ST. LAWRENCE RIVER TRACE ORGANIC CONTAMINANTS STUDY (PART I), 1985

M.E. Comba, V.S. Palabrica
and K.L.E. Kaiser

NWRI Contribution No. 89-50

Nearshore/Offshore Interactions Project
Lakes Research Branch
National Water Research Institute
Burlington, Ontario L7R 4A6, CANADA

MANAGEMENT PERSPECTIVE

ST. LAWRENCE RIVER TRACE ORGANIC CONTAMINANTS STUDY (PART I), 1985

M.E. Comba, V.S. Palabrica and K.L.E. Kaiser

Analytical and research data compiled in this document are part of the St. Lawrence River Project / Connecting Channels Project / Nearshore-Offshore Interactions Project, addressing contaminant issues. In this report, data for the May, 1985 and October, 1985 cruises are presented and briefly discussed.

EXECUTIVE SUMMARY

ST. LAWRENCE RIVER TRACE ORGANIC CONTAMINANTS STUDY (PART I), 1985

M.E. Comba, V.S. Palabrica and K.L.E. Kaiser

This report is a summary of experimental and analytical data of sampling undertaken in 1985, as part of the St. Lawrence River Project / Connecting Channels Project / Nearshore-Offshore Interactions Project. The report provides analytical data, sampling locations, experimental details and procedures used to quantitate and validate the data.

TABLE OF CONTENTS

ABSTRACT

Polychlorinated biphenyls and selected organochlorine hydrocarbons were measured in suspended particulates of the St. Lawrence River during May and October 1985 while volatile halocarbon concentrations were measured in surface waters at numerous locations during October 1985. These initial analytical measurements are part of a project on contaminant behaviour and transport in the St. Lawrence River and its upper estuary receiving waters. Ten localized areas of impaired water quality were identified. The suspended particulate phase of the St. Lawrence River transports polychlorinated biphenyls and mirex from Lake Ontario to Quebec City.

LIST OF TABLES

LIST OF FIGURES

NATIONAL WATER RESEARCH INSTITUTE

LAKES RESEARCH BRANCH

This report is a compilation of experimental and analytical data arising from work undertaken by the Nearshore-Offshore Interactions Project. Material in this report will eventually appear in published form, and prior right to publication is reserved. Enquiries concerning the contents of this report should be addressed to K.L.E. Kaiser.

ACKNOWLEDGEMENTS

This research would not have been possible without the professional assistance of the Technical Operations Division of the National Water Research Institute and the crews of the Fisheries and Oceans support vessels, C.S.S. Advent and C.S.S. - Limnos, whom we thank deeply.

INTRODUCTION

The St. Lawrence River / Connecting Channels Project of the National Water Research Institute was initiated in 1984 in order to answer a number of questions on the origin, pathways, fates and effects of contaminants in large river systems in general and for the St. Lawrence River specifically. Knowledge of organic contaminants in large rivers is comparatively scanty, probably because of the difficulties encountered in collecting and analyzing representative samples. In contrast to most lakes, such rivers are strongly influenced by seasonal and other variations. For example, at its mouth, the flow of the St. Lawrence River varies from approximately 5,000 m3/s to approximately 18,000 m3/s. Its variability of water quality parameters, such as temperature, pH, concentrations of suspended sediments, dissolved organic and inorganic matter is similarly large. Further sampling, analytical and interpretation complications arise from cross-river gradients, which are known to exist in some areas.

Organic contaminants, such as polychlorinated biphenyls (PCB) and mirex have previously been found in water, sediments and biota of Lake Ontario, the source of the St. Lawrence River. Their presence in fish resulted in provincial and US state advisories or bans on fish consumption (MOE, 1987), loss of

Canadian eel sales to Europe (Homer, 1986) and contaminated sturgeon in the St. Lawrence River (Desjardins, 1986). Volatile halocarbons and cadmium are present throughout the St. Lawrence River system and show localized impairment of the water quality near industrial and urban areas (Lum and Kaiser, 1986). Further downstream, the beluga whale population of the upper St. Lawrence River estuary is impacted by pollution and perceived to be endangered. It is known to be severely contaminated with PCBs, mirex and polynuclear hydrocarbons (Masse et al., 1986; Martineau et al., 1987) and also subject to viral infections arising from human waste (Martineau and Beland, 1987). Both PCB and mirex are also common contaminants in fish eating birds on the east coast of this continent (Noble and Elliott, 1986).

Questions which arise here ask what are the sources of these contaminants? What are their pathways and fates? What are the trends in contaminant concentrations and loadings? How long will these compounds persist under certain input reduction scenarios, and soforth.

Besides these specific questions on the St. Lawrence system, there is a general need to understand the processes and rates which control the contaminants' environmental significance. The St. Lawrence River Project / Connecting Channels Project / Nearshore-Offshore Interactions Project is intended to create the

vital data on both organic and inorganic contaminants that are needed to resolve the questions.

NARRATIVE

Two sampling excursions on the St. Lawrence River were undertaken in 1985. From May 6-17, the vessel C.S.S. Advent collected samples between Kingston, Ontario and Quebec City. During September 10 to October 18, the vessel C.S.S. Limnos was engaged in similar sampling operations that extended east of Quebec City into the upper estuary. The respective chronology of events and sampling can be obtained from the Technical Operations cruise reports, 85-22-701 and 85-07-001 with locations as provided in Appendex A of this report. Surface data taken during these sampling periods are also recorded in the S.T.A.R. data base at the National Water Research Institute.

The determination of organics in the May samples provided information on contaminant levels and knowledge of the river system that would form the basis for further sampling. The measurements focused on polychlorinated biphenyls and mirex concentrations on suspended solids. In October a number of these stations were revisited and larger samples taken. Extensive volatile halocarbon measurements were made in October to define point source inputs, water circulation and mixing zones.

EXPERIMENTAL

Sample Collection

Suspended particulates

Suspended particulates were collected from bulk water samples from the separation bowls of a Westfalia centrifuge. The centrifuge was operated at 9800 rpm and the water sample was passed through at a rate of 6 L/min. The contents of the separation bowl were obtained by slurrying retained sample water with the particulate film using a nylon toothbrush or small nylon bristle paint brush. The sample was poured and rinsed into a 500 mL wide-mouth glass jar and stored at 4 C until processing at the main laboratory. In May 1985, these samples were acquired by filling a 600 L polyethylene tub from a depth of 2 m and centrifuging the tub to dryness. In October 1985 samples were taken in a similar manner, with two 600-L tubs being used to acquire the sample.

Volatile halocarbons

Subsurface water samples were collected in 200 mL glass bottles. The sample bottles were filled completely so as to avoid any headspace and processed on board the C.S.S. Limnos, usually within two hours of collection. For the processing, a 100 mL aliquot of each sample was transferred to a 125 mL cylindrical separatory funnel, the funnel evacuated and placed in a water bath at 95 C for three minutes. The volatile con-

taminants, so purged into the funnel headspace, were transferred to an evacuated septum-equipped 15 mL vial held in liquid nitrogen. After completion of the transfer, the vials were stored at room temperature until gas chromatographic analysis in the laboratory.

The processing apparatus was purged with hot air after each sample to avoid cross contamination between samples.

Details of the procedures to isolate the headspace samples, recoveries and subsequent analyses have been described by Comba and Kaiser (1983), Comba et al. (1985) and Kaiser and Comba (1986a).

Sample Preparation

Suspended particulates

The samples in 500 mL jars were allowed to settle for one day prior to removal of the surface water above the particulate layer, by suction through a water aspirator using a disposable pipette. The sample water was removed approximately 1 cm above the suspended particulate layer; covered with a Medi-wipe (McGaw Supply Ltd., Mississauga, Ontario), secured with an elastic, frozen and then freeze dried.

Freeze drying was performed in a Virtis 100-SRC Sublimator with a shelf temperature of 20 °C and a vacuum of 15 to 30 Torr. Samples were prepared in batches for a period of 72 to 100 hours. The concentration of particulate matter recovered by

this procedure is given in Table 1, for the May samples and Table 2 for the October samples. One gram of the May 1985 suspended particulates were soxhlet extracted with acetone/hexane according to the method of Oliver and Nicol (1982) and after removal of the acetone with water were concentrated. The sample extract was divided into two equal portions of which one was analyzed for the organics reported hereafter. The October 1985 particulates after fractionation on silica gel were extracted by the ultrasonic procedure using methylene chloride as previously reported by the authors (Comba et al., 1985), solvent exchanged to hexane and reduced to 1 mL. Because of the sample requirements of short-term radionuclide determinations and the inorganic parameters, many stations were not analyzed for organics at this time due to insufficient sample size. Sample amounts varied from 0.5 to 2.5 g dry weight.

Sample Cleanup

Column chromatography

Glass columns 300 x 1 cm prewashed with acetone, toluene and hexane were prepared by gravity settling through hexane to a height of 10 cm with 3% deactivated silica gel. An acid silica gel column was prepared by placing a teflon wool plug into a 5 x 0.2 cm column with a 24/40 female ground glass fitting reservoir. The teflon plug was prewashed with toluene and hexane before the column portion was filled with 4 cm of 44% (by weight H_2SO_4) acid silica gel and rinsed with 25 mL hexane. The acid

silica gel column was placed in a 250 mL round bottom flask and positioned beneath the silica gel column, which previously had the hexane layer drained to the top of the silica gel bed.

The prepared sample was added to the top of the silica gel column and eluted to the top of the bed. The sample container was rinsed twice with 2 mL of hexane and the above procedure repeated for each addition. Another 21 mL of hexane was then added to the column and the eluant allowed to chomatograph through the acid silica gel column beneath the silica gel column. The flask was removed and the acid reservoir rinsed with 10 mL of hexane and labelled Fraction A. Another 250 mL round bottom flask was placed beneath the silica gel column, and eluted with 25 mL methylene chloride. The chromatographic eluant was solvent exchanged to 1 mL hexane with 0.5 mL heptane as keeper and labelled Fraction B. These procedures are summarized in Figure 1.

Acid silica gel preparation

Kiesel gel 60, 70-230 mesh, ASTM as supplied by Merck, was activated by heating for 24 hours at 500 C. The acid silica gel was prepared by adding, by weight, Aristar sulfuric acid to the silica gel and tumbling the mixture for 24 hours on a rotary evaporation unit.

Silica gel 3% deactivated

The previously activated silica gel was deactivated with a 3% by weight addition of water and tumbled on a rotary evaporation unit for 24 hours.

Sample Analyses

Volatile halocarbons

Five hundred microlitre manual injections of the headspace samples were analyzed on a Hewlett Packard 5890 gas chromatograph using an electron capture detector. Split/splitless conditions were employed with a splitless delay time of 10 seconds. Temperatures from -20 C for 2 min to 80 C at 4 C/min were used for chromatographic separation on a 30 m x 0.25 mm OV-101 fused silica capillary column.

Organochlorines

All extracts were analyzed by gas chromatography using electron capture detectors on both HP 5880-A and HP 5890 instruments. Quality assurance was maintained by using two different stationary phases with narrow bore (0.25 um) fused silica columns. The following column types were used (i) a 30-m DB-1 (from Chromatographic Specialties Ltd., Brockville, Ontario) and (ii) a 30-m HP-5 (Hewlett-Packard) column. Aliquots of 1 uL volume were injected with an autosampler and an acceptance window of 0.05 minutes was used for component identification by retention time comparison utilizing the HP 5880-A instrument with DB-1 column. Manual injections were made onto the HP 5890 instrument at similar qualitative restrictions. Both instruments

were used in the split/splitless mode of injection and employed hold times of 0.2 minutes at the initial injection. The initial column temperatures were 90 C, isothermal for 2 minutes, programmed at 4 C/min to 280 C and held isothermal for 5 minutes. The carrier gas was hydrogen.

Sample Quantitation and Quality Assurance

Volatile halocarbons

The performance of the sample processing and analytical procedure was verified each day by comparing halocarbon values on triplicate water samples. Standards for gas chromatography determinations were prepared from stock solutions and checked for deterioration by comparison of individual response ratios of each compound against carbon tetrachloride and chloroform.

Polychlorinated biphenyls

Quantitation of PCB was determined by relative response to a U.S. EPA standard reference mixture of 10:5:3.5:3 of Aroclors (1221:1016:1254:1262) from which 16 peaks of PCB congeners [(18,15); 31; 52; 44; 101; (66,98); 110; 118; 153; 138; 174; 187; 180; 201; (203,196); and 194] are calibrated to specific response fractions.

A second procedure for the quantitation of PCB was also used. Five groups of four resolved congeners were selected across the chlorine distribution of the standard. Each congener was assigned a ratio equivalent to the concentration of the standard based on its area response to the electron capture detector. The

two results from the first procedure (DB-1 and HP-5) were averaged with the results from the latter technique to produce a mean total PCB value. The ratio produced value also provides an indication if the polychlorinated biphenyls in the suspended solid samples have undergone any severe "weathering effects" or are not of similar composition to the standard. Our observations to date, for suspended solids, indicate no appreciable difference in total PCB concentration between methods or any significant profile variations for the samples and standard mixture, although there was a tendency to have greater amounts of lower chlorinated congeners in the samples with less higher chlorinated congeners in comparison to this standard.

Selected samples were cross referenced by B.G. Oliver's laboratory using the procedure of Oliver and Niimi (1987) based on specific congener analyses of 92 isomers, excellent results for total PCB were achieved.

Organochlorine contaminants

Individual organochlorine contaminants were qualitatively identified and quantitated to standard response factors by retention time matches on both capillary column phases. Under the conditions used, polychlorinated biphenyls, aldrin, heptachlor, o,p- and p,p- DDEs and DDTs along with mirex eluted in Fraction A (see Figure 1). The BHCs, chlordanes, endrin, dieldrin, heptachlor epoxide, endosulfans, methoxychlor, o,p- and p,p- DDDs eluted in Fraction B.

RESULTS

Volatile halocarbons

This group includes some 20 to 30 chemicals, most of which are of industrial origin. We have recently demonstrated their general association with other contaminants (Kaiser et al., 1985; Comba and Kaiser, 1985), and their widespread occurrence in some of the Great Lakes (Kaiser and Valdmanis, 1979; Kaiser et al., 1983; Kaiser and Comba, 1986b). In addition, our research proved the possibility of using such comtaminants for tracking river plumes in receiving waters (Comba and Kaiser, 1984; Kaiser and Comba, 1986a). Based on our experience and years of field observations, volatile halocarbon (VHC) occurrences have empirical relationships to municipal and industrial activities, a summary of which can be found in Table 3. These measurements of volatile halocarbons (Table 4) at many locations in the St. Lawrence River, indicate that VHCs are widely distributed throughout the river system. Relative to contamination in other rivers in the Great Lakes basin, some of the values are higher than anywhere else (Lum and Kaiser, 1986). Areas that had significant sources of volatile halocarbons were at Maitland, Cornwall/Massena, Montreal, Sorel and Quebec. In addition, volatile halocarbon inputs were evident from the Ottawa, Yamaska, St. François and St. Maurice Rivers. Volatile halocarbon measurements for six VHCs, with levels of analytical importance are shown in Figure 2a,b and c with our interpretation as to possible contaminant inputs related to such municipal and

industrial activities as summarized in Table 5.

Based on the predominance of the VHCs measured in the river system, the likely related activities could be ranked as follows: pulp and paper wastes, municipal wastes, primary or metal fabrication production, chemical/petroleum products and contaminant burdens associated with such wastes.

Polychlorinated biphenyls

Polychlorinated biphenyl measurements for May and October 1985 on suspended solids (Tables 6 and 7) indicate higher concentrations near Lake Ontario with decreasing concentrations towards Quebec City. Loadings transmitted by particulates however are reversed, as a ten-fold increase in suspended solid concentration combined with the 35% increase in flow, double the PCB export rate by particulates at Quebec City as compared to the input of particulates from Lake Ontario (see Figure 3).

Although the annual flux of particulate PCB (see Figure 3) based on May 1985 (Table 6) and October 1985 measurements (Table 7) are provisional and the flow rate values (Table 8) are not station specific, the calculations should be a reasonable approximation of the true value for the sampling event.

The parameters that control contaminant flux are particle type and contaminant concentration in the particulate and water phase. These values are dependent upon conditions of

trophic state, seasonal period and organic matrix of the water column. The measurement of contaminant concentration and subsequent interpretation as to flux becomes complicated by conditions of flow, representative nature of the sampling point and the partitioning or release of contaminants as a result of these (Allan, 1986).

A number of significant variations in values for PCB particulate transmission occur for each of the seasonal periods sampled. Assessment into the cause of such variations is difficult since partitioning is suspected as one of the critical factors and at this stage of the program only the particulate phase was sampled.

In May 1985, the PCB flux on particulates was reasonably uniform in the upper portions of the river (200 to 250 kg/yr). Below Montreal, however, the flux estimates begin to show greater variation although the concentration of PCB on the particulates did not change significantly. In October 1985 a similar pattern was observed. Although a greater PCB particulate flux (700 kg/yr) is observed at the two stations below Cornwall (32 and 41), it remains relatively constant down to Lake St. Louis, where additional inputs appear to enter from sources both along the St. Lawrence River and the Ottawa River. East of Montreal, PCB flux values for suspended solids are strongly fluctuating, which may be due to local sources and to incomplete mixing of the Ottawa River tributary with the St. Lawrence River water.

In reviewing sampling conditions, the cause of some of these variations may be explained. In May 1985, the Ottawa River flow was around 5800 m3/sec with a suspended particulate concentration of 4.25 mg/L. PCB flux on particulates from the Ottawa River was small compared to the value for the St. Lawrence River. The low value for the Ottawa River may be a result of incomplete recovery or of the high flow which may have purged the river prior to sampling. These factors could also contribute to the greater flux values downstream at stations 243 and 112. Some of the variation may be attributed to cross-river variations of the water mass, particularly during this period of extremely high flow of the Ottawa River. In October 1985, these stations again show great variability in PCB flux estimates at lower river flow and reduced suspended load conditions. Part of these fluctuations can be attributed to vigorous storm conditions during the sampling of Lac Saint-Pierre, that caused the samples to include resuspended bottom sediments. The remaining uncertainty in the PCB flux is most likely related to the concentrations and types of particulates present.

Mirex

Mirex was found to be present in suspended solids up to Maitland, Ontario in the May 1985 samples and as far as Trois Rivières in the October 1985 samples (see Figure 4). The detection of mirex is limited due to the sample size available for analyses and its concentration on the particulates. Measurements taken in 1986 (Comba et al., 1989a) report mirex

being detected as far as Quebec City. Loadings of mirex between Lake Ontario and Quebec City through particulate phase transport appear to be a function of suspended particulate concentration, implying that Lake Ontario is the principal source of this material. The elevated levels in the Lac Saint-Pierre region may represent the first significant depositional zone in the river for those suspended particulates responsible for mirex transport. However, the 1986 data do not support this interpretation.

The possibility that mirex may also exist as a separate particle moiety as a result of the manufacturing and grinding process along with the above theories are being examined. Biologically, however, eels may play a more significant role (Lum et al., 1987), in the net transport of mirex out of Lake Ontario.

SUMMARY

Results from the 1985 sampling season show transport of mirex and polychlorinated biphenyls in the particulate phase of the St. Lawrence River. Although Lake Ontario is a primary source for both of these materials, other inputs of PCB were observed within the watershed predominantly in those areas previously designated as having localized impairment of water quality on the basis of their volatile halocarbon concentrations. The critical empirical relationships for some volatile halocarbons with trace metals (Table 5) also give good agreement with published cadmium levels (Lum and Kaiser 1986) and are found in those parts of the river identified as having metal production or

fabrication activities.

Mirex values and suspended solids fluxes measured in 1985 and 1986 (Comba et al., 1988a) were important in revising a sediment budget for Lake Ontario (Lum et al., 1987) and determining transport mechanisms for mirex within the river system. The stable particulate transport regime of mirex in comparison to fluctuating PCB concentrations is related to a number of factors, but mainly to Lake Ontario being a constant and the principal source of mirex, while inputs of PCB are active throughout the river. The variability of PCB particulate concentrations also demonstrates the greater effects that season, weather conditions and the organic matrix of the suspended or dissolved material have on the partitioning process. Loadings determined from samples influenced by such events will not provide an accurate indication of net PCB flux in the St. Lawrence River. A more thorough understanding of the mechanisms controlling contaminant transport will be required.

The results of the 1985 field year provided valuable information towards the preparation of a more comprehensive experimental design. While much was accomplished in the initial year, the project revealed more unresolved issues than solutions and stressed the importance in determining the distribution, pathways and environmental consequences of organic contaminants in this system. In particular, the physical and chemical processes which influence contaminant uptake into the foodchain need to be investigated in areas of considerable biological and

economical importance, such as the St. Lawrence River estuary. Considering the contamination of sturgeon in the St. Lawrence River (Desjardins 1986), the beluga whale population of the upper estuary (Masse et al., 1986; Martineau et al., 1987; Martineau and Beland, 1987) and most of the fish eating birds off the east coast (Noble and Elliot, 1986), it is of environmental significance that a contaminant introduced twenty-six years earlier into a large lake system and perceived to be dormant has been transported at least 800 miles through the St. Lawrence River, possibly even as far as the Sargasso Sea by migration of the eels. In the estuary, primarily the upper estuary, between the cities of Quebec and Tadoussac, the river's fresh water mixes with the salt water of the Atlantic Ocean. Because of the many differences between these water masses, notably salinity and density, the pathways and effects of contaminants will be strongly influenced by these natural conditions.

While some measurements were made in the upper estuary in 1985, interpretation would be rudimentary at this point.

REFERENCES

Allan, R.J., 1986. The role of particulate matter in the fate of contaminants in aquatic systems. Environment Canada, Inland Waters Directorate, Scientific Series No. 142, National Water Research Institute, Burlington, Ontario, 128 p.

Comba, M.E. and Kaiser, K.L.E., 1983. Determination of volatile contaminants at the ng/L level in water by capillary gas chromatography with electron capture detection. Intern. J. Environ. Anal. Chem. 16: 17-31.

Comba, M.E. and Kaiser, K.L.E., 1984. Tracking River Plumes with volatile halocarbon contaminants: The Niagara River - Lake Ontario example. J. Great Lakes Res. 10(4): 375-382.

Comba, M.E. and Kaiser, K.L.E., 1985. Volatile halocarbons in the Detroit River and their relationship to contaminant sources. J. Great Lakes Res. 11: 404-418.

Comba, M.E., Kaiser, K.L.E., Maguire, R.J., Tkacz, R.J. and Platford, R.F., 1985. A chemical survey of the Detroit River, 1983. National Water Research Institute, Report No. 85-85, 85 p.

Comba, M.E., Palabrica, V.S., Wasslen, J., Bengert, G.A. and Kaiser, K.L.E., 1989a. St. Lawrence River organic contaminants study (Part II), 1986. National Water Research Institute, Report 89-51, 97p.

Comba, M.E. and Kaiser, K.L.E., 1989b. Suspended particulate concentrations in the St. Lawrence River (1985-1987) determined by centrifugation and filtration. Sci. Total Envir., in preparation.

Desjardins, C., 1986. Personal communication to M. Comba.

Homer, S., 1986. Low tide at Kamouraska. Harrowsmith 11:47-52.

Kaiser, K.L.E. and Valdmanis, I., 1979. Volatile chloro- and chlorofluorocarbons in Lake Erie - 1977 and 1978. J. Great Lakes Res. 5: 150-160.

Kaiser, K.L.E., Comba, M.E. and Huneault, H., 1983. Volatile halocarbon contaminant in the Niagara River and in Lake Ontario. J. Great Lakes Res. 9:212-223.

Kaiser, K.L.E., Comba, M.E., Hunter, H., Maguire, R.J., Tkacz, R.J. and Platford, R.F., 1985. Trace organic contaminants in the Detroit River. J. Great Lakes Res. 11(3):386-399.

Kaiser, K.L.E. and Comba, M.E., 1986a. Tracking river plumes with volatile halocarbon contaminants: The St. Clair River - Lake St. Clair example. Environ. Toxicol. Chem. 5: 965-976.

Kaiser, K.L.E. and Comba, M.E., 1986b. Volatile halocarbon contaminant survey of the St. Clair River. Water Poll. Res. J. Can. 21: 323-331.

Lum, K.R. and Kaiser, K.L.E., 1986. Organic and inorganic contaminants in the St. Lawrence River: Some preliminary results on their distributions. Water Poll. Res. J. Canada 21(4): 592-602.

Lum, K.R., Kaiser, K.L.E. and Comba, M.E., 1987. Export of mirex from Lake Ontario to the St. Lawrence estuary. Science of the Total Environ. 67: 41-51.

Martineau, D. and Beland, P., 1987. Mirex as a tracer of food chain organochlorine transport from the Great Lakes into the beluga whales of the St. Lawrence estuary. Presented at the 30th Conference of Great Lakes Research, Ann Arbor, Michigan.

Martineau, D., Beland, P., Desjardins, C. and Lagace, A., 1987. Levels of organochlorine chemicals in tissues of beluga whales (Delphinapterus leucas) from the St. Lawrence estuary, Quebec, Canada. Arch. Environ. Contam. Toxicol. 16: 137-147.

Masse, R., Martineau, D., Tremblay, L. and Beland, P., 1986. Concentrations and chromatographic profile of DDT metabolites and polychlorobiphenyl (PCB) residues in stranded beluga whales (Delphinapterus leucas) from the St. Lawrence estuary, Canada. Arch. Environ. Contam. Toxicol. 15: 567-579.

MOE, 1987. Guide to eating Ontario sport fish 1986-87. Ontario Ministry of the Environment, Ministry of Natural Resources 130 p.

Noble, D.G. and Elliott, J.E., 1986. Environmental contaminants in Canadian seabirds, 1968-1985: trends and effects. Technical Report Series No. 13, Canadian Wildlife Service, Ottawa.

Oliver, B.G. and Niimi, A.J., 1987. Trophodynamic analysis of PCB congener and other chlorinated hydrocarbons in the Lake Ontario ecosystem. Environ. Sci. Technol. 22: 388-397.

Oliver, B.G. and Nicol, K.D., 1982. Gas chromatographic determination of other chlorinated hydrocarbons in environmental samples using fused silica capillary columns. Chromatographia 16: 336-340.

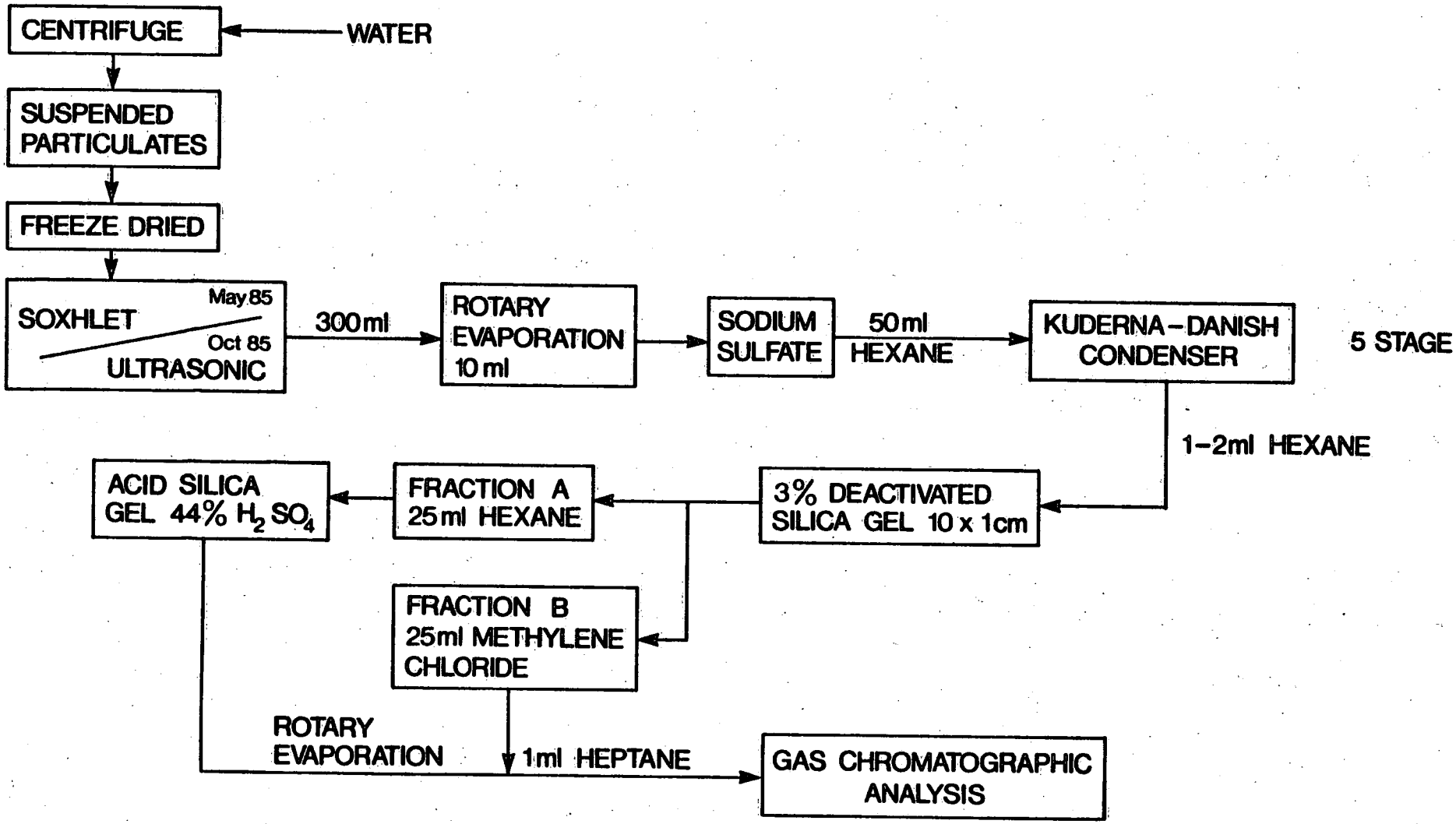


Figure 1. Extraction scheme for organochlorine components in suspended particulates.

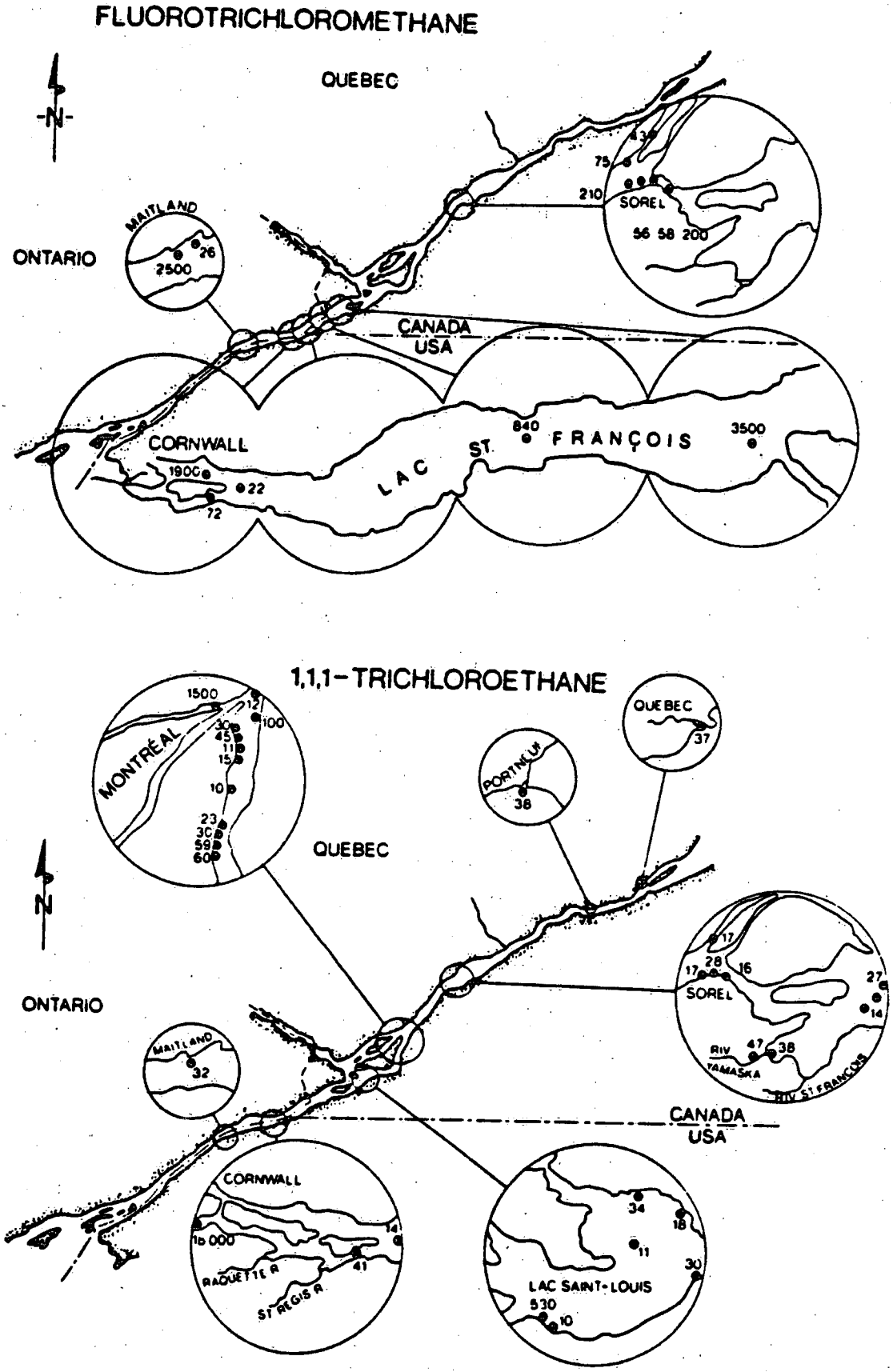


Figure 2a: Selected volatile halocarbon concentrations in 1985 St. Lawrence river surface water.

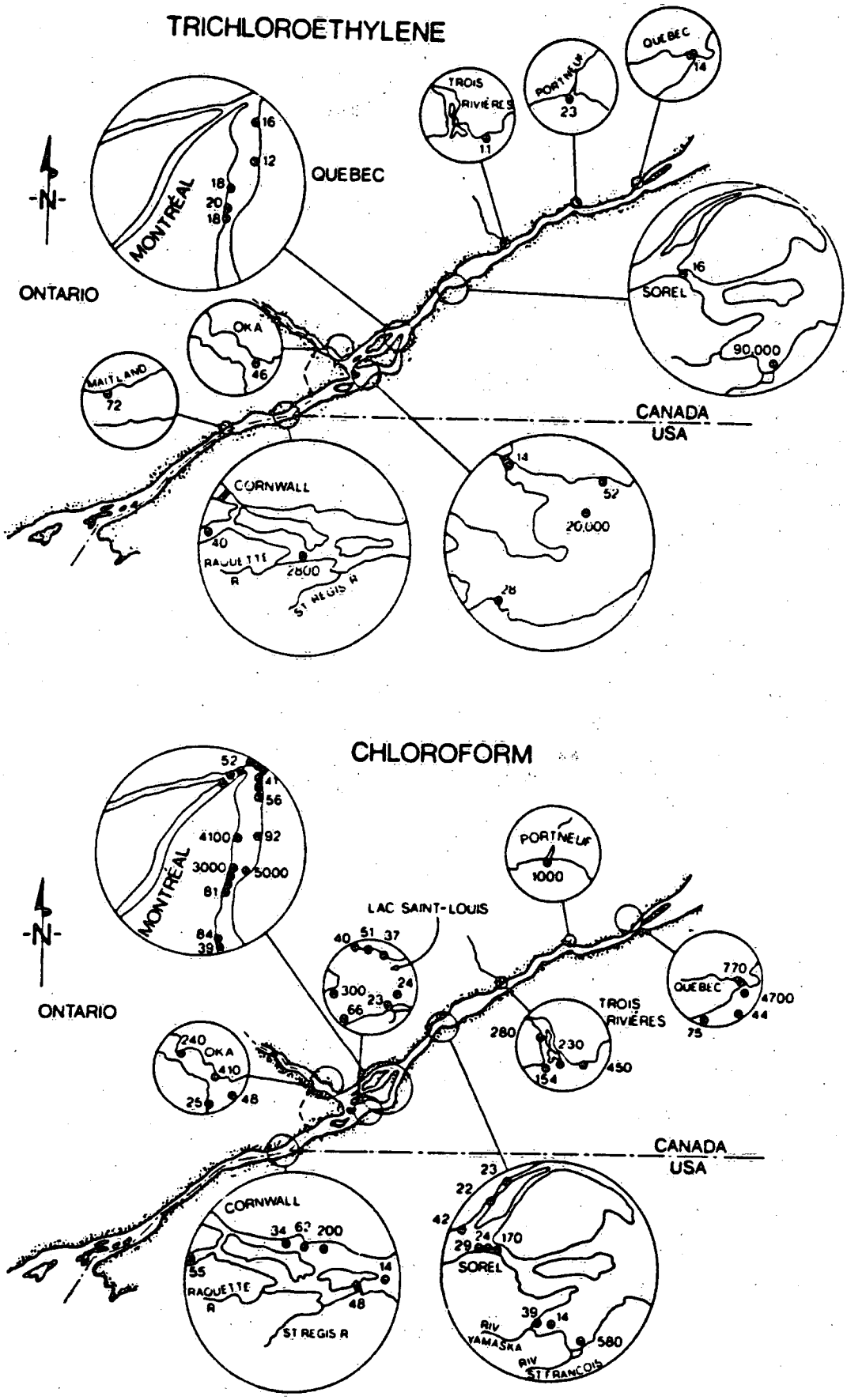


Figure 2b: Selected volatile halocarbon concentrations in 1985 St. Lawrence River surface water.

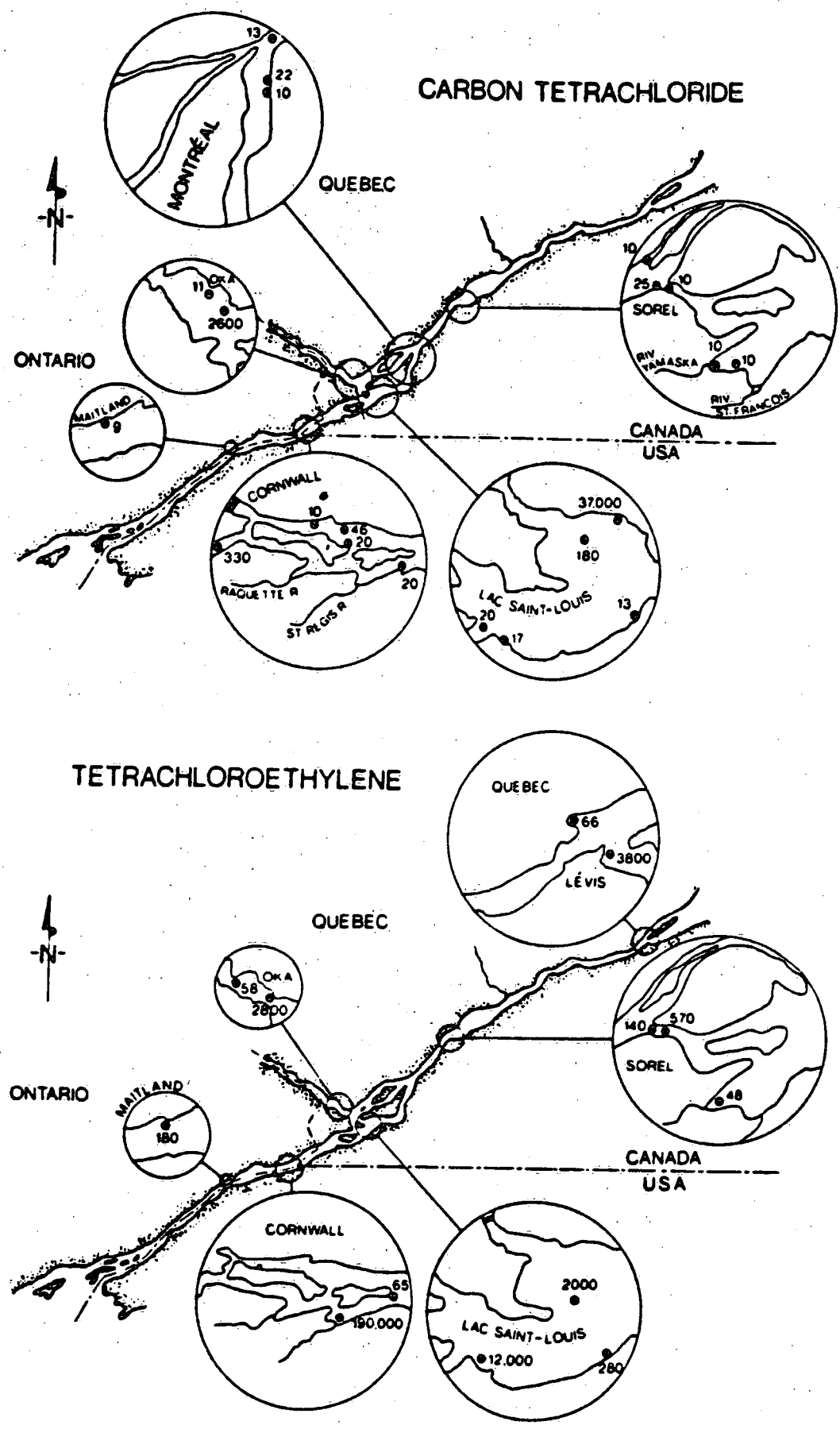


Figure 2c: Selected volatile halocarbon concentrations in 1985 St. lawrence River surface water.

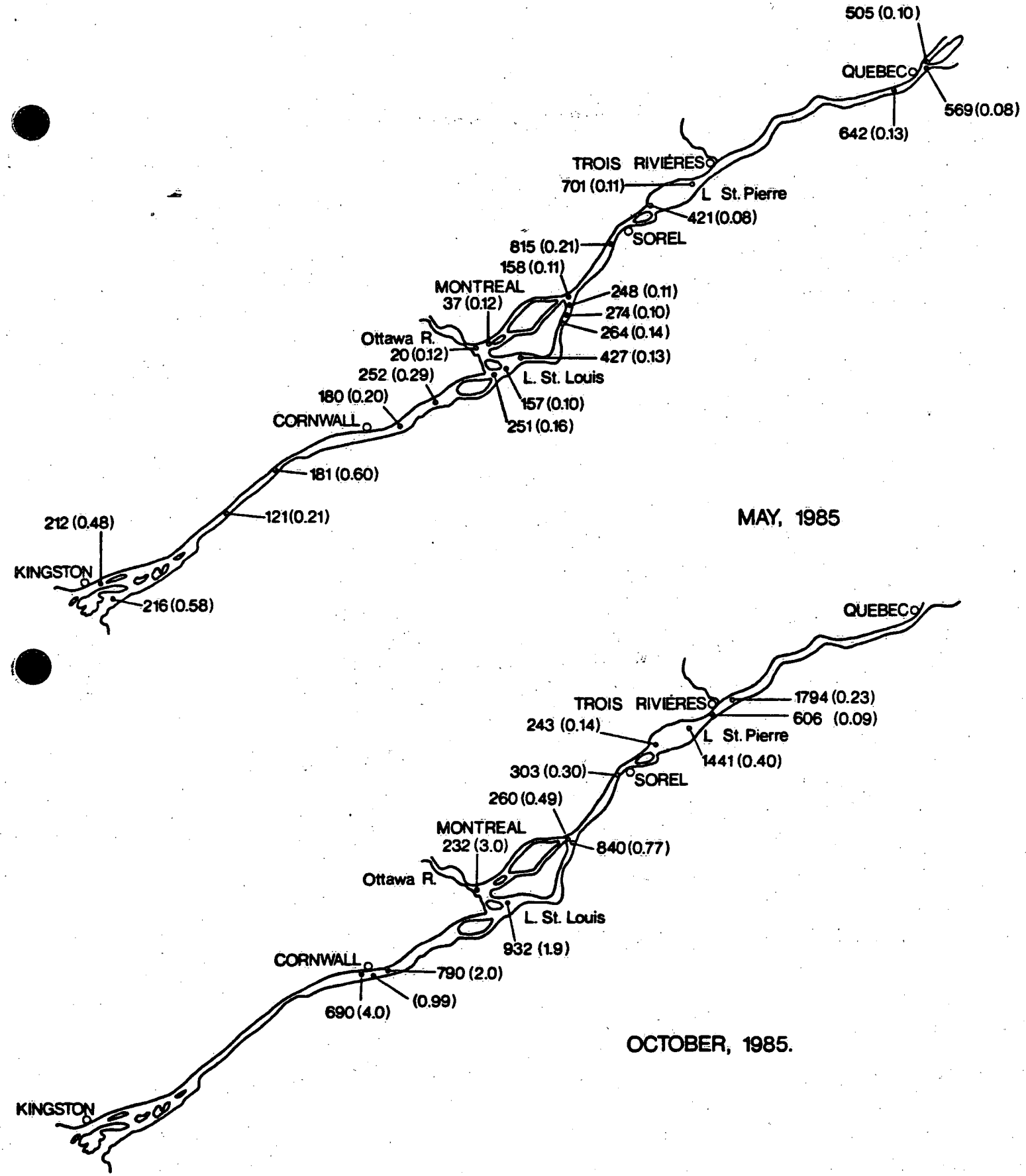


Figure 3. Provisional loadings (kg/yr) and (concentrations: ug/g) of polychlorinated biphenyls on suspended particulate matter in the St. Lawrence River, 1985.

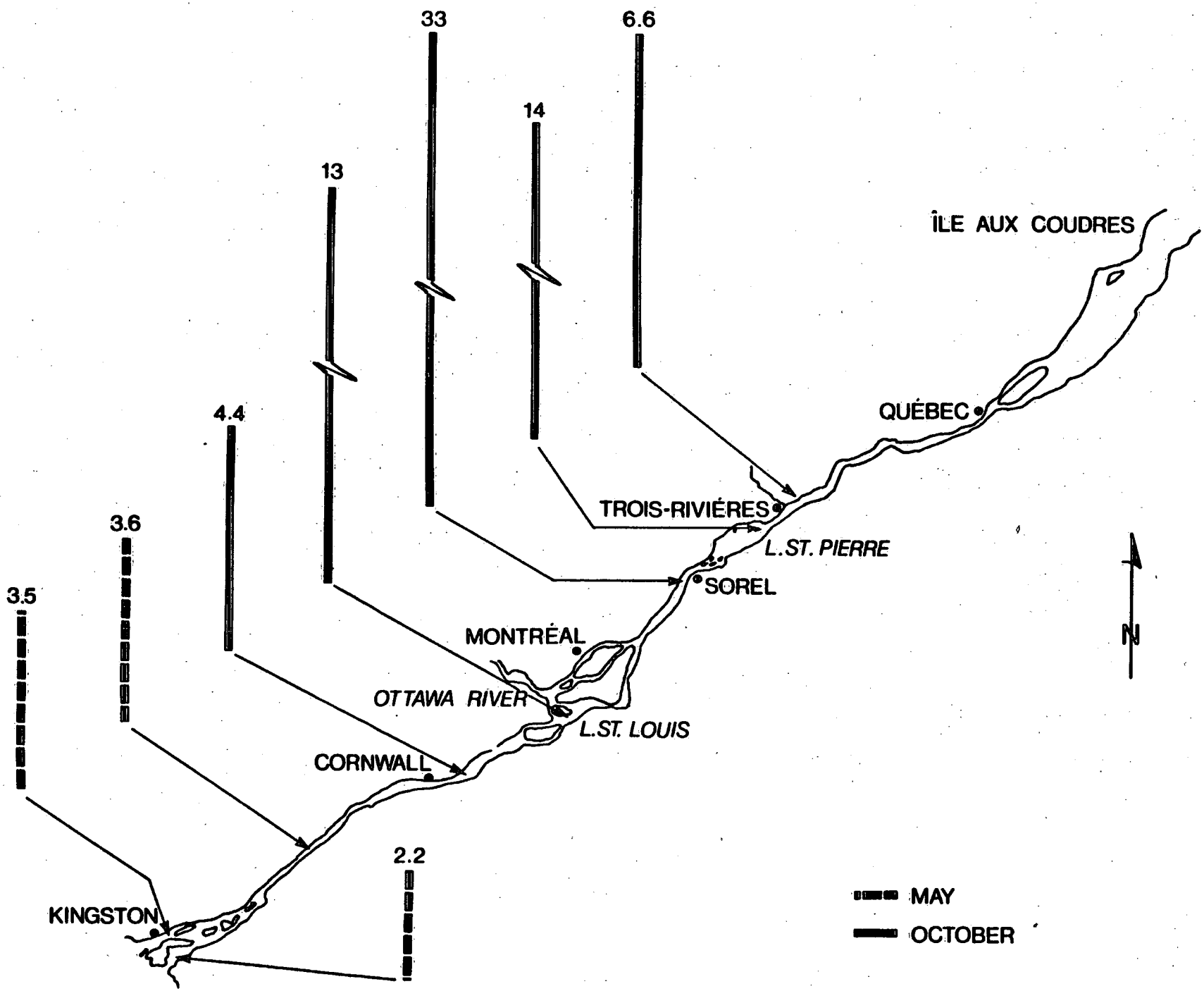


Figure 4. Provisional loadings (kg/yr) of mirex on suspended particulate matter in the St. Lawrence River, 1985.

TABLE 1: Concentration of Suspended Particulate Material in the St. Lawrence River, May 1985 (mg/L).

Station[a]	[ppm][b]	Latitude N.	Longitude W.
1	1.42	44°07'14"	76°22'08"
2	1.68	44°14'28"	76°19'20"
3	1.97	44°40'46"	75°33'07"
4	2.43	44°42'53"	75°28'22"
5	2.82	45°01'28"	74°40'45"
6	2.96	45°13'42"	74°08'35"
7	3.79	45°19'26"	73°54'02"
8	3.80	45°22'04"	73°49'34"
9	7.08	45°24'16"	73°43'39"
10	6.27	45°24'26"	73°34'44"
11	4.25	45°24'05"	73°57'03"
12	4.86	45°43'10"	73°26'32"
13	2.82	45°44'12"	73°26'11"
14	7.37	45°59'11"	73°10'53"
15	10.0	46°06'21"	72°58'13"
16	12.1	46°22'37"	72°28'52"
17	9.60	46°51'06"	71°09'07"
18	13.5	46°50'36"	71°05'17"
19	9.38	46°44'32"	71°20'05"
20	5.89	45°35'51"	73°30'30"
21	4.06	45°31'34"	73°33'32"
22	3.24	45°27'26"	74°06'00"
23	2.99	45°29'27"	73°57'26"
24	2.97	45°09'32"	74°21'55"
25	3.07	45°02'41"	74°34'49"
26	3.78	44°59'13"	74°46'18"

(a) See Appendix for locations.
(b) Based on 600 litres of centrifuged water at a depth of 2 metres.

TABLE 2: Concentration of Suspended Particulate Material in the St. Lawrence River, October 1985 (mg/L).

Station[a]	(c)	[ppm][b]	Latitude N.	Longitude W.
27	2	-	44°14'30"	76°19'19"
28	1	0.67	44°07'15"	76°22'08"
29	3	1.02	44°38'19"	75°35'51"
30	26	7.98	44°59'15"	74°46'15"
31		1.65	45°00'17"	74°39'35"
32	5	1.92	45°01'23"	74°40'50"
41	25	1.53	45°02'39"	74°34'50"
44	24	0.79	45°11'19"	74°19'27"
48		-	45°13'15"	74°12'16"
51	6	1.00	45°13'50"	74°08'37"
53		2.66	45°19'26"	73°54'06"
54	7	1.20	45°20'14"	73°55'44"
56	8	1.81	45°22'09"	73°49'35"
59		0.33	45°24'43"	73°49'39"
62	11	1.79	45°26'52"	74°03'02"
66	10	0.91	45°24'20"	73°43'44"
79	12	1.85	45°43'22"	73°25'23"
82	13	3.80	45°43'54"	73°26'18"
85		24.5	46°07'09"	72°56'02"
95	15	10.4	46°07'41"	72°56'59"
104		5.01	46°11'21"	72°53'47"
112		10.3	46°14'11"	72°45'38"
123	16	19.9	46°16'19"	72°37'43"
124		22.0	46°22'36"	72°28'50"
243	14	3.18	45°58'44"	73°11'32"

(a) See Appendix for locations.
(b) Based on 1200 litres of centrifuged water at a depth of 3 metres.
(c) Equivalent or approximately similar stations in May 1985. See Table 1.

TABLE 3: **Observed Empirical Relationships of Volatile Halocarbons with Industrial or Municipal Activities.**

Compound	Activities
Trichlorofluormethane Methylene chloride	Blowing agent, aerosol in plastics, foams, paints
Trichloroethane Trichloroethylene Tetrachloroethylene	Primary metal production, metal fabrication
Carbon tetrachloride	Chemical production
Chloroform Bromomethanes	Municipal wastes Pulp and paper wastes
Bromo/Chloro ethanes/ ethylenes	Petroleum residues Synthetic fibers
Chloropropanes	Synthetic - natural rubbers or plastics

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		27	28	29	30	31	32
Location:	Latitude North	44°14'30"	44°07'15"	44°38'19"	44°59'15"	45°00'17"	45°01'23"
	Longitude West	76°19'19"	76°22'18"	75°35'51"	74°46'15"	74°39'35"	74°40'50"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		12	18	6.7	21	14	10
1,1-Dichloroethylene			Tr		Tr	Tr	Tr
Carbon disulfide		Tr	Tr	Tr	Tr	Tr	Tr
Dichloromethane		300	250	130	Tr	Tr	Tr
1,2-Dichloroethylene							Tr
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		5.7	2.4	6.3	3.7	4.1	200
1,2-Dichloroethane							
1,1,1-Trichloroethane		10	1.9	13	19	1.8	6.1
Carbon tetrachloride		4.4	2.8	4.2	3.2	6.0	46
1,2-Dichloropropane							
Trichloroethylene		Tr	Tr	Tr	Tr	2800	Tr
Dibromomethane		Tr		Tr			Tr
Bromodichloromethane		Tr		Tr			1.7
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							Tr
Tetrachloroethylene		3.2	4.0	3.1	3.8	2.4	7.6
Ethylene dibromide							
Bromoform							Tr
1,1,2,2-Tetrachloroethane							Tr

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		34	35	37	39	41	43
Location:	Latitude North	45°01'39"	45°01'48"	45°01'09"	45°01'19"	44°02'39"	45°10'57"
	Longitude West	74°38'24"	74°38'32"	74°37'01"	74°37'11"	74°34'50"	74°19'06"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		1900	24	21	16	22	15
1,1-Dichloroethylene		*	Tr	Tr	Tr	Tr	Tr
Carbon disulfide		*	Tr	Tr	Tr	Tr	Tr
Dichloromethane		350	74	Tr	Tr	Tr	Tr
1,2-Dichloroethylene					Tr		
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		14	27	2.7	8.5	17	8.4
1,2-Dichloroethane		Tr			Tr		
1,1,1-Trichloroethane		8.2	2.1	6.4	41	14	2.8
Carbon tetrachloride		9.2	10	4.6	20	6.7	7.0
1,2-Dichloropropane		*					
Trichloroethylene		Tr	3.8	3.7	4.3	6.8	Tr
Dibromomethane		Tr	Tr	Tr	Tr		Tr
Bromodichloromethane			2.8	Tr	Tr	Tr	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane			Tr	Tr			
Tetrachloroethylene		12	3.8	6.3	65	6.0	2.5
Ethylene dibromide							
Bromoform				Tr			
1,1,2,2-Tetrachloroethane				Tr	Tr		Tr

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		45	46	48	50	51	53
Location:	Latitude North	45°11'52"	45°12'10"	45°13'15"	45°14'30"	45°13'50"	45°19'26"
	Longitude West	74°20'00"	74°11'17"	74°12'16"	74°13'12"	74°08'37"	73°54'06"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		840	12	3500	9.1	16	8.7
1,1-Dichloroethylene							Tr
Carbon disulfide			Tr	Tr		Tr	Tr
Dichloromethane			Tr	Tr		Tr	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		Tr	Tr	5.0	48	4.8	11
1,2-Dichloroethane							
1,1,1-Trichloroethane		Tr	1.7	2.9	7.3	1.5	2.4
Carbon tetrachloride		Tr	2.7	10	9.4	4.5	6.4
1,2-Dichloropropane							
Trichloroethylene					Tr	7.8	Tr
Dibromomethane			7.2		Tr		Tr
Bromodichloromethane					Tr	13	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane					Tr		
Tetrachloroethylene		2.1	0.9	1.5	1.6	2.7	2.2
Ethylene dibromide						690	
Bromoform							Tr
1,1,2,2-Tetrachloroethane					Tr		

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		54	56	57	59	61	62
Location:	Latitude North	45°20'14"	45°22'09"	45°24'32"	45°24'43"	45°24'53"	45°26'52"
	Longitude West	73°55'44"	73°49'35"	73°47'30"	73°49'39"	73°51'33"	74°03'02"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		70	7.8	3.7	14	13	12
1,1-Dichloroethylene		Tr	Tr		Tr		Tr
Carbon disulfide		1100	Tr		Tr	Tr	Tr
Dichloromethane		Tr	10,000		Tr	100	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		60	300	15	15	6.8	4.9
1,2-Dichloroethane							
1,1,1-Trichloroethane			2.9	Tr	11	2.1	2.3
Carbon tetrachloride		20	7.3	3.9	180	2.0	3.7
1,2-Dichloropropane							
Trichloroethylene		5.8	4.0		20,000	1.4	3.1
Dibromomethane							
Bromodichloromethane						Tr	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane						2.3	
Tetrachloroethylene		6.9	2.9	Tr	14	1.6	4.5
Ethylene dibromide							
Bromoform			20				
1,1,2,2-Tetrachloroethane				Tr			

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		63	65	66	71	73	79
Location:	Latitude North	45°26'40"	45°27'14"	45°24'20"	45°41'36"	45°41'36"	45°43'22"
	Longitude West	74°03'50"	74°03'22"	73°43'44"	73°26'42"	73°27'15"	73°25'23"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		23		9.3	25	6.1	32
1,1-Dichloroethylene		Tr	*		Tr		
Carbon disulfide		Tr	*		Tr		
Dichloromethane		Tr	*		130		150
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		41	410	7.4	20	17	24
1,2-Dichloroethane							
1,1,1-Trichloroethane		1.9	3.1	6.6	2.7	12	3.7
Carbon tetrachloride		6.3	840	8.7	4.2	13	14
1,2-Dichloropropane							
Trichloroethylene		5.6	46	3.8	5.2	5.1	7.1
Dibromomethane				Tr	Tr		
Bromodichloromethane		Tr		Tr	Tr	Tr	
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane					Tr		
Tetrachloroethylene		35	2800	5.3	8.0	25	11
Ethylene dibromide			3000				
Bromoform				Tr			
1,1,2,2-Tetrachloroethane			3.0	Tr			

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		82	85	95	104	108	111
Location:	Latitude North	45°43'54"	46°07'09"	46°07'41"	46°11'21"	46°11'27"	46°14'02"
	Longitude West	73°26'18"	72°56'02"	72°56'56"	72°53'47"	72°48'00"	72°50'24"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		27	24	27	270	4.3	4.6
1,1-Dichloroethylene							
Carbon disulfide						Tr	
Dichloromethane		270	Tr	Tr	220	63	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		3.3	22	57	5.8	2.0	3.9
1,2-Dichloroethane							
1,1,1-Trichloroethane		3.7	38	17	9.4	3.5	Tr
Carbon tetrachloride		1.8	10	9.0	25	0.3	Tr
1,2-Dichloropropane			Tr				
Trichloroethylene		Tr	6.5	Tr	17		
Dibromomethane		Tr		Tr			
Bromodichloromethane		Tr	4.6	*			
Bromotrichloromethane							
1,1,2-Trichloroethane			Tr				
Dibromochloromethane		Tr	Tr				
Tetrachloroethylene		28	45	16	11	0.6	Tr
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane					1.3		

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		112	113	117	123	124	131
Location:	Latitude North	46°14'11"	46°13'52"	46°15'48"	46°16'19"	46°22'36"	44°35'03"
	Longitude West	72°45'38"	72°43'18"	72°45'08"	72°37'43"	72°28'50"	75°41'09"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		23	5.4	11	11	4.8	5.8
1,1-Dichloroethylene			Tr				
Carbon disulfide			Tr	Tr			
Dichloromethane		Tr	100	210	100	Tr	300
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		14	9.5	74	12	Tr	7.1
1,2-Dichloroethane							
1,1,1-Trichloroethane		27	3.9	4.9	5.2	Tr	4.9
Carbon tetrachloride		4.4	Tr	1.6	1.6	Tr	4.0
1,2-Dichloropropane							
Trichloroethylene			0.5	2.6	Tr		2.3
Dibromomethane							
Bromodichloromethane				1.3	Tr		
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							
Tetrachloroethylene		7.0	5.9	23	5.9	0.7	7.7
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane					Tr		

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		133	134	135	136	137	139
Location:	Latitude North	44°39'34"	44°40'00"	44°40'36"	44°42'26"	44°41'34"	44°42'36"
	Longitude West	75°34'30"	75°34'00"	75°33'30"	75°30'57"	75°30'32"	75°29'12"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		2500	18	26	3.9	17	14
1,1-Dichloroethylene			Tr	Tr	Tr		Tr
Carbon disulfide					Tr		Tr
Dichloromethane		150		260	Tr	160	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		56	2.4	13	Tr	Tr	2.8
1,2-Dichloroethane		210					
1,1,1-Trichloroethane		32	1.6	6.1	1.3	1.3	1.5
Carbon tetrachloride		76	1.6	4.2	Tr	2.0	1.8
1,2-Dichloropropane							
Trichloroethylene		72	Tr	Tr	Tr	Tr	Tr
Dibromomethane		8.9	Tr	Tr			
Bromodichloromethane		56	Tr	Tr			
Bromotrichloromethane		22					
1,1,2-Trichloroethane		11					
Dibromochloromethane		47	Tr	Tr			
Tetrachloroethylene		180	8.6	6.1	3.6	3.7	3.6
Ethylene dibromide		75					
Bromoform		8.1	Tr				
1,1,2,2-Tetrachloroethane		37	Tr	Tr			

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		140	141	142	143	145	146
Location:	Latitude North	44°42'27"	45°02'30"	45°00'05"	44°59'26"	44°59'14"	44°59'11"
	Longitude West	75°28'48"	74°36'27"	74°38'24"	74°41'25"	74°44'54"	74°46'16"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		11	20	72	11	25	5.0
1,1-Dichloroethylene			Tr	Tr	Tr	Tr	
Carbon disulfide			Tr	Tr	Tr	Tr	
Dichloromethane		150	Tr	Tr	Tr	Tr	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		Tr	18	48	8.5	6.4	Tr
1,2-Dichloroethane							
1,1,1-Trichloroethane		1.8	1.5	2.1	Tr	1.4	Tr
Carbon tetrachloride		Tr	7.6	3.4	2.2	3.2	Tr
1,2-Dichloropropane							
Trichloroethylene		Tr	Tr	3.3		2.3	Tr
Dibromomethane							
Bromodichloromethane			Tr			110	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							Tr
Tetrachloroethylene		2.7	22	190,000	0.8	7.5	3.4
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane							Tr

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		147	148	149	150	151	153
Location:	Latitude North	44°59'16"	45°00'20"	45°00'37"	45°00'57"	45°01'10"	45°10'56"
	Longitude West	74°46'24"	74°45'45"	74°44'40"	74°42'21"	74°41'38"	74°22'12"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		20	21	7.9	18	4.8	9.2
1,1-Dichloroethylene		270	Tr	Tr	Tr	Tr	Tr
Carbon disulfide		*	Tr	Tr	Tr	Tr	Tr
Dichloromethane		Tr	Tr	Tr	Tr	380	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane		Tr					
Bromochloromethane							
Chloroform		55	2.7	3.4	34	62	19
1,2-Dichloroethane							
1,1,1-Trichloroethane		18,000	6.2	1.2	1.5	1.5	2.5
Carbon tetrachloride		330	3.4	4.7	10	5.8	8.7
1,2-Dichloropropane				Tr			
Trichloroethylene		40	Tr	3.2	Tr	Tr	Tr
Dibromomethane					Tr		Tr
Bromodichloromethane		Tr	3.6	Tr	Tr	Tr	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane		30		Tr	Tr		Tr
Tetrachloroethylene		13	3.9	Tr	3.2	1.2	4.1
Ethylene dibromide							
Bromoform			Tr				
1,1,2,2-Tetrachloroethane			Tr	Tr		Tr	

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		154	155	156	157	158	159
Location:	Latitude North	45°12'24"	45°19'03"	45°19'02"	45°24'03"	45°25'44"	45°26'06"
	Longitude West	74°18'57"	73°53'15"	73°52'48"	73°45'08"	73°49'03"	73°45'04"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		19	8.9	7.7	9.9	23	93
1,1-Dichloroethylene			Tr	Tr	Tr	Tr	
Carbon disulfide			100	Tr	Tr	Tr	
Dichloromethane		Tr	Tr	Tr	Tr	Tr	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane			8.1				
Chloroform		13	24	66	23	23	37
1,2-Dichloroethane							
1,1,1-Trichloroethane		1.1	530	9.8	30	1.8	34
Carbon tetrachloride		1.9	17	4.7	13	4.1	3.4
1,2-Dichloropropane							
Trichloroethylene		Tr	28	7.0	5.2	1.8	4.3
Dibromomethane		Tr		Tr	5.1		Tr
Bromodichloromethane		Tr	Tr	7.6	5.6	Tr	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane			*				
Dibromochloromethane				Tr	Tr		Tr
Tetrachloroethylene		1.3	12,000	2.5	280	4.6	3.7
Ethylene dibromide							
Bromoform				Tr	20	Tr	Tr
1,1,2,2-Tetrachloroethane		Tr				Tr	Tr

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		160	161	162	163	164	165
Location:	Latitude North	45°26'17"	45°25'54"	45°24'05"	45°24'04"	45°31'09"	45°31'35"
	Longitude West	73°43'27"	73°41'46"	73°56'06"	73°57'18"	74°20'06"	74°20'39"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane		9.8					
Trichlorofluoromethane		11	21	11	18	9.3	24
1,1-Dichloroethylene		Tr	Tr		Tr	Tr	Tr
Carbon disulfide		Tr	Tr		Tr	Tr	Tr
Dichloromethane		Tr			Tr	100	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		51	12	40	26	46	11
1,2-Dichloroethane							
1,1,1-Trichloroethane		18	5.1	2.7	1.8	11	1.7
Carbon tetrachloride		37,000	3.5	6.5	3.0	3.5	2.8
1,2-Dichloropropane							
Trichloroethylene		52	4.5	14	2.5	4.2	1.8
Dibromomethane			Tr		Tr	Tr	Tr
Bromodichloromethane			Tr		810	4.7	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane					42	Tr	
Tetrachloroethylene		1.4	1.9	160	4.6	4.2	3.0
Ethylene dibromide				760			
Bromoform							
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		166	167	168	169	170	171
Location:	Latitude North	45°31'33"	45°29'54"	45°28'04"	45°27'43"	45°29'59"	45°30'00"
	Longitude West	74°20'54"	74°18'41"	74°07'28"	74°07'38"	73°32'45"	73°32'56"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		15	20	37	Tr	18	7.8
1,1-Dichloroethylene			Tr	Tr	Tr	Tr	
Carbon disulfide			Tr	Tr	Tr	Tr	Tr
Dichloromethane			Tr	Tr	Tr	Tr	100
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		19	65	240	Tr	39	84
1,2-Dichloroethane							
1,1,1-Trichloroethane		2.4	1.6	300	Tr	66	59
Carbon tetrachloride		2.9	2.8	11	Tr	4.1	4.1
1,2-Dichloropropane							
Trichloroethylene		3.9	3.0	Tr	1.9	18	20
Dibromomethane			Tr	Tr			
Bromodichloromethane			Tr	Tr		8.5	17
Bromotrichloromethane				Tr			
1,1,2-Trichloroethane				Tr			
Dibromochloromethane				Tr		Tr	
Tetrachloroethylene		4.4	5.7	58	9.8	36	26
Ethylene dibromide		72		60			
Bromoform							
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		172	173	174	175	177	178
Location:	Latitude North	45°30'02"	45°30'12"	45°30'22"	45°30'34"	45°31'16"	45°31'54"
	Longitude West	73°33'04"	73°32'58"	73°32'58"	73°32'25"	73°32'40"	73°32'27"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		19	20	21	Tr	30	16
1,1-Dichloroethylene							Tr
Carbon disulfide		Tr				Tr	Tr
Dichloromethane		200	370	190	Tr	90	120
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		22	14	9.4	7.0	14	3000
1,2-Dichloroethane							
1,1,1-Trichloroethane		29	8.8	23	2.0	10	3.2
Carbon tetrachloride		2.6	5.5	2.7	3.4	5.4	2.7
1,2-Dichloropropane							
Trichloroethylene		9.1	4.4	6.6		3.8	Tr
Dibromomethane							
Bromodichloromethane		4.8				Tr	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane		Tr				Tr	
Tetrachloroethylene		16	2.2	13	1.5	11	6.1
Ethylene dibromide							
Bromoform		Tr				Tr	
1,1,2,2-Tetrachloroethane		Tr		3.3			

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		179	180	181	182	183	184
Location:	Latitude North	45°32'27"	45°32'53"	45°33'18"	45°33'26"	45°33'45"	45°34'14"
	Longitude West	73°32'00"	73°31'38"	73°31'17"	73°30'20"	73°31'10"	73°30'51"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		18	16	11	17	12	15
1,1-Dichloroethylene							
Carbon disulfide		Tr	Tr	80			Tr
Dichloromethane		90	Tr	80	190	110	130
1,2-Dichloroethylene						Tr	
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		44	17	16	5000	20	7.9
1,2-Dichloroethane							
1,1,1-Trichloroethane		12	7.9	15	2.1	19	5.6
Carbon tetrachloride		6.6	3.4	9.4	3.1	4.1	3.5
1,2-Dichloropropane							
Trichloroethylene		6.6	4.9	Tr	Tr	18	3.3
Dibromomethane					Tr		
Bromodichloromethane		4.3	3.4	Tr	Tr	8.3	Tr
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane		Tr	Tr	Tr		3.3	Tr
Tetrachloroethylene		18	216	8.9	3.2	23	9.5
Ethylene dibromide							
Bromoform		Tr	Tr		Tr		Tr
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		185	186	187	189	190	191
Location:	Latitude North	45°34'45"	45°34'42"	45°35'13"	45°37'14"	45°37'58"	45°38'51"
	Longitude West	73°28'51"	73°28'40"	73°30'16"	73°30'05"	73°29'25"	73°26'50"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		18	11	17	26	12	15
1,1-Dichloroethylene			Tr		Tr		
Carbon disulfide			Tr	Tr	Tr	Tr	
Dichloromethane		Tr	290	120	150	Tr	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		3.2	92	4100	15	11	56
1,2-Dichloroethane							Tr
1,1,1-Trichloroethane		Tr	2.2	5.6	45	29	6.5
Carbon tetrachloride		2.7	2.6	4.7	4.3	2.2	10
1,2-Dichloropropane							100
Trichloroethylene		Tr	Tr	Tr	7.4	Tr	12
Dibromomethane				Tr	Tr	Tr	
Bromodichloromethane			17	Tr	7.9	Tr	9.3
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane			Tr		Tr	Tr	Tr
Tetrachloroethylene		2.3	3.0	2.3	12	5.0	16
Ethylene dibromide							35
Bromoform			Tr				
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		193	194	195	196	197	199
Location:	Latitude North	45°40'33"	45°41'21"	45°42'57"	45°42'14"	45°42'02"	45°42'38"
	Longitude West	73°26'42"	73°26'37"	73°28'54"	73°29'14"	73°28'32"	73°26'00"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		3.5	9.5	15	60	19	10
1,1-Dichloroethylene		Tr			Tr	Tr	
Carbon disulfide		Tr			Tr	Tr	
Dichloromethane		Tr			Tr	Tr	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		Tr	57	52	21	30	41
1,2-Dichloroethane							
1,1,1-Trichloroethane		1.5	6.5	4.0	1500	6.9	100
Carbon tetrachloride		Tr	22	2.3	5.9	3.2	7.3
1,2-Dichloropropane							220
Trichloroethylene		Tr	6.7	3.3	5.4	6.1	16
Dibromomethane						Tr	
Bromodichloromethane			8.0	4.0	2.3	2.4	6.9
Bromotrichloromethane							
1,1,2-Trichloroethane			Tr	Tr	Tr		Tr
Dibromochloromethane			Tr	Tr	Tr		Tr
Tetrachloroethylene		4.0	18	7.2	8.1	12	7.4
Ethylene dibromide							
Bromoform			Tr		Tr		Tr
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		200	201	202	203	204	205
Location:	Latitude North	45°59'56"	46°00'58"	46°02'25"	46°02'47"	46°02'44"	46°02'57"
	Longitude West	73°10'25"	73°11'02"	73°09'02"	73°08'35"	73°07'12"	73°06'54"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		9.9	75	210	58	56	200
1,1-Dichloroethylene							
Carbon disulfide			*				
Dichloromethane		110	220	Tr	Tr	Tr	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		13	42	29	16	24	170
1,2-Dichloroethane							
1,1,1-Trichloroethane		8.3	17	16	5.5	2.6	28
Carbon tetrachloride		2.7	10	5.2	4.4	2.2	9.9
1,2-Dichloropropane							
Trichloroethylene		0.9	3.0	0.4	15	5.8	16
Dibromomethane			Tr			Tr	
Bromodichloromethane			11	Tr	Tr	Tr	
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane			Tr				
Tetrachloroethylene		3.7	11	7.5	4.8	140	570
Ethylene dibromide							
Bromoform					Tr		3.4
1,1,2,2-Tetrachloroethane					Tr		

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		207	208	210	211	213	214
Location:	Latitude North	46°05'22"	46°07'48"	46°04'45"	46°04'54"	46°07'28"	46°13'15"
	Longitude West	73°10'25"	73°06'53"	72°56'45"	72°57'58"	72°52'46"	72°55'28"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		43	14	30	29	16	3.8
1,1-Dichloroethylene							
Carbon disulfide							Tr
Dichloromethane		170	Tr	200	110	Tr	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		22	23	39	14	580	Tr
1,2-Dichloroethane							
1,1,1-Trichloroethane		5.0	5.7	17	47		Tr
Carbon tetrachloride		3.7	7.8	2.6	7.2	1.5	Tr
1,2-Dichloropropane							
Trichloroethylene		2.8	6.5	2.4	5.0	390,000	
Dibromomethane							
Bromodichloromethane			2.4	Tr	Tr		
Bromotrichloromethane				Tr			
1,1,2-Trichloroethane				Tr			
Dibromochloromethane			Tr				
Tetrachloroethylene		5.6	5.6	15	48	26	Tr
Ethylene dibromide							
Bromoform			Tr				
1,1,2,2-Tetrachloroethane			Tr			5.8	

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		215	216	217	218	219	220
Location:	Latitude North	46°15'22"	46°15'20"	46°15'10"	46°19'34"	46°20'22"	46°20'51"
	Longitude West	72°49'34"	72°49'03"	72°39'09"	72°33'04"	72°32'22"	72°31'44"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		8.7	13	38	3.6	8.6	7.9
1,1-Dichloroethylene		Tr	Tr				
Carbon disulfide		Tr	Tr	Tr	Tr	Tr	
Dichloromethane		100	100	200	Tr	100	
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		3.2	6.1	78	2.5	36	150
1,2-Dichloroethane							
1,1,1-Trichloroethane		3.5	2.5	6.2	Tr	3.5	3.7
Carbon tetrachloride		Tr	1.0	1.7	Tr	1.6	Tr
1,2-Dichloropropane							
Trichloroethylene		Tr	2.5	Tr	Tr	2.9	Tr
Dibromomethane							
Bromodichloromethane				Tr	Tr	Tr	
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							
Tetrachloroethylene		4.0	6.4	1.6	2.6	18	10
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane						3.3	

Tr = Trace amount.

* Compounds present but not quantified.

TABLE 4: **St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).**

Station Number		221	222	223	224	225	226
Location:	Latitude North	46°21'22"	46°21'19"	46°21'31"	46°21'24"	46°22'21"	46°22'48"
	Longitude West	72°32'18"	72°30'46"	72°30'51"	72°30'25"	72°29'32"	72°26'06"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		10	8.0	6.3	8.6	9.5	12
1,1-Dichloroethylene							
Carbon disulfide				Tr		Tr	
Dichloromethane			500	55	Tr	90	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		280	12	200	230	450	Tr
1,2-Dichloroethane							
1,1,1-Trichloroethane		Tr	1.9	2.2	1.6	2.3	Tr
Carbon tetrachloride		Tr	6.0	0.6	Tr	1.3	Tr
1,2-Dichloropropane							
Trichloroethylene		5.8	Tr	4.5	7.8	11	
Dibromomethane							
Bromodichloromethane			Tr	Tr	Tr	1.7	
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							
Tetrachloroethylene		2.9	4.2	2.7	4.7	7.8	2.6
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane				1.5			

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		227	227A	228	229	230	231
Location:	Latitude North	46°24'06"	46°26'44"	46°31'14"	46°32'51"	46°36'32"	46°41'14"
	Longitude West	72°21'30"	72°16'51"	72°14'15"	72°11'50"	71°58'26"	71°52'38"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		7.0	4.6	17	5.5	6.6	4.1
1,1-Dichloroethylene							Tr
Carbon disulfide							
Dichloromethane		Tr	Tr	99	280	300	Tr
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		53	36	4.5	3.0	19	1000
1,2-Dichloroethane							
1,1,1-Trichloroethane		2.7	1.9	3.8	1.5	Tr	38
Carbon tetrachloride		Tr	Tr	Tr	Tr	Tr	6.3
1,2-Dichloropropane							
Trichloroethylene							23
Dibromomethane							
Bromodichloromethane							
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							
Tetrachloroethylene		4.2	5.2	0.9	0.5	0.8	42
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.

* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		232	233	234	235	236	238
Location:	Latitude North	46°40'04"	46°44'46"	46°44'32"	46°49'57"	46°49'55"	46°49'23"
	Longitude West	71°44'48"	71°20'34"	71°16'40"	71°09'25"	71°11'36"	71°12'35"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		17	16	7.6		4.0	8.4
1,1-Dichloroethylene							Tr
Carbon disulfide							Tr
Dichloromethane		Tr	220	100		190	970
1,2-Dichloroethylene							
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		5.0	75	Tr	20		770
1,2-Dichloroethane							
1,1,1-Trichloroethane		1.9	3.7	Tr	2.2		37
Carbon tetrachloride		Tr	Tr	Tr	2.2		9.6
1,2-Dichloropropane							
Trichloroethylene		Tr	Tr	Tr	1.8		14
Dibromomethane							
Bromodichloromethane			Tr				29
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane					Tr		Tr
Tetrachloroethylene		3.2	3.7	3.9	3800		66
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane							

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		240	241	242	244	245	246
Location:	Latitude North	46°45'49"	46°47'29"	46°49'08"	45°57'12"	45°52'08"	45°48'04"
	Longitude West	71°13'54"	71°13'27"	71°11'59"	73°12'34"	73°15'35"	73°19'48"
Depth (m)		0.5	0.5	0.5	0.5	0.5	0.5
Compound Name:							
Dichlorodifluoromethane							
Trichlorofluoromethane		5.0	0.5	0.5	12	8.9	2.2
1,1-Dichloroethylene							Tr
Carbon disulfide					Tr		Tr
Dichloromethane		900	170	170	*	340	180
1,2-Dichloroethylene							Tr
1,1-Dichloroethane							
Bromochloromethane							
Chloroform		44	7.1	4700	6.9	34	50
1,2-Dichloroethane							
1,1,1-Trichloroethane		2.7	2.7	9.7	7.0	2.4	Tr
Carbon tetrachloride		2.5	2.6	2.6	0.9	5.6	
1,2-Dichloropropane							
Trichloroethylene		Tr		Tr	Tr	Tr	Tr
Dibromomethane							
Bromodichloromethane		Tr		20			19
Bromotrichloromethane							
1,1,2-Trichloroethane							
Dibromochloromethane							4.9
Tetrachloroethylene		4.4	4.4	2.6	1.2	2.9	9.5
Ethylene dibromide							
Bromoform							
1,1,2,2-Tetrachloroethane						Tr	

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 4: St. Lawrence River October 1985 Volatile Halocarbon Analyses. Concentration in Water as ng/L (ppt).

Station Number		247	248	249	250
Location:	Latitude North	45°25'35"	45°24'21"	45°27'18"	45°29'06"
	Longitude West	73°59'15"	74°00'22"	73°59'30"	73°57'42"
Depth (m)		0.5	0.5	0.5	0.5
Compound Name:					
Dichlorodifluoromethane					
Trichlorofluoromethane		11	8.4	15	9.6
1,1-Dichloroethylene		Tr			
Carbon disulfide		Tr			Tr
Dichloromethane		1300	480		100
1,2-Dichloroethylene					
1,1-Dichloroethane					
Bromochloromethane					
Chloroform		48	25	8.0	28
1,2-Dichloroethane					
1,1,1-Trichloroethane		4.5	1.1	31	6.8
Carbon tetrachloride		0.8	Tr		Tr
1,2-Dichloropropane					
Trichloroethylene					Tr
Dibromomethane					
Bromodichloromethane					Tr
Bromotrichloromethane					
1,1,2-Trichloroethane					
Dibromochloromethane					
Tetrachloroethylene		1.8	1.1	7.9	4.0
Ethylene dibromide					
Bromoform					
1,1,2,2-Tetrachloroethane					

Tr = Trace amount.
* Compounds present but not quantified.

TABLE 5: Suspected Contaminant Inputs to the Saint Lawrence River

Area	Volatile Compounds		Suspected Contaminant Types
	Major	Minor	
Maitland	$CFCl_3$ $C_2H_2Cl_2$ C_2HCl_3 Unidentified	$C_2H_3Cl_3$ C_2Cl_4 $C_2H_2Br_2$	• Synthetic fibres • Plastics • Petroleum additives • Metals
Cornwall-Massena	$CFCl_3$ $CHCl_3$ $C_2H_3Cl_3$ C_2HCl_3 CCl_4	C_2Cl_4	• Pulp wastes • Synthetic fibres • Chemical • Primary metal production • Metal fabrication • Municipal wastes
Lac Saint-Louis	CCl_4 C_2HCl_3 $C_2H_2Cl_3$	$CHCl_3$	• Chemical production • Primary metal production • Metal fabrication • Pulp wastes
Lac Des Deux Montagnes	CCl_4 $CHCl_3$ Unidentified	C_2HCl_3 $C_2H_2Br_2$ $C_2H_4Cl_2$	• Pulp • Chemical • Petroleum products • Municipal
Montréal (East)	$CHCl_3$	$C_2H_3Cl_3$ C_2HCl_3	• Municipal wastes • Metal production • Metal fabrication • Petroleum products
Sorel	$CFCl_3$	CCl_4 C_2HCl_3 $C_2H_3Cl_3$ $CHCl_3$	• Synthetic fibres/plastics • Municipal wastes • Primary metal production • Metal fabrication
Yamaska-St. Francois	$CHCl_3$ C_2HCl_3	$CHCl_3$ CCL_4	• Primary metal production • Metal fabrication • Chemical production • Pulp wastes
Trois Riviéres	$CHCl_3$	C_2HCl_3	• Municipal • Pulp wastes • Metal fabrication
Portneuf	$CHCl_3$	C_2HCl_3 $C_2H_3Cl_3$	• Municipal wastes • Pulp wastes • Metals (primary; fabrication)
Québec	$CHCl_3$ C_2Cl_4	$C_2H_3Cl_3$	• Municipal wastes • Pulp wastes • Metals

TABLE 6: Organochlorine Compounds Detected in St. Lawrence River Suspended Solids, May 1985. Concentration ug/g (ppm) dry weight.

Station[(a)]	1	2	3	4	5	6
Pentachlorobenzene	0.007	0.005	0.012	0.014	0.013	0.018
Hexachlorobenzene	0.005	0.003	0.006	0.009	0.008	0.018
p,p-DDT	0.003	0.032	ND	0.12	0.091	0.099
p,p-DDD	ND	0.034	ND	0.012	0.063	0.097
alpha-Chlordane	ND	ND	0.065	0.013	0.037	0.14
gamma-Chlordane	ND	ND	0.057	0.009	0.037	0.056
alpha-BHC	ND	ND	0.071	0.004	0.018	0.056
beta-BHC	0.45	ND	0.47	ND	0.25	0.55
gamma-BHC	0.014	ND	0.10	ND	ND	ND
Mirex	0.006	0.008	0.007	0.006	0.004	0.008
Polychlorinated biphenyls	0.58	0.48	0.21	0.60	0.43	0.69

Station[(a)]	7	8	9	10	11	12
Pentachlorobenzene	0.014	0.006	0.007	0.008	0.011	0.008
Hexachlorobenzene	0.018	0.003	0.003	0.004	0.003	0.003
p,p-DDT	0.12	ND	ND	0.014	ND	ND
p,p-DDD	0.11	ND	ND	ND	ND	ND
alpha-Chlordane	0.052	ND	ND	ND	ND	ND
gamma-Chlordane	0.078	ND	0.006	ND	ND	0.008
alpha-BHC	ND	ND	0.030	ND	0.040	0.030
beta-BHC	0.030	ND	0.018	ND	0.063	0.037
gamma-BHC	ND	ND	0.011	ND	ND	0.013
Mirex	0.003	ND	ND	ND	ND	ND
Polychlorinated biphenyls	0.16	0.10	0.13	0.19	0.10	0.11

Station[(a)]	13	14	15	16	17	18
Pentachlorobenzene	0.009	0.015	0.008	0.010	0.009	0.009
Hexachlorobenzene	0.003	0.003	0.003	0.003	0.003	0.003
p,p-DDT	ND	ND	ND	ND	ND	ND
p,p-DDD	ND	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND
gamma-Chlordane	0.014	0.020	0.008	0.028	0.017	ND
alpha-BHC	0.051	0.023	ND	ND	0.039	0.037
beta-BHC	ND	0.13	ND	ND	0.066	0.035
gamma-BHC	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND
Polychlorinated biphenyls	0.11	0.21	0.08	0.11	0.10	0.08

(a) See Table 1 for suspended solid concentrations and Appendix for locations.

ND = Not detected.

TABLE 6: Organochlorine Compounds Detected in St. Lawrence River Suspended Solids, May 1985. Concentration ug/g (ppm) dry weight.

Station[a]	19	20	21	22	23	24
Pentachlorobenzene	0.014	0.008	0.008	0.014	0.012	0.012
Hexachlorobenzene	0.005	0.003	0.002	0.003	0.003	0.010
p,p-DDT	ND	ND	ND	ND	ND	ND
p,p-DDD	0.085	ND	ND	ND	ND	ND
alpha-Chlordane	ND	ND	ND	ND	ND	ND
gamma-Chlordane	ND	0.023	0.024	ND	0.002	ND
alpha-BHC	0.097	0.050	0.048	0.021	0.011	ND
beta-BHC	0.34	0.12	0.077	0.024	0.032	ND
gamma-BHC	0.088	ND	0.031	0.007	0.009	ND
Mirex	ND	ND	ND	ND	ND	ND
Polychlorinated biphenyls	0.13	0.10	0.14	0.12	0.12	0.29

Station[a]	25	26
Pentachlorobenzene	0.025	0.016
Hexachlorobenzene	0.012	0.012
p,p-DDT	ND	0.036
p,p-DDD	ND	0.006
alpha-Chlordane	ND	ND
gamma-Chlordane	ND	0.004
alpha-BHC	0.033	0.023
beta-BHC	0.094	0.014
gamma-BHC	0.034	0.003
Mirex	ND	ND
Polychlorinated biphenyls	0.20	1.3

(a) See Table 1 for suspended solid concentrations and Appendix for locations.

ND = Not detected.

TABLE 7: Organochlorine Compounds Detected in St. Lawrence River Suspended Solids, October 1985. Concentration ug/g (ppm) dry weight.

Station[(a)]	30	41	53	85	243	94
Pentachlorobenzene	0.010	0.050	0.003	0.014	ND	0.015
Hexachlorobenzene	0.014	0.047	0.010	0.006	0.018	0.010
p,p-DDE	0.008	0.008	0.022	0.003	0.014	ND
p,p-DDT	0.013	ND	0.028	ND	0.030	ND
p,p-DDD	0.002	0.014	ND	0.002	0.006	0.002
alpha-BHC	ND	0.022	ND	ND	ND	ND
beta-BHC	0.001	0.012	ND	0.003	0.007	ND
gamma-BHC	ND	0.010	ND	0.0004	0.001	ND
Mirex	0.010	0.011	0.019	0.0013	0.010	0.004
Polychlorinated biphenyls	0.99	2.0	0.38	0.37	0.30	0.17

Station[(a)]	104	112	123	124
Pentachlorobenzene	0.016	0.006	0.0005	0.001
Hexachlorobenzene	0.018	0.007	0.002	0.002
p,p-DDE	0.005	0.004	ND	0.002
p,p-DDT	ND	ND	0.002	0.005
p,p-DDD	0.002	ND	0.002	ND
alpha-BHC	ND	0.012	0.0005	ND
beta-BHC	ND	0.024	0.002	0.003
gamma-BHC	ND	0.017	0.0008	ND
Mirex	0.001	0.004	0.001	0.002
Polychlorinated biphenyls	0.14	0.40	0.088	0.23

Station[(a)]	32	56	82	79	62
Pentachlorobenzene	*	*	*	*	*
Hexachlorobenzene	0.005	0.004	0.002	0.004	0.005
p,p-DDE	ND	ND	0.018	0.012	0.062
p,p-DDT	0.025	ND	0.094	0.029	0.005
p,p-DDD	0.081	ND	ND	0.030	0.007
alpha-BHC	*	*	*	ND	0.014
beta-BHC	*	*	*	ND	ND
gamma-BHC	*	*	*	ND	ND
Mirex	0.008	0.006	0.008	0.006	ND
Polychlorinated biphenyls	4.0	1.9	0.77	0.49	3.0

(a) See Table 2 for suspended solid concentrations and Appendix for locations.

ND = Not detected.

* = Not quantitative.

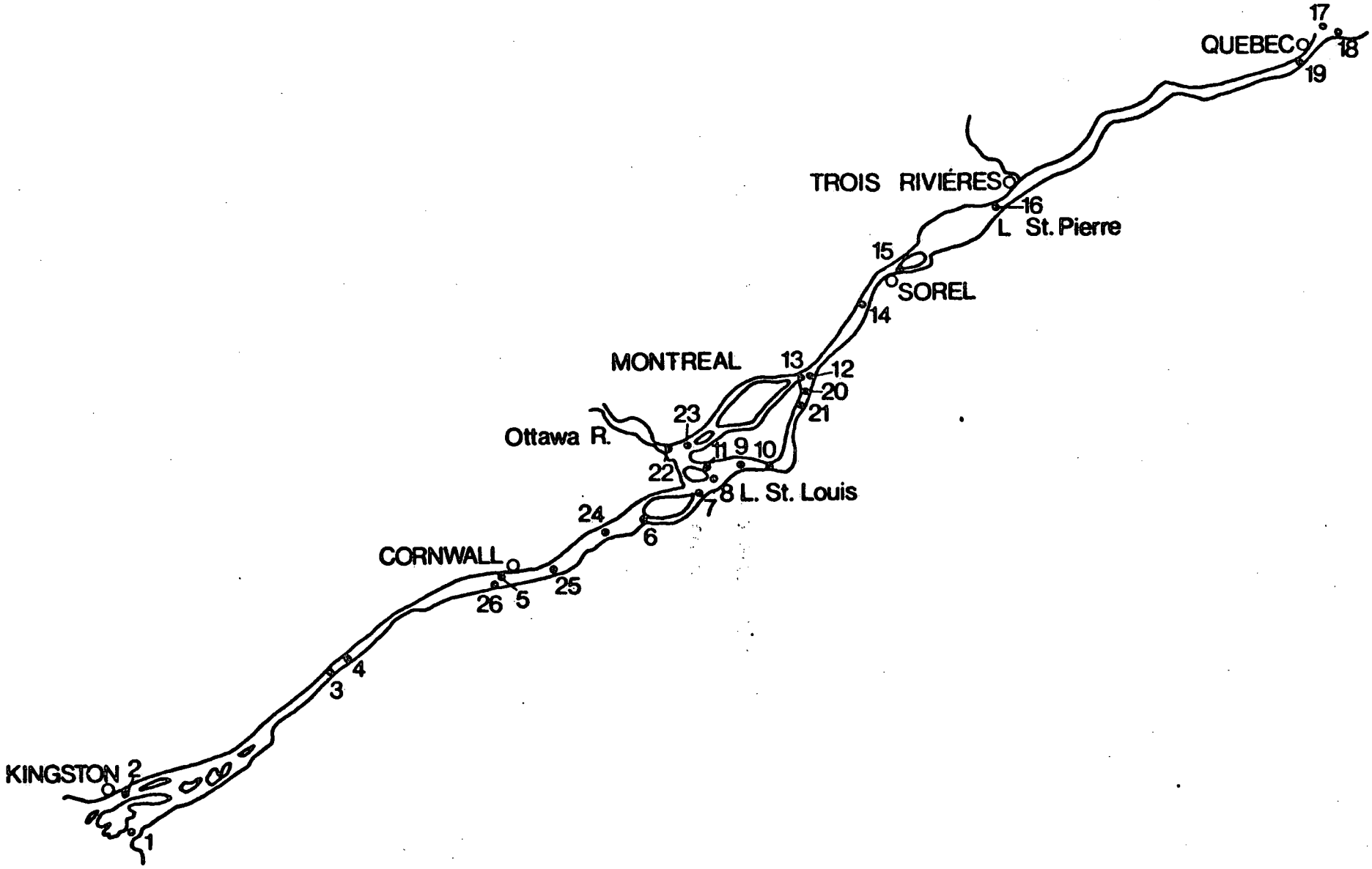
TABLE 8: St. Lawrence River flow data (m^3/s), 1985.

Location	Data Source	May			October					
		7	8	9	1	2	3	4	5	6
Lake Ontario outflow	(a)	8213	8213		7798	8396	8379			
Saunders Dam	(b)	8212			8297	8297				
Beauharnois turbine	(b)		6462		6966	6660	7028			
Cateau control structure	(b)		1733			1421	1616			
Cornwall power diversion	(c)									
North Channel		-	34.4%							
South Channel		-	65.5%							
Rivière des Mille Îles	(d)		754	726			88.8	83.2	85.9	100
Rivière des Prairies	(d)		2314	2218			804	790	853	840
Ste. Anne	(d)		1500	1440			297	297	260	351
Vaudreuil	(d)		1160	1090			165	165	144	198
Rivière Châteauguay	(d)		52	43.8			15.1	15.5	14.8	19.4
La Salle Channel	(d)		11,700	11,600			9060	8970	9120	9150
Sorel to Quebec City	(e)		15,000	15,000			10,000	10,000	10,000	10,000

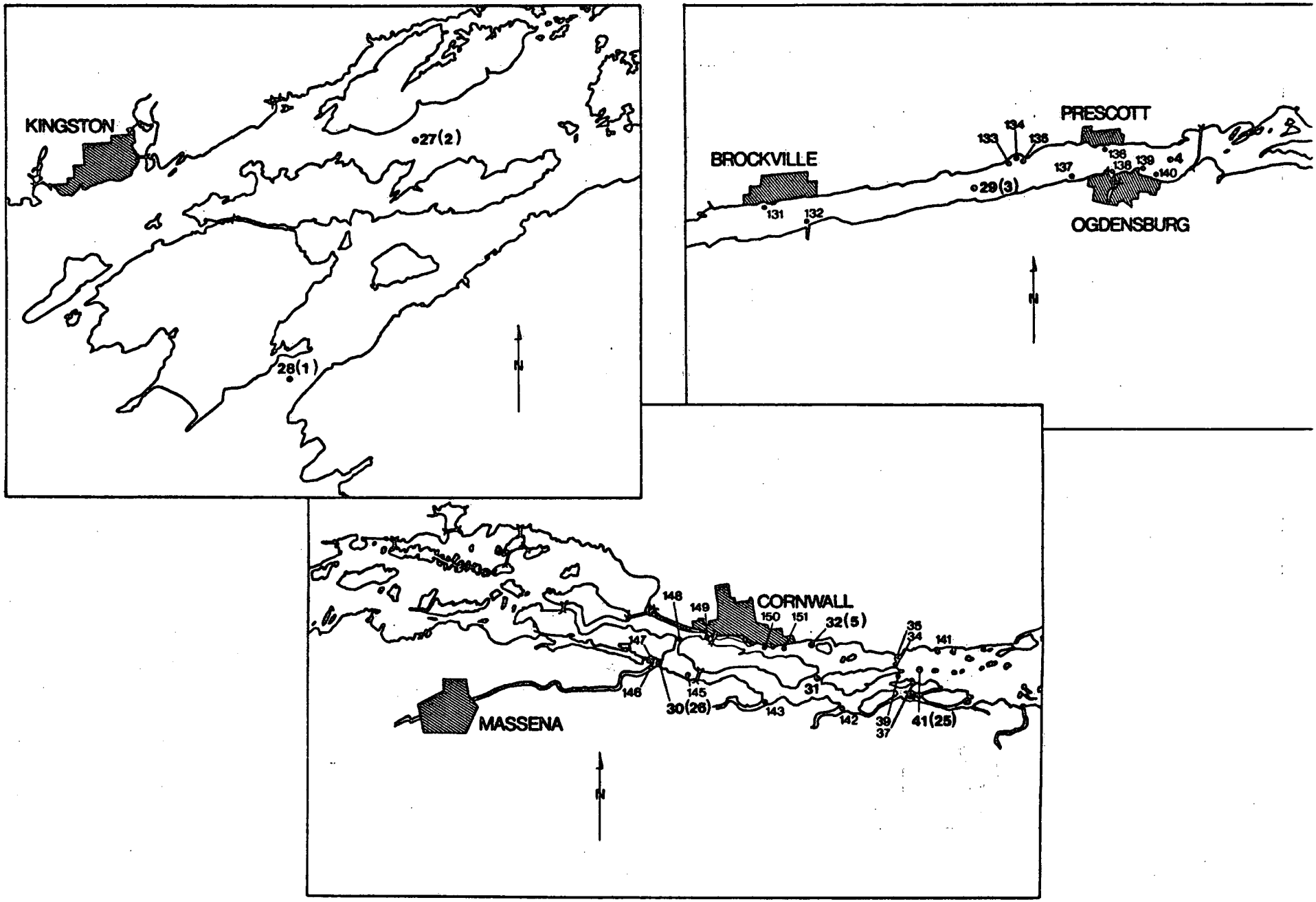
Information Sources;
(a) International St. Lawrence River Board of Control, from Water Resources Branch, Guelph, Ontario.
(b) Seaway Authority, Cornwall, Ontario.
(c) Ontario Hydro, Cornwall, Ontario, from Corps of Engineers Report, 1974.
(d) Water Resources Branch, Longueuil, Quebec.
(e) Estimated.

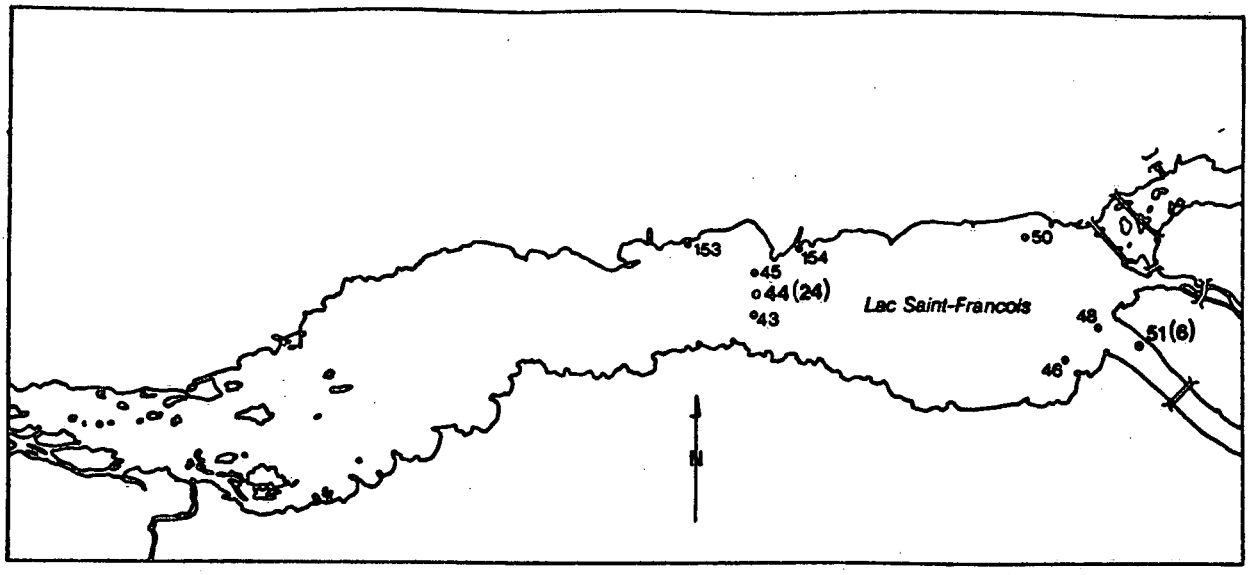
APPENDIX

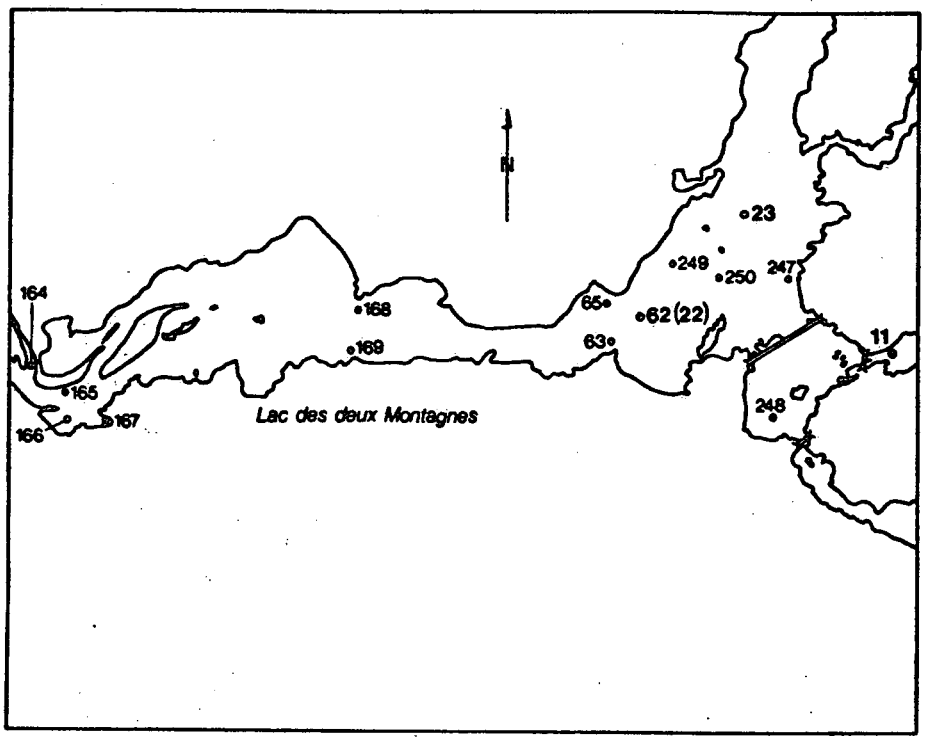
TRACE ORGANIC CONTAMINANT SAMPLING LOCATIONS IN THE ST. LAWRENCE RIVER, 1985

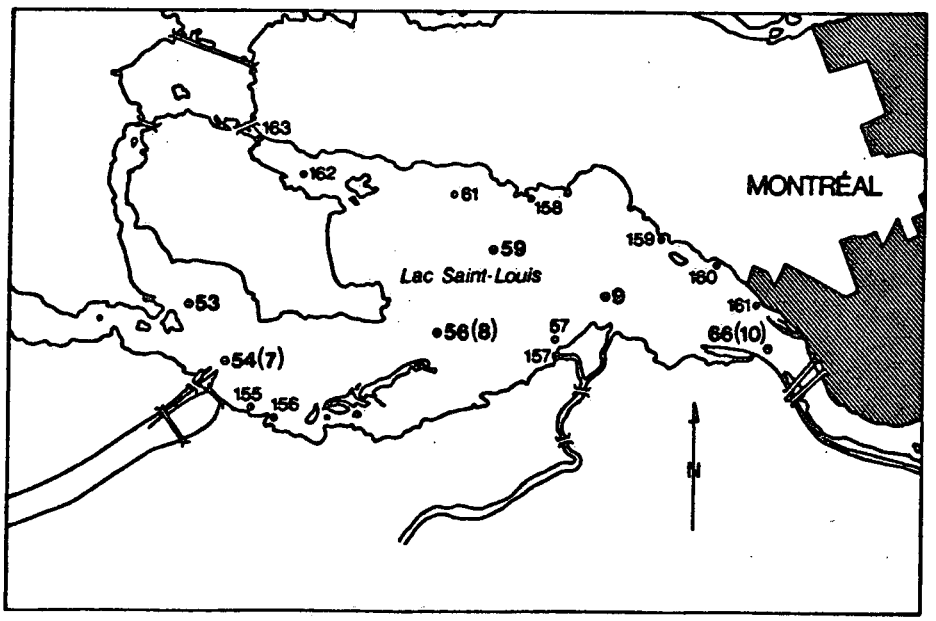


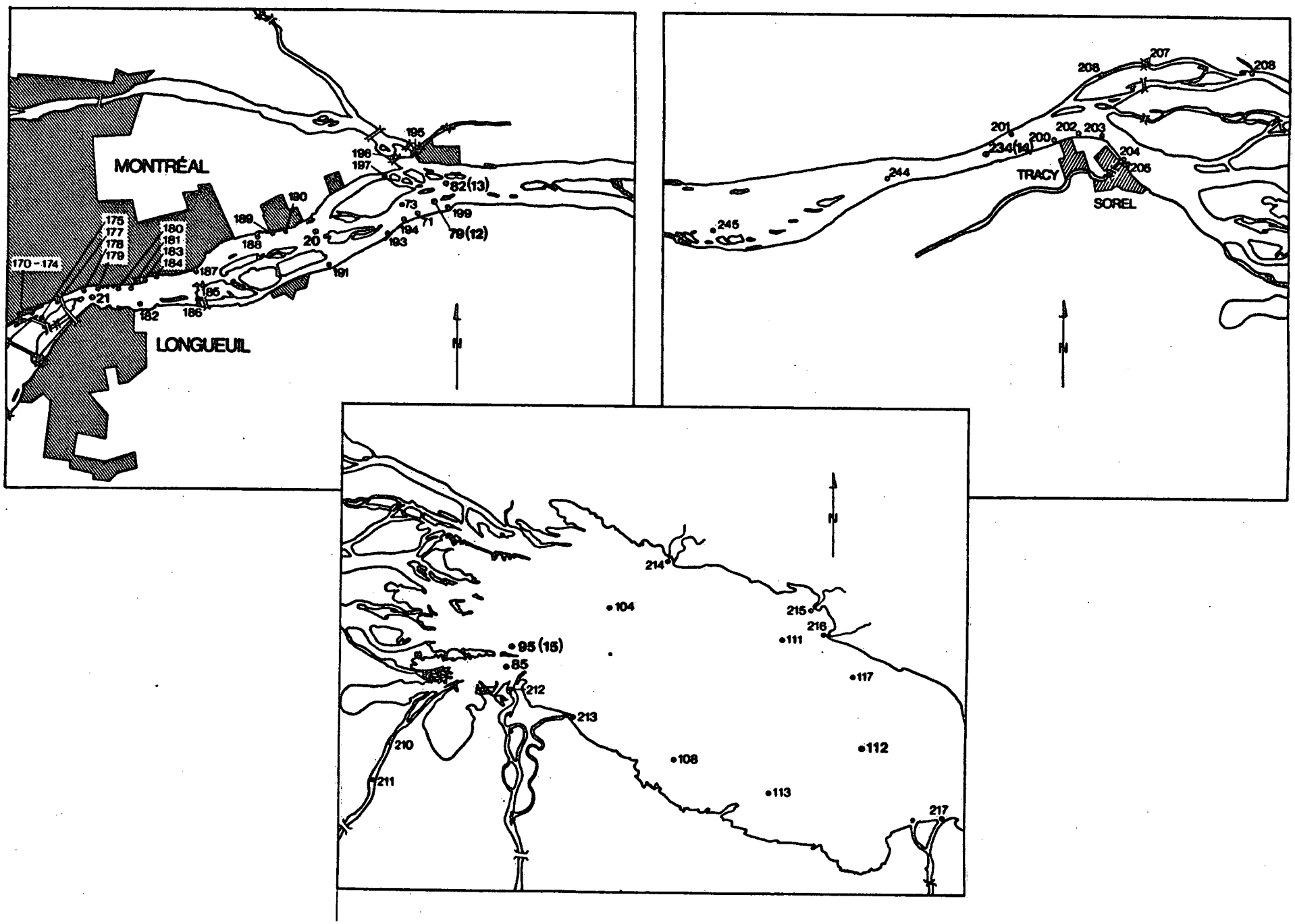
Major chemistry sampling locations in the St. Lawrence River, 1985.

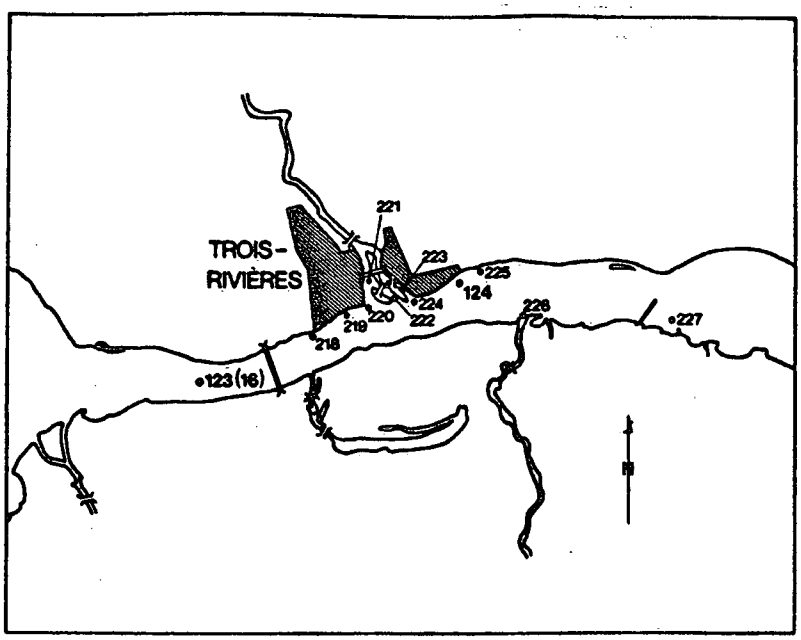

KINGSTON
27(2)
28(1)
N
BROCKVILLE
PRESCOTT
OGDENSBURG
131
132
133
134
135
136
137
138
139
140
29(3)
N
CORNWALL
MASSENA
145
146
147
148
149
150
151
32(5)
30(26)
31
141
142
143
39
37
41(25)
N

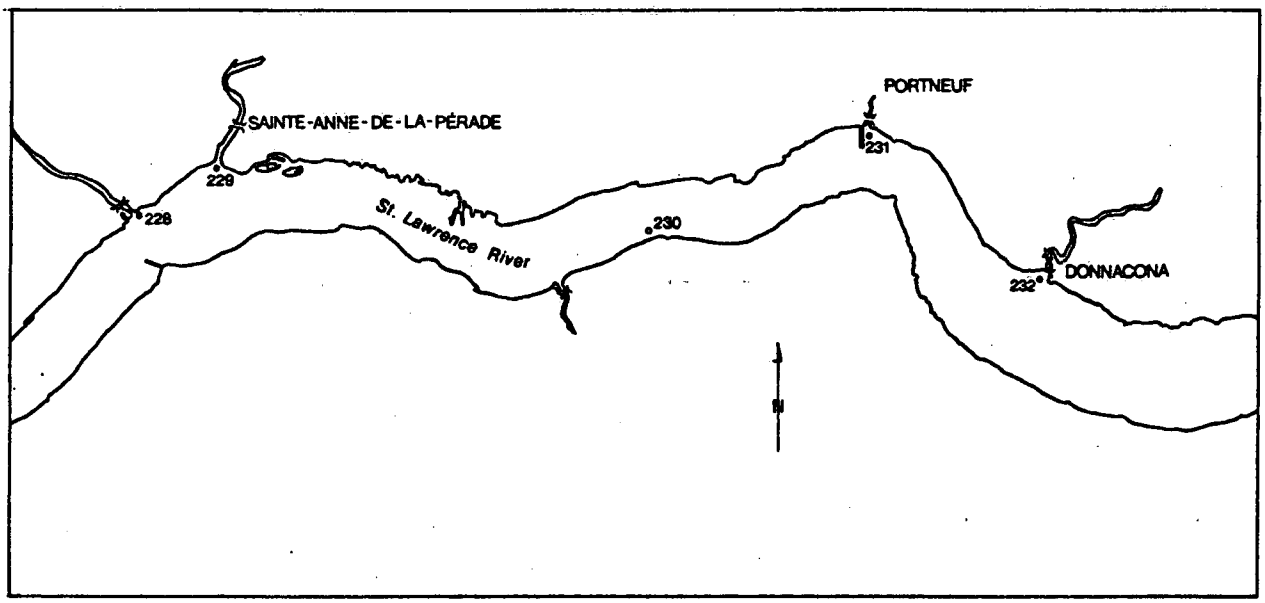

153
154
45
44(24)
43
Lac Saint-Francois
50
48
51(6)
46
N

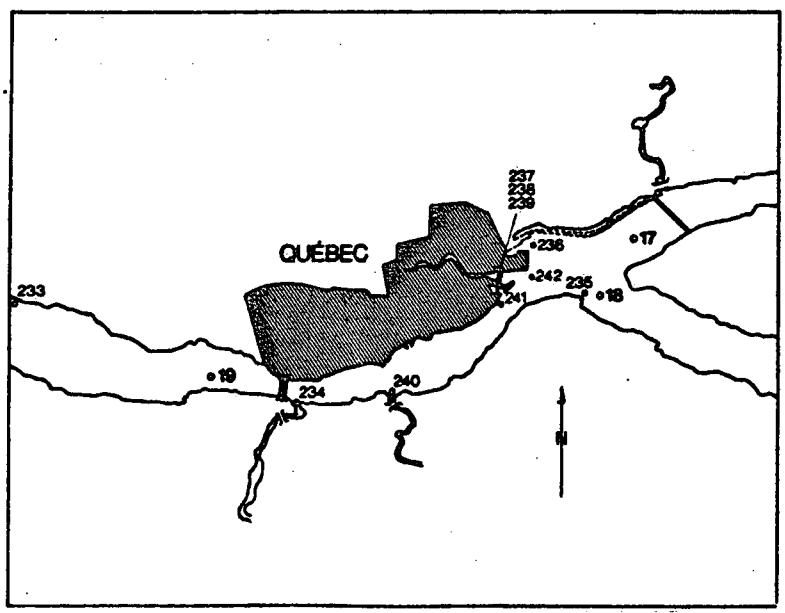

N
23
249
250
247
164
168
65
62(22)
169
63
11
165
248
166
167
Lac des deux Montagnes


163
162
61
158
MONTRÉAL
59
159
Lac Saint-Louis
160
53
9
161
56(8)
57
66(10)
54(7)
157
155
156
N


MONTRÉAL
LONGUEUIL
TRACY
SOREL
N
170 - 174
175
177
178
179
180
181
183
184
185
186
187
188
189
190
191
193
194
195
196
197
199
20
21
182
71
73
79(12)
82(13)
201
234(14)
200
202
203
204
205
206
207
208
244
245
214
215
216
111
104
95 (15)
85
212
213
210
211
108
112
113
117
217


TROIS-
RIVIÈRES
221
223
225
124
224
219
220
222
218
226
227
123(16)
N


SAINTE-ANNE-DE-LA-PÉRADE
PORTNEUF
231
229
228
St. Lawrence River
230
DONNACONA
232
N


237
238
239
QUÉBEC
236
17
242
235
18
233
241
19
234
240
N