due to bacterial contamination appeared during spring run off, however, the levels found in treated drinking water did not exceed Ontario Drinking Water Objectives.

The drinking water intake for Cornwall is located in Lake St. Lawrence upstream of the power dam at a depth of 18.3 metres. Raw and treated water were analyzed five times in 1987, once each month from March 23 to July 27 for which results are available (see Appendix II).

Two raw water and three treated water samples contained traces of lindane, all raw water and three treated water samples contained traces of α-BHC (breakdown product of lindane). No other pesticides were found above detection limits.

Chloroform levels ranged from trace levels in 2 raw water samples to 28.9 to 44.7 μg/L in treated water. Dichlorobromomethane levels ranged from trace in one raw water sample to 12.25 to 15.0 μg/L in treated water. Total trihalomethanes were detected in two raw water samples at 0.5 and 1.5 μg/L and in all treated water samples at between 45.15 and 64.7 μg/L.

Pentachlorobenzene occurred once at a trace level in raw water and was not detected in treated water. Trace levels of 1,2,3 and 1,3,5-Trichlorobenzene were found in two treated water samples.

Zinc, cadmium, copper, mercury, lead and PCBs were below detection limits in raw and treated water with the exception of 0.014 mg/L in treated water in March and of 0.002 mg/L of copper in May and June.

The maximum raw water bacteria readings were found in March at 159/100 ml fecal coliform and 3200/100 ml total coliforms. Only one treated water sample (June) showed any bacteria (total coliform count of 1.0/100 ml).

6.2 Sediment Quality

6.2.1 Suspended Sediments

A 1979 survey (Kauss *et al.*, 1988) yielded information on concentrations of PCBs, ether solubles (oils and greases) and heavy metals associated with suspended sediments in the St. Lawrence River (Appendix III). The highest concentrations of chromium, lead, mercury, zinc and PCBs associated with suspended particulates along the north shore of the river were near the Courtaulds outfalls. The following section summarizes the 1988 suspended sediment collection which was performed in conjunction with the water quality sampling program (Appendix III). A full presentation of the study findings is contained in Anderson & Biberhofer, (in press).

Nutrients

The results for the 1988 analysis of suspended solids were inconclusive with regard to spatial differences in concentrations. Analytical difficulties were experienced at the laboratory and few results are available. As expected, the nutrient content (total phosphorus, total Kjeldahl Nitrogen) of the suspended solids is high. The concentrations were well in excess of the guidelines for the open water disposal of dredged sediments. The abundance of phytoplankton in the St. Lawrence River system and low silt content may account for much of the nutrient content in the particulate fraction of the river water.

Nutrients associated with the suspended solids in the effluents are typically low. Unfortunately the analyses for the STP discharge are unavailable. By comparison to the background St. Lawrence River levels, the inputs from local sources do not appear to influence the conditions in this section of the river.

Inorganic Contaminants

Elevated levels of copper, nickel, zinc, iron, cadmium and chromium were observed at all stations sampled for suspended sediments in the river. When compared with the Provincial guidelines for the open water disposal of dredged sediments, all of the above metals exceeded the available guidelines at every station: Copper (25 µg/g), Nickel (25 µg/g), Zinc (100 µg/g), Iron (10,000 µg/g), Cadmium (µg/g), Chromium (25 µg/g). In addition, lead and arsenic levels were slightly elevated at a few stations.

Mercury in suspended solids in the water column ranged from 0.11 to 0.25 µg/g (dry weight). At these concentrations, mercury in bottom sediments would still be acceptable for open water disposal if dredged. The guideline is 0.3 µg/g.

The Courtaulds plants in the 1988 survey has the highest mercury, zinc, copper and lead concentrations in the suspended solids component of the effluents. These results confirm the 1979 river monitoring results for suspended solids in Kauss *et al.* (1988). An Environment Ontario report on sediment quality in the Cornwall area based on 1985 bottom sediment concentrations indicated that local sources of the same inorganic contaminants are responsible for concentrations in sediment which exceed the Provincial Guidelines for open water disposal of dredged sediments (Anderson, 1990).

Organic Contaminants

PCB concentrations in suspended sediments collected by sediment traps during a 1985-86 study at two stations in Lake St. Francis were 29 and 110 ng/g (Kaiser *et al.*, 1989). Merriman (1988) reported a PCB concentration of 1800 µg/kg on suspended sediment collected in 1981 at the mouth of the Grasse River.

Trace levels of PCBs (< 130 ng/g) in the suspended solids at station 74 (Figure 6-3) were found in the June 1988 sampling at the mouth of the Raquette River. The remainder of the available PCB analyses were non-detected. In June, PCBs were found in Courtaulds Acid effluent discharge at 725 ng/g and at trace levels (< 75 ng/g) in the sulphide discharge. Most of the results for the September survey were unavailable with the exception of the combined Domtar/ICI (formerly CIL)/Cornwall Chemicals effluent which was non-detected. Although some sporadic detections of PCBs are found in effluents and in the river, the major source is from the U.S. side of the river. PCBs at trace levels tend to be ubiquitous in the aquatic environment as shown by levels at the upstream locations and at Wolfe Island (see Section 7.5.2) and Cornwall sources do not appear to be significant.

Generally the organochlorine pesticide results in the river and effluents in 1988 were non-detected as well with a few trace levels of HCB and p,p'-DDD found. A majority of the results for samples taken in September were unavailable however it may be concluded that there are no significant sources of organochlorine pesticides in the Cornwall/Massena area. Low background/upstream levels are likely due to Lake Ontario levels and agricultural inputs along the length of the river.

No chlorinated benzene results were available from the September 1988 survey of suspended solids in the river. In the June survey, 2,4,5-trichlorotoluene was found at station 069 in the north channel downstream of Cornwall at 37.0 ng/g and at station 74 at 13.0 ng/g. All other available results were non-detected or at trace levels. In June, all the industrial effluent results were unavailable. The STP analyses were all non-detected with the exception of pentachlorobenzene at 13 ng/g. In September as well, all results were unavailable, non-detected or trace.

The majority of both the river and effluent results were unavailable from the 1988 sampling however, 2,4,6 trichlorophenol was detected in the Courtaulds sulphide sewer (134.00 ng/g) in June and in the acid sewer (240 ng/g) in September. All of the chlorinated phenolics analyzed were not detected in the Courtaulds acid sewer in June when most were found in the September sampling. The sporadic nature of the results emphasizes the variability of effluent discharges.

The highest levels of PAHs in suspended solids were observed at Station 372 between Cornwall Island and St. Regis Island in 1988 (Figure 6-12). Total PAHs in June were 6.54 $\mu g/g$ and 2.55 $\mu g/g$ in September with the most prevalent compounds being Fluoranthene, Pyrene, Benzo(a)anthracene, Benzo(b)fluorene and Benzo(a)pyrene. Benzo(a)pyrene is regarded as a potent carcinogen and mutagen (MOE, 1984), however, concentrations in water during the same surveys were at trace levels. Industrial sites in Massena are a source of PAHs to this section of the St. Lawrence River as supported by the presence of these compounds at station 372. The combined discharge of Domtar/ICI (formerly CIL)/Cornwall Chemicals represents a source of PAH compounds where up to 23.77 $\mu g/g$ (dry weight) total PAHs were observed in June and 18.66 $\mu g/g$ in September, 1988. The compounds which comprise over 70% of that total are Phenanthrene, Fluoranthene, Pyrene and Chrysene. Courtaulds Fibres, Courtaulds Films (closed 1989) and the STP also had detectable levels of PAHs in their effluent discharges. No elevated PAH levels downstream of the Cornwall discharges were noted in the suspended solids analyses.

6.2.2 Bottom Sediments

6.2.2.1 Physical

The fast flow of the St. Lawrence River along the north shore and the resultant particle sorting is evident from the high proportion of gravel downriver from the Domtar/ICI (formerly CIL)/Cornwall Chemicals diffuser outfall, where up to 60 percent gravel and 19 percent very coarse sand were found in 1979 (Kauss *et al.*, 1988). Further downstream, a widening and deepening of the channel results in a decrease in current velocity along the north shore. This results in the deposition not only of gravel and sand, but also of the finer particulates.

High silt content was also characteristic of bottom sediment samples collected in and near the mouths of tributaries to this section of the St. Lawrence River. Paired comparison of 1979 and 1985 grain size results showed no significant difference in particle size distribution between the two surveys (Anderson, 1990).

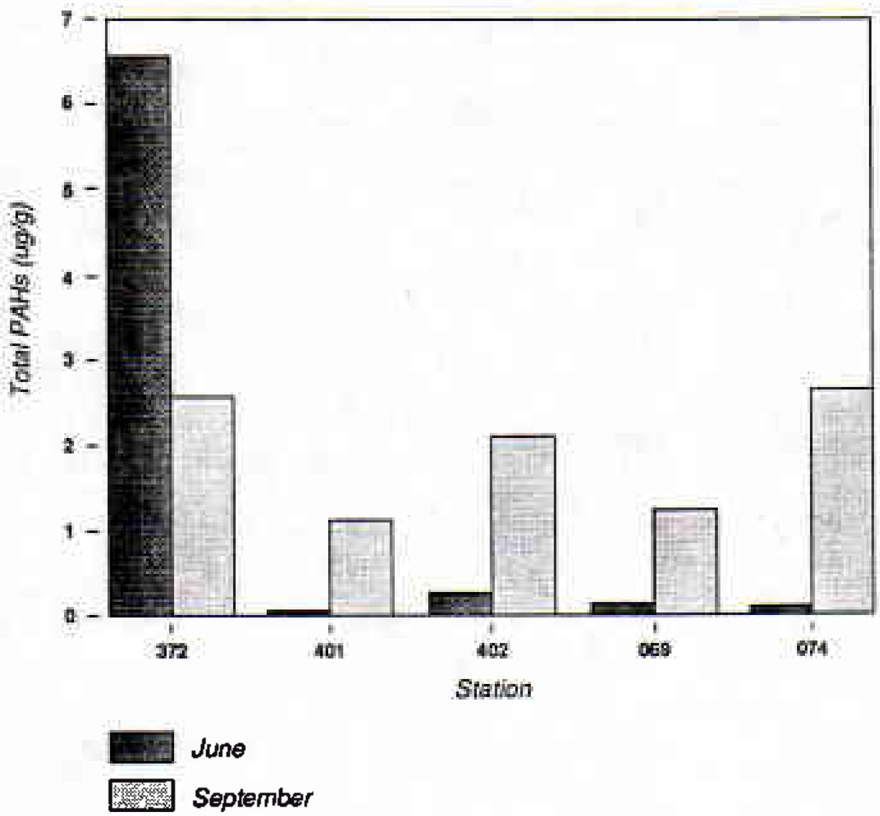
6.2.2.2 Chemical

This section is based on bottom sediments collected during surveys undertaken in 1979 and 1985 by Environment Ontario.

figure 6-12

St. Lawrence Remedial Action Plan

Total PAHs in suspended sediment in the St. Lawrence River at Cornwall, 1988



The results of the 1979 sediment survey indicate high concentrations of various contaminants in sediments downstream of the mouths of rivers in both Ontario and New York (Kauss *et al.*, 1988). Kauss *et al.* (1988) note that samples taken adjacent to industrial outfalls indicate no direct evidence of discharge of the contaminants in question. They suggest that this is a result of high flow in the St. Lawrence River which entrains suspended particulates and associated contaminants introduced to the river via effluents. The fine-grained sediments tend be deposited in the quiescent reaches such as embayments and river mouths downstream of source areas. These are the zones of low energy or depositional areas (Thomas *et al.*, 1972). Kauss *et al.* (1988) indicate, however, that exceedences of Provincial guidelines for open water disposal of dredged material occur for cadmium, chromium, copper, iron, lead, mercury and zinc in sediments located in the vicinity and downstream of outfalls, particularly those of Domtar and Courtaulds.

Concentrations of total phosphorus, nitrogen, total carbon and total organic carbon in sediments along the north shore in 1979 were highest downstream of major sources, for example, in the vicinity of Courtaulds Fibres/Courtaulds Films (closed 1989) complex and at the mouth of Raisin River. The Environment Ontario guidelines for the open water disposal of dredged material for total phosphorus and total Kjeldahl nitrogen (TKN) are 1.0 mg/g and 2 mg/g, respectively. The phosphorus guideline was exceeded in 9 percent of the samples in 1985 while the TKN guideline was exceeded in 56 percent of the samples. The highest concentrations of total phosphorus and total nitrogen were found downstream of Courtaulds and around Pilon Island in 1985 (Anderson, 1990). Table 6-8 summarizes the results of the 1985 sediment survey.

6.2.2.3 PCBs and Other Organic Contaminants

North shore sediments in 1979 also contained elevated levels of PCBs generally exceeding the Environment Ontario guideline (50 μg/kg) for open water disposal by a factor of 2 or less. Near the Courtaulds outfalls, however, sediments exceeded the guideline by a factor of 53. Bottom sediments collected in 1981 by Merriman (1988) near Cornwall and at the mouth of the Grasse River had PCB concentrations of 850 and 8740 μg/kg, respectively. These exceed Ontario's open water disposal guideline by 17 to 170 times. In 1985, approximately 60 percent of the north shore sediment samples exceeded the guideline for PCBs (Table 6-10). The highest levels were found near Courtaulds with values up to 20 times the guideline. These data are insufficient, however, to establish any trend.

Of the organic contaminants, PCB inputs from the Cornwall and Massena areas had the farthest-reaching impact, as indicated by detectable levels in downstream sediments in the vicinity of Ile St. Regis and the entrance to Lake St. Francis. This, as well as the overall differences between north and south channel PCB concentrations, is consistent with the results of studies conducted by Environment Canada in Lake St. Francis between 1979 and 1981 (Sloterdijk, 1985). These studies found that PCB concentrations were highest at the entrance to Lake St. Francis and along the south channel (Figure 6-13). The 1985 study also shows the highest PCB levels along the south channel (Figure 6-14). As well, sediment cores taken in 1985-86 in Lake St. Francis show PCB levels ranging from 46 to 530 ng/g (Kaiser *et al.*, 1989).

As part of the national dioxin survey, river sediments in the vicinity of the Domtar discharge were analyzed for dioxin in the fall of 1989. Sediment samples were collected upstream and downstream of the Domtar diffuser (Trudel, 1991). The limited nature of the sampling program restricts the conclusions which can be drawn and therefore is regarded as preliminary information only. Fish tissue analysis for dioxins and furans included are not available at this time.

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans were detected in sediment downstream from Domtar. Upstream values were unreliable so there is no "control" site for comparison. Specifically, hepta (7CDD) and octa (8CDD) chlorinated dibenzo-p-dioxins were found, as well as penta (5CDF), hexa (6CDF), hepta (7CDF) and octa (8CDF) chlorinated dibenzofurans. Each of these groups of compounds are referred to as congeners. The report describes the sediment contamination as "high" based on the toxic

Table 6-8 Summary of Sediment Chemistry in the St. Lawrence River at Cornwall-Massena, 1985 (Anderson, 1990).

Parameter	Provincial Dredging Guideline	North Channel				South Channel			
		Mean*	S.D.	Range	% > Guideline	Mean*	S.D.	Range	% > Guideline
Total Phosphorus (mg/g)	1.0	0.78	0.17	0.43-1.09	8.7	0.65	0.25	0.24-1.12	11.0
Total Kjeldahl Nitrogen (mg/g)	2.0	2.2	1.4	0.4-5.1	56.0	1.3	0.93	0.2-3	28.0
Oils and Greases (μg/g)	1,500	2,918	3,419	256-16,748	74.0	1,335	1,284	12-5,479	33.0
Arsenic	8.0	3.50	1.82	1.21-6.96	0.0	2.44	1.31	0.41-5.11	0.0
Cadmium	1.0	0.4	-	ND-1.3	8.7	0.25	-	ND-0.98	0.0
Chromium	25	35.1	16.4	14-82	65.0	31.1	16	6.2-64	50.0
Copper	25	26.2	27.6	6.8-125	52.0	17	-	ND-63	28.0
Iron	10,000	12,922	3,507	6,600-19,000	74.0	13,600	5,925	5,500-25,000	61.0
Lead	50	33.9	53	3.4-270	4.4	15	10.4	2.3-37	0.0
Mercury	0.3	0.55	0.9	0.01-4.4	39.0	0.13	0.23	0.01-0.8	11.0
Zinc	100	319.7	771.7	19-3,800	48.0	77	48.9	14-210	22.0
Nickel	25	14.9	8.3	5.50-37.00	4.3	11.7	6.8	2.20-26.00	5.5
PCBs Total (ng/g)	50	60	-	ND-1,010	59.0	135	-	ND-13,750	61.0
Aldrin		ND	-	ND-33	-	-	-	ND	-
Dieldrin		ND	-	ND-27	-	ND	-	ND-22	-
α-BHC		-	-	ND	-	-	-	ND	-
β-BHC		-	-	ND	-	-	-	ND	-
γ-BHC		-	-	ND	-	-	-	ND	-
α-Chlordane		ND	-	ND-12	-	-	-	ND	-
γ-Chlordane		ND	-	ND-12	-	-	-	ND	-
o,p-DDT		-	-	ND	-	ND	-	ND	-
p,p'-DDT		-	-	ND	-	ND	-	ND-9	-
p,p'-DDD		-	-	ND	-	ND	-	ND-6	-
p,p'-DDE		ND	-	ND-6	-	ND	-	ND-2	-
Endrin		ND	-	ND-1	-	-	-	ND-1	-
Heptachlor		-	-	ND	-	ND	-	ND	-
Heptachlor epoxide		ND	-	ND-10	-	-	-	ND-10	-
Hexachlorobenzene		ND	-	ND-14	-	-	-	ND	-
Mirex		-	-	ND	-	-	-	ND	-
Endosulphan I		ND	-	ND-4	-	-	-	ND	-
Endosulphan II		ND	-	ND-10	-	-	-	ND	-
Endosulphan sulphate		ND	-	ND-22	-	ND	-	ND-9	-

* Mean = median for samples with NDs
ND – not detected

Figure 6-13

St. Lawrence Remedial Action Plan - Cornwall - Massena Study Area

Distribution pattern of PCB concentration (ng/g, dry weight) in Lake St-Francis sediments, 1981

(after Sloterdijk 1984)

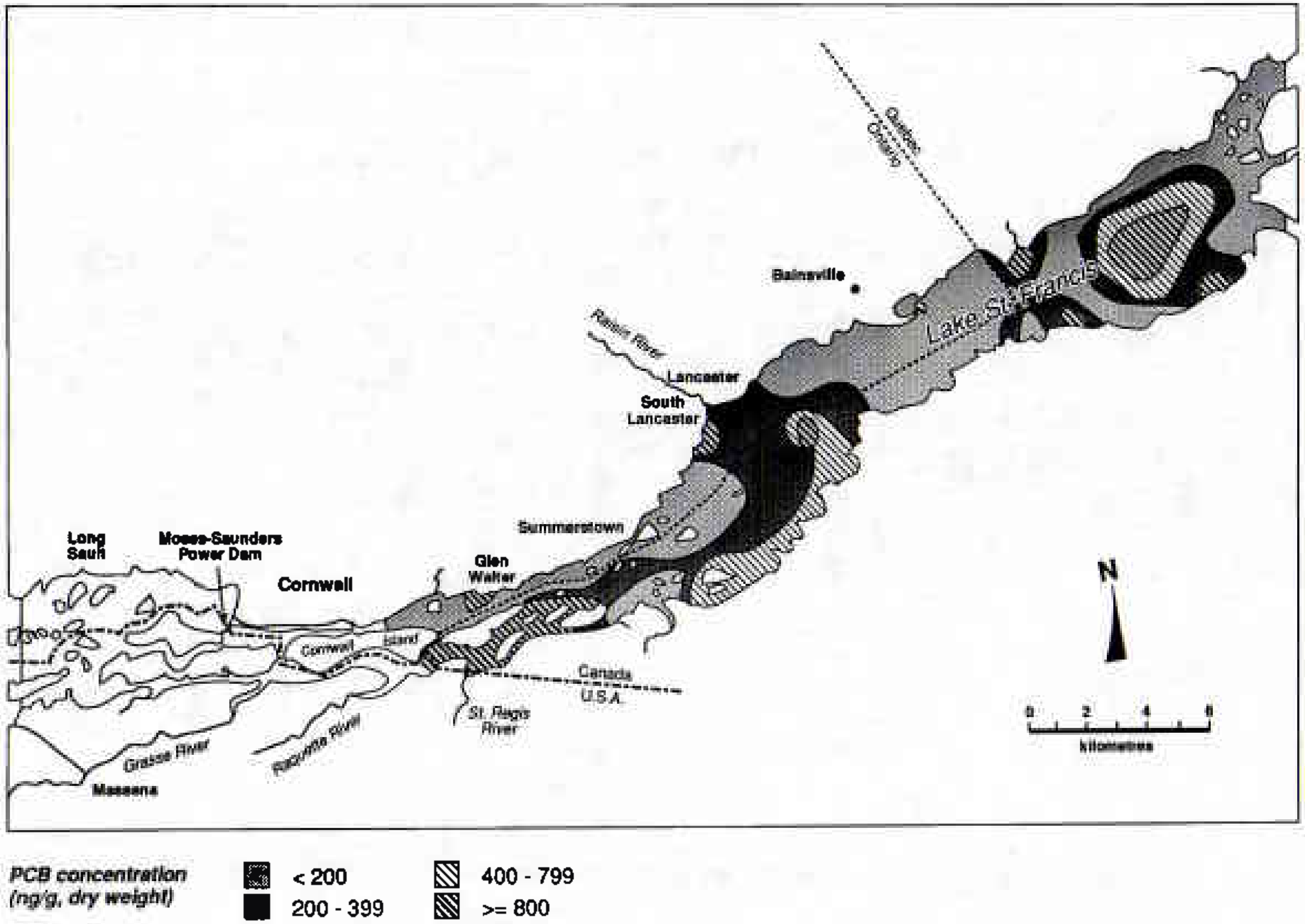
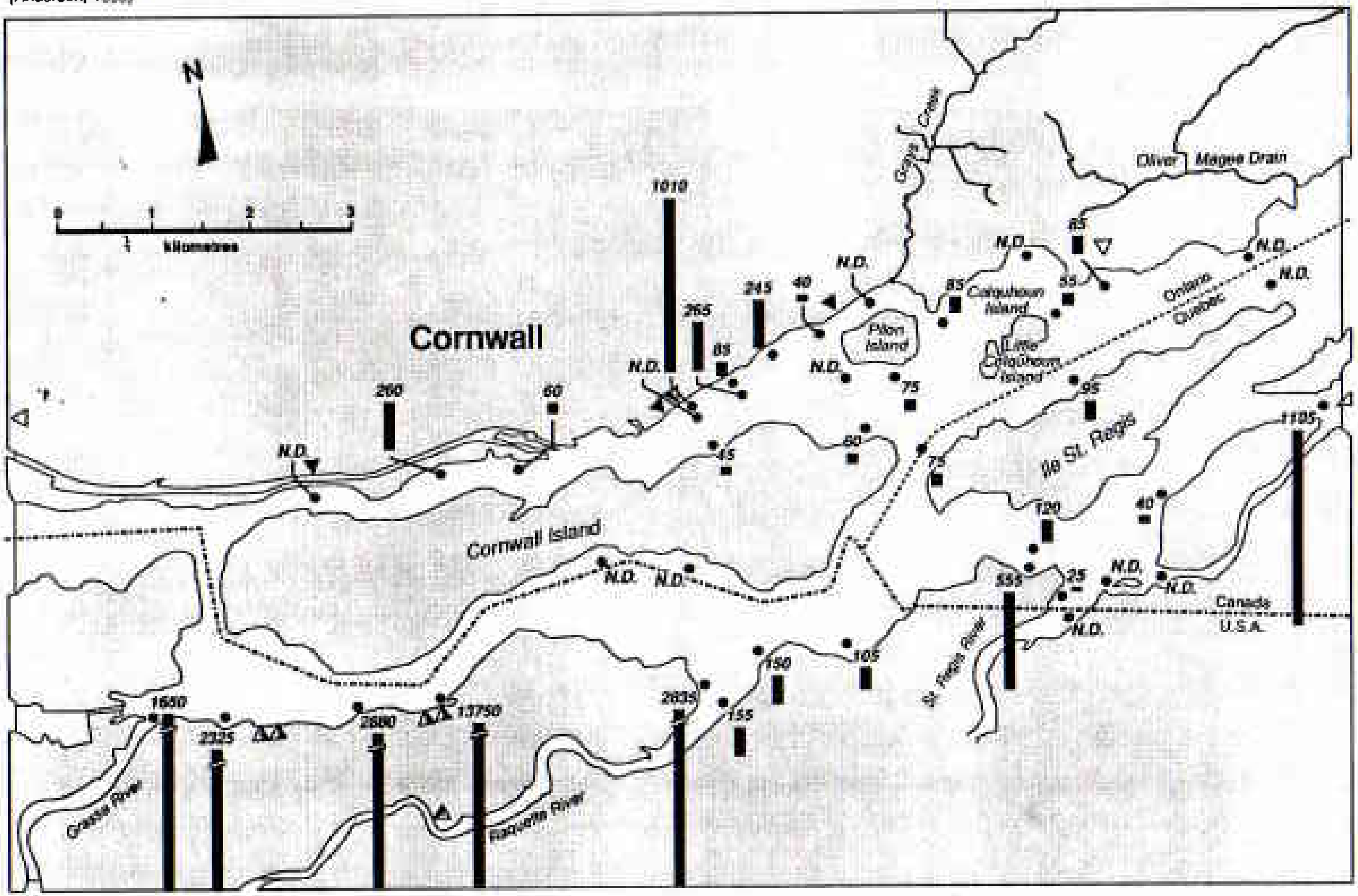


figure 6-14

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

PCB levels (ng/g) in sediment from the Cornwall-Massena reach of the St. Lawrence River, 1985

(Anderson, 1990)



△ Intake
▲ Outfall (in pipe)
▲ Outfall (in river at shore)

260 ▌ PCB levels in ng/g

equivalents of 2,3,7,8 TCDD. By using a "toxic equivalency factors" all congeners present are converted to the equivalent amount of 2,3,7,8 TCDD, since this is the most toxic compound in the family. This produces a "Toxicity Equivalent Value" which provides a uniform approach for summarizing the data rather than providing values for all the congeners listed above. This is then used as a yardstick or an indicator of particular problem areas but is not used as a measure of toxicity or hazard assessment. Based on this preliminary information, future sampling in this area is required to determine the extent (spatially and quantitatively) of dioxin/furan contaminated sediment and to determine food chain transfer and implications. Currently, there are no dioxin/furan sediment quality guidelines or criteria by which the significance of sediment contamination could be judged.

Dredging projects, either routine navigational work or special projects requiring permits, are subject to the guidelines for open water disposal for dredged material. Confined disposal is required for all sediments which do not meet the guidelines. The requirement for a confined disposal facility is regarded as one of the 14 impairments listed by the International Joint Commission for areas of concern.

6.2.2.4 Inorganic Contaminants

Mercury concentrations in sediments sampled in 1979 and 1985 along the Ontario shoreline of the river exceeded the Environment Ontario guideline for open water disposal (0.3 mg/kg). The highest mercury levels were detected in sediments near the Courtaulds shore-based discharge (Figure 6-15), however, these were lower than those observed in 1970 and 1975 (Table 6-9). In 1985, 40 percent of the samples collected along the Ontario shoreline exceeded the guideline.

As shown in Figure 6-16, Lake St. Francis sediment mercury levels also exceed 0.3 mg/kg in large areas of the lake (Sloterdijk, 1984). A sediment survey in Lake St. Francis was carried out in 1989 by the Centre Saint-Laurent to compare to the earlier results but the data are not available yet.

Ontario Guidelines for open water disposal of dredged material were exceeded for chromium and iron in at least 50% of the samples collected in 1985. Guidelines were exceeded for copper (41%) and zinc (37%) at several sampling sites in the north and south channel and in lead, nickel and cadmium at only a few locations. Except for iron, mean values for all inorganic contaminants were higher in the north channel than the south. Concentrations of most metals in the north channel exceeded the guidelines at stations along the shoreline. Concentrations of cadmium (>1 ppm) and chromium (>25 ppm) also exceeded Environment Ontario's open water disposal guidelines in Lake St. Francis at the Lancaster Bar (Environment Canada, 1988). Routine navigational dredging at the Lancaster Bar is therefore interpreted as an impairment in the area of concern. In addition, smaller dredging projects (eg. marina development) would be subject to restrictions for the disposal of sediments if the guidelines were not met at that location. Confined disposal facilities, at a minimum, are required for contaminated sediments.

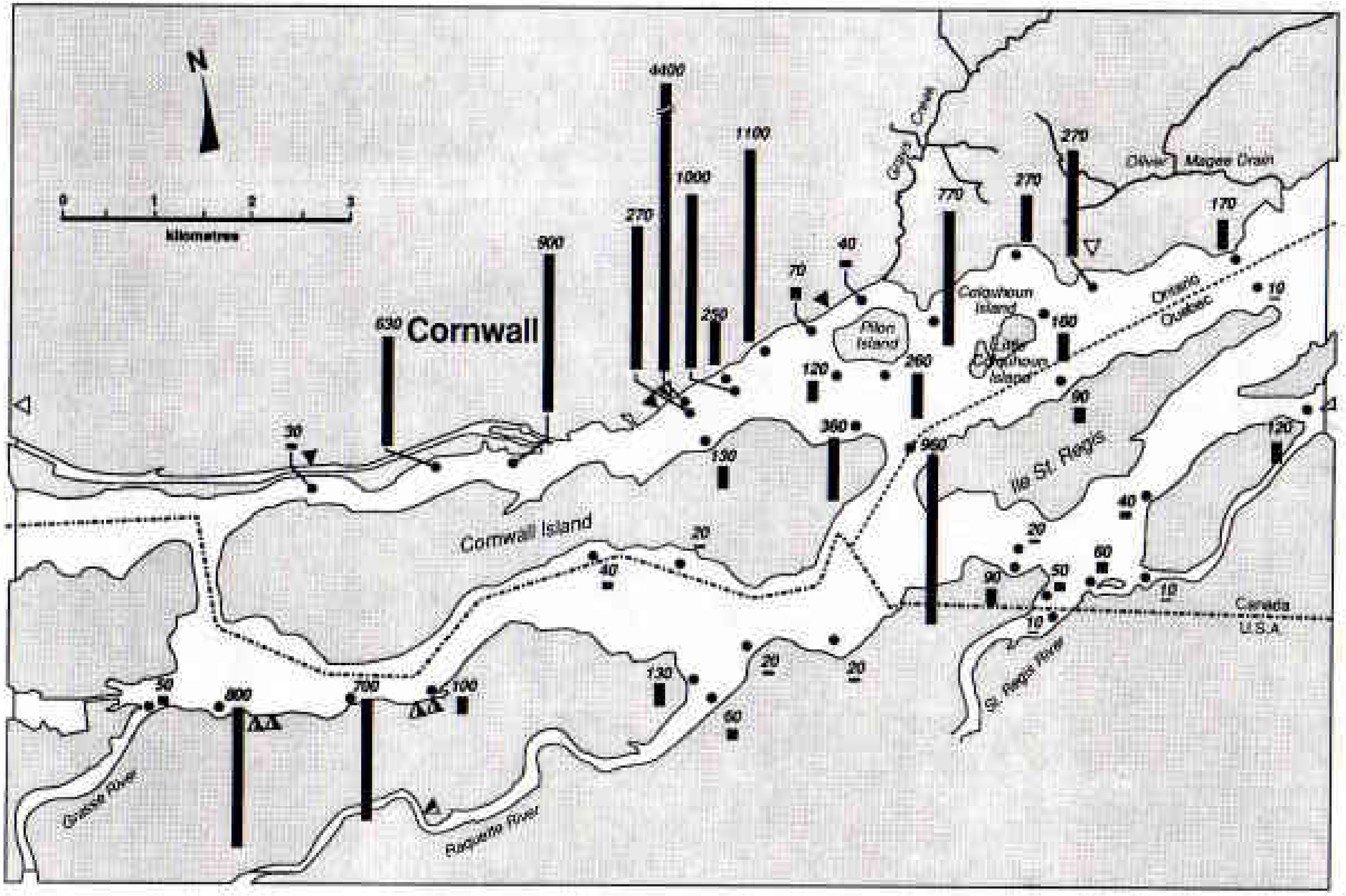
Provincial Sediment Quality Guidelines (Persaud et al, 1990) are based on the impact of contaminants on the benthic community. The guidelines are set according to three levels: (1) no-effect level; (2) lowest effect level; and (3) severe effect level. Based on the 1985 survey, concentrations of zinc, lead, copper, chromium, nickel, arsenic and cadmium were all greater than the "lowest effect level" at many sampling sites within the area of concern. This is the level of sediment contamination that can be tolerated by the majority of benthic organisms. Since concentrations were greater than this level the benthic communities in these areas may be impaired.

Concentrations were above the "severe effect level" (this is the sediment concentration of a compound that would be detrimental to the majority of benthic species), for zinc, lead and copper in the sediment at the Courtaulds Fibres/Courtaulds Films (closed 1990) discharger. This is the only location where the "severe effect level" was exceeded, however, the maximum concentrations observed in sediment in 1985 for arsenic, cadmium, chromium and nickel were also near or downstream of the Courtaulds Fibres/Courtaulds Films

Figure 6-15

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Mercury levels in sediment, 1985 (Anderson, 1990)



△ Intake
▲ Outfall (in pipe)
▲ Outfall (in river at shore)

260 ▮ mercury levels in hg/g

Table 6-9 Comparison of Sediment Mercury Concentrations with Distance Along the North Shore of the St. Lawrence River (Source: Anderson, 1990)

Area/Location	1970	1975	1979	1985*
Upstream of Cornwall	0.20 (0.06-0.29)	0.04 (0.02-0.09)	0.09 (0.06-0.12)	0.03†
0-1.4 km Downstream of CIL	4.7 (0.85-14.50)	5.69 (0.05-18.2)	6.80 (1.50-19.8)	0.63†
3-5 km Downstream of CIL (in vicinity of Courtaulds BCL)	14.23 (1.24-35.85)	9.51 (0.62-44.0)	5.40 (0.13-18.0)	1.19 (0.13-4.4)
6-14 km Downstream of CIL (area around and downstream of Pilon Island)	5.87 (4.00-7.74)	1.87 (0.20-5.87)	0.68 (0.16-1.80)	0.30 (0.01-0.97)

NOTE: Values are means of samples in each area.
Range of values in brackets.

* Stations (1985): Upstream of Cornwall: 362
0-1.4 km Downstream: 365
3-5 km Downstream: 368, 369, 370
6-14 km Downstream: 371, 372, 373, 374, 375, 376

† Only one sample analyzed

(closed 1990) outfall. Concentrations of lead and zinc in Courtaulds Fibres/Courtaulds Films (closed 1990) effluent were higher than concentrations in Courtaulds's intake and the Provincial Water Quality Objective for zinc was exceeded in 32% of the samples collected near Courtaulds Fibres/Courtaulds Films. In 1988, Courtaulds Fibres/Courtaulds Films effluents had high concentrations of zinc, copper and lead in the suspended solid fraction (Anderson & Biberhofer, (in press)). Based on this information Courtaulds Fibres/Courtaulds Films was likely the source of these contaminants found in the sediment in this area, however, the 1985 study showed that the spatial distribution of arsenic, cadmium, chromium, iron and nickel in the area of concern is such that there are no major local sources of these parameters. Upstream loadings are likely responsible for these metals.

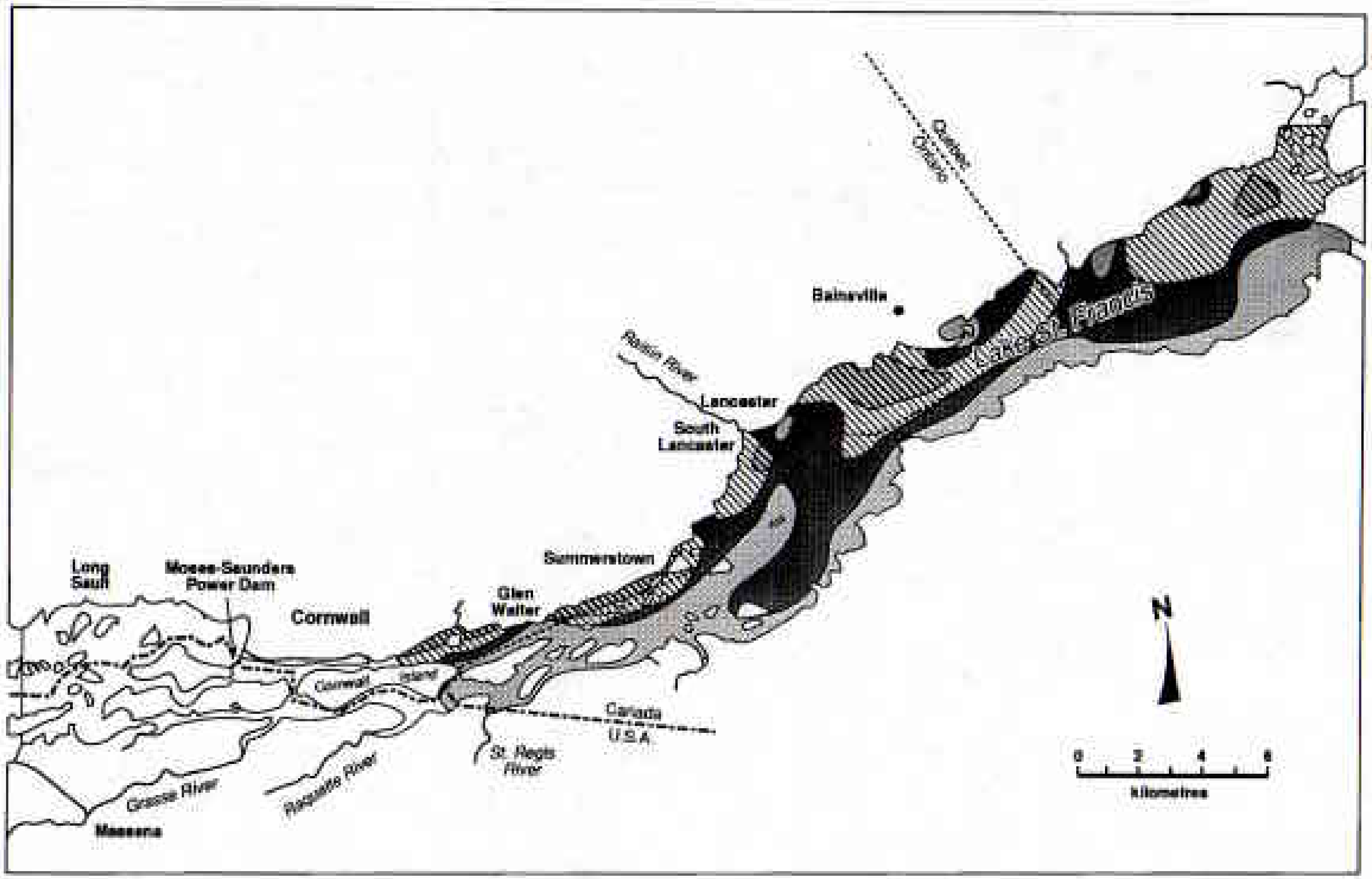
The direct impact on the benthic community is unknown, however, a 1985 Environment Ontario study (Griffiths, 1988) found that the invertebrate community at the Courtaulds Fibres/Courtaulds Films outfall and several sites downriver had lower species richness compared with less contaminated sites. As well, the species composition suggested degraded environmental conditions. These communities were likely impaired because of high organic matter enrichment, poor oxygen conditions, the presence of coarse particulate organic matter and possibly metal toxicity. The absence of insects (with the exception of chironomids) and low density of snails from the site at the Courtaulds Fibres/Courtaulds Films diffuser suggests metal toxicity to these fauna. The high concentrations of zinc, oils and greases present in the sediment may be an important determining factor at many of these stations.

Figure 6-16

St. Lawrence Remedial Action Plan - Cornwall - Massena Study Area

Distribution pattern of mercury concentration (ng/g, dry weight) in Lake St-Francis sediments, 1981

(Sloterdijk 1984)



Hg concentration (ng/g, dry weight)

- < 150
- 150 - 299
- 300 - 599
- >= 600

6.3 Biota

6.3.1 Benthic Invertebrates

A July 1985 benthic invertebrate survey by Environment Ontario (Griffiths, 1988) showed zones of impaired environmental quality in the north channel caused by Cornwall point source discharges (eg. wood fibres and chips from Domtar) and oil and grease levels in sediments. Invertebrates were found at all stations sampled along the Cornwall waterfront, but communities were impaired compared with those of the south channel, where no point source effects on benthic communities were noted. Griffiths (1988) concludes that considerable improvement in the environmental quality has occurred since the previous benthic invertebrate survey carried out in 1966 by the former Ontario Water Resources Commission (Owen and Veal, 1968).

Six communities occurring at three or more of the 39 sampling stations were identified as follows: Community 1 was characterized by an abundance of the midges *Chironomus* and *Phaenopsectra*, the amphipod *Gammarus*, the clam *Pisidium* and the worm *Limnodrilus hoffmeisteri*; Community 2 by high species richness and lack of any abundant species; Community 3 by the abundance of *Gammarus*, *Chironomus* and the isopod *Asellus*; Community 4 by the abundance of *L. hoffmeisteri* and *Asellus*; Community 5 by the abundance of *Gammarus*, *L. hoffmeisteri*, *Asellus* and *Chironomus*; and Community 6 was characterized by the abundance of *Pisidium* (Griffiths, 1988). The locations of these six communities and the species compositions are listed in Appendix IV.

The 1985 study reports that benthic invertebrate communities have been altered by the probable addition to the sediment of coarse particulate organic matter (wood chips and fibres) from Domtar; zinc and hydrogen sulphide from Courtaulds; fine particulate organic matter, metals, oils and grease from the sewage treatment plant; and oil and grease from the Cornwall Port area. Figure 6-17 shows the locations of the environmental quality zones interpreted from this study.

As part of the Environment Ontario in-place-pollutant program, a benthic invertebrate survey was carried out at ten stations along the Cornwall waterfront in 1986 (Lomas, 1988). The main conclusions reached are as follows: 1) Benthic invertebrate distribution and density appear to be most affected by the organic content of the sediments and coupled with this, the occurrence of aquatic macrophytes. 2) No effects from other factors were evident despite visual observation of oil-like substances in the sediment and metal levels above Environment Ontario recommended guidelines (for open water disposal of dredged sediments).

6.3.2 Fisheries

6.3.2.1 Habitat

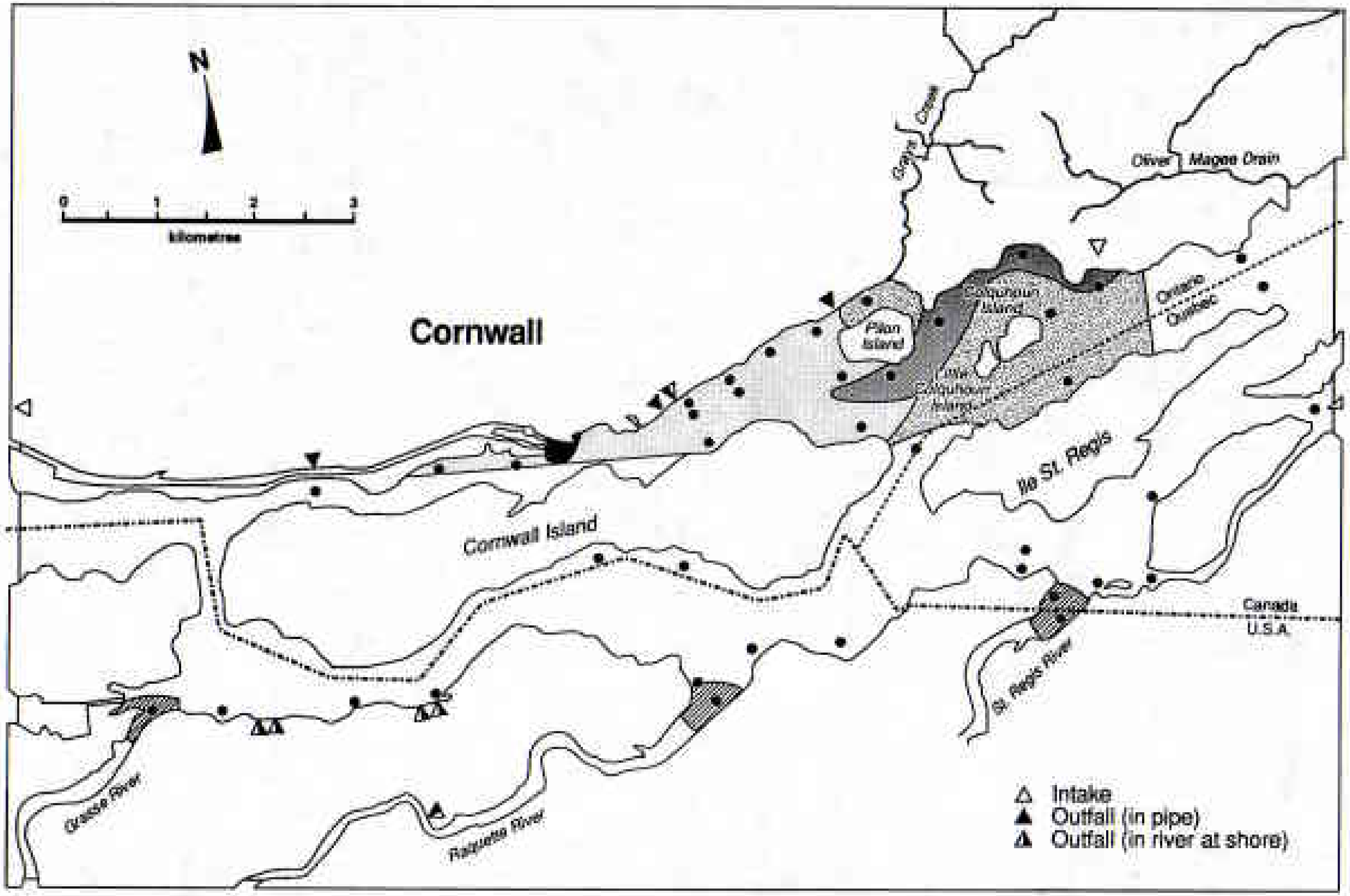
The single biggest impact on fisheries habitat in the Cornwall area has been the impoundment of Lake St. Francis for power generation in the 1800s and the construction of the St. Lawrence Seaway (1954-1958). The major alteration in water depth and current, as well as the massive dredging operations resulted in changes to sedimentation patterns and aquatic vegetation density and distribution (Owen and Wile, 1975).

They also presumably altered a number of sensitive habitats, such as spawning areas for walleye and sturgeon, as well as altering extensively the invertebrate and forage fish food web upon which all the major sport and commercial fish species depend.

Presently, activities such as shoreline development continue to threaten the nearshore, littoral zone fish habitat which is so crucial to maintenance of a diverse fish community. The continued degradation of the major

Figure 6-17

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area
Distribution of environment quality zones, July 1985
(Griffiths 1988)



Environmental Quality Zones

■ Degraded	affected by oils and grease	
▩ Degraded	affected by accumulations of coarse particulate organic matter, reduced oxygen concentrations and possible metal toxicity (Zn)	
□ Impaired	affected by accumulations of coarse particulate organic matter	
⊡ Slightly Impaired	affected by diluted wastes from upriver	
▨ Best	indicates less eutrophic conditions	

tributaries due to nutrient enrichment, channel modification and control of water discharge has reduced the suitability of sections of these streams as spawning and nursery habitat for a variety of species (i.e. walleye, perch, smallmouth bass) which use these areas seasonally.

The overall impact of hydro-electric power related construction and Seaway development in Lake St. Francis was to create a very productive, shallow-water reservoir which has a very fast flushing rate. The aquatic vegetation has remained relatively stable since 1975. Water level fluctuations in Lake St. Francis are minimal. The total area of Lake St. Francis is 24,373 ha of which 7,380 ha are in Ontario, 16,319 ha in Quebec and 674 ha in New York State. The mean depth is 5.5 m (whole lake) and 4.6 m (Ontario portion). The maximum depth is 22 m (Ontario Ministry of Natural Resources, 1987b).

The general water quality in Lake St. Francis, as it affects fish production, is adequate (Ontario Ministry of Natural Resources, 1987b). There is no thermal stratification due to the strong currents. The temperature regime is suitable for the coolwater-warmwater fish community reaching mainstream maxima of 20-23°C with higher temperatures in the sheltered embayments. Although occasional small fish kills in the spring have been reported in Lake St. Francis, the cause is not known. Dissolved oxygen, pH, turbidity, total dissolved solids (TDS) and alkalinity are all within tolerance ranges for all species (Ontario Ministry of Natural Resources, 1987b). The acute toxicity of some of the Cornwall effluents to fish is quite high (see Section 7.1.5 and Appendix XIV). However, the dilution of the effluents is so rapid once they enter the river that fish mortality in the river associated with these effluents has not been demonstrated.

Eutrophication was identified as a problem in the 1960s but a 1975 Environment Ontario study (Owen & Wile, 1975) indicated that nutrient levels had stabilized to some degree. In recent years, reports from commercial fishermen of algal build-up on their nets suggests a worsening problem, however, this needs to be quantified.

6.3.2.2 Toxic Effects on Fish and Fish Tumours

Of more concern, from a fisheries standpoint, is the levels of toxic contamination in the system. The focus of fisheries studies has been the measurement of body burdens of contaminants, the establishment of human consumption guidelines, the status of the fish community and the sport and commercial harvests.

Mercury levels in the fish (up to 2 mg/kg) appear to low enough to preclude any toxicological effects on the fish themselves (present when levels range from just less than 10 mg/kg up to 100 mg/kg). PCB levels in the main lake and the north channel are also low from a toxicological viewpoint. Locally elevated levels of some contaminants in sediment (i.e. zinc in the north channel) may be impacting slightly on the fish community's food web but the relative isolation of these disturbances means that the fish community across all of Lake St. Francis is probably not adversely affected. The presence of polycyclic aromatic hydrocarbons (PAH's) in the aquatic environment has been documented (see sections 6.1 Water Quality and 6.2 Sediment Quality) including benzo-a-pyrene which has carcinogenic properties and is a suspected cause of fish tumours. The 1988 levels of benzo-a-pyrene in water (Anderson & Biberhofer, (in press)) however, do not exceed the IJC recommended objective for the protection of aquatic life of 10 ng/L (IJC Ecosystems Objectives Committee Recommendation). For the protection of human health, the U.S. EPA has set an objective of 31 ng/L for total PAH's based on cancer risk over a lifetime from drinking water and consumption of fish. PAH levels observed are also below this objective in the St. Lawrence River.

The preliminary information from a 1990 survey of skin lesions and liver tumours in walleye and white suckers from Lake St. Francis however may be cause for concern. The tentative (not confirmed by histopathology) results showed liver abnormalities in walleye affecting approximately 20% of males sampled and 50% of females. Pending histopathological examinations, no conclusions can be drawn from this data, although the high frequency of occurrence remains problematic with respect to health effects on the fish themselves and consequently, on the fish community. Also present in the walleye population was lymphocystic and dermal sarcoma, skin conditions induced by viruses which do not indicate any toxic effect of chemicals. Analysis of the white sucker population is also pending. On a more positive note, it should be remembered that the fish community does not appear, based on the population assessment data, to have been catastrophically affected. The impacts of contaminants on the community either directly (on the fish themselves) or indirectly (through food web effects) may be exerting some influence on fish population abundance but this influence is not readily detectable using the relatively imprecise monitoring tools available.

6.3.2.3 Fish Production and Distribution

Lake St. Francis

As previously discussed, the fish habitat in this lake is productive for coolwater-warmwater species. Index netting indicates that yellow perch are particularly abundant and grow very quickly producing an excellent fishery.

Recent studies by the Ontario Ministry of Natural Resources indicate that the perch population has been stable over the past decade although year class strengths do fluctuate (Ontario Ministry of Natural Resources, 1987a). The population is heavily fished which has increased production but no decline in abundance has occurred. The critical spawning habitat for perch is characterized by shallow water (0.5-2.0 m) with emergent and/or submergent vegetation and is wind-protected (Ontario Ministry of Natural Resources, 1986). The diet of perch is comprised of numerous items but *Gammarus* is of particular importance as are emerald shiners and smaller perch. Snails are seasonally important.

Zooplankton such as ostrapods and copepods are important dietary items for young-of-the-year perch. All dietary plankton and invertebrate species require aquatic vegetation as an essential habitat component (Ontario Ministry of Natural Resources, 1986).

Northern pike populations are strong and stable and are presently not believed to be over-exploited (Ontario Ministry of Natural Resources, 1987a). Walleye have recovered in the system to fairly abundant levels following a population crash after Seaway construction. The major spawning area is the Raisin River. Walleye are heavily fished but the major factors thought to be controlling year-class strength are spawning success and the survival of young fish which have been enhanced by recent habitat rehabilitation efforts in the Raisin River.

Data on other fish species (smallmouth bass, bullhead, white sucker and crappie) are now being collected on a trend-through-time basis but no conclusions can be drawn regarding their status.

Muskellunge are relatively uncommon in the lake although a small trophy fishery exists (Ontario Ministry of Natural Resources, 1987a). Recent reports from anglers indicate that muskellunge may be recovering slightly in recent years although this has not been confirmed.

Sturgeon have declined considerably over the last several decades although good assessment data are only available for the New York section of the lake. The sturgeon habitat in Lake St. Francis is concentrated in the area downstream of the dam in the deeper, faster section. Over-exploitation has been identified as a major problem (Joliff & Eckert, 1970) but habitat alterations which occurred with the Seaway development may also be a contributing factor. Dumont *et al.* (1987) studied the St. Lawrence River sturgeon population (including Lake St. Francis). They also concluded that sturgeon decline is due principally to overfishing and habitat loss (as reported in Sylvestre, 1989).

In general, perch production in the lake is exceptionally high and the population appears to be stable despite heavy exploitation. All the other species are thought to be in relatively good condition with the exception of sturgeon. Further monitoring will be required to confirm this. It should be noted that these assessment data are for Lake St. Francis from Pilon Island east.

Cornwall Waterfront

Collection of fish by electrofishing was done along the Cornwall waterfront and Cornwall Island during the nights of October 22 and 23, 1986 (Ontario Ministry of Natural Resources, 1987b). Electrofishing employs an electronic charge generated between two poles mounted on a boat. Fish are stunned temporarily and are subsequently sorted for sampling. The purpose was to establish the presence/absence of fish species in the sampled areas (eight stations, 1000 seconds of electro-fishing per station). The station locations are shown in Figure 6-18. Physical descriptions for each station are provided in Appendix V. This area (Cornwall waterfront) had not previously been evaluated from a fisheries standpoint.

A total of 979 fish comprised of 24 species was captured (Appendix V). An Integrated Biotic Index (IBI) was calculated for each station based on species richness and composition, trophic composition and fish abundance and health (Table 6-10). A high index is derived from a large diversity of species, a large number of percid and/or salmonoid species, a high percentage of insectivores and planktivores, a low percentage of trophic "generalists" (carp, suckers), a high percentage of piscivores and a low frequency of diseased specimens. A high index denotes a robust and diverse fish community.

Of the eight runs, six were classed as having poor quality fish habitat based on the IBI (Table 6-10). Overall relative abundance values and species diversity were not high. Only two runs (Stations 6 and 8) were classed as having fair quality fish environment.

Examination of the species distribution, in conjunction with the habitat characteristics and the discharge points leads to the preliminary conclusion that species distribution in the north channel is primarily controlled by the physical characteristics of this part of the river. The fast currents, sparse aquatic vegetation and general lack of shallow, littoral zone are probably the major factors contributing to the poor fish habitat rating of most stations. Station 6 and 8 generally had a superior combination of substrate, depth, current and aquatic vegetation and this was responsible for their higher rating.

Of additional interest was that the only evidence of external abnormalities was the presence of lip papillomas on several white suckers taken at Station 5 and the evident unnatural odour of three walleye taken at the same station.

These results must be considered to be preliminary because of the lack of sampling intensity which reduced the probability of detecting the very local effects of certain discharges on species distribution.

Zebra mussels were first found in the south channel of the St. Lawrence River in September 1989. They were subsequently found in fairly large numbers in the Snell and Eisenhower Locks (late 1989) and the south channel (at the mouth of the Grasse River and near the International bridge in June 1990). The ecological impacts of this exotic species are unpredictable to some degree but its affinity for hard substrates, tendency to develop extremely dense colonies and ability to filter large amounts of phytoplankton from the ecosystem make it very likely that the St. Lawrence is going to undergo a major shift in its energy and nutrient dynamics. The major disruption of the plankton food web will cause changes in the fish community, possibly resulting in a permanent shift. How the existing fish community will adapt remains unknown, although the impacts will probably be evident within 5 years. Control of this exotic is not possible and an amelioration of its ecological impacts are unlikely.

Table 6-10 Summary of Data Collected in the St. Lawrence River, Near Cornwall During Electrofishing, 1986 (MNR, 1987B)

Run	CUE[a]	Diversity[b]	IBI[c]	%Macro-phyte	Habitat[d] Index
1	90.0	6.65	22	65	8
2	129.98	5.15	21	65	10
3	110.24	6.34	21	40	10
4	176.00	4.45	23	100	8
5	51.89	3.19	18	5	8
6	145.00	7.40	29	85	11
7	123.33	4.40	21	80	10
8	171.00	5.37	29	65	8

[a] CUE = number of fish caught/1000 seconds of electrofishing

[b] Diversity = $\frac{(S-1)}{\log N}$

S = number of species
N = number of individuals of all species

[c] IBI = Integrated Biotic Index

[d] Habitat Index = Range 0 (poor) to 12 (excellent)

6.3.3 Wildlife

6.3.3.1 Habitat

The St. Lawrence River basin has been identified by the Canadian and United States governments in the North American Waterfowl Management Plan as an area of national significance for waterfowl nesting and raising of young ducks as well as a stop-over location during the spring and fall migrations (Anonymous, 1986). Surveys conducted in 1976 and 1985 by the Canadian Wildlife Service of Environment Canada has identified Lake St. Francis as the second most important area for fall staging along the Ontario portion of the St. Lawrence River and the third most important area for spring and fall combined staging use (Ross, 1986). Canadian Wildlife Service surveys conducted in 1975 indicated that the Quebec portion of Lake St. Francis is also important for spring and fall staging.

The impoundment of Lake St. Francis has created excellent staging habitat for diving ducks (scaup, goldeneye, bufflehead, redheads). The shallow, productive offshore system with extensive beds of submergent aquatic vegetation is the main factor in attracting staging waterfowl. The diverse aquatic plant community consists of *Myriophyllum*, *Vallisneria*, *Elodea*, *Chara*, *Scirpus* and *Typha*.

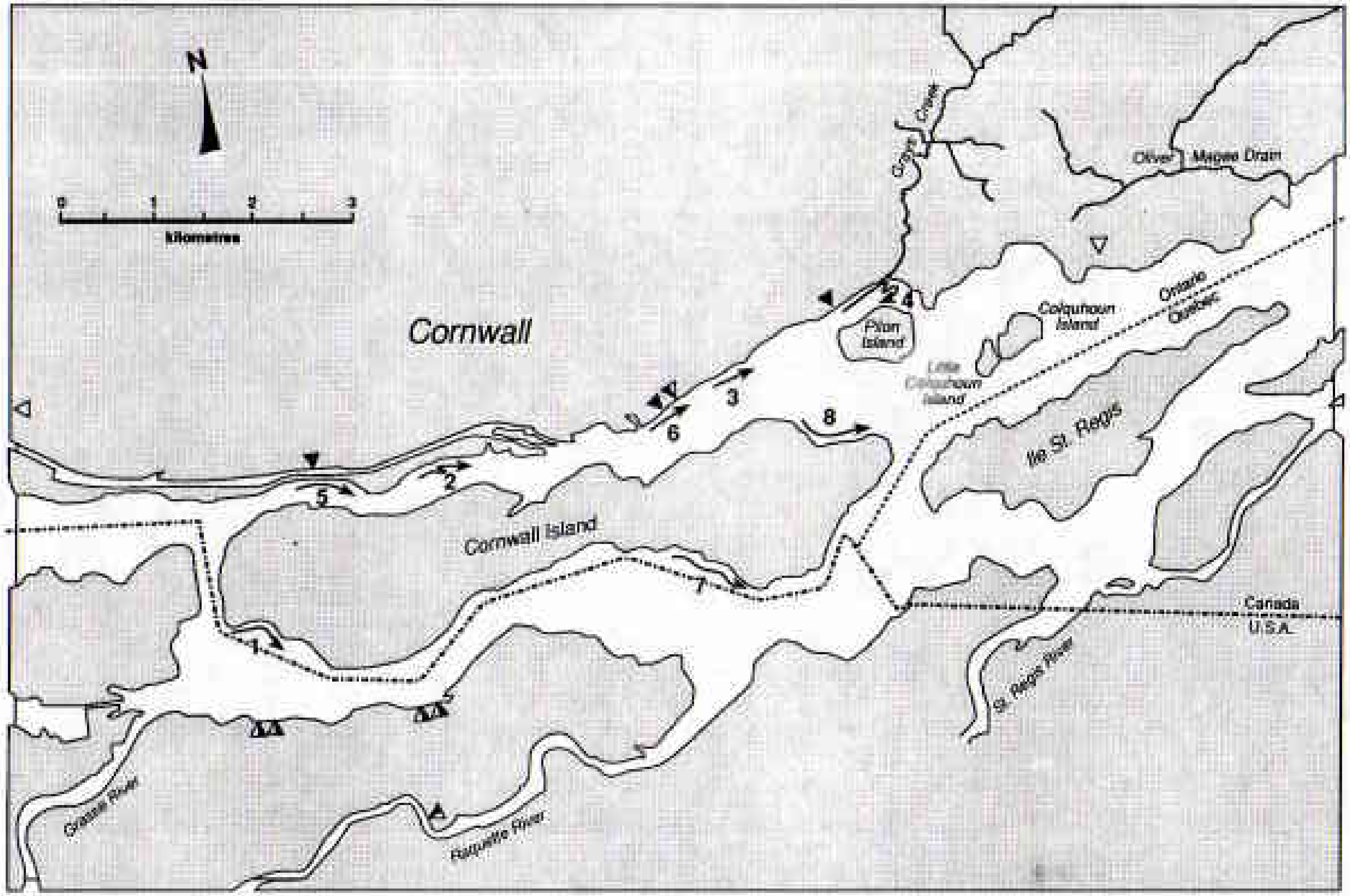
Waterfowl production is concentrated on the Quebec side of the Lake which has suitable stands of emergent vegetation. Localized production areas on the Ontario side include Charlottenburg Marsh and Bainsville Bay. Mallards, blue-winged teal, American wigeon, gadwall, blacks and common mergansers are the species produced. With stable water levels, as established by the Beauharnois control structure, these areas of emergent vegetation can be expected to gradually in-fill. This, in turn, will affect wildlife populations by reducing substantially the diversity of these areas. Recent Ducks Unlimited marsh rehabilitation projects on the Ontario and Quebec sides have enhanced the value of some wetlands dramatically for waterfowl staging and production.

Figure 6-18

St. Lawrence Remedial Action Plan - Cornwall / Lake St. Francis area

Electrofishing station locations, **October 1986**

(MNR 1987b)



△ Intake
▲ Outfall (in pipe)
Δ Outfall (in river at shore)

There are other wildlife species associated with this part of the St. Lawrence. Great blue herons use the area extensively for feeding and Dickerson Island in Lake St. Francis (Akwesasne lands, Quebec) has a small heronry. The island also serves as a nesting site for black-crowned night herons, green herons and great egrets. Not much information is available on other avian species other than that more than 150 species have been identified as breeding in extreme Eastern Ontario and many of these species (more than 100) depend on wetland habitats including those on Lake St. Francis.

Wetlands provide habitat for provincially significant flora and fauna and contain extensive submerged plant beds essential for waterfowl staging and production. They provide habitat for resident and migratory birds, mammals, reptiles and amphibians. Valuable wildlife resources in the Cornwall area wetlands include bullfrogs, muskrats, beavers, raccoons, mink, red fox, turtles and coyotes (Carreiro, 1989).

The evaluation system for wetlands of southern Ontario (Ontario Ministry of Natural Resources and Environment Canada, 1984) provides a scheme for classifying wetlands. They are classified on a sliding scale from Class 1 (most valuable) to Class 7 (least valuable). Class 1 and 2 wetlands are considered to be provincially significant. There are three shoreline marshes on the Ontario side of Lake St. Francis, two of which can be considered to be important. Charlottenburg Marsh, 851 ha, is a Class 1 wetland which stretches from Glengarry Point to Lancaster. Bainsville Bay Marsh (472 ha) is a Class 2 wetland located south of Bainsville (presently being re-evaluated to determine if it merits a higher classification). Both areas are important to staging waterfowl and serve as spawning areas for perch, northern pike and bullhead. In addition, their size and diversity contribute to their importance (Ontario Ministry of Natural Resources, 1987c).

6.3.3.2 Waterfowl Populations

The number of waterfowl days in Cornwall-Lake St. Francis area increased in the late 1950s as a result of the construction of the St. Lawrence Seaway. Flooding behind dams increased the area of shoreline and associated wildlife habitat. A 1985 survey by the Canadian Wildlife Service of waterfowl staging (spring and fall) in the St. Lawrence indicated that a total of 736,000 waterfowl days (staging) were spent in the Ontario portion of Lake St. Francis (Ross, 1986, 1989). The majority of these waterfowl were scaup, ringnecks and redheads. Goldeneye, merganser and large dabblers (mallards, blacks and gadwall) were present in smaller numbers. The area immediately below the dam is used during the winter by mergansers and goldeneye but the remainder of Lake St. Francis is ice-covered.

Waterfowl staging may have declined or levelled off since the mid 1970s. Local staff of the Ontario Ministry of Natural Resources have observed a reduction in staging which is attributable to a reduction in the number of scaup. Although this is not borne out by the Canadian Wildlife Service study, Ross (1989) noted a reduction in the number of waterfowl using this area in the spring but an increase in the number of bay ducks observed during the fall. He suggests that the decrease in the number of waterfowl during the spring may be attributed to some unknown change in the inlet area near Cornwall.

A study in 1975 of the south shore in Quebec indicated that there was extensive production in the marshes. The production on the north shore is intrinsically lower due to the reduced habitat availability. Historic wetland loss in this area may be counter-acted to some degree by the large Ducks Unlimited projects in Charlottenburg Marsh and Bainsville Bay which were completed in 1985.

To maintain the current production and staging capability, it is essential that further shoreline wetland loss be prevented and that the offshore littoral areas be maintained in their current state.

6.3.4 Contaminants in Biota

Information has been obtained by Environment Ontario concerning the bioaccumulation of contaminants by aquatic organisms and distribution in the environment along the St. Lawrence River system. These data include the uptake of contaminants by young fish collected to reflect the significance of localized sources, by sport fish species collected under the Provincial Sport Fish Contaminant Monitoring Program, and for waterfowl (collected by OMNR and CWS).

6.3.4.1 Young Fish

The Nearshore Juvenile Fish Contaminants Surveillance Program was initiated by Environment Ontario in 1975 to identify problem areas associated with organochlorine and inorganic contaminants in the Great Lakes system.

Young-of-the-year spottail shiners (*Notropis hudsonius*) have proven to be sensitive biomonitors for these type of chemical pollutants. Accumulated residues of organic and inorganic substances reflect the most recent water quality conditions and the bioavailability of contaminants for a given locality. Due to their restricted nearshore habitat, young-of-the-year spottail shiners have useful applications in compliance monitoring and the detection of recently introduced persistent contaminants from land-based sources.

Young-of-the-year spottail shiners have been collected from the Cornwall area eight times between 1979 to 1990 by Environment Ontario and in 1984 by Environment Canada, Inland Waters Directorate Quebec Region. The results of these studies up to 1989 are summarized in Table 6-11.

Inorganics

The mercury level in spottail shiners collected from the MacDonnell Island (Lake St. Lawrence) and Cornwall sites is well below the Great Lakes Water Quality Agreement Specific Objective for the protection of aquatic life of 0.5 $\mu g/g$ (or 500 ng/g).

The 1979 levels of mercury in Spottail shiners from the Cornwall sites were slightly higher than those in shiners from the upstream Lake St. Lawrence MacDonnell Island site and sampling locations on the south shore at the mouths of the Grasse and Raquette Rivers (Table 6-11). The slightly higher Hg levels in north shore spottail shiners reflects both the historical and the ongoing discharges from Cornwall.

The 1987 data shows that Hg levels were slightly lower in 1987 than those reported in previous years. In addition, Hg concentrations in shiners collected from sites downstream of the Moses-Saunders Power Dam were similar to those in shiners from the upstream MacDonnel Island control site. In 1988 a considerable increase in Hg concentrations in shiners collected from the Cornwall waterfront upstream of the marina was noted. The highest mercury levels found in 1989 were again at this site. There is no clear explanation for this increase in Hg, however, these results support effluent survey results showing mercury residues in the ICI (formerly CIL) discharge, located just upstream (Kauss et al, 1988).

Young-of-the-year perch collected by Environment Canada in 1984 from the Ile aux Chats (Valleyfield) area at the easterly end of Lake St. Francis had average Hg residues (20 ppb) well below the Great Lakes Water Quality Agreement Specific Objective for the protection of fish-eating wildlife which is 500 ppb (Guay, 1986).

Table 6-11 Contaminant Residues (ng/g) in Young-of-the-Year Spottail Shiners - Suns *et al.* 1991

	Sample Year	No. Samp	Fish Size mm	% Fat	Hg	Total PCBs	Total DDT	OCS	Mirex	HCB	Chlordane Total
Bluechurch Bay	1983	5	56 (4)	2.0 (0.5)		148 (73)	22 (6)	1 (0)		2 (1)	
(Maitland)	1985	5	56 (3)	2.3 (0.3)		72 (27)	10 (3)	ND		5 (3)	
	1988	7	39 (3)	2.7 (0.9)		ND	6 (4)	ND		2 (1)	
	1989	7	53 (3)	7.4 (0.8)		ND	8 (4)	ND		2 (1)	
Morrisburg	1988	6	55 (2)	1.5 (0.2)	19 (8)	ND	6 (3)			ND	
	1989	7	41 (5)	4.8 (0.3)		ND	6 (2)			ND	
MacDonnell Island	1979	8	49 (5)	1.5 (0.6)	56 (5)	ND	79 (20)		ND	ND	9 (2)
	1987	7	57 (5)	2.1 (0.3)	38 (4)	36 (19)	8 (2)	ND	ND	ND	
	1988	7	50 (2)	1.3 (0.2)	20 (13)	ND	2 (2)	ND	ND	TR	
	1989	5	46 (3)	2.6 (0.2)	11 (8)	ND	11 (2)	ND		ND	
Cornwall Island	1987	7	52 (1)	1.9 (0.2)	40 (0)	58 (44)	8 (8)	ND	ND	ND	
- North	1988	7	50 (1)	2.4 (0.4)		261 (65)	46 (17)	ND	ND	ND	
	1989	7	39 (3)	2.8 (0.5)		47 (72)	23 (13)	ND		ND	
Cornwall	1979	3	50 (3)	3.6 (1.2)	70 (10)	243 (31)	62 (14)		7 (1)	3 (1)	
- Upstream of marina	1980	4	55 (3)	4.1 (0.8)	68 (10)	367 (100)	50 (10)		12 (2)	2 (1)	
	1981	4	52 (3)	2.0 (0.0)		234 (34)	22 (8)		8 (2)	ND	
	1983	5	51 (4)	2.8 (0.3)		199 (71)	25 (12)	2 (1)	8 (5)	2 (1)	
	1987	7	56 (4)	1.9 (0.3)	46 (5)	37 (20)	5 (3)	ND	ND	ND	
	1988	7	53 (1)	2.5 (0.5)	102 (29)	161 (43)	19 (9)	ND	ND	ND	
	1989	6	51 (8)	4.5 (0.8)	85 (10)	78 (63)	14 (6)	ND		1 (2)	
Training Institute	1987	7	52 (1)	2.1 (0.2)	40 (0)	38 (19)	7 (1)	ND		ND	
	1989	7	45 (5)	4.4 (0.6)		76 (67)	18 (6)	ND		ND	
Pilon Island	1987	5	53 (1)	2.4 (0.2)	40 (0)	92 (4)	8 (5	ND	ND	ND	
	1988	7	48 (2)	2.5 (0.4)	48 (18)	74 (48)	9 (8)	ND	ND	ND	
	1989	7	53 (5)	4.6 (0.8)	25 (11)	54 (62)	14 (6)	ND		ND	
Grasse River, NY	1979	7	51 (2)	1.9 (0.4)	43 (12)	2072 (187)	95 (14)		TR	ND	
	1981	7	53 (2)	1.7 (0.3)		1117 (235)	39 (13)		8 (5)	ND	
	1983	6	52 (4)	1.6 (0.2)		954 (343)	5 (4)	2 (2)	6 (2)	ND	
	1987	7	53 (3)	1.7 (0.2)	40 (0)	953 (197)	15 (2)	ND	ND	ND	
	1988	7	50 (3)	3.1 (0.2)	38 (0)	7729 (2027)	ND	ND	ND	ND	
	1989	7	50 (7)	6.1 (1.1)		9071 (2004)	2 (2)	ND		ND	
Cornwall Island	1987	7	48 (1)	2.1 (0.4)	47 (6)	252 (83)	24 (8)	1 (1)	ND	ND	
- South	1988	7	50 (1)	2.1 (0.3)		164 (38)	7 (6)	ND	ND	1 (1)	
	1989	5	46 (7)	3.9 (0.6)		392 (147)	5 (3)	8 (4)		1 (1)	
GM Plant at Bridge,	1987	7	50 (1)	1.4 (0.2)		1262 (324)	30 (10)	ND	ND	ND	
NY	1988	7	45 (1)	2.0 (0.6)		21529 (4299)	ND	ND	ND	3 (3)	
	1989	5	50 (12)	4.6 (0.7)		22640 (1402)	ND	ND		ND	
Raquette River, NY	1979	7	50 (2)	2.1 (0.5)	39 (7)	377 (81)	92 (25)		6 (4)	ND	
	1987	5	53 (4)	1.5 (0.2)	38 (5)	84 (17)	5 (3)	2 (1)	ND	ND	
	1988	7	50 (1)	3.0 (0.4)		1837 (455)	22 (8)	ND	ND	ND	
	1989	7	36 (5)	4.4 (0.9)		1203 (402)	9 (8)	ND		ND	
Reynolds Aluminum, NY	1989	5	53 (13)	6.7 (0.7)		16600 (894)	20 (8)	ND		ND	
Regis River, NY	1987	7	52 (1)	2.1 (0.2)	27 (8)	126 (30)	7 (2)	TR		ND	
	1989	7	57 (6)	2.0 (0.5)		36 (26)	5 (2)	ND		ND	
Salmon River, Quebec	1987	7	53 (2)	2.3 (0.2)	19 (7)	59 (12)	27 (26)	ND		ND	
	1989	7	41 (4)	2.3 (0.4)		ND	32 (10)	ND		ND	
Thompson Island	1987	7	49 (1)	2.1 (0.3)	40 (0)	46 (24)	7 (3)	ND		ND	
(Lake St. Francis)	1988	7	43 (1)	1.9 (0.1)		23 (22)	3 (3)	ND		ND	
	1989	7	49 (3)	2.1 (0.1)		ND		ND		ND	

Note: Values are Means in ng/g wet weight with (Standard Deviation) of whole fish analyses. ND = not detected, TR = trace

Organic Contaminants

i) PCBs

PCB residues in spottail shiners collected by Environment Ontario (Suns, 1985) from the St. Lawrence River in the vicinity of Cornwall changed little during the four year interval from 1979-1983 (Table 6-11). Average concentrations ranged from 199 to 367 ng/g, with the lowest concentration being measured in 1983. These levels of PCBs were substantially above those measured in spottail shiners from upstream locations in Lake St. Lawrence at MacDonnell Island suggesting a local source of PCBs to the St. Lawrence during this period.

In 1987 the levels of PCBs were low, however, in 1988 average concentrations were in the same range as during the 1979-1983 period (Table 6-11). Significant ($p < 0.05\%$) increases were found in the 1988 spottail shiner collection from Ontario waters (Table 6-11). In 1989, PCB concentrations decreased significantly ($p<0.05$) in shiners from the northern shoreline of Cornwall Island and Cornwall Marina, but did not change (>0.05) in the Pilon Island collections. The levels of PCBs in these fish (1989 collection) are within the Great Lakes Water Quality Agreement Specific Objective of 100 ng/g (ppb) for the protection of wildlife which consume fish.

Young-of-the-year spottail shiners sampled from the mouth of the Grasse River during the 1979-83 period contained high levels of PCBs with averages ranging from 954 to 2072 ng/g. The lowest concentrations were detected in 1983 (Suns *et al.*, 1991). The ALCOA aluminum plant has been identified as a source of PCBs to the Grasse River and subsequently to the St. Lawrence River.

Spottail shiner collections in 1987 and 1988 from the mouth of the Grasse River averaged 953 and 7729 ng/g, respectively. The 1988 samples indicated a substantial increase in PCB concentrations in these forage fish. All PCB levels in the 1988 spottail shiner collections were elevated well above those in the upstream MacDonnell control site, indicating a major source of PCBs within the area of concern. Although water quality and sediment surveys have identified General Motors and Reynolds' plants on the St. Lawrence, and ALCOA on the Grasse Rivers, reasons for the sudden, massive PCB concentration increases in 1988 are not known.

Using the 1988 PCB concentrations in shiners as a baseline, PCB levels in 1989 did not change significantly (>0.05) in the Grass River and General Motors Plant collections, but they decreased ($p<0.05$) in Raquette River samples (Table 6-11). PCB concentrations increased significantly ($p<0.05$) in shiners from the southern shoreline of Cornwall Island.

Concentrations of PCBs in shiners collected from the north channel continue to be significantly lower than those in the south channel. In 1989, only the south channel collections exceeded the Great Lakes Water Quality Specific Objective for the protection wildlife which consume fish.

Average residue levels of PCBs in young-of-the-year spottail shiners collected in 1984 by Environment Canada from both the north and south channels of the St. Lawrence River near Cornwall, the mouth of the St. Regis River and the north and south shores of Lake St. Francis in the Valleyfield area exceeded the Great Lakes Water Quality Agreement Specific Objective (100 ng/g) for the protection of fish-eating birds. The average concentrations of PCBs ranged from a low of 100 ppb in shiners from the north shore Valleyfield sample to a high of 210 ppb at both the south channel and St. Regis River sites.

Young-of-the-year perch were collected in 1984 by Environment Canada at the St. Regis River mouth and from 3 different locations in the Valleyfield area (north shore, south shore and Ile aux Chats) of Lake St. Francis. All average PCB concentrations were at or above the 100 ppb Great Lakes Water Quality Agreement Specific Objective except for the perch collected from the north shore near the Valleyfield site (Guay and Dandurand, 1986).

Recent data reported by Sloterdijk (1988 as cited in Sylvestre, 1989) showed that emerald shiners from Lake St. Francis, having only slightly higher percentage fat levels, contain PCBs at a concentration 5 times higher than spottail shiners.

ii) DDT

Total DDT residues in spottail shiners throughout the Great Lakes and St. Lawrence River declined substantially during the late 1970s (1976-1979) and all recent (1982-1988) concentrations are lower than comparable values in initial surveys (Suns *et al.*, 1991). The low DDT residues (Table 6-11) may be attributed to the province-wide restriction on the use of DDT in the early 1970s. Total DDT residues in the most recent collections from the Cornwall-Massena area are well below the Great Lakes Water Quality Agreement Specific Objective for the protection of aquatic life of 1000 ng/g (ppb) and the DDT residues consisted largely of the metabolite DDE.

All DDT concentrations in both young-of-the-year spottail shiners and perch collected by Environment Canada were well below the Great Lakes Water Quality Agreement Specific Objective for fish-eating wildlife protection of 1000 ppb. Average residue levels ranged from 9 to 90 ppb in young-of-the-year perch (Guay and Dandurand, 1986) and from 20 to 40 ppb in young-of-the-year spottail shiners. Residue data suggest that DDT levels are decreasing in the Cornwall marina, Grasse River, MacDonnell Island and Raquette River collections.

iii) Mirex

Mirex (Dechlorane) residues have changed little in spottail shiner collections from the St. Lawrence River at Cornwall throughout the interval of 1979-1983 (Table 6-11). Average residue levels in spottail shiners ranged from 7 to 12 ng/g (Suns *et al.*, 1991). Data from 1988 and 1989 indicate non-detectable concentrations of mirex in both upstream (MacDonnell Island) shiners and in shiners from all locations in the area of concern.

iv) Chlordane

Recent (1988 and 1989) residues of total Chlordane were below detection and lower than levels detected in samples from the previous years. The data indicate a decline in total chlordane residues over the sampling period from 1979 to 1989 for all locations in the area of concern.

v) ΣBHC

The data base for ΣBHC is too small to derive a temporal trend, however, the most recent data (1988 and 1989) consist of non-detected levels of ΣBHC in spottail shiners from all locations in the Cornwall-Massena area.

vi) Hexachlorobenzene (HCB) and Octachlorostyrene (OCS)

Residue levels near their detection limits for HCB were found in the Maitland, Cornwall Marina and Cornwall Island south collections, whereas OCS was only found at Cornwall Island south.

vii) Summary-Forage Fish

PCBs are clearly the main contaminant of concern in forage fish. Concentrations in young-of-the-year spottail shiners from the Grasse River, General Motors Plant, Reynolds Aluminum and Raquette River sites are not only the highest in the area of concern but also exceed concentrations found anywhere else in the Great Lakes Basin (Appendix XIX) and consistently exceed the Great Lakes Water Quality Specific Objective of 100 ng/g for the protection of wildlife which consumes fish. These concentrations are therefore considered a threat to the health of wildlife which prey on these forage fish. Cornwall waterfront samples are similar in concentrations to other urban areas in the Great Lakes (Appendix XIX). Levels in excess of the guideline were not found in 1989 at Cornwall, upstream of the marina or at Cornwall Island sites as they were in 1988 (Table 6-11).

6.3.4.2 Sportfish

Sportfish from the Cornwall-Lake St. Francis section of the St. Lawrence River have been collected and analyzed by Environment Ontario for mercury, PCB, mirex and other pesticides since 1977. Studies are ongoing with samples being collected regularly by the Ontario Ministry of Natural Resources, Cornwall

District Office for analysis by Environment Ontario. During the years of 1976-1979 and 1989 the Ontario Ministry of Natural Resources was assisted by the Mohawk Council of Akwesasne in carrying out these collections. The Quebec Ministry of the Environment has also collected sportfish from Lake St. Francis to evaluate the level of contamination.

All data are assessed using Health and Welfare Canada's guidelines for human consumption of the edible portion (0.5 mg/kg mercury and 2.0 mg/kg PCB). Consumption advice on fish from the Cornwall-Lake St. Francis section of the St. Lawrence River has been made available to the public by means of the "Guide to Eating Ontario Sportfish" (Environment Ontario and Ontario Ministry of Natural Resources, 1989) which has been published annually since 1978 and by the Quebec Guide Book on fish consumption (ministere de l'Environnement and ministere de la Sante et des Services sociaux, 1985).

In 1985, sport fish from the eastern end of Lake St. Francis were sampled by Environment Quebec. Sampling sites included Ile au Mouton, Ile au Grenadier and Ile au Lalonde. A comparison of the Environment Quebec and Environment Ontario sport fish data for PCBs, mercury and mirex is shown in Table 6-12, with the resulting consumption restrictions shown in Table 6-13. The consumption restrictions resulting from the most recent fish collections are summarized in Table 6-14.

Table 6-12 Comparison of Environment Quebec and Environment Ontario Sport Fish Data for Lake St. Francis

	Environment Quebec, 1985			MOE, 1984		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
PCB (mg/kg)						
Y. Perch	0.03	<0.01	0.03	0.024	ND	0.074
Walleye	0.06	0.04	0.09	0.298*	0.080	0.480
N. Pike	0.10			0.073	0.031	0.117
Hg (mg/kg)						
Y. Perch	0.50	0.34	1.20	0.65*	0.24	1.30
Walleye	0.54	0.28	0.99	0.53	0.18	1.20
N. Pike	0.46	0.40	0.62	0.64	0.32	1.00
Mirex (mg/kg)						
Y. Perch	0.001	0.001	0.001	ND	ND	ND
Walleye	<0.001	0.002	0.005	ND*	ND*	ND
N. Pike	0.001	0.003	0.004	ND	ND	ND

* Levels measured in 1985

Table 6-13 Restrictions on Fish Consumption as Promulgated by Quebec and Ontario

Fish Species (MOE, MNR, 1988)	No rest.	225-230 gr/week	136 gr/week	225-230 gr/week	Not permit.
Walleye	<45 cm	45-55 cm	55-65 cm		>65 cm
Northern pike	<55 cm	55-75 cm	>75 cm		
Sturgeon				>45 cm	
Yellow perch	<25 cm	>25 cm			
Channel catfish				>30 cm	
White sucker	<45 cm	>45 cm			
Pumpkinseed	<20 cm				
Brown bullhead	<35 cm				
Smallmouth bass	<30 cm	30-45 cm	45-55 cm		
Fish Species (MSSS, MENVIQ, CTQ, 1985)	**No rest.**	**225-230 gr/week**	**136 gr/week**	**225-230 gr/week**	**Not permit.**
Walleye				●	
Northern pike				●	
Sturgeon		●			
Yellow perch		●			
Channel catfish					
White sucker		●			
Pumpkinseed		●			
Brown bullhead		●			
Smallmouth bass				●	
Burbot				●	
Muskellunge				●	

Note: It is recommended that children under 15 and women of child-bearing age should eat only fish in the no-restriction catagory

Source: Sylvestre, 1989

Table 6-14 Consumption Restrictions for Lake St. Francis (Ontario Waters), the North Channel and South Channel of the St. Lawrence River at Cornwall

	Lake St. Francis (1988)	North Channel (1989)	South Channel (1989)
Walleye	>45 cm	>35 cm	>45 cm
Yellow perch	unlimited[a] (<35 cm)	>25 cm	unlimited (<25 cm)
Northern pike	>45 cm	>45 cm	>45 cm
Smallmouth bass	>35 cm	N/A	N/A
Brown bullhead	unlimited (<30 cm)	unlimited (<30 cm)	unlimited (<30 cm)
Channel catfish	N/A[b]	N/A	>55 cm
Carp		unlimited (all)	>75 cm
White sucker	>45 cm		
Redhorse sucker	N/A	unlimited (<45 cm)	unlimited (<55 cm)
Sturgeon	No Consumption of This Species (>45 cm)		

Note: It is recommended that children under 15 and women of child-bearing age should eat only fish in the unlimited catagory.

[a] Unlimited means no consumption restriction for fish less than the length shown in brackets. No fish were sampled which were larger than the length shown in brackets.
[b] N/A - not available

Inorganics

In 1969 elevated levels of mercury in fish flesh exceeding the acceptable limit for unrestricted consumption of 0.5 ppm were found in most commercial and sportfish sampled from waters throughout Ontario receiving major point source discharges of mercury. Accordingly, restrictions on commercial fishing were instituted and anglers were advised not to consume contaminated species. The same restriction on commercial fishing was applied in Quebec during the early 1970s.

The major source of mercury discharges to the St. Lawrence River prior to 1970 was the chlor-alkali plant of Canadian Industries Limited (CIL). To a lesser extent the Domtar Fine Papers Limited's pulp and paper mill, the Courtaulds Fibres rayon factory and Courtaulds Films (closed 1989) cellophane plant were contributors. In 1970, the use of mercurial slimicides at the Domtar mill was terminated and mercury discharges from the ICI (formerly CIL) chlor-alkali plant were substantially reduced to comply with the Federal Chlor-alkali Mercury Liquid Effluent Regulation of 0.0025 kg mercury per ton of chlorine produced per day. Compliance with this federal regulation equates to an allowable loading of 0.30 kg of Hg/per day. However, the actual amount of Hg discharged by ICI (formerly CIL) is approximately 0.025 kg/day.

Coinciding with the termination of mercurial slimicides at Domtar and the reduction of mercury discharged by ICI (formerly CIL), mercury levels in the edible portion (skinless, boneless fillet) of walleye have shown a steady decline since 1970 (Figure 6-19). At present, Ontario's consumption advice indicates that walleye up to 45 cm (18 inches) will contain less than 0.5 ppm mercury.

Average mercury concentrations in walleye from Lake St. Francis remained elevated through 1987 compared to upstream locations such as Lake St. Lawrence (Table 6-15) and at Morrisburg. Comparisons of mercury concentrations in muscle tissue with standardized length of walleye between Lake St. Lawrence and Lake St. Francis are shown in Figure 6-20. These graphs indicate that, for walleye of any given length, mercury concentrations are higher in fish living downstream of Cornwall-Massena. These data provide additional evidence of the impact of historical and ongoing mercury discharges in the area of concern.

Table 6-15 Concentrations of Mercury and PCBs in Walleye

	Location	Year	N	Length (cm)	Weight (g)	Level*
Mercury	Lake St. Francis	1985	20	50.5 (38.5-70.0)	1598 (580-3560)	0.65 (0.24-1.30)
		1986	20	52.2 (38.2-76.5)	1665 (550-4753)	0.74 (0.24-1.90)
		1987	9	53.4 (45.4-69.4)	1838 (940-3850)	0.62 (0.30-1.20)
	Lake St. Lawrence	1985	20	46.7 (38.5-63.0)	1239 (550-2800)	0.28 (0.11-0.71)
		1986	20	51.0 (43.0-60.0)	1609 (800-2725)	0.458 (0.20-0.67)
		1987	20	46.7 (33.4-59.6)	1226 (355-2680)	0.20 (0.08-0.45)
PCBs	Lake St. Francis	1985	5	64.6 (58.3-70.0)	3070 (2400-3650)	298 (80-480)
		1986	-	-	-	-
		1987	9	53.4 (45.4-69.4)	1838 (940-3850)	163 (40-290)
	Lake St. Lawrence	1985	20	46.7 (38.5-63.0)	1239 (550-2800)	89 (ND-290)
		1986	20	51.0 (43.0-60.0)	1609 (800-2725)	149.2 (ND-500)
		1987	20	46.7 (33.4-59.6)	1226 (355-2680)	ND (ND-90)

* Levels: Mercury – ppm
PCBs – ppb

Note: A complete listing of data on PCBs in sport fish from the St. Lawrence River - Lake St. Francis appears in Appendix VI.

Mercury data on northern pike, white sucker and brown bullhead show little difference between Lake St. Francis and upstream locations in Lake St. Lawrence (Table 6-15).

Average mercury residue levels in all sport fish collected by Environment Quebec and Environment Ontario/Ontario Ministry of Natural Resources in 1985 were very similar, reflecting little if any change in mercury levels in fish between the eastern and western ends of Lake St. Francis.

Preliminary results of the 1988 Environment Quebec survey show that walleye and northern pike from the central and eastern section of Lake St. Francis still exceed the mercury guideline (unpublished data of the ministere de l'Environnement du Québec, cited in Sylvestre, 1989).

The results of the 1989 sampling of fish from the north and south channels of the St. Lawrence show a slight elevation in mercury levels for the same species from the north channel compared to individuals from the south channel and the main lake. This supports the spottail data in indicating greater uptake of mercury in the Cornwall waterfront area than in other parts of Lake St. Francis.

Figure 6-19

St. Lawrence Remedial Action Plan

Trends in mercury content (ug/g wet weight) in edible portion (dorsal musculature) of Lake St. Francis Walleye, 1970 - 1987

(after Kauss et al 1988)

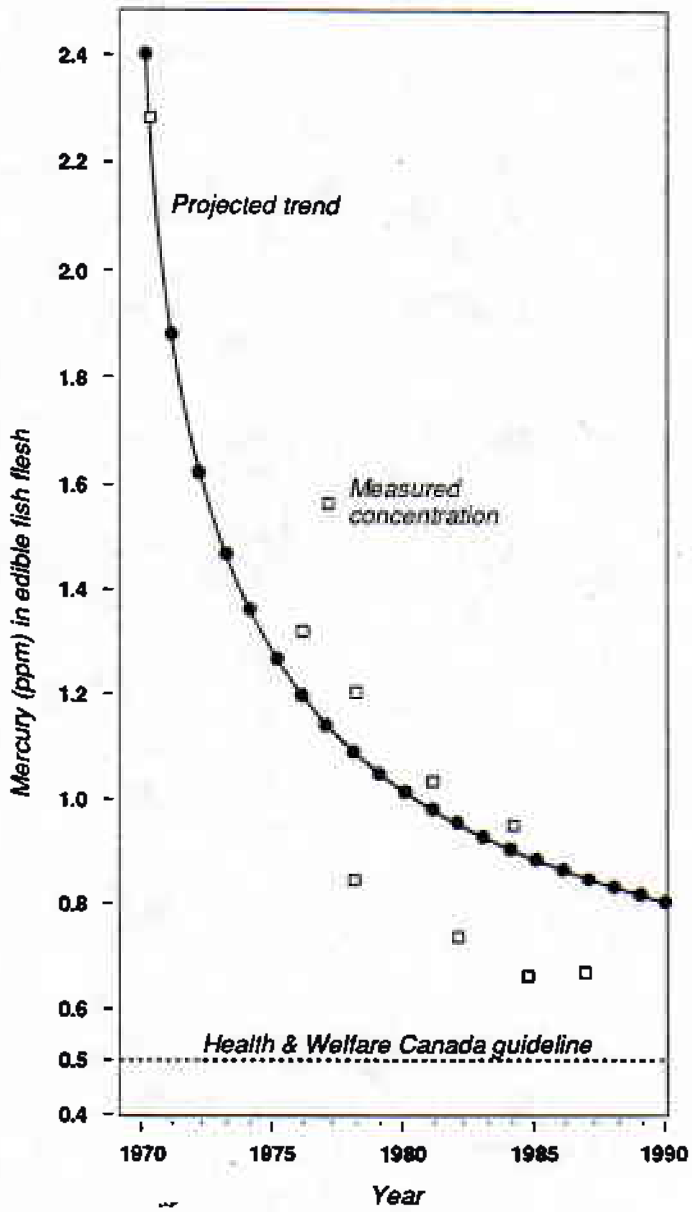
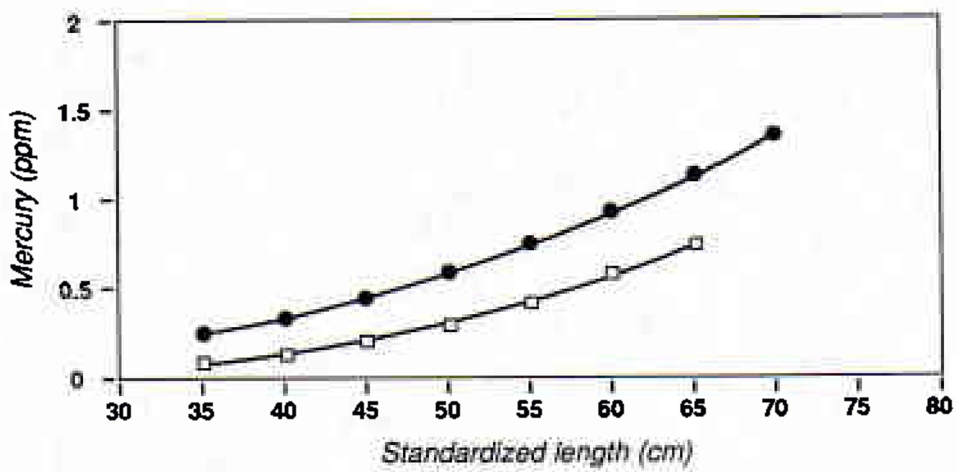


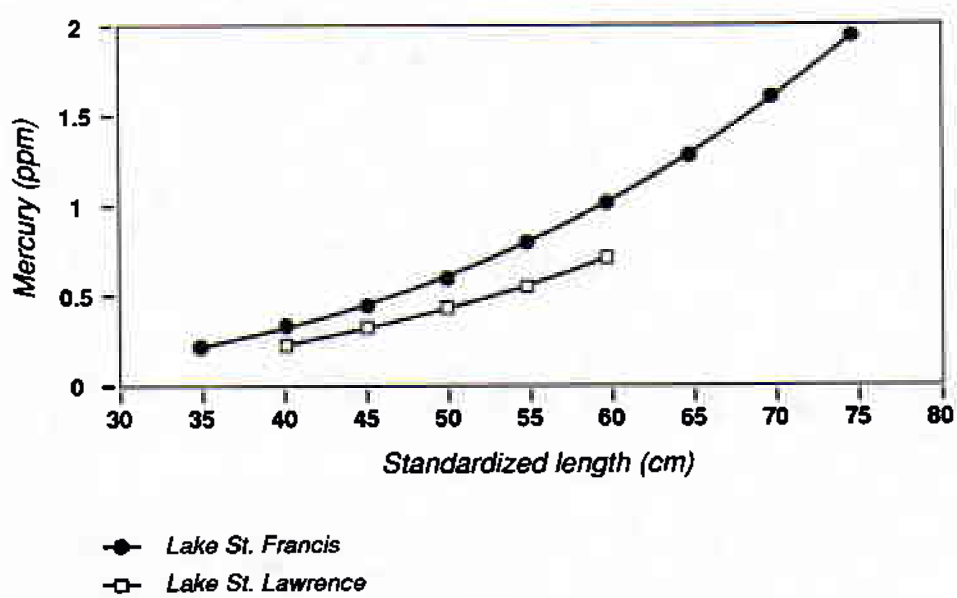
Figure 6-20

St. Lawrence Remedial Action Plan

Comparison of mercury concentration in length-standardized walleye from upstream and downstream of Cornwall, 1985



1986



Organic Contaminants

i) PCBs

PCB concentrations in the edible portion of walleye from Lake St. Francis (Ontario portion) are elevated above concentrations detected in walleye from Lake St. Lawrence and in the river at Morrisburg (Table 6-15). All fish tested recently contained less than the Canadian maximum allowable level of 2.0 ppm (2000 ppb). PCB levels in Lake St.Francis walleye collected at the Raisin River in 1978 averaged 1.114 ppm compared to Lake St. Francis walleye in 1987 which averaged 0.163 ppm PCBs. This reduction in PCB levels is reflective of the 1978 banning on the use of PCB.

PCB levels in northern pike collected from Lake St. Francis in 1984 were low (less than 117 ppb) with an average PCB residue level of 73 ppb. Brown bullhead collected in 1978 from the Ile Ste. Regis south channel area of Lake St. Francis had an average of 1.812 ppm PCBs, only 0.2 ppm below the Health and Welfare Canada consumption guideline of 2 ppm. Some of the brown bullhead from this sample ranged above the consumption guideline with a maximum of 5.940 ppm PCB being attained and levels were generally higher than bullheads collected from the north channel. No collections from the Ile St. Regis location have been completed since 1978. Brown bullhead collected from Lake St. Francis in 1982 showed an average PCB level of 0.055 ppm well below the bullheads collected from Ile St. Regis in 1978 and below the maximum acceptable level of 2 ppm.

The highest levels of PCBs in the edible portions of sportfish from the St. Lawrence River in the vicinity of Cornwall have been measured in a sturgeon (15.5 ppm) and in a channel catfish (44.0 ppm) caught at Cornwall Island in 1977 and 1978, respectively.

Both residue levels represent maximum measurements and were well above the federal guideline of 2 ppm. Because these two species of fish are both long-lived, high fat content species, it can be assumed that the average PCB content in a sample of the population from Lake St. Francis will decline, but slowly, following the cessation of point source discharges. In addition, these fish dwell and feed at the bottom of rivers and lakes in close proximity to contaminated sediments thus increasing their exposure to PCBs.

Average PCB concentrations of 0.03 ppm in yellow perch found by Environment Quebec in 1985 were equal to the average concentration in perch collected by Environment Ontario from the more westerly portion of Lake St. Francis. Average PCB levels in northern pike were also similar at 0.10 ppm and 0.07 ppm, respectively in the 1985 Quebec and 1984 Ontario collections. However, the average PCB concentration in Walleye collected in 1985 by Environment Ontario was 0.26 ppm above the 0.04 average detected in walleye by Environment Quebec.

ii) Mirex

Mirex residue levels appear to have changed little in walleye collections from Lake St. Francis throughout the sampling period from 1978 to 1984. Samples collected in 1981 and 1982 contained average mirex concentrations of non-detectable (ND) and 14 ppb respectively. These concentrations were substantially lower than levels of mirex in the 1978 collections. Present mirex levels in all walleye sampled are below the Health and Welfare restricted consumption guideline of 0.1 ppm with all walleye having non-detectable concentrations in 1985 and 1987.

The sources of mirex to Lake Ontario and subsequently the St. Lawrence River are a former mirex processor in Niagara Falls, New York and a manufacturing plant in Oswego, New York. Two southern Ontario companies used mirex under the trade name 'Dechlorane' as a fire retardant in their manufactured products. Data on Mirex in other species of sportfish is listed in Appendix VI.

All levels of mirex in fish collected by both Environment Quebec and Environment Ontario in 1985 were near or below the analytical detection limit of 1 ppb (1 μg/kg) in biological tissue.

iii) Other Organics

As part of the sport fish monitoring program, a number of other organic chemicals have been analyzed for in the edible portions of fish from the Cornwall-Massena area of concern. These chemicals include: hexachlorobenzene; α-BHC; γ-BHC; heptachlor; aldrin; DDT and metabolites; chlordane; toxaphene; and octachlorostyrene. None of these chemicals have been detected at levels which would require consumption restrictions. For example, the highest levels of DDT in fish from the Cornwall-Massena area was found in a channel catfish collected in 1978. Although the concentration was high, it was below the Health and Welfare consumption guideline of 5 ppm. Walleye that were sampled in 1987 from Lake St. Francis averaged 18 ppb. All other organics from this collection were non-detectable or in the low ppb range.

iv) Summary-Sport Fish

In summary, the two main contaminants of concern in fish from Lake St. Francis are PCBs and mercury. Both chemicals occur in fish in this lake at higher concentrations than in fish collected upstream from Lake St. Lawrence. These elevated concentrations are evidence of the impact of historical and ongoing local discharges.

Mercury is the major contaminant restricting consumption of most species of sport fish. PCBs are responsible for consumption restrictions on sturgeon and channel catfish from the south channel of the St. Lawrence. It must be noted that no samples of sturgeon have been collected from this area since 1978.

Mercury levels are higher in fish collected from the north channel of the St. Lawrence than from the south channel or further east in Lake St. Francis. Conversely, PCB levels are higher in fish collected from the south channel than they are elsewhere in Lake St. Francis.

Mercury levels are declining although the rate of decline seems to be slowing, perhaps reflecting the decline in the rate in which mercury is being prevented from reaching the biota in Lake St. Francis.

Fish of various species formed a relatively large portion of the diet for the Mohawk People. In 1978 the Mohawk Governments of Akwesasne issued a fish advisory as a result of concern regarding concentrations of both PCBs and mercury. The advisory was reissued in 1986. It advised women of child bearing age, pregnant women and children under the age of 15 not to consume any fish species taken from the St. Lawrence River.

6.3.4.3 Wildlife

Sylvestre (1989) reports on a 1988 Canadian Wildlife Service study in which a female domestic duck placed near St. Regis Island accumulated 2 mg/kg PCBs in its liver after a two month exposure.

During 1988 and 1989, various species of waterfowl were collected for contaminant analysis. These collections consisted of two sets of samples. Waterfowl broods (ducklings and the hen) were collected during July of 1988 and 1989 by OMNR to determine the body burdens of waterfowl which were only exposed to contaminants in the Area of Concern. Secondly, juvenile and adult waterfowl were collected during the fall hunting season. These birds would be a mixture of local and migrating individuals but the sample would represent the contaminant levels of birds harvested in the Area of Concern. The collection of birds in the fall was done by CWS.

To date only the 1988 results are available. The 1988 analysis for the local birds (i.e. broods) included only organochlorines (no metals). The samples were analyzed as individual samples and reported as ng/g (wet weight) for liver tissue and muscle from two sampling locations (Lake St.Francis and Cornwall Island). The 1988 CWS results for fall harvested birds are for the Charlottenburg Marsh area. The two data sets (Tables 6-16 and 6-17) show remarkable similarities. Liver levels from local birds are greater than those in muscle (this is normal for organochlorines). Comparisons of the summer (local) and fall (local and migrating mixed) muscle samples show that there were 10 (fall) and 11 (summer) contaminants found. Only octochlorostyrene was detected in local birds and not detected in birds from the migratory period. All other levels from the two periods are within an order of magnitude of each other, showing remarkable agreement. There are two possible explanations. Either the fall sample consisted of most or all local birds (a possibility) or the migratory birds were in the area sufficiently long to acquire the various contaminants. The first explanation is more probable. Given the tremendous range of contaminant levels in waterfowl collected across Ontario, it is unlikely that migrants would arrive in the area with similar contaminant profiles. It is also unlikely, based on migratory behaviour, that all or most of the fall-sampled birds would have been staging in Lake St. Francis for several weeks prior to their collection early in October.

Table 6-16 Mean Concentrations of Organochlorines (ng/g wet weight) in Lake St. Francis and Cornwall Island Area Waterfowl 1988 (OMNR, publication pending)

	Adult				Juvenile			
	Lake St. Francis		Cornwall Island		Lake St. Francis		Cornwall Island	
	Liver	Muscle	Liver	Muscle	Liver	Muscle	Liver	Muscle
Sample size	1	1	5	5	5	5	4	4
% Lipid	3.7	2.0	3.2	1.5	3.8	0.6	3.6	1.1
1,2,4,5-tetrachlorobenzene	0	0	0	0	0	0	0	0
1,2,3,4-tetrachlorobenzene	0	0	0	0	0	0	0	0
Pentachlorobenzene	0	0	0	0	0	0	0	0
HCB	0.6	0.3	1.1	0.4	1.2	0.2	1.2	0.3
α-HCH	0	0	0	0	0	0	0	0
β-HCH	0	0	0.03	0	0	0	0	0
γ-HCH (lindane)	0	0	0	0	0	0	0	0
OCS	3.0	0	6.7	0.05	5.1	0.02	19.0	0
oxy-chlordane	4.8	1.1	0	0.1	10.9	0	3.8	0.2
trans-chlordane	0	0	0	0	0	0	0	0
cis-chlordane	0	0.3	0	0.3	0	0.1	0.3	0.5
trans-nonachlor	1.0	0.1	2.6	0.3	2.3	0.06	3.4	0.2
p,p'-DDE	7.2	3.4	23.0	7.6	20.0	3.5	25.4	5.3
p,p'-DDD	0	0	0	0	0	0	0	0
cis-nonachlor	0	0.2	3.1	0.8	0.5	0.1	3.1	0.6
p,p'-DDT	0	0	0	0	0	0	0	0
photo-mirex	0.3	0.2	2.4	0.4	3.9	0.1	4.9	0.3
mirex	1.3	0.6	3.7	1.6	2.7	0.4	3.2	1.0
heptachlor epoxide	3.7	0	4.1	0.2	5.2	0	8.1	0.1
dieldrin	9.2	0.6	18.2	0.7	14.3	0.5	17.4	0.8
Total PCBs	62.1	16.0	827.7	123.8	243.1	22.2	723.5	78.9

Table 6-17 Mean Concentrations of Organochlorines (ng/g wet weight) and Metals (mg/kg) of Lake St. Francis Waterfowl (Local and Migrating Birds Combined) Fall of 1988 (CWS, 1990)

	Breast Muscle (Mallard)		
	Juvenile	Adult	Mixed (Adult/Juvenile)
Sample size	5	6	11
% Lipid	1.39	2.25	0.95
1,2,4,5-tetrachlorobenzene	N/D	N/D	N/D
1,2,3,4-tetrachlorobenzene	N/D	N/D	N/D
Pentachlorobenzene	N/D	N/D	N/D
HCB	0.15	0.34	0.40
α-HCH	N/D	N/D	N/D
β-HCH	N/D	N/D	N/D
γ-HCH (lindane)	N/D	N/D	N/D
OCS	N/D	N/D	N/D
oxy-chlordane	0.38	0.74	0.86
trans-chlordane	N/D	N/D	0.61
cis-chlordane	0.33	0.39	0.72
trans-nonachlor	0.11	0.18	0.18
p,p'-DDE	3.18	5.84	6.98
p,p'-DDD	N/D	N/D	N/D
cis-nonachlor	N/D	0.17	0.23
p,p'-DDT	N/D	N/D	N/D
photo-mirex	0.11	0.15	0.18
mirex	0.24	0.81	0.66
heptachlor epoxide	N/D	N/D	0.33
dieldrin	0.68	1.12	0.53
PCBs (Arochlor 1254:1260)	11.29	48.04	43.83
Cadmium	0.03	0.03	N/A
Arsenic	<0.10	<0.10	N/A
Lead	0.55	0.19	N/A
Selenium	0.19	0.32	N/A
Total Mercury	<0.05	<0.05	N/A

The levels of contaminants in the birds collected during the hunting season had body burdens of little concern with the exception of total chlordanes and PCBs, both of which exceeded Health and Welfare Canada's maximum residue limits in poultry. At this time the agencies are still analyzing the 1989 collection which will provide a larger and more comprehensive sample upon which decisions can be made regarding consumption advisories.

The heavy metals analysis (Table 6-17) done on birds present in Lake St. Francis in the fall (CWS) showed elevated levels of lead in breast muscle which exceeds the Health and Welfare Canada maximum of 0.5 ppm for fish. Historical lead shot studies done in the early 1980s on Lake St. Francis found that almost 5% of mallards in Lake St. Francis ingest lead shot. At this time the source of the lead i.e. environmental from effluent or from lead shot cannot be determined. While lead body burden levels are not directly linked to biologically available lead, lead poisoning (i.e. lethal and non-lethal health effects on waterfowl) does occur and is of some concern in this area. The fall-sampled birds were analyzed for dioxins and furans but no detectable residues were found.

Contaminant levels in other wildlife species have not been extensively studied however some data (Table 6-18) are available from three snapping turtles collected on Cornwall Island in 1988 (OMNR, publication pending). The kinds of contaminants found mirror those found in waterfowl but at levels substantially higher. Results are presented for liver and muscle tissue. At this time, the biological significance of these data is unknown although OMNR has advised that snapping turtles from this area should not be consumed.

Table 6-18 Mean Concentrations of Organochlorines (ng/g wet weight) for Snapping Turtles on Cornwall Island 1988 (OMNR, publication pending)

	Liver	Muscle
Sample size	3	3
% Lipid	16.2	0.33
1,2,4,5-tetrachlorobenzene	0	0
1,2,3,4-tetrachlorobenzene	0	0.5
Pentachlorobenzene	0	0
HCB	15.5	0.28
α-HCH	0	0
β-HCH	0.8	0
γ-HCH (lindane)	0	0
OCS	6.8	0
oxy-chlordane	87.8	0.17
trans-chlordane	0.1	0
cis-chlordane	10.4	0.25
trans-nonachlor	191.1	1.7
p,p'-DDE	2358.5	21.8
p,p'-DDD	8.5	0
cis-nonachlor	732.0	7.1
p,p'-DDT	1.8	0
photo-mirex	162.0	1.4
mirex	476.0	4.5
heptachlor epoxide	0	0.26
dieldrin	116.2	2.9
Total PCBs	2368.9	21.8

Many species of fish and wildlife have been collected by the New York State Department of Environmental Conservation for PCB analysis, primarily related to the Remedial Investigations underway at General Motors, Reynolds and ALCOA.

The Mohawk Governments of Akwesasne have placed an advisory for no consumption of turtles due to elevated levels of PCBs in turtle flesh.

6.3.4.4 Other Biota

During a 1979 Environment Ontario survey, benthic macroinvertebrates and macrophytes were collected at 8 locations and analyzed for metals, PCBs, organochlorine pesticides and chlorinated phenolics (Kauss *et al.*, 1988). Organisms (eg. snails) attached to the macrophytes were also collected and analyzed. The results indicated that generally higher levels of PCBs in biota occur at stations in the Massena area, particularly at the mouths of the Grasse and Raquette Rivers, than in the Cornwall area. Caution must be taken in comparing the concentrations in macroinvertebrates because the samples were composites containing different combinations of species from station to station.

Concentrations of mercury in macrophytes were most elevated near Courtaulds, corresponding with the elevated bottom sediment concentrations and suspended solids collected during the same survey. Mercury levels in benthic macroinvertebrates, however, were most elevated further downstream (below Pilon Island). This may be the result of flow conditions around the island which favours the deposition of mercury-contaminated sediments.

Benthic invertebrates collected along the north channel at Cornwall in 1986, appeared to have bioaccumulated arsenic, copper, chromium, zinc, cadmium, mercury, nickel, iron, aluminium, lead and manganese (Lomas, 1988). The benthic invertebrates also had elevated levels of PCBs at all stations. The 1986 study concluded that contaminants of concern in the Cornwall area (Mercury, PCBs & other metals) are found mainly in the sediment but also may be taken up by biota directly from the water column. Source control was identified as the only apparent way of eliminating these contaminants from the water body and decreasing the concern for contaminant uptake and food chain transfer.

Native mussels (*Elliptio complanata* and *Lampsilis radiata*) were collected in 1985 from 17 locations on the St. Lawrence River (Metcalfe and Charlton, 1989). Five of these locations were within the area of concern. The mussels, as biomonitors provide both an indication of contaminant bioavailability and persistence in organisms. Analyses included organochlorine pesticides, chlorobenzenes, octachlorostyrene and PCB congeners.

The patterns of contaminant levels in mussels along the length of the river identified Lake Ontario as the source of Mirex and DDT derivatives to the St. Lawrence River system and the Grasse River as the major source of PCBs. Numbers of PCB congeners in mussels increased from 21-27 in the upper river to 56-59 in the Cornwall-Massena section, mainly due to the presence of di-, tri- and tetrachlorobiphenyls from local sources.

The highest concentration of PCBs (492 ng/g) was observed in a mussel from the mouth of the Grasse River and the findings suggested that the majority of the PCB compounds entering the St. Lawrence River at Massena persist in resident mussels for several hundred kilometres downstream in a characteristic accumulation pattern which differs from that occurring in locations such as the upper river and the Ottawa River.

Studies conducted in 1988 using caged mussels will update the information on contaminants in biota, indicating more specific sources and the potential for bioaccumulation within the food chain. These samples are awaiting complete laboratory analysis, however preliminary chlorinated dibenzo-p-dioxin and dibenzofuran analyses (Table 6-19) for 5 locations along the nearshore in the vicinity of the Reynolds and general Motors Plants and the Grasse River in Massena. The canal and Courtaulds areas in Cornwall show generally low levels of these compounds in both the sediment and mussel tissue. Samples taken near the Reynolds facility, however, are elevated particularly for tetra and penta chlorinated dibenzofurans in the sediment (61 ng/g and 18 ng/g respectively) and reflect a source (either historical or ongoing) to the river at this location. By comparison, levels of tetrachlorinated dibenzofurans, representing an active source (Kraft pulp mill) in Jackfish Bay, Lake Superior were recorded in sediment at a maximum level of 6.2 ng/g (Sherman et al, 1990), or approximately one tenth the concentration observed near Reynolds. There were no detections of 2,3,7,8 TCDD in the St. Lawrence River samples.

Table 6-19 Chlorinated Dibenzo-p-dioxins (CDD) and Chlorinated Dibenzofurans (CDF) in Caged Mussels (ng/g wet weight) and Bottom Sediment (ng/g dry weight) June, 1988

	Sampling Location				
	Grasse River	Reynolds	GM	Cornwall Canal	Courtaulds
Mussels					
2,3,7,8 TCCD	ND*	ND	ND	ND	ND
Tetra CDD	ND	ND	ND	ND	ND
Penta CDD	ND	ND	ND	ND	ND
Hexa CDD	ND	0.023	ND	ND	ND
Hepta CDD	ND	0.006	ND	ND	ND
Octa CDD	ND	ND	ND	ND	ND
Tetra CDF	0.043	0.002	0.005	0.003	0.005
Penta CDF	0.019	0.001	0.005	0.002	0.003
Hexa CDF	ND	0.011	ND	ND	ND
Hepta CDF	ND	0.008	ND	ND	ND
Octa CDF	ND	ND	ND	ND	ND
Sediment					
Tetra CDD	ND	0.29	0.008	ND	ND
Penta CDD	ND	0.25	0.002	ND	ND
Hexa CDD	ND	0.35	0.042	ND	ND
Hepta CDD	ND	0.15	0.079	ND	0.13
Octa CDD	0.04	0.51	0.028	0.08	1.2
Tetra CDF	0.07	61	0.6	ND	0.17
Penta CDF	0.06	18	0.21	ND	0.03
Hexa CDF	ND	3.5	0.15	ND	0.02
Hepta CDF	ND	0.48	0.13	ND	0.13
Octa CDF	ND	0.39	0.09	ND	0.06

* ND – not detected

6.4 Aesthetics

Aesthetic impacts on the aquatic environment refer to visual conditions which are considered objectionable, such as oily slicks, foams, scums, floating debris; objectionable odour and taste of water and fish; excessive aquatic weed growth; and objectionable colour or turbidity that may be caused by anthropogenic activities or naturally occurring phenomena such as algae blooms and microbiological activity. These are highly visible indicators of threats to the aquatic ecology and beneficial uses of the water resources.

During the summer of 1970, four physical observation cruises (Boyer *et al.*, 1972) were carried out on the St. Lawrence River from Kingston to Cornwall as part of a study covering both the Canadian and United States shorelines. Results of this study are used to describe historic problems associated with aesthetic pollution such as objectionable deposits, algae growth and discolouration on the St. Lawrence River.

Observations from the cruises indicated that oil spills were prevalent on the St. Lawrence. The remains of a spill which occurred in August 1969 in the North Channel west of Cornwall, was still noticeable in May 1970 lining the shores in the area. An oil spill that occurred approximately in March 1970 at the Reynolds Metals Limited facility in the United States and a gasoline-oil mixture (source unknown) which appeared just below the Courtaulds Plant in July 1970, caused aesthetic problems (oily films) which persisted into the summer.

Results of the 1970 observation cruise also reported that during the later part of the summer of 1970, excessive weed growth caused a decline in the tourist trade, inaccessibility to marinas by small craft, depreciation of waterfront property, limitations on the availability of body contact and non-body contact recreational areas and a decline in the natural beauty of certain areas.

Wastes from industries on both sides of the St. Lawrence were noted for causing discolouration of the river below their outfalls. Most notably were: Ault Milk Products, Brockville, Ontario; Diamond National Co., Ogdensburg, N.Y.; Canada Starch, Cardinal, Ontario; Courtaulds, Cornwall, Ontario; Reynolds Aluminum, Massena, N.Y.; and General Motors Engine Plant, Massena, N.Y.

Government imposed reductions on nutrients and phosphorous along with tighter controls on the discharge of aesthetic pollutants has helped in the substantial recovery of the St. Lawrence River from its depressed state of the early 1970s. However, excessive aquatic weed growth is still prevalent in some reaches of the St. Lawrence. In addition, Cornwall discharges continue to present localized objectionable odour and discolouration impairment. Spills from ships and pleasure-craft using this section of the river also have the potential to cause either local or widespread aesthetic impairment.

At the mouth of the Riviere a la Guerre in the Quebec section of Lake St. Francis, an increase in turbidity along the shore due to local sources results in aesthetic degradation (Sylvestre, 1989). This turbidity has caused problems in the past for private water intakes.

6.4.1 Aquatic Weed Growth

Aquatic weed growth along the north shore of Lake St. Francis is quite substantial. Without the use of aquatic weed harvesters, access by small craft to and from marinas would be difficult. Nuisance aquatic plant growth primarily resulted from the changes in flows in Lake St. Francis as a result of the construction of the Seaway (Owen and Wile, 1975). The slower flow has resulted in sedimentation and conditions that promote aquatic weed growth along the north shore of Lake St. Francis. The invasion of the exotic Eurasian milfoil and its subsequent expansion has also contributed to the proliferation of dense growth of aquatic vegetation (Owen and Wile, 1975). Nutrient levels, while they contribute to the growth of aquatic plants are a secondary factor and recent investigations have shown that nutrients are at surplus levels. This means that even significant reductions in nutrient levels would not result in the elimination of nuisance aquatic plant growth.

During the 1970s, Environment Ontario funded the Aquatic Weed Harvesting Program, an experimental program aimed at investigating suitable control technologies and the development of a protocol to ensure weed harvesting is carried out in an environmentally sound manner. Under this program, experimental harvesting operations were carried out on Lake St. Francis and results demonstrated that harvesting is a viable control option for nuisance weed growth. The opening of several channels which, before were unnavigable, resulted in improved boat access in the area.

Since the completion of the experimental Aquatic Weed Harvesting Program, Environment Ontario ceased funding the harvesting operations throughout the province. In the Ontario section of Lake St. Francis, the Raisin Region Conservation Authority continued harvesting operations with financial assistance from the Ontario Ministry of Natural Resources for several years.

In 1986, the Ontario Ministry of Natural Resources stopped the funding assistance for this program, but in 1987 the Ministry gave the Raisin Region Conservation Authority a one-time grant to help it with the purchase of the weed harvesting equipment. The Conservation Authority has continued to harvest weeds since the summer of 1987. An annually revised management plan co-ordinates the harvesting of approximately 80 ha of boat traffic lanes annually.

A study conducted in October 1988 concluded that the aquatic plant community distribution has not changed significantly from that shown in 1980 and 1973 surveys. Water milfoil (*Myriophyllum spicatum*) and tapegrass (*Vallisneria americana*) continue to be the most abundant species in Lake St. Francis. As in the earlier studies, milfoil growth is not limited by the availability of nitrogen or phosphorus (Beak, 1989).

Sylvestre (1989) reports that excessive aquatic weed growth in Quebec along the shore near Saint-Zotique, Saint-Anicet and in Baie des Brises and Baie de la Faim has caused aesthetic degradation and obstruction for water activities. This in turn has led to a reported loss in tourism and a drop in nearshore property values.

6.4.2 Fish Tainting

In 1964, the former Ontario Water Resources Commission, in co-operation with the Ontario Department of Lands and Forests, carried out a series of panel tests to investigate the presence and absence of foreign flavour in several species of fish collected from the St. Lawrence River upstream and downstream of Cornwall.

The results of the tests indicated that the river water in the vicinity of Cornwall imparted a taint to the flesh of a large percentage of fish of several species. The frequency and intensity of the off-flavour declined downstream, however, considerable impairment of flavour occurred for a distance of at least 20 km.

When the odours of several effluents were presented for comparison, wastes from the Domtar Pulp and Paper Company at Cornwall were deemed to resemble the foreign flavour in fish most closely. The inference was that discharges from the Domtar plant were the source of the tainting compounds.

The installation by Domtar of an effluent diffuser in 1971 and the shutdown of its sulphite mill and construction of a clarifier in 1972 helped to reduce the zone impacted by tainting substances.

In 1983, Domtar carried out a dispersion and dilution study to evaluate the effectiveness of modifications made to its diffusor ports to improve mixing and to re-evaluate the tainting propensity of the mill effluent in order to define a zone of impact. Results of this study indicated the zone of impact was relatively small with less than 2 percent of the river volume being affected at 470 m downstream of the diffusor. Although there have been no recent complaints from anglers of fish tainting, one of the reasons the Cornwall section of the St. Lawrence has been identified as an area of concern was because of a large zone of elevated 4-Aminoantipyrine (4-AAP) reactive phenolics above the Provincial Water Quality Objective of 1 μg/L. According to the Provincial Water Quality Objective for total phenols, concentrations above 1 μg/L result in the tainting of edible fish flesh.

In the recent electrofishing study (October 1986) several walleye with an unusual odour were caught downstream of the Domtar outfall. A 1988 survey of more than 800 anglers on Lake St. Francis failed to find a significant number of anglers who thought that the flavours of perch (the most frequently caught and consumed fish) had deteriorated or was "tainted". This survey covered the area from the power dam downstream to the Lancaster area. As a final confirmation of the situation, a fish tainting evaluation was conducted in 1990 using caged and native fish to determine if tainting occurs along the Cornwall waterfront specifically. The results of this study were inconclusive. Differences in odour of indigenous perch collected upstream and downstream may be more attributable to differences in collection of these fish from the two locations than exposure to industrial effluents. The downstream collection site was approximately 10 km from Domtar and it is highly unlikely, at this distance, the effluent would be at concentrations that are strong enough to impart an odour or taste in fish.

Because of the remaining questions on fish tainting a study, using existing data, on the potential of Domtar's effluent (i.e. fish tainting threshold concentration) and dispersion modelling, developed for this stretch of the St. Lawrence River, will be used to further investigate the issue in 1991.

7.0 DESCRIPTION OF SOURCES

7.1 Point Sources

The majority of the information collected or reported to Environment Ontario pertains to the conventional parameters, such as biochemical oxygen demand (BOD), suspended solids, total dissolved solids, phosphorus and chemical oxygen demand. The information available on the concentration of persistent and problem compounds in effluents is limited but is becoming more available.

Effluents from each of the industries and from the Cornwall WPCP were extensively sampled in 1987 or 1988 for the initial phase of Environment Ontario's Municipal and Industrial Strategy for Abatement program (MISA). The second phase of the MISA program is the monitoring regulation and it is now in force. Under this regulation, all industries discharging effluent in Cornwall are being required to conduct a comprehensive sampling and analysis program.

The primary sources of waste water in the Cornwall area are the three direct dischargers to the St. Lawrence River:

1. Domtar Fine Papers and ICI (formerly CIL)/Cornwall Chemicals;
2. Courtaulds Fibres and Courtaulds Films (closed 1989); and
3. The Cornwall WPCP.

Each of the discharges is described below and their location shown in Figure 7-1. Typical effluent characteristics for conventional parameters are shown in Table 7-1. The results of the initial phase of the MISA program carried out during 1987 and 1988 are provided in Appendices VII through XIII. This program involved a short-term (2 to 4 day) sampling period undertaken by each company. Data are provided for influent and effluent samples collected at each of six point sources including Domtar Fine Papers, ICI (formerly CIL), Cornwall Chemicals, Stanchem, Courtaulds Fibres and the Cornwall Water Pollution Control Plant. Parameters analyzed include various conventional parameters, metals, inorganics and organics. Appendix XVI provides derived loading estimates for selected parameters based on longer term sampling conducted in 1980 and 1981 by Environment Canada (1985a).

7.1.1 Domtar Fine Papers

With a flow of 130,000 m^3/day, Domtar Fine Papers is the largest discharger of industrial wastewater in the area. About 750 metric tonnes per day of various grades of fine paper, such as bond, copy paper, offset and coated board are produced at the Domtar mill. About 50 percent of the pulp needed to produce the paper is manufactured at the kraft mill on the same site, the remainder is purchased.
The pulp mill utilizes a bleached kraft process in which hardwood chips are converted into pulp by cooking them under pressure with sodium hydroxide and sodium sulphide. The brown-coloured pulp which is produced is bleached white by successive treatments using chlorine, oxygen, sodium hydroxide and chlorine dioxide.

Domtar's effluent is relatively high in 5-day biochemical oxygen demand (BOD_5) and suspended solids (Table 7-1, Appendix VII). The suspended solids are largely lime, clay and wood fibre. The oxygen demanding materials are mainly dissolved organic waste material from the pulping of wood.

Most of the effluent generated at Domtar undergoes primary treatment. A clarifier removes suspended solids which are then landfilled. A low suspended solids stream bypasses the clarifier and joins with the main effluent stream before discharging to the St. Lawrence River.

Figure 7-1

St. Lawrence Remedial Action Plan
Cornwall point sources
(EPS 1985)

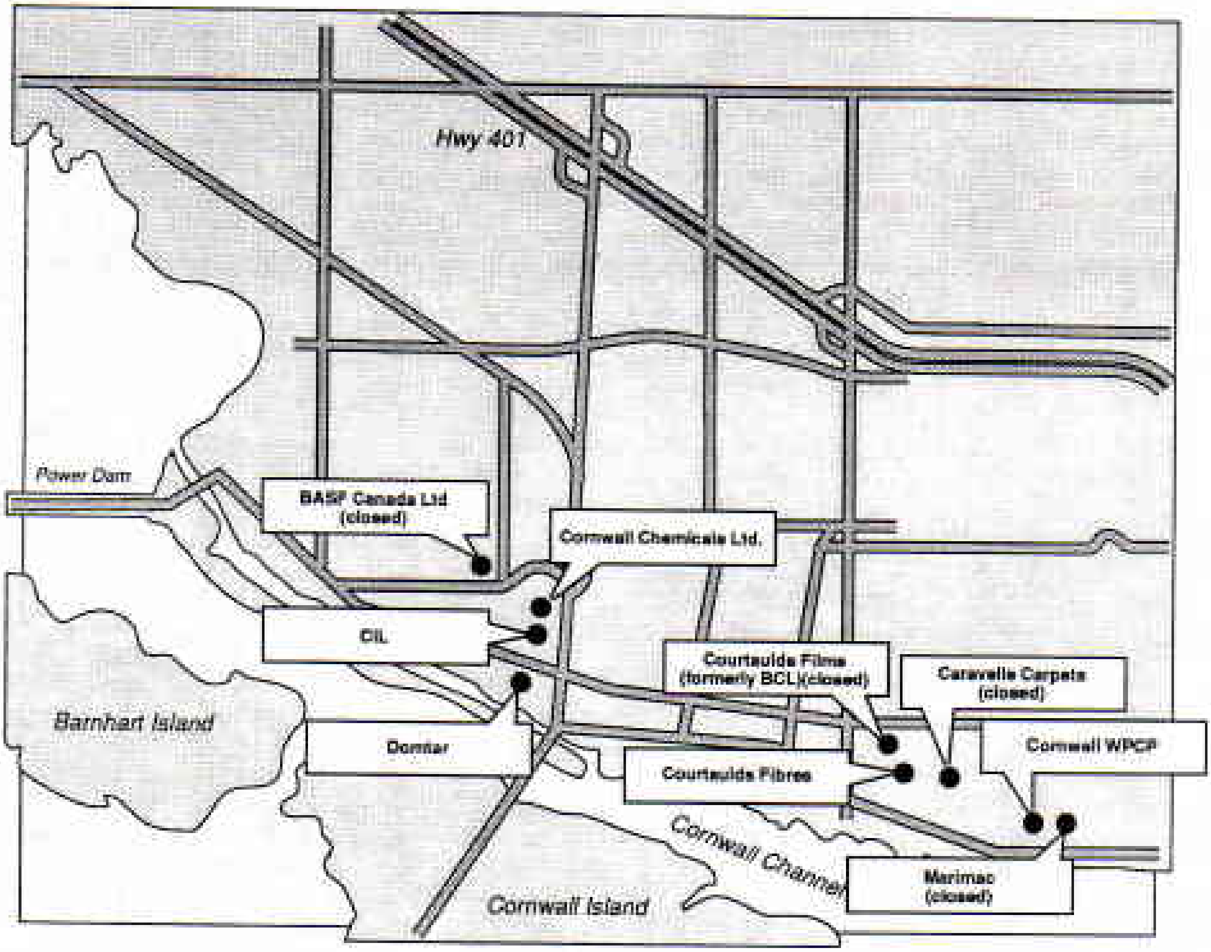


Table 7-1 Typical Characteristics of Cornwall Industrial Discharges (1988)

	Range	Average
Domtar Clarifier Effluent		
Flow	-	-
BOD_5	100-300 mg/L	150 mg/L
COD	300-900 mg/L	480 mg/L
Suspended Solids	40-150 mg/L	80 mg/L
Total Dissolved Solids	800-1,500 mg/L	950 mg/L
Domtar Bypass Effluent		
Flow	-	-
BOD_5	50-1,200 mg/L	200 mg/L
COD	100-3,000 mg/L	800 mg/L
Suspended Solids	5-150 mg/L	25 mg/L
Total Dissolved Solids	300-3,500 mg/L	850 mg/L
ICI (formerly CIL)		
Flow	2,500-4,500 m^3/day	3,100 m^3/day
BOD_5	Less than 1 to 20 mg/L	4 mg/L
COD	10-300 mg/L	80 mg/L
Suspended Solids	20-200 mg/L	90 mg/L
Total Dissolved Solids	1,500-5,000 mg/L	2,700 mg/L
Mercury	0.006-0.100 mg/L	0.014 mg/L
Cornwall Chemicals		
Flow	-	850 m^3/day
BOD_5	10-250 mg/L	105 mg/L
COD	30-350 mg/L	210 mg/L
Suspended Solids	2-25 mg/L	10 mg/L
Total Dissolved Solids	1,500-4,000 mg/L	2,500 mg/L
Marimac (closed 1990)		
Flow	2,500-4,000 m^3/day	2,800 m^3/day
BOD_5	80-300 mg/L	180 mg/L
COD	190-800 mg/L	460 mg/L
Suspended Solids	5-80 mg/L	35 mg/L
Courtaulds - BCL Acid Sewer		
Flow	4,500-9,000 m^3/day	7,500 m^3/day
BOD_5	100-300 mg/L	180 mg/L
COD	200-800 mg/L	400 mg/L
Suspended Solids	20-250 mg/L	100 mg/L
Courtaulds - BCL Viscose Sewer		
Flow	1,000-5,000 m^3/day	2,500 m^3/day
BOD_5	200-500 mg/L	300 mg/L
COD	200-1,200 mg/L	600 mg/L
Suspended Solids	30-500 mg/L	100 mg/L
Courtaulds - BCL Sulphide Sewer		
Flow	1,000-2,500 m^3/day	1,500 m^3/day
BOD_5	20-200 mg/L	50 mg/L
Suspended Solids	1-20 mg/L	4 mg/L

Note: The loading of contaminants in kg/day can be calculated from the following formula:
LOADING (kg/day) = FLOW (m^3/day) X CONCENTRATION (mg/L) X 10^{-3}

The results of the pre-monitoring regulation sampling are presented in Appendix VII. Domtar's effluent is typical for kraft pulp mills having significant concentrations of resin and fatty acids (not shown in Appendix VII), phenols, aluminum and chloroform. These acids are acutely toxic to fish and can bioaccumulate in the environment. High concentrations of phenol are characteristic of hardwood kraft mills and high aluminum concentrations are the result of the use of aluminum sulphate in the paper-making process.

Other parameters which were found to be higher in the final effluent than the intake included: volatiles such as benzene, dibromochloromethane, ethylbenzene and 1,1,1-trichloroethane; PAHs such as acenaphyhylene, anthracene, fluoranthene, naphthalene and phenanthrene; cadmium; chromium; copper; lead; zinc; chloride; sulphate; nitrate; sodium; potassium; total phosphorus; total Kjeldahl nitrogen; and ammonia. Most of these parameters are found in the effluent at concentrations up to twice that of the influent.

Ontario's Industrial Effluent Objectives are exceeded for BOD_5, suspended solids and cadmium. The objectives are 15, 15 and 0.001 mg/L, respectively. Concentrations measured in effluent ranged from 85 to 179 mg/L for BOD_5, 40 to 65 mg/L for suspended solids and 0.0008 to 0.0013 mg/L for cadmium. These objectives will be replaced by facility-specific regulations to be established under MISA.

This information shows that the soluble component of the Domtar effluent is a complex mixture of organic compounds (Appendix VII). Some of the compounds of concern, primarily the resin and fatty acids and chlorinated phenolics, tend to be present in lower concentrations than other pulp and paper effluents in Ontario. Phenolic compounds can impart off-tastes to fish and some of the chlorinated ones are suspected carcinogens.

In 1988, the suspected presence of dioxins and furans in pulp mill effluent became a concern across Canada. Environment Ontario and Environment Canada initiated a baseline survey to measure adsorbable organic halogen (AOX, which is a measure of the concentration of chlorinated organic contaminants) and dioxin levels in all Ontario bleached kraft mill effluents. Three rounds of sampling were conducted between July 1988 and August 1989. A final compilation of all survey results has not been completed.

Limited sampling of Domtar's effluent conducted by Environment Ontario in 1987 revealed no detectable dioxins or furans in the effluent. The clarifier sludge, however, was found to have detectable concentrations of certain of these compounds (Environment Ontario, 1986). This sludge is disposed of at the company's approved landfill site located at the north end of their property (see Section 7.2.2). A similar site operated by the Boise Cascade kraft mill in Fort Frances, Ontario was found to be leaching dioxins and furans into a nearby creek. Since the leachate from the Domtar site discharges to the city's sewer system, no direct environmental impacts are expected. Once the Ministry of the Environment's dioxin laboratory can handle more routine work, samples of this leachate will be taken for analysis.

In December of 1988, Environment Canada served notice under the Canadian Environmental Protection Act requiring all pulp mills to provide information on a number of items including: data on dioxins, furans and chlorinated organic compounds in effluents, wastewater treatment sludges and in the receiving environment (water, sediment, biota); and information on control technologies. The information submitted by Domtar will be used by Environment Canada to develop a control strategy if necessary.

As part of the national dioxin survey, river sediments in the vicinity of the Domtar discharge were analyzed for dioxin in the fall of 1989. Sediment samples were collected upstream and downstream of the Domtar diffuser (Trudel, 1991). The limited nature of the sampling program restricts the conclusions which can be drawn and therefore is regarded as preliminary information only (see Section 6.2 Bottom Sediments). Fish tissue analysis for dioxins and furans included are not available at this time.

7.1.2 ICI Forest Products (formerly CIL)-Cornwall Chemicals-Stanchem

The effluents from ICI (formerly CIL), Cornwall Chemicals and Stanchem are combined prior to discharge. The flow from these three facilities totals about 4,000 m^3/day and is characterized by its low BOD_5 and suspended solids (Table 7-1, Appendices VIII, IX and X). This effluent is discharged directly to the St. Lawrence River through the Domtar diffuser.

At ICI (formerly CIL), salt is dissolved and converted into sodium hydroxide and chlorine by electrolysis, using the mercury cell process. All the liquid effluent that is or could be contaminated is collected and treated to remove mercury. The amount of mercury discharged easily meets the federal Chlor-Alkali Regulation (0.0025 kg per tonne of chlorine produced).

Appendix IX shows the results of Environment Ontario's MISA pre-regulation monitoring. Concentrations of most persistent and problem compounds are very low. The only exception is for mercury. Concentrations of mercury in 4 effluent streams ranged from 0.0029 to 0.0073 mg/L which exceed the Ontario Industrial Effluent Objective (0.001 mg/L). Suspended solids ranged from 2.0 to 160 mg/L and oil and grease from less than 1 to 57 mg/L. The Ontario Industrial Effluent Objectives for suspended solids (15 mg/L) and oil and grease (15 mg/L) are both exceeded in these samples.

Organic parameters which were found at low, but detectable, concentrations include tetra- and pentachlorodibenzofurans and the bis(2-ethylhexyl)phthalate (Appendix IX).

At Cornwall Chemicals, a number of industrial chemicals, such as sodium hydrosulphide, hydrochloric acid, carbon tetrachloride and carbon disulphide are manufactured from the chlorine and sodium hydroxide produced at ICI (formerly CIL). The effluent produced by these processes is clarified before discharge. Typical characteristics of this effluent are shown in Table 7-1.

Because of its source, the effluent contains significant quantities of carbon tetrachloride and measurable levels of chloroform. The concentrations of these two chemicals present in the effluent are shown in the results of the 1987 MISA pre-regulation monitoring data (Appendix X). Both chemicals are considered problems in the environment because of their suspected carcinogenicity. The data in Appendix X also indicate that effluent concentrations of 25 other halogenated volatiles exceed intake water (see column labelled 'well-city') by up to 10 times. These parameters include methylene chloride, trichloroethylene and vinyl chloride.

Other parameters which are elevated above intake concentrations include toluene, xylenes, acrolein, acrylonitrile, carbon disulfide, octachlorodibenzo-p-dioxin, octachlorodibenzofuran, fluoranthene, benzyl butyl phthalate and di-n-octyl phthalate.

Concentrations of mercury (0.002 to 0.0037 mg/L) and zinc (0.14 to 2.93 mg/L) measured in Cornwall Chemicals' effluent exceed the Ontario Industrial Effluent Objectives of 0.001 and 1.0 mg/L, respectively (Appendix X).

Cornwall Chemicals has carried out considerable in-plant process control work to locate sources of contaminants in order to recover more of the product prior to entering the waste stream.

Stanchem operates a packaging plant that produces small quantities of chemicals in bottles, carboys or cylinders for laboratory or industrial use. The small amount of effluent that it produces is neutralized before being combined with the Cornwall Chemicals' effluent.

Results of the MISA pre-monitoring regulation analyses of the effluent from Stanchem is provided in Appendix XI. These results indicate that the effluent exceeded the Ontario Industrial Effluent Objectives in at least one waste stream for pH (11.91), suspended solids (69 to 320 mg/L), cadmium (0.017 to 0.029 mg/L), copper (2.0 mg/L), lead (1.2 to 2.2 mg/L), mercury (0.003 to 0.0054 mg/L) and oil and grease (31 mg/L). Objectives for these parameters are: pH, 5.5 to 9.5; suspended solids, 15 mg/L; cadmium, 0.001 mg/L; copper, 1.0 mg/L; lead, 1.0 mg/L; mercury, 0.001 mg/L; and oil and grease, 15 mg/L.

The data in Appendix XI also indicate that the effluent from Stanchem contains several organic contaminants including two PAHs, Bis(2-ethylhexyl)phthalate and di-n-butylphthalate; bromodichloromethane, chloroform, chloromethane, dibromochloromethane, tetrachloroethene, hexachloroethane, hexachlorobenzene and PCBs. The source of many of these parameters is believed to be from the contamination of containers which are returned to Stanchem for refilling. The waste stream likely becomes contaminated as a result of washing-out the containers prior to refilling.

7.1.3 Courtaulds Fibres and Courtaulds Films (closed 1989)

Courtaulds Fibres produces rayon, a man-made fibre with similar properties to cotton, by treating wood pulp with sodium hydroxide and carbon disulphide to form an intermediate product-viscose containing zinc and sodium sulphate. The viscose is injected into a sulphuric acid bath to form the rayon fibres. Rayon is used in the manufacturing of clothing and fabrics.

Courtaulds Films (closed 1989) (formerly BCL Canada Ltd.) bought viscose from Courtaulds Fibres and injected it into a sulphuric acid bath through a long narrow slit to produce cellophane. Cellophane is used for packaging goods or making adhesive tape. Courtaulds Films ceased operations in September 1989.

The acid, sulphide and storm sewers are process sewers which originally serviced both companies. The other process sewer, the viscose sewer, discharges wastes generated at Courtaulds Fibres. There are also three sewers which discharge cooling or condensate water generated in the Courtaulds Fibres acid Recovery Plant. These include the acid recovery sewer, Caravelle Carpets sewer and the tank car unloading sewer. Figure 7-2 is a schematic showing their locations.

The viscose sewer is alkaline with a pH in the 10 to 12 range, relatively high BOD and low suspended solids. At the river bank, they combine and discharge through a diffuser. The end of the diffuser is located in the river, 244 m from shore.

The acid sewer is characterized by low pH, low BOD, low suspended solids and high concentrations of zinc and sulphuric acid. Courtaulds Fibres is the primary source of zinc from Cornwall area sources. This sewer discharges to the St. Lawrence River through the acid diffuser, which is also about 244 m into the river. The total amount of the effluent from the Courtaulds Fibres/Courtaulds Films (closed 1989) complex amounts to about 10,000 m^3/day. Table 7-1 lists some typical analyses for conventional parameters for these sewers.

Effluent from all the process sewers are extremely toxic to fish. Environment Ontario has an extensive data bank for all Courtaulds' sewers. The LC50 test indicates that a mixture containing only two to 10 percent of the effluent kills 50 percent of the test fish within 96 hours.

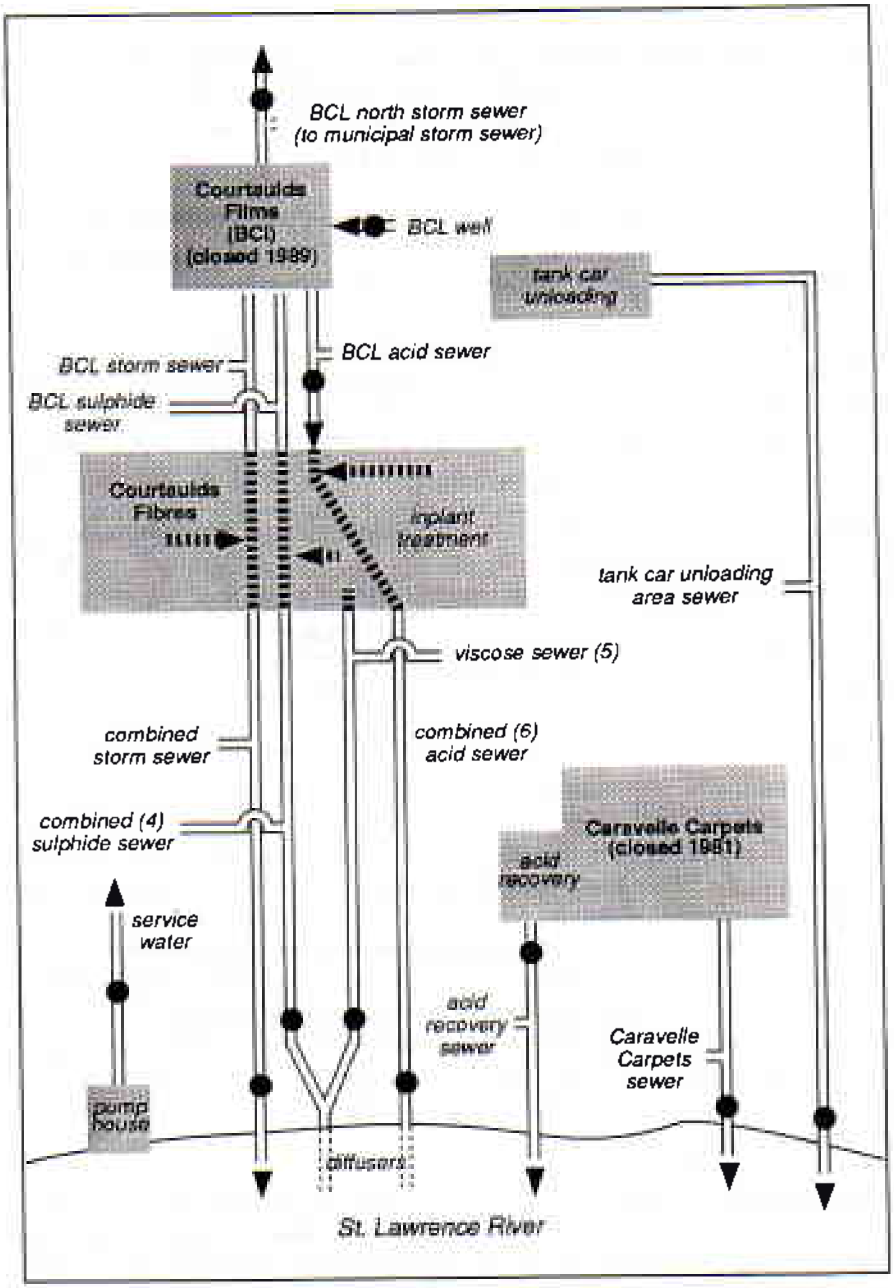
Appendix XII contains a summary of the results of the 1987 MISA pre-regulation monitoring program. These data indicate that the Ontario Industrial Effluent Objectives are exceeded in at least one effluent stream for pH, suspended solids, mercury and zinc. Concentrations of zinc were up to 45 times the objective which is 1.0 mg/L. The pH objective was exceeded at both extremes (5.5 to 9.5) with the alkaline sewer up to 11.5 and the acid site sewer as low as 1.8.

Figure 7-2

St. Lawrence Remedial Action Plan

Schematic of sewers at Courtaulds and Caravelle Carpets

(EPS 1985)



● sampling points, 1985

Section 80 of this part of the act defines a spill as being abnormal in quantity and quality and capable of causing an adverse effect on the environment. Part IX goes on to define the legal onus that the person responsible for, or the controller, has to clean up the spill, how the Ministry of the Environment can take responsibility to clean up a spill, and the legal basis for the right for compensation if one suffers personal or property damage.

Courtaulds Fibres has previously been convicted of a spill of acid and of viscose (1983). The company still continues to have problems with spills. Appendix XV lists all the spills reported to the Ministry of the Environment that occurred in the Cornwall district in 1988 and 1989. The diversity of locations and chemicals stands out. Very few spills are directly to the St. Lawrence River except for frequent losses of acids from Courtaulds Fibres Canada. Table 7-2 shows the number, amount, and causes of spills from that company from June 1986 to June 1990. The Ministry of the Environment has laid charges for about 16 of these incidents. The first five days of the trial were heard in April of 1991 and are scheduled to resume in September, 1991.

An Order for the company has been prepared that will require it to implement a comprehensive spill control program. Once approval to proceed is obtained from within the Ministry, a public meeting will be held to discuss the proposed Order. The company has already started work on many of the requirements.

ICI (formerly CIL) was charged with discharging mercury in excess of the level permitted by the Chlor-alkali Regulations of the Fisheries Act. At the trial, the company was able to show the effluent discharged during the day for which it was charged was generated over several days. Even though the amount of the mercury discharged during the 24 hour period exceeded the permitted level, the regulation allowed the amount to be averaged over the period the effluent was generated. This reduced the amount to below the limit.

7.2 Non-Point Sources

Most of the area between Cornwall and Lancaster is drained by the Raisin River. The Raisin flows approximately parallel to the St. Lawrence and discharges into it at the Village of Lancaster. The Raisin River does pick up some storm drainage from the north end of the City of Cornwall, as well as any leachate generated by the recently-closed City of Cornwall landfill site.

The remainder of the Raisin River drainage basin is largely agricultural. Therefore, the river contains relatively high levels of nutrients that are associated with agricultural runoff. Table 6-5 lists the results of analyses of the river water for 1980 to 1984.

The shoreline between Cornwall and the Quebec border is fully built-up. A review by a consulting engineer hired by Environment Ontario to evaluate the private waste systems of houses bordering the St. Lawrence River in the Glen Walter area revealed many direct discharges of grey water as well as a few discharges of sanitary wastes. This situation is typical of other portions of the north shore of the river. The impact from these discharges is not known. They may cause locally elevated levels of coliform bacteria in the water along the shore. At times, these levels may be higher than what the Ministry of Health considers safe for swimming.

In the last few years, several manufacturing plants have curtailed operations in Cornwall. Courtaulds Films and Marimac have closed completely. Both BASF and Pfizer shut down their major production facilities but they have retained small production units in operation. These sites may represent a potential cause of impairment and all plants are being decommissioned.

Table 7-2 Spills from Courtaulds Fibres, June 1986 to June 1990

Date	Material (in water)	Amount	Cause
06/29/88	caustic, 11%	2,500 L	operator error
04/30/89	H_2SO_4, 9%	50 gal	equipment failure
06/19/89	H_2SO_4, 93%	2,446 kg	equipment failure
07/13/89	alkaline sewer		error – sewer damage
07/17/89	TiO_2 slurry	20 L	operator error
07/27/89	viscose		
08/04/89	spin bath acid	1,000 gal	
08/14/89	caustic	600 gal	equipment failure
08/18/89	H_2SO_4, spin bath		equipment failure
08/19/89	H_2SO_4, 11.4%	1,000 gal	equipment failure
08/25/89	spin bath acid	10,000 L	equipment failure
09/07/89	H_2SO_4, 9.8%		equipment failure
09/28/89	sodium hydrosulphide	25 gal	operator error
10/07/89	HCl, 30%	20 gal	?
10/21/89	H_2SO_4, spin bath	150 gal	equipment failure
10/25/89	H_2SO_4, spin bath	150 gal	operator error
10/30/89	H_2SO_4, 10%	150 gal	equipment failure
11/03/89	H_2SO_4, spin bath	10,000 L	operator error
11/16/89	sodium hydrosulphide	850 L	equipment/operator error
12/08/89	magma	100 gal	operator error
12/13/89	H_2SO_4, spin bath	3,000 L	error
12/22/89	evaporated acid	1,900 gal	?
12/27/89	caustic, 11%	750 gal	equipment failure
01/05/90	caustic		equipment failure
01/09/90	H_2SO_4, spin bath	2,400 L	equipment failure
01/11/90	sodium hydrosulphide	30 gal	equipment failure
01/16/90	spin bath acid	12,000 gal	
01/22/90	H_2SO_4	800 gal	

(Table 7-2 Cont'd)

Date	Material (in water)	Amount	Cause
02/20/90	spin bath acid	600 gal	equipment failure
02/27/90	H_2SO_4, spin bath	300 gal	
02/28/90	spin bath acid	100 gal	new equipment
02/28/90	spin bath acid		
02/28/90	spin bath acid	700 gal	#3 tank and duct joint
03/07/90	spin bath acid	1,500 L	equipment failure
03/10/90	H_2SO_4, spin bath	4,000 gal	equipment failure
03/20/90	spin bath acid	90 gal	equipment failure
03/27/90	spin bath acid	400 gal	
04/06/90	caustic	25 gal	error
04/09/90	spin bath acid	280 gal	equipment failure
04/30/90	caustic	25 gal	
05/04/90	spin bath acid	100 gal	
05/07/90	sodium hydrosulphide, 34%	2,000 gal	operator error
05/11/90	H_2SO_4	25 gal	equipment failure
05/11/90	sodium hydrosulphide	800 gal	operator error
05/13/90	spin bath acid	9,000 L	equipment failure
05/17/90	spin bath acid		
05/31/90	H_2SO_4, 70%	2,000 gal	operator error
06/02/90	sodium hydrosulphide	20 gal	spill and regulated effluent
06/03/90	spin bath acid	600 L	equipment failure
06/05/90	spin bath acid	700 gal	equipment failure
06/12/90	spin bath acid	150 gal	error
06/17/90	dearborn 40-20	500 ml	error

7.2.1 Urban Runoff

The annual loading of persistent toxic substances from Cornwall in 1980 was calculated (Wong, 1981) and is presented in Table 7-3. Samples were taken in the fall of 1980 and contaminant and suspended sediment concentrations in stormwater from institutional, residential and industrial (Courtaulds) areas were combined with an urban runoff model (STORMS) which calculated annual runoff. Samples were analyzed for organochlorine pesticides, PCBs, polyaromatic hydrocarbons (PAHs), chlorinated benzenes and heavy metals.

Table 7-3 Summary of Annual Loadings of Persistent Toxic Substances from the City of Cornwall

City of Cornwall	PCBs Loading (g/annum)	PCBs Loading/ha (g/ha/annum)	Pesticides Loading (g/annum)	Pesticides Loading/ha (g/ha/annum)	Chlor Benzene Loading (g/annum)	Chlor Benzene Loading/ha (g/ha/annum)
Residential Low	91.75	0.117	52.31	0.067	3.81	0.005
Residential High	77.76	0.169	44.85	0.098	5.30	0.012
Open	31.79	0.055	18.17	0.031	ND*	ND
Commercial Low	109.43	0.691	20.97	0.137	16.98	0.107
Commercial High	60.20	0.729	13.87	0.168	8.84	0.107
Institute	4.15	0.074	2.30	0.041	0.22	0.004
Industrial	86.29	0.290	18.06	0.061	13.72	0.046
Total (g)	461.19		170.53		48.87	

City of Cornwall	Heavy Metals Loading (g/annum)	Heavy Metals Loading/ha (g/ha/annum)	PAH Loading (g/annum)	PAH Loading/ha (g/ha/annum)
Residential Low	708.57	0.902	73.11	0.093
Residential High	556.20	1.211	101.59	0.221
Open	224.87	0.386	ND	ND
Commercial Low	548.01	3.687	363.52	2.295
Commercial High	436.93	5.290	189.24	2.291
Institute	7.93	0.141	ND	ND
Industrial	1,131.89	3.800	299.39	1.005
Total (g)	3,650.40		1,026.85	

* ND – Concentrations of samples were below detection limits

Source: Wong, 1981

Loadings of contaminants from the City of Cornwall were calculated as follows: 48.87 grams per year (g/yr) chlorinated benzenes; 170.53 g/yr pesticides; 461.19 g/yr total PCBs; 1026.85 g/yr PAHs; and 3650.43 g/yr heavy metals. For the Courtaulds catchment area, calculated loadings include: 0.57 g/yr chlorinated benzenes; 0.76 g/yr pesticides; 3.66 g/yr PCBs; 12.54 g/yr PAHs; and 47.64 g/yr heavy metals.

The study showed that, although solids account for only 0.01 percent of the total runoff mass, these solids transport up to 100 percent of the total loading for some chemical groups such as chlorinated benzenes. The study did not, however, account for any seasonal variation as only fall sampling was carried out.

7.2.2 Waste Disposal Sites

In the area of concern, there are four active waste disposal sites. Three are sanitary landfills operated by municipalities. The remaining one is a disposal site for the solid waste products generated by Domtar's pulp and paper facility in Cornwall.

The municipally operated sanitary landfill sites located in the Townships of Cornwall and Charlottenburg are within the Raisin River watershed. They are relatively small and cause only localized contamination of ground or surface water; they are not significant sources of contamination to the St. Lawrence River.

Both the Domtar waste disposal site and the City of Cornwall sanitary landfill have leachate collection systems that discharge to the municipal sewer system. Because of these systems, groundwater contamination should be avoided.

Two closed waste disposal sites are known to produce leachate that is discharged to surface waters. The old City of Cornwall landfill site, closed in 1987, produces leachate that flows into the south branch of the Raisin River. A permanent cap for the site was completed in 1989 and has reduced the amount of the leachate. During the operating life of this landfill, industrial wastes, including liquids and brine purification muds containing low levels of mercury from ICI (formerly CIL), were disposed of there. Because of these past practices and other problems with the site, a study was done and recommended a leachate collection system be installed. A certificate of approval issued by Environment Ontario requires the completion of the collection system by the end of 1991. The collection system will discharge to the City of Cornwall sewer system. The need for leachate treatment will be studied. Investigative work around the site has shown some limited contamination of the shallow groundwater. The capping of the site and the leachate collection system should rectify the problems.

An industrial waste disposal site owned by Courtaulds Fibres, which was closed in 1973, produces leachate that discharges to the St. Lawrence River via a municipal storm sewer. A 1980 study conducted for Environment Ontario made a number of recommendations, including investigating the necessity for installing a leachate collection system. A leachate cell system was installed by the company. Ontario did not accept many of the other recommendations.

Another closed industrial waste site may be producing leachate that could contaminate ground water. The Pfizer plant in Cornwall disposed of waste gypsum at this site before the company shut down its plant in 1987. Pfizer has hired a consultant to determine if any contamination is occurring and to recommend ways to properly close the site.

There are three other waste disposal sites that have been closed by the City of Cornwall over the years. None are known to be sources of contamination to surface or ground waters.

In 1987, the Mohawk Council of Akwesasne directed the closure of the Cornwall Island and Chenail waste disposal sites. Both sites had received only residential waste; Cornwall Island for 50 to 60 years and the Chenail for approximately 10 years. Some leachate movement off-site was noted in 1987 and closure plans prepared in late 1988 (Totten Sims Hubicxi Associates, 1988). Residential waste has been directed to an existing landfill site in Massena, New York since 1987.

7.2.3 Atmospheric Emissions

Besides discharging mercury to the St. Lawrence, the chloro-alkali plant operated by ICI (formerly CIL) discharges mercury to the atmosphere. The annual atmospheric emissions from the plant for the years 1984-1988 are shown in Appendix XVII. ICI's emission rates easily comply with the federal Environmental

Protection Act. Monitoring by Environment Ontario shows that 90 percent of the mercury emitted to the atmosphere would fall-out within 1 km of the plant property line (Rennie, 1985).
The mercury that is deposited on soil is likely bound-up very rapidly by the soil organic matter and would not leach. Any mercury falling on sidewalks and roads would be washed into the sewer system by precipitation. Since the sewer system in that neighbourhood of the city is combined, the mercury would enter the sewage treatment plant. The primary treatment is efficient at removing mercury as illustrated by the extremely low concentrations in the sewage treatment plant effluent (Appendix XIII).

Extremely small amounts of mercury are expected to fall-out directly on the St. Lawrence River because of the greater than 1 km distance from ICI (formerly CIL) to the nearest shoreline, the relatively low frequency of north and northwest winds and the small surface area of the river in the vicinity of the Seaway International Bridge.

The Reynolds Metal Company just west of the Seaway International Bridge in New York State is a source of fluoride and PAHs (polyaromatic hydrocarbons). The fluoride emission rate is about 75 kg/hr. The emission rate of PAH is unknown. A large percentage of these chemicals when emitted by Reynolds to the atmosphere will deposit directly on the St. Lawrence River. The plant is located on the shore and the predominant winds are southwest.

Atmospheric deposition of PAHs may be an important source of this contaminant. Further studies may be required to determine the source of the recently discovered high concentrations of this contaminant in the area of concern. Any of the PAHs deposited on land will likely be bound up by the organic matter in the soil.

The impact of the fluoride emissions are expected to be negligible. The large volume of water flowing by the Reynolds Plant already has a significant amount of fluoride in it. The average concentration of fluoride in the St. Lawrence River water is 0.12 ppm which is equivalent to a load of over 1,000 kg/hr.

7.3 Historical Point Source Discharges

In Ontario prior to 1960, industrial plants and municipalities did little to control the liquid waste discharges to the environment. There were no government agencies to develop and enforce pollution control laws and policies. Few municipalities or companies had pollution control policies or strategies.

The city of Cornwall's sewage treatment plant was not installed until 1968. Prior to that, the raw sewage collected by the sewage system was discharged straight to the St. Lawrence River at many places along the Cornwall waterfront. The flow and quality would have been at least that of the influent to the sewage treatment plant. The worst aspect of this practice would have been the failure to control the potentially pathogenic discharges of bacteria. The effluent from the sewage treatment plant is now disinfected prior to discharge.

Since 1881, there has been a pulp and paper mill at the same site in Cornwall as the one currently operated by Domtar. Pulp and paper mills have always produced large quantities of wastewater that were discharged untreated until the mid-1960s. About then, the local mill started to implement water conservation practices and in-plant pollution control measures. Surveys conducted during the 1960s by the Ontario Water Resources Commission (OWRC), one of the forerunners of Environment Ontario, indicated the approximate flow of wastewater was 50 million gallons per day. Approximately 90 tonnes of BOD and suspended solids were being discharged.

The chlor-alkali plant at ICI (formerly CIL) was started up in 1935. The earliest monitoring done by the company and reported to the government was completed in early 1970. Losses of about 150 kg of mercury per year were reported. Losses were likely at least equal or greater than that amount during previous years of operation.

Courtaulds has been making rayon at the same site since 1925. As with most other industrial processes, much more water was used per unit of production in the past than is used today. The wastewater discharge to the St. Lawrence was also likely more contaminated than it is today. During the period that the recently closed Courtaulds Films (closed 1989) commenced operation (1955), the discharge of wastewater and contaminants would have been more than double current levels.

Prior to the serving of Control Orders on Courtaulds Films (closed 1989) and Courtaulds Fibres in 1977, a review of previous surveys was completed to estimate each company's loadings. These calculations put the Courtaulds Films (closed 1989) loadings at 1,820 kg/day of BOD and 1,500 kg/day of suspended solids and Courtaulds Fibres loading 1,280 kg/day of BOD and 987 kg/day of suspended solids. Monitoring by Environment Ontario in 1980 showed that Courtaulds Films (closed 1989) was discharging about 8 tonnes/day of sulphuric acid and Courtaulds Fibres about 15 tonnes/day to the river.

Prior to 1978, the wastewater from the two companies discharged into a natural bay of the St. Lawrence River through four pipes that terminated between 10 and 17 m from shore. Since Windmill Point deflects the main flow of the river around this bay, contamination of the waters and sediment of the bay resulted. Studies done by Environment Ontario documented high acidity and zinc concentrations in the waters as well as high mercury and zinc levels in the sediment. Even though the diffusers installed in late 1977 now discharge the wastewater into the main current to achieve proper dispersion, much of the contaminated sediment remains.

Historical discharges of PCBs from Massena's industrial dischargers, ALCOA, Reynolds Metals and the General Motors Central Foundry as well as PAHs and Fluorides from ALCOA and Reynolds have also contributed to the contamination of the river as reflected by current and past results of water quality, sediment and fish monitoring programs.

7.4 Present Regulatory Mechanisms

7.4.1 Ontario

In Ontario, the issuing of either a Control Order or a Requirement and Direction to an industry or municipality is the main mechanism used by Environment Ontario to require a reduction in the discharge of contaminants to a water body.

Control Orders have legal status under the Ontario Environmental Protection Act, while the Requirement and Directions have legal status under the Ontario Water Resources Act. Both can be enforced through the provincial courts. They lay out a program of abatement with compliance dates for each step. In the past, Courtaulds Films (closed 1989), Courtaulds Fibres and Domtar have been served with Control Orders. A Control Order, which would require significant improvements in the effluents discharged by Courtaulds Fibres and Courtaulds Films (closed 1989), has been prepared. Its implementation, however has been delayed as the result of an independent financial review of the company's claim that confirmed it cannot afford to do the required work.

Ontario has recently announced a new program to examine discharges and require necessary reductions. This program is called the Municipal Industrial Strategy for Abatement (MISA). The allowable level for contaminants in each municipal or industrial discharge will be developed in two ways:

1. The characteristics required to prevent any impairment of the quality of the receiving stream will be determined.

2. The characteristics that would result by subjecting the effluent to the best available, economically achievable, treatment technology will also be determined.

The discharge must meet the stricter of the above two requirements. The St. Lawrence River in the vicinity of Cornwall is one of the pilot sites to develop the procedures for determining the quality of effluent that will not impair the quality of the receiving stream.

A new Control Order was recently served on Domtar. It will require the mill to control spills, BOD and adsorbable organic halogen to at least a minimum standard set for all kraft pulp mills in the province and is expected to be in force by the fall of 1989. The requirements in a previous control order for suspended solids were recently removed as a result of a hearing and decision by the Ontario Environmental Appeal Board.

Most of the dischargers in the Cornwall area fall into industrial sectors for which the MISA program will be setting discharge regulations based on the Best Available Technology Economically Achievable. Courtaulds Fibres, and Cornwall Chemicals are in the organic chemical sector, ICI (formerly CIL) is in the inorganic chemical sector, Domtar, the pulp and paper sector and the Cornwall WPCP is in the municipal sector. For these sectors, extensive characterizations of the components of effluents have been or are near completion. Monitoring regulations for the companies in the organic chemical sector will be in force by mid-1989. Ontario has strict controls for the disposal of hazardous wastes. Under regulation 309 of the Environmental Protection Act, all hazardous wastes generated must be registered and disposed of at approved facilities. Only licensed carriers are allowed to haul such wastes.

7.4.2 Municipal

The City of Cornwall has a sewer-use by-law that sets standards for industries discharging wastes to the city sewer system. Several industries such as BASF have installed extensive pre-treatment systems for their effluents to comply with the by-law.

7.4.3 Mohawk Council of Governments

The powers of the Band Council, as determined under the Indian Act (Canada) include the power to make by-laws pursuant to Section 81 of the Act. The by-laws come into effect forty days after it is passed, unless it is disallowed by the Minister of Indian Affairs. A by-law cannot be inconsistent with other provisions of the Indian Act or its regulations.

The by-laws are federal statutory instruments. As such, they govern the territory of the reserve. Where they conflict with federal regulations which are more general in nature the by-laws take precedence. They also have the legal effect of overriding any provincial laws that are inconsistent with them.

Although the Indian Act has not been substantially revised since the 1920s, the powers of the Band Council are broad enough to deal with environmental concerns under several different sections. By-laws can be enacted to:

1. provide for the health of residents on the reserve and to prevent the spreading of contagious and infectious diseases;
2. prevent disorderly conduct and nuisances;
3. destroy and control noxious weeds;
4. construct and regulate the use of public wells, cisterns, reservoirs and other water supplies; and
5. preserve, protect and manage fur-bearing animals, fish and other game on the reserve.

7.5 Lake Ontario Input

7.5.1 Nutrients

Since the early 1970s, one of the major concerns in the lower Great Lakes Basin has been eutrophication and the associated growth of nuisance algae. The initial problem was to define and implement a control strategy. Later, it became a matter of monitoring the effects of the control strategy (phosphorus reduction) and now it is mainly a matter of maintaining the existing conditions and improving the control strategy where local problem areas exist.

In the St. Lawrence River, a station was established on the south shore of Wolfe Island by Environment Canada in 1977. One of the main objectives of this station was to measure the nutrient outflow loadings from Lake Ontario to the St. Lawrence River. The station was also to be used to monitor long term changes in water quality of the Lake Ontario outflow to the St. Lawrence River (Sylvestre *et al.*, 1987a).

The discharge for the St. Lawrence River has been increasing since 1983 with the highest discharge on record since this station was established occurring in 1986. This has a considerable effects on loading calculations.

Concentrations and loadings (in metric tonnes/year) of total phosphorus, nitrate and nitrite and chloride are shown in Figures 7-3 and 7-4 (Sylvestre *et al.*, 1987b). Total phosphorus concentrations and loadings have been decreasing steadily since 1978. A similar decreasing trend has been reported in Lake Ontario (Neilson and Stevens, 1985). Annual mean concentrations and loadings of nitrate and nitrite nitrogen have increased drastically in 1984 and 1985. Some of this increase in loadings is due to record high discharges, however, much of it is not understood. Similar increases have been reported for the Niagara River (Kuntz, 1985), in Lake Ontario (Neilson and Stevens, 1985) and in the Upper Great Lakes (Stevens *et al.*, 1985 and Chan and Perkins, 1985).

Chloride concentrations and loadings have shown a considerable decrease at an annual rate of 0.38 mg/L for concentrations from 1977 to 1985. Slightly higher loads in 1984 and 1985 are attributed to the record high discharge levels.

A reduction of industrial chloride loadings to the Detroit River (Sonzogni *et al.*, 1983) was reported by the United States Environmental Protection Agency to have occurred beginning in 1972. This may have resulted in decreased chloride concentrations in the lower Great Lakes including the St. Lawrence River. Decreasing concentrations have also been reported for Lake Erie (Whyte, 1986), the Niagara River (Kuntz, 1985) - which represents 71 percent of the chloride load to Lake Ontario (Effler *et al.*, 1985) - and in Lake Ontario (Fraser, 1981 and Neilson, 1983).

7.5.2 Toxic Substances

Table 7-4 gives the percentage of occurrence of organochlorines, PCBs, PAHs and chlorinated benzenes in water and suspended sediment samples taken at the Wolfe Island station. Of the 17 organochlorines and PCBs measured in whole water samples on a monthly basis, only 2 compounds (α-BHC and γ-BHC) were detected in more than 60 percent of the samples collected at values above 0.4 ng/L for OCs and 0.9 ng/L for PCBs (Sylvestre, 1987). Annual means for α-BHC ranged from 3.8 to 6.9 ng/L and for γ-BHC from 0.7 to 1.5 ng/L during the 1982-85 period. Loadings were estimated from 165-356 kg/yr for γ-BHC and 946-1,674 kg/yr for α-BHC for the whole water fraction (Sylvestre, 1987).

In suspended sediments, only 4 compounds of the 39 measured occurred in more than 60 percent of the samples collected. Total DDT (annual mean 0.011-0.032 mg/kg), PCBs (annual mean 0.12-0.19 mg/kg), dieldrin (annual mean 0.007-0.012 mg/kg) and HCB (annual mean 0.007-0.020 mg/kg) were measured at greater than 0.044 mg/kg for OCs and 0.09 mg/kg for PCBs. Figure 7-5 illustrates a general decrease in concentrations and loadings of PCBs during the period 1982-1985.

Figure 7-3

St. Lawrence Remedial Action Plan

Concentrations for total phosphorus, nitrite + nitrate and chloride in the St. Lawrence River at Wolfe Island (1977-1985)

(after Sylvestre et al. 1987b)

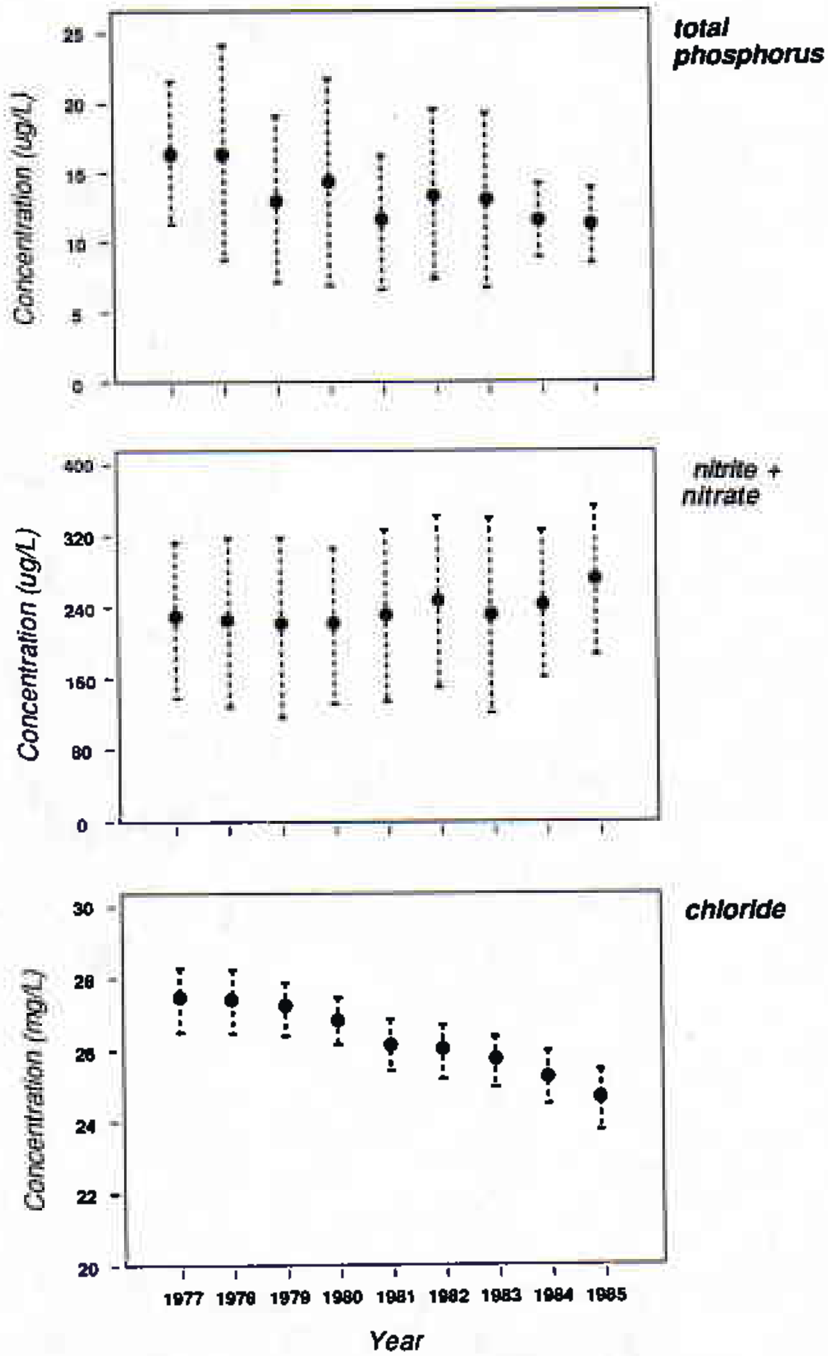


Figure 7-4

St. Lawrence Remedial Action Plan

Loadings for total phosphorus, nitrite + nitrate and chloride in the St. Lawrence River at Wolfe Island (1977-1985)

(Sylvestre et al. 1987b)

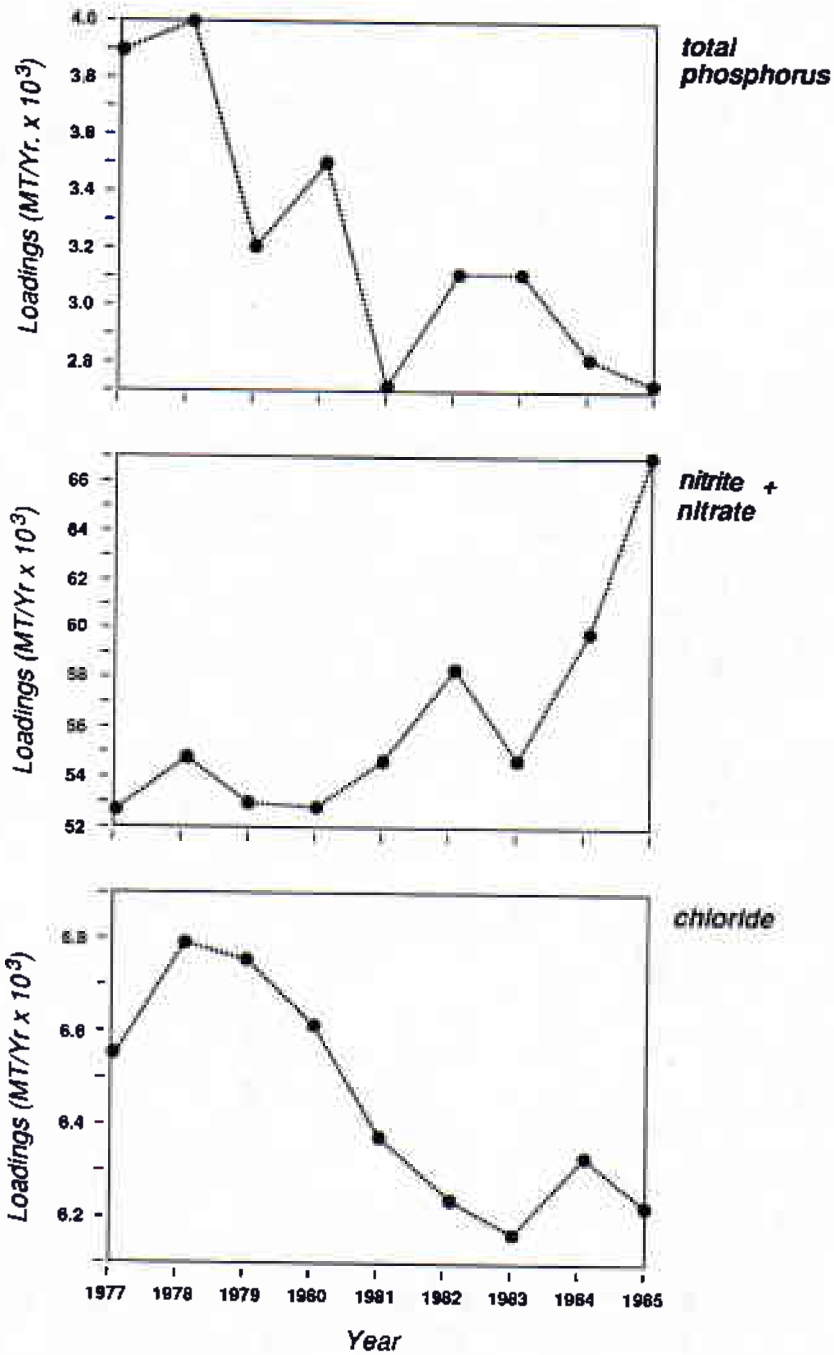


Table 7-4 Occurrence of Organochlorine Pesticides, PCB, Polyaromatic Hydrocarbons and Chlorinated Benzenes in Whole Water and Suspended Sediment at Wolfe Island, 1982-1986

Compound	Whole Water		Suspended Sediment	
	Total Number of Samples	% Detected	Total Number of Samples	% Detected
Organochlorine Pesticides				
p,p-DDT	40	0	42	7
o,p-DDT	40	0	42	0
p,p-DDE	40	0	42	91
p,p-Methoxychlor	30	0	42	0
Heptachlor	36	0	42	0
Heptachlor Epoxide	40	0	41	5
α-Endosulphan	36	0	42	10
β-Endosulphan	36	0	42	12
α-(cis) Chlordane	40	0	42	26
γ-(trans) Chlordane	40	0	42	2
Mirex	40	0	42	38
p,p-TDE	40	5	42	41
Endrin	40	10	42	17
Aldrin	36	11	42	12
HEOD (dieldrin)	40	43	42	81
γ-BHC	40	86	42	0
α-BHC	40	98	42	48
Aroclor Total (PCBs)	40	5	42	90
Polyaromatic Hydrocarbons				
Fluorene			25	0
1,2,3,4-Tetrahydronaphthalene			25	0
2-Methylnaphthalene			25	0
β-Chloronaphthalene			25	0
Acenaphthene			25	0
Quinoline			25	0
Phenanthrene			25	0
Pyrene			25	4
1-Methylnaphthalene			25	8
Acenaphthalene			25	12
Fluoranthene			25	20
Indene			25	28
Chlorinated Benzenes				
1,4-Dichlorobenzene			40	0
1,3,5-Trichlorobenzene			40	0
1,2,3-Trichlorobenzene			40	0
1,3-Dichlorobenzene			40	8
1,2-Dichlorobenzene*			40	28
Pentachlorobenzene			40	40
1,2,3,4-Tetrachlorobenzene			40	45
1,2,4-Trichlorobenzene			40	55
Hexachlorobenzene			42	95

* Contamination of solvent suspected

Detection limits in water: PCB = 0.9 ng/L; All others = 0.4 ng/L
Detection limits in sediment: PCB = 0.090 mg/kg; organochlorine pesticides and chlorinated benzenes = 0.004 mg/kg; polyaromatic hydrocarbons = 0.050 mg/kg

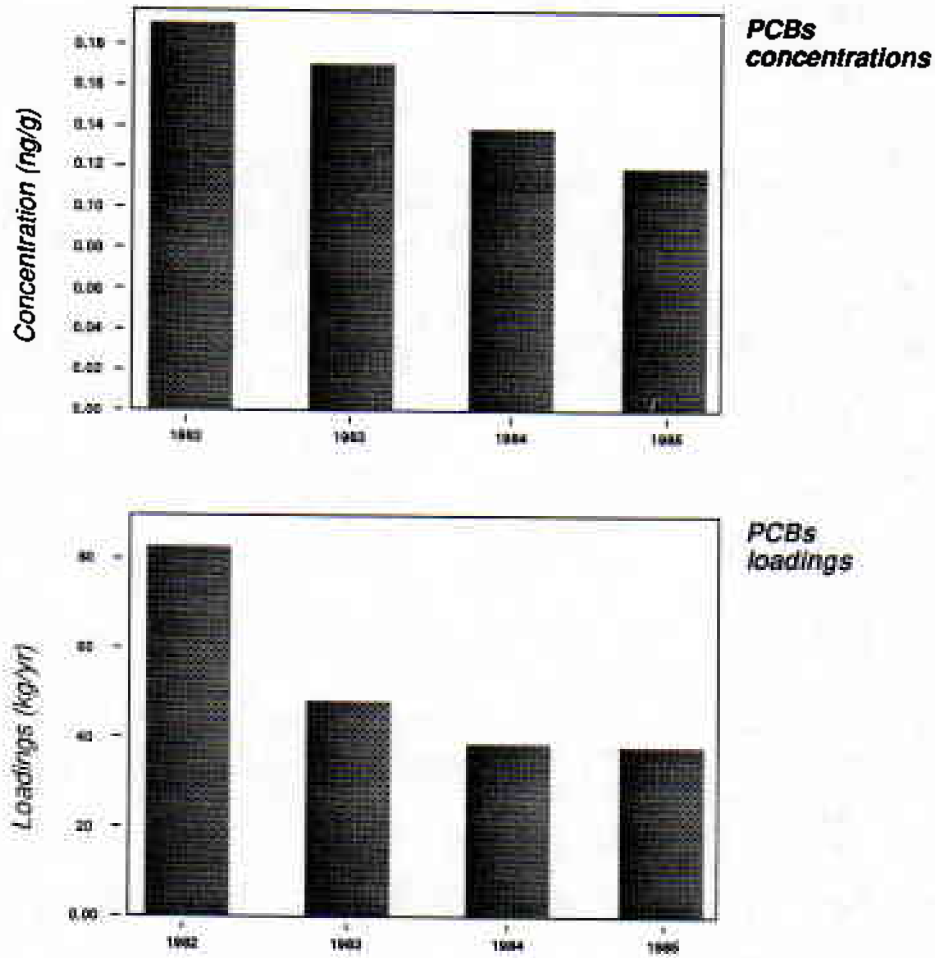
Source: Sylvestre, 1987 as shown in IJC, 1989

Figure 7-5

St. Lawrence Remedial Action Plan

PCB concentrations and loadings in suspended solids in the St. Lawrence River at Wolfe Island (1982 - 1985)

(after Sylvestre et al. 1987c)



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MEASUREMENT UNITS

metre - m	1 m	=	3.281 ft.		
gram - g	1000 g		= 1 kg	=	2.205 pounds
tonne - t	1 t	=	2.205 pounds		
litre - L	1 L	=	0.2642 gallons (U.S.)	=	0.2200 gallons (Canadian)

kilogram	10^{3} grams	kg	
milligram	10^{-3} grams	mg	
microgram	10^{-6} grams	ug	
nanogram	10^{-9} grams	ng	
millilitre	10^{-3} litres	mL	
cubic metre per day		m^3/d	
tonnes per year		t/yr	
milligram per litre		mg/L	part per million
microgram per litre		ug/L	part per billion
nanogram per litre			ng/L part per trillion
microgram per litre		ug/L	part per million
milligram per kilogram		mg/kg	part per million
microgram per kilogram		ug/kg	part per billion
nanogram per kilogram			ng/kg part per trillion
kilograms per day		kg/d	
pounds per day		lbs/d	
cubic meters per second		cms	
cubic feet per second		cfs	

APPENDIX I. ST. LAWRENCE RIVER WATER QUALITY, 1979

PCBs AND ORGANOCHLORINE PESTICIDES CONCENTRATIONS (ug/L) IN RIVER WATER SAMPLES COLLECTED FROM THE NORTH SHORE OF THE ST. LAWRENCE RIVER DURING THE 1979 SURVEY

Sampling Location	Sampling Date	PCBs	Aldrin	Dieldrin	α-BHC	β-BHC	Lindane	α-Chlordane	γ-Chlordane	o,p-DDT	p,p-DDT	p,p-DDE	p,p-DDD	Endrin	Heptachlor	Heptachlor epoxide	HCB	Mirex	Thiodan I	Thiodan II
Cornwall Stn. 112 (Control)	Oct.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	.002	X	X	X	X
Cornwall WTP	Sept.21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.25	X	X	X	X	X	.005	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.26	.090	X	X	X	X	X	X	X	X	X	.004	X	X	X	X	X	X	X	X
	Sept.28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	.001	X	X	.004	X
Cornwall Canal	Sept.25	X	X	X	.002	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.26	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.27	X	X	X	.008	X	.001	.001	X	X	X	.002	.005	X	X	.001	X	X	X	.003
Stn. 104 Courtaulds SCL	Oct.10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	.003	X	X	X	X
Stn. 094	Sept.24	X	X	.001	.003	.001	.003	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.25	X	X	X	.001	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Sept.26	X	X	X	.006	.001	.002	.005	X	.015	.005	X	.005	X	X	X	X	X	X	X
Stn. 095	Oct.12	X	X	.001	X	X	X	X	X	X	X	X	X	X	X	.002	X	X	X	X
Stn. 071	Oct.13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Raisin R. Stn. 055	Sept.27	X	X	X	.005	X	.001	.001	X	X	X	X	.020	X	X	X	X	X	X	X
Stn. 057	Sept.27	X	X	X	.007	X	.002	X	X	X	X	X	.020	X	X	X	X	X	X	X
Detection Limit		.020	.001	.001	.001	.001	.001	.001	.001	.005	.005	.001	.005	.001	.001	.001	.001	.005	.001	.001
Water Quality Objectives	GLWQA	-		.001	-	-	.010		.060			.003		.002		.001	-	ABSENT		-
	PWQO	.001		.001	-	-	.010		.060			.003		.002		.001	-	.001		.003

" - " indicates no sample or no analytical result.
X indicates not detected (ND)

Source: Kauss et al. 1988

INORGANIC TRACE CONTAMINANTS CONCENTRATIONS IN RIVER WATER SAMPLES COLLECTED FROM THE NORTH SHORE OF THE ST. LAWRENCE RIVER DURING THE 1979 SURVEY

Sampling Location	Sampling Date	Cyanide (mg/L)	Aluminum (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Mercury (µg/L)	Filtered Mercury (µg/L)	Zinc (mg/L)
Stn. 112 (Control)	Oct. 2	-	.06	.006	<.02	<0.01	.05	<.03	0.15	0.04	.01
Cornwall WTP	Sept. 21	<.01	<.02	.007	<.02	<.01	.10	<.03	<.03	-	.02
	Sept. 25	<.01	<.02	<.005	<.02	<.01	.13	.06	<.02	-	.02
	Sept. 26	<.01	<.02	<.005	.02	<.01	.18	<.03	<.02	-	.02
	Sept. 28	<.01	<.02	<.005	<.02	<.01	.14	<.03	<.02	-	.94
Cornwall Canal	Sept. 25	<.01	.04	<.005	<.02	<.01	.05	<.03	.04	0.04	<.01
	Sept. 26	<.01	.04	<.005	<.02	<.01	.05	<.03	.02	0.06	<.01
	Sept. 27	<.01	.04	<.005	<.02	<.01	<.02	<.03	.05	0.02	.02
Stn. 104	Oct. 10	-	-	-	-	-	-	-	-	-	-
Stn. 094	Sept. 24	-	.14	<.005	<.02	.02	.24	<.03	.02	-	.18
	Sept. 25	<.01	.04	<.005	<.02	<.01	.06	<.03	.13	0.06	.08
	Sept. 26	<.01	.08	<.005	<.02	.02	.05	<.03	.10	0.13	.10
Stn. 095	Oct. 12	-	-	-	-	-	-	-	-	-	-
Farlinger's Point Stn. 071	Oct. 13	-	-	-	-	-	-	-	-	-	-
Raisin River Stn. 055	Sept. 27	<.01	.08	<.020	<.005	<0.01	.08	<.03	0.04	0.02	.010
Stn. 057	Sept. 27	<.01	<.02	<.020	<.005	<0.01	<.02	<.03	0.03	0.03	.02
Water Quality Objective:	GLWQA			.0002	.100	.005	.30	.025		0.2	.03
	PWQO	.005**		.0002	.050	.005	.30	.025		0.2	.03

NOTES:
1) "-" indicates no sample or no analytical result
2) * as unionized ammonia; percentages of total varies with termperature and pH.
3) ** free cyanide.

Source: Kauss et al, 1988

APPENDIX II. DRINKING WATER QUALITY

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
1,1 DICHLOROETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1,1 DICHLOROETHYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 SPS	.000 <W
1,2 DICHLOROBENZENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1,2 DICHLOROETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1,2 DICHLOROPROPANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1,3 DICHLOROBENZENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1,4 DICHLOROBENZENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
111, TRICHLOROETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
112 TRICHLOROETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
1122 T-CHLOROETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
123 TRICHLOROBENZENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	10.000 <T	5.000 <W
1234 T-CHLOROBENZENE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
1235 T-CHLOROBENZENE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
124 TRICHLOROBENZENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
1245 T-CHLOROBENZENE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
135 TRICHLOROBENZENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	6.000 <T	5.000 <W	5.000 <W
2,4 D PROPIONIC ACID	NG/L	R				100.00 <W	
		T				100.00 <W	
2,4,5-T	NG/L	R				50.000 <W	
		T				50.000 <W	
2,4-D	NG/L	R				100.00 <W	
		T				100.00 <W	
234 TRICHLOROPHENOL	NG/L	R				100.00 <W	
		T				100.00 <W	
2345 T-CHLOROPHENOL	NG/L	R				20.000 <W	
		T				20.000 <W	
2356 T-CHLOROPHENOL	NG/L	R				10.000 <W	
		T				10.000 <W	
236 TRICHLOROTOLUENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
245 TRICHLOROTOLUENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
245-TRICHLOROPHENOL	NG/L	R				100.00 <W	
		T				100.00 <W	
246-TRICHLOROPHENOL	NG/L	R				20.000 <W	
		T				20.000 <W	
24DCHLRPHENOXYBUTYRC	NG/L	R				200.00 <W	
		T				200.00 <W	
26A TRICHLOROTOLUENE	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
ALACHLOR	NG/L	R	500.00 <W	500.00 <W	500.00 <W	500.00 <W	500.00 <W
		T	500.00 <W	500.00 <W	500.00 <W	500.00 <W	500.00 <W
ALDRIN	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
ALKALINITY	MG/L-CAC	R	104.70	112.60	110.10	101.70	104.30
		T	101.70	106.90	97.900	98.800	98.700
ALPHA BHC	NG/L	R	4.000 <T	2.000 <T	2.000 <T	1.000 <T	1.000 <T
		T	2.000 <T	1.000 <W	2.000 <T	2.000 <T	1.000 <W
ALPHA CHLORDANE	NG/L	R	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
		T	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
ALUMINUM	MG/L-AL	R	.110	.140	.055	.078	.170
		T	.077	.150	.150	.200	.230
AMETRINE	NG/L	R	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
		T	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27	SAMPLE DATE					
AMINOCARB	NG/L	R T				.000 NP .000 NP							
AMMONIUM TOTAL	MG/L-N	R T	.020 .004 <T	.002 <T .012	.006 <T .006 <T	.028 .012	.022 .006 <T						
ARSENIC	MG/L-AS	R T	.001 < .001 <	.001 < .001 <	.001 < .001 <	.001 < .001 <	.001 < .001 <						
ATRATONE	NG/L	R T	50.000 <W 50.000 <W	50.000 <W 50.000 <W	50.000 <W 50.000 <W	50.000 <W 50.000 <W	50.000 <W 50.000 <W						
ATRAZINE	NG/L	R T	50.000 <W 90.000 <T	50.000 <W 50.000 <W	50.000 <W 50.000 <W	50.000 <W 50.000 <W	50.000 <W 50.000 <W						
BARIUM	MG/L-BA	R T	.021 .019	.021 .020	.020 .019	.023 .020	.020 .019						
BENOMYL	NG/L	R T				.000 NP .000 NP							
BENZENE	UG/L	R T	.000 <W .000 <W	.000 <W .000 <W	.000 <W .000 <W	.000 <W .100 UIN	.000 <W .000 <W						
BERYLLIUM	MG/L-BE	R T	.001 < .001 <	.001 < .001 <	.001 < .001 <	.001 < .001 <	.001 < .001 <						
BETA BHC	NG/L	R T	1.000 <W 1.000 <W	1.000 <W 1.000 <W	1.000 <W 1.000 <W	1.000 <W 1.000 <W	1.000 <W 1.000 <W						
BLADEX	NG/L	R T	100.00 <W 100.00 <W	100.00 <W 100.00 <W	100.00 <W 100.00 <W	100.00 <W 100.00 <W	100.00 <W 100.00 <W						

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		SAMPLE DATE 87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
BORON	MG/L-BO	R	.030	.030	.030 <T	.010	.020 <T
		T	.030	.050	.030 <T	.040	.030 <T
BROMOFORM	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
BUX	NG/L	R				2000.0 <W	
		T				2000.0 <W	
CADMIUM	UG/L-CD	R	.300 <	.300 <	.300 <	.300 <	.300 <
		T	.300 <	.300 <	.300 <	.300 <	.300 <
CALCIUM	MG/L-CA	R	38.100	39.700	38.400	40.000	38.000
		T	38.500	40.000	38.000	40.400	38.000
CARBOFURAN	NG/L	R				2000.0 <W	
		T				2000.0 <W	
CARBON TETRACHLORIDE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
CHLORIDE	MG/L-CL-	R	15.500	17.500	15.000	15.500	15.500
		T	19.000	21.000	18.500	18.500	18.500
CHLOROBENZENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
CHLORODIBROMOMETHANE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	6.000	3.000	4.000	5.300	6.600
CHLOROFORM	UG/L	R	.000 <W	1.000	.000 <W	.500 <T	.000 <W
		T	35.000	42.000	28.900	44.700	34.300
CHROMIUM	MG/L-CR	R	.001 <	.001 <	.001 <	.001 <	.001 <
		T	.001 <	.001 <	.001 <	.001 <	.001 <

CORNWALL W.T.P. OWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
CICP	NG/L	R				2000.0 <W	
		T				2000.0 <W	
COBALT	MG/L-CO	R	.001 <	.001 <	.001 <	.001 <	.001 <
		T	.002	.001 <	.001 <	.001 <	.001 <
COLOUR	HZU	R	3.000	4.000	.500 <W	1.000 <T	3.000
		T	1.500 <T	1.500 <T	.500 <T	.500 <W	1.500 <T
CONDUCTIVITY	UMHO/CM	R	302.00	321.00	306.00	292.00	294.00
		T	312.00	328.00	302.00	299.00	297.00
COPPER	MG/L-CU	R	.001	.001	.002	.002	.001
		T	.001 <W	.001 <W	.001	.001	.001 <W
CYANIDE	MG/L-CN	R	.001 <W	.001 <W	.001 <W	.001 <W	.001 <W
		T	.001 <W	.001 <W	.001 <W	.001 <W	.001 <W
DDD	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
DIALLATE	NG/L	R				2000.0 <W	
		T				2000.0 <W	
DIAZINON	NG/L	R					
		T				20.000 <W	
DICAMBA	NG/L	R				50.000 <W	
		T				50.000 <W	
DICHLOROBROMOMETHANE	UG/L	R	.000 <W	.500 <T	.000 <W	.000 <W	.000 <W
		T	15.000	13.000	12.250	14.700	12.600

CORNWALL W.T.P. DWSP RESULTS

SAMPLE DATE

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
DICHLOROVOS	NG/L	R T				20.000 <W	
DIELDRIN	NG/L	R T	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W
DURSBAN	NG/L	R T				20.000 <W	
ENDOSULFAN 1	NG/L	R T	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W	2.000 <W 2.000 <W
ENDOSULFAN II	NG/L	R T	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W
ENDOSULFAN SULPHATE	NG/L	R T	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W
ENDRIN	NG/L	R T	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W	4.000 <W 4.000 <W
EPTAM	NG/L	R T				2000.0 <W 2000.0 <W	
ETHION	NG/L	R T				20.000 <W	
ETHLYENE DIBROMIDE	UG/L	R T	.000 <W .000 <W	.000 <W .000 <W	.000 <W .000 <W	.000 <W .000 <W	.000 <W .000 <W
ETHYLBENZENE	UG/L	R T	.000 <W .000 <W	.000 <W .000 <W	.000 <W .150 <T	.000 <W .350 <T	.000 <W .200 <T
FECAL COLIFORM MF	CT/100ML	R T	159.00	.000		.000	4.000

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
FLD CHLORINE (COMB)	MG/L-CL	R	.150				
		T	1.200	.250	.300	.250	1.100
FLD CHLORINE (TOTAL)	MG/L-CL	R	.150				
		T	1.200	1.200	1.200	1.200	.200
FLD CHLORINE FREE	MG/L-CL	R	.100				
		T	1.000	.950	.900	.950	.900
FLD PH		R	7.900	8.300	8.200	8.100	7.900
		T	7.700	7.900	7.900	7.900	7.900
FLD TEMPERATURE	DEG.C	R	5.200	9.900	11.700	19.900	20.000
		T	5.900	11.000	12.000	19.900	21.100
FLD TURBIDITY	FTU	R	5.700	4.500	4.300	3.800	8.300
		T	.140	.090	.070	.180	.140
FLUORIDE	MG/L-F	R	.160	.150	.140	.140	.130
		T	.120	.140	.130	.130	.110
GAMMA CHLORDANE	NG/L	R	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
		T	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
GUTHION	NG/L	R					
		T				.000 NP	
HARDNESS	MG/L-CAC	R	129.50	137.50	131.00	134.00	131.00
		T	131.50	138.50	130.00	136.00	130.00
HCB	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		SAMPLE DATE 87/03/23	87/04/27	87/05/25	87/06/22	87/07/27						
HEPTACHLOR	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
HEPTACHLOR EPOXIDE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
HEXACHLOROBUTADIENE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
HEXACHLOROETHANE	NG/L	R	3.000 <T	1.000 <W	1.000 <W	1.000 <W	1.000 <W						
		T	5.000 <T	1.000 <W	4.000 <T	1.000 <T	1.000 <W						
IPC	NG/L	R				2000.0 <W							
		T				2000.0 <W							
IRON	MG/L-FE	R	.092	.080	.095	.110	.100						
		T	.001 <	.009	.010 <	.005	.001 <						
LEAD	MG/L-PB	R	.003 <	.003 <	.003 <	.003 <	.003 <						
		T	.014	.003 <	.003 <	.003 <	.003 <						
LINDANE	NG/L	R	1.000 <W	2.000 <T	1.000 <W	1.000 <T	1.000 <W						
		T	1.000 <T	1.000 <W	1.000 <T	1.000 <T	1.000 <W						
M-XYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W						
		T	.000 <W	.000 <W	.500 <T	1.200	.500 RMP						
MAGNESIUM	MG/L-MG	R	8.400	9.300	8.500	8.200	8.600						
		T	8.600	9.400	8.600	8.400	8.500						
MALATHION	NG/L	R											
		T				20.000 <W							
MANGANESE	MG/L-MN	R	.004	.003	.004	.005	.006						
		T	.001 <W	.001 <W	.001 <W	.001 <W	.001 <W						

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27						
MERCURY	UG/L-HG	R T	.010 < .010 <	.010 < .010 <	.010 < .010 <	.010 .010	.010 .010						
METHOXYCHLOR	NG/L	R T	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W						
METHYL PARATHION	NG/L	R T				50.000 <W							
METHYLENE CHLORIDE	UG/L	R T	.000 <W .000 <W	.000 CS .000 CS	.000 <W .000 <W	.000 <W .000 <W	.000 <W .000 <W						
METHYLTRITHION	NG/L	R T				20.000 <W							
METOLACHLOR	NG/L	R T	500.00 <W 500.00 <W	500.00 <W 500.00 <W	500.00 <W 500.00 <W	500.00 <W 500.00 <W	500.00 <W 500.00 <W						
MEVINPHOS	NG/L	R T				20.000 <W							
MIREX	NG/L	R T	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W	5.000 <W 5.000 <W						
MOLYBDENUM	MG/L-MB	R T	.001 <W .001	.001 .001	.001 <W .001	.001 .001	.001 <W .001						
NICKEL	MG/L-NI	R T	.002 < .002 <	.002 < .002 <	.002 < .002 <	.002 < .002 <	.002 < .002 <						
NITRITE	MG/L-N	R T	.004 <T .001 <W	.002 <T .001 <W	.055 .002 <T	.022 .004 <T	.023 .001 <W						

SAMPLE DATE

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
NITROGEN TOT KJELD	MG/L-N	R	.170	.300	.150 UAL	.140	.210
		T	.070 <T	.180	.120	.230	.150
O-XYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.200 <T	.450 <T	.000 <W
OCTACHLOROSTYRENE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
OPDDT	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
OXYCHLORDANE	NG/L	R	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
		T	2.000 <W	2.000 <W	2.000 <W	2.000 <W	2.000 <W
P-XYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 RMP	.000 RMP	.000 RMP
P/A BOTTLE	0=ABSENT	R					
		T	.000	.000	.000	.000	.000
PARATHION	NG/L	R				20.000 <W	
		T					
PCB	NG/L	R	20.000 <W	20.000 <W	20.000 <W	20.000 <W	20.000 <W
		T	20.000 <W	20.000 <W	20.000 <W	20.000 <W	20.000 <W
PENTACHLOROBENZENE	NG/L	R	1.000 <W	1.000 <T	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
PENTACHLOROPHENOL	NG/L	R				10.000 <W	
		T				10.000 <W	
PH		R	8.260	8.460	8.470	8.460	8.260
		T	8.110	8.450	8.180	8.330	8.210

CORNWALL W.T.P. DWSP RESULTS

SAMPLE DATE

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
PHENOLICS		R	.200 <W	9.600 CIC	.000 NR	.400 <T	.200 <T
		T	.200 <W	.400 <T	.200 <T	.200 <T	.200 <W
PHORATE	NG/L	R					
		T				20.000 <W	
PHOSPHORUS FIL REACT	MG/L-P	R	.001 <T	.001 <T	.004	.004	.004
		T	.000 <W	.000 <T	.001 <T	.000 <W	.000 <W
PHOSPHORUS TOTAL	MG/L-P	R	.011	.023	.009 UAL	.004 <T	.019
		T	.002 <W	.010	.003 <T	.003 <T	.005 <T
PICHLORAM	NG/L	R				.000 NP	
		T				.000 NP	
PPDDE	NG/L	R	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
		T	1.000 <W	1.000 <W	1.000 <W	1.000 <W	1.000 <W
PPDDT	NG/L	R	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
		T	5.000 <W	5.000 <W	5.000 <W	5.000 <W	5.000 <W
PROMETONE	NG/L	R	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
		T	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
PROMETRYNE	NG/L	R	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
		T	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
PROPAZINE	NG/L	R	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
		T	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
PROPOXUR	NG/L	R				2000.0 <W	
		T				2000.0 <W	

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
RELDAN	NG/L	R					
		T				20.000 <W	
RONNEL	NG/L	R					
		T				20.000 <W	
SELENIUM	MG/L-SE	R	.001 <	.001 <	.001 <	.001 <	.001 <
		T	.001 <	.001 <	.001 <	.001 <	.001 <
SENCOR	NG/L	R	100.00 <W	100.00 <W	100.00 <W	100.00 <W	100.00 <W
		T	100.00 <W	100.00 <W	100.00 <W	100.00 <W	100.00 <W
SEVIN	NG/L	R				200.00 <W	
		T				200.00 <W	
SILVEX	NG/L	R				20.000 <W	
		T				20.000 <W	
SIMAZINE	NG/L	R	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
		T	50.000 <W	50.000 <W	50.000 <W	50.000 <W	50.000 <W
SODIUM	MG/L-NA	R	8.900	9.300	9.400	8.200	8.200
		T	8.900	9.200	10.600	8.000	8.400
STANDRD PLATE CNT MF	CT/ML	R	210.00	34.000		950.00	2400.0 >
		T	.000	2.000	3.000	9.000	2400.0 >
STRONTIUM	MG/L-SR	R	.160	.190	.150	.160	.150
		T	.150	.190	.150	.150	.150
SUTAN	NG/L	R				2000.0 <W	
		T				2000.0 <W	
T COLIFORM BCKGRD MF	CT/100ML	R	9100.0	38.000		2400.0 >	0000.0
		T	1.000	.000	.000	1.000	2400.0 >

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27
T-CHLOROETHYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
T1,2DICHLOROETHYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
TIN	MG/L-SN	R	.000 NP	.000 NP	.000 NP	.000 NP	.000 NP
		T	.000 NP	.000 NP	.000 NP	.000 NP	.000 NP
TOLUENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.800 <T	.950	1.600	.900
TOTAL COLIFORM MF	CT/100ML	R	3200.0	.000		289.00 A3C	4.000 A3C
		T	.000	.000	.000	1.000	.000
TOTAL NITRATES	MG/L-N	R	.280	.525	.250	.195	.165
		T	.350	.560	.220	.180	.130
TOTAL SOLIDS	MG/L	R	176.00	209.00 CRO	199.00 CRO	190.00 CRO	191.00 CRO
		T	203.00 CRO	213.00 CRO	196.00 CRO	194.00 CRO	193.00 CRO
TOTL TRIHALOMETHANES	UG/L	R	.000 <W	1.500	.000 <W	.500	.000 <W
		T	56.000	58.000	45.150	64.700	53.500
TOXAPHENE	NG/L	R	.000 NP	.000 NP	.000 NP	.000 NP	.000 NP
		T	.000 NP	.000 NP	.000 NP	.000 NP	.000 NP
TRICHLOROETHYLENE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
TRIFLUOROCHLOROTOLUE	UG/L	R	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W
		T	.000 <W	.000 <W	.000 <W	.000 <W	.000 <W

CORNWALL W.T.P. DWSP RESULTS

PARAMETERS	UNITS		87/03/23	87/04/27	87/05/25	87/06/22	87/07/27						
TURBIDITY	FTU	R T	4.100 .080	.470 .110	1.920 .130	1.600 .150 <T	6.100 .210						
URANIUM	UG/L-U	R T	.310 .200 <	.410 .240	.000 IS .180	.300 .280	.410 .270						
VANADIUM	MG/L-V	R T	.001 <W .001 <W	.001 <W .001 <W	.001 <W .001 <W	.001 <W .001 <W	.001 <W .001 <W						
ZINC	MG/L-ZN	R T	.001 <W .001 <W	.001 <W .001	.001 <W .001 <	.010 .001	.001 .001						

APPENDIX III. CONTAMINANTS IN SUSPENDED SOLIDS, ST. LAWRENCE RIVER, 1979 AND 1988

CONCENTRATION OF METALS*, PCBs AND ETHER SOLUBLES (μg/g)**
IN SUSPENDED SEDIMENTS FROM THE ST. LAWRENCE RIVER (1979)

	STATION							
	112	104	095	071	055	033	003	068
Aluminum	-	17000	17000	15000	26000	22000	17000	12000
Cadmium	-	0.35	1.2	1.5	<1.5	0.6	2.0	1.8
Chromium	-	56	110	49	61	60	55	43
Copper	-	140	140	130	88	65	220	62
Iron	-	23000	22000	21000	34000	33000	34000	36000
Lead	-	62	100	84	70	34	90	63
Mercury	0.86	0.66	2.4	0.69	0.14	0.19	0.47	0.32
Zinc	-	210	550	410	200	150	370	300
PCBs	ND	0.076	0.235	0.037	-	0.660	0.035	0.130
Ether solubles	33,000	5,666	-	10,250	5,000	4,220	9,000	2,100

* = Metals are "total".
** = Dry Weight Basis.
"-" = No Data Available (insufficient material for analysis).
ND = Not Detected (detection limit = 0.01 μg/g).

Source: Kauss et al. 1988

Table
Inorganic Contaminants (ug/g dry wt), Nutrients and Major Ions (mg/g dry wt) in Suspended So1ids, June/88

	Sampling location				
	372	*401*	*402*	*69*	*74*
Copper	99.00	170.00	200.00	260.00	1700.00
Nickel	32.00	29.00	30.00	32.00	40.00
Lead	86.00	32.00	35.00	35.00	65.00
Zinc	160.00	140.00	150.00	140.00	220.00
Iron	17,000.00	19,000.00	19,000.00	19,000.00	20,000.00
Aluminum	13,000.00	17,000.00	18,000.00	17,000.00	17,000.00
Arsenic	NR	7.10	6.60	6.40	6.20
Cadmium	1.40	1.70	1.90	1.70	2.10
Cobalt	12.00	11.00	12.00	12.00	13.00
Chromium	44.00	42.00	46.00	49.00	51.00
Mercury	0.23	0.13	0.11	0.13	0.19
Magnesium	7,600.00	10,000.00	9,800.00	9,500.00	9,600.00
Selenium	NR	3.50	5.90	3.40	3.80
pH	NR	NR	NR	NR	NR
Sulphate	NR	NR	NR	NR	NR
Total Nitrates	NR	NR	NR	NR	NR
Total Residual (L0I)	320.00	NR	NR	NR	270.00
Total Phosphorus	2.79	NR	NR	NR	2.47
Total Kjeldahl Nitrogen	19.64	NR	NR	NR	18.50
Total Ammonium	NR	NR	NR	NR	NR
Chloride	NR	NR	NR	NR	NR
Fluorine	64.00	NR	NR	NR	72.00
Total Organic Carbon	170.00	NR	NR	NR	140.00

Note:
NR - no result

Table

Inorganic Contaminants (ug/g dry wt), Nutrients and Major Ions (mg/g dry wt) in Suspended Solids, Sept/88.

	Sampling location				
	372	*401*	*402*	*69*	*74*
Copper	130.00	120.00	120.00	130.00	88.00
Nickel	36.00	39.00	38.00	42.00	36.00
Lead	34.00	36.00	37.00	39.00	35.00
Zinc	150.00	160.00	150.00	160.00	160.00
Iron	24,000.00	25,000.00	26,000.00	26,000.00	25,000.00
Aluminum	19,000.00	21,000.00	21,000.00	22,000.00	21,000.00
Arsenic	7.30	7.40	7.20	8.10	5.80
Cadmium	2.20	2.20	2.20	2.20	2.10
Cobalt	11.00	12.00	12.00	13.00	12.00
Chromium	51.00	54.00	54.00	60.00	51.00
Mercury	0.20	0.16	0.18	0.21	0.17
Selenium	1.90	2.00	1.90	2.00	1.80
pH	NR	NR	NR	NR	NR
Sulphate	NR	NR	NR	NR	NR
Total Nitrates	NR	NR	NR	NR	NR
Total Residual (LOI)	NR	36.0RVU	NR	NR	NR
Total Phosphorus	2.70	3.20	2.80	3.20	3.60
Total Kjeldahl Nitrogen	9.70	13.00	12.00	13.00	16.00
Total Ammonium	NR	NR	NR	NR	NR
Chloride	NR	NR	NR	NR	NR
Fluorine	NR	93.00	82.00	83.00	NR
Total Organic Carbon	NR	89.00	80.00	98.00	NR
Magnesium	12,000.00	12,000.00	13,000.00	13,000.00	12,000.00

Note:
ND - non-detected
NR - no result
RVU - reported value unusual: unable to reanalyze

Table
PCBs and Organochlorine Pesticides (ng/g dry wt.) in Suspended Solids, June '88

	Sampling location				
	372	*401*	*402*	*69*	*74*
Total PCBs	NR	ND	ND	ND	ND
Hexachlorobenzene	NR	ND	ND	2<T	ND
Heptachlor	NR	ND	ND	ND	ND
Heptachlor epoxide	NR	ND	ND	ND	ND
Aldrin	NR	ND	ND	ND	ND
Dieldrin	NR	ND	ND	ND	ND
Endrin	NR	ND	ND	ND	ND
pp-DDE	NR	ND	ND	ND	ND
op-DDT	NR	ND	ND	ND	ND
pp-DDD	NR	ND	ND	ND	ND
pp-DDT	NR	ND	ND	ND	ND
DMDT Methoxychlor	NR	ND	ND	ND	ND
a-BHC Hexachlorocyclohex	NR	ND	ND	ND	ND
b-BHC Hexachlorocyclohex	NR	ND	ND	ND	ND
g-BHC Hexachlorocyclohex	NR	ND	ND	ND	ND
a-Chlordane	NR	ND	ND	ND	ND
g-Chlordane	NR	ND	ND	ND	ND
Oxychlordane	NR	ND	ND	ND	ND
Endosulphan I	NR	ND	ND	ND	ND
Endosulphan II	NR	ND	ND	ND	ND
Endosulphan sulphate	NR	ND	ND	ND	ND
Mirex	NR	ND	ND	ND	ND
Octachlorostyrene	NR	ND	ND	ND	ND

Note:
ND - non-detected
NR - no result
<T - a measurable trace amount: interpret with caution

Table
Chlorinated Phenolics and Chlorinated Benzenes (ng/g dry wt) in Suspended Solids, June/88

	Sampling location				
	372	401	402	69	74
2,4,6-Trichlorophenol	NR	NR	NR	NR	NR
2,4,5-Trichlorophenol	NR	NR	NR	NR	NR
2,3,4-Trichlorophenol	NR	NR	NR	NR	NR
2,3,5,6-Tetrachlorophenol	NR	NR	NR	NR	NR
2,3,4,5-Tetrachlorophenol	NR	NR	NR	NR	NR
Pentachlorophenol	NR	NR	NR	NR	NR
Hexachloroethane	NR	ND	ND	ND	ND
Hexachlorobutadiene	NR	ND	ND	ND	ND
1,2,3-Trichlorobenzene	NR	ND	ND	ND	ND
1 3, 5-Trichlorobenzene	NR	ND	ND	19<T	ND
1,2,4-Trichlorobenzene	NR	ND	ND	ND	ND
2,4,5-Trichlorotoluene	NR	ND	ND	37.00	ND
2,3,6-Trichlorotoluene	NR	ND	ND	ND	ND
2,6,a-Trichlorotoluene	NR	ND	ND	ND	ND
1,2,3,4-Tetrachlorobenzene	NR	ND	ND	3<T	ND
1 2,3,4-Tetrachlorobenzene	NR	ND	ND	ND	ND
1,2,4,5-Tetrachlorobenzene	NR	ND	ND	ND	ND
1,2,3,4-Tetrachlorobenzene	NR	ND	ND	ND	ND
Pentachlorobenzene	NR	ND	7<T	ND	13.00

Note:
ND - non-detected
<T - a measurable trace amount: interpret with caution
NR - no result

Table
Chlorinated Phenolics, Chlorinated Benzenes, PCBs and Organochlorine Pesticides (ng/g dry wt) in Suspended Solids, Sept/88

	Sampling location				
	372	*401*	*402*	*69*	*74*
2,4,6-Trichlorophenol	NR	NR	NR	NR	NR
2,4,5-Trichlorophenol	NR	NR	NR	NR	NR
2,3,4-Trichlorophenol	NR	NR	NR	NR	NR
2,3,5,6-Tetrachlorophenol	NR	NR	NR	NR	NR
2,3,4,5-Tetrachlorophenol	NR	NR	NR	NR	NR
Pentachlorophenol	NR	NR	NR	NR	NR
Hexachloroethane	NR	NR	NR	NR	NR
Hexachlorobutadiene	NR	NR	NR	NR	NR
1,2,3-Trichlorobenzene	NR	NR	NR	NR	NR
2,4,5-T'chlorotoluene	NR	NR	NR	NR	NR
2,3,6-Trichlorotoluene	NR	NR	NR	NR	NR
1,2,3,5-Tetrachlorobenzene	NR	NR	NR	NR	NR
1,2,4,5-Tetrachlorobenzene	NR	NR	NR	NR	NR
2,6,a-Trichlorotoluene	NR	NR	NR	NR	NR
1,2,3,4-Tetrachlorobenzene	NR	NR	NR	NR	NR
Pentachlorobenzene	NR	NR	NR	NR	NR
Total PCBs	ND	ND	ND	ND	130<T P48
Hexachlorobenzene	ND	7<T	7<T	ND	ND
Heptachlor	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND
Aldrin	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND
pp-DDE	ND	ND	ND	ND	ND
op-DDT	ND	ND	ND	ND	ND
pp-DDD	ND	ND	ND	ND	10<T
pp-DDT	ND	ND	ND	ND	ND
DMDT Methoxychlor	ND	ND	ND	ND	ND
a-BHC Hexachlorocyclohex	ND	ND	ND	ND	ND
b-BHC Hexachlorocyclohex	ND	ND	ND	ND	ND
g-BHC Hexachlorocyclohex	ND	ND	ND	ND	ND
a-Chlordane	ND	ND	ND	ND	ND
g-Chlordane	ND	ND	ND	ND	ND
Oxychlordane	ND	ND	ND	ND	ND
Endosulphan I	ND	ND	ND	ND	ND
Endosulphan II	ND	ND	ND	ND	ND
Endosulphan sulphate	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND
Octachlorostyrene	ND	ND	ND	ND	ND

Note:
ND - non-detected
NR - no result
<T - a measurable trace amount: interpret with caution
P 48 - PCB resembled Arochlor 1248

Table
Polynuclear Aromatic Hydrocarbons (ug/g dry wt) in Suspended Solids, June/88

	Sampling location				
	372	*401*	*402*	*69*	*74*
Dibenzo (a,h) anthracene	0.06	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Benzo (g,h,i)perlyene	0.39	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Naphthalene	0.14	0.04 <T	0.04 <T	0.00	0.04 <T
Acenaphthylene	0.06	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Acenaphthene	0.04 <T	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Fluorene	0.08	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Phenanthrene	0.32	0.07 <T	0.07 <T	0.07 <T	0.07 <T
Anthracene	0.08	0.10 <T	0.10 <T	0.10 <T	0.10 <T
Flouranthrene	0.76	0.03	0.05	0.05	0.05
Pyrene	0.59	0.06 <T	0.06 <T	0.06 <T	0.06 <T
Benzo (a) anthracene	0.68	0.02 <T	0.02 <T	0.05	0.02 <T
Chrysene	0.46	0.02 <T	0.04	0.03	0.04
Benzo (k) fluoranthene	0.47	0.02 <T	0.02 <T	0.02 <T	0.02 <T
Benzo (b) fluorene	0.94	0.06 <T	0.08	0.06 <T	0.06 <T
Benzo (a) pyrene	1.00	0.04 <T	0.08	0.04 <T	0.04 <T
Indeno (1,2,3-cd) pyrene	0.51	0.04 <T	0.04 <T	0.04 <T	0.04 <T
QA/QC (%Recovery)					
D10-Acenaphthene	91.00	74.00	74.00	79.00	64.00
D10-Phenanthrene	111.00	95.00	95.00	103.00	95.00
D12-Chrysene	85.00	86.00	96.00	86.00	88.00
D12-Perylene	114.00	100.00	111.00	95.00	73.00
D10-Acenaphthene	54.00	34.00	30.00	39.00	37.00

Note:
<T - a measurable trace amount: interpret with caution

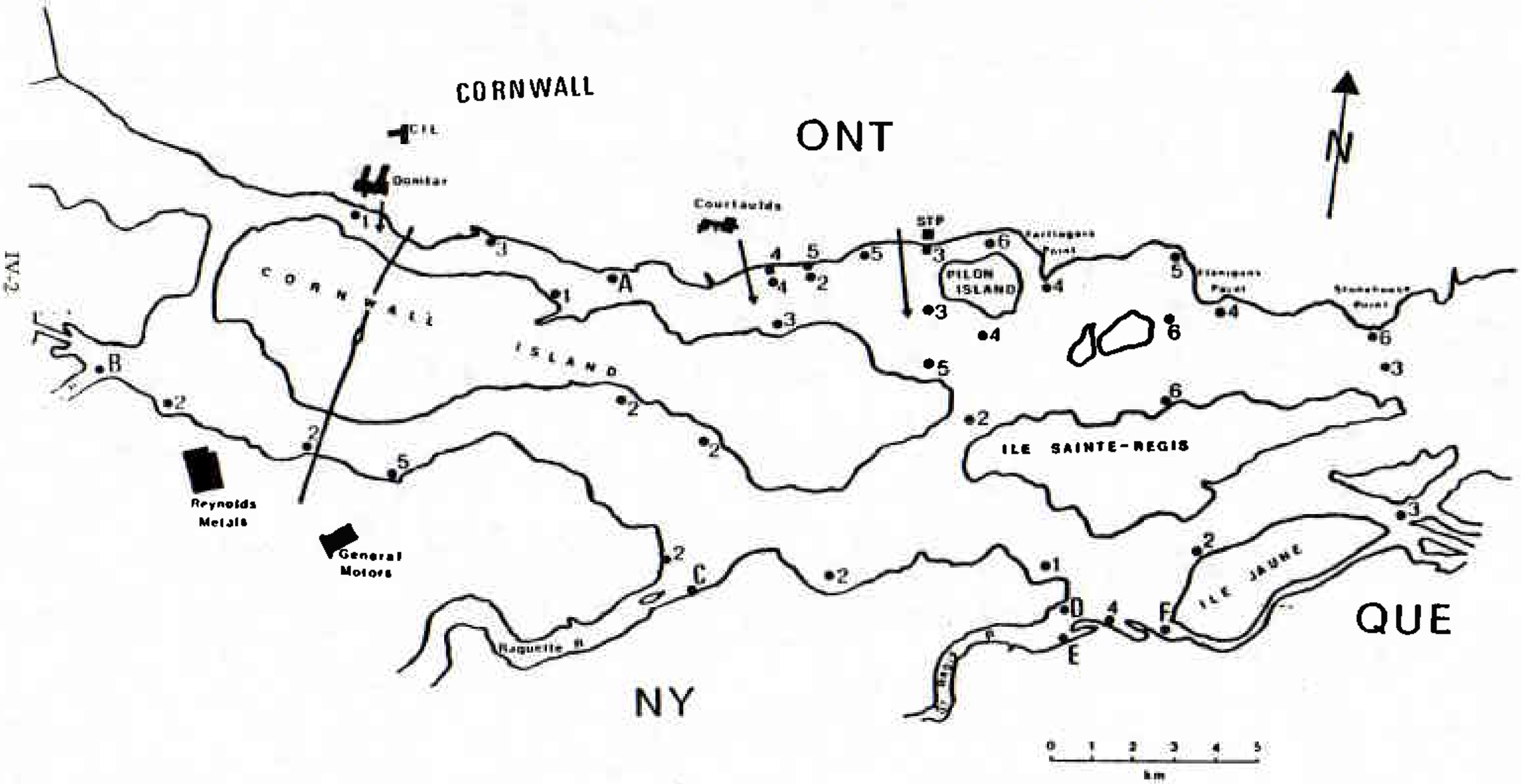
Table
Polynuclear Aromatic Hydrocarbons (ug/g dry wt) In Suspended Solids, Sept/88

	Sampling location				
	372	*401*	*402*	*69*	*74*
Dibenzo (a,h) anthracene	0.12	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Benzo (g,h,i)perlyene	0.22	0.12	0.20	0.11	0.25
Naphthalene	0.04 <T	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Acenaphthylene	0.04 <T	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Acenaphthene	0.04 <T	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Fluorene	0.04 <T	0.04 <T	0.04 <T	0.04 <T	0.04 <T
Phenanthrene	0.11	0.07 <T	0.09	0.08	0.07 <T
Anthracene	0.03	0.01 <T	0.02	0.01	0.10
Flouranthrene	0.28	0.17	0.27	0.18	0.29
Pyrene	0.25	0.16	0.21	0.14	0.25
Benzo (a) anthracene	0.11	0.02 <T	0.12	0.06	0.04
Chrysene	0.24	0.15	0.19	0.11	0.35
Benzo (k) fluoranthene	0.17	0.08	0.22	0.11	0.26
Benzo (b) fluorene	0.46	0.18	0.40	0.20	0.61
Benzo (a) pyrene	0.30	0.13	0.17	0.11	0.22
Indeno (1,2,3-cd) pyrene	0.26	0.12	0.20	0.12	0.26
QA/QC (% Recovery)					
D10-Acenaphthene	61.00	92.00	47.00	69.00	79.00
D10-Phenanthrene	87.00	93.00	86.00	86.00	88.00
D12-Chrysene	93.00	99.00	96.00	81.00	83.00
D12-Perylene	104.00	91.00	106.00	92.00	71.00
D10-Acenaphthene	35.00	63.00	17.00	55.00	48.00

Note:
<T - a measurable trace amount: interpret with caution

APPENDIX IV. LOCATIONS AND SPECIES COMPOSITION OF BENTHIC COMMUNITIES IN THE ST. LAWRENCE RIVER NEAR CORNWALL, JULY 1985

Distribution of benthic invertebrate communities in the St. Lawrence River, near Cornwall, July 1985.



Source: Griffiths, 1988

Species composition (mean number per 516 cm²) of benthic communities 1-6 in the St. Lawrence River near Cornwall, July 1985. P denotes a mean density of less than 1 per sample.

	Benthic Community 1	2	3	4	5	6
AQUATIC CATERPILLARS:						
Pyralidae	P	P	2.1	P	P	
BEETLES:						
Elmidae	P			P		
Gyrinidae		P	P			
CADDISFLIES:						
Brachycentrus	2.5		1.7			
Hydroptila	P	P				
Ceraclea	1.0	P				
Mystacides		P				P
Oecetis	P	P	P	P		P
Triaenodes	P		P			
Phylocentropus		P		P	P	P
MAYFLIES:						
Brachycercus		P				
Caenis	P	P		P		
Hexagenia		P	P	P		
TRUE FLIES:						
Ceratopogonidae	1.0	P	P	P		P
Chironomus	180.5	18.7	31.0	1.0	30.3	12.0
Cladopelma		P	P	P	1.0	
Cryptochironomus		1.0	1.1		P	
Dicrotendipes	1.4	1.2	P	P	P	
Glytotendipes		P				
Harnischia		P	P			
Microtendipes	2.2	1.8	1.6	P	P	3.3
Parachironomus	1.2	P	P		P	
Paralauterborniella	6.9	P				1.4
Paratanytarsus	4.6	2.8	2.3	P		P
Paratendipes	2.9	P				P
Phaenopsectra	26.3	3.9	5.3	P	P	P
Polypedilum	1.3	6.2			1.3	P
Rheotanytarsus	5.9	1.2	1.8	P	P	P
Stictochironomus						
Tanytarsus		1.4	P			2.0
Tribelos	4.1	4.9	1.8	P	P	1.6
Cricotopus/Orthocladius	9.1	P	4.1	P	2.0	P
Nanocladius			P	P	P	
Psectrocladius	P	1.2		P		P
Ablabesmyia			P			
Clinotanypus		1.0		P	P	P
Procladius	3.5	8.1	P	P	8.5	P
CRUSTACEANS:						
Gammarus	111.5	6.4	188.3	17.8	138.3	17.4
Asellus	2.1	P	33.0	20.9	37.4	7.0

	Benthic Community					
	1	2	3	4	5	6
CLAMS:						
Pisidium	35.7	8.6	11.9	3.1	18.1	31.4
Sphaerium	1.5	2.8	4.0	1.6	2.9	10.1
Unionidae	P	P	P		P	P
SNAILS:						
Ferrissia		P				P
Bithynia	16.8	2.4	15.2	2.2	8.6	18.3
Amnicola	11.3	10.3	6.8	2.0	19.7	12.1
Probythinella		P		P	P	
Somatogyrus	1.7	P			P	P
Fossaria	1.6	6.1	1.4	P	3.2	P
Lymnaea	P	P		P	P	
Pseudosuccinea			P			
Stagnicola		P				P
Physa	4.6	3.4	1.2	1.0	7.9	P
Gyraulus	2.4	P	1.2	P	2.7	P
Helisoma		1.2	P	P	1.0	P
Promenetus		P			P	
Goniobasis	P	P			1.0	
Valvata	P	P	1.4	P	1.7	4.2
Campeloma	P				P	
LEECHES:						
Erpobdellidae	P	P	P		P	P
Glossiphonidae	2.6	P	P	P	2.3	1.5
POLYCHAETES:						
Manaynunkia speciosa		P				
WORMS:						
Lumbricidae	1.1	2.9	P	P		1.3
Stylodrilus herringianus		P	P			P
Stylaria		P				
Aulodrilus americanus		P				
Ilyodrilus templetoni	P	1.1		P	1.1	P
Isochaetes freyi						
Limnodrilus cervix				1.2		
L. hoffmeisteri	31.5	8.1	6.4	42.9	41.3	1.7
L. udekemianus				1.5	1.7	
Potamothrix moldaviensis		P				
Quistadrilus multisetosus		1.3	P	P	4.9	P
Spirosperma ferox	9.4	4.3	1.1	P	P	7.7
PROBOSCIS WORMS:						
Prostoma	P	1.0	P		P	P
NEMATODES	5.5	P	2.0	P	1.0	1.3
FLATWORMS	P	P	3.4	P	2.4	1.6
MEAN NUMBER OF TAXA	22.8	19.7	16.2	10.7	17.7	18.0
MEAN DENSITY OF ORGANISMS	501.5	122.5	339.8	105.7	347.5	147.8

Species composition (mean number per 516 cm²) of benthic communities A-F in the St. Lawrence River near Cornwall, July 1985. The station location is noted below each community type. P denotes a mean density of less than 1 individual per sample.

	Benthic Community					
	A 366A	B 393	C 386	D 382	E 381	F 379
AQUATIC CATERPILLARS:						
Pyralidae						
BEETLES:						
Elmidae		2.0		1.0	1.0	P
Gyrinidae						
CADDISFLIES:						
Brachycentrus						11.0
Hydroptila						
Ceraclea						1.5
Mystacides						
Oecetis		2.0				
Triaenodes						
Phylocentropus		P	1.0	1.0		
MAYFLIES:						
Brachycercus					P	
Caenis		P				
Hexagenia				1.5		
TRUE FLIES:						
Ceratopogonidae		P	1.5	3.0		P
Chironomus	40.0		3.0	5.5		
Cladopelma						
Cryptochironomus			3.0	2.0	8.0	
Dicrotendipes		4.0	3.0	3.0		
Glytotendipes		1.0	3.0	2.0		
Harnischia				3.0		
Microtendipes						1.0
Parachironomus		1.0				
Paralauterborniella						
Paratanytarsus		1.5				
Paratendipes						
Phaenopsectra	8.0					3.5
Polypedilum		4.0		3.0		3.5
Rheotanytarsus						11.0
Stictochironomus			3.0		2.0	
Tanytarsus				7.0	1.0	
Tribelos						
Cricotopus/Orthocladius		1.5			1.0	7.5
Nanocladius						
Psectrocladius						
Ablabesmyia				3.0		2.0
Clinotanypus		1.5		1.0		
Procladius		5.0	3.0	2.0	P	
CRUSTACEANS:						
Gammarus		6.5			P	10.5
Asellus				1.0		

	Benthic Community					
	A	B	C	D	E	F
	366A	393	386	382	381	379
CLAMS:						
Pisidium	24.0	P		1.0		5.0
Sphaerium		P	1.0	1.0		9.5
Unionidae		2.5		P		1.5
SNAILS:						
Ferrissia						
Bithynia		1.0			P	1.5
Amnicola		P	5.0	5.5	P	6.0
Probythinella						
Somatogyrus			2.0			1.0
Fossaria						P
Lymnaea						
Pseudosuccinea		P				
Stagnicola						
Physa						
Gyraulus						
Helisoma						
Promenetus						
Goniobasis						10.0
Valvata		P				P
Campeloma						
LEECHES:						
Erpobdellidae						
Glossiphonidae				P	P	
POLYCHAETES:						
Manaynunkia speciosa						
WORMS:						
Lumbricidae		P	2.5			
Stylodrilus herringianus		1.5				P
Stylaria				1.0		
Aulodrilus americanus			2.0	8.5		
Ilyodrilus templetoni			P			
Isochaetes freyi			3.0		5.0	
Limnodrilus cervix						
L. hoffmeisteri	8.0	7.0	3.0	14.5	4.0	
L. udekemianus						
Potamothrix moldaviensis		2.0				
Quistadrilus multisetosus		P				
Spirosperma ferox		13.5				1.5
PROBOSCIS WORMS:						
Prostoma		P				
NEMATODES	8.0					P
FLATWORMS						
MEAN NUMBER OF TAXA	3.0	18.5	10.5	15.0	8.0	17.5
MEAN DENSITY OF ORGANISMS	88.0	64.0	39.5	71.5	25.0	90.5

APPENDIX V. CHARCTERISTICS OF ELECTROFISHING STATIONS AND STATION DATA

STATION DESCRIPTIONS - 1986 ELECTROFISHING PROGRAM
CORNWALL WATERFRONT (MNR, 1987B)

Stn. 1	Weather	Water Temp (°C)	Depth Fished (m)	Visi-bility (m)	Cond. (µhmos)	Macrophytes (%)	Substrate Features	Shoreline Features	Water Current	Comments/ Efficiency
1	0% cloud SSW 7-15 km/h 13.5C	12	>0.5	2	325	65% Vallisneria & Myriophyllum	Gravel/rubble	Rubble & Emergent	Med. Eddy	High. Except many small eels in rubble - hard to net.
2	14°C	12	0.5-2.5	2.5	325	65% submergents Unidentified	Rubble/sand/ gravel	Rubble	Slow	High
3	As above	12	0.5-3	1.5	325	40% submergents Unidentified	Rubble/sand	Rubble & sand	Slow	High. Many alewives & smelt not captured.
4	10% cloud SW 10-20 km/h 14°C	12	0.5-3	2.5	325	100% dense submergents	Silt/sand	Offshore	Nil	Medium/high. Small fish (pumkinseed) missed in dense weeds.
5	100% cloud NW 10-15 km/h 10°C	12	0.25-2	1.5	365	Sparse	Rubble/gravel	Rubble Steep dropoff	FAST!	Medium. Fast current. Many suckers & small eels & 1 trout missed.
6	As above	12	0.5-3	1.5	365	85% Vallisneria & myriophyllum	Rubble/gravel sand	Rubble Steep slope	Slow	Medium/high. Many small fish & eels in Vallisneria missed. Many alewives & smelt not netted.
7	As above	12	0.5-2	1.5	365	80% sparse Vallisneria	Sand/gravel	Sand, grass-covered	Slow/ med.	High. Many small eels missed.
8	40% cloud NW 5-10 km/h	12	0.5-3	1.5	365	65% submergent unidentified	Rubble/gravel boulder	Rubble/trees/ brush	Slow	High. Some eels missed.

SUMMARY OF FISH COLLECTIONS MADE DURING ELECTROFISHING RUNS
IN ST. LAWRENCE RIVER, CORNWALL, OCTOBER 22-23, 1986 (MNR, 1987B)

SPECIES	SIZE RANGE	ELECTROFISHING RUNS								SPECIES
		1	2	3	4	5	6	7	8	TOTAL
	(mm TL)									
Alewife	60-170	7	-	18	-	-	14	1	3	43
Brown trout	518	-	-	-	-	1	-	-	-	1
Rainbow smelt	70-150	-	-	21	-	1	3	1	-	26
Northern pike	136-817	3	5	4	4	-	12	3	8	39
Carp	300-750	2	5	10	2	-	-	-	3	22
Eastern silvery minnow	58	-	-	-	-	-	1	-	-	1
Golden shiner	40-107	-	-	-	1	-	-	-	3	4
Spottail shiner	50-103	5	2	-	-	-	2	6	-	15
Bluntnose minnow	53-78	2	2	-	1	-	1	-	5	11
Fallfish	103-127	-	-	2	-	-	-	-	-	2
White sucker	63-520	34	48	23	17	27	19	64	17	249
Moxostoma sp.	250-650	1	18	2	60	-	15	-	17	113
Brown bullhead	50-340	9	10	-	14	-	3	-	6	42
American eel	260-750	2	2	3	-	-	1	5	3	16
Banded killifish	57-66	1	-	-	-	-	1	-	-	2
Morone sp.	90	-	-	1	-	-	-	-	-	1
Rock bass	15-200	7	3	12	-	4	15	14	9	64
Pumpkinseed	60-250	1	18	2	60	-	15	-	17	113
Largemouth bass	65-235	-	-	-	1	-	18	-	-	19
Black crappie	200-300	-	-	1	4	-	5	-	-	10
Tessellated darter	52-76	-	2	-	-	1	-	3	14	20
Yellow perch	53-298	15	22	11	12	-	19	13	66	158
Logperch	105	1	-	-	-	-	-	-	-	1
Walleye	402-650	-	-	2	-	3	1	1	-	7
Total #fish/run		90	137	112	176	37	145	111	171	979
Effort (electrofishing seconds)		1000	1054	1016	1000	713	1000	900	1000	7683

APPENDIX VI. SPORT FISH CONTAMINANT DATA, ST. LAWRENCE RIVER

SPORT FISH CONTAMINANT DATA

				LENGTH (cm)			WEIGHT (gm)			HG (ppm)			PCB (ppb)			MIREX (ppb)		
	YEAR	SPECIES	NO	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX
St. Lawrence River, Cornwall Island, South Channel	1978	P'seed	41	14	10.5	17.5	119	-	-	-	-	-	408	72	1050	15	ND	50
		Y. Perch	54	20.8	17.7	31.0	184	-	-	-	-	-	242	25	640	10	ND	56
		Pike	20	51.8	32.7	68.6	1396	-	-	-	-	-	861	280	4130	34	ND	140
		B. Bullhead	30	25.1	20.0	29.2	338	-	-	-	-	-	352	65	970	2	ND	18
		B. Crappie	37	15.4	12.7	19.5	124	-	-	-	-	-	160	53	400	4	ND	42
		C. Catfish	15	42.8	35.6	57.1	1289	-	-	-	-	-	11524	380	44670	146	ND	420
		W. Sucker	23	43.9	40.0	49.5	1606	-	-	-	-	-	1217	130	9320	16	ND	210
		Walleye	2	47.7	47.0	48.3	1574	-	-	-	-	-	2541	2440	2642	94	91	96
		Whitefish	1	36.8	-	-	469	-	-	-	-	-	600	-	-	45	-	-
		R.H. Sucker	1	54.6	-	-	3518	-	-	-	-	-	8680	-	-	136	-	-
		P'seed	36	13.9	10.5	17.5	115	60	210	0.25	0.08	0.57	-	-	-	-	-	-
		Y. Perch	4	21.3	20.0	22.0	203	190	220	0.29	0.22	0.35	-	-	-	-	-	-
		Pike	7	51.4	36.5	67.0	1154	350	2110	0.94	0.31	1.53	-	-	-	-	-	-
		W. Sucker	1	42	-	-	1250	-	-	-	0.34	-	-	-	-	-	-	-
		B. Bullhead	4	24.6	23.5	26.0	280	250	310	0.19	0.14	0.23	-	-	-	-	-	-
		B. Crappie	8	16.0	15.0	19.5	119	80	200	0.51	0.21	1.04	-	-	-	-	-	-
St. Lawrence River Cornwall Island North Channel	1978	C. Catfish	2	56.5	56.0	57.0	3204	2985	3423	-	-	-	1780	1060	2500	ND	ND	ND
		R. Bass	1	21.0	-	-	326	-	-	-	-	-	260	-	-	ND	-	-
		Carp	1	57.0	-	-	4515	-	-	-	-	-	12230	-	-	ND	-	-
		B. Crappie	1	23	-	-	340	-	-	-	-	-	1550	-	-	ND	-	-
		Walleye	13	52.7	46.0	63.0	1963	-	-	-	-	-	808	190	1806	10	ND	89
		Y. Perch	29	17.6	8.0	22.0	137	80	255	-	-	-	512	57	1330	3	ND	14
		Pike	25	59.1	41.3	73.7	1797	-	-	-	-	-	25	487	80	18	ND	52
		W. Sucker	56	45.7	35.6	60.0	1670	-	-	-	-	-	1031	120	4650	10	ND	95
		B. Bullhead	16	25.2	19.0	55.0	283	140	520	-	-	-	833	410	1550	56	36	88

CONTINUED: SPORT FISH CONTAMINANT DATA

Location	YEAR	SPECIES	NO	LENGTH (cm) MEAN	MIN	MAX	WEIGHT (gm) MEAN	MIN	MAX	HG (ppm) MEAN	MIN	MAX	PCB (ppb) MEAN	MIN	MAX	MIREX (ppb) MEAN	MIN	MAX
St. Lawrence River, St. Regis Island, North Channel	1978	B. Bullhead	25	24.4	20.0	29.0	309	-	-	-	-	-	591	170	1830	9	ND	21
		Pike	9	53.3	37.0	81.5	1184	-	-	-	-	-	846	370	2510	57	22	140
		Y. Perch	24	21.7	19.5	31.0	194	-	-	-	-	-	529	100	2450	6	ND	25
		P'seed	7	13.0	11.5	13.0	91	-	-	-	-	-	538	320	970	41	23	62
		B. Crappie	16	15.5	13.5	17.5	110	-	-	-	-	-	125	65	200	2	ND	10
		B. Bullhead	15	23.6	20.0	29.0	281	160	490	0.15	0.07	0.28	-	-	-	-	-	-
		Pike	4	59.6	51.0	81.5	1359	1050	1625	0.72	0.61	0.88	-	-	-	-	-	-
		Y. Perch	10	21.4	20.0	23.0	193	160	260	0.38	0.25	0.67	-	-	-	-	-	-
		P'seed	6	12.8	11.5	13.5	90	70	120	0.18	0.16	0.21	-	-	-	-	-	-
		W. Sucker	2	45.5	45.0	46.0	1620	1500	1740	0.54	0.35	0.73	525	380	670	36	27	45
St. Regis Island, South Channel		B. Bullhead	30	25.9	20.3	37.9	360	-	-	-	-	-	1812	170	5940	TR	ND	5
		Pike	34	54.4	34.0	73.6	1474	-	-	-	-	-	856	250	3120	ND	ND	ND
		Y. Perch	64	20.8	14.0	27.3	179	-	-	-	-	-	470	64	1300	1	ND	8
		P'seed	25	14.4	9.5	17.7	130	-	-	-	-	-	373	68	920	1	ND	10
		B. Crappie	8	19.1	14.0	22.9	224	-	-	-	-	-	578	190	1410	35	ND	58
		Bowfin	1	-	-	-	61.0	-	-	3289	-	-	130	-	-	24	-	-

SPORT FISH CONTAMINANT DATA

St. Lawrence River, Lake St. Francis				LENGTH (cm)			WEIGHT (gm)			HG (ppm)			PCB (ppb)			MIREX (ppb)		
	YEAR	SPECIES	NO	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX
	1985	Walleye	5	64.6	58.3	70.0	3070	2440	3650	-	-	-	298	80	480	ND	ND	ND
		Walleye	20	50.5	38.5	70.0	1598	580	3650	0.65	0.24	1.30						
	1984	Walleye	10	56.1	51.7	67.2	1883	1350	3000	0.95	0.58	2.10	679	80	3454	42	ND	152
		Pike	10	69.7	60.9	80.2	2136	1600	3000	-	-	-	73	31	117	ND	ND	9
		Y. Perch	32	22.9	14.2	29.3	182	38	323	-	-	-	24.5	ND	74	ND	ND	6
		S.M. Bass	18	38.9	27.5	49.5	1051	300	2050	-	-	-	224	35	474	ND	ND	664
		Walleye	10	56.1	51.7	67.2	1883	1350	3000	0.95	0.58	2.10	-	-	-	-	-	-
		Pike	48	54.3	31.4	80.2	1035	380	3000	0.53	0.18	1.20	-	-	-	-	-	-
		S.M. Bass	18	38.9	27.5	49.5	1051	300	2050	0.64	0.32	1.00	-	-	-	-	-	-
		Y. Perch	61	23	14.2	29.3	187	39	400	0.29	0.11	0.72	-	-	-	-	-	-
	1983	Y. Perch	28	25.2	2.4	27.5	238	158	359	0.36	0.18	0.62						
	1982	Walleye	11	54.9	37.6	72.6	1964	-	-	-	-	-	182	48	473	14	ND	34
		Walleye	20	53.2	37.6	72.6	1711	440	450	0.74	0.39	2.10	-	-	-	-	-	-
		B. Bullhead	20	27.9	24.2	33.5	312	191	551	0.07	0.03	0.11	55	ND	198	ND	ND	15
		W. Sucker	20	50.0	43.5	57.5	1489	1015	2272	0.44	0.24	0.74						
	1981	Walleye	21	52.4	31.5	73.8	1540	255	3326	1.04	0.30	1.10	177	ND	627	ND	ND	ND
		Y. Perch	20	23.0	21.3	27.0	171	129	275	0.30	0.22	0.46	48	ND	366	ND	ND	ND
		Pike	21	57.8	33.0	77.2	1275	186	2957	0.75	0.25	1.50	65	20	195	1	ND	15
		W. Sucker	25	53.1	44.1	64.5	1756	1077	2418	0.48	0.22	0.79	91	ND	498	3	ND	11
		L.M. Bass	5	26.0	23.0	29.6	285	215	401	0.44	0.38	0.51	22	ND	37	ND	ND	ND
		S.M. Bass	17	33.2	23.0	40.2	608	176	973	0.61	0.30	1.10	393	36	1835	14	ND	80
		B. Bullhead	21	29.4	23.6	34.5	383	176	634	0.12	0.04	0.17	45	ND	117	1	ND	6
	1977	Sturgeon	11	123.2	86.10	175.0	13042	4994	24970	0.44	0.25	0.80	5832	1730	15500	54	23	98
	1976	W. Sucker	15	48.8	43.4	47	1609	1033	2862	0.51	0.20	0.79	-	-	-	-	-	-
		Pike	1	74.9	-	-	2858	-	-	1.27	-	-	-	-	-	-	-	-
		Walleye	19	54.6	44.0	75.0	1891	803	4077	1.32	0.60	3.40	-	-	-	-	-	-

SPORT FISH CONTAMINANT DATA

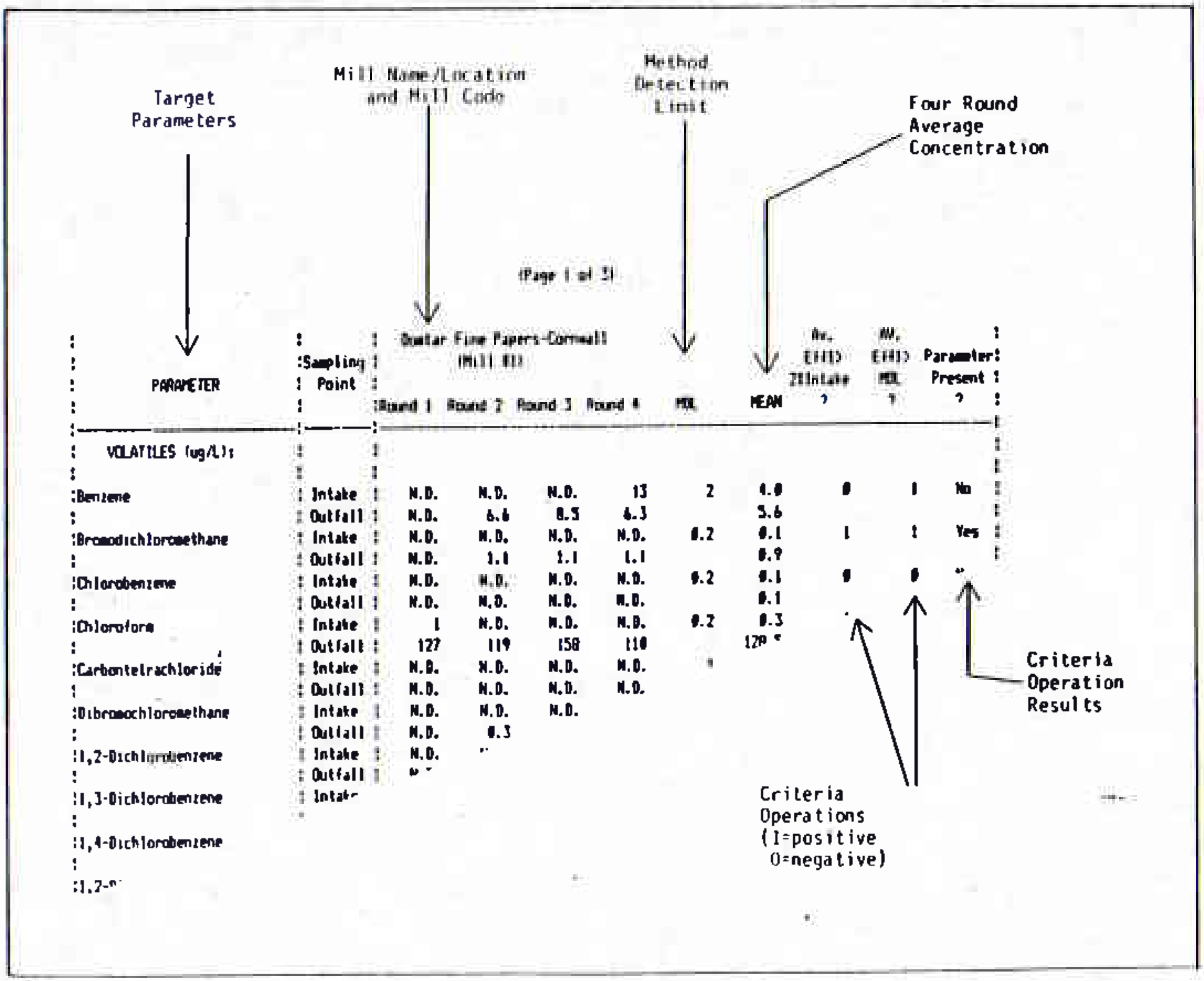
Location	YEAR	SPECIES	NO	LENGTH (cm) MEAN	LENGTH (cm) MIN	LENGTH (cm) MAX	WEIGHT (gm) MEAN	WEIGHT (gm) MIN	WEIGHT (gm) MAX	HG (ppm) MEAN	HG (ppm) MIN	HG (ppm) MAX	PCB (ppb) MEAN	PCB (ppb) MIN	PCB (ppb) MAX	MIREX (ppb) MEAN	MIREX (ppb) MIN	MIREX (ppb) MAX
St. Lawrence River, Cornwall Island, South Channel	1978	P'seed	41	14	10.5	17.5	119	-	-	-	-	-	408	72	1050	15	ND	50
		Y. Perch	54	20.8	17.7	31.0	184	-	-	-	-	-	242	25	640	10	ND	56
		Pike	20	51.8	32.7	68.6	1396	-	-	-	-	-	861	280	4130	34	ND	140
		B. Bullhead	30	25.1	20.0	29.2	338	-	-	-	-	-	352	65	970	2	ND	18
		B. Crappie	37	15.4	12.7	19.5	124	-	-	-	-	-	160	53	400	4	ND	42
		C. Catfish	15	42.8	35.6	57.1	1289	-	-	-	-	-	11524	380	44670	146	ND	420
		W. Sucker	23	43.9	40.0	49.5	1606	-	-	-	-	-	1217	130	9320	16	ND	210
		Walleye	2	47.7	47.0	48.3	1574	-	-	-	-	-	2541	2440	2642	94	91	96
		Whitefish	1	36.8	-	-	469	-	-	-	-	-	600	-	-	45	-	-
		R.H. Sucker	1	54.6	-	-	3518	-	-	-	-	-	8680	-	-	136	-	-
		P'seed	36	13.9	10.5	17.5	115	60	210	0.25	0.08	0.57	-	-	-	-	-	-
		Y. Perch	4	21.3	20.0	22.0	203	190	220	0.29	0.22	0.35	-	-	-	-	-	-
		Pike	7	51.4	36.5	67.0	1154	350	2110	0.94	0.31	1.53	-	-	-	-	-	-
		W. Sucker	1	42	-	-	1250	-	-	-	0.34	-	-	-	-	-	-	-
		B. Bullhead	4	24.6	23.5	26.0	280	250	310	0.19	0.14	0.23	-	-	-	-	-	-
		B. Crappie	8	16.0	15.0	19.5	119	80	200	0.51	0.21	1.04	-	-	-	-	-	-
St. Lawrence River Cornwall Island North Channel	1978	C. Catfish	2	56.5	56.0	57.0	3204	2985	3423	-	-	-	1780	1060	2500	ND	ND	ND
		R. Bass	1	21.0	-	-	326	-	-	-	-	-	260	-	-	ND	-	-
		Carp	1	57.0	-	-	4515	-	-	-	-	-	12230	-	-	ND	-	-
		B. Crappie	1	23	-	-	340	-	-	-	-	-	1550	-	-	ND	-	-
		Walleye	13	52.7	46.0	63.0	1963	-	-	-	-	-	808	190	1806	10	ND	89
		Y. Perch	29	17.6	8.0	22.0	137	80	255	-	-	-	512	57	1330	3	ND	14
		Pike	25	59.1	41.3	73.7	1797	-	-	-	-	-	25	487	80	18	ND	52
		W. Sucker	56	45.7	35.6	60.0	1670	-	-	-	-	-	1031	120	4650	10	ND	95
		B. Bullhead	16	25.2	19.0	55.0	283	140	520	-	-	-	833	410	1550	56	36	88

SPORT FISH CONTAMINANT DATA

St. Lawrence River, Lake St. Francis	YEAR	SPECIES	NO	LENGTH (cm) MEAN	LENGTH (cm) MIN	LENGTH (cm) MAX	WEIGHT (gm) MEAN	WEIGHT (gm) MIN	WEIGHT (gm) MAX	HG (ppm) MEAN	HG (ppm) MIN	HG (ppm) MAX	PCB (ppb) MEAN	PCB (ppb) MIN	PCB (ppb) MAX	MIREX (ppb) MEAN	MIREX (ppb) MIN	MIREX (ppb) MAX
	1985	Walleye	5	64.6	58.3	70.0	3070	2440	3650	-	-	-	298	80	480	ND	ND	ND
		Walleye	20	50.5	38.5	70.0	1598	580	3650	0.65	0.24	1.30						
	1984	Walleye	10	56.1	51.7	67.2	1883	1350	3000	0.95	0.58	2.10	679	80	3454	42	ND	152
		Pike	10	69.7	60.9	80.2	2136	1600	3000	-	-	-	73	31	117	ND	ND	9
		Y. Perch	32	22.9	14.2	29.3	182	38	323	-	-	-	24.5	ND	74	ND	ND	6
		S.M. Bass	18	38.9	27.5	49.5	1051	300	2050	-	-	-	224	35	474	ND	ND	664
		Walleye	10	56.1	51.7	67.2	1883	1350	3000	0.95	0.58	2.10	-	-	-	-	-	-
		Pike	48	54.3	31.4	80.2	1035	380	3000	0.53	0.18	1.20	-	-	-	-	-	-
		S.M. Bass	18	38.9	27.5	49.5	1051	300	2050	0.64	0.32	1.00	-	-	-	-	-	-
		Y. Perch	61	23	14.2	29.3	187	39	400	0.29	0.11	0.72	-	-	-	-	-	-
	1983	Y. Perch	28	25.2	2.4	27.5	238	158	359	0.36	0.18	0.62						
	1982	Walleye	11	54.9	37.6	72.6	1964	-	-	-	-	-	182	48	473	14	ND	34
		Walleye	20	53.2	37.6	72.6	1711	440	450	0.74	0.39	2.10	-	-	-	-	-	-
		B. Bullhead	20	27.9	24.2	33.5	312	191	551	0.07	0.03	0.11	55	ND	198	ND	ND	15
		W. Sucker	20	50.0	43.5	57.5	1489	1015	2272	0.44	0.24	0.74						
	1981	Walleye	21	52.4	31.5	73.8	1540	255	3326	1.04	0.30	1.10	177	ND	627	ND	ND	ND
		Y. Perch	20	23.0	21.3	27.0	171	129	275	0.30	0.22	0.46	48	ND	366	ND	ND	ND
		Pike	21	57.8	33.0	77.2	1275	186	2957	0.75	0.25	1.50	65	20	195	1	ND	15
		W. Sucker	25	53.1	44.1	64.5	1756	1077	2418	0.48	0.22	0.79	91	ND	498	3	ND	11
		L.M. Bass	5	26.0	23.0	29.6	285	215	401	0.44	0.38	0.51	22	ND	37	ND	ND	ND
		S.M. Bass	17	33.2	23.0	40.2	608	176	973	0.61	0.30	1.10	393	36	1835	14	ND	80
		B. Bullhead	21	29.4	23.6	34.5	383	176	634	0.12	0.04	0.17	45	ND	117	1	ND	6
	1977	Sturgeon	11	123.2	86.10	175.0	13042	4994	24970	0.44	0.25	0.80	5832	1730	15500	54	23	98
	1976	W. Sucker	15	48.8	43.4	47	1609	1033	2862	0.51	0.20	0.79	-	-	-	-	-	-
		Pike	1	74.9	-	-	2858	-	-	1.27	-	-	-	-	-	-	-	-
		Walleye	19	54.6	44.0	75.0	1891	803	4077	1.32	0.60	3.40	-	-	-	-	-	-

APPENDIX VII. INFLUENT/EFFLUENT MONITORING DATA: DOMTAR FINE PAPERS

ORGANIZATION OF MILL SUMMARIES (APPENDIX 1)



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PARAMETER	Sampling Point	Round 1	Round 2	Round 3	Round 4	MDL	MEAN	Av. Effl> 2xIntake ?	Av. Effl> MDL ?	Parameter Present ?
		Quintar Fine Papers-Cornwall (Mill 81)								
VOLATILES (ug/L):										
Benzene	Intake	N.D.	N.D.	N.D.	13	2	4.0	0	1	No
	Outfall	N.D.	6.6	8.5	6.3		5.6			
Bromodichloromethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	1	1	Yes
	Outfall	N.D.	1.0	1.1	1.1		0.9			
Chlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	"
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
Chloroform	Intake	1	N.D.	N.D.	N.D.	0.2	0.3			
	Outfall	127	119	158	110		128			
Carbontetrachloride	Intake	N.D.	N.D.	N.D.	N.D.					
	Outfall	N.D.	N.D.	N.D.	N.D.					
Dibromochloromethane	Intake	N.D.	N.D.	N.D.						
	Outfall	N.D.	0.3							
1,2-Dichlorobenzene	Intake	N.D.								
	Outfall	N.[illegible]								
1,3-Dichlorobenzene	Intake									
1,4-Dichlorobenzene										
1,2-[illegible]										

PARAMETER	Sampling Point	Domtar Fine Papers-Cornwall (Mill #1) Round 1	Round 2	Round 3	Round 4	MDL	MEAN	Av. Effl> 2XIntake ?	AV. Effl> MDL ?	Parameter Present ?
VOLATILES (ug/L):										
Benzene	Intake	N.D.	N.D.	N.D.	13	2	4.0	0	1	No
	Outfall	N.D.	6.6	8.5	6.3		5.6			
Bromodichloromethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	1	1	Yes
	Outfall	N.D.	1.1	1.1	1.1		0.9			
Chlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
Chloroform	Intake	1	N.D.	N.D.	N.D.	0.2	0.3	1	1	Yes
	Outfall	127	119	158	110		128.5			
Carbontetrachloride	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.5			
Dibromochloromethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	1	1	Yes
	Outfall	N.D.	0.3	0.3	0.5		0.3			
1,2-Dichlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.3	0.2	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.2			
1,3-Dichlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.3	0.2	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.2			
1,4-Dichlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.3	0.2	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.2			
1,2-Dichloroethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
1,1-Dichloroethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
1,1-Dichloroethene	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
1,2-Dichloropropane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
Ethylbenzene	Intake	N.D.	N.D.	N.D.	N.D.	0.5	0.3	0	0	No
	Outfall	0.3	N.D.	0.3	0.6		0.4			
Methylene chloride	Intake	58	111	15	N.D.	10	47.3	0	1	No
	Outfall	49.5	32.8	18.1	N.D.		26.4			
Tetrachloroethene	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
Toluene	Intake	5.7	N.D.	N.D.	N.D.	3	2.6	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		1.5			
1,1,1-Trichloroethane	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	1	1	Yes
	Outfall	0.6	N.D.	N.D.	0.4		0.3			
1,1,2-Trichloroethane	Intake	N.D.	N.D.	N.D.	N.D.	0.5	0.3	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.3			
Trichloroethene	Intake	N.D.	N.D.	N.D.	N.D.	0.2	0.1	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.1			
Trichlorofluoromethane	Intake	N.D.	N.D.	N.D.	N.D.	0.5	0.3	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.3			
BASE/NEUTRALS (ug/L):										
Acenaphthylene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	1	1	Yes
	Outfall	N.D.	1.4	4	3.2		2.3			
Anthracene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	1.1	1.6		0.9			

PARAMETER	Sampling Point	Domtar Fine Papers-Cornwall (Mill #1) Round 1	Round 2	Round 3	Round 4	MDL	MEAN	Av. Effl > 2XIntake ?	AV. Effl > MDL ?	Parameter Present ?
Benzyl butyl phthalate	Intake	N.D.	N.D.	2.5	4.3	1	2.0	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.5			
Bis-(2-ethylhexyl) phthalate	Intake	1.4	1.1	24	5.1	1	7.9	0	1	No
	Outfall	2.2	2	3.5	5.7		3.4			
Di-n-butyl phthalate	Intake	12	9.8	8.6	90	1	30.1	0	1	No
	Outfall	15.5	4.4	5.6	99		31.1			
1,3-Dichlorobenzene	Intake	N.D.	N.D.	N.D.	N.D.	2	1.0	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		1.0			
Dimethyl phthalate	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.5			
Diethyl phthalate	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.5			
Fluoranthene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	1	1	Yes
	Outfall	1.3	1.3	2	N.D.		1.3			
Isophorone	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.5			
Naphthalene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	1	1	Yes
	Outfall	3.3	3.9	8.3	10.6		6.5			
Phenanthrene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	1	1	Yes
	Outfall	5.4	7.1	7.1	8.2		7.0			
Pyrene	Intake	N.D.	N.D.	N.D.	N.D.	1	0.5	0	0	No
	Outfall	N.D.	N.D.	1.2	N.D.		0.7			
ACIDS (ug/L):										
Phenol	Intake	N.D.	N.D.	N.D.	N.D.	2	1.0	1	1	Yes
	Outfall	93.6	133	70.1	380		169.2			
2,4-Dichlorophenol	Intake	N.D.	N.D.	N.D.	N.D.	5	2.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		2.5			
2,4,6-Trichlorophenol	Intake	N.D.	N.D.	N.D.	N.D.	5	2.5	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		2.5			
METALS & Cyanide (mg/L):										
Aluminum	Intake	0.12	0.06	0.26	0.08	0.02	0.1300	1	1	Yes
	Outfall	2.9	1.55	2.4	2.1		2.2375			
Arsenic	Intake	0.001	N.D.	0.001	N.D.	0.001	0.0008	0	0	No
	Outfall	N.D.	N.D.	0.002	N.D.		0.0009			
Cadmium .001	Intake	0.0006	0.0003	0.0004	0.0003	0.0002	0.0004	1	1	Yes
	Outfall	0.0013	0.0011	0.0011	0.0008		0.0011			
Chromium 1.0	Intake	N.D.	N.D.	N.D.	N.D.	0.01	0.0050	1	1	Yes
	Outfall	0.02	0.015	N.D.	N.D.		0.0113			
Copper 1.0	Intake	N.D.	N.D.	0.01	N.D.	0.005	0.0044	1	1	Yes
	Outfall	0.015	0.02	0.01	0.01		0.0138			
Cyanide	Intake	N.D.	N.D.	N.D.	N.D.	0.002	0.0010	0	0	No
	Outfall	N.D.	0.004	N.D.	N.D.		0.0018			
Lead 1.0	Intake	0.001	0.001	0.001	N.D.	0.001	0.0009	1	1	Yes
	Outfall	0.004	0.009	0.004	0.003		0.0050			
Mercury	Intake	0.00005	N.D.	N.D.	N.D.	0.00005	0.000031	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.000025			

PARAMETER	Sampling Point	Domtar Fine Papers-Cornwall (Mill #1) Round 1	Round 2	Round 3	Round 4	MDL	MEAN	Av. Effl> 2XIntake ?	AV. Effl> MDL ?	Parameter Present ?
Nickel	Intake	N.D.	N.D.	N.D.	N.D.	0.01	0.0050	0	0	No
	Outfall	0.01	N.D.	N.D.	0.01		0.0075			
Thallium	Intake	N.D.	N.D.	N.D.	N.D.	0.02	0.0100	0	0	No
	Outfall	0.02	0.02	0.02	0.02		0.0200			
Zinc	Intake	N.D.	N.D.	0.01	0.02	0.01	0.0100	1	1	Yes
	Outfall	0.04	0.04	0.05	0.04		0.0425			
CONVENTIONALS:										
BOD5 (mg/L)	Outfall	152	85	179	115	1	132.8			
TSS (mg/L)	Outfall	40	45	64	65	1	53.5			
pH	Outfall	7.54	7.62	7.38	7.4	-				
INORGANICS (mg/L):										
Chloride	Intake	21	22	22.7	23	0.02	22.2	1	1	Yes
	Outfall	137	121	151	114		130.8			
Sulfate	Intake	25	27	27.5	27	0.05	26.6	1	1	Yes
	Outfall	200	148	178	175		175.3			
Nitrate	Intake	0.28	0.011	0.09	0.17	0.01	0.1	1	1	Yes
	Outfall	1.4	0.7	1.96	1.8		1.5			
Nitrite	Intake	N.D.	0.008	0.003	0.004	0.001	0.0039	0	0	No
	Outfall	N.D.	N.D.	N.D.	N.D.		0.0005			
Sodium	Intake	11	11	12	12	0.005	11.5	1	1	Yes
	Outfall	178	118	189	141		156.5			
Potassium	Intake	1.55	1.45	1.95	1.7	0.01	1.7	1	1	Yes
	Outfall	8.4	6	10.6	6.8		8.0			
Calcium	Intake	38	34	37	36	0.01	36.3	0	1	No
	Outfall	59	61	57	51		57.0			
Magnesium	Intake	7.7	8.1	8.3	3.3	0.002	6.9	0	1	No
	Outfall	8.9	9.6	9.4	8.7		9.2			
Total-P	Intake	0.025	0.05	0.018	0.013	0.01	0.0265	1	1	Yes
	Outfall	0.35	0.33	0.51	0.25		0.4			
TKN	Intake	0.41	0.48	0.23	0.27	0.1	0.3	1	1	Yes
	Outfall	3	2.3	2.8	1.9		2.5			
Ammonia-N	Intake	0.03	0.04	0.03	0.02	0.01	0.0300	1	1	Yes
	Outfall	0.02	0.46	0.06	0.1		0.2			
96 Hour LC50 (%v/v)		100	100	66	100	-				

Note: N.D. : Parameter below detection limit
MEAN : For calculation purposes, N.D.=1/2 MDL

ORGANIC POLLUTANTS (ug/l): DOMTAR PRIMARY CLARIFIER INFLUENT AND EFFLUENT (FINAL EFFLUENT), 1981

Fraction/Compound	Clarifier Influent	Clarifier Effluent		
	Oct. 20-21	Oct. 20-21	Oct. 21-22	Oct. 22-23
1. <u>Purgeable Fraction (PP)</u> (Analysed packed column GC/MS)				
Chloroform		176	277	
Benzene	Not	6	9	Not
Toluene		3	2	
Bromodichloromethane <u>or</u> Thiophene (NPP)	Analyzed	55	74	Analyzed
2. <u>Acid Fraction (PP)</u> (Analysed capillary column GC/MS)				
Phenol	180	210	210	200
3. <u>Base Neutral Fraction (PP)</u> (Analysed capillary column GC/MS)				
Naphthalene	2	1	5	6
Diphenylhydrazine	-	-	1	-
Phenanthrene	2	1	1	2
Di-n-butylphthalate	13	5	15	6
4. <u>Pesticides/PCBs (PP)</u>				
PCBs (Detection limit 0.02 ug/l) (Analysed by MOE)	N/A	N/A	-	-
Pesticides not analyzed by EPS.				
5. <u>Other Compounds (NPP)</u>				
Dimethyldisulphide	N/A	Major Peak, mg/l level, 3 effluents		
Thiobismethane <u>or</u> Ethanethiol	N/A	Major Peak, mg/l level, 3 effluents		
Methanethiol	N/A	Major Peak, up to mg/l level, 3 effluents		
Methoxy Phenol (o-isomer is Guaiacol)	-	Major peak, 3 days, up to 200 ug/l		
Methyl Phenol (Cresol)	Large Peak, influent, 3 effluents			
Dimethoxy Phenol (2,6-isomer is syringol)	-	Major peak, 3 days, up to 200 ug/l		
$C_9H_{10}O_3$ (Methyl Vanillin)	-	-	P	P
$C_{10}H_{12}O_4$ (Methylmethoxy Vanillin)	-	-	P	P
Hexadecanoic (Palmitic) Acid	P	P	-	-
Dehydroabietic Acid*	P	P	P	P
Alkanes C_{12}-C_{13}	P	P	-	P
Sulfur Compounds	P	P	P	P
Benzene Methanol	P	P	P	P
Methyl Cyclopentanone (2 isomers)	-	P	P	P

ORGANIC POLLUTANTS (ug/l): DOMTAR PRIMARY CLARIFIER
INFLUENT AND EFFLUENT (FINAL EFFLUENT), 1981

Fraction/Compound	Clarifier Influent Oct. 20-21	Clarifier Effluent Oct. 20-21	Clarifier Effluent Oct. 21-22	Clarifier Effluent Oct. 22-23
$C_3H_6O_2S$	-	P	P	P
Hexadiene & Furanyl Ethanone	P	P	P	P
Benzaldehyde	-	P	P	P
Dimethyltrisulphide	P	P	P	P
$C_4H_{10}S_2$	P	P	P	P
Trimethyl Cyclopentenone (3 isomers)	-	P	P	P
$C_8H_{14}O$ (Non-Aromatic Ketone)	P	-	-	-
Benzene Ethanol	P	P	P	P
Tetramethyl Benzene (2 isomers)	1 isomer	P	P	P
Dimethoxy Benzene	-	P	P	P
1,2,3,4-Tetrahydronaphthalene	-	P	P	P
Ethyl Phenol	-	P	P	P
Methyl-1,2,3,4-Tetrahydronaphthalene	P	P	P	P
1-(2,4-Dihydroxy Phenyl)- Ethanone $C_8H_8O_3$	-	P	P	P
Methyl Naphthalene (2 isomers)	-	P	P	P
Trimethoxy Benzene (2 isomers)	-	P	P	P
Aromatic Hydrocarbon ($C_{12}H_{16}$)	-	P	P	P
2-Methoxy-4-Propyl Phenol	-	P	P	P
Dimethyl-1,2,3,4-Tetra- hydronaphthalene	P	P	P	P
Alkyl Benzene $C_{12}H_{18}$	-	-	P	-
Dimethylnaphthalene (4 isomers)	1 isomer	2 isomers	4 isomers	2 isomers
3,4-Dimethoxy Benzoic Acid ($C_9H_{10}O_4$)	-	P	P	P
Trimethylnaphthalene	P	P	P	P
2,6-Dimethoxy-4-(2-Propenyl) Phenol $C_{11}H_{14}O_3$	-	P	P	P
Substituted Naphthalenol	P	P	P	P
$C_{10}H_{12}O_4$ (Ethanone Derivative)	-	-	P	-
Alkyl Phenol ($C_{16}H_{26}O$)	P	-	-	-
C_{19}-C_{20} Straight Chain Alcohol	P	P	-	P
$C_{16}H_{25}N$	P	P	P	P
Numerous Alkanes	P	P	P	P

Note: P - Present (Not quantified); PP - Priority Pollutants;
NPP - Non-Priority Pollutants; (-) Not Detected
N/A - not analysed

ORGANIC POLLUTANTS (ug/l):
DOMTAR PRIMARY CLARIFIER EFFLUENT - ORGANIC ACIDS, 1981
(FINAL EFFLUENT)

Compound and Group	Oct. 20-21	Oct. 21-22	Oct. 22-23
Fatty Acids*			
Capric (Decanoic)	-	-	-
Lauric (Dodecanoic)	-	-	-
Myristic (Tetradecanoic)	-	-	-
Palmitic (Hexadecanoic)	310	340	460
Stearic (Octadecanoic)	80	130	120
Oleic (Octadecenoic)	130	260	310
Linoleic (Octadecadienoic)	660	1,390	3,720
Linolenic (Octadecatrienoic)	30	70	60
TOTAL FATTY ACIDS	1,210	2,190	4,670
Aromatic Acids*			
Benzoic	20	30	20
Salicylic	-	-	-
Phthalic	100	240	220
TOTAL AROMATIC ACIDS	120	270	240
Resin Acids**			
Pimaric	160	160	140
Sandaracopimaric	-	-	-
Levopimaric	-	-	-
Isopimaric	100	111	80
Neoabietic	410	490	420
Abietic	1,190	1,110	1,120
Dehydroabietic	40	90	90
TOTAL RESIN ACIDS	1,900	1,960	1,850

* Detection Limit 10 ug/l
** Detection Limit 40 ug/l

APPENDIX VIII. EFFLUENT MONITORING DATA: DOMTAR DIFFUSER (COMPOSED OF EFFLUENT FROM DOMTAR, ICI, CORNWALL CHEMICALS AND STANCHEM)

RESULTS OF ENVIRONMENT ONTARIO SURVEY OF COMBINED DOMTAR-CIL-CORNWALL CHEMICALS EFFLUENT - JUNE 18-20, 1985: HEAVY METALS (mg/L)

METAL (mg/L)	JUNE 18			JUNE 19			JUNE 20		
	830-1030	1100-1300	1330-1530	830-1030	1100-1300	1330-1530	830-1030	1100-1300	1330-1530
Iron	.60	.38	.38	.50	.65	.54	.23	.25	.38
Arsenic	.002	.002	.001	.002	.002	.001	.001	.001	.001
Cadmium	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002	<.002
Chromium	<.01	<0.01	0.013	<.02	0.021	<.02	<.01	<.01	<.01
Copper	.03	.03	.04	.07	.06	.06	.02	.03	.03
Mercury ug/L	1.7	2.2	1.9	3.1	2.4	2.4	1.2	0.9	1.3
Nickel	<.01	<.01	<.01	<.02	<.02	<.02	<.01	<.01	<.01
Lead	<.03	<.03	<.03	<.02	<.02	<.02	<.03	<.03	<.03
Zinc	.039	.035	.037	.071	.066	.071	.097	0.083	0.088

Note: All concentrations in mg/L unless otherwise indicated. The samples are two-hour composites taken during the period shown.

RESULTS OF ENVIRONMENT ONTARIO SURVEY OF COMBINED DOMTAR-CIL- CORNWALL CHEMICALS EFFLUENT (JUNE 18-20, 1985) ORGANIC COMPOUNDS

COMPOUND (ug/L)	JUNE 18			JUNE 19			JUNE 20		
	830-1030	1100-1300	1330-1530	830-1030	1100-1300	1330-1530	830-1030	1100-1300	1330-1530
1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	950	300	280	500	190	210	240	260	240
1,1,1-Trichloroethane	3	ND	ND	ND	1	ND	ND	2	2
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	430	1000	600	390	270	450	320	310	310
Benzene	14	20	23	ND	9	15	13	12	9
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	1
Bromodichloromethane	ND	ND	ND	2	2	3	3	4	3
Toluene	2	ND	16	2	1	1	2	1	2
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	1	ND
Tetrachloroethylene	3	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	11	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	2	51	ND	5	2	1	3	2	3
M- & P-Xylenes	3	75	11	11	4	2	3	3	3
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-Xylene	14	40	ND	10	19	12	18	1	1
1,1,2,2,-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2 Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected.

Note: All results are in micrograms per litre. They were measured by gas chromatography and have not been confirmed by mass spectrometer. All samples are two-hour composites, taken during the period shown.

RESULTS OF ENVIRONMENT ONTARIO SURVEY OF COMBINED-DOMTAR-CIL-CORNWALL CHEMICALS
EFFLUENT (JUNE 18-20, 1985) - PHENOLIC COMPOUNDS

COMPOUND	JUNE 18			JUNE 19			JUNE 20		
	830-1030	1100-1300	1330-1530	830-1030	1100-1300	1330-1530	30-1030	1100-1300	1330-1530
Phenol	250,000	192,188	128,569	212,500	104,168	131,250	100,000	81,250	65,000
Vanilline	ND	ND	ND	ND	ND	ND	ND	ND	ND
Homovanillic Acid	18,500	4,250	3,000	19,500	ND	18,000	3,875	3,250	ND
Guaicol	300,000	328,125	16,963	189,581	52,081	293,750	366,069	323,125	247,500
Syring-aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aceto-vanillone	20,831	15,625	12,500	ND	ND	46,093	333,931	21,875	15,000
Aceto-syringone	ND	ND	ND	ND	ND	ND	ND	ND	ND
P-cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,5-xylenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-dichloro-phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-tri-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
pentachloro-phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
m-chloro-p-cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-tri-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5,6-tetra-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,5-tetra chlorphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total PCB	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected

Note: The samples are two-hour composites taken during the period shown. All results are in nanograms per litre (ng/L).

APPENDIX IX. INFLUENT/EFFLUENT MONITORING DATA: ICI CORNWALL (FORMERLY CIL CORWALL)

3.1 MISA - INORGANICS - CIL - CORNWALL

MOE #	Parameter (mg/l)	881673 CITY INTAKE-2	881716 CITY INTAKE-4	881671 WELL INTAKE-2	881717 WELL INTAKE-4
---	Barium	</<	<	<	<
	Bismuth	</<	<	<	<
	Boron	</<	<	<	<
	Calcium	38 / 38	41	110	480
	Cerium	</<	<	<	<
	Dysprosium	</<	<	<	<
	Erbium	</<	<	<	<
	Europium	</<	<	<	<
	Gadolinium	</<	<	<	<
	Gallium	</<	<	<	<
	Germanium	</<	<	<	<
	Gold	</<	<	<	<
	Hafnium	</<	<	<	<
	Holmium	</<	<	<	<
	Indium	</<	<	<	<
	Iridium	</<	<	<	<
	Iron	</<	<	<	<
	Lanthanum	</<	<	<	<
	Lithium	</<	<	<	<
	Lutetium	</<	<	<	<
	Magnesium	7.8 / 8.1	8.2	15	67
	Manganese	</<	<	<	<
	Neodymium	</<	<	<	<
	Niobium	</<	<	<	<
	Osmium	</<	<	<	<
	Palladium	</<	<	<	<
	Platinum	</<	<	<	<
	Potassium	1.7 / 1.9	1.7	5.7	9.6
	Praseodymium	</<	<	<	<
	Rhenium	</<	<	<	<
	Rhodium	</<	<	<	<
	Ruthenium	</<	<	<	<
	Samarium	</<	<	<	<
	Scandium	</<	<	<	<
	Silicon	</<	<	1.3	4.0
	Sodium	12 / 12	13	1600	180
	Strontium	</<	<	1.6	13
	Sulphur	10 / 11	11	610	450
	Tantalum	</<	<	<	<
	Tellurium	</<	<	<	<
	Terbium	</<	<	<	<
	Thorium	</<	<	<	<
	Thulium	</<	<	<	<
	Tin	</<	<	<	<
	Titanium	</<	<	<	<
	Tungsten	</<	<	<	<
	Uranium	</<	<	<	<
	Yttrium	</<	<	<	<
	Ytterbium	</<	<	<	<
	Zirconium	</<	<	<	<

ANALYSIS FOR VOLATILE ORGANICS (µg/L)

PARAMETER (Groups 16,17,18)	MDL	881673 City Intake-2	881716 City Intake-4	881671 Well Intake-2	881717 Well Intake-4
Acrolein	50	<	<	<	<
Acrylonitrile	50	<	<	<	<
Benzene	10	<	<	<	<
Bromodichloromethane	10	13	10	<	<
Bromoform	10	<	<	<	<
Bromomethane	20	<	<	<	<
1,3-Butadiene	50	<	<	<	<
Carbon Tetrachloride	10	<	<	<	<
Chlorobenzene	10	<	<	<	<
Chloroform	10	22	35	<	<
Chloromethane	20	<	<	<	<
Dibromochloromethane	10	<	<	<	<
Ethylene Dibromide	10	<	<	<	<
1,2-Dibromoethane	10	<	<	<	<
1,2-Dichlorobenzene	10	<	<	<	<
1,3-Dichlorobenzene	10	<	<	<	<
1,4-Dichlorobenzene	10	<	<	<	<
1,1-Dichloroethane	10	<	<	<	<
1,2-Dichloroethane	10	<	<	<	<
1,1-Dichloroethene	10	<	<	<	<
cis-1,2-Dichloroethene	10	<	<	<	<
trans-1,2-Dichloroethene	10	<	<	<	<
cis-1,3-Dichloropropene	10	<	<	<	<
1,2-Dichloropropane	10	<	<	<	<
trans-1,3-Dichloropropene	10	<	<	<	<
Ethylbenzene	10	<	<	<	<
Methyl ethyl ketone	10	<	<	<	<
Methylene chloride	10	<	<	<	<
Styrene	10	<	<	<	<
1,1,2,2-Tetrachloroethane	10	<	<	<	<
Tetrachloroethene	10	<	<	<	<
Toluene	10	<	<	<	<
1,1,2-Trichloroethane	10	<	<	<	<
Trichloroethene	10	<	<	<	<
Trichlorofluoromethane	10	<	<	<	<
Vinyl chloride	20	<	<	<	<
0-Xylene	10	<	<	<	<
m &p-Xylene	10	<	<	<	<
SURROGATE RECOVERIES - %					
Bromochloromethane		98	97	119	106
Difluorobenzene		92	91	114	91
d5-Chlorobenzene		105	102	113	103
d4-1,2-Dichloroethane		89	83	119	105
d8-Toluene		106	96	109	104
Bromofluorobenzene		103	104	117	105

< - Less than MDL

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881673 City Intake-2	881716 City Intake-4	881671 Well Intake-2	881717 Well Intake-4
Acenaphthene	1	<	<	<	<
Acenaphthylene	10	<	<	<	<
Anthracene	10	<	<	<	<
Benzo(a)anthracene	10	<	<	<	<
Benzo(b/k)fluoranthene	10	<	<	<	<
Benzo(a)pyrene	10	<	<	<	<
Benzo(ghi)perylene	10	<	<	<	<
Benzylbutylphthalate	10	<	<	<	<
Bis(2-chloroethyl)ether	10	<	<	<	<
Bis(2-chloroethoxy)methane	10	<	<	<	<
Bis(2-ethylhexyl) phthalate	1	1.1	1.2	1.1	2.6
Bis(2-chloroisopropyl)ether	10	<	<	<	<
4-Bromodiphenylether	10	<	<	<	<
Camphene	10	<	<	<	<
1-Chloronaphthalene	10	<	<	<	<
2-Chloronaphthalene	10	<	<	<	<
4-Chlorodiphenylether	10	<	<	<	<
Chrysene	10	<	<	<	<
Dibenzo(a,h)anthracene	10	<	<	<	<
Di-n-butyl phthalate	1	<	<	<	<
Di-n-octylphthalate	10	<	<	<	<
2,4-Dinitrotoluene	10	<	<	<	<
2,6-Dinitrotoluene	10	<	<	<	<
Diphenylamine	10	<	<	<	<
Diphenylether	10	<	<	<	<
Fluoranthene	10	<	<	<	<
Fluorene	10	<	<	<	<
Indeno(1,2,3-cd)pyrene	10	<	<	<	<
Indole	10	<	<	<	<
1-Methyl naphthalene	10	<	<	<	<
2-Methyl naphthalene	10	<	<	<	<
Naphthalene	10	<	<	<	<
5-Nitroacenaphthene	10	<	<	<	<
N-Nitrosodi-n-propylamine	10	<	<	<	<
N-Nitrosodiphenylamine	10	<	<	<	<
Perylene	10	<	<	<	<
Phenanthrene	10	<	<	<	<
Pyrene	10	<	<	<	<

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881673 City Intake-2	881716 City Intake-4	881671 Well Intake-2	881717 Well Intake-4
Acid Extractables					
4-Chloro-3-methylphenol	10	<	<	<	<
2-Chlorophenol	10	<	<	<	<
2,4-Dichlorophenol	10	<	<	<	<
2,6-Dichlorophenol	10	<	<	<	<
2,4-Dimethylphenol	10	<	<	<	<
2,4-Dinitrophenol	10	<	<	<	<
4,6-Dinitrophenol-o-cresol	10	<	<	<	<
4-Nitrophenol	10	<	<	<	<
Pentachlorophenol	10	<	<	<	<
Phenol	10	<	<	<	<
o-cresol	10	<	<	<	<
m-cresol	10	<	<	<	<
p-cresol	10	<	<	<	<
2,4,5-Trichlorophenol	10	<	<	<	<
2,4,6-Trichlorophenol	10	<	<	<	<
2,3,4-Trichlorophenol	10	<	<	<	<
2,3,5-Trichlorophenol	10	<	<	<	<
2,3,4,5-Tetrachlorophenol	10	<	<	<	<
2,3,4,6-Tetrachlorophenol	10	<	<	<	<
2,3,5,6-Tetrachlorophenol	10	<	<	<	<
% SURROGATE RECOVERY					
d3 -Dichlorophenol		65	76	80	56
d10-Anthracene		92	118	114	120
d12- Benzo(a)pyrene		79	81	91	89
d5-Phenol		32	37	64	28

< - Less than MDL
MDL - Minimum detection Limit

MISA - INORGANICS - CIL

MOE #	Parameter (mg/l)	881665 LEL2-1	881668 LEL2-2	881710 LEL2-3	881713 LEL2-4
---	Total Chlorine (ave.)	< 0.01	< 0.01	0.23	< 0.01
1	COD	120	170 / 195	120 / 90	155
2	Cyanide	< 0.001 / 2	< 0.001	< 0.001	< 0.001
3	pH (20 °C)	7.68	8.45	6.29	9.41
4	Nitrogen-ammonia	0.046	0.045	0.021	0.070
	Nitrogen-nitrate	2.6	5.2	2.4	3.8
	Nitrogen-nitrite	< 0.03 / 2	< 0.03	< 0.03 / 2	< 0.03
	Nitrogen-TKN	< 0.3	< 0.3	< 0.3	0.45
-----	Fluoride	< 1	< 1	< 1	< 1
	Chloride	1300	1600	770	1200
	Bromide	< 1	< 1	< 1	< 1
	Iodide	< 1	< 1	< 1	< 1
	Sulphate	130	120	91	110
6	Total Phosphorus	0.16 / 0.16	0.16	0.17	0.18
7	Spec.Cond.(µS/cm)	3300 / 3400	3300	2000 / 2000	2900
8	Total Susp. Solids	50	160	6.0	4.0 / 2.0
9	Aluminum	0.11	0.12	0.11	0.11
	Beryllium	< 0.01	< 0.01	< 0.01	< 0.01
	Cadmium	< 0.002	< 0.002	< 0.002	< 0.002
	Chromium	< 0.02	< 0.02	< 0.02	< 0.02
	Cobalt	< 0.02	< 0.02	< 0.02	< 0.02
	Copper	0.027	0.014	0.022	0.026
	Lead	< 0.03	< 0.03	< 0.03	< 0.03
	Molybdenum	< 0.02	< 0.02	< 0.02	< 0.02
	Nickel	< 0.02	< 0.02	< 0.02	< 0.02
	Silver	< 0.03	< 0.03	< 0.03	< 0.03
	Thallium	< 0.03	< 0.03	< 0.03	< 0.03
	Vanadium	< 0.03	< 0.03	< 0.03	< 0.03
	Zinc	0.051	0.037	0.059	0.14
10	Arsenic	< 0.005	< 0.005	< 0.005	< 0.005
	Antimony	0.010	0.007	< 0.005	< 0.005
	Selenium	< 0.005	< 0.005	< 0.005	< 0.005
11	Chromium (VI)	na	na	na	na
12	Mercury	0.0073	0.0031	0.0056	0.0029
13	Total Alkyl Lead	na	na	na	na
14	Phenolics	0.009	0.013	< 0.002	< 0.002
15	Sulphide	< 0.02	< 0.02	0.039	0.12
25	Oil & Grease **	44	<1	57	<1

MISA - INORGANICS - CIL - CORNWALL

MOE #	Parameter (mg/l)	881665 LEL2-1	881668 LEL2-2	881710 LEL2-3	881713 LEL2-4
—	Barium	<	<	<	<
	Bismuth	<	<	<	<
	Boron	<	<	<	<
	Calcium	120	110	65	56
	Cerium	<	<	<	<
	Dysprosium	<	<	<	<
	Erbium	<	<	<	<
	Europium	<	<	<	<
	Gadolinium	<	<	<	<
	Gallium	<	<	<	<
	Germanium	<	<	<	<
	Gold	<	<	<	<
	Hafnium	<	<	<	<
	Holmium	<	<	<	<
	Indium	<	<	<	<
	Iridium	<	<	<	<
	Iron	2.8	<	<	1.4
	Lanthanum	<	<	<	<
	Lithium	<	<	<	<
	Lutetium	<	<	<	<
	Magnesium	16	13	10	9.3
	Manganese	<	<	<	<
	Neodymium	<	<	<	<
	Niobium	<	<	<	<
	Osmium	<	<	<	<
	Palladium	<	<	<	<
	Platinum	<	<	<	<
	Potassium	66	160	88	120
	Praseodymium	<	<	<	<
	Rhenium	<	<	<	<
	Rhodium	<	<	<	<
	Ruthenium	<	<	<	<
	Samarium	<	<	<	<
	Scandium	<	<	<	<
	Silicon	<	<	1.0	<
	Sodium	710	570	350	680
	Strontium	<	<	<	<
	Sulphur	58	66	31	38
	Tantalum	<	<	<	<
	Tellurium	<	<	<	<
	Terbium	<	<	<	<
	Thorium	<	<	<	<
	Thulium	<	<	<	<
	Tin	<	<	<	<
	Titanium	<	<	<	<
	Tungsten	<	<	<	<
	Uranium	<	<	<	<
	Yttrium	<	<	<	<
	Ytterbium	<	<	<	<
	Zirconium	<	<	<	<

ANALYSIS OF PCDD/PCDF (ng/L)

PARAMETER	MDL	881666 MH#15-1	881669 MH#15-2	881711 MH#15-3	881714 MH#15-4	881665 LEL2-1	881668 LEL2-2	881670 LEL2-2 Duplicate
T4CDF	0.30	1.1	22	0.98	1.3	<	0.60	0.91
P5CDF	0.30	0.64	11	0.50	0.52	<	0.26	0.32
H6CDF	0.30	<	< 0.75	< 0.5	<	<	< 0.85	<
H7CDF	0.30	<	< 0.85	<	<	<	<	<
O8CDF	0.30	<	3.0	<	<	<	<	<
T4CDD	0.30	<	<	<	<	<	<	<
P5CDD	0.30	< 2.4 *	< 2.0 *	< 2.0 *	< 2.0 *	< 2.3 *	< 2.3 *	< 2.5 *
H6CDD	0.30	<	< 2.3	<	<	< 1.3	< 0.5	< 0.7
H7CDD	0.30	< 0.37	< 0.56	<	<	<	< 0.5	< 0.5
O8CDD	0.30	<	<	<	<	<	<	<
Surrogate Recoveries %								
2,3,7,8-TCDD 13C12		68	74	55	62	39	61	51
1,2,3,6,7,8-HCDD 13C12		44	70	62	68	46	59	63
OCDD 13C12		79	122	82	91	85	100	103

< - Not present at MDL
MDL - Minimum Detection Limit
* -High detection limit due to single interference peak - No evidence of PCDD

ANALYSIS OF PCDD/PCDF (ng/L)

PARAMETER	MDL	881710 LEL2-3	881713 LEL2-4	881667 Stanchem-1	881672 Stanchem-2	881712 Stanchem-3	881715 Stanchem-4
T4CDF	0.30	<	<	<	<	<	<
P5CDF	0.30	<	<	<	<	<	<
H6CDF	0.30	<	<	<	< 0.4	<	<
H7CDF	0.30	<	<	<	<	<	<
O8CDF	0.30	<	<	<	<	<	<
T4CDD	0.30	<	<	<	<	<	<
P5CDD	0.30	< 2.0 *	< 2.3 *	< 2.8 *	< 1.9 *	< 2.1*	< 2.0 *
H6CDD	0.30	<	<	< 0.31	< 0.72	< 0.66	< 0.75
H7CDD	0.30	<	<	< 0.45	< 0.42	<	<
O8CDD	0.30	<	<	<	<	<	< 0.46
Surrogate Recoveries %							
2,3,7,8-TCDD 13C12		67	53	54	37	57	55
1,2,3,6,7,8-HCDD 13C12		62	64	48	23	47	52
OCDD 13C12		64	81	90	49	71	76

< - Not present at MDL
MDL - Minimum Detection Limit
* -High detection limit due to single interference peak - No evidence of PCDD

ZENON ENVIRONMENTAL INC.7/26/88

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881665 LEL2-1	881668 LEL2-2	881670 LEL2-2	881710 LEL2-3
Acenaphthene	1	<	<	<	<
Acenaphthylene	10	<	<	<	<
Anthracene	10	<	<	<	<
Benzo(a)anthracene	10	<	<	<	<
Benzo(b/k)fluoranthene	10	<	<	<	<
Benzo(a)pyrene	10	<	<	<	<
Benzo(ghi)perylene	10	<	<	<	<
Benzylbutylphthalate	10	<	<	<	<
Bis(2-chloroethyl)ether	10	<	<	<	<
Bis(2-chloroethoxy)methane	10	<	<	<	<
Bis(2-ethylhexyl) phthalate	1	2.0	1.3	2.9	1.2
Bis(2-chloroisopropyl)ether	10	<	<	<	<
4-Bromodiphenylether	10	<	<	<	<
Camphene	10	<	<	<	<
1-Chloronaphthalene	10	<	<	<	<
2-Chloronaphthalene	10	<	<	<	<
4-Chlorodiphenylether	10	<	<	<	<
Chrysene	10	<	<	<	<
Dibenzo(a,h)anthracene	10	<	<	<	<
Di-n-butyl phthtalate	1	<	<	<	<
Di-n-octylphthalate	10	<	<	<	<
2,4-Dinitrotoluene	10	<	<	<	<
2,6-Dinitrotoluene	10	<	<	<	<
Diphenylamine	10	<	<	<	<
Diphenylether	10	<	<	<	<
Fluoranthene	10	<	<	<	<
Fluorene	10	<	<	<	<
Indeno(1,2,3-cd)pyrene	10	<	<	<	<
Indole	10	<	<	<	<
1-Methyl naphthalene	10	<	<	<	<
2-Methyl naphthalene	10	<	<	<	<
Naphthalene	10	<	<	<	<
5-Nitroacenaphthene	10	<	<	<	<
N-Nitrosodi-n-propylamine	10	<	<	<	<
N-Nitrosodiphenylamine	10	<	<	<	<
Perylene	10	<	<	<	<
Phenanthrene	10	<	<	<	<
Pyrene	10	<	<	<	<

< - Less than MDL
MDL - Minimum detection Limit

Base/Neutral Extractables	MDL (µg/L)	881665 LEL2-1	881668 LEL2-2	881670 LEL2-2	881710 LEL2-3
Acid Extractables					
4-Chloro-3-methylphenol	10	<	<	<	<
2-Chlorophenol	10	<	<	<	<
2,4-Dichlorophenol	10	<	<	<	<
2,6-Dichlorophenol	10	<	<	<	<
2,4-Dimethylphenol	10	<	<	<	<
2,4-Dinitrophenol	10	<	<	<	<
4,6-Dinitrophenol-o-cresol	10	<	<	<	<
4-Nitrophenol	10	<	<	<	<
Pentachlorophenol	10	<	<	<	<
Phenol	10	<	<	<	<
o-cresol	10	<	<	<	<
m-cresol	10	<	<	<	<
p-cresol	10	<	<	<	<
2,4,5-Trichlorophenol	10	<	<	<	<
2,4,6-Trichlorophenol	10	<	<	<	<
2,3,4-Trichlorophenol	10	<	<	<	<
2,3,5-Trichlorophenol	10	<	<	<	<
2,3,4,5-Tetrachlorophenol	10	<	<	<	<
2,3,4,6-Tetrachlorophenol	10	<	<	<	<
2,3,5,6-Tetrachlorophenol	10	<	<	<	<
% SURROGATE RECOVERY					
d3 -Dichlorophenol		34	19	26	66
d10-Anthracene		72	48	67	116
d12- Benzo(a)pyrene		50	28	51	96
d5-Phenol		80	31	80	45

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881713 LEL2-4	881667 Stanchem 1	881672 Stanchem 2	881712 Stanchem 3
Acid Extractables					
4-Chloro-3-methylphenol	10	<	<	<	<
2-Chlorophenol	10	<	<	<	<
2,4-Dichlorophenol	10	<	<	<	<
2,6-Dichlorophenol	10	<	<	<	<
2,4-Dimethylphenol	10	<	<	<	<
2,4-Dinitrophenol	10	<	<	<	<
4,6-Dinitrophenol-o-cresol	10	<	<	<	<
4-Nitrophenol	10	<	<	<	<
Pentachlorophenol	10	<	<	<	<
Phenol	10	<	<	<	<
o-cresol	10	<	<	<	<
m-cresol	10	<	<	<	<
p-cresol	10	<	<	<	<
2,4,5-Trichlorophenol	10	<	<	<	<
2,4,6-Trichlorophenol	10	<	<	<	<
2,3,4-Trichlorophenol	10	<	<	<	<
2,3,5-Trichlorophenol	10	<	<	<	<
2,3,4,5-Tetrachlorophenol	10	<	<	<	<
2,3,4,6-Tetrachlorophenol	10	<	<	<	<
2,3,5,6-Tetrachlorophenol	10	<	<	<	<
% SURROGATE RECOVERY					
d3 -Dichlorophenol		44	25	0	1
d10-Anthracene		111	85	10	21
d12- Benzo(a)pyrene		110	55	2	10
d5-Phenol		33	83	25	6

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS FOR VOLATILE ORGANICS (µg/L)

		881666	881669	881711	881714	881665	881668
PARAMETER (Groups 16,17,18)	MDL	MH#15-1	MH#15-2	MH#15-3	MH#15-4	LEL2-1	LEL2-2
Acrolein	50	<	<	<	<	<	<
Acrylonitrile	50	<	<	<	<	<	<
Benzene	10	<	<	<	<	<	<
Bromodichloromethane	10	<	<	<	<	<	28
Bromoform	10	<	<	<	<	<	<
Bromomethane	20	<	<	<	<	<	<
1,3-Butadiene	50	<	<	<	<	<	<
Carbon Tetrachloride	10	<	<	<	<	<	<
Chlorobenzene	10	<	<	<	<	<	<
Chloroform	10	<	16	<	<	<	71
Chloromethane	20	<	<	<	<	<	<
Dibromochloromethane	10	<	<	<	<	<	11
Ethylene Dibromide	10	<	<	<	<	<	<
1,2-Dibromoethane	10	<	<	<	<	<	<
1,2-Dichlorobenzene	10	<	<	<	<	<	<
1,3-Dichlorobenzene	10	<	<	<	<	<	<
1,4-Dichlorobenzene	10	<	<	<	<	<	<
1,1-Dichloroethane	10	<	<	<	<	<	<
1,2-Dichloroethane	10	<	<	<	<	<	<
1,1-Dichloroethene	10	<	<	<	<	<	<
cis-1,2-Dichloroethene	10	<	<	<	<	<	<
trans-1,2-Dichloroethene	10	<	<	<	<	<	<
cis-1,3-Dichloropropene	10	<	<	<	<	<	<
1,2-Dichloropropane	10	<	<	<	<	<	<
trans-1,3-Dichloropropene	10	<	<	<	<	<	<
Ethylbenzene	10	<	<	<	<	<	<
Methyl ethyl ketone	10	<	<	<	<	<	<
Methylene chloride	10	<	<	<	<	<	<
Styrene	10	<	<	<	<	<	<
1,1,2,2-Tetrachloroethane	10	<	<	<	<	<	<
Tetrachloroethene	10	<	<	<	<	<	18
Toluene	10	<	<	<	<	<	<
1,1,2-Trichloroethane	10	<	<	<	<	<	<
Trichloroethene	10	<	<	<	<	<	<
Trichlorofluoromethane	10	<	<	<	<	<	<
Vinyl chloride	20	<	<	<	<	<	<
0-Xylene	10	<	<	<	<	<	<
m &p-Xylene	10	<	<	<	<	<	<
SURROGATE RECOVERIES - %							
Bromochloromethane		102	122	108	121	77	92
Difluorobenzene		90	110	93	96	81	100
d5-Chlorobenzene		95	110	109	109	84	97
d4-1,2-Dichloroethane		100	97	109	108	65	99
d8-Toluene		90	93	103	111	65	100
Bromofluorobenzene		100	94	102	112	71	102

< - Less than MDL

ANALYSIS OF NEUTRAL CHLORINATED ORGANICS (μg/L)

PARAMETER	MDL	Zenon #: 881665 Sample ID: LEL2-1	881668 LEL2-2	881670 LEL2-2 Duplicate	881710 LEL2-3	881713 LEL2-4
Hexachloroethane	0.01	0.025	0.030	0.067	<	<
1,3,5-Trichlorobenzene	0.05	<	<	<	<	<
1,2,4-Trichlorobenzene	0.05	<	<	<	<	<
1,2,3-Trichlorobenzene	0.05	<	<	<	<	<
Hexachlorobutadiene	0.01	<	< 0.02	< 0.03	<	<
2,4,5-Trichlorotoluene	0.01	<	< 0.03	< 0.05	<	<
1,2,3,5 + 1,2,4,5-TetraCB	0.01	<	< 0.02	< 0.02	<	<
Hexachlorocyclopentadiene	0.01	<	<	<	<	<
1,2,3,4-Terachlorobenzene	0.01	<	<	<	<	<
Pentachlorobenzene	0.01	<	0.015	0.026	<	<
Hexachlorobenzene	0.01	0.043	0.034	0.054	<	<
Octachlorostyrene	0.01	<	<	<	<	<
PCB	0.1	< 0.5	< 1	< 1	<	<
Surrogate Recoveries (%)						
Hexabromobenzene		83	65	76	72	89

< - Not detected at MDL
MDL - Minimum detection Limits
CB - Chlorobenzene

ANALYSIS FOR VOLATILE ORGANICS (µg/L)

PARAMETER (Groups 16,17,18)	MDL	881670 LEL2-2 Duplicate	881710 LEL2-3	881713 LEL2-4	881667 Stanchem-1	881672 Stanchem-2
Acrolein	50	<	<	<	<	<
Acrylonitrile	50	<	<	<	<	<
Benzene	10	<	<	<	<	<
Bromodichloromethane	10	<	<	<	13	120
Bromoform	10	<	<	<	<	<
Bromomethane	20	<	<	<	<	<
1,3-Butadiene	50	<	<	<	<	<
Carbon Tetrachloride	10	<	<	<	<	<
Chlorobenzene	10	<	<	<	<	<
Chloroform	10	10	15	13	54	170
Chloromethane	20	<	<	<	<	<
Dibromochloromethane	10	<	<	<	<	34
Ethylene Dibromide	10	<	<	<	<	<
1,2-Dibromoethane	10	<	<	<	<	<
1,2-Dichlorobenzene	10	<	<	<	<	<
1,3-Dichlorobenzene	10	<	<	<	<	<
1,4-Dichlorobenzene	10	<	<	<	<	<
1,1-Dichloroethane	10	<	<	<	<	<
1,2-Dichloroethane	10	<	<	<	<	<
1,1-Dichloroethene	10	<	<	<	<	<
cis-1,2-Dichloroethene	10	<	<	<	<	<
trans-1,2-Dichloroethene	10	<	<	<	<	<
cis-1,3-Dichloropropene	10	<	<	<	<	<
1,2-Dichloropropane	10	<	<	<	<	<
trans-1,3-Dichloropropene	10	<	<	<	<	<
Ethylbenzene	10	<	<	<	<	<
Methyl ethyl ketone	10	<	<	<	<	<
Methylene chloride	10	<	<	<	<	<
Styrene	10	<	<	<	<	<
1,1,2,2-Tetrachloroethane	10	<	<	<	<	<
Tetrachloroethene	10	<	<	<	63	55
Toluene	10	<	<	<	<	<
1,1,2-Trichloroethane	10	<	<	<	<	<
Trichloroethene	10	<	<	<	<	<
Trichlorofluoromethane	10	<	<	<	<	<
Vinyl chloride	20	<	<	<	<	<
0-Xylene	10	<	<	<	<	<
m &p-Xylene	10	<	<	<	<	<

SURROGATE RECOVERIES - %

	881670	881710	881713	881667	881672
Bromochloromethane	99	110	103	92	88
Difluorobenzene	99	107	100	98	104
d5-Chlorobenzene	96	112	104	110	98
d4-1,2-Dichloroethane	82	107	96	92	158
d8-Toluene	100	105	100	100	123
Bromofluorobenzene	81	111	95	98	155

< - Less than MDL

ORGANIC POLLUTANTS (ug/l): CIL LEL 2 EFFLUENT (FINAL EFFLUENT)

Fraction/Compound	Oct 15/80	Oct 16/80	Oct 17/80
1. Purgeable Fraction (PP) Analysed packed column GC only, not confirmed MS			
Methylene Chloride	--	--	P
Chloroform	--	T	410
1,2-Dichloroethane	--	12	T
1,1,1-Trichloroethane	--	T	T
Carbon tetrachloride	--	24	T
Bromodichloromethane	--	T	T
1,2-Dichloropropane	T	T	T
trans-1,3-Dichloropropene	45	T	T
Trichloroethylene or cis-1,3-Dichloropropene	--	12	--
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	--	T	T
Toluene	T	T	T
2. Acid Fraction (PP) (Oct. 16 sample extract analysed GC/MS, capillary column)			
p-chloro-m-cresol		3.0	
3. Base/Neutral Fraction (PP) (Oct. 16 sample extract analysed GC/MS, capillary column)			
None detected			
4. Pesticide/PCB Fraction (PP) (capillary column GC/MS)			
None detected in composite extract (Oct. 15-17)			
5. Other Compounds (NPP) Analysed packed column GC, not confirmed MS			
Acetone	P	55	10
THF (Tetrahydrofuran)	--	T	T

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base/neutral, 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants
Pesticides detection limit = 0.05 - 0.5 ug/l

Source: EPS, 1985

**ORGANIC POLLUTANTS (ug/l): CIL LEL 2 EFFLUENT
(FINAL EFFLUENT)**

Fraction/Compound	Oct 15/80	Oct 16/80	Oct 17/80
1. Purgeable Fraction (PP) Analysed packed column GC only, not confirmed MS			
Methylene Chloride	—	—	P
Chloroform	—	T	410
1,2-Dichloroethane	—	12	T
1,1,1-Trichloroethane	—	T	T
Carbon tetrachloride	—	24	T
Bromodichloromethane	—	T	T
1,2-Dichloropropane	T	T	T
trans-1,3-Dichloropropene	45	T	T
Trichloroethylene or cis-1,3-Dichloropropene	—	12	—
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	—	T	T
Toluene	T	T	T
2. Acid Fraction (PP) (Oct. 16 sample extract analysed GC/MS, capillary column)			
p-chloro-m-cresol		3.0	
3. Base/Neutral Fraction (PP) (Oct. 16 sample extract analysed GC/MS, capillary column)			
None detected			
4. Pesticide/PCB Fraction (PP) (capillary column GC/MS)			
None detected in composite extract (Oct. 15-17)			
5. Other Compounds (NPP) Analysed packed column GC, not confirmed MS			
Acetone	P	55	10
THF (Tetrahydrofuran)	—	T	T

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base/neutral, 5 ug/l [purgeable]); PP - Priority Pollutants;
NPP - Non-Priority Pollutants
Pesticides detection limit = 0.05 - 0.5 ug/l

APPENDIX X. INFLUENT/EFFLUENT MONITORING DATA: CORNWALL CHEMICALS

ORGANIC POLLUTANTS (ug/l): CORNWALL CHEMICALS EFFLUENT (FINAL EFFLUENT)

Fraction Compound	Oct 15/80	Oct 16/80	Oct 17/80
1. <u>Purgeable Fraction (PP)</u> Analysed packed column GC, not confirmed MS			
Methylene Chloride	--	P	P
1,1-Dichloroethane	T	--	--
Chloroform	1,200	283	265
1,2-Dichloroethane	T	T	T
1,1,1-Trichloroethane	T	T	T
Carbon tetrachloride	45,500	T	36,500
Bromodichloromethane	25	T	T
1,2-Dichloropropane	T	T	T
trans-1,3-Dichloropropene	--	T	--
Trichloroethylene or cis-1,3-Dichloropropene	T	T	T
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	--	T	T
Toluene	T	T	T
Chlorobenzene	--	T	--
Ethylbenzene	T	--	T
2. <u>Acid Fraction (PP)</u> (Oct. 16 sample extract analysed GC/MS, capillary column)			
2,4,6-Trichlorophenol		9.0	
4-chloro-m-cresol		1.0	
3. <u>Base/Neutral Fraction (PP)</u> (Oct. 16 sample extract, analysed GC/MS capillary column)			
None detected			
4. <u>Pesticide/PCB Fraction (PP)</u> (capillary column GC/MS)			
None detected in composite effluent (Oct. 15-17)			
5. <u>Other Compounds (NPP)</u>			
Acetone*	P	P	P
THF(Tetrahydrofuran)*	T	T	T
Phthalic acid		P	

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid base/neutral, 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants
Pesticides detection limit = 0.05 - 0.5 ug/l

* Analysed packed column GC, not confirmed MS

Source: EPS, 1985

ORGANIC POLLUTANTS (ug/l): CORNWALL CHEMICALS EFFLUENT (FINAL EFFLUENT)

Fraction Compound	Oct 15/80	Oct 16/80	Oct 17/80
1. Purgeable Fraction (PP) Analysed packed column GC, not confirmed MS			
Methylene Chloride	--	P	P
1,1-Dichloroethane	T	—	—
Chloroform	1,200	283	265
1,2-Dichloroethane	T	T	T
1,1,1-Trichloroethane	T	T	T
Carbon tetrachloride	45,500	T	36,500
Bromodichloromethane	25	T	T
1,2-Dichloropropane	T	T	T
trans-1,3-Dichloropropene	--	T	--
Trichloroethylene or cis-1,3-Dichloropropene	T	T	T
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	--	T	T
Toluene	T	T	T
Chlorobenzene	--	T	--
Ethylbenzene	T	--	T

2. Acid Fraction (PP) (Oct. 16 sample extract analysed GC/MS, capillary column)

2,4,6-Trichlorophenol	9.0
4-chloro-m-cresol	1.0

3. Base/Neutral Fraction (PP) (Oct. 16 sample extract, analysed GC/MS capillary column)

None detected

4. Pesticide/PCB Fraction (PP) (capillary column GC/MS)

None detected in composite effluent (Oct. 15-17)

5. Other Compounds (NPP)

Acetone*	P	P	P
THF(Tetrahydrofuran)*	T	T	T
Phthalic acid		P	

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid base/neutral, 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants
Pesticides detection limit = 0.05 - 0.5 ug/l

* Analysed packed column GC, not confirmed MS

PROJECT NUMBER: D-0409

	UNITS	MISA DETECTION LIMIT	MH-26 MONDAY	MH-26 TUESDAY	MH-26 WEDNESDAY	MH-26 THURSDAY	MH-27 TUESDAY	MH-27 THURSDAY	174-3-4 WELL-CITY WEDNESDAY
Chemical Oxygen Demand <COD>	mg/L	10.0000	74.00	80.00	61.00	59.00	133.00	138.00	8.80
Cyanide	mg/LK	0.0010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hydrogen ion (PH)	N.A.	N.A.	7.06	7.10	7.50	7.25	7.25	7.36	7.32
Specific conductance	uS/cm	2uS/cm	2300	2400	2100	2000	3000	2600	2900
Nitrogen - Ammonia plus Ammonium	mg/L	0.0100	0.12	<0.01	<0.1	<0.1	<0.1	0.15	0.16
Nitrogen - Nitrate plus Nitrite	mg/L	0.1500	0.19	0.13	0.02	0.30	0.02	0.18	0.56
Nitrogen - Nitrite	mg/L	0.0300	0.02	0.02	0.02	0.09	0.02	0.02	0.02
Nitrogen - Nitrate	mg/L	0.1500	0.17	0.11	<0.01	0.21	<0.01	0.16	0.54
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	0.84	0.18	0.70	0.80	0.68	0.95	0.59
Organic carbon - Dissolved <DOC>	mg/L	0.5000	5.00	4.70	5.30	5.80	3.60	4.50	1.50
Total organic carbon	mg/L								
Total Phosphorus	mg/L	0.0600	0.08	0.11	0.49	0.29	0.21	0.08	<0.01
Total suspended solids <TSS>	mg/L	2.0000	9.70	8.60	9.90	11.60	16.70	9.40	3.40
Phenolics <4AAP	mg/L	0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium <Hexavalent>	mg/L	0.0100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total metal - Silver	mg/L	0.0300	0.0060	0.006	0.003	0.004	0.004	0.009	0.002
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	0.0020	0.0028	0.0035	0.0011	0.0018	0.0033	0.0080
Total metal - Berryilium	mg/L	1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Total metal - Cadmium	mg/L	0.0020	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total metal - Cobalt	mg/L	0.0100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total metal - Chromium	mg/L	0.0200	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Total metal - Copper	mg/L	0.0100	0.36	0.04	0.06	0.04	0.12	0.10	0.08
Total metal - Iron	mg/L	0.0200	0.67	1.19	0.57	0.78	1.38	1.13	0.05
Total metal - Mercury	mg/L	0.0001	0.00372	0.00207	0.00200	0.00191	0.00154	0.00121	0.0009
Total metal - Nickel	mg/L	0.0200	0.007	0.024	<0.003	0.016	0.021	0.019	0.004
Total metal - Lead	mg/L	0.0300	<0.03	<0.03	<0.003	<0.03	<0.03	<0.03	<0.03
Total metal - Antimony	mg/L	0.0050	0.0009	0.0051	0.0035	0.0038	0.0077	0.0055	0.0016
Total metal - Selenium	mg/l	0.0050	0.0033	0.0018	0.0029	0.0025	0.0033	0.0018	0.0011
Total metal - Thallium	mg/L	1	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70	<0.70
Total metal - Vanadium	mg/L	0.0300	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09
Total metal - Zinc	mg/L	0.0100	<0.02	1.05	0.14	0.17	2.93	0.22	0.06
Volatiles halogenated									
1.1.1-Trichloroethane	ug/L	10	5.8	< 20	< 20	< 20	< 2	< 20	5.4
1.1.2.2-Tetrachloroethane	ug/L	10	< 100	< 1000	< 1000	< 1000	< 100	< 1000	< 100
1.1.2-Trichloroethane	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
1.1-Dichloroethane	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
1.1-Dichloroethylene	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
1.2-Dibromoethane (Ethylene dibromide)	ug/L	10	<50	<50	<50	<50	<50	<50	<50
1.2-Dichlorobenzene	ug/L	10	3.8	< 20	< 20	< 20	< 2	< 20	< 2
1.2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
1.2-Dichloropropane	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
1.3-Dichlorobenzene	ug/L	10	5	< 20	34.1	< 20	< 2	3.9	< 2
1.4-Dichlorobenzene	ug/L	10							
Bromoform	ug/L	10	< 100	< 1000	< 1000	< 1000	< 100	< 1000	< 100
Carbon tetrachloride	ug/L	10	6977	75036	8990	5440	5592	22847	< 10

Benoit Lagarde, chemist

Michel Courtois, chemist

eco

PROJECT NUMBER: D-0409	UNITS	MISA DETECTION LIMIT	MH-26 MONDAY	MH-26 TUESDAY	MH-26 WEDNESDAY	MH-26 THURSDAY	MH-27 TUESDAY	MH-27 THURSDAY	1/4-5/4 WELL-CITY WEDNESDAY
Chlorobenzene	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Chloroform	ug/L	10	311	1152	380	419	276	1167	5.7
Cis-1,2-Dichloroethylene	ug/L	ND	<50	<50	<50	<50	<50	<50	<50
Cis-1,3-Dichloropropylene	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Dibromochloromethane	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Dibromomethane (Methylene Bromide)	ug/L	ND	<50	<50	<50	<50	<50	<50	<50
Dichlorobromomethane	ug/L	10	< 10	< 100	< 100	< 100	< 10	< 100	< 10
Ethyl chloride	ug/L	ND	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Methyl bromide (Bromomethane)	ug/L	ND	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Methyl chloride	ug/L	ND	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Methylene chloride	ug/L	10	139	255	620	624	77.7	343	29.9
Tetrachloroethylene (Perchloroethylene)	ug/L	10	10.2	< 20	57.2	< 20	15.1	< 20	5.3
Trans-1,2-Dichloroethylene	ug/L	10	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Trans-1,3-Dichloropropylene	ug/L	ND	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Trichloroethylene	ug/L	10	19.8	< 20	< 20	< 20	13	< 20	< 2
Vinyl chloride (Chloroethylene)	ug/L	ND	< 2	< 20	< 20	< 20	< 2	< 20	< 2
Volatiles, non-chlorinated									
Benzene	ug/L	10	< 1	< 5	< 5	< 5	< 1	< 5	< 1
Butadiene	ug/L	10	ND	ND	ND	ND	ND	ND	ND
Cumene	ug/L	ND	< 0.5	< 5	< 5	< 5	0.5	< 5	< 0.5
Diethyl benzene	ug/L	10	ND	ND	ND	ND	ND	ND	ND
Ethyl toluene	ug/L	10	< 0.5	< 5	< 5	< 5	0.5	< 5	< 0.5
Ethylbenzene	ug/L	10	2.3	< 5	5.1	< 5	2.4	5.5	1.7
Propylbenzene	ug/L	10	< 0.5	< 5	< 5	< 5	< 0.5	< 5	< 0.5
Styrene	ug/L	ND	1.2	< 5	< 5	< 5	< 0.5	< 5	< 0.5
Toluene	ug/L	10	4.6	394	4328	1164	6	304	5.5
Trimethylbenzene(s)	ug/L	10	< 0.5	< 5	< 5	< 5	< 0.5	< 5	< 0.5
Xylenes	ug/L	10	9.6	11.4	27.4	10.2	10.6	20.1	7.4
Volatiles, Water Soluble									
Acrolein	ug/L	ND	< 10	< 100	< 100	< 100	< 10	< 100	< 10
Acrylonitrile	ug/L	ND	< 30	< 300	< 300	< 300	< 30	< 300	< 30
Carbone Disulfide	ug/L	ND	23	147	< 10	< 10	< 10	< 10	
Extractables, Base Neutral									
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	ND	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Benoit Lagarde, chemist

Michel comtois, chemist

eco

PROJECT NUMBER: D-0409

	UNITS	MISA DETECTION LIMIT	MH-26 MONDAY	MH-26 TUESDAY	MH-26 WEDNESDAY	MH-26 THURSDAY	MH-27 TUESDAY	MH-27 THURSDAY	1/4-3 - WELL-[illegible] WEDNES[illegible]
Anthracene	mg/L	0.01	< 0.002	< 0.001	< 0.002	< 0.001	0.007	0.006	< 0.[illegible]
Benz(a)anthracene	mg/L	0.01	-	-	-	-	-	-	-
Benzo(a)pyrene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003	0.004	0.004	< 0.[illegible]
Benzo(b)fluoranthene	mg/L	0.01	0.003	0.003	0.003	0.002	0.003	< 0.001	< 0.[illegible]
Benzo(ghi)perylene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.003	< 0.002	< 0.[illegible]
Benzo(k)fluoranthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.004	0.[illegible]
Benzyl butyl phthalate	mg/L	0.01	0.04	0.07	0.09	0.08	0.06	0.09	0.[illegible]
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.[illegible]
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.[illegible]
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.[illegible]
Bis-2-ethylhexyl phthalate	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.[illegible]
Chrysene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002	< 0.[illegible]
Di-isobutyl phthalate	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	mg/L	0.01	< 0.004	< 0.003	< 0.004	< 0.004	< 0.004	< 0.004	< 0.[illegible]
Di-n-octyl phthalate	mg/L	0.01	0.35	0.31	0.09	0.19	0.06	0.15	0.[illegible]
Dibenz(a,h)anthracene	mg/L	0.01	0.003	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.[illegible]
Diethyl phthalate	mg/L	0.01	< 0.002	< 0.003	< 0.003	< 0.003	< 0.004	< 0.003	< 0.[illegible]
Dimethyl phthalate	mg/L	0.01	< 0.007	< 0.006	< 0.007	< 0.007	< 0.007	< 0.007	< 0.[illegible]
Fluoranthene	mg/L	0.01	0.04	0.03	0.02	0.02	< 0.02	0.32	< 0.[illegible]
Fluorene	mg/L	0.01	0.002	0.002	< 0.001	< 0.001	0.003	0.002	< 0.[illegible]
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.[illegible]
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.[illegible]
Naphthalene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.[illegible]
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.[illegible]
Phenanthrene	mg/L	0.01	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.[illegible]
Pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.[illegible]
Extractables, Acid (Phenolics)									
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND
2,3-Dichlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,4-Dimethyl phenol	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.00[illegible]
2,4-Dinitrophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2-Nitrophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
4,6-Dinitro-o-cresol	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
4-Chloro-m-cresol	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
4-Nitrophenol	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.00[illegible]
Pentachlorophenol	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.002	< 0.003	< 0.003	< 0.003
Phenol	mg/L	0.01	< 0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.003
Extractables, Phenoxy Acid Herbicides									
2,4,5-T	ug/L	1	< 0.1	< 0.1	< 0.1	< 0.2	< 1	< 1	< 0.5
2,4-D	ug/L	0.5	< 0.15	< 0.15	< 0.15	< 0.5	< 1.5	< 1.5	< 0.[illegible]

Extractables.

Benoit Lacarde, chemist

Michel Comtois, chemist

PROJECT NUMBER: D-0409

	UNITS	MISA DETECTION LIMIT	MH-26 MONDAY	MH-26 TUESDAY	MH-26 WEDNESDAY	MH-26 THURSDAY	MH-27 TUESDAY	MH-27 THURSDAY	[illegible] WELL-CITY WEDNESDAY
Organochlorine Pesticides									
Aldrin	ug/L	0.01	< 0.005	0.005	< 0.005	0.005	< 0.005	< 0.005	[illegible]
Benzene hexachloride, alpha	ug/L	0.01	< 0.03	< 0.03	< 0.03	< 0.01	< 0.01	< 0.01	[illegible]
Benzene hexachloride, beta	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	[illegible]
Benzene hexachloride, gamma	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	[illegible]
Chlordane, alpha	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	[illegible]
Chlordane, gamma	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	[illegible]
Heptachlor	ug/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Heptachlor epoxide	ug/L	0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Methoxychlor	ug/L	0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	[illegible]
o,p'-DDT	ug/L	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	[illegible]
p,p'-DDD	ug/L	0.01	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	[illegible]
p,p'-DDE	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	[illegible]
p,p'-DDT	ug/L	0.01	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	[illegible]
Extractables, Neutral-Chlorinated									
1,2,3,4-Tetrachlorobenzene	ug/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	ug/L	0.01	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	ug/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	ug/L	0.01	-	-	-	-	-	-	-
2,4,5-Trichlorotoluene	ug/L	0.01	-	-	-	-	-	-	-
2,6,a-Trichlorotoluene	ug/L	0.01	-	-	-	-	-	-	-
Heptachlorostyrene	ug/L	0.01	-	-	-	-	-	-	-
Hexachlorobenzene	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.003	< 0.003	< 0.003	[illegible]
Hexachlorobutadiene	ug/L	0.01	< 0.009	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	[illegible]
Hexachloroethane	ug/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	[illegible]
Octachlorostyrene	ug/L	0.01	-	-	-	-	-	-	-
Pentachlorobenzene	ug/L	0.01	-	-	-	-	-	-	-
Chlorinated Dibenzo-p-dioxins and Dibenzofurans			(X10 E-3)			(X10 E-3)			(X10 E-3)
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/L	0.0003	< 0.4			< 0.4			[illegible]
Octachlorodibenzo-p-dioxin	ug/L	0.0003	0.5			24.1			0.4
Octachlorodibenzofuran	ug/L	0.0003	< 0.1			0.5			< 0.1
Total heptachlorinated dibenzo-p-dioxins	ug/L	0.0003	< 0.2			< 0.4			< 0.4
Total heptachlorinated dibenzofurans	ug/L	0.0003	< 0.2			< 0.2			< 0.3
Total hexachlorinated dibenzo-p-dioxins	ug/L	0.0003	< 0.2			< 0.4			< 0.3
Total hexachlorinated dibenzofurans	ug/L	0.0003	< 0.2			< 0.3			< 0.3
Total pentachlorinated dibenzo-p-dioxins	ug/L	0.0003	< 0.9			< 1.8			< 2.1
Total pentachlorinated dibenzofurans	ug/L	0.0003	< 0.2			< 0.2			< 2.3
Total tetrachlorinated dibenzo-p-dioxins	ug/L	0.0003	< 0.4			< 0.4			[illegible]
Total tetrachlorinated dibenzofurans	ug/L	0.0003	< 0.2			< 0.2			< 0.2
Oil and grease (Solvent Extractables)									
Oil and grease (Solvent Extractables)	ug/L	1000	1000	<500	1000	<500	1000	1500	<500
Oil and grease minerals	ug/L	1000	1000	<500	<500	<500	1000	1500	<500

Benoit Lagarde, chemist

Michel Comtois, chemist

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PROJECT NUMBER: D-0409

	UNITS	MISA DETECTION LIMIT	MH-26 MONDAY	MH-26 TUESDAY	MH-26 WEDNESDAY	MH-26 THURSDAY	MH-27 TUESDAY	MH-27 THURSDAY	1/4-3-4 WELL-CITY WEDNESDAY
(Solvent Extractables)									
PCB'S									
PCB'S (ID aroclors present & total conc.)	ug/L	0.10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25

Benoit Lagarde, Chemist

Michel Comtois, Chemist

APPENDIX XI. INFLUENT/EFFLUENT MONITORING DATA: STANCHEM

MISA - INORGANICS

MOE #	Parameter (mg/l)	881667 STAN-1	881672 STAN-2	881712 STAN-3	881715 STAN-4
---	Total Chlorine (ave.)	na	na	na	na
1	COD	190	24	120	150
2	Cyanide	< 0.001	< 0.001	< 0.001	< 0.001
3	pH (20 °C)	7.31 / 7.37	7.87	7.27	11.91
4	Nitrogen-ammonia	0.11	0.013	0.013	0.10
	Nitrogen-nitrate	1.5	44	4.5	4.6
	Nitrogen-nitrite	< 0.03	< 0.03	< 0.03	< 0.03
	Nitrogen-TKN	0.55	< 0.3	< 0.3	0.45
-----	Fluoride	< 1	< 1	< 1	< 1
	Chloride	530	1900	580	700
	Bromide	< 1	< 1	< 1	< 1
	Iodide	< 1	< 1	< 1	< 1
	Sulphate	500	2500	100	1330
6	Total Phosphorus	0.88	0.34	0.14	0.51
7	Spec.Cond.(µS/cm)	1600	6400	2200	4900
8	Total Susp. Solids	210	150	69	320
9	Aluminum	0.48 / 0.49	0.41	0.42	0.48
	Beryllium	< 0.01 / 2	< 0.01	< 0.01	< 0.01
	Cadmium	0.025 / 0.023	0.020	0.029	0.017
	Chromium	0.17 / 0.18	0.12	0.11	0.075
	Cobalt	< 0.02 / 2	< 0.02	< 0.02	< 0.02
	Copper	2.0 / 2.1	0.51	0.33	0.25
	Lead	2.2 / 2.2	1.2	0.70	0.60
	Molybdenum	< 0.02 / 2	< 0.02	< 0.02	< 0.02
	Nickel	0.13 / 0.14	0.087	0.080	0.065
	Silver	< 0.03 / 2	< 0.03	< 0.03	< 0.03
	Thallium	< 0.03 / 2	< 0.03	0.13	0.086
	Vanadium	< 0.03	< 0.03	< 0.03	< 0.03
	Zinc	0.45 / 0.46	0.18	0.29	0.30
10	Arsenic	0.007	< 0.005 / 0.008	< 0.005	0.006 / 0.005
	Antimony	< 0.005	0.010 / 0.010	< 0.005	0.019 / 0.021
	Selenium	< 0.005	< 0.005	< 0.005	< 0.005 / 2
11	Chromium (VI)	< 0.01	0.050	0.11 / 0.11	0.12 * * interference
12	Mercury	0.0006	0.0054	0.0030	0.0036
13	Total Alkyl Lead	0.46	0.27	0.22	0.47
14	Phenolics	< 0.002	0.005	< 0.002	< 0.002
15	Sulphide	< 0.02	< 0.02	< 0.02	< 0.02
25	Oil & Grease **	31	<1	14	<1

MISA - INORGANICS CORNWALL

MOE #	Parameter (mg/l)	881667 STAN-1	881672 STAN-2	881712 STAN-3	881715 STAN-4
	Barium	<	<	<	<
	Bismuth	<	<	<	<
	Boron	<	<	<	<
	Calcium	52	58	59	120
	Cerium	<	<	<	<
	Dysprosium	<	<	<	<
	Erbium	<	<	<	<
	Europium	<	<	<	<
	Gadolinium	<	<	<	<
	Gallium	<	<	<	<
	Germanium	<	<	<	<
	Gold	<	<	<	<
	Hafnium	<	<	<	<
	Holmium	<	<	<	<
	Indium	<	<	<	<
	Iridium	<	<	<	<
	Iron	87	66	32	32
	Lanthanum	<	<	<	<
	Lithium	<	<	<	<
	Lutetium	<	<	<	<
	Magnesium	8.0	8.1	8.6	17
	Manganese	<	<	<	<
	Neodymium	<	<	<	<
	Niobium	<	<	<	<
	Osmium	<	<	<	<
	Palladium	<	<	<	<
	Platinum	<	<	<	<
	Potassium	3.2	5.2	4.2	7.0
	Praseodymium	<	<	<	<
	Rhenium	<	<	<	<
	Rhodium	<	<	<	<
	Ruthenium	<	<	<	<
	Samarium	<	<	<	<
	Scandium	<	<	<	<
	Silicon	1.1	1.0	<	1.4
	Sodium	360	1800	540	1100
	Strontium	<	<	<	<
	Sulphur	130	610	240	350
	Tantalum	<	<	<	<
	Tellurium	<	<	<	<
	Terbium	<	<	<	<
	Thorium	<	<	<	<
	Thulium	<	<	<	<
	Tin	<	<	<	<
	Titanium	<	<	<	<
	Tungsten	<	<	<	<
	Uranium	<	<	<	<
	Yttrium	<	<	<	<
	Ytterbium	<	<	<	<
	Zirconium	<	<	<	<

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881713 LEL2-4	881667 Stanchem 1	881672 Stanchem 2	881712 Stanchem 3
Acenaphthene	1	<	<	<	<
Acenaphthylene	10	<	<	<	<
Anthracene	10	<	<	<	<
Benzo(a)anthracene	10	<	<	<	<
Benzo(b/k)fluoranthene	10	<	<	<	<
Benzo(a)pyrene	10	<	<	<	<
Benzo(ghi)perylene	10	<	<	<	<
Benzylbutylphthalate	10	<	<	<	<
Bis(2-chloroethyl)ether	10	<	<	<	<
Bis(2-chloroethoxy)methane	10	<	<	<	<
Bis(2-ethylhexyl) phthalate	1	21	5.9	4.1	21
Bis(2-chloroisopropyl)ether	10	<	<	<	<
4-Bromodiphenylether	10	<	<	<	<
Camphene	10	<	<	<	<
1-Chloronaphthalene	10	<	<	<	<
2-Chloronaphthalene	10	<	<	<	<
4-Chlorodiphenylether	10	<	<	<	<
Chrysene	10	<	<	<	<
Dibenzo(a,h)anthracene	10	<	<	<	<
Di-n-butyl phthtalate	1	<	1.7	20	6.2
Di-n-octylphthalate	10	<	<	<	<
2,4-Dinitrotoluene	10	<	<	<	<
2,6-Dinitrotoluene	10	<	<	<	<
Diphenylamine	10	<	<	<	<
Diphenylether	10	<	<	<	<
Fluoranthene	10	<	<	<	<
Fluorene	10	<	<	<	<
Indeno(1,2,3-cd)pyrene	10	<	<	<	<
Indole	10	<	<	<	<
1-Methyl naphthalene	10	<	<	<	<
2-Methyl naphthalene	10	<	<	<	<
Naphthalene	10	<	<	<	<
5-Nitroacenaphthene	10	<	<	<	<
N-Nitrosodi-n-propylamine	10	<	<	<	<
N-Nitrosodiphenylamine	10	<	<	<	<
Perylene	10	<	<	<	<
Phenanthrene	10	<	<	<	<
Pyrene	10	<	<	<	<

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES ($\mu g/L$)

Base/Neutral Extractables	MDL ($\mu g/L$)	881715 Stanchem 4	881718 Trip Blank	Method Blank #1	Method Blank #2
Acenaphthene	1	<	<	<	<
Acenaphthylene	10	<	<	<	<
Anthracene	10	<	<	<	<
Benzo(a)anthracene	10	<	<	<	<
Benzo(b/k)fluoranthene	10	<	<	<	<
Benzo(a)pyrene	10	<	<	<	<
Benzo(ghi)perylene	10	<	<	<	<
Benzylbutylphthalate	10	<	<	<	<
Bis(2-chloroethyl)ether	10	<	<	<	<
Bis(2-chloroethoxy)methane	10	<	<	<	<
Bis(2-ethylhexyl) phthalate	1	7.2	5.3	<	<
Bis(2-chloroisopropyl)ether	10	<	<	<	<
4-Bromodiphenylether	10	<	<	<	<
Camphene	10	<	<	<	<
1-Chloronaphthalene	10	<	<	<	<
2-Chloronaphthalene	10	<	<	<	<
4-Chlorodiphenylether	10	<	<	<	<
Chrysene	10	<	<	<	<
Dibenzo(a,h)anthracene	10	<	<	<	<
Di-n-butyl phthtalate	1	2.6	<	<	<
Di-n-octylphthalate	10	<	<	<	<
2,4-Dinitrotoluene	10	<	<	<	<
2,6-Dinitrotoluene	10	<	<	<	<
Diphenylamine	10	<	<	<	<
Diphenylether	10	<	<	<	<
Fluoranthene	10	<	<	<	<
Fluorene	10	<	<	<	<
Indeno(1,2,3-cd)pyrene	10	<	<	<	<
Indole	10	<	<	<	<
1-Methyl naphthalene	10	<	<	<	<
2-Methyl naphthalene	10	<	<	<	<
Naphthalene	10	<	<	<	<
5-Nitroacenaphthene	10	<	<	<	<
N-Nitrosodi-n-propylamine	10	<	<	<	<
N-Nitrosodiphenylamine	10	<	<	<	<
Perylene	10	<	<	<	<
Phenanthrene	10	<	<	<	<
Pyrene	10	<	<	<	<

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS OF SEMI-VOLATILE EXTRACTABLES (µg/L)

Base/Neutral Extractables	MDL (µg/L)	881715 Stanchem 4	881718 Trip Blank	Method Blank #1	Method Blank #2
Acid Extractables					
4-Chloro-3-methylphenol	10	<	<	<	<
2-Chlorophenol	10	<	<	<	<
2,4-Dichlorophenol	10	<	<	<	<
2,6-Dichlorophenol	10	<	<	<	<
2,4-Dimethylphenol	10	<	<	<	<
2,4-Dinitrophenol	10	<	<	<	<
4,6-Dinitrophenol-o-cresol	10	<	<	<	<
4-Nitrophenol	10	<	<	<	<
Pentachlorophenol	10	<	<	<	<
Phenol	10	<	<	<	<
o-cresol	10	<	<	<	<
m-cresol	10	<	<	<	<
p-cresol	10	<	<	<	<
2,4,5-Trichlorophenol	10	<	<	<	<
2,4,6-Trichlorophenol	10	<	<	<	<
2,3,4-Trichlorophenol	10	<	<	<	<
2,3,5-Trichlorophenol	10	<	<	<	<
2,3,4,5-Tetrachlorophenol	10	<	<	<	<
2,3,4,6-Tetrachlorophenol	10	<	<	<	<
2,3,5,6-Tetrachlorophenol	10	<	<	<	<
% SURROGATE RECOVERY					
d3 -Dichlorophenol		0	52	88	38
d10-Anthracene		0	109	107	93
d12- Benzo(a)pyrene		0	74	94	102
d5-Phenol		0	24	43	124

< - Less than MDL
MDL - Minimum detection Limit

ANALYSIS FOR VOLATILE ORGANICS (µg/L)

PARAMETER (Groups 16,17,18)	MDL	881670 LEL2-2 Duplicate	881710 LEL2-3	881713 LEL2-4	881667 Stanchem-1	881672 Stanchem-2
Acrolein	50	<	<	<	<	<
Acrylonitrile	50	<	<	<	<	<
Benzene	10	<	<	<	<	<
Bromodichloromethane	10	<	<	<	13	120
Bromoform	10	<	<	<	<	<
Bromomethane	20	<	<	<	<	<
1,3-Butadiene	50	<	<	<	<	<
Carbon Tetrachloride	10	<	<	<	<	<
Chlorobenzene	10	<	<	<	<	<
Chloroform	10	10	15	13	54	170
Chloromethane	20	<	<	<	<	<
Dibromochloromethane	10	<	<	<	<	34
Ethylene Dibromide	10	<	<	<	<	<
1,2-Dibromoethane	10	<	<	<	<	<
1,2-Dichlorobenzene	10	<	<	<	<	<
1,3-Dichlorobenzene	10	<	<	<	<	<
1,4-Dichlorobenzene	10	<	<	<	<	<
1,1-Dichloroethane	10	<	<	<	<	<
1,2-Dichloroethane	10	<	<	<	<	<
1,1-Dichloroethene	10	<	<	<	<	<
cis-1,2-Dichloroethene	10	<	<	<	<	<
trans-1,2-Dichloroethene	10	<	<	<	<	<
cis-1,3-Dichloropropene	10	<	<	<	<	<
1,2-Dichloropropane	10	<	<	<	<	<
trans-1,3-Dichloropropene	10	<	<	<	<	<
Ethylbenzene	10	<	<	<	<	<
Methyl ethyl ketone	10	<	<	<	<	<
Methylene chloride	10	<	<	<	<	<
Styrene	10	<	<	<	<	<
1,1,2,2-Tetrachloroethane	10	<	<	<	<	<
Tetrachloroethene	10	<	<	<	63	55
Toluene	10	<	<	<	<	<
1,1,2-Trichloroethane	10	<	<	<	<	<
Trichloroethene	10	<	<	<	<	<
Trichlorofluoromethane	10	<	<	<	<	<
Vinyl chloride	20	<	<	<	<	<
0-Xylene	10	<	<	<	<	<
m &p-Xylene	10	<	<	<	<	<
SURROGATE RECOVERIES - %						
Bromochloromethane		99	110	103	92	88
Difluorobenzene		99	107	100	98	104
d5-Chlorobenzene		96	112	104	110	98
d4-1,2-Dichloroethane		82	107	96	92	158
d8-Toluene		100	105	100	100	123
Bromofluorobenzene		81	111	95	98	155

< - Less than MDL

ANALYSIS FOR VOLATILE ORGANICS (µg/L)

PARAMETER (Groups 16,17,18)	MDL	881712 Stanchem-3	881715 Stanchem-4	881718 Trip Blank	Method Blank #1	Method Blank #2
Acrolein	50	<	<	<	<	<
Acrylonitrile	50	<	<	<	<	<
Benzene	10	<	<	<	<	<
Bromodichloromethane	10	37	45	<	<	<
Bromoform	10	<	<	<	<	<
Bromomethane	20	<	<	<	<	<
1,3-Butadiene	50	<	<	<	<	<
Carbon Tetrachloride	10	<	<	<	<	<
Chlorobenzene	10	<	<	<	<	<
Chloroform	10	130	360	<	<	<
Chloromethane	20	68	99	<	<	<
Dibromochloromethane	10	28	22	<	<	<
Ethylene Dibromide	10	<	<	<	<	<
1,2-Dibromoethane	10	<	<	<	<	<
1,2-Dichlorobenzene	10	<	<	<	<	<
1,3-Dichlorobenzene	10	<	<	<	<	<
1,4-Dichlorobenzene	10	<	<	<	<	<
1,1-Dichloroethane	10	<	<	<	<	<
1,2-Dichloroethane	10	<	<	<	<	<
1,1-Dichloroethene	10	<	<	<	<	<
cis-1,2-Dichloroethene	10	<	<	<	<	<
trans-1,2-Dichloroethene	10	<	<	<	<	<
cis-1,3-Dichloropropene	10	<	<	<	<	<
1,2-Dichloropropane	10	<	<	<	<	<
trans-1,3-Dichloropropene	10	<	<	<	<	<
Ethylbenzene	10	<	<	<	<	<
Methyl ethyl ketone	10	<	<	<	<	<
Methylene chloride	10	<	<	<	<	<
Styrene	10	<	<	<	<	<
1,1,2,2-Tetrachloroethane	10	<	<	<	<	<
Tetrachloroethene	10	64	79	<	<	<
Toluene	10	<	<	<	<	<
1,1,2-Trichloroethane	10	<	<	<	<	<
Trichloroethene	10	<	<	<	<	<
Trichlorofluoromethane	10	<	<	<	<	<
Vinyl chloride	20	<	<	<	<	<
0-Xylene	10	<	<	<	<	<
m &p-Xylene	10	<	<	<	<	<
SURROGATE RECOVERIES - %						
Bromochloromethane		94	68	93	101	109
Difluorobenzene		98	98	86	147	109
d5-Chlorobenzene		100	104	96	72	96
d4-1,2-Dichloroethane		96	101	85	121	119
d8-Toluene		100	112	80	103	109
Bromofluorobenzene		102	106	93	-	100

< - Less than MDL

ANALYSIS OF NEUTRAL CHLORINATED ORGANICS (µg/L)

		Zenon #: 881667	881672	881712	881715
		Sample ID: Stanchem-1	Stanchem-2	Stanchem-3	Stanchem-4
PARAMETER	**MDL**				
Hexachloroethane	0.01	2.4	6.2	4.9	2.0
1,3,5-Trichlorobenzene	0.05	< 0.3	<	< 0.1	<
1,2,4-Trichlorobenzene	0.05	< 0.3	<	<	<
1,2,3-Trichlorobenzene	0.05	< 0.3	<	< 0.2	<
Hexachlorobutadiene	0.01	< 0.05	<	< 0.1	<
2,4,5-Trichlorotoluene	0.01	< 0.05	0.71	< 0.1	<
1,2,3,5 + 1,2,4,5-TetraCB	0.01	< 0.05	<	<	<
Hexachlorocyclopentadiene	0.01	< 0.05	<	< 0.02	< 0.1
1,2,3,4-Terachlorobenzene	0.01	< 0.05	0.34	< 0.15	0.027
Pentachlorobenzene	0.01	< 0.07	< 0.12	< 0.07	< 0.07
Hexachlorobenzene	0.01	1.7	2.8	2.7	1.6
Octachlorostyrene	0.01	< 0.05	<	<	0.019
PCB	0.1	< 2	< 2	< 2	< 1
Surrogate Recoveries (%)					
Hexabromobenzene		61	68	75	73

< - Not detected at MDL
MDL - Minimum detection Limits
CB - Chlorobenzene

ANALYSIS OF PCDD/PCDF (ng/L)

PARAMETER	MDL	881710 LEL2-3	881713 LEL2-4	881667 Stanchem-1	881672 Stanchem-2	881712 Stanchem-3	881715 Stanchem-4
T4CDF	0.30	<	<	<	<	<	<
P5CDF	0.30	<	<	<	<	<	<
H6CDF	0.30	<	<	<	< 0.4	<	<
H7CDF	0.30	<	<	<	<	<	<
O8CDF	0.30	<	<	<	<	<	<
T4CDD	0.30	<	<	<	<	<	<
P5CDD	0.30	< 2.0 *	< 2.3 *	< 2.8 *	< 1.9 *	< 2.1*	< 2.0 *
H6CDD	0.30	<	<	< 0.31	< 0.72	< 0.66	< 0.75
H7CDD	0.30	<	<	< 0.45	< 0.42	<	<
O8CDD	0.30	<	<	<	<	<	< 0.46
Surrogate Recoveries %							
2,3,7,8-TCDD 13C12		67	53	54	37	57	55
1,2,3,6,7,8-HCDD 13C12		62	64	48	23	47	52
OCDD 13C12		64	81	90	49	71	76

< - Not present at MDL
MDL - Minimum Detection Limit
* -High detection limit due to single interference peak - No evidence of PCDD

APPENDIX XII. INFLUENT/EFFLUENT MONITORING DATA: COURTAULDS FIBRES

RESULTS OF ANALYSES
ACCORDING TO THE MISA PROGRAM

NOTE:

Meaning of:

S.D. Analysed on Special Demand

N.D. - If in MISA detection limit column, no detection limit specified by MISA's initial draft.

- If in results not determined, correspond to 50 ppb detection limit.

+ Sampled after sampling dates given in the report.

* Based on dilution of a pure sample.

** Level detected for all sampling sites are very low except for alkaline site sample on both sampling periods. Since the results are consistant on both sampling periods. We therefore recommend an internal evaluation of your processes.

*** Not due to contamination of our apparatus taken into consideration that the result for the pump house inlet, the Saturday acid recovery and Saturday alkaline site samples show less than the detection limit.

eco

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Chemical Oxygen Demand (COD)	mg/L	10.0000	< 3	< 3	3	< 3	411	424
Cyanide	mg/L	0.0010	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		7.9	7.9	7.3	7.35	11.5	11.5
Specific conductance	umhos/cm		300	300	1150	340	3100	2900
Nitrogen - Ammonia plus Ammonium	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0.39	0.33	0.31	0.35	15.40	14.25
Nitrogen - Nitrite	mg/L	0.03	<0.01	<.01	<0.01	<0.01	<.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.39	0.33	0.31	0.35	15.40	14.25
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	0.78	0.82	2.25	0.92	0.63	0.78
Organic carbon - Dissolved (DOC)	mg/L	0.5000	3.9	4.7	3.2	3.2	47	41
Total Phosphorus	mg/L	0.0600	<0.01	<0.01	<0.01	<0.01	<0.01	0.03
Total suspended solids (TSS)	mg/L	2.0000	3.2	3.1	3.9	3.2	45.1	28.8
Phenolics (4AAP)	mg/L	0.0010	0.003	0.004	0.002	0.002	0.003	0.005
Total metal - Silver	mg/L	0.0300	0.006	0.002	0.0013	0.018	0.009	0.0024
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	< 0.0007	0.0009	0.001	0.0008	0.0015	0.0015
Total metal - Berryllium	mg/L	ND	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Total metal - Cadmium	mg/L	0.0020	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.16	0.02	0.14	0.34	0.28	0.32
Total metal - Mercury	mg/L	0.0001	0.00035	0.0004	0.00035	<0.0001	0.00208	0.00203
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.005	< 0.002	0.003	< 0.002	<0.002	0.094
Total metal - Antimony	mg/L	0.0050	<0.0007	0.0009	0.0011	0.0013	0.0031	0.0033
Total metal - Selenium	mg/l	0.0050	0.0039	0.0009	0.0026	0.0030	0.0038	0.0033
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	0.53	< 0.02	0.91	0.07	0.68	0.49
Volatiles halogenated								
1,1,1-Trichloroethane	ug/L	10 ***	< 10	< 10	88030	< 10	20699	< 10
1,1,2,2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10	82.4	< 10

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND	ND	ND
Volatiles, non-chlorinated								
Benzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Volatiles, Water Soluble								
Acrolein	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Carbone disulfide	ug/L	50	< 10	< 10	< 10	< 10	< 10	< 10
Extractables, Base Neutral								
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: [illegible]
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Benzidine	mg/L	0.01	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	0.014	< 0.002	0.003	0.013	< 0.002	0.008
Benzo(ghi)perylene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Benzo(k)fluoranthene	mg/L	0.01	< 0.002	< 0.002	0.005	< 0.002	< 0.002	< 0.002
Benzyl butyl phthalate	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phtalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphtalene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Di-isobutyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Di-n-butyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	mg/L	0.01	0.11	0.05	0.38	0.06	0.032	0.44
Dibenz(a,h)anthracene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Diethyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Dimethyl phthalate	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
1,2-Diphenyl hydrazine	mg/L	0.01	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Extractables, Acid (Phenolics)								
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND
2-chlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2,3-Dichlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2,4-Dichlorophenol	mg/L	0.01	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
2,4,6-Trichlorophenol	mg/L	0.01	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
2,4-Dimethyl phenol	mg/L	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2,4-Dinitrophenol	mg/L	0.01	<0.009	<0.009	<0.009	0.01	<0.009	<0.009
2-Nitrophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
4,6-Dinitro-o-cresol	mg/L	0.01	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4-Chloro-m-cresol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
4-Nitrophenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Pentachlorophenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003	0.84	0.51
Phenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003

Benoit Lagarde, chemist

Amr Rouchdy, chemist

eco

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Extractables. Organochlorine Pesticides								
Aldrin	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, alpha	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, beta	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, gamma	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlordane, alpha	ug/L	0.02	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlordane, gamma	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan, Alpha	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan, Beta	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	ug/L	0.02	ND	ND	ND	ND	ND	ND
Endrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND	ND	ND
Heptachlor	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	ug/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	ug/L	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDD	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDE	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	ug/L	0.1	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Extractables. Neutral-Chlorinated								
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Hexachloropentadiene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Chlorinated Dibenzo-p-dioxins and Dibenzofurans								
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0003		< 0.0011		< 0.0008	
Octachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0011		0.0024		< 0.0010	
Octachlorodibenzofuran	ug/L	* 0.0003	< 0.0004		< 0.0007		< 0.0006	
Total heptachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0010		< 0.0010		< 0.0010	
Total heptachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0005		< 0.0004		< 0.0007	
Total hexachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0005		< 0.0008		< 0.0008	

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: CO[illegible]AULDS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Total hexachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0003		< 0.0005		< 0.0007	
Total pentachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0006		< 0.0022		< 0.0023	
Total pentachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0002		< 0.0004		< 0.0005	
Total tetrachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0003		< 0.0011		< 0.0008	
Total tetrachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0002		< 0.0007		< 0.0007	
Oil and grease (Solvent Extractables)	ug/L	1000	920	820	1140	1200	2200	2600
Oil and grease minerals (Solvent Extractables)	ug/L	1000	510	510	570	500	1100	1400

PCB'S

	UNITS	MISA DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
PCB'S (ID aroclors present & total conc.)	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Rouchdy, chemist

eco

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Chemical Oxygen Demand (COD)	mg/L	10.0000	29	47	565	522
Cyanide	mg/L	0.0010	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		7.4	7.5	1.9	1.8
Specific conductance	umhos/cm		730	860	12500	13500
Nitrogen - Ammonia plus Ammonium	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0.33	0.05	1.75	7.86
Nitrogen - Nitrite	mg/L	0.03	<0.01	<0.01	<0.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.33	0.05	1.75	7.86
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	1.06	2.05	1.16	0.5
Organic carbon - Dissolved (DOC)	mg/L	0.5000	13	2.3	143	150
Total Phosphorus	mg/L	0.0600	0.14	0.12	0.08	0.06
Total suspended solids (TSS)	mg/L	2.0000	4.4	6.4	55.3	81.6
Phenolics (4AAP)	mg/L	0.0010	0.006	0.007	0.019	0.018
Total metal - Silver	mg/L	0.0300	0.001	< 0.010	0.005	0.0013
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	0.0016	0.0014	0.0024	0.0027
Total metal - Berryllium	mg/L	ND	< 0.003	< 0.003	< 0.003	<0.003
Total metal - Cadmium	mg/L	0.0020	< 0.001	< 0.001	< 0.001	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	< 0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.70	0.78	2.20	2.05
Total metal - Mercury	mg/L	0.0001	0.00045	0.00050	0.00158	0.00242
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.004	0.005	0.071	0.076
Total metal - Antimony	mg/L	0.0050	0.0020	0.0011	0.0042	0.0049
Total metal - Selenium	mg/l	0.0050	0.0021	0.0021	0.0052	0.0008
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	1.29	1.19	42.55	45.35
Volatiles halogenated						
1,1,1-Trichloroethane	ug/L	10 ***	963.6	< 10	7634.5	< 10
1,1,2,2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND
1,2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichlorobenzene	ug/L	10	< 10	59.44	10	14.25
1,3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1,4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10

Benoit Laçarde, chemist

Amr Rouchdy, chemist

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SAMPLING: APRIL 10 TO 12

CLIENT: COL[illegible]LDS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND
Volatiles, non-chlorinated						
Benzene	ug/L	10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50
Volatiles, Water Soluble						
Acrolein	ug/L	10	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50
Carbone disulfide	ug/L	50	< 10	< 10	< 10	< 10
Extractables, Base Neutral						
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Benzidine	mg/L	0.01	ND	ND	ND	ND
Benzo(a)pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(ghi)perylene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
Benzo(k)fluoranthene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzyl butyl phthalate	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phtalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphtalene	mg/L	0.01	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Di-isobutyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Di-n-butyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND
Di-n-octyl phthalate	mg/L	0.01	0.32	0.11	0.068	0.064
Dibenz(a,h)anthracene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Diethyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Dimethyl phthalate	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007
1,2-Diphenyl Hydrazine	mg/L	0.01	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.001	< 0.001	0.001	< 0.001
Fluorene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphtalene	mg/L	0.01	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Extractables, Acid (Phenolics)						
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2-chlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005
2,3-Dichlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	0.05
2,4-Dichlorophenol	mg/L	0.01	<0.007	<0.007	<0.007	<0.007
2,4,6-Trichlorophenol	mg/L	0.01	<0.006	<0.006	<0.006	<0.006
2,4-Dimethyl phenol	mg/L	0.01	<0.002	<0.002	<0.002	<0.002
2,4-Dinitrophenol	mg/L	0.01	<0.009	<0.009	<0.009	<0.009
2-Nitrophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005
4,6-Dinitro-o-cresol	mg/L	0.01	<0.004	<0.004	<0.004	<0.004
4-Chloro-m-cresol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003
4-Nitrophenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003
Pentachlorophenol	mg/L	0.01	<0.003	<0.003	0.04	<0.003
Phenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003

Benoit Lagarde, chemist

Amr Rouchdy, chemist

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SAMPLING: APRIL 10 TO 12

CLIENT: COL[illegible]
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Extractables. Organochlorine Pesticides						
Aldrin	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, alpha	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, beta	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, gamma	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Chlordane	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Chlordane, alpha	ug/L	0.02	<0.1	<0.1	<0.1	<0.1
Chlordane, gamma	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Dieldrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan, Alpha	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan, Beta	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	ug/L	0.02	ND	ND	ND	ND
Endrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND
Heptachlor	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Methoxychlor	ug/L	0.1	<0.05	<0.05	<0.05	<0.05
o,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDD	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDE	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	ug/L	0.1	<0.15	<0.15	<0.15	<0.15
Extractables. Neutral-Chlorinated						
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015
Hexachlorocyclopentadiene	mg/L	0.01	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND
Chlorinated Dibenzo-p-dioxins and Dibenzofurans						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0014		< 0.0057	
Octachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0016		< 0.0058	
Octachlorodibenzofuran	ug/L	* 0.0003	< 0.0009		< 0.0039	
Total heptachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0012		< 0.0088	
Total heptachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0012		< 0.0063	
Total hexachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0019		< 0.0073	

Benoit Lagarde, chemist

Amr Rouchdi, chemist

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SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Total hexachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0020		< 0.0059	
Total pentachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0024		< 0.0084	
Total pentachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0008		< 0.0031	
Total tetrachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0014		< 0.0057	
Total tetrachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0008		< 0.0028	
Oil and grease (Solvent Extractables)	ug/L	1000	1200	1400	1900	2000
Oil and grease minerals (Solvent Extractables)	ug/L	1000	600	600	1200	1100
PCB'S						
PCB'S (ID aroclors present & total conc.)	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: CO..-..DS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Chemical Oxygen Demand (COD)	mg/L	10.0000	< 3	25	< 3	< 3
Cyanide	mg/L	0.0010	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		7.8	7.2	7.1	6.3
Specific conductance	umhos/cm		430	420	360	720
Nitrogen - Ammonia plus Ammonium	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0.39	0.43	0.25	0.10
Nitrogen - Nitrite	mg/L	0.03	<0.01	<0.01	<0.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.39	0.43	0.25	0.10
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	1.11	0.65	1.27	0.84
Organic carbon - Dissolved (DOC)	mg/L	0.5000	5.8	5.7	6.8	6.8
Total Phosphorus	mg/L	0.0600	<0.01	<0.01	<0.01	<0.01
Total suspended solids (TSS)	mg/L	2.0000	4.6	2.3	3.9	4.7
Phenolics (4AAP)	mg/L	0.0010	0.005	0.003	0.007	0.004
Total metal - Silver	mg/L	0.0300	0.003	0.0035	0.002	0.003
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	0.0021	0.0024	0.0017	0.0014
Total metal - Berryllium	mg/L	ND	<0.003	<0.003	<0.003	<0.003
Total metal - Cadmium	mg/L	0.0020	< 0.001	< 0.001	< 0.001	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	< 0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.11	0.08	0.29	0.34
Total metal - Mercury	mg/L	0.0001	0.00025	0.00030	0.00030	0.0002
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.014	0.033	0.009	0.005
Total metal - Antimony	mg/L	0.0050	0.0020	0.0056	0.0022	0.0060
Total metal - Selenium	mg/L	0.0050	0.0010	< 0.0007	0.0031	< 0.0007
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	0.05	0.3	0.35	2.02
Volatiles halogenated						
1,1,1-Trichloroethane	ug/L	10 ***	< 10	< 10	< 10	< 10
1,1,2,2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND
1,2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichlorobenzene	ug/L	10	7.07	3.08	10	10
1,3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1,4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10

Benoit Lagarde, chemist

Amr Rouchdy, chemist

eco

SAMPLING: APRIL 10 TO 12

CLIENT: [illegible]
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	152 UNLOADING FRIDAY	152 UNLOADING SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND
Volatiles, non-chlorinated						
Benzene	ug/L	10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50
Volatiles, Water Soluble						
Acrolein	ug/L	10	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50
Carbone disulfide	ug/L	50	< 10	< 10	TO BE RE-ANALYSED	
Extractables, Base Neutral						
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Benzidine	mg/L	0.01	ND	ND	ND	ND
Benzo(a)pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(ghi)perylene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
Benzo(k)fluoranthene	mg/L	0.01	< 0.002	0.009	< 0.002	0.003
Benzyl butyl phthalate	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phtalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphtalene	mg/L	0.01	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Di-isobutyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Di-n-butyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND
Di-n-octyl phthalate	mg/L	0.01	0.098	0.042	0.09	0.093
Dibenz(a,h)anthracene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Diethyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Dimethyl phthalate	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007
1,2-Diphenyl hydrazine	mg/L	0.01	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001

Extractables, Acid (Phenolics)

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2-chlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005
2,3-Dichlorophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005
2,4-Dichlorophenol	mg/L	0.01	<0.007	<0.007	<0.007	<0.007
2,4,6-Trichlorophenol	mg/L	0.01	<0.006	<0.006	<0.006	<0.006
2,4-Dimethyl phenol	mg/L	0.01	<0.002	<0.002	<0.002	<0.002
2,4-Dinitrophenol	mg/L	0.01	<0.009	<0.009	<0.009	<0.009
2-Nitrophenol	mg/L	0.01	<0.005	<0.005	<0.005	<0.005
4,6-Dinitro-o-cresol	mg/L	0.01	<0.004	<0.004	<0.004	<0.004
4-Chloro-m-cresol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003
4-Nitrophenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003
Pentachlorophenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003
Phenol	mg/L	0.01	<0.003	<0.003	<0.003	<0.003

Benoit Lagarde, chemist

Amr Rouchdy, chemist

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SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: 0567

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Extractables. Organochlorine Pesticides						
Aldrin	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, alpha	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, beta	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Benzene hexachloride, gamma	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Chlordane	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Chlordane, alpha	ug/L	0.02	<0.1	<0.1	<0.1	<0.1
Chlordane, gamma	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Dieldrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan, Alpha	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan, Beta	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	ug/L	0.02	ND	ND	ND	ND
Endrin	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND
Heptachlor	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	ug/L	0.02	<0.01	<0.01	<0.01	<0.01
Methoxychlor	ug/L	0.1	<0.05	<0.05	<0.05	<0.05
o,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDD	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDE	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDT	ug/L	0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	ug/L	0.1	<0.15	<0.15	<0.15	<0.15
Extractables. Neutral-Chlorinated						
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015
Hexachlorocyclopentadiene	mg/L	0.01	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND
Chlorinated Dibenzo-p-dioxins and Dibenzofurans						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0001		< 0.0005	
Octachlorodibenzo-p-dioxin	ug/L	* 0.0003	< 0.0004		< 0.0011	
Octachlorodibenzofuran	ug/L	* 0.0003	< 0.0004		< 0.0004	
Total heptachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0005		< 0.0010	
Total heptachlorinated dibenzofurans	ug/L	* 0.0003	< 0.00025		< 0.0005	
Total hexachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0004		< 0.0005	

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 10 TO 12

CLIENT: COURTAULDS
PROJECT NUMBER: D567

	UNITS	MISA DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Total hexachlorinated dibenzofurans	ug/L	* 0.0003	< 0.00025		0.0007	
Total pentachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.00025		< 0.0006	
Total pentachlorinated dibenzofurans	ug/L	* 0.0003	< 0.0001		< 0.0003	
Total tetrachlorinated dibenzo-p-dioxins	ug/L	* 0.0003	< 0.0001		< 0.0005	
Total tetrachlorinated dibenzofurans	ug/L	* 0.0003	< 0.00008		< 0.0003	
Oil and grease (Solvent Extractables)	ug/L	1000	1000	1400	1500	1500
Oil and grease minerals (Solvent Extractables)	ug/L	1000	500	600	500	500
PCB'S						
PCB'S <ID aroclors present & total conc.>	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Rouchdy, chemist

RESULTS OF ANALYSES
ACCORDING TO THE MISA PROGRAM

SAMPLING APRIL 24 TO 26, 1987

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Chemical Oxygen Demand	mg/L	10.0000	10	7	9	11	315	290
Cyanide	mg/L	0.0010	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		8.0	7.9	7.7	8.1	11.4	11.3
Specific conductance	mmhos/cm		300	310	450	400	2600	2550
Nitrogen - Ammonia plus Ammonia	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0..33	0.35	0.35	0.31	13.0	13.0
Nitrogen - Nitrite	mg/L	0.03	<0.01	<.01	<0.01	<0.01	<.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.33	0.35	0.35	0.31	13.0	13.0
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	1.13	0.40	1.98	1.42	1.01	0.88
Organic carbon - Dissolved (DOC)	mg/L	0.5000	2.5	2.1	3.1	4.5	46	41
Total Phosphorus	mg/L	0.0600	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total suspended solids (TSS)	mg/L	2.0000	2.8	1.5	1.8	1.0	41.0	28.0
Phenolics (4AAP)	mg/L	0.0010	0.002	0.003	0.002	0.004	0.007	0.004
Total metal - Silver	mg/L	0.0300	0.0039	0.0017	0.033	0.003	0.0123	0.007
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	< 0.0007	<0.0007	<0.0007	<0.0007	0.0021	0.0021
Total metal - Berryllium	mg/L	ND	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Total metal - Cadmium	mg/L	0.0020	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.44	2.45	0.09	0.22	0.29	0.69
Total metal - Mercury	mg/L	0.0001	0.0017	<0.0001	<0.0001	<0.0001	0.0023	0.0020
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.003	0.002	0.002	0.004	0.064	0.063
Total metal - Antimony	mg/L	0.0050	0.0029	0.0011	0.0009	0.0009	0.0018	0.0018
Total metal - Selenium	mg/l	0.0050	< 0.0008	< 0.0008	0.0010	< 0.0008	0.0038	< 0.0008
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	0.21	0.06	0.17	0.20	0.29	0.27
Volatiles halogenated								
1,1,1-Trichloroethane	ug/L	10 ***	11.50	< 10	< 10	926.48	< 10	< 10
1,1,2,2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,2-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
1,4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND	ND	ND
Volatiles, non-chlorinated								
Benzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Volatiles, Water Soluble								
Acrolein	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50	< 50	< 50
Carbon disulfide	ug/L	50	< 10	34	< 10	< 10	< 10	< 10
Extractables, Base Neutral								
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Acenaphthylene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Anthracene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Benzidine	mg/L	0.01	ND	ND	ND	ND	ND	ND

Benoit Lagarde, chemist

Amr Rouendu, chemist

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Benzo(a)anthracene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Benzo(a)pyrene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Benzo(e)pyrene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	0.002	0.005	< 0.002	0.003	0.012	0.013
Benzo(ghi)perylene	mg/L	0.01	< 0.003	< 0.004	< 0.003	< 0.004	< 0.003	< 0.003
Benzo(k)fluoranthene	mg/L	0.01	0.006	0.013	0.004	0.009	< 0.002	< 0.002
Benzyl butyl phthalate	mg/L	0.01	< 0.006	< 0.009	< 0.007	< 0.009	< 0.006	< 0.006
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphthalene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.001	< 0.001
Di-isobutyl phthalate	mg/L	0.01	< 0.007	< 0.009	< 0.007	< 0.009	< 0.007	< 0.006
Di-n-butyl phthalate	mg/L	0.01	< 0.002	0.004	< 0.002	0.004	< 0.002	0.003
Di-n-octyl phthalate	mg/L	0.01	0.19	0.039	0.096	0.036	0.094	0.036
Dibenz(a,h)anthracene	mg/L	0.01	< 0.002	0.007	< 0.002	0.006	< 0.002	< 0.002
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND	ND	ND
Diethyl phthalate	mg/L	0.01	< 0.004	0.011	< 0.004	0.011	< 0.003	0.005
Dimethyl phthalate	mg/L	0.01	< 0.008	< 0.01	< 0.009	< 0.01	< 0.007	< 0.007
1,2-Diphenyl Hydrazine	mg/L	0.01	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Fluorene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.001
Extractables, Acid (Phenolics)								
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND	ND	ND
2-Chlorophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
2,3-Dichlorophenol	mg/L	0.01	< 0.004	< 0.005	< 0.004	< 0.005	0.009	0.013
2,4-Dichlorophenol	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
2,4,6-Trichlorophenol	mg/L	0.01	< 0.004	< 0.006	< 0.004	< 0.006	< 0.004	< 0.004
2,4-Dimethyl phenol	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
2,4-Dinitrophenol	mg/L	0.01	< 0.006	< 0.009	< 0.007	< 0.009	< 0.007	0.009
2-Nitrophenol	mg/L	0.01	< 0.004	< 0.006	< 0.005	< 0.006	< 0.004	< 0.004
4,6-Dinitro-o-cresol	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.004	< 0.002	< 0.002
2-Chlorophenol	mg/L	0.01	< 0.003	< 0.004	< 0.003	< 0.004	< 0.003	< 0.002
4-Chloro-m-cresol	mg/L	0.01	< 0.003	< 0.004	< 0.003	< 0.004	< 0.003	< 0.002
4-Nitrophenol	mg/L	0.01	< 0.002	< 0.003	< 0.002	< 0.003	< 0.002	< 0.002
Pentachlorophenol	mg/L	0.01	< 0.002	< 0.004	< 0.002	< 0.004	< 0.002	< 0.002

Benoit Lagarde, chemist

Amer Bouchdy, chemist

eco

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: 0567

	UNITS	DETECTION LIMIT	PUMP HOUSE INLET FRIDAY	PUMP HOUSE INLET SATURDAY	ACID RECOVERY FRIDAY	ACID RECOVERY SATURDAY	SITE ALKALINE FRIDAY	SITE ALKALINE SATURDAY
Phenol	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.003	< 0.002	< 0.002
Extractables, Organochlorine Pesticides								
Aldrin	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, alpha	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, beta	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, gamma	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane	ug/L	0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Chlordane, alpha	ug/L	0.02	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Chlordane, gamma	ug/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Dieldrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Alpha	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Beta	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan Sulfate	ug/L	0.02	ND	ND	ND	ND	ND	ND
Endrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND	ND	ND
Heptachlor	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.05	< 0.05
Heptachlor epoxide	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Methoxychlor	ug/L	0.1	< 0.05	< 0.05	< 0.07	< 0.07	< 0.1	< 0.1
o,p'-DDD	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
p,p'-DDD	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
o,p'-DDE	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
p,p'-DDT	ug/L	0.01	< 0.01	< 0.01	< 0.05	< 0.05	< 0.07	< 0.07
Toxaphene	ug/L	0.10	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15
Extractables, Neutral-Chlorinated								
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Hexachloropentadiene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND	ND	ND
Oil and grease (Solvent extractables)	ug/L	1000	700	800	700	700	1800	2500
Oil and grease, minerals (Solvent extractable)	ug/L	1000	600	600	500	500	1300	2000
PCB'S								
(ID aroclors present & total conc.)	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Rouchdy, chemist

eco

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: 0567

	UNITS	DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Chemical Oxygen Demand	mg/L	10.0000	43	35	504	489
Cyanide	mg/L	0.0010	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		7.4	7.0	1.9	1.8
Specific conductance	mmhos/cm		640	640	14000	17000
Nitrogen - Ammonia plus Ammonia	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0.05	0.05	0.05	0.05
Nitrogen - Nitrite	mg/L	0.03	<0.01	<0.01	<0.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.05	0.05	0.05	0.05
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	1.53	1.39	1.33	0.61
Organic carbon - Dissolved <DOC>	mg/L	0.5000	9.4	10.8	146	166
Total Phosphorus	mg/L	0.0600	<0.01	<0.01	<0.01	<0.01
Total suspended solids <TSS>	mg/L	2.0000	4.5	5.0	60.7	29.3
Phenolics <4AAP>	mg/L	0.0010	0.005	0.003	0.016	0.017
Total metal - Silver	mg/L	0.0300	0.012	0.017	0.003	0.004
Total metal - Aluminium	mg/L	0.0300	<0.03	<0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	0.0008	0.0009	0.0012	0.0012
Total metal - Berryllium	mg/L	ND	< 0.003	< 0.003	< 0.003	<0.003
Total metal - Cadmium	mg/L	0.0020	0.003	< 0.001	0.0013	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.77	0.43	1.86	2.24
Total metal - Mercury	mg/L	0.0001	<0.0001	<0.0001	0.0025	0.0030
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.028	0.015	0.094	0.080
Total metal - Antimony	mg/L	0.0050	0.0020	0.0009	0.0051	0.0025
Total metal - Selenium	mg/l	0.0050	< 0.0008	< 0.0008	< 0.0008	< 0.0008
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	1.05	1.18	44.5	60.00
Volatiles halogenated						
1,1,1-Trichloroethane	ug/L	10 ***	< 10	< 10	12.35	67.85
1,1,2,2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1,2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1,1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND
1,2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10
1,2-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1,3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1,4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10

Benoit Lagarde, chemist

Amr Rouchdy, chemist

eco

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: 0567

	UNITS	DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND
Volatiles, non-chlorinated						
Benzene	ug/L	10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50
Volatiles, Water Soluble						
Acrolein	ug/L	10	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50
Carbon disulfide	ug/L	50	< 10	< 10	< 10	< 10
Extractables, Base Neutral						
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Acenaphthylene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Benzidine	mg/L	0.01	ND	ND	ND	ND

Benoit Lagarde, chemist   Amr Rouchdy, chemist

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SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Benzo(a)anthracene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(e)pyrene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	0.003	0.014	0.012	0.026
Benzo(ghi)perylene	mg/L	0.01	< 0.003	0.004	< 0.003	< 0.003
Benzo(k)fluoranthene	mg/L	0.01	0.010	< 0.002	< 0.002	< 0.002
Benzyl butyl phthalate	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.007
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphtalene	mg/L	0.01	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.001	< 0.002	< 0.001	< 0.002
Di-isobutyl phthalate	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007
Di-n-butyl phthalate	mg/L	0.01	< 0.002	< 0.002	0.002	< 0.002
Di-n-octyl phthalate	mg/L	0.01	0.12	0.033	0.04	0.19
Dibenz(a,h)anthracene	mg/L	0.01	0.009	< 0.002	< 0.002	< 0.003
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND
Diethyl phthalate	mg/L	0.01	< 0.003	< 0.004	< 0.003	< 0.004
Dimethyl phthalate	mg/L	0.01	< 0.007	< 0.008	< 0.007	< 0.009
1,2-Diphenyl Hydrazine	mg/L	0.01	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.001	< 0.001	< 0.001	< 0.001
Extractables, Acid (Phenolics)						
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2-Chlorophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,3-Dichlorophenol	mg/L	0.01	< 0.004	< 0.004	0.009	0.011
2,4-Dichlorophenol	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007
2,4,6-Trichlorophenol	mg/L	0.01	< 0.004	< 0.004	< 0.003	< 0.004
2,4-Dimethyl phenol	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
2,4-Dinitrophenol	mg/L	0.01	0.037	< 0.006	0.006	< 0.002
2-Nitrophenol	mg/L	0.01	< 0.004	< 0.004	< 0.003	< 0.004
4,6-Dinitro-o-cresol	mg/L	0.01	< 0.002	< 0.002	< 0.003	0.002
2-Chlorophenol	mg/L	0.01	< 0.003	< 0.003	< 0.002	< 0.003
4-Chloro-m-cresol	mg/L	0.01	< 0.003	< 0.003	< 0.002	< 0.003
4-Nitrophenol	mg/L	0.01	< 0.002	< 0.002	< 0.005	< 0.004
Pentachlorophenol	mg/L	0.01	< 0.002	< 0.003	< 0.003	< 0.003

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: 0567

	UNITS	DETECTION LIMIT	STORM FRIDAY	STORM SATURDAY	SITE ACID FRIDAY	SITE ACID SATURDAY
Phenol	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Extractables, Organochlorine Pesticides						
Aldrin	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, alpha	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, beta	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, gamma	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane	ug/L	0.01	< 0.02	< 0.02	< 0.02	< 0.02
Chlordane, alpha	ug/L	0.02	< 0.1	< 0.1	< 0.1	< 0.1
Chlordane, gamma	ug/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02
Dieldrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Alpha	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Beta	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan Sulfate	ug/L	0.02	ND	ND	ND	ND
Endrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND
Heptachlor	ug/L	0.01	< 0.03	< 0.03	< 0.01	< 0.01
Heptachlor epoxide	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Methoxychlor	ug/L	0.1	< 0.05	< 0.05	< 0.05	< 0.05
o,p'-DDD	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
o,p'-DDE	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
o,p'-DDE	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
o,p'-DDT	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toxaphene	ug/L	0.10	< 0.15	< 0.15	< 0.15	< 0.15
Extractables, Neutral-Chlorinated						
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015
Hexachloropentadiene	mg/L	0.01	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND
Oil and grease (Solvent extractables)	ug/L	1000	900	700	1300	1100
Oil and grease, minerals (Solvent extractable)	ug/L	1000	500	500	900	700
PCB'S						
(ID aroclors present & total conc.)	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 24 TO 25

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Chemical Oxygen Demand	mg/L	10.0000	5	14	7	14
Cyanide	mg/L	0.0010	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen ion (PH)	N.A.		7.8	7.9	7.3	7.0
Specific conductance	mmhos/cm		370	363	360	720
Nitrogen - Ammonia plus Ammonia	mg/L	0.0100	<0.1	<0.1	<0.1	<0.1
Nitrogen - Nitrate plus Nitrite	mg/L	** 0.1500	0.39	0.35	0.05	0.17
Nitrogen - Nitrite	mg/L	0.03	<0.01	<0.01	<0.01	<0.01
Nitrogen - Nitrate	mg/L	0.15	0.39	0.35	0.05	0.17
Nitrogen - Total Kjeldahl Nitrogen	mg/L	0.3000	1.81	0.22	0.17	0.39
Organic carbon - Dissolved (DOC)	mg/L	0.5000	2.7	3.7	5.5	5.9
Total Phosphorus	mg/L	0.0600	<0.01	<0.01	<0.01	<0.01
Total suspended solids (TSS)	mg/L	2.0000	1.8	1.5	0.8	1.0
Phenolics (4AAP)	mg/L	0.0010	0.004	0.005	0.004	0.003
Total metal - Silver	mg/L	0.0300	0.021	0.003	0.001	0.001
Total metal - Aluminium	mg/L	0.0300	<0.03	0.03	<0.03	<0.03
Total metal - Arsenic	mg/L	0.0050	0.0010	0.0011	0.0009	0.0012
Total metal - Berryllium	mg/L	ND	<0.003	<0.003	<0.003	<0.003
Total metal - Cadmium	mg/L	0.0020	< 0.001	< 0.001	< 0.001	< 0.001
Total metal - Cobalt	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Chromium	mg/L	0.0200	< 0.007	< 0.007	< 0.007	< 0.007
Total metal - Copper	mg/L	0.0100	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Iron	mg/L	0.0200	0.09	0.32	0.17	0.31
Total metal - Mercury	mg/L	0.0001	0.0001	<0.0001	<0.0001	<0.0001
Total metal - Nickel	mg/L	0.0200	< 0.01	< 0.01	< 0.01	< 0.01
Total metal - Lead	mg/L	0.0300	0.018	0.030	0.011	0.006
Total metal - Antimony	mg/L	0.0050	0.0016	0.0060	0.0030	0.0040
Total metal - Selenium	mg/l	0.0050	< 0.0008	< 0.0008	< 0.0008	< 0.0008
Total metal - Thallium	mg/L	ND	<0.7	<0.7	<0.7	<0.7
Total metal - Vanadium	mg/L	0.0300	< 0.09	< 0.09	< 0.09	< 0.09
Total metal - Zinc	mg/L	0.0100	0.13	0.49	0.20	0.65
Volatiles halogenated						
1.1.1-Trichloroethane	ug/L	10 ***	< 10	57.13	< 10	52.26
1.1.2.2-Tetrachloroethane	ug/L	10	< 10	< 10	< 10	< 10
1.1.2-Trichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1.1-Dichloroethane	ug/L	10	< 10	< 10	< 10	< 10
1.1-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
1.2-Dibromoethane (Ethylene dibromide)	ug/L	10	ND	ND	ND	ND
1.2-Dichloroethane (Ethylene dichloride)	ug/L	10	< 10	< 10	< 10	< 10
1.2-Dichloropropane	ug/L	10	< 10	< 10	< 10	< 10
1.2-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1.3-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
1.4-Dichlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Bromoform	ug/L	10	< 10	< 10	< 10	< 10
Carbon tetrachloride	ug/L	10	< 10	< 10	< 10	< 10
Chlorobenzene	ug/L	10	< 10	< 10	< 10	< 10
Chloroform	ug/L	10	< 10	< 10	< 10	< 10

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Cis-1,2-Dichloroethylene	ug/L	ND	< 10	< 10	< 10	< 10
Cis-1,3-Dichloropropylene	ug/L	10	< 10	< 10	< 10	< 10
Dibromochloromethane	ug/L	10	< 10	< 10	< 10	< 10
Dibromomethane (Methylene Bromide)	ug/L	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/L	10	< 10	< 10	< 10	< 10
Ethyl chloride	ug/L	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ug/L	ND	ND	ND	ND	ND
Methyl chloride	ug/L	ND	< 10	< 10	< 10	< 10
Methylene chloride	ug/L	10	< 10	< 10	< 10	< 10
Tetrachloroethylene (Perchloroethylene)	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,2-Dichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	10	< 10	< 10	< 10	< 10
Vinyl chloride (Chloroethylene)	ug/L	ND	ND	ND	ND	ND
Volatiles, non-chlorinated						
Benzene	ug/L	10	< 10	< 10	< 10	< 10
Butadiene	ug/L	10	< 50	< 50	< 50	< 50
Cumene	ug/L	10	< 50	< 50	< 50	< 50
Diethyl benzene	ug/L	10	< 50	< 50	< 50	< 50
Ethyl toluene	ug/L	10	< 50	< 50	< 50	< 50
Ethylbenzene	ug/L	10	< 10	< 10	< 10	< 10
Propylbenzene	ug/L	10	< 50	< 50	< 50	< 50
Styrene	ug/L	10	< 50	< 50	< 50	< 50
Toluene	ug/L	10	< 10	< 10	< 10	< 10
Trimethylbenzene(s)	ug/L	10	< 50	< 50	< 50	< 50
Xylenes	ug/L	10	< 50	< 50	< 50	< 50
Volatiles, Water Soluble						
Acrolein	ug/L	10	< 50	< 50	< 50	< 50
Acrylonitrile	ug/L	10	< 50	< 50	< 50	< 50
Carbon disulfide	ug/L	50	< 10	< 10	10.103	0.430
Extractables, Base Neutral						
2,4-Dinitrotoluene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,6-Dinitrotoluene	mg/L	0.01	< 0.003	< 0.003	< 0.003	< 0.003
2-Chloroethylvinylether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenyl phenyl ether	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
4-Chlorophenyl phenyl ether	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
Acenaphthene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Acenaphthylene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Anthracene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Benzidine	mg/L	0.01	ND	ND	ND	ND

Benoit Lagarde, chemist

Amr Rouchdy, chemist

SAMPLING: APRIL 24 TO 26

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: 3567

	UNITS	DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Benzo(a)anthracene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Benzo(e)pyrene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Benzo(b)fluoranthene	mg/L	0.01	0.003	0.029	< 0.001	0.010
Benzo(ghi)perylene	mg/L	0.01	< 0.004	< 0.003	< 0.002	< 0.002
Benzo(k)fluoranthene	mg/L	0.01	0.01	< 0.002	0.005	< 0.001
Benzyl butyl phthalate	mg/L	0.01	< 0.01	< 0.006	< 0.004	< 0.005
Bis(2-chloroethoxy)methane	mg/L	0.01	< 0.006	< 0.006	< 0.006	< 0.006
Bis(2-chloroisopropyl)ether	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Bis(2-chloroethyl)ether	mg/L	0.01	< 0.050	< 0.050	< 0.050	< 0.050
Bis-2-ethylhexyl phthalate	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
Chloronaphtalene	mg/L	0.01	ND	ND	ND	ND
Chrysene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Di-isobutyl phthalate	mg/L	0.01	< 0.01	< 0.006	< 0.005	< 0.005
Di-n-butyl phthalate	mg/L	0.01	0.005	< 0.002	0.002	< 0.002
Di-n-octyl phthalate	mg/L	0.01	0.055	0.036	0.033	0.022
Dibenz(a,h)anthracene	mg/L	0.01	0.004	< 0.002	< 0.002	< 0.002
3,3-Dichlorobenzidine	mg/L	0.01	ND	ND	ND	ND
Diethyl phthalate	mg/L	0.01	0.016	< 0.003	0.005	< 0.003
Dimethyl phthalate	mg/L	0.01	< 0.01	< 0.007	< 0.006	< 0.006
1,2-Diphenyl Hydrazine	mg/L	0.01	ND	ND	ND	ND
Fluoranthene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Fluorene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Indeno(1,2,3-cd)pyrene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Isophorone	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Methyl naphthalene	mg/L	0.01	ND	ND	ND	ND
N-Nitrosodimethylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodiphenylamine	mg/L	0.01	< 0.002	< 0.002	< 0.002	< 0.002
N-Nitrosodipropylamine	mg/L	0.01	< 0.020	< 0.020	< 0.020	< 0.020
Naphthalene	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.001
Nitrobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Pyrene	mg/L	0.01	< 0.002	< 0.001	< 0.001	< 0.001
Extractables, Acid (Phenolics)						
2,3,4,5-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	mg/L	0.01	ND	ND	ND	ND
2-Chlorophenol	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
2,3-Dichlorophenol	mg/L	0.01	< 0.005	< 0.004	< 0.003	< 0.004
2,4-Dichlorophenol	mg/L	0.01	< 0.007	< 0.007	< 0.007	< 0.007
2,4,6-Trichlorophenol	mg/L	0.01	< 0.006	< 0.004	< 0.003	< 0.004
2,4-Dimethyl phenol	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
2,4-Dinitrophenol	mg/L	0.01	< 0.009	< 0.009	< 0.004	< 0.008
2-Nitrophenol	mg/L	0.01	< 0.005	< 0.004	< 0.003	< 0.003
4,6-Dinitro-o-cresol	mg/L	0.01	< 0.003	< 0.003	< 0.002	< 0.002
2-Chlorophenol	mg/L	0.01	< 0.003	< 0.003	< 0.002	< 0.002
4-Chloro-m-cresol	mg/L	0.01	< 0.004	< 0.003	< 0.002	< 0.002
4-Nitrophenol	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Pentachlorophenol	mg/L	0.01	< 0.003	< 0.003	< 0.002	< 0.002

Benoit Lagarde, chemist

Amr Rouchdy, chemist

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SAMPLING: APRIL 24 TO 25

CLIENT: COURTAULDS CANADA
PROJECT NUMBER: D567

	UNITS	DETECTION LIMIT	CARAVELLE FRIDAY	CARAVELLE SATURDAY	CS2 UNLOADING FRIDAY	CS2 UNLOADING SATURDAY
Phenol	mg/L	0.01	< 0.003	< 0.002	< 0.001	< 0.002
Extractables. Organochlorine Pesticides						
Aldrin	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, alpha	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, beta	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene hexachloride, gamma	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlordane	ug/L	0.01	< 0.02	< 0.02	< 0.02	< 0.02
Chlordane, alpha	ug/L	0.02	< 0.1	< 0.1	< 0.1	< 0.1
Chlordane, gamma	ug/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02
Dieldrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Alpha	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan, Beta	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endosulfan Sulfate	ug/L	0.02	ND	ND	ND	ND
Endrin	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Endrin Aldehyde	ug/L	0.02	ND	ND	ND	ND
Heptachlor	ug/L	0.01	< 0.05	< 0.05	< 0.04	< 0.04
Heptachlor epoxide	ug/L	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Methoxychlor	ug/L	0.1	< 0.05	< 0.05	< 0.05	< 0.05
o,p'-DDT	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
p,p'-DDD	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
p,p'-DDE	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
p,p'-DDT	ug/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toxaphene	ug/L	0.10	< 0.15	< 0.15	< 0.15	< 0.15
Extractables. Neutral-Chlorinated						
1,2,3,4-Tetrachlorobenzene	mg/L	0.01	< 0.005	< 0.005	< 0.005	< 0.005
1,2,3,5-Tetrachlorobenzene	mg/L	0.01	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.01	< 0.004	< 0.004	< 0.004	< 0.004
2,3,6-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2 4,5-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
2,6,a-Trichlorotoluene	mg/L	0.01	ND	ND	ND	ND
Heptachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	mg/L	0.01	< 0.008	< 0.008	< 0.008	< 0.008
Hexachloroethane	mg/L	0.01	< 0.015	< 0.015	< 0.015	< 0.015
Hexachloropentadiene	mg/L	0.01	ND	ND	ND	ND
Octachlorostyrene	mg/L	0.01	ND	ND	ND	ND
Pentachlorobenzene	mg/L	0.01	ND	ND	ND	ND
Oil and grease (Solvent extractables)	ug/L	1000	800	800	1100	700
Oil and grease, minerals (Solvent extractable)	ug/L	1000	500	500	500	500
PCB'S						
(ID aroclors present & total conc.)	ug/L	0.10	< 0.1	< 0.1	< 0.1	< 0.1

Benoit Lagarde, chemist

Amr Roochdy, chemist

ORGANIC POLLUTANTS (ug/l): COURTAULDS/BCL COMBINED SULFIDE SEWER (FINAL EFFLUENT), 1980

Fraction/Compound	Sept. 24	Sept. 25	Sept. 26	Oct. 01	Oct. 02	Oct. 03
1. <u>Purgeable Fraction (PP)</u> Analysed packed column GC, not confirmed MS						
Methylene Chloride	P	P	P	P	P	P
Chloroform	55	T	198	214	T	--
1,2-Dichloroethane	6	T	T	T	T	--
1,1,1-Trichloroethane	T	T	T	--	T	T
Carbon tetrachloride	--	--	--	T	T	--
Bromodichloromethane	10	T	54	17	T	T
1,2-Dichloropropane	--	T	T	T	T	--
trans-1,2-Dichloropropene	T	--	--	T	T	--
Trichloroethylene or cis-1,3-Dichloropropene	--	T	T	T	--	--
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	T	T	T	--	T	--
Toluene	14	23.0	40	T	T	--
Chlorobenzene	--	--	--	--	T	--
Ethylbenzene	--	--	--	--	T	--
2. <u>Acid Fraction (PP)</u>						
None detected (Oct. 3 sample extract) Analysed GC/MS capillary column						
3. <u>Base/Neutral Fraction (PP)</u>						
None detected (Oct. 1 sample extract) Analysed GC/MS capillary column						
4. <u>Pesticide/PCB Fraction (PP)</u> (capillary column GC/MS)						
None detected in composite extract (Sept.24-Oct.3)						
5. <u>Other Compounds (NPP)</u>						
Acetone*	P	P	P	P	P	P
THF(Tetrahydrofuran)*	172	2,100	4,000	121	97	T
Trithiolane						P
Octanoic acid						P
Decanoic acid						P
Dodecanoic acid (major peak)				P		P
Tetradecanoic acid				P		P
Hexadecanoic acid				P		P

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base/neutral] 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants

Pesticides detection limit = 0.05 - 0.5 ug/l

* Analysed packed column GC, not confirmed MS

Source: EPS, 1985

ORGANIC POLLUTANTS (ug/l): COURTAULDS VISCOSE SEWER (FINAL EFFLUENT), 1980

Fraction/Compound	Sept. 24	Sept. 25	Sept. 26	Oct. 01	Oct. 02	Oct. 03
1. <u>Purgeable Fraction (PP)</u> Analysed packed column GC, not confirmed MS						
Chloroform	--	T	--	--	--	--
1,2-Dichloroethane	--	--	T	T	T	T
1,1,1-Trichloroethane	T	T	T	--	--	T
Bromodichloromethane	6	T	T	T	T	T
1,2-Dichloropropane	--	T	T	T	T	13
trans-1,3-Dichloropropene	77	--	--	T	--	--
Trichloroethylene or cis-1,3-Dichloropropene	--	T	T	T	T	T
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	T	--	--	T	--	--
Toluene	15	28	27	T	T	T
Chlorobenzene	--	--	T	T	6	--
Ethyl benzene	T	--	--	--	--	--
2. <u>Acid Fraction (PP)</u> (Sept.24 sample extract), GC/MS, capillary column						
Phenol	P					
3. <u>Base/Neutral Fraction (PP)</u>						
None detected (Sept. 26 and Oct. 2 sample extracts), analysed GC/MS, capillary column						
4. <u>Pesticide/PCB Fraction (PP)</u> (capillary column GC/MS)						
None detected in composite extract (Sept.24-Oct.3)						
5. <u>Other Compounds (NPP)</u>.						
Acetone*	P	P	P	P	P	P
THF(Tetrahydrofuran)*	22	2,400	17,000	101	110	138
Dioctylhexanedioic acid			P			
Oxybis ethanol			P			
Dicyclohexanone			P			
Tributyl phosphoric acid			P			
Tetradecanoic acid			P			
Dodecanal			P			
C_{12} and C_{16} phthalates			P			
Dimethylethyl Phenol			P			

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base/neutral] 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants
Pesticides detection limit = 0.05 - 0.5 ug/l
* Analysed packed column GC, not confirmed MS

ORGANIC POLLUTANTS (ug/l): COURTAULDS/BCL COMBINED ACID OF SEWER (FINAL EFFLUENT), 1980

Fraction/Compound	Sept. 24	Sept. 25	Sept. 26	Oct. 01	Oct. 02	Oct. 03
1. Purgeable Fraction (PP) Analysed packed column GC, not confirmed MS						
Methylene Chloride	--	--	P	P	P	--
1,1-Dichloroethane	--	--	8	--	--	--
1,2-Dichloroethane	T	T	--	T	T	T
1,1,1-Trichloroethane	T	T	T	T	--	T
Bromodichloromethane	16	T	T	T	22	15
1,2-Dichloropropane	T	T	--	61	T	T
trans-1,3-Dichloropropene	T	--	T	--	T	T
Trichloroethylene or cis-1,3-Dichloropropene	T	T	T	--	T	T
1,1,2-Trichloroethane or Dibromochloromethane or Benzene	T	T	--	T	T	T
Bromoform	--	T	--	T	--	--
Ethyl benzene	--	--	--	T	--	--
Toluene	T	T	T	--	--	T

2. Acid Fraction (PP)

None detected (September 24 sample extract), analysed GC/MS, capillary column

3. Base/Neutral Fraction (PP) (October 1 sample extract), analysed GC/MS, capillary column

Di-n-Octyl Phathalate < 10

4. Pesticide/PCB Fraction (PP) (capillary column GC/MS)

None detected in composite extract (Sept.24-Oct.3)

5. Other Compounds (NPP)

Compound	Sept. 24	Sept. 25	Sept. 26	Oct. 01	Oct. 02	Oct. 03
Acetone*	P	P	P	P	P	P
THF(Tetrahydrofuran) *	592	43	87	28	T	T
Octanoic Acid (Major Peak)				P		
Dihydroxypropyloctadecanoic acid (Major Peak)				P		
Dodecanoic Acid				P		
Tributyl phosphoric acid				P		
cyclododecane				P		
n-phenyl benzamine				P		
Tetrakis Benzene				P		
Hexanoic Acid				P		
Decanoic Acid				P		
Tetradecanoic Acid				P		

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base neutral] 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non Priority Pollutants
Pesticides detection limit = .05 - .5 ug/l

* Analysed packed column GC, not confirmed MS

COURTAULDS - BCL EFFLUENT DATA, 1985

Parameter	Units	SEWER: Combined Acid	SEWER: Viscose	SEWER: Sulphide	SEWER: Effective Outfall's Effluent
Reference 1:					
Flow Rate	IMGPM	572	533	194	1,299
	m^3/s	.043	.040	.015	.098
Conductivity	UMHO/cm @ 25°C	19,600	1,650	2,540	9,662
Total Hardness	mg/L as $CaCO_3$	80.4	14.1	29.0	
Calcium	mg/L as Ca	21.0	4.0	8.5	
Magnesium	mg/L as Mg	6.80	1.00	1.90	
Sodium	mg/L as Na	1,900	292.0	420.0	
Potassium	mg/L as K	2.60	1.30	0.75	
Total Alkalinity	mg/L as $CaCO_3$	<.2	463.4	159.2	
pH		1.92	11.16	8.64	
Total Acidity	mg/L as $CaCO_3$	3,073.0	<.00	<.00	
Fluoride	mg/L as F	0.18	0.13	0.01	
Chloride	mg/L as Cl	163.4	107.8	560.8	
Sulphate	mg/L as SO_4	7,400	230	165	3,366
Total Ammonium	mg/L as N	0.10	0.05	0.05	
Total Nitrates	mg/L as N	0.30	0.05	0.70	
Nitrite	mg/L as N	0.030	0.015	0.005	
Dissolved Organic Carbon	mg/L as C	132.0	30.5	43.5	
Dissolved Inorganic Carbon	mg/L as C	1.2	27.0	29.6	
Aluminum	mg/L as Al	.310	.240	.470	0.306
Arsenic	mg/L as As	(.002)	(.001)	(.001)	(0.0014)
Cadmium	mg/L as Cd	<.002(<.002)	<.0020(<.0020)	<.002(<.002)	<.0020(<.0020)
Chromium	mg/L as Cr	0.024(0.036)	0.130(0.092)	0.015(<0.020)	0.066
Cobalt	mg/L as Co	<.010	<.010	<.010	
Copper	mg/L as Cu	0.03(0.05)	0.02(0.02)	0.09(0.05)	(0.04)
Iron	mg/L as Fe	2.40(3.67)	0.54(0.64)	1.60(0.46)	(1.94)
Lead	mg/L as Pb	0.140(0.310)	0.061(0.073)	0.100(<0.030)	(0.170)
Manganese	mg/L as Mn	0.320	0.500	0.023	
Mercury	ug/L as Hg	(8.70)	(5.30)	(4.65)	(6.69)
Nickel	mg/L as Ni	0.017(0.026)	<0.10(<0.020)	<0.010(<0.020)	(0.023)
Zinc	mg/L as Zn	6.100(31.2)	2.000(2.70)	0.180(0.128)	3.52(14.8)
Carbonyl sulphide	ug/L	<2.	7	<2.0	
Carbon Disulphide	ug/L	1,400	121	<2.0	664
Hydrogen Sulphide	ug/L	590	7	<2.0	<262*
Benzene	ug/L	0.(0)	4.(0)	0.(0)	2.
Bromodi-chloromethane	ug/L	0.(0)	0.(8)	100.(28)	15.0
Carbon Tetra-chloride	ug/L	0.(0)	0.(1)	20.(3)	1.0
Chlorodi-bromomethane	ug/L	0.(0)	0.(0)	2.(1)	3.0
Chloroform	ug/L	4.(10)	6.(328)	(4)	(139.)
Dichloromethane	ug/L	57.(0)	0.(0)	0.(0)	25.0
Toluene	ug/L	2.(3)	1.(29)	0.(2)	(13.0)

APPENDIX VIII (Cont'd)

Parameter	Units	Sewer: Combined Acid	Sewer: Viscose	Sewer: Sulphide	Sewer: Effective Outfall's Effluent
Reference 2:					
Sulphuric Acid		0.331%			
SS	mg/L	68.0	48.0	17.0	
COD	mg/L	512.0	483.0	-	
BOD_5	mg/L	49.0	348.0	186.0	
Reference 3:					
Carbon Disulphide	ug/l	15,000	9,000	3,200	10,745.0
Hydrogen Sulphide	ug/l	3,100	3,00	15.0	2,587.0*
Zinc	mg/L	50.0/60.0			

Note:

Reference 1: MOE - 1985; June 18 sample, (Average of June 19, 20 sample)

2: Monthly Reports filed by Courtaulds for April, 1985

3: MOE - 1985

* Does not include, production of H_2S resulting from mixtures of Acid

APPENDIX XIII. EFFLUENT MONITORING DATA: CORNWALL WATER POLLUTION CONTROL PLANT

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SOURCES OF MUNICIPAL WATER POLLUTION CONTROL PLANT RAW SEWAGE

GENERAL DESCRIPTION OF WATER POLLUTION CONTROL PLANT (WPCP)

NAME OF WPCP	CORNWALL WPCP
WORKS NUMBER	110000132
TREATMENT TYPE	PRIMARY PHOSPHORUS REMOVAL CONTINUOUS
DESIGN CAPACITY (1000 m3/d)	37.505
1986 AVERAGE DAY FLOW (1000 m3/d)	52.927
POPULATION SERVED	46800

% OF TOTAL FLOW ATTRIBUTED TO:

INDUSTRIAL SOURCES (%)	10
COMMERCIAL SOURCES (%) (Population x 0.0757)	7
RESIDENTIAL SOURCES (%) (Population x 0.175)	15
UNACCOUNTED FOR, INCL. INFILTRATION (100-% Contributed from industrial, commercial and residential sources)	68

PROFILE OF INDUSTRIES IN CATCHMENT

TOTAL NO OF INDUSTRIES	111
INDUSTRIES WITH WATER	23
NO OF SIC CATEGORIES	34

DESCRIPTION OF THE TOP 5 INDUSTRIES DISCHARGED TO THE WPCP
(BASED ON WATER USE DATA)

DESCRIPTION	SIC	# OF COMPANIES
ORGANIC CHEMICAL & PESTICIDES	2869-2869	3
TEXTILE PRODUCTS	2271-2299	5
DAIRY	2021-2026	2
PLASTICS, RESIGNS, SYNTHETICS	2821-2824	1
PRIMARY TEXTILES	2211-2269	3

CORNWALL WPCP
Primary
Phosphorus Removal - Continuous
Capacity - 37.505 10(3)m3/day

PARAMETER	1981	1982	1983	1984	1985	5 YEAR AVERAGE 81-85
Avg. Daily Flow (1000 m3/day)	48.64	47.59	49.15	48.54	47.67	48.32
BOD5 - Influent (mg/L)	55.73	79.61	77.82	88.67	72.58	74.86
BOD5 - Effluent (mg/L)	37.47	47.37	39.22	45.58	40.40	42.01
Annual BOD5 Significantly Different from Mean Annual Average BOD5?	N	N	N	N	N	
TSS - Influent (mg/L)	119.84	92.16	92.92	110.25	105.83	104.20
TSS - Effluent (mg/L)	52.60	46.98	28.40	23.69	24.45	35.22
Annual TSS Significantly Different from Mean Annual Average TSS?	Y	Y	N	Y	Y	
Total P - Influent (mg/L)	2.74	2.73	2.60	2.65	2.65	2.69
Total P - Effluent (mg/L)	1.67	1.58	0.99	0.98	0.99	1.24
Annual TP Significantly Different from Mean Annual Average TP?	Y	Y	N	N	N	
TP in Compliance?	N	N	Y	Y	Y	N

I.D. - Insufficient Data

OPERATIONAL EVALUATION FOR: C O R N W A L L   W P C P

TREATMENT FACILITY: Primary
PERIOD ENDING: May 8, 1987
SAMPLING SEASON: Summer (Warm Weather)
DESIGN AVG FLOW: 37,500 m3/d

PARAMETER	PRE-SAMPLING PERIOD						
	DAY 8	DAY 9	DAY 10	DAY 11	DAY 12	DAY 13	DAY 14
RAW SEWAGE FLOW		52,020	56,430	48,460	43,630	43,140	37,590
% of Design Flow		138.72%	150.48%	129.23%	116.35%	115.04%	100.24%
Influent BOD (mg/L)		52.0					
Primary BOD (mg/L)							
Secondary BOD (mg/L)		49.0					
% PRIMARY REMOVAL							
% SECONDARY REMOVAL		5.8%					
Influent SS (mg/L)		133.0					
Primary SS (mg/L)							
Secondary SS (mg/L)		28.0					
% PRIMARY REMOVAL							
% SECONDARY REMOVAL		78.9%					
Influent NH4 (mg/L)							
Primary NH4 (mg/L)							
Secondary NH4 (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent TKN (mg/L)		15.2					
Primary TKN (mg/L)							
Secondary TKN (mg/L)		14.8					
% PRIMARY REMOVAL							
% SECONDARY REMOVAL		2.6%					
Influent Total P (mg/L)		1.80	1.80	2.30			
Primary Total P (mg/L)							
Secondary Total P (mg/L)		0.80	0.80	0.80			
% PRIMARY REMOVAL							
% SECONDARY REMOVAL		55.6%	55.6%	65.2%			

OPERATIONAL EVALUATION FOR: C O R N W A L L   W P C P

TREATMENT FACILITY: Primary
PERIOD ENDING: May 8, 1987
SAMPLING SEASON: Summer (Warm Weather)
DESIGN AVG FLOW: 37,500 m3/d

PARAMETER	SAMPLING PERIOD						
	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19	DAY 20	DAY 21
RAW SEWAGE FLOW	41,620	41,220	42,660	43,890	42,330	39,460	
% of Design Flow	110.99%	109.92%	113.76%	117.04%	112.88%	105.23%	
Influent BOD (mg/L)							
Primary BOD (mg/L)							
Secondary BOD (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent SS (mg/L)	157.0						
Primary SS (mg/L)							
Secondary SS (mg/L)	29.0						
% PRIMARY REMOVAL							
% SECONDARY REMOVAL	81.5						
Influent NH4 (mg/L)							
Primary NH4 (mg/L)							
Secondary NH4 (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent TKN (mg/L)							
Primary TKN (mg/L)							
Secondary TKN (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent Total P (mg/L)	3.20	2.30	2.50			3.30	
Primary Total P (mg/L)							
Secondary Total P (mg/L)	1.30	1.90	1.40			1.40	
% PRIMARY REMOVAL							
% SECONDARY REMOVAL	59.4	17.4	44.0			57.6	

OPERATIONAL EVALUATION FOR: C O R N W A L L W P C P

TREATMENT FACILITY: Primary
PERIOD ENDING: April 3, 1987
SAMPLING SEASON: Winter (Cold Weather)
DESIGN AVG FLOW: 37,500 m3/d

PARAMETER	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19	DAY 20	DAY 21
	SAMPLING PERIOD						
RAW SEWAGE FLOW	62,120	66,110	57,460	54,870	55,090		
% of Design Flow	165.65%	176.29%	153.23%	146.32%	146.91%		
Influent BOD (mg/L)							
Primary BOD (mg/L)							
Secondary BOD (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent SS (mg/L)	94.0						
Primary SS (mg/L)							
Secondary SS (mg/L)	35.0						
% PRIMARY REMOVAL							
% SECONDARY REMOVAL	62.8						
Influent NH4 (mg/L)							
Primary NH4 (mg/L)							
Secondary NH4 (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent TKN (mg/L)							
Primary TKN (mg/L)							
Secondary TKN (mg/L)							
% PRIMARY REMOVAL							
% SECONDARY REMOVAL							
Influent Total P (mg/L)	1.80	1.50	1.80	1.80			
Primary Total P (mg/L)							
Secondary Total P (mg/L)	1.20	0.70	0.90	1.00			
% PRIMARY REMOVAL							
% SECONDARY REMOVAL	33.3	53.3	50.0	44.4			

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Raw Sewage
SAMPLE FORM : Wet Weight

CONTAM-INANT	CONTAMINANT NAME	UNITS	QC CODE	PLANT MIN. CONC. > 5 DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ. DET.	GLOBAL # SAMPLES	GLOBAL # DET	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
CONVENTIONALS																
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	29.40	134.00	10	10	100.0	267	266	99.6	60.41	140.23	1.54	1.93	100.0
COD	CHEMICAL OXYGEN DEMAND	mg/L	0	66.00	222.00	10	10	100.0	260	258	99.2	133.86	287.75	1.57	1.82	100.0
DOC	DISSOLVED ORGANIC CARBON	mg/L	0	9.00	18.50	10	10	100.0	271	271	100.0	12.53	22.39	1.27	1.81	100.0
NNHTFR	AMMONIUM,TOTAL,FILT.REAC.	mg/L	0	4.55	9.75	10	10	100.0	275	274	99.6	6.35	15.37	1.30	1.69	100.0
NNTKUR	NITROGEN-TOT-KJEL,UNF.TOT	mg/L	0	8.50	16.30	10	10	100.0	273	273	100.0	12.36	25.44	1.30	1.47	100.0
PH	(-LOG(H+(CONC))		0	6.78	7.06	10	10	100.0	275	275	100.0	6.91	6.90	1.01	1.05	100.0
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	1.63	3.55	10	10	100.0	248	248	100.0	2.54	5.18	1.40	1.51	100.0
RSP	RESIDUE, PARTICULATE	mg/L	0	35.30	94.20	8	8	100.0	267	266	99.6	54.45	128.88	1.42	1.93	100.0
METALS																
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	610.00	3600.00	11	11	100.0	322	306	95.0	1450.00	1000.10	1.83	2.65	97.3
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	30.00	30.00	1	1	100.0	49	48	98.0	30.00	110.60	0.00	2.28	97.1
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	0.06	0.20	10	10	100.0	283	274	96.8	0.13	0.23	1.44	2.11	100.0
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	800.00	1200.00	11	11	100.0	319	318	99.7	940.00	370.70	1.13	2.14	100.0
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	30.00	100.00	11	11	100.0	322	315	97.8	60.00	211.00	1.27	2.94	100.0
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	20.00	50.00	11	7	63.6	322	237	73.6	20.00	51.10	1.95	3.44	89.2
COUT	COBALT,UNFILT.TOTAL	ug/L	0	10.00	20.00	11	3	27.3	322	82	25.5	10.00	9.30	1.77	2.31	83.8
AGUT	SILVER,UNFILT.TOTAL	ug/L	0	10.00	30.00	11	2	18.2	321	82	25.6	10.00	10.40	1.75	2.53	75.7
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0	40.00	40.00	11	1	9.1	321	41	12.8	10.00	12.40	1.52	1.72	56.8
PBUT	LEAD,UNFILT.TOTAL	ug/L	0	130.00	130.00	11	1	9.1	322	57	17.7	50.00	59.50	1.33	1.86	51.4
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS																
PMMCRE	M-CRESOL	ug/L	1	22.80	69.40	10	5	50.0	275	167	60.7	16.98	25.59	2.50	3.45	86.5
PMPHEN	PHENOL	ug/L	2	18.40	21.10	10	2	20.0	275	118	42.9	9.10	14.52	1.50	2.46	78.4
PESTICIDES,HERBICIDES,PCBS																
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	0.09	0.68	10	10	100.0	276	214	77.5	0.27	0.13	2.22	3.72	100.0
P1BHCG	GAMMA-BHC(HEXACHLOROCYCLOHEXANE)	ug/L	2	0.02	0.04	10	6	60.0	276	143	51.8	0.02	0.02	1.66	2.29	94.6
P1FNDS	ENDOSULFAN SULPHATE	ug/L	3	0.14	0.27	10	4	40.0	276	13	4.7	0.08	0.04	2.48	1.56	16.2
P1BHCB	BETA-BHC (HEXACHLOROCYCLOHEXANE)	ug/L	1	0.02	0.04	10	2	20.0	276	32	11.6	0.01	0.01	1.60	1.66	35.1
P1MIRX	MIREX	ug/L	1	0.03	0.04	10	2	20.0	276	6	2.2	0.01	0.01	1.70	1.28	10.8
P3SILV	SILVEX	ug/L	3	0.10	0.10	10	2	20.0	276	28	10.1	0.06	0.06	1.34	1.68	40.5
P1PCBT	PCB, TOTAL	ug/L	2	0.10	0.10	10	1	10.0	276	42	15.2	0.09	0.06	4.04	2.31	46.0
P1PPDD	PP-DDD	ug/L	1	0.03	0.03	10	1	10.0	276	6	2.2	0.01	0.01	1.42	1.38	13.5
P1PPDE	PP-DDE	ug/L	1	5.80	5.80	10	1	10.0	276	15	5.4	0.02	0.01	7.48	1.74	24.3
P1PPDT	PP-DDT	ug/L	3	0.09	0.09	10	1	10.0	276	9	3.3	0.04	0.04	1.29	1.35	18.9
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	0.04	0.04	10	1	10.0	276	35	12.7	0.01	0.01	1.53	2.48	40.5
X2HCE	HEXACHLOROETHANE	ug/L	3	0.02	0.02	10	1	10.0	276	5	1.8	0.01	0.01	1.25	1.26	13.5
VOLATILES ORGANIC COMPOUNDS																
X1111T	1,1,1-TRICHLOROETHANE	ug/L	1	91.00	230.00	10	5	50.0	274	21	7.7	56.74	23.18	3.08	1.74	18.9
X1CHLO	CHLOROFORM	ug/L	1	47.00	112.00	10	3	30.0	274	28	10.2	30.27	23.90	2.02	1.75	32.4
X1DCLE	1,1-DICHLOROETHENE	ug/L	1	130.00	220.00	10	2	20.0	274	7	2.6	30.65	20.55	2.48	1.28	13.5
B2EBNZ	ETHYLBENZENE	ug/L	1	45.00	45.00	10	1	10.0	274	30	11.0	21.69	23.50	1.29	1.75	29.7
B2STYR	STYRENE	ug/L	1	38.00	38.00	10	1	10.0	274	9	3.3	22.25	21.40	1.40	1.39	10.8
X112CE	1,2-DICHLOROETHANE	ug/L	1	120.00	120.00	10	1	10.0	274	2	0.7	23.92	20.26	1.76	1.17	5.4
X112CP	1,2-DICHLOROPROPANE	ug/L	1	42.00	42.00	10	1	10.0	274	1	0.4	21.54	20.05	1.26	1.03	2.7
X1CTET	CARBON TETRACHLORIDE	ug/L	1	99.00	99.00	10	1	10.0	274	2	0.7	23.47	20.19	1.66	1.12	5.4

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Final Effluent
SAMPLE FORM : Wet Weight

CONTAMINANT	CONTAMINANT NAME	UNITS	QC COD	STD. FOR SURFACE WATER	STD. REF.	PLANT MIN. CONC > DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ DET.	GLOBAL # SAMPLES	GLOBAL # DET.	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
CONVENTIONALS																		
BOD5	BOD, 5 DAY - TOTAL DEMAND	mg/L	0		-	18.00	112.00	10	10	100.0	40	40	100.0	59.28	48.40	1.75	2.05	100.0
COD	CHEMICAL OXYGEN DEMAND	mg/L	0		-	50.00	376.00	10	10	100.0	40	40	100.0	122.13	109.54	1.90	1.56	100.0
DOC	DISSOLVED ORGANIC CARBON	mg/L	0		-	10.40	38.50	10	10	100.0	40	40	100.0	14.36	12.80	1.46	1.40	100.0
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0		-	2.20	10.10	10	10	100.0	40	40	100.0	5.42	10.46	1.80	1.66	100.0
NNTKUR	NITROGEN TOT KJEL,UNF TOT	mg/L	0		-	8.30	15.30	10	10	100.0	40	40	100.0	11.36	15.36	1.28	1.30	100.0
PH	(-LOG(H+CONCN))		0		-	6.75	7.04	10	10	100.0	40	40	100.0	6.89	6.88	1.01	1.03	100.0
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0		-	0.75	2.55	11	11	100.0	34	34	100.0	1.26	1.34	1.55	1.98	100.0
RSP	RESIDUE, PARTICULATE	mg/L	0		-	26.20	71.30	9	9	100.0	39	39	100.0	36.23	29.57	1.46	1.73	100.0
NNO2FR	NITRITE,FILT. REACT.	mg/L	0		-	0.15	0.53	10	4	40.0	40	4	10.0	0.02	0.00	9.11	4.03	14.3
NNOTFR	NITRATES,TOTAL FILT.REAC.	mg/L	0		-	0.90	1.53	10	4	40.0	40	4	10.0	0.12	0.05	6.88	3.16	14.3
PHNOL	PHENOLICS (4AAP)	mg/L	0	0.00	ONT-MOE	0.11	0.17	10	3	30.0	40	7	17.5	0.07	0.06	1.63	2.01	57.1
METALS																		
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	75.00	ONT-MOE	2000.00	4800.00	12	12	100.0	48	46	95.8	2920.00	350.00	1.43	3.45	100.0
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	0.20	ONT-MOE	0.03	0.08	8	8	100.0	39	38	97.4	0.04	0.05	1.40	2.42	100.0
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	3750.00	ONT-MOE	680.00	1030.00	12	12	100.0	48	47	97.9	880.00	304.90	1.13	2.83	100.0
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	30.00	ONT-MOE	30.00	40.00	12	12	100.0	48	48	100.0	30.00	69.80	1.15	3.04	100.0
CDUT	CADMIUM,UNFILT.TOTAL	ug/L	0	0.20	ONT-MOE	0.00	10.00	12	9	75.0	48	18	37.5	0.00	2.50	1.93	1.96	85.7
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	100.00	ONT-MOE	10.00	10.00	12	8	66.7	48	29	60.4	10.00	10.80	1.37	1.94	85.7
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	5.00	ONT-MOE	10.00	10.00	2	1	50.0	8	7	87.5	10.00	18.20	1.00	1.85	100.0
COUT	COBALT,UNFILT.TOTAL	ug/L	0	5.00	NYS-STD	10.00	20.00	12	3	25.0	48	11	22.9	10.00	6.50	1.74	1.58	85.7
NIUT	NICKEL,UNFILT.TOTAL	ug/L	0	25.00	ONT-MOE	10.00	20.00	12	2	16.7	48	10	20.8	10.00	8.70	1.34	2.86	57.1
CCNFUR	CYANIDE FREE,UNFILT.REAC.	ug/L	0	5.00	ONT-MOE	10.00	10.00	10	1	10.0	40	3	7.5	0.00	0.90	2.50	2.61	42.9
AGUT	SILVER,UNFILT.TOTAL	ug/L	0	0.10	ONT-MOE	10.00	10.00	12	1	8.3	48	8	16.7	10.00	6.40	1.63	1.61	57.1
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0		-	10.00	10.00	12	1	8.3	48	11	22.9	10.00	6.60	1.22	1.66	71.4
PBUT	LEAD,UNFILT.TOTAL	ug/L	0	25.00	ONT-MOE	30.00	30.00	12	1	8.3	48	9	18.8	20.00	20.80	1.27	1.94	71.4
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS																		
PMMCRE	M-CRESOL	ug/L	1		-	9.10	32.40	10	8	80.0	39	18	46.2	9.62	3.90	2.86	2.97	71.4
PNNAPH	NAPHTHALENE	ug/L	1	10.00	NYS-STD	2.20	2.60	10	3	30.0	39	5	12.8	1.30	1.13	1.54	1.42	42.9
PMPHEN	PHENOL	ug/L	2	1.00	ONT-MOE	3.40	6.40	10	2	20.0	39	5	12.8	1.88	1.78	1.65	1.60	42.9
PMBBF	BUTYLBENZYLPHTHALATE	ug/L	1	50.00	NYS-GUL	8.90	8.90	10	1	10.0	39	8	20.5	1.24	1.42	2.00	2.10	57.1
PESTICIDES,HERBICIDES,PCBS																		
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	4.00	ONT-MOE	0.02	1.00	10	10	100.0	40	27	67.5	0.13	0.06	3.41	4.96	85.7
P1BHCG	GAMMA-BHC(HEXACHLOROCYCLOHEXANE)	ug/L	3	0.06	ONT-MOE	0.02	0.04	10	7	70.0	40	29	72.5	0.02	0.02	2.26	2.28	85.7
X2HCB	HEXACHLOROETHANE	ug/L	3		-	0.02	0.03	10	5	50.0	40	5	12.5	0.01	0.01	2.19	1.64	14.3
P1BHCB	BETA-BHC (HEXCHLOROCYCLOHEXANE)	ug/L	1	0.01	ONT-MOE	0.01	0.01	10	4	40.0	40	6	15.0	0.01	0.01	1.43	1.36	28.6
P3245T	2,4,5-TRICLOROPHENOXYACETIC ACID	ug/L	3		-	0.06	0.15	10	4	40.0	40	7	17.5	0.04	0.04	2.11	2.61	42.9
P1PCBT	PCB, TOTAL	ug/L	2	0.00	ONT-MOE	0.06	0.15	10	2	20.0	40	7	17.5	0.05	0.03	3.03	3.06	28.6
P3SILV	SILVEX	ug/L	3		-	0.06	0.10	10	2	20.0	40	9	22.5	0.03	0.03	1.64	2.19	57.1
P1ENDS	ENDOSULFAN SULPHATE	ug/L	3		-	0.14	0.14	10	1	10.0	40	1	2.5	0.02	0.02	1.85	1.36	14.3
P1HEPT	HEPTACHLOR	ug/L	3	0.00	ONT-MOE	0.02	0.02	10	1	10.0	40	1	2.5	0.01	0.01	1.35	1.25	14.3
P1MIRX	MIREX	ug/L	1	0.00	ONT-MOE	0.04	0.04	10	1	10.0	40	1	2.5	0.01	0.01	1.93	1.39	14.3
P1PPDT	PP-DDT	ug/L	3	0.00	ONT-MOE	0.11	0.11	10	1	10.0	40	1	2.5	0.02	0.02	1.71	1.31	14.3
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/L	3	0.07	NYS-STD	0.06	0.06	10	1	10.0	40	1	2.5	0.05	0.05	1.06	1.03	14.3
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	0.50	ONT-MOE	0.03	0.03	10	1	10.0	40	1	2.5	0.01	0.01	1.76	1.33	14.3

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Final Effluent
SAMPLE FORM : Wet Weight

CONTAM-INANT	CONTAMINANT NAME	UNITS	QC CODE	STD. FOR SURFACE WATER	STD. REF.	PLANT MIN. CONC. > DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ. DET.	GLOBAL # SAMPLES	GLOBAL # DET.	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
VOLATILES	ORGANIC COMPOUNDS																	
X1111T	1,1,1-TRICHLOROETHANE	ug/L	1	50.00	NYS-GUL	3.70	160.00	10	9	90.0	38	10	26.3	20.99	2.34	4.77	3.17	28.6
X1CTET	CARBON TETRACHLORIDE	ug/L	1	0.40	NYS-GUL	4.60	53.00	10	9	90.0	38	9	23.7	15.22	2.05	3.23	3.84	14.3
X1TETR	TETRACHLOROETHYLENE	ug/L	1	0.70	NYS-GUL	2.70	12.00	10	8	80.0	38	21	55.3	4.12	4.39	2.38	5.84	85.7
X1CHLO	CHLOROFORM	ug/L	1	0.20	NYS-STD	12.00	16.00	10	5	50.0	38	15	39.5	3.75	2.07	4.04	2.72	71.4
X1DCLE	1,1-DICHLOROETHENE	ug/L	1	0.07	NYS-GUL	70.00	110.00	10	3	30.0	38	3	7.9	3.87	1.43	8.86	3.44	14.3
B2OXYL	O-XYLENE	ug/L	1	100.00	ONT-MOB	2.70	3.00	10	2	20.0	38	13	34.2	1.23	1.94	1.56	3.05	85.7
B2MPXY	M-, AND P-XYLENES	ug/L	1	50.00	NYS-GUL	3.80	3.80	10	1	10.0	38	10	26.3	1.14	1.83	1.53	3.42	85.7
B2STYR	STYRENE	ug/L	1	15.00	ONT-MOB	15.00	15.00	10	1	10.0	38	1	2.6	1.89	1.59	2.07	1.45	14.3
X1TRIC	TRICHLOROETHYLENE	ug/L	1	3.00	NYS-GUL	23.00	23.00	10	1	10.0	38	7	18.4	1.37	1.71	2.70	3.60	42.9

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Raw Sludge
SAMPLE FORM : Dry Weight

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	PLANT MIN. CONC. > DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ. DET.	GLOBAL # SAMPLES	GLOBAL # DET	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
CONVENTIONALS																
COD	CHEMICAL OXYGEN DEMAND	mg/kg	0	1095427.44	1209302.33	2	2	100.0	45	45	100.0	1150937.40	892721.45	1.07	3.19	100.0
NNH3TFR	AMMONIUM,TOTAL FILT.REAC.	mg/kg	0	1097.42	2558.14	2	2	100.0	48	47	97.9	1675.51	5911.32	1.82	4.59	100.0
NNOTFR	NITRATES,TOTAL FILT.REAC.	mg/kg	0	5.96	9.51	2	2	100.0	48	43	89.6	7.53	25.44	1.39	2.21	93.9
NNTKUR	NITROGEN TOT KJEL.UNF.TOT	mg/kg	0	15805.17	27061.31	2	2	100.0	51	51	100.0	20681.13	36897.88	1.44	2.98	100.0
PH	PH(HYDROGEN ION)	mg/kg	0	5.95	5.97	2	2	100.0	49	49	100.0	5.96	6.03	1.00	1.10	100.0
PHNOL	PHENOLICS (4AAP)	mg/kg	0	59.20	238.57	2	2	100.0	50	41	82.0	118.84	82.36	2.68	3.54	83.3
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/kg	0	12823.06	20359.42	2	2	100.0	42	42	100.0	16157.66	20347.70	1.39	4.43	100.0
RST	RESIDUE, TOTAL	mg/kg	0	47300.00	50300.00	2	2	100.0	51	51	100.0	48776.94	33783.31	1.04	1.81	100.0
RSTLOI	RESIDUE,TOT LOSS ON IGNI.	mg/kg	0	30700.00	30800.00	2	2	100.0	51	51	100.0	30749.96	20801.05	1.00	1.77	100.0
METALS																
AGUT	SILVER,UNFILT.TOTAL	mg/kg	0	11.73	15.22	2	2	100.0	45	40	88.9	13.36	30.17	1.20	2.61	84.4
ALUT	ALUMINUM,UNFILT.TOTAL	mg/kg	0	57083.45	59642.15	2	2	100.0	51	51	100.0	58348.27	9835.74	1.03	2.51	100.0
ASUT	ARSENIC,UNFILT.TOTAL	mg/kg	0	6.34	6.56	2	2	100.0	51	50	98.0	6.45	6.13	1.02	2.01	97.1
CDUT	CADMIUM,UNFILT.TOTAL	mg/kg	0	1.37	1.99	2	2	100.0	43	40	93.0	1.65	9.74	1.30	4.35	90.0
CRUT	CHROMIUM,UNFILT.TOTAL	mg/kg	0	52.83	53.68	2	2	100.0	51	50	98.0	53.26	301.43	1.01	3.68	97.1
CUUT	COPPER,UNFILT.TOTAL	mg/kg	0	261.31	261.31	1	1	100.0	46	46	100.0	261.31	606.31	0.00	1.72	100.0
HGUT	MERCURY,UNFILT.TOTAL	mg/kg	0	1.59	1.69	2	2	100.0	50	50	100.0	1.64	2.21	1.04	1.67	100.0
MOUT	MOLYBDENUM,UNFILT.TOTAL	mg/kg	0	2.78	2.96	2	2	100.0	37	23	62.2	2.87	3.80	1.04	2.88	64.3
NIUT	NICKEL,UNFILT.TOTAL	mg/kg	0	10.34	21.14	2	2	100.0	46	44	95.7	14.93	50.17	1.64	2.90	93.3
PBUT	LEAD,UNFILT.TOTAL	mg/kg	0	88.79	149.11	2	2	100.0	49	48	98.0	115.06	173.99	1.44	2.24	96.9
SEUT	SELENIUM,UNFILT.TOTAL	mg/kg	0	1.59	2.11	2	2	100.0	50	48	96.0	1.83	3.04	1.22	1.93	93.9
SRUT	STRONTIUM,UNFILT.TOTAL	mg/kg	0	380.55	397.61	2	2	100.0	51	51	100.0	388.99	231.70	1.03	1.97	100.0
ZNUT	ZINC,UNFILT.TOTAL	mg/kg	0	317.12	337.97	2	2	100.0	51	51	100.0	327.38	905.39	1.05	2.39	100.0
COUT	COBALT,UNFILT.TOTAL	mg/kg	0	3.58	3.58	2	1	50.0	41	30	73.2	3.38	9.29	3.87	4.69	73.3
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS																
PM4CRE	M-CRESOL	ug/kg	1	35785.30	194503.20	2	2	100.0	51	42	82.3	83428.70	116847.30	3.31	12.16	85.7
DIOXINS AND FURANS																
PI4CDF	TETRACHLORODIBENZOFURAN	ug/kg	2	6.40	6.40	2	1	50.0	50	3	6.0	3.70	2.40	2.30	2.96	8.8
PESTICIDES,HERBICIDES,PCBS																
PIBHCB	BETA-HEXACHLOROCYCLOHEX.	ug/kg	1	8.00	38.10	2	2	100.0	51	18	35.3	17.50	7.40	3.02	3.29	38.2
PIBHCG	GAMMA-HEXACHLOROCYCLOHEX	ug/kg	2	11.90	16.90	2	2	100.0	51	28	54.9	14.20	8.90	1.28	2.69	67.7
PIDIEL	DIELDRIN	ug/kg	2	6.00	12.70	2	2	100.0	51	20	39.2	8.70	7.20	1.70	3.10	50.0
PIMOXT	METHOXYCHLOR	ug/kg	1	39.60	63.40	2	2	100.0	51	19	37.3	61.30	45.80	3.04	5.15	44.1
PIPCBT	PCB, TOTAL	ug/kg	2	23.90	69.80	2	2	100.0	51	40	78.4	40.80	88.70	2.13	1.18	79.4
PIPPDE	PP DDE	ug/kg	1	4.00	4.20	2	2	100.0	51	22	43.1	4.10	7.30	1.04	2.31	52.9
PI24D	2,4-DICHLOROPHENOXYACETIC	ug/kg	3	16.90	472.80	2	2	100.0	51	38	74.5	84.50	93.20	9.74	6.50	82.3
X124	1,2,4-TRICHLOROBENZENE	ug/kg	3	10.60	11.90	2	2	100.0	51	17	33.3	11.20	9.30	1.09	4.06	41.2
PIBHCA	ALPHA-HEXACHLOROCYCLOHEX.	ug/kg	1	21.10	21.10	2	1	50.0	51	12	23.5	6.50	5.50	5.29	2.74	35.3
PIESN2	ENDOSULFAN II	ug/kg	3	13.90	13.90	2	1	50.0	51	6	11.8	5.40	4.20	3.81	2.38	17.7
PIESNS	ENDOSULFAN SULPHATE	ug/kg	3	516.90	516.90	2	1	50.0	51	6	11.8	66.30	18.60	18.26	2.80	17.7

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Raw Sludge
SAMPLE FORM : Dry Weight

CONTAM INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	PLANT MIN. CONC. > DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ. DET.	GLOBAL # SAMPLES	GLOBAL # DET	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
[illegible]	HEPTACHLOR EPOXIDE	ug/kg	2	9.90	9.90	2	1	50.0	51	12	23.5	4.60	5.00	2.99	1.82	31.4
[illegible]	[illegible]	ug/kg	1	6.30	6.30	2	1	50.0	51	13	25.5	3.30	5.10	2.23	2.49	35.3
VOLATILES ORGANIC COMPOUNDS																
X1BDCM	BROMODICHLOROMETHANE	ug/kg	1	1749.50	1749.50	2	1	50.0	51	1	2.0	1031.30	934.60	2.05	1.82	2.9
X1CHLO	CHLOROFORM (CHCL3)	ug/kg	1	6763.30	6763.30	2	1	50.0	51	12	23.5	1640.10	1225.10	7.42	4.24	35.3

PLANT NAME : Cornwall
PLANT TYPE : Primary

SAMPLING TYPE : Treated Sludge
SAMPLE FORM : Dry Weight

CONTAMINANT	CONTAMINANT NAME	UNITS	QA/QC CODE	PLANT MIN. CONC. > DL	PLANT MAX. DET. CONC.	PLANT # SAMPLES	PLANT # DET.	PLANT % FREQ. DET.	GLOBAL # SAMPLES	GLOBAL # DET	GLOBAL % FREQ. DET.	PLANT GEO. MEAN	GLOBAL GEO. MEAN	PLANT SPREAD FACTOR	GLOBAL SPREAD FACTOR	GLOBAL % PREV.
CONVENTIONALS																
COD	CHEMICAL OXYGEN DEMAND	mg/kg	0	968880.89	968880.89	1	1	100.0	36	36	100.0	968880.89	308097.94	0.00	4.65	100.0
NNTKUR	NITROGEN TOT KJEL,AMP,TOT	mg/kg	0	22500.00	25800.00	2	2	100.0	49	49	100.0	24093.57	38494.12	1.10	1.77	100.0
PH	PH (CONCN)	mg/kg	0	7.10	7.20	2	2	100.0	47	47	100.0	7.15	7.17	1.01	1.09	100.0
PHNOL	PHENOLICS (4AAP)	mg/kg	0	25.33	66.06	2	2	100.0	49	41	83.7	40.91	43.05	1.97	3.14	87.9
PPUT	PHOSPHORUS,UNFILT TOTAL	mg/kg	0	25119.99	45940.01	2	2	100.0	43	43	100.0	33970.76	26638.67	1.53	6.91	100.0
RST	RESIDUE, TOTAL	mg/kg	0	225000.00	227000.00	2	2	100.0	50	50	100.0	225997.79	80434.06	1.01	3.23	100.0
RSTLOI	RESIDUE TOT LOSS ON IGNI	mg/kg	0	109187.00	117000.00	2	2	100.0	50	50	100.0	113026.01	43379.33	1.05	3.19	100.0
METALS																
AGUT	SILVER,UNFILT TOTAL	mg/kg	0	13.74	22.06	2	2	100.0	44	44	100.0	17.41	37.78	1.40	2.33	100.0
ALUT	ALUMINUM,UNFILT TOTAL	mg/kg	0	65462.56	79111.11	2	2	100.0	50	50	100.0	71961.99	10715.94	1.14	2.82	100.0
ASUT	ARSENIC,UNFILT TOTAL	mg/kg	0	5.73	6.67	2	2	100.0	50	49	98.0	6.18	5.40	1.11	2.06	97.1
CDUT	CADMIUM,UNFILT TOTAL	mg/kg	0	2.64	2.67	2	2	100.0	45	41	91.1	2.65	10.47	1.01	3.98	90.3
COUT	COBALT,UNFILT TOTAL	mg/kg	0	8.00	8.00	1	1	100.0	39	32	82.1	8.00	9.14	0.00	2.75	83.7
CRUT	CHROMIUM,UNFILT TOTAL	mg/kg	0	46.26	75.54	2	2	100.0	50	50	100.0	59.12	333.06	1.41	3.59	100.0
CUUT	COPPER,UNFILT TOTAL	mg/kg	0	320.00	320.00	1	1	100.0	43	43	100.0	320.00	732.26	0.00	2.16	100.0
HGUT	MERCURY,UNFILT TOTAL	mg/kg	0	2.53	3.83	2	2	100.0	50	49	98.0	3.12	3.24	1.34	2.04	97.1
NIUT	NICKEL,UNFILT TOTAL	mg/kg	0	32.44	32.44	1	1	100.0	45	42	93.3	32.44	72.95	0.00	2.95	90.0
PBUT	LEAD,UNFILT TOTAL	mg/kg	0	133.33	144.91	2	2	100.0	50	49	98.0	139.01	196.62	1.06	2.46	97.5
SEUT	SELENIUM,UNFILT TOTAL	mg/kg	0	1.76	1.78	2	2	100.0	50	48	96.0	1.77	3.67	1.01	2.98	97.1
SRUT	STRONTIUM,UNFILT TOTAL	mg/kg	0	343.61	457.78	2	2	100.0	50	50	100.0	396.61	240.93	1.22	2.34	100.0
ZNUT	ZINC,UNFILT TOTAL	mg/kg	0	409.69	417.78	2	2	100.0	50	50	100.0	413.71	988.90	1.01	2.37	100.0
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS																
PNPHEN	PHENANTHRENE	ug/kg	1	5333.30	7048.50	2	2	100.0	50	12	24.0	6131.20	3220.50	1.22	4.27	26.5
PNCHRY	CHRYSENE	ug/kg	1	4296.40	4296.40	2	1	50.0	50	4	8.0	1375.70	1475.50	5.01	3.39	11.8
PESTICIDES,HERBICIDES,PCBS																
P1PCBT	PCB, TOTAL	ug/kg	2	89.60	207.60	2	2	100.0	50	32	64.0	136.40	114.10	1.81	4.58	67.7
X2124	1,2,4-TRICHLOROBENZENE	ug/kg	3	26.80	120.00	2	2	100.0	50	22	44.0	56.70	14.80	2.09	5.02	52.9
P1BHCB	BETA BHC (HEXACHLOROCYCLOHEX)	ug/kg	1	17.30	17.30	2	1	50.0	50	19	38.0	8.70	8.80	2.63	4.39	47.1
P1CHLA	ALPHA CHLORDANE	ug/kg	1	20.50	20.50	2	1	50.0	50	22	44.0	9.30	6.30	2.97	2.41	55.9
P1CHLG	GAMMA CHLORDANE	ug/kg	1	26.00	26.00	2	1	50.0	50	21	42.0	10.70	6.80	3.51	2.58	52.9
P1DIEL	DIELDRIN	ug/kg	2	10.30	10.30	2	1	50.0	50	15	30.0	6.70	6.50	1.82	3.51	38.2
P1DMOT	METHOXYCHLOR	ug/kg	1	74.90	74.90	2	1	50.0	50	15	30.0	40.60	34.10	2.38	4.42	38.2
P1ENDS	ENDOSULFAN SULFATE	ug/kg	3	71.40	71.40	2	1	50.0	50	6	12.0	35.60	17.50	2.67	2.53	17.7
P1HEPE	HEPTACHLOR EPOXIDE	ug/kg	2	11.80	11.80	2	1	50.0	50	10	20.0	7.20	5.20	2.01	2.66	23.5
P1PPDD	PP DDD	ug/kg	1	33.00	33.00	2	1	50.0	50	7	14.0	13.00	4.60	4.16	2.47	20.6
P1PPDE	PP DDE	ug/kg	1	23.90	23.90	2	1	50.0	50	34	68.0	10.30	11.10	3.31	2.72	73.5
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/kg	3	86.90	86.90	2	1	50.0	50	8	16.0	43.90	34.20	2.62	2.76	23.5
VOLATILE ORGANIC COMPOUNDS																
H2EBNZ	ETHYLBENZENE [illegible]	ug/kg	1	1155.60	1155.60	2	1	50.0	50	14	28.0	319.10	606.50	6.12	5.59	32.4
X1CHBD	[illegible]	ug/kg	1	297.80	297.80	2	1	50.0	50	12	24.0	162.00	441.70	2.37	4.35	35.3

PERFORMANCE DATA - CORNWALL WATER POLLUTION CONTROL PLANT - bJAN/83 - DEC/83

	FLOW DATA Design Capacity: 37.504 1000m³				BIOCHEMICAL OXYGEN DEMAND DESIGN BOD: 130.0 mg/L				SUSPENDED SOLIDS DESIGN SUSPENDED SOLIDS: 160.0 mg/L				TOTAL PHOSPHORUS			
MONTH	TOTAL VOL. 1000m³/dy	AVG. DAY 1000m³/dy	MAX. DAY 1000m³/dy	Peak Rt. 1000m³/dy	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg
JAN.	1279.980	41.290	78.400	99.000	110	77.0	30	42.2	110	42.0	61	87.0	2.8	1.52	47	1.741
FEB.	1169.600	41.770	82.600	103.000	135	82.3	39	61.6	99	40.0	59	69.9	3.0	1.29	57	2.023
MARCH	1636.600	52.770	90.600	98.000	63	34.7	45	46.7	65	27.3	58	62.8	2.4	.83	66	2.716
APRIL	2079.830	69.330	90.800	102.000	57	27.0	52	62.3	61	38.0	38	49.2	1.9	1.12	42	1.747
MAY	1763.150	56.880	86.700	100.000	50	21.5	57	50.2	98	23.8	75	131.3	2.3	.87	62	2.609
JUNE	1294.990	43.170	58.400	89.000	79	22.5	71	73.1	95	19.8	79	98.4	3.0	.71	76	3.043
JULY	1310.450	42.270	51.300	110.000	90	21.5	59	42.6	88	17.3	80	93.5	3.0	.73	75	2.988
AUGUST	1332.270	42.980	72.200	110.000	53	56.0	38	38.4	88	20.8	76	89.7	2.8	.88	68	2.585
SEPT.	1108.320	36.940	65.200	110.000	90	56.0	38	383.4	122	30.7	75	102.1	3.3	1.11	66	2.427
OCT.	1284.700	41.440	69.900	106.000	86	48.0	44	49.4	103	34.8	66	88.6	3.2	1.15	64	2.698
NOV.	1889.270	62.980	92.900	99.000	85	47.2	44	72.9	84	23.9	71	114.3	2.1	.77	63	2.513
DEC.	1797.670	57.990	96.100	102.000	33	19.0	42	25.1	95	23.3	75	130.1	1.8	.89	52	1.762
TOTAL	17946.250							664.7				1117.5				28.852
AVERAGE		49.151			77	39.2	50		92	28.4	68		2.6	.98	62	
MAXIMUM			96.100	111.00												
NO. OF SAMPLES					39	39			80	80			187	187		

Source: MOE, 1984

CORNWALL WATER POLLUTION CONTROL PLANT - JAN/84 - DEC/84

	FLOW DATA Design Capacity: 37.504 1000m³				BIOCHEMICAL OXYGEN DEMAND DESIGN BOD: 130.0 mg/L				SUSPENDED SOLIDS DESIGN SUSPENDED SOLIDS: 160.0 mg/L				TOTAL PHOSPHORUS			
MONTH	TOTAL VOL. 1000m³/dy	AVG. DAY 1000m³/dy	MAX. DAY 1000m³/dy	PEAK RT. 1000m³/dy	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg
JAN.	1272.800	41.060	52.900	79.000	111	65.7	40	57.6	91	36.9	59	68.8	2.8	1.57	43	1.566
FEB.	1742.680	60.090	90.400	102.000	89	58.5	34	53.1	110	38.0	65	125.4	2.7	1.40	48	2.265
MARCH	1718.420	55.430	88.900	96.000	95	43.0	54	89.3	106	25.0	76	139.1	2.5	1.06	58	2.560
APRIL	2110.600	70.350	90.000	105.000	58	46.5	19	24.2	148	18.4	87	273.5	1.9	.76	60	2.406
MAY	1947.460	68.820	85.300	96.000	63	41.0	34	42.8	104	16.5	84	170.4	1.19	.86	54	2.025
JUNE	14102.070	46.790	71.500	110.000	94	45.0	52	68.7	100	22.7	77	108.3	2.4	.90	62	2.103
JULY	1334.010	43.030	59.800	92.000	57	17.7	68	52.4	90	16.0	82	98.7	2.6	.69	73	2.548
AUGUST	1370.050	44.200	64.500	104.000	54	29.0	46	34.2	82	23.0	71	80.8	2.8	.78	72	2.768
SEPT.	1090.100	36.340	47.000	82.000	125	59.5	52	70.9	132	23.3	81	118.4	3.3	1.04	68	2.446
OCT.	1082.450	34.920	52.400	86.000	125	59.5	52	70.9	119	22.5	81	104.4	3.3	1.104	68	2.446
NOV.	1102.900	36.760	57.400	98.000	123	62.5	49	66.7	125	21.3	82	114.3	3.2	.95	70	2.482
DEC.	1387.860	44.770	77.800	93.000	88	50.5	42	52.0	116	20.7	82	132.2	2.6	.89	65	2.373
TOTAL	17561.400							698.4				1534.9				27.820
AVERAGE		48.543			88	45.5	47		110	23.6	77		2.6	.98	62	
MAXIMUM			90.400	110.000												
NO. OF SAMPLES					27	27			56	56			179	166		

CORNWALL WATER POLLUTION CONTROL PLANT - JAN/85 - DEC/85

MONTH	FLOW DATA Design Capacity: 37.504 1000m³				DESIGN BOD: 130.0 mg/L BIOCHEMICAL OXYGEN DEMAND				SUSPENDED SOLIDS DESIGN SUSPENDED SOLIDS: 160.0 mg/L				TOTAL PHOSPHORUS			
	TOTAL VOL. 1000m³/dy	AVG. DAY 1000m³/dy	MAX. DAY 1000m³/dy	Peak Rt. 1000m³/day	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg	INFLUENT	EFFLUENT	% REMOVAL	REDUCTION 1000 kg	INFLUENT mg/L	EFFLUENT mg/L	% REMOVAL	REDUCTION 1000 kg
JAN.	1138.87	36.74	47.80	92.00	66.00	35.30	46.52	34.96	103.80	27.20	73.80	87.24	3.03	1.19	60.73	2.10
FEB.	1321.20	47.19	91.00	96.00	60.50	38.50	36.36	29.07	95.50	29.50	69.11	87.20	2.76	1.25	54.71	2.00
MARCH	2194.50	70.79	90.60	97.00	45.00	25.50	43.33	42.79	81.00	19.00	76.54	136.06	1.83	0.81	55.74	2.24
APRIL	1767.67	58.92	90.70	95.00	60.00	32.50	45.83	48.61	85.00	18.20	78.59	118.08	2.07	0.78	62.32	2.28
MAY	1332.64	42.99	66.20	94.00	95.00	56.50	40.53	51.31	127.50	26.80	78.98	134.20	2.81	1.13	59.79	2.24
JUNE	1610.85	53.70	85.10	96.00	81.00	62.50	22.84	29.80	111.00	29.70	73.24	130.96	2.35	0.87	62.98	2.38
JULY	1416.16	45.68	62.90	85.00	73.00	28.00	61.64	63.73	134.00	23.00	82.84	157.19	2.83	1.03	63.60	2.55
AUGUST	1320.51	42.60	63.80	94.00	62.00	23.00	62.90	51.50	94.00	21.00	77.66	96.40	2.96	0.88	70.27	2.75
SEPT.	1235.38	41.18	78.70	104.00	92.00	42.00	54.35	61.77	108.00	28.00	74.07	98.83	3.19	1.31	58.93	2.32
OCT.	1412.92	45.58	66.80	99.00	88.00	55.00	37.50	46.63	112.00	23.00	79.46	125.75	2.71	0.85	68.63	2.63
NOV.	1415.83	47.19	77.10	92.00	74.00	29.00	60.81	63.71	121.00	18.00	85.12	145.83	2.60	0.82	68.46	2.52
DEC.	1222.65	39.44	63.00	82.00	73.00	57.00	21.92	19.56	96.00	30.00	68.75	80.69	2.59	1.01	61.00	1.93
TOTAL	17389.18							543.24				1398.43				27.93
AVERAGE	-	47.67			72.46	40.40	44.24		105.73	24.45	76.88		2.64	0.99	62.40	2.33
MAXIMUM	-		91.00	104.00												
NO. OF SAMPLES																

ORGANIC POLLUTANTS (ug/l): CORNWALL WPCP EFFLUENT AFTER CHLORINATION (FINAL EFFLUENT), 1980

Fraction/Compound	June 4	June 11	Nov. 20
1. Purgeable Fraction (PP) Analysed packed column GC, not confirmed MS			
Methylene Chloride	*	*	75
Trichlorofluoromethane or 1,1-Dichloroethylene			T
1,1-Dichloroethane			21
Chloroform			T
1,1,1-Trichloroethane			17
Carbon Tetrachloride			48
1,2-Dichloropropane			17
Trans-1,3-Dichloropropene			24
Trichloroethylene or cis-1,3-Dichloropropene			T
1,1,2-Trichloroethane or Dibromochloromethane or Benzene			T
Toluene			T

* Purgeables not analysed June 4, 11

2. Acid Fraction (PP)

None detected, analysed GC/MS, packed column (June samples)

3. Base/Neutral Fraction (PP) (GC/MS packed column, Nov. 20 Not Analysed)

Fraction/Compound	June 4	June 11	Nov. 20
Di-n-butyl Phthalate	80	94	
Anthracene	T	-	
Di-n-octyl Phthalate	T	T	

4. Pesticide/PCB Fraction (PP)

None detected packed column GC

5. Other Compounds (NPP)

Fraction/Compound	June 4	June 11	Nov. 20
Acetone*	--	--	35
THF(Tetrahydrofuran)*	--	--	T
Octanoic Acid	--	--	P
Methly Propyl Acetic Acid	--	--	P
Phthalic Acid	T	--	P
Phthalic Acid Derivatives	--	--	P
2-Methylphenol	T	--	--
Benzoic Acid	P	--	--
Tetrakis Benzene	T	--	--

Note: P-Present (not quantified); T-Trace (less than 1 ug/l [acid, base/neutral] 5 ug/l [purgeable]); PP - Priority Pollutants; NPP - Non-Priority Pollutants
* Analysed packed column GC, not confirmed MS

Source: EPS, 1985

APPENDIX XIV. TOXICITY RESULTS FOR CORNWALL EFFLUENTS

The statistics involved in calculating LC50s are specialized to the field of toxicology (for more details see Stephan, 1977). This is because the observation on the fish establishes whether it is alive or dead and nothing in between. It also involves a concept of the median fish. Individual fish vary in their sensitivity to a given effluent. Some have unusual sensitivity to the effluent, while others show unusual resistance, but most show an average sensitivity somewhere in the middle. At 50% survival, therefore, we find the largest numbers of a population responding and hence the greatest strength statistically. This is why LC50s are chosen as the preferred endpoint.

Ontario's new monitoring regulations require an acute lethality test using *Daphnia magna* as well as the one using trout (see protocol, Poirier *et al.*, 1988). *Daphnia*-like organisms are an extremely important group of aquatic animals and have very different anatomy and physiology to that of fish.

Daphnia magna are small invertebrate animals of 2 to 5 mm in length. They are covered by a translucent clam-shaped surface layer through which the internal structures can be seen. They move in a hopping motion through the water by means of their large second antennae. They feed by filtering water and particles with their thoracic legs found under the carapace. In healthy cultures, almost all of the individuals are females. They reproduce asexually, producing fully mobile young which are genetically identical to the adult and, when released, they look very much like the adult except for size. These young animals (no older than 24 h) are the ones used in the toxicity test.

The acute lethality test involving *Daphnia magna* is set up much the same as in the trout test except that 50 ml test tubes are used instead of 20 litre test buckets. Also, three animals are used in each of four test tubes at each concentration which is replicated six times. This means that at least $3 \times 4 \times 6 = 72$ young *Daphnia* are used for each sample. The test can be done on as little as 500 ml of sample. Another major difference is the exposure duration which is two days instead of four as in the trout test. This difference is appropriate because of the much shorter life span of *Daphnia* compared to trout.

For some effluents *Daphnia* are more sensitive than are trout, whereas for other effluents the reverse is true. Since the objective is to conserve all aquatic life, both animals need to be protected and both are valuable toxicity test organisms. Most people realize the importance of fish to aquatic environments but one normally has to study biology to become aware of the importance of *Daphnia*. Nearly all the life in any body of water is derived in one way or another from the photosynthetic activity of algae. Generally, fish do not eat algae directly but consume smaller animals that are able to filter and digest the algae. In freshwater environments, the various species of *Daphnia* are typically the most common members of this group. Loss or reduction in populations of *Daphnia* can cause algal blooms, since they feed on algae; or the collapse of sport fish populations, because they are themselves an important food source.

Documentation of industrial effluent toxicity has only been gathered since 1976 for industries situated in Cornwall. Toxicity testing of the Cornwall Municipal Water Pollution Control Plant was conducted in 1981 and 1987. All of the toxicity results are discussed below and summarized in Appendix XIII.

Table 1. Toxicity of Courtaulds Fibres effluent samples on Rainbow trout.

Sample site	Sample Number	Sample Date	96 Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
Acid sewer	76-14	03/09/76	2.3	3.2 - 1.8
	76-49	08/27/76	1.0	5.0 - 1.0
	77-40	06/27/77	1.4	2.5 - 1.0
	77-101A	08/16/77	0.9	1.1 - 0.7
	77-124	11/29/77	2.1	2.7 - 1.6
	77-127	11/30/77	2.2	2.8 - 1.7
	79-12	04/24/79	1.4	2.0 - 0.5
	80-173	09/23/80	0.8	1.1 - 0.6
	80-179	10/01/80	4.0	5.0 - 3.0
	81-1	06/17/81	1.7	5.0 - 1.0
	81-2	06/18/81	1.3	5.0 - 1.0
	81-3	06/19/81	1.4	5.0 - 1.0
	81-4	06/20/81	1.1	5.0 - 0.5
	81-5	06/21/81	1.1	5.0 - 0.5
	81-6	06/22/81	1.1	5.0 - 0.5
	81-7	06/23/81	1.1	5.0 - 0.5
	81-8	06/24/81	1.1	5.0 - 0.5
	81-9	06/25/81	0.9	5.0 - 0.5
	81-10	06/26/81	1.0	5.0 - 0.5
	81-11	06/27/81	2.0	5.0 - 1.0
	81-12	06/28/81	1.6	5.0 - 1.0
	81-13	06/29/81	1.4	5.0 - 1.0
	81-14	06/30/81	2.0	5.0 - 1.0
	81-15	07/01/81	1.6	5.0 - 1.0
	81-16	07/02/81	1.9	5.0 - 1.0
	81-17	07/03/81	1.6	5.0 - 1.0
	84-088	07/26/84	0.3	0.5 - 0.2
	85-36	06/18/85	2.2	5.0 - 1.0
	01880210	09/29/88	0.5	1.1 - 0.0

Table 2. Toxicity of Courtaulds Films effluent samples to Rainbow trout.

Sample site	Sample Number	Sample Date	96 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
TCF well	80-168	09/23/80	non-lethal	
Sewer #1	76-37	09/10/76	26.0	30.0 - 20.0
	77-36	06/27/77	20.0	30.0 - 10.0
	77-96	08/16/77	45.0	50.0 - 40.0
	77-123	11/29/77	45.0	50.0 - 40.0
	79-16	04/24/79	44.3	50.0 - 40.0
Sewer #2	77-37	06/27/77	non-lethal	
	77-36	08/16/77	non-lethal	
	80-185	10/01/80	non-lethal	
Sewer #3	76-48	08/06/76	4.2	5.0 - 1.0
	77-38	06/27/77	6.0	10.0 - 5.0
	79-15	04/24/79	1.3	5.0 - 1.0
	80-159	09/23/80	1.7	2.0 - 1.4
	80-176	10/01/80	3.0	3.5 - 2.5

Table 3. Toxicity of Canadian Industries Limited Effluent Samples To Rainbow Trout

Sample site	Sample Number	Sample Date	96Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
Lel 2 sewer	79-191	10/05/79	non-lethal	
	79-192	12/06/79	71.0	100 - 50.0
	m28121	07/14/81	>100.0	
	81-43	08/04/81	non-lethal	
	87-194	11/10/87	non-lethal	

Table 4. Toxicity of Cornwall Municipal STP effluent samples to Rainbow trout

Sample site	Sample Number	Sample Date	96Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
influent	81-84	06/25/81	non-lethal	
final effluent	81-85	06/25/81	non-lethal	
	87-190	11/10/87	100	>100 - 65.0

Table 5. Toxicity of Cornwall Chemicals effluent samples to Rainbow trout

Sample site	Sample Number	Sample Date	96Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
combined final	76-28	07/23/76	24.0	30.0 - 20.0
	76-38	08/10/76	7.5	10.0 - 5.6
	77-43	06/28/77	non-lethal	
	79-189	12/05/79	87.0	100 - 75.0
	79-190	12/06/79	71.0	100 - 50.0
	m28122	07/14/81	77.0	100 - 50.0
	81-45	08/04/81	84.0	100 - 65.0
	87-193	11/10/87	76.0	82.8 - 69.8

Table 6. Toxicity of Domtar Fine Papers Ltd effluent samples to Rainbow trout

Sample site	Sample Number	Sample Date	96Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
final effluent	m27629	07/23/76	76.0	100 - 56.0
	m27742	06/28/77	94.0	97.0 - 89.0
	80-199	10/15/80	77.0	98.0 - 61.0
	m28123	07/14/81	59.0	70.0 - 50.0
	82-047	07/07/82	36.7	45.0 - 30.0
	84-059	06/19/84	55.1	61.8 - 49.2
	84-086	07/26/84	non-lethal	
	84-134	10/18/84	80.6	100 - 65.0
	86-49	07/17/86	46.1	51.9 - 40.9
	86-74	08/27/86	50.3	65.0 - 40.0
	86-84	10/08/86	non-lethal	
	87-192	11/10/87	non-lethal	
	01880212	09/29/88	non-lethal	
sewer bypass	87-191	11/10/87	non-lethal	
	01880213	09/29/88	non-lethal	

Table 7. Toxicity of Marimac effluent samples to Rainbow trout.

Sample site	Sample Number	Sample Date	96Hour LC50 (% effluent)	95% Fiducial Limits Upper-Lower (% effluent)
final effluent	86-84	10/08/86	36.5	40.0 - 30.0

Table 8. Toxicity of Courtaulds Fibres effluent samples to Daphnia magna

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limit Upper - Lower (% effluent)
Acid sewer	02800159	09/24/80	1.7	
	02800162	09/24/80	2.0	2.5 - 1.6
	02800176	10/01/80	4.4	
	02880210	09/29/88	0-5	
Viscose sewer	02800161	09/23/80	19.3	23.2 - 14.4
	02800172	09/24/80	86.6	105 - 71.0
	02800178	10/01/80	31.2	38.0 - 25.5
	02880209	09/29/88	5.0	
Sulphide sewer	02800177	10/01/80	45.5	57.1 - 33.3
	02880211	09/29/88	81.7	97.8 - 44.9

Table 9. Toxicity of Canadian Industries Ltd. effluent samples to Daphnia magna.

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
Lel 2 sewer	02790189	12/05/79	87.4	93.4 - 81.7
	02791189	12/05/79	>100	
	02790191	12/05/79	>100	
	02791191	12/05/79	>100	
	02790192	12/05/79	36.9	50.2 - 27.1
	02791192	12/05/79	75 - 100	
	02790190	12/06/79	74.6	86.7 - 62.8
	02791190	12/06/79	>100	
	02870194	11/10/87	non-lethal	

Table 10. Toxicity of Cornwall Municipal STP effluent samples to Daphnia magna.

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
final effluent	02870190	11/10/87	0.8	7.7 - 0.0

Table 11. Toxicity of Cornwall Chemicals effluent samples to Daphnia magna.

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
combined final	02790193	12/05/79	13.8	19.1 - 10.1
	02791193	12/05/79	36.1	52.8 - 18.4
	02870193	11/10/87	47.3	54.8 - 40.7

Table 12. Toxicity of Domtar Fine Papers effluent samples to Daphnia magna.

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
final effluent	02800199	10/01/80	non-lethal	
	02860074	08/25/86	non-lethal	
	02860084	10/07/86	63.3	76.4 - 53.3
	02870055	06/09/87	non-lethal	
sewer bypass	02870191	11/10/87	>100	

Table 13. Toxicity of Marimac effluent samples to Daphnia magna.

Sample site	Sample Number	Sample Date	48 Hour LC50 (% effluent)	95% Fiducial Limits Upper - Lower (% effluent)
final effluent	02861084	10/08/86	>100	

APPENDIX XV. SPILLS REPORTED IN THE CORNWALL DISTRICT, 1988-89

sac_num	ste_nam	occ_dte	mun_dsc	mat_nml
8802093	IROQUOIS CHEMICALS		CORNWALL CITY	WASTE WATER
8803814			WILLIAMSBURGH T	CHLORINATED SEWAGE
8900460	DOMTAR		CORNWALL CITY	BUNDER "C" OIL
8905389	HARVEX AGROMART (CIL		FINCH TWP.	HYDRAULIC OIL
8908793	DOMTAR FINE PAPERS		CORNWALL CITY	PCB-CONTAMINATED OIL
8910591	CORNWALL ELECTRIC		CORNWALL CITY	HYDRAULIC OIL
8910966	COURTAULDS		CORNWALL CITY	SULPHURIC ACID
8911004	DOMTAR FINE PAPERS		CORNWALL CITY	TRANSFORMER OIL
8914293	RESIDENT		FINCH TWP.	PETROLEUM OIL N.O.S.
8800725	HEUGA	88/01/01	CORNWALL CITY	OTHER OILS
8800978	CORNWALL WPCP MOE	88/01/06	CORNWALL CITY	RAW SEWAGE
8801195	CIL	88/01/08	CORNWALL CITY	PCB-CONTAMINATED OIL
8804333		88/01/12	MAXVILLE VILL.	VARSOL
8802784	CITIZEN - BRIAN LISC	88/01/24	CORNWALL CITY	SEWAGE
8811764	GUINDON LTD.	88/01/26	CORNWALL CITY	DIESEL FUEL
8800366	COURTAULDS	88/02/06	CORNWALL CITY	CARBON DISULFIDE
8800179	CIL	88/02/10	CORNWALL CITY	MERCURY
8800286	SERVAAS RUBBER	88/02/15	CORNWALL CITY	PHENOLIC VAPOURS
8800354		88/02/15	CORNWALL CITY	FURNACE OIL (HOME HE
8800363		88/02/17	CORNWALL CITY	GASOLINE
8800540		88/02/23	CORNWALL CITY	OLEIC ACID
8800656	PRIVATE RESIDENCE	88/02/23	CORNWALL CITY	FURNACE OIL (HOME HE
8800586	TRANS NORTHERN PIPEL	88/02/25	CORNWALL CITY	DIESEL FUEL
8800626	COURTAULDS CANADA	88/02/26	CORNWALL CITY	OTHER GASES
8800818	UNKNOWN	88/03/02	VANKLEEK HILL T	FURNACE OIL (HOME HE
8800887	PETRO CANADA	88/03/04	CLARENCE TWP.	GASOLINE
8801040	CONSOLTEX INC.	88/03/07	ALEXANDRIA TOWN	MINERAL OIL (LT 50 P
8801036	ROBERT TRANSPORT	88/03/08	CORNWALL TWP.	ALCOHOLS, N.O.S.
8801125		88/03/11	CORNWALL CITY	SODIUM SULFIDE, HYDR
8801170	MCEWEN FUELS	88/03/12	MAXVILLE VILL.	PETROLEUM OIL N.O.S.
8801186	ONTARIO HYDRO	88/03/12	MATILDA TWP.	TRANSFORMER OIL
8801245	UNKNOWN	88/03/15	ALEXANDRIA TOWN	GASOLINE
8801436	CONSOLTEX INC.	88/03/18	ALEXANDRIA TOWN	XYLENES
8801341	COMBUSTION ENGINEERI	88/03/19	CORNWALL CITY	DIESEL FUEL
8801549	LACKIE TRANSPORT	88/03/25	CORNWALL TWP.	TRANSFORMER OIL
8801603	UNKNOWN	88/03/26	CORNWALL CITY	GASOLINE
8801605	DOMTAR FINE PAPER	88/03/27	CORNWALL CITY	HYDROGEN SULFIDE
8801658	R G SEGUIN	88/03/28	ROCKLAND TOWN	FURNACE OIL (HOME HE
8910581	TRANSFORMER	88/03/31	CORNWALL CITY	TRANSFORMER OIL
8801861	UNKNOWN	88/04/01	IROQUOIS VILL.	DIESEL FUEL
8801866	WESTFRONT CONSTRUCTI	88/04/02	CORNWALL CITY	SMOKE
8801877	UNIDENTIFIED SEPTIC	88/04/02	CLARENCE TWP.	SEWAGE
8802317	BCL CANADA INC.	88/04/12	CORNWALL CITY	PROPYLENE GLYCOL
8802333	COURTAULDS	88/04/13	CORNWALL CITY	HYDROGEN SULFIDE
8802766		88/04/25	STORMONT/DUNDAS	FURNACE OIL (HOME HE
8803156	ONTARIO HYDRO	88/05/05	WINCHESTER TWP.	TRANSFORMER OIL
8803220	HARVEST AGROMAT	88/05/06	WINCHESTER TWP.	FERTILIZER
8906435	DOMTAR	88/05/10	CORNWALL CITY	BUNKER FUEL OIL (NO.
8803510		88/05/13	CLARENCE TWP.	HYDRAULIC OIL
8803546	IROQUOIS CHEMICALS	88/05/13	CORNWALL CITY	METHYL ETHYL KETONE
8804035	PRIVATELY OWNED	88/05/13	NORTH PLANTAGEN	TRANSFORMER OIL
8803553	NOT PROVIDED	88/05/14	CORNWALL CITY	GASOLINE
8804051	G. A. BERCIER	88/05/16	SOUTH PLANTAGEN	MANURE
8803779		88/05/18	WINCHESTER TWP.	DIESEL FUEL
8803799	UNKNOWN	88/05/18	WINCHESTER TWP.	DIESEL FUEL
8804060	IMPERIAL OIL	88/05/18	ROCKLAND TOWN	GASOLINE
8804157	ONTARIO HYDRO	88/05/26	STORMONT/DUNDAS	TRANSFORMER OIL
8804412	COURTAULDS	88/05/31	CORNWALL TWP.	SULFURIC ACID
8804578	FARMER	88/06/02	SOUTH PLANTAGEN	GASOLINE
8804577	SHELL	88/06/03	LANCASTER TWP.	WASTEWATER (NOT OTHE
8804788	ONTARIO HYDRO	88/06/07	WINCHESTER VILL	PCB-CONTAMINATED OIL
8804970	ONTARIO HYDRO	88/06/12	ALFRED TWP	TRANSFORMER OIL

8805822	TRANSCONTINENTAL PRI	88/06/15	CORNWALL CITY	OTHER GASES
8805251	ONTARIO HYDRO	88/06/17	MOUNTAIN TWP.	TRANSFORMER OIL
8805367	ONTARIO HYDRO	88/06/18	KENYON TWP.	TRANSFORMER OIL
8812098	ONTARIO HYDRO	88/06/18	KENYON TWP.	TRANSFORMER OIL
8805454	HENKEL CANADA	88/06/21	CORNWALL CITY	TEXAPHOR SPECIAL
8805564	ULTRAMAR	88/06/23	CASSELMAN VILL.	GASOLINE
8805690	DOMTAR FINE PAPER	88/06/25	CORNWALL CITY	PROCESS WATER
8805699	GROULX-ROBERTSON LTD	88/06/26	ALEXANDRIA TOWN	PERCHLORETHYLENE
8903605		88/06/29	CORNWALL CITY	CAUSTIC ALKALI LIQIU
8805922	DOMTAR FINE PAPER	88/07/01	CORNWALL CITY	SUSPENDED SOLIDS
8805953	CORNWALL PUBLIC WORK	88/07/02	CORNWALL CITY	TRANSFORMER OIL
8805970		88/07/02	CORNWALL CITY	SODIUM HYPOCHLORITE
8806141	PETRO CANADA	88/07/06	CHARLOTTENBURGH	GASOLINE
8906439	PETRO CANADA	88/07/06	CHARLOTTENBURGH	DIESEL FUEL
8806366	ST-ISIDORE CO-OP	88/07/08	RUSSELL TWP.	AMMONIUM NITRATE (GT
8906440	IVACO ROLLING MILLS	88/07/09	L'ORIGNAL VILL.	DUST
8806420	DIXON'S CORNERS DS	88/07/11	MATILDA TWP.	TRANSFORMER OIL
8906441	MTC	88/07/11	LANCASTER VILL.	DIESEL FUEL
8906450	SERVASS RUBBER	88/07/11	CORNWALL CITY	UNKNOWN
8906442	MR. GAS	88/07/14	ALFRED VILL.	DIESEL FUEL
8906446	DOUG'S AUTO SALES	88/07/18	ROXBOROUGH TWP.	SMOKE
8807100	KERSHAW MANUFACTURIN	88/07/25	CORNWALL CITY	ARGON (COMPRESSED GA
8807230	SUNOCO	88/07/29	CORNWALL CITY	GASOLINE
8807249	NOT DETERMINED	88/07/29	CORNWALL TWP.	DIESEL FUEL
8807566		88/08/04	CORNWALL CITY	VISCOSE
8807604	CORNWALL PUBLIC WORK	88/08/05	CORNWALL CITY	MINERAL OIL (LT 50 P
8807798	KRAFT	88/08/10	OSNABRUCK TWP.	AMMONIA GAS (ANHYDRO
8807882	UNKNOWN	88/08/12	CORNWALL CITY	MOTOR OIL
8807978	ONTARIO HYDRO	88/08/14	MATILDA TWP.	PCB-CONTAMINATED OIL
8906453	IROQUOIS CHEMICALS	88/08/18	CORNWALL CITY	STYRENE
8906456	ONTARIO HYDRO	88/08/19	VANKLEEK HILL T	HYDRAULIC OIL
8808442		88/08/22	CORNWALL CITY	HYDROGEN SULFIDE
8808472		88/08/23	ROCKLAND TOWN	HYDRAULIC OIL
8808526	ONTARIO HYDRO	88/08/24	WINCHESTER TWP.	TRANSFORMER OIL
8808556		88/08/25	CORNWALL CITY	TOLUENE
8808656	UNKNOWN	88/08/27	CORNWALL CITY	PETROLEUM OIL N.O.S.
8906376	ONTARIO HYDRO	88/08/29	PLANTAGENET VIL	TRANSFORMER OIL
8906460	ROHM AND HAAS CANADA	88/09/01	MORRISBURG VILL	PETROLEUM OIL N.O.S.
8809041		88/09/06	STORMONT/DUNDAS	SEWAGE
8809085	HERB'S GARAGE	88/09/08	ALEXANDRIA TOWN	SMOKE
8809095	IROQUOIS CHEMICALS	88/09/08	CORNWALL CITY	MALEIC ANHYDRIDE
8809191		88/09/09	CORNWALL CITY	DIESEL FUEL
8809299		88/09/12	CORNWALL TWP.	DIESEL FUEL
8906521	ONTARIO HYDRO	88/09/12	LANCASTER TWP.	HYDRAULIC OIL
8906465	LEISCO	88/09/14	CORNWALL TWP.	RESIN
8809568	ONTARIO HYDRO	88/09/18	CLARENCE TWP.	TRANSFORMER OIL
8809571	CORNWALL WPCP MOE	88/09/18	CORNWALL CITY	RAW SEWAGE
8906469	CIL	88/09/18	CORNWALL CITY	PETROLEUM OIL N.O.S.
8809723	CIL	88/09/22	CORNWALL CITY	CHLORINE (COMPRESSED
8809848	ULTRAMAR	88/09/23	CORNWALL CITY	DIESEL FUEL
8809866	TRANSCANADA PIPELINE	88/09/25	STORMONT/DUNDAS	HYDRAULIC OIL
8810010	MCDOUGAL'S GENERAL S	88/09/29	KENYON TWP.	HYPOCHLORITE SOLUTIO
8906431	PRIVATE RESIDENCE	88/09/29	ROXBOROUGH TWP.	HYPOCHLORITE SOLUTIO
8906566	SUNOCO	88/10/03	CORNWALL CITY	GASOLINE
8810274	EMBRUN COOP	88/10/05	RUSSELL TWP.	FURNACE OIL
8906427	ONTARIO HYDRO	88/10/17	MOUNTAIN TWP.	HYDRAULIC OIL
8810642	ONTARIO HYDRO	88/10/18	ROXBOROUGH TWP.	TRANSFORMER OIL
8810704		88/10/21	CORNWALL CITY	GASOLINE
8906471	LALLY BLANCHARD FUEL	88/10/21	CORNWALL CITY	PETROLEUM OIL N.O.S.
8810747	TRANSPORT TRUCK	88/10/22	OSNABRUCK TWP.	DIESEL FUEL
8810792	ONTARIO HYDRO	88/10/23	WINCHESTER VILL	TRANSFORMER OIL
8810793	ONTARIO HYDRO	88/10/23	RUSSELL TWP.	HYDRAULIC OIL
8810915	CIL	88/10/27	CORNWALL CITY	CAUSTIC WASTE WATER
8811011		88/10/30	CORNWALL TWP.	SODIUM HYDROXIDE (SO
8811062	ONTARIO HYDRO	88/10/31	CORNWALL CITY	MINERAL OIL (LT 50 P
8906422	COURTAULDS	88/11/01	CORNWALL CITY	CAUSTIC ALKALI LIQIU

8811165	RESIDENT	88/11/02	CORNWALL CITY	FURNACE OIL
8811164	UNKNOWN	88/11/03	CORNWALL CITY	UNKNOWN
8810948	ONTARIO HYDRO	88/11/09	LANCASTER TWP.	TRANSFORMER OIL
8811382	ONTARIO HYDRO	88/11/09	CHARLOTTENBURGH	MINERAL OIL (LT 50 P
8811428	ONTARIO HYDRO	88/11/10	EAST HAWKESBURY	TRANSFORMER OIL
8811458	ONTARIO HYDRO	88/11/10	CORNWALL TWP.	TRANSFORMER OIL
8811425	POWELL FUELS	88/11/10	MOUNTAIN TWP.	DIESEL FUEL
8811438	ONTARIO HYDRO	88/11/10	WILLIAMSBURGH T	TRANSFORMER OIL
8811440	ONTARIO HYDRO	88/11/10	LANCASTER TWP.	MINERAL OIL (LT 50 P
8811464	NOT APPLICABLE	88/11/11	ROXBOROUGH TWP.	DIESEL FUEL
8811613	TRANSPORT TRUCK	88/11/15	CORNWALL CITY	HYDROGEN PEROXIDE (M
8811706	ST ISIDORE ABATTOIR	88/11/16	PLANTAGENET VIL	BLOOD WASTES
8812084	COURTAULDS CANADA	88/11/25	CORNWALL TWP.	SODIUM HYDROXIDE (SO
8812083	COURTAULDS CANADA	88/11/25	CORNWALL TWP.	SOKIUM SULFIDE, HYDR
8812111	COURTAULDS CANADA	88/11/26	CORNWALL CITY	OTHER GASES
8812351	CIL	88/12/01	CORNWALL CITY	WASTEWATER (NOT OTHE
8812436	ALEC ROBERTSON SAW M	88/12/05	STORMONT/DUNDAS	DIESEL FUEL
8812480	ONTARIO HYDRO	88/12/06	KENYON TWP.	MINERAL OIL (LT 50 P
8812523	COURTAULDS CANADA	88/12/07	STORMONT/DUNDAS	OLEIC ACID
8812525	IROQUOIS CHEMICALS	88/12/08	CORNWALL CITY	SOLVENT (N.O.S.)
8812516	TEXACO	88/12/08	LANCASTER TWP.	DIESEL FUEL
8812635	SERVICE STATION	88/12/09	CHARLOTTENBURGH	GASOLINE
8812609	COURTAULDS CANADA	88/12/11	CORNWALL CITY	OTHER GASES
8812832	DOMTAR	88/12/18	CORNWALL CITY	MILL EFFLUENT
8813150	LALLY BLANCHARD FUEL	88/12/20	CORNWALL CITY	FURNACE OIL
8902189		88/12/21	ALEXANDRIA TOWN	GASOLINE
8812960	UNIVERSAL TERMINALS	88/12/21	MORRISBURG VILL	DIESEL FUEL
8812943	TRIANGLE PUMPING	88/12/21	CORNWALL CITY	DIESEL FUEL
8812932	CORNWALL PUBLIC WORK	88/12/21	CORNWALL CITY	TRANSFROMER OIL
8902188	UNKNOWN	88/12/23	LANCASTER TWP.	PETROLEUM OIL N.O.S.
8902190	HOME HEATING FUEL DE	88/12/23	LANCASTER TWP.	FURNACE OIL
8813014	UNKNOWN	88/12/23	CORNWALL CITY	UNKNOWN
8902192	DOMTAR	88/12/27	CORNWALL CITY	SUSPENDED SOLIDS
8900170	UNIVERSAL TERMINALS	89/01/06	CORNWALL CITY	CAUSTIC ALKALI LIQIU
8900261	ONTARIO HYDRO	89/01/08	EAST HAWKESBURY	MINERAL OIL (LT 50 P
8900313	DOMTAR	89/01/10	CORNWALL CITY	CALCIUM CARBONATE (L
8900311	ONTARIO HYDRO	89/01/10	WILLIAMSBURGH T	MINERAL OIL (LT 50 P
8900340	DOMTAR	89/01/11	CORNWALL CITY	DIRTY WATER (SUSPEND
8901188	TRANSPORT TRUCK	89/01/12	LANCASTER TWP.	DIESEL FUEL
8901187	BARKER FUELS	89/01/16	ROXBOROUGH TWP.	DIESEL FUEL
8900594		89/01/19	CORNWALL CITY	GASOLINE
8900587	PROVOST CARTAGE	89/01/19	CORNWALL CITY	OILS, CRUDE
8900624	TRANSPORT TRUCK	89/01/20	CORNWALL TWP.	DIESEL FUEL
8900652	MCNEIL - MCGATH TRAN	89/01/21	PRESCOTT & RUSS	DIESEL FUEL
8900700	DOMTAR FINE PAPER	89/01/23	CORNWALL CITY	BLACK LIQUOR
8902230	ROHM AND HAAS	89/01/24	MORRISBURG VILL	ACRYLIC RESIN (METHA
8900899	ONTARIO HYDRO	89/01/27	WILLIAMSBURGH T	HYDRAULIC OIL
8900971	UNIVERSAL TERMINALS	89/01/29	MORRISBURG VILL	GASOLINE
8901179	UNKNOWN	89/02/05	CORNWALL CITY	GASOLINE
8901299	CONSOLTEX INC.(613-5	89/02/09	ALEXANDRIA TOWN	HYDROGEN PEROXIDE (8
8901352	DOMTAR	89/02/10	CORNWALL CITY	LIME SLURRY/SLUDGE
8901398	UNKNOWN	89/02/12	MORRISBURG VILL	DIESEL FUEL
8901507	ROHM AND HAAS CANADA	89/02/15	MORRISBURG VILL	OIL ADDITIVES
8901668		89/02/15	CORNWALL CITY	SODIUM CELLULOSE XAN
8901586	GLED HILL EQUIPMENT	89/02/17	CORNWALL TWP.	DIESEL FUEL
8901703	IROQUOIS CHEMICALS	89/02/21	CORNWALL CITY	METHYL ETHYL KETONE
8901838	ROHM AND HAAS CANADA	89/02/25	MORRISBURG VILL	WATER/GLYCOL SOLUTIO
8901912	UNKNOWN	89/02/27	CORNWALL CITY	GASOLINE
8901933	LALLY BLANCHARD FUEL	89/02/28	CORNWALL TWP.	FURNACE OIL
8902193	TELEDYNE	89/03/06	CORNWALL CITY	VARSOL
8902178	SERVAAS RUBBER	89/03/07	CORNWALL CITY	SMOKE
8902225	TRANSPORT TRUCK	89/03/08	CORNWALL CITY	DIESEL FUEL
8902235		89/03/08	LANCASTER TWP.	HYDRAULIC OIL
8902462	ONTARIO HYDRO	89/03/13	ROXBOROUGH TWP.	TRANSFORMER OIL
8902479		89/03/14	CORNWALL TWP.	SODIUM SULFATE (SALT
8907030	CHAMPLAIN INDUSTRIES	89/03/15	CORNWALL CITY	SULFURIC ACID

8902608	ZELLER'S	89/03/17	STORMONT/DUNDAS	DIESEL FUEL
8902780	CORNWALL PUBLIC WORK	89/03/22	STORMONT/DUNDAS	TRANSFORMER OIL
8902877	CN RAIL	89/03/24	MAXVILLE VILL.	DIESEL FUEL
8902890	UNKNOWN	89/03/25	CHESTERVILLE VI	GASOLINE
8903108	VIC'S RESTAURANT	89/03/26	HAWKESBURY TOWN	FURNACE OIL
8903359		89/04/04	CORNWALL CITY	AMMONIA GAS (ANHYDRO
8907721	CIL	89/04/04	CORNWALL CITY	AMMONIUM HYDROXIDE (
8903429		89/04/05	CORNWALL CITY	GASOLINE
8903450	SPRAGUE ENERGY	89/04/06	CORNWALL CITY	BUNKER FUEL OIL (NO.
8911392	COURTAULDS	89/04/23	CORNWALL CITY	SODIUM SULFATE (SALT
8904243	ALEXANDRIA F.D.	89/04/25	LOCHIEL TWP.	SMOKE
8904311	IVACO ROLLING MILLS	89/04/26	CORNWALL CITY	ASKAREL
8904346	UNKNOWN	89/04/27	CORNWALL CITY	MOTOR OIL
8904449		89/04/30	CORNWALL TWP.	SULFURIC ACID
8904727	ONTARIO HYDRO	89/05/06	WEST HAWKESBURY	PETROLEUM OIL N.O.S.
8904850	SHELL	89/05/09	CORNWALL CITY	DIESEL FUEL
8907095	MUNICIPAL GARAGE	89/05/10	HAWKESBURY TOWN	PETROLEUM OIL N.O.S.
8904933	MOTOR VEHICLE	89/05/10	CORNWALL CITY	MOTOR OIL
8907058	SERVASS RUBBER	89/05/11	CORNWALL CITY	FURNACE OIL
8905092		89/05/14	CORNWALL CITY	SULFURIC ACID.
8905132	ST. REGIS INDIAN RES	89/05/14	CORNWALL TWP.	FURNACE OIL
8907096	UNITED CO-OP	89/05/15	CASSELMAN VILL.	FERTILIZER
8907091	ONTARIO HYDRO	89/05/16	VANKLEEK HILL T	TRANSFORMER OIL
8907057	ONTARIO HYDRO	89/05/16	VANKLEEK HILL T	HYDRAULIC OIL
8907495	SHELL CANADA	89/05/17	CORNWALL CITY	STOVE OIL
8905354	FARM	89/05/18	CORNWALL CITY	PIG MANURE
8905386	HARVEX AGROMART (CIL	89/05/19	FINCH TWP.	NOT SPECIFIED
8905643	ONTARIO HYDRO	89/05/24	CORNWALL CITY	MINERAL OIL (LT 50 P
8905702	GENERAL CHEMICAL	89/05/25	STORMONT/DUNDAS	CALCIUM CHLORIDE
8905864	HAWKSBURY HYDRO	89/05/29	HAWKESBURY TOWN	TRANSFORMER OIL
8905929	IVACO ROLLING MILLS	89/05/29	LONGUEIL TWP.	ASKAREL
8906038		89/05/31	CORNWALL TWP.	SULFURIC ACID
8906340	A & B WASTE	89/06/05	CORNWALL CITY	PHOTOPROCESSING WAST
8907482	ONTARIO HYDRO	89/06/06	WINCHESTER TWP.	HYDRAULIC OIL
8906676		89/06/09	ROCKLAND TOWN	DIESEL FUEL
8906697	ONTARIO HYDRO	89/06/10	CORNWALL CITY	TRANSFORMER OIL
8906827	DOMTAR	89/06/10	CORNWALL CITY	SULFURIC ACID
8906799	CIL	89/06/12	CORNWALL CITY	TSR-2000 (CAUSTIC AN
8907154	GLENGARRY TRANSPORT	89/06/16	STORMONT/DUNDAS	DYE
8907331	COURTAULDS	89/06/19	CORNWALL CITY	TITANIUM DIOXIDE
8907317	COURTAULDS	89/06/19	CORNWALL CITY	SULFURIC ACID
8909221	COURTAULDS	89/06/19	CORNWALL CITY	SULFURIC ACID
8911388	ONTARIO HYDRO	89/06/22	LOCHIEL TWP.	TRANSFORMER OIL
8907672	HOTEL DIEU HOSPITAL	89/06/25	CORNWALL CITY	MERCURY
8907684	BASF	89/06/26	CORNWALL CITY	DIOCTYL PHTHALATE
8908796	ONTARIO HYDRO	89/06/26	VANKLEEK HILL T	PCB-CONTAMINATED OIL
8907840	ONTARIO HYDRO	89/06/29	RUSSELL TWP.	TRANSFORMER OIL
8908155	COURTAULDS	89/07/05	CORNWALL CITY	HYDROGEN SULFIDE
8908161	COURTAULDS LTD	89/07/06	CORNWALL CITY	CARBON DISULFIDE
8908179	COURTAULDS	89/07/07	CORNWALL CITY	CARBON BISULFIDE
8908250	PERMANENT CONCRETE	89/07/08	CORNWALL CITY	FURNACE OIL
8908252	SERVAAS RUBBER	89/07/08	CORNWALL CITY	SULFUR VAPOUR
8908375	DOMTAR	89/07/10	CORNWALL CITY	CHLORINE DIOXIDE
8908376	BASF CANADA INC.	89/07/10	CORNWALL CITY	PETROLEUM OIL N.O.S.
8908537	COURTAULDS	89/07/13	CORNWALL CITY	CAUSTIC ALKALI LIQUI
8908597	CURRUTHERS UTILITY C	89/07/14	RUSSELL TWP.	MOTOR OIL
8909291	DOMTAR	89/07/25	CORNWALL CITY	CLAY/WATER
8909213	MARINE VESSEL	89/07/26	NEW YORK STATE	XYLENE
8909297	MOE	89/07/27	WINCHESTER TWP.	RAW SEWAGE
8909334	BCL CANADA INC.	89/07/27	CORNWALL CITY	VISCOSE
8915491	ONTARIO HYDRO	89/07/27	ROXBOROUGH TWP.	TRANSFORMER OIL
8909419	DOMTAR	89/07/29	CORNWALL CITY	BUNKER FUEL OIL (NO.
8915137	ONTARIO HYDRO	89/07/31	MATILDA TWP.	PETROLEUM OIL N.O.S.
8909632	ESSO PETROLEUM	89/08/02	CORNWALL CITY	DIESEL FUEL
8909635	COURTAULDS	89/08/02	CORNWALL CITY	CARBON BISULFIDE
8909681	KINGSWAY TRANSPORT	89/08/04	CORNWALL TWP.	PAINT OR PAINT RELAT

8909702	BASF CANADA INC.	89/08/04	CORNWALL CITY	DIOCTYL PHTHALATE
8909704	CIL	89/08/04	CORNWALL CITY	HYDROGEN SULFIDE
8909742	COURTAULDS	89/08/04	CORNWALL CITY	SPIN BATH LIQUOR
8910589	TEXACO	89/08/04	ALEXANDRIA TOWN	MOTOR OIL
8909814	PRIVATE RESIDENCE	89/08/05	MATILDA TWP.	MOTOR OIL
8909970	GLENGARRY TRANSPORT	89/08/10	WINCHESTER VILL	DIESEL FUEL
8910201	COURTAULDS	89/08/14	CORNWALL CITY	CAUSTIC ALKALI LIQIU
8910552	COURTAULDS	89/08/18	CORNWALL CITY	SPIN BATH
8910590	CANADIAN NATIONAL RA	89/08/21	CORNWALL CITY	SMOKE
8910627	DOMTAR	89/08/22	CORNWALL CITY	SULFURIC ACID
8910707	QUEENSWAY TANK LINES	89/08/23	HAWKESBURY TOWN	GASOLINE
8910810	COURTAULDS	89/08/25	CORNWALL CITY	ACID (NOT OTHERWISE
8910852	COURTAULDS	89/08/26	CORNWALL CITY	CARBON BISULFIDE
8910875	MOTOR VEHICLE	89/08/26	CORNWALL CITY	MOTOR OIL
8910919	UNKNOWN	89/08/27	OSNABRUCK TWP.	BUNKER FUEL OIL (NO.
8911044	COURTAULDS	89/08/29	CORNWALL CITY	SULFURIC ACID
8911123	LAIDLAW TRANSPORT	89/08/30	CORNWALL TWP.	FERTILIZER
8911073	IKO INDUSTRIES LTD.	89/08/30	PRESCOTT & RUSS	TAR
8911482	COURTAULDS	89/09/07	CORNWALL CITY	SULPHURIC ACID
8911516	NOT DETERMINED	89/09/08	ALEXANDRIA TOWN	FUEL OIL
8911658	MOTOR VEHICLE	89/09/11	ALFRED VILL.	DIESEL FUEL
8911753	GANECA TRANSPORT	89/09/12	CORNWALL CITY	DIESEL FUEL
8911819	BERTRAND QUARRY	89/09/14	ST. ISIDORE DE	PHENOL FORMALDEHYDE
8912012	COURTAULDS	89/09/17	CORNWALL CITY	OFF-GASES
8912399	CIL	89/09/20	CORNWALL CITY	CHLORINE (COMPRESSED
8912273	COURTAULDS	89/09/21	CORNWALL CITY	BUNKER FUEL OIL (NO.
8912166	QUEENSWAY TANK LINES	89/09/23	WINCHESTER VILL	GASOLINE
8912224	COURTAULDS	89/09/24	CORNWALL CITY	CARBON BISULFIDE
8912304	ONTARIO HYDRO	89/09/25	KENYON TWP.	TRANSFORMER OIL
8912316	MARINE FREIGHTER	89/09/26	IROQUOIS VILL.	UNKNOWN
8913238	ONTARIO HYDRO	89/09/27	WINCHESTER TWP.	PCB-CONTAMINATED OIL
8912437	COURTAULDS	89/09/28	CORNWALL CITY	SODIUM HYDROSULFIDE
8912549	UNKNOWN	89/09/30	CORNWALL CITY	PETROLEUM OIL N.O.S.
8912675	BASF	89/10/03	CORNWALL CITY	SCRUBBER WATER
8912711	BASF CANADA INC.	89/10/04	CORNWALL CITY	DIOCTYL PHTHALATE
8912777	CONSOLTEX INC.	89/10/05	ALEXANDRIA TOWN	SODIUM HYDROXIDE (SO
8912838	DOMTAR	89/10/07	CORNWALL CITY	BUNKER FUEL OIL (NO.
8912849	COURTAULDS	89/10/07	CORNWALL CITY	SULFURIC ACID
8913004	COURTAULDS LTD	89/10/12	CORNWALL CITY	CARBON DISULFIDE
8913068	CIL	89/10/13	CORNWALL CITY	MERCURY
8913205	COURTAULDS LTD	89/10/17	CORNWALL CITY	CARBON DISULFIDE
8913237	COURTAULDS LTD	89/10/18	CORNWALL CITY	CARBON DISULFIDE
8913314	TANKER TRUCK (N.O.S.	89/10/19	KENYON TWP.	ALUM (ALUMINUM SULFA
8913349	COURTAULDS	89/10/21	CORNWALL CITY	SULFURIC ACID
8913502	COURTAULDS	89/10/25	CORNWALL CITY	SULFURIC ACID
8913635	ONTARIO HYDRO	89/10/27	LANCASTER TWP.	MINERAL OIL (LT 50 P
8913636	PUC	89/10/27	CORNWALL CITY	DIESEL FUEL
8913796	COURTAULDS	89/10/30	CORNWALL CITY	SPIN BATH
8913938	COURTAULDS	89/11/03	CORNWALL CITY	SULFURIC ACID
8913946	DOMTAR	89/11/04	CORNWALL CITY	BUNKER FUEL OIL (NO.
8914041	COURTAULDS LTD	89/11/07	CORNWALL CITY	CARBON DISULFIDE
8914083	UNIVERSAL TERMINALS	89/11/08	WILLIAMSBURGH T	GASOLINE
8914274	CHAMPLAIN INDUSTRIES	89/11/13	CORNWALL CITY	CONTAMINATED RUN-OFF
8914278	TRANSPORT TRUCK	89/11/13	SOUTH PLANTAGEN	DIESEL FUEL
8914415	COURTAULDS	89/11/16	CORNWALL CITY	SODIUM HYDROSULFIDE
8915492	ROHM AND HAAS CANADA	89/11/22	MORRISBURG VILL	OIL ADDITIVES
8914733	COURTAULDS	89/11/25	CORNWALL CITY	OTHER GASES
8914824	ONTARIO HYDRO	89/11/28	RUSSELL TWP.	DIESEL FUEL
8914825	TRANSFORMER	89/11/28	ROCKLAND TOWN	TRANSFORMER OIL
8914865	ONTARIO HYDRO	89/11/29	CORNWALL CITY	HYDRAULIC OIL
8915050	CORNWALL ELECTRIC	89/12/04	CORNWALL CITY	HYDRAULIC OIL
8915157	CIL	89/12/06	CORNWALL CITY	HYDROGEN SULFIDE
8915212	COURTAULDS CANADA	89/12/08	CORNWALL CITY	MAGMA (SODIUM SULPHA
8915270	PETRO CANADA	89/12/10	CASSELMAN VILL.	GASOLINE
8915322	RESIDENCE	89/12/10	WINCHESTER VILL	FURNACE OIL
8915361	COURTAULDS	89/12/13	CORNWALL CITY	SULFURIC ACID

APPENDIX XVI. LOADINGS OF SPECIFIC POLLUTANTS FROM CORNWALL OUTFALLS, 1980-81

CORNWALL OUTFALLS AS SOURCES OF SPECIFIC POLLUTANTS, 1980-81[a]

PARAMETER AND CLASS	TOTAL SURVEY LOADING	LOADING kg/day (% of TOTAL LOADING) DOMTAR[b]	CIL[b] CORNWALL CHEMICALS CONPAC	BCL COURTAULDS CARAVELLE[c]	CELANESE[c]	CORNWALL WPCP
I Conventional						
BOD	28,225	19,442 (69)	161.4 (1)	1,983 (7)	4,855 (17)	1,754 (6)
SS	19,612	13,222 (67)	15.9 (<1)	5,207 (27)	26.7 (<1)	1,141 (6)
DS	234,145	85,985 (37)	4,354 (2)	124,154 (53)	48 (<1)	19,602 (8)
TKN	1,308	359.3 (27)	2.69 (1)	40.1 (3)	0	905.2 (69)
Ammonia - Nitrogen	365	0	0.76 (<1)	4.4 (1)	0	360.4 (99)
Phosphorus	163	78.2 (48)	0	33.7 (21)	0	51.7 (32)
II Metals[d]						
Aluminum	499.6	347.8 (70)	0	16.6 (3)	0	135.2 (27)
Zinc	378.16	7.00 (2)	1.00 (<1)	368.8 (98)	0	1.39 (<1)
Iron	123.92	46.7 (38)	6.09 (5)	46.6 (38)	0.43 (<1)	24.2 (20)
Titanium	>37.76	N/A	0.2 (<1)	36.7 (97)	0.1 (<1)	0.94 (2)
Copper	8.74	7.00 (80)	0.2 (2)	0.58 (7)	0	0.96 (11)
Chromium	5.63	2.33 (41)	0.1 (2)	2.71 (48)	0	0.49 (9)
Vanadium	4.51	N/A	0	0	0	4.51 (100)
Tin	>2.14	N/A	0.05 (3)	0.31 (14)	0.33 (15)	1.45 (68)
Strontium	>1.93	N/A	0	1.6 (83)	0.11 (6)	0.22 (11)
Lead	1.54	0	0.24 (16)	1.30 (84)	0	0
Arsenic	1.17	1.17 (100)	0	0	0	0
Nickel	1.00	0	0.08 (8)	0.51 (51)	0.16 (16)	0.25 (25)
III Purgeables[d] (identifications tentative)						
Carbon Tetrachloride	159	0	27.5 (17)	0.006	130 (82)	1.8 (1)
1,1-Dichloroethane	66.7	0	0	0.26 (<1)	65.7 (98)	0.77 (1)
Chloroform	36.7	26.4 (72)	0.89 (2)	1.6 (4)	7.72 (21)	0.1 (<1)
1,1,1-Trichloroethane	15.5	0	0.006 (<1)	0.18 (1)	14.7 (95)	0.62 (4)
1,1,2,2-Tetrachloroethane or Tetrachloroethylene	15.0	0	0	0	15.0 (100)	0
Methylene Chloride	>10.9	0	>0	0	7.16 (66)	2.8 (34)
Chlorobenzene	4.37	0	0	0.065 (1)	4.3 (99)	0
1,2-Dichloropropane	2.51	0	0.07 (3)	0.62 (24)	1.27 (49)	0.63 (24)
Benzene[e]	3.19	0.88 (28)	0.006 (<1)	0.02 (1)	2.19 (69)	0.09 (3)

a. Environment Canada 1985.
b. Discharge to Brookdale Avenue Industrial Sewer; combined effluent discharges to St. Lawrence River via diffuser.
c. Caravelle Carpets and Celanese now permanently closed.
d. Metals and Purgeables reported are those discharged in total > 1 kg/d (excluding magnesium, barium, manganese, bismuth), Extractables > 0.1 kg/d
e. or Dibromochloromethane or 1,1,2-Trichloroethane.
N/A Not analyzed.

APPENDIX XVII. ATMOSPHERIC DEPOSITION DATA

APPENDIX XVII. ATMOSPHERIC DEPOSITION DATA

Annual Atmospheric Emissions from ICI (formerly CIL)
Cornwall, 1984-1988.

YEAR	AMOUNT (kg)
1984	58.00
1985	60.21
1986	85.71
1987	88.55
1988	92.61

Source: MOE Cornwall

APPENDIX XVIII. GLOSSARY

GLOSSARY

BHC: Benzene hexachloride or hexachlorocyclohexane. There are several isomers of BHC: alpha, beta and gamma are three of the ones more commonly detected. Gamma-BHC is the insecticide lindane.

The concentration of lindane in water should not exceed 0.01 ug/L (PWQO) nor should the edible portion of fish exceed 0.3 ug/g for the protection of human consumers of fish.

BIOACCUMULATION: A general term describing a process by which chemical substances are accumulated by aquatic organisms directly from water and/or through consumption of food containing the chemicals.

BIOAVAILABLE: The fraction of the total chemical in the surrounding environment which can be taken up by organisms. The environment may include water, sediment, suspended particles and food items.

BIOCONCENTRATION: The amount of a substance accumulated by an organism by adsorption and by absorption via oral or other routes of entry. The result is an increased concentration of the substance by the organism or specific tissues.

BIOMAGNIFICATION: The magnification of a chemical along the food chain.

BIOMONITORING: The use of organisms as indicators of chemical pollution.

CONVENTIONAL POLLUTANT: Conventional pollutants include phosphorus, nitrogen, chemical oxygen demand (COD), biochemical oxygen demand (BOD), total organic carbon (TOC), suspended solids, dissolved solids, oil and grease, total and fecal coliforms.

CREEL CENSUS: The determination of an angler's catch and fishing effort through on-water interviews with anglers.

CSL: Centre Saint-Laurent, Environment Canada, Montreal.

CUE: Catch per unit effort.

CWS: Canadian Wildlife Service, Environment Canada.

DDT: DDT was developed during the Second World War to control a wide variety of insects. Afterwards it was used as an insecticide for agricultural and public health uses.

DDT does not easily break down in the natural environment and can bioaccumulate in the fatty tissues of fish.

The accumulation of DDT in fish reduced the reproductive capability in a number of fish species and fish-eating birds, and led to restrictions in its use in the mid-1960s. In 1969, the Ontario Pesticides Control Act limited the use of DDT to very specific purposes and by special permit only.

The maximum concentration for DDT and metabolites should not exceed 0.002 ug/L in water (PWQO) nor should the whole fish exceed 1 ug/g for the protection of fish-consuming birds.

DFO: Department of Fisheries and Oceans Canada

DL: Detection limit

ELECTROFISHING: Electrofishing employs an electronic charge generated between two poles mounted on a boat. Fish are temporarily stunned and then sorted for sampling.

EUTROPHIC: The condition of a lake or other waterbody which has high productivity due to the high levels of nutrients in the water. Such a lake would have blooms of algae and problems of low oxygen in deep waters because of decomposition of organic matter.

EUTROPHICATION: The overproduction of microscopic plants due to the presence of an unnatural abundance of nutrients. Symptoms of eutrophication include: increased turbidity (cloudiness), aesthetic nuisances, changes in algal species, filter clogging, taste and odour problems in water supplies and oxygen depletion in lake waters.

HEPTACHLOR: (also known as heptachlorodicyclopentadiene) Heptachlor is an insecticide which has not been used since the mid 1960s. It is very persistent with significant potential for biomagnification. Heptachlor may be highly toxic to aquatic biota. The maximum concentration of heptachlor and heptachlor epoxide should not exceed 0.001 ug/L in water nor should the edible portion of fish exceed 0.3 ug/g for the protection of human consumers of fish.

HEPTACHLOR EPOXIDE: Heptachlor epoxide is a metabolite of heptachlor. It is highly persistent in the environment and very toxic to aquatic biota. See heptachlor for maximum environmental concentrations.

INTEGRATED BIOTIC INDEX (IBI): An index proposed by Karr (1981) which is used to evaluate the quality or health of an aquatic resource based on the attributes of indigenous fish communities.

IWD/ QR: Inland Waters Directorate, Environment Canada/ Quebec Region.

MENVIQ: Ministere de l'Environment du Quebec

MERCURY: Mercury occurs naturally in low concentrations in many types of rock and can enter the aquatic environment through weathering of rock. Mercury was widely used in pesticides, paints, pharmaceuticals, manufacturing of chlorine, medical and dental equipment and batteries. Its major industrial sources in Ontario, ie. chloralkali plants, were virtually eliminated in the early 1970s.

Mercury readily attaches to organic particles in the aquatic environment. It can be remobilized from sediments through methylation by bacteria and become readily available for uptake in aquatic life. The organic (methylated) forms of mercury are very toxic and can also bioaccumulate to levels affecting wildlife and humans.

Concentrations of total mercury in filtered water should not exceed 0.2 ug/L (PWQO). Concentrations of total mercury in whole fish should not exceed 0.5 ug/g. The unlimited consumption advisory for fish in the St. Lawrence River/ Cornwall area is 0.5 ug/g in the edible portion of fish and is found in the " Guide to Eating Ontario Sport Fish" (MOE and MNR, 1989).

MIREX (DECHLORANE): Mirex is a chlorinated carbon compound used as a pesticide in the Southern United States. It was never registered for such use in Canada. Because of its chemical stability, mirex was used by two southern Ontario companies in the 1960s as a fire retardant in their manufactured products.

Mirex does not break down easily in an aquatic environment. When ingested by fish, mirex accumulates in their fatty tissues. Animal experiments have found that the compound is a possible cause of cancer. The maximum concentration for mirex should not exceed 0.001 ug/L in water (PWQO). The provisional consumption guideline is 0.1 ug/g in the edible portion of fish.

MOE: Environment Ontario (Ontario Ministry of the Environment)

MNR: Ontario Ministry of Natural Resources

NWRI: National Water Research Institute, Environment Canada, Burlington, Ontario.

PAPILLOMA: A benign tumour.

PHENOLS (4- Aminoantipyrene Reactive): Phenols and phenolic compounds originate from the petroleum, coke, chemical and pulp and paper industries; wood distillation; domestic and animal wastes; and through the natural decomposition of vegetation. 4-Aminoantipyrene (4-AAP) reactive phenols are those phenolic compounds that react with 4-AAP in the test for "total phenols" routinely used by the Ontario Ministry of the Environment.

The St. Lawrence River, in the vicinity of Cornwall, has been identified by the International Joint Commission as an Area of Concern because "total phenols" exceeded the PWQO of 1 ug/L.

PHOSPHORUS: Phosphorus occurs naturally in igneous and other types of rock and may enter the aquatic environment through weathering of rock or precipitation. Some uses for phosphorus includes soaps and detergents, fertilizer production, pesticides and insecticides. Domestic and livestock wastes, industrial effluents and agricultural drainage from fertilized land contribute phosphorus to waters.

Phosphorus (total and soluble reactive) is an important nutrient utilized by plants and algae. It is usually found in low concentrations in surface water because it is actively taken up by aquatic plants.

High concentrations of phosphorus can promote nuisance levels of algal and plant growth. Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 ug/L.

PHYTOPLANKTON: These algae (microscopic plants) live suspended in the water column of a lake. They form the base of a natural food chain.

POLYCHLORINATED BIPHENYLS (PCBs): PCBs are a group of chlorinated organic compounds first commercially developed in the late 1920s. As they are not of natural origin or formed in the natural environment, their presence is always attributed to human activity. PCBs are stable and relatively inert compounds: they break down very slowly in the environment and are destroyed by burning only at very high temperatures. These properties led to widespread use of PCBs as electrical transformer insulating fluids, extreme pressure oils and greases, hydraulic fluids, and as fire retardants and plasticizers in products such as paints, inks, caulking compounds and sealants.

In the early 1970's, it was discovered that PCBs accumulated to high levels in the environment. Their sale was restricted to closed-cycle uses, such as in electrical transformers. In July 1980, the use of PCBs in Canada was banned. Strict regulations for the storage and disposal of PCBs and PCB contaminated equipment minimize the chance of polluting the environment with this compound.

PWQO: Ontario Provincial Water Quality Objective as outlined in Water Management: Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment, Ontario Ministry of the Environment, 1978, Revised May, 1984.

THERMAL STRATIFICATION: The tendency of deep lakes to form three distinct layers of water (epilimnion, thermocline and hypolimnion) as a result of vertical change in temperature and therefore in the density of the water.

W.P.C.P.: Water Pollution Control Plant

WTP: Water Treatment Plant

ZOOPLANKTON: The animal portion of the community that lives suspended in the water column of a lake.

APPENDIX XIX. GREAT LAKES BASIN YOUNG-OF-THE-YEAR SPOTTAIL SHINER DATA SUMMARIES

FIGURE 2: TOTAL PCB CONCENTRATIONS IN YOUNG-OF-THE-YEAR SPOTTAIL SHINERS FROM THE GREAT LAKES AND CONNECTING CHANNELS IN THE MOST RECENT YEAR, 1986, 1987, OR 1988. (N = NOT DETECTED, T = TRACE). IJC AQUATIC LIFE GUIDELINE FOR PCB = 100 ng/g .

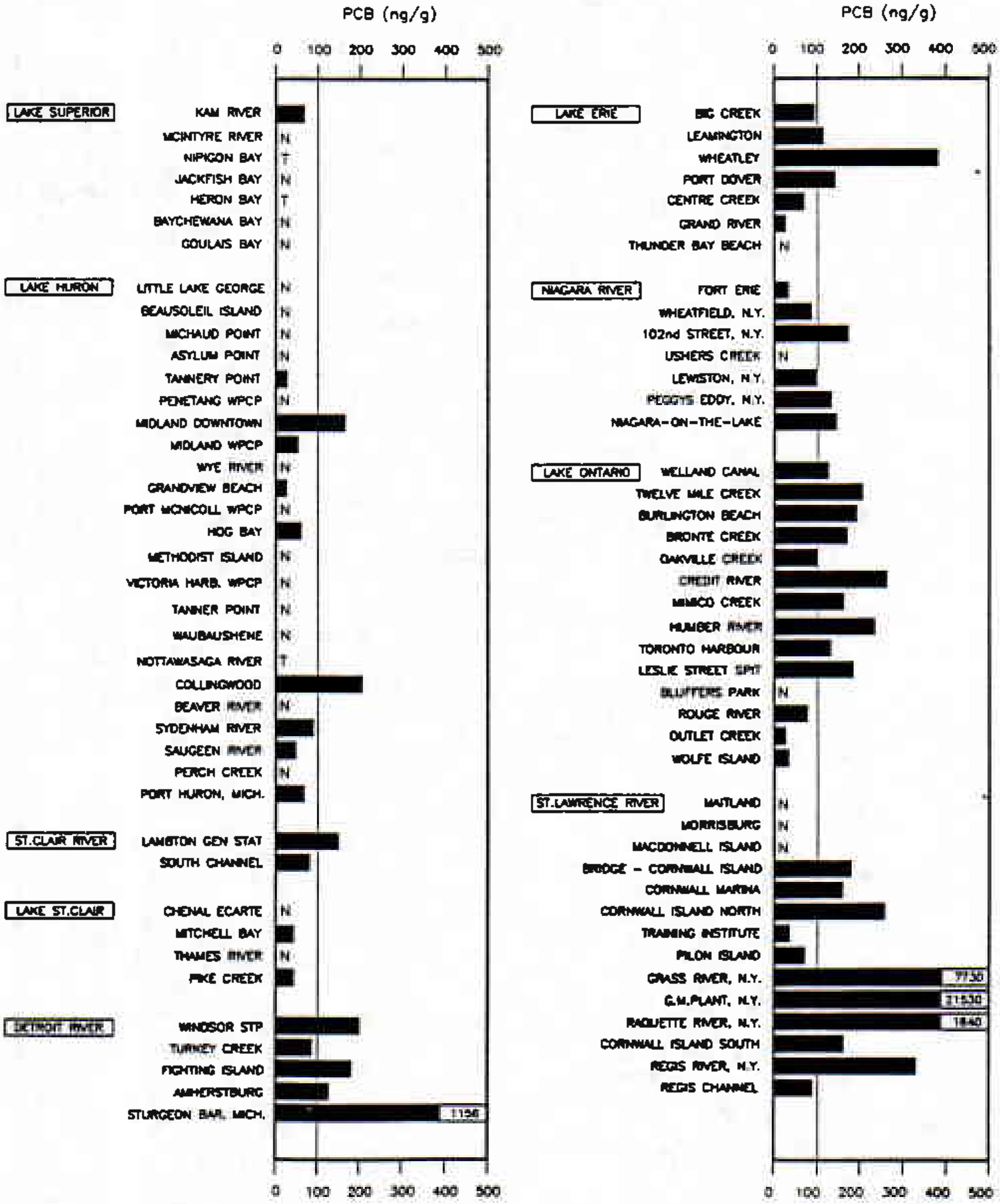

FIG. 8: FORAGE FISH CONTAMINANT INDEX (FFCI) FOR CONTAMINANTS WITH WILDLIFE PROTECTION GUIDELINES OR OBJECTIVES. VALUES ARE THE SUM OF MEASURED CONCENTRATIONS IN YOUNG-OF-THE-YEAR SPOTTAIL SHINERS (MOST RECENT YEAR, 1986, 1987 OR 1988) DIVIDED BY THE GUIDELINE FOR EACH CONTAMINANT (PCB = 100ng/g, DDT = 200ng/g, MIREX = 0 ng/g [used 1 ng/g], CHLORDANE = 500 ng/g, HCB = 330 ng/g, AND OCS = 20 ng/g). WILDLIFE RISK LEVEL = 1.