

Canada-Ontario Agreement on Great Lakes Water Quality



Ministry
of the
Environment

CANADA-ONTARIO GREAT LAKES SURVEILLANCE PROGRAMS 1979/80



Prepared by the Surveillance Committee
for the Review Board
Canada-Ontario Agreement on Great Lakes Water Quality

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**CANADA - ONTARIO
SURVEILLANCE AND RELATED
RESEARCH PROJECTS**

1979/80

PREPARED BY THE SURVEILLANCE COMMITTEE
FOR THE REVIEW BOARD,
CANADA - ONTARIO AGREEMENT

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INTRODUCTION:

When the first Canada/U.S. Agreement on Great Lakes Water Quality was signed in 1972, it established a set of principles which would guide the two countries in the task of preserving and enhancing the water quality of the Great Lakes. The most important of these included:

- a) the development of water quality objectives to be met in the Lakes;
- b) the commitment to undertake all reasonable and practicable control programs; and
- c) the institution of a surveillance and monitoring program which would assess compliance with the objectives, assess the effectiveness of implemented control programs and detect the emergence of new problems.

When the revised Agreement was signed in 1978, it preserved these basic principles, but at the same time broadened the scope of the Agreement and introduced an ecosystem approach concept.

Within the federal government, Environment Canada has been assigned the lead responsibility to ensure that the work required by the Agreement is undertaken. Although much of this work can be undertaken directly by the federal government, a great deal is within the jurisdictional responsibility of the province. The Canada-Ontario Agreement Respecting Great Lakes Water Quality and the Canada-Ontario Accord for the Protection and Enhancement of Environmental Quality are the primary mechanisms whereby the two governments commit themselves to various undertakings.

Specifically, the Canada-Ontario Agreement (COA) provides the umbrella for sharing 50% of the cost of provincial surveillance efforts on the Great Lakes. This Agreement is presently undergoing revision to make it compatible with the revised (1978) Canada-U.S. Agreement.

This document summarizes the planned 1979/80 surveillance and related research activities of Environment Canada, Fisheries and Oceans Canada, and the Ontario Ministry of the Environment. The combined federal/provincial effort is directed toward meeting the Canadian responsibilities required in (c) above. The projects are conducted within the framework of the Great Lakes International Surveillance Plan (GLISP) presently being developed by the Water Quality Board of the International Joint Commission (IJC), and within the Terms of Reference of the Surveillance Committee of the Canada-Ontario Review Board.

Briefly these state:

"The Federal Government will concentrate its water quality surveillance activities on the open lake waters and connecting channels to:

- (i) determine compliance with IJC (Water Quality Agreement) objectives;
- (ii) delineate problem areas; and
- (iii) determine long term trends."

The Province's activities will include:

"The assessment of water quality in the nearshore waters of the Great Lakes and in the connecting channels including the evaluation of the impact of Ontario based effluents and emissions for the purposes of:

- (i) delineating areas where Agreement objectives are not being met
- (ii) identifying the source(s) of degradation and possible remedial measures;
- (iii) providing early warning of emerging problems; and
- (iv) evaluating the effectiveness of remedial action."

Highlights of the Province's 1979/80 program include: -

1. Follow-up studies of the effectiveness of major remedial works which are either complete or will be complete in 1979 at Thunder Bay, the St. Marys River, Penetang, Wheatley Harbour, Toronto Harbour and the Bay of Quinte.
2. Completion of the second year of the intensive "state-of-the-lake" study of the Lake Erie nearshore zone, as part of the international two year intensive effort on that lake under the Great Lakes International Surveillance Plan.
3. Continuing surveillance of known problems in Serpent Harbour (radioactivity and pH depression); the St. Clair River (organics, dissolved solids, mercury); the Detroit River (bacteriological, nutrients); and Hamilton Harbour (dissolved oxygen depletion, nutrients).
4. Continuation of the water intake monitoring program with the addition of three new locations at Grimsby and Cobourg in Lake Ontario and Terrace Bay in Lake Superior.
5. Continued monitoring of contaminants in sport and commercial fish.

In response to the broadened scope of the 1978 Canada/U.S. Agreement the Province is also undertaking a series of new projects requiring further funding from COA beyond the 1978/79 level. Among the new projects are:

1. Studies on source identification and biomagnification of trace contaminants.
2. Investigations on the relationships between biomass, nutrient enrichment/availability/transport, and phosphorus controls.
3. Two site-specific *Cladophora* studies.
4. Designation of Limited Use Zones.
5. A feasibility study on satisfying surveillance requirements for the new water quality objective for radioactivity.
6. Enhanced hydrologic event-oriented monitoring of 10 significant tributaries using automatic samplers and on-site observers and upgraded sampling by selected toxics and metals.

Highlights of the 1979/80 federal Surveillance Program include:

1. Continuing surveillance of the open lake waters of Lake Ontario for detecting the occurrence of unacceptable water quality (non-compliance with water quality objectives), determining trends in important indicators of water quality and assessing the lake response to implemented remedial programs.
2. Estimating contaminant loadings to Lake Ontario from the Niagara River and transported from the lake by the St. Lawrence River; a feasibility study on measuring contaminant transport in suspended sediment.
3. Continuing operation of the atmospheric deposition network for measuring atmospheric loadings of contaminants and nutrients to the lakes.
4. Continued analysis of contaminant levels in fish and other biota from the open waters of the Great Lakes.
5. Continuing investigations of contaminant levels and reproductive success in herring gulls and other fish-eating birds.

Related research activities planned in 1979/80 by Environment Canada and Fisheries include:

1. Assessment of the predictive capability of presently available water quality models.
2. Evaluation of the applications of the NIMBUS G Coastal Zone Colour Scanner to Great Lakes research and surveillance.

3. Development of methodologies for the statistical analysis of Great Lakes surveillance data.
4. Estimation of the bio-availability of phosphorus and organic and inorganic contaminants in fluvial sediments.
5. Development of an inexpensive, routine and reliable method of assessing lakewide phytoplankton population response to changing nutrient status.

Modifications have also been made to the federal portion of the Surveillance Program for 1979/80 in response to the broadened requirements of the 1978 Canada/U.S. Agreement and in light of new information obtained through the analysis of previous years' data. Briefly, these modifications include:

1. Additional sampling for trace metals and organics on selected cruises within the regular Surveillance schedule for Lake Ontario.
2. A decrease in the number of samples collected for major ion analyses.
3. An increase in the number of surveys on the Upper Niagara River to comply with the requirements of the intensive year Plan for Lake Erie as outlined in the Great Lakes International Surveillance Plan.

Additional research efforts with direct application to Surveillance have also been implemented, including:

1. Implementation of sediment sampling on a selected number of cruises to determine the bioavailability of phosphorus from Great Lakes sediments as recommended by PLUARG.
2. Evaluation of the application of remote sensing techniques, in particular, the coastal colour scanner to routine surveillance.

SECTION 1

**ENVIRONMENT CANADA
FISHERIES AND OCEANS CANADA**

**SURVEILLANCE PROGRAMME
AND
RELATED RESEARCH ACTIVITIES
1979/80**

PREPARED BY THE
SURVEILLANCE COMMITTEE

FOR THE

CANADA/ONTARIO AGREEMENT REVIEW BOARD

PROJECT TITLE: OPEN LAKE SURVEILLANCE

- Background:** This project forms part of a continuing commitment to the Surveillance Subcommittee and the Great Lakes Water Quality Board in their requirement to report annually to the IJC on the state of the Great Lakes. Assessment of the offshore water quality of Lake Ontario is conducted annually in accordance with the schedule (Fig. 1) outlined in the Great Lakes International Surveillance Plan (GLISP). Annual Surveillance of Lake Ontario will detect progressive and long term changes in water quality that might be obscured by the highly variable water quality found nearshore, in harbours and in tributaries. In addition, it will provide an invaluable gauge against which the effectiveness of pollution abatement measures can be evaluated.
- Objectives:**
- To detect and report any and all violations of the specific water quality objectives incorporated in the Great Lakes Water Quality Agreement of 1978.
 - To establish trends in the physical, chemical and biological characteristics of Lake Ontario.
 - To relate these changes in the physical, chemical and biological character of Lake Ontario to the effects of remedial programs, if possible.
- Scope:** The program will consist of sampling ninety-five stations (Fig. 2) on each of nine cruises between March and November, 1979. Cruises will take place at approximately monthly intervals, beginning in the middle of March. Sampling will emphasize those parameters which are specifically mentioned in the Water Quality Agreement of 1978, including phosphorus, oxygen, specific conductance, pH, trace metals and organics. Additional data will be collected to aid in the development and calibration of predictive models for the lake. (See also GLOBL Project: Great Lakes Water Quality Surveillance Eutrophication).
- Output:** An annual report, identifying all violations of specific objectives is submitted to the Surveillance Subcommittee of the IJC. This is supplemented with a summary report, evaluating the state of Lake Ontario in 1979, and comparing this evaluation with

previous years.

During 1979, some samples will be collected for trace metals and organic contaminant analysis in accordance with the requirements of the 1978 Great Lakes Water Quality Agreement.

Resources Required:	MY	31.5
	\$K	1596.7

FIGURE 1 Great Lakes International Surveillance Intensive Schedule.

DESIGN COMPONENT	1978	1979	1980	1981	1982	1983	1984	1985	1986
MAIN LAKE - INTENSIVE									
Lake Superior						X			
Lake Michigan								X	X
Lake Huron			X						
Lake Erie	X	X							
Lake Ontario				X	X				
NEARSHORE - INTENSIVE									
Lake Superior						X			
Lake Michigan								X	X
Lake Huron			X						
Lake Erie	X	X							
Lake Ontario				X	X				
CONNECTING CHANNEL - INTENSIVE									
St. Marys River			X					X	
St. Clair River	X					X			
Lake St. Clair			X				X		
Detroit River	X					X			
Niagara River			X						
St. Lawrence River				X					

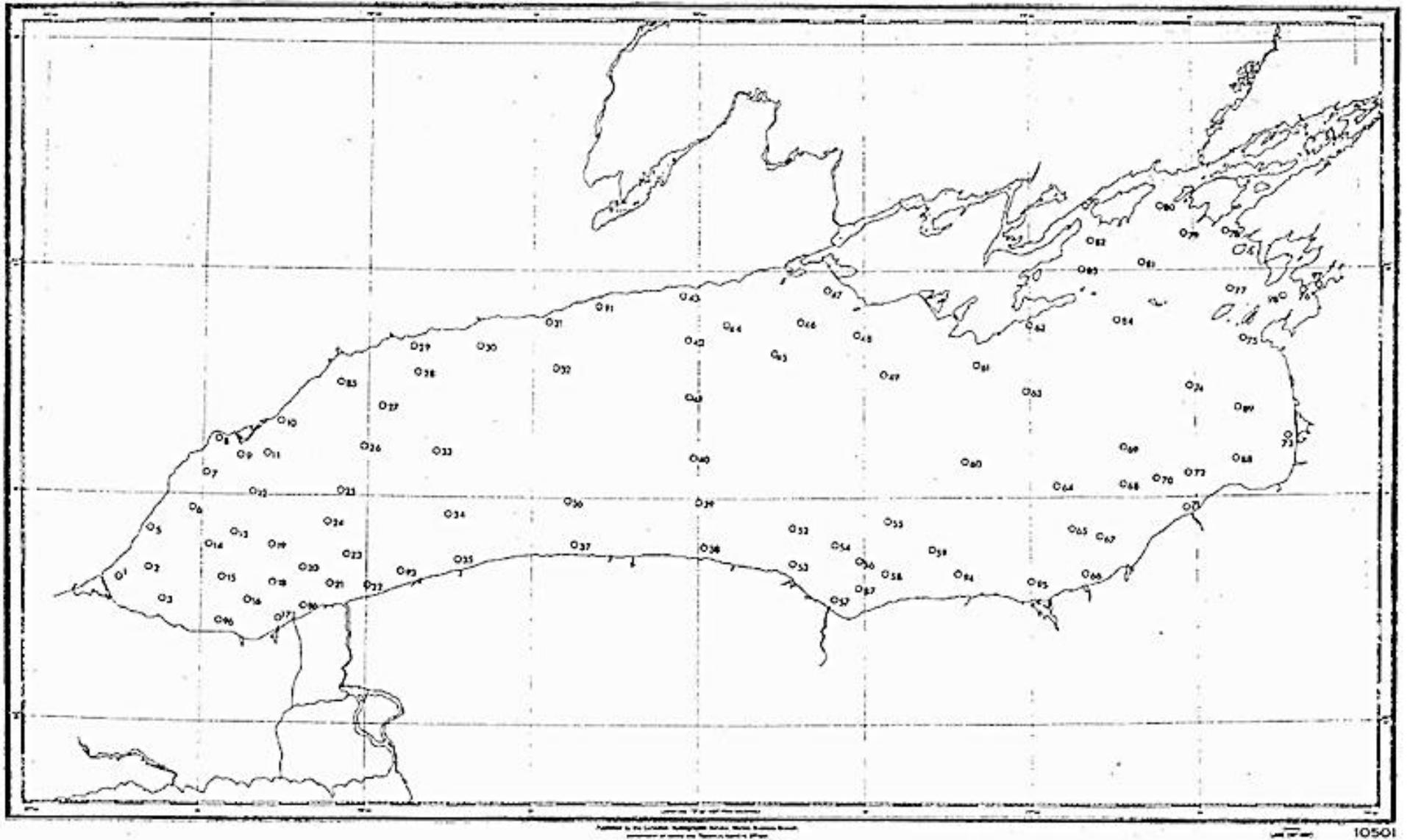


Figure 2. Station Pattern - lake Ontario Surveillance 1979-80

PROJECT TITLE:	CONNECTING CHANNEL SURVEILLANCE
Background:	The connecting channels are important water resources as indicated by their intensive use and proximity to major urban and industrial complexes. Of broader interest, is their role in linking the Great Lakes. The type and amount of materials transported from lake to lake is an important aspect of the total data base needed to evaluate long term lake response to loading changes. The Great Lakes International Surveillance Plan (GLISP) specifies continuation of on-going efforts to detect violations of water quality objectives within these water bodies as well as measuring loadings, particularly for phosphorus.
Objectives:	To detect and report any and all violations of the specific water quality objectives incorporated in the 1978 Great Lakes Water Quality Agreement. To establish trends in the physical, chemical and biological characteristics in the connecting channels. Specifically for 1979/80, to determine the feasibility of sampling suspended loads for contaminants in the connecting channels.
Scope:	The major field study will consist of surveys to evaluate the water quality of the Upper Niagara River as part of the Lake Erie intensive assessment. The continuous data collections from automatic samplers in the Niagara and St. Lawrence Rivers will be maintained to calculate loadings to and from Lake Ontario. (See Also NWRI Project: Bacteriological Water Quality Surveillance of the Niagara River).
Output:	The annual material loading estimates to and from Lake Ontario will be calculated. Emphasis will be placed on analyzing and evaluating the results from the suspended sediment contaminant program and from the surveys of the Upper Niagara.
Coordination with Other Agencies:	Connecting channels surveillance requires continuous dialogue between the Canadian provincial and federal agencies. Field programs are defined before every field season, and co-ordinated so that no duplication of effort occurs.
Resources Required:	MY 5.2 \$K 227.0

PROJECT TITLE: ATMOSPHERIC LOADING

Background: Atmospheric deposition of various substances is a necessary component to accurately quantify loadings to the Great Lakes. The identification of the need for this type of information in the Great Lakes International Surveillance Plan lead to the establishment of a precipitation sampling network in the Ontario Region of IWD. This sampling network is illustrated in Fig. 3.

Objective: To determine the quantity of material loaded to the Great Lakes via direct atmospheric precipitation (both wet and dry deposition).
To identify any trends in the chemical composition of atmospheric precipitation and the effects on the loadings to the Great Lakes Basin.

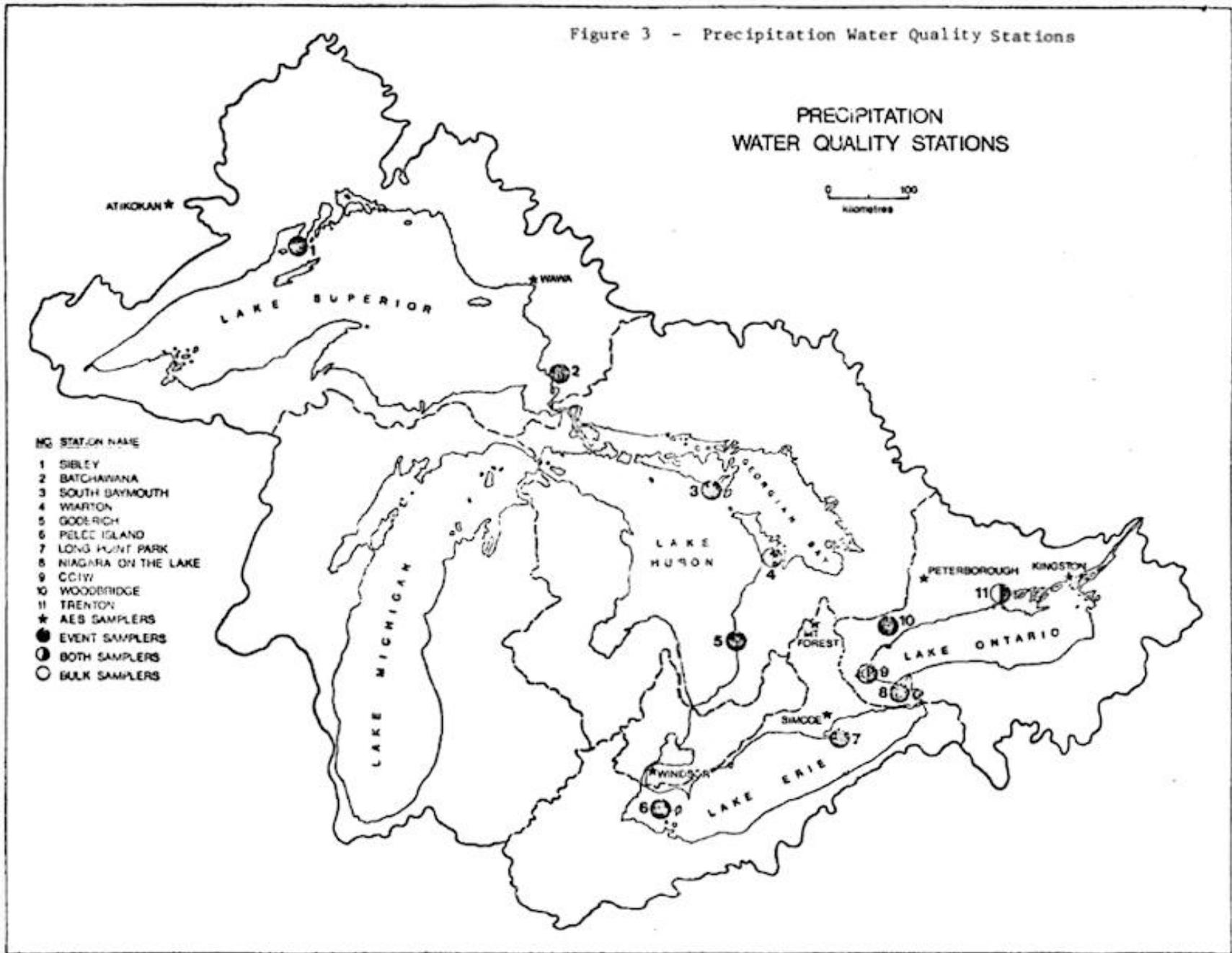
Scope: Monthly integrated samples of wet deposition will be collected from the stations illustrated in Fig. 3 and analyzed for their chemical composition to determine wet deposition rates (mg/m²/da). The material in the dry deposition container of the sampler will be washed out with an aliquot of distilled deionized water and the wash solution analyzed to calculate dry deposition rates. The parameters measured include nutrients, major ions, and seven trace metals.

Output: As a minimum, the annual report will include estimates of the atmospheric loadings to the lake for each of the parameters sampled. Trends will be identified by using a simple 13 month running mean.

Coordination with
Other Agencies: This type of program requires close cooperation between federal, provincial and U.S. agencies.
To this end, information exchange is a continuous process, and inter-agency coordination assures that this exchange continues.

Resources Required: MY 3.6
\$K 143.3

Figure 3 - Precipitation Water Quality Stations



PROJECT TITLE: FISH CONTAMINANTS

Background: The Water Quality Board of the IJC requests an annual report on the state of the Great Lakes, areas of degradation and the effect on the Great Lakes fish community with respect to contaminant levels. In response to an IJC (Surveillance Subcommittee) recommendation, a monitoring program on persistent contaminants in the Great Lakes biota (fish, plankton and benthos) has been developed.

Objectives: To survey collectively and report on the concentration of contaminants in selected species of Great Lakes fish and other biota with the specific purpose of determining trends in contaminant levels and relating these, where possible, to sources of such pollution, the effectiveness of remedial actions and the potential implications to Great Lakes fish stocks.

Scope: The Fish Contaminant Surveillance Program emphasizes the long term trends of lake conditions, the relative condition of the lakes to each other, protection of fish stocks, trans-boundary movement of contaminants, the impact of nearshore regulatory controls on the whole lake and evaluation of non-point sources (particularly atmospheric) contaminants. Responsibility for this program is shared jointly by the Great Lakes Biolimnology Laboratory (GLBL) of Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources (OMNR). Specific tasks of the program are:

- 1) provide an indication of environmental quality;
- 2) identify contaminant levels and their trends;
- 3) assess the impact of regulatory controls on the whole lake conditions;
- 4) provide an early warning for new contaminants;
- 5) forewarning of the possible occurrence of intolerable residues in fish stocks;
- 6) identify trans-boundary contamination.

Output: The program's effectiveness will be continually evaluated and annual reports will be prepared on information collected. An interpretation will be provided on any trends in contaminant levels that were observed.

Coordination with
Other Agencies:

The Great Lakes Contaminants Program incorporates both near-shore and offshore monitoring programs. The nearshore program places its emphasis on local problem evaluation, source identification and human health protection while the offshore program evaluates long-term trends of lake conditions and the relative condition of the lakes to each other. The nearshore program to determine contaminous levels in edible portions of fish is a cooperative project between the provincial Ministries of Environment and Natural Resources (OME and OMNR). The data generated by this program is stored in the OMNR Ontario Fisheries Information System (OFIS).

The offshore program, measuring contaminant levels in whole fish and other biota, is funded through the IJC and is conducted jointly by DFE, Great Lakes Biolimnology Laboratory and OMNR with the data being reported to the Great Lakes Water Quality Board and also stored in the OFIS data base.

Both programs possess a similar contaminant parameter list and utilize similar fish species for monitoring. A portion of the offshore program's fish samples are analyzed on an edible portion basis to provide a common data set between the two programs.

These programs currently are being coordinated through the Surveillance Committee of the Canada-Ontario Review Board.

Resources Required:

MY 3.6
\$K 160.1

This resource statement was derived from the 3 GLBL projects:

- 1) The Bioavailability of Phosphorus and Contaminants from Great Lakes Sediments.
- 2) Biological Surveillance: Assessment and Design-Contaminants).
- 3) Early Warning of Contaminants in the Great Lakes.

PROJECT TITLE: WILDLIFE CONTAMINANTS

Background: Analysis of contaminant trends and reproductive success in Great Lakes Wildlife will provide an early warning system of potentially harmful contaminants in the Great Lakes. The highest concentrations of persistent toxic contaminants in the Great Lakes have been found in fish-eating birds and their eggs. This group at the top of the Great Lakes food web has been shown to be a concentrator of environmental contaminants. Even compounds entering the lakes in substantial quantities can be so rapidly transferred to living organisms that detection in water is not feasible.

Objectives: To report the concentrations of persistent toxic contaminants and their geographical and temporal trends in wildlife in the Great Lakes System.

To report trends in reproductive success in selected wildlife populations such as fish-eating birds.

Scope: 1) Collecting samples of eggs and other wildlife tissues and analysis of contaminant levels therein.
2) Monitoring reproductive success of contaminated species.
3) Interpreting trends in contaminant levels and reproductive success.
4) Continual evaluation surveillance techniques.

Output: An annual report summarizing the nature, extent and consequences of environmental contamination of fish-eating birds with toxic substances.

Resources Required: MY 3.0
\$K 140.4

PROJECT TITLE: DATA QUALITY (INTERLAB, AGENCY, COUNTRY)

Background: In the past, water quality programs usually evolved with limited inter-agency and intergovernmental coordination. This often lead to the development of parallel and incompatible data analysis and processing systems and in the duplication of data banks, data retrieval systems and laboratory services. The purpose of this project is to prevent these problems from occurring in the Great Lakes International Surveillance Program (GLISP).

Objective: To assure that data obtained from the surveillance sampling network, for all phases of the GLISP are valid, reliable, and may be used for interpretation to ascribe significance and confidence in reporting on Great Lakes Water Quality and environmental impact assessment. The importance of this component cannot be understated as the quality of data obtained is vital to the entire surveillance program.

Scope:

- 1) Ongoing quality control checks within an agency on analysis and sampling including duplicate samples, split sample analysis, standards, blanks and spike retrievals.
- 2) Interlaboratory analysis checks for various substances to determine compatibility and areas for improvement.
- 3) The interlaboratory analysis check routines will be expanded to include laboratories in both the U.S. and Canada that are concerned with data quality in the surveillance program, including municipal and industrial laboratories.
- 4) The evaluation of various methodologies for analysis of water, seston and sediments with the long term aim of obtaining full comparable methodologies in place in all agencies concerned with Great Lakes Surveillance.

Output: Annual output will contain recommendations for sampling methodologies, results of laboratory inter-comparisons and suggestions as to how data from different agencies can be compared.

Resources Required:

MY	1.5
\$K	43.6

PROJECT TITLE: DATA MANAGEMENT

Background: The need to develop inter-agency and inter-governmental coordination with regard to data storage, retrieval and processing has been recognized by the IJC surveillance subcommittee. Therefore, a separate project devoted to this goal has been identified as one of the surveillance components.

This project has resulted in the means to exchange data between the U.S. STORET and the Canadian STAR data systems, and between the Province of Ontario's System 2000 and STORET.

Objective: To facilitate data usage, interagency data exchange and data availability for the purpose of expediting the interpretation phase of the surveillance program.

To investigate ways and means of improving data handling capabilities for ongoing reporting procedures and assuring that format conversion between various systems operated by agencies involved in the IJC surveillance program can be effected.

Scope: The further development of conversion routines between the U.S. STORET system, and systems and formats used in the Canadian federal surveillance program will be continued.

The maintenance of Canadian archives of water quality data will include editing and updating procedures such that the necessary high quality data base required by investigators for interpretation and reporting will be provided by the national NAQUADAT data system.

Output: The output will include software conversion packages for data system interconversion as well as recommendations for future procedures which will simplify and expedite data exchange.

Resources Required: MY 3.3
\$K 74.0

Sum of NWRI projects 071 and 072 as per F. Elder memo January 19th, 1979.

PROJECT TITLE: SUPPORT Of IJC SURVEILLANCE SUBCOMMITTEE

Background: Agency participation in both the execution of the Great Lakes International Surveillance Plan and annual assessment of Great Lakes water quality is obviously critical to the success of the Great Lakes Water Quality Agreement.

Objective: To provide the advice and resources necessary to serve the IJC Surveillance Subcommittee in its task of achieving coordination through meetings of the Committee, its task groups and workshops; to provide the manpower necessary to prepare the Annual Report on Water Quality and the Great Lakes International Surveillance Program design; and to provide the data necessary to keep the IJC Surveillance Manual up to date.

Scope: Participation in the following Committees and Subcommittees:

- Surveillance Subcommittee and its four task groups
- Data Quality Workgroup and its task groups
- Data Management and Interpretation Workgroup
- Radioactivity Subcommittee

Occasional involvement in meetings of the Implementation Committee, Water Quality Board and presentations to the Commission.

Output: Preparation of problem area reports, advice on matters referred to the Surveillance Subcommittee (such as the implication of a new water quality objective), and response to IJC Regional Office requests for specific data sets on operational information. Preparation of position papers on proposals for implementing new approaches or new methods in surveillance. Preparation of assigned segments of coordinated sections of the Annual Report of the Surveillance Subcommittee. Responsibility for writing of the final report is shared between Environment Canada and Fisheries and Oceans Canada. Both engage in similar tasks or reporting to the Subcommittee for inventories, problem areas and details for updating the manual.

Resources Required: MY 2.5
\$K 63.7

PROJECT TITLE: RADIOACTIVITY

Background: Present declining levels of man-made radioactivity due to bomb-testing will be supplanted by contamination from nuclear-powered generating stations.

Objective: To obtain data on both near-source and mid-lake radioactivity levels for comparison with agreed objectives, and for trend analysis.

Scope and Output: To collect and analyze samples for radioactive components in mid-lake regions and report the results annually to the IJC through the Radioactivity and Surveillance Subcommittees of the Water Quality Board.

Resources Required: MY 1.0
\$K 23.0

This is a 1979 estimate including "A" Base reallocation.

NATIONAL WATER RESEARCH INSTITUTE (NWRI)

SURVEILLANCE AND RELATED

RESEARCH ACTIVITIES

1979/80

PROJECT TITLE: ENVIRONMENTAL SIMULATION/MODEL APPLICATION AND EVALUATION

Background: The ultimate goal of water management in the Great Lakes is to be able to predict lake response to any given set of conditions. To do this requires a comprehensive, predictive water quality model. The long-term goal of this project is to produce a working model of this type.

Objective: The 1978-79 objective is to assess the predictive capability of presently available water quality models.

Scope: The work is essentially a continuation of last year's effort in the evaluation of models for Lake Erie and centres on the following areas:

- 1) Descriptive and mathematical analysis of long term (10 years) environmental data (climatical parameters, lake nutrient concentrations, loadings, etc.).
- 2) The ability to simulate the nutrient-plankton relationship, its response to nutrient loadings and climatic variations, and the effects on the anoxia and eutrophication problems.
- 3) The ability to simulate thermocline development, physical transports, and wind-wave turbulence, and their effects on the nearshore-offshore exchanges and sediment-hypolimnion-epilimnion fluxes of dissolved and suspended materials.
- 4) The application of advanced mathematical methodologies to evaluate and to enhance the performance of models, and to incorporate new process research results in the models.

Output: It should be possible to determine where deficiencies exist and to recommend a course of action to determine the direction of future research efforts.

Resources Required: MY 2.0
\$K 50.0

PROJECT TITLE: STATISTICAL EVALUATION OF SURVEILLANCE DATA

Background: Data analysis and evaluation has been a neglected aspect of surveillance programs. Resources are required to bring this up to standards needed for the annual assessment of water quality.

Objective: To develop methods for statistical analysis of the Great Lakes surveillance data. This study will lead eventually to the design of an appropriate sampling design.

Scope: The study will consist of three parts:

- a) Literature review of statistical techniques applicable to surveillance data and of previous analysis of this data.
- b) Choice and/or development of statistical methods and preparation of computer programs.
- c) Application to surveillance data on Lake Erie.

Output: Recommendations regarding the summaries of large quantities of surveillance data will be forthcoming, as will suggestions for improved and more efficient design of sampling programs.

Resources Required: MY 0.9
\$K 24.5

PROJECT TITLE: BACTERIOLOGICAL WATER QUALITY SURVEILLANCE OF THE NIAGARA RIVER

Background: As part of Environment Canada's responsibility to provide the IJC with water quality data on the Boundary Waters, the Microbiology Laboratories Section provides the bacteriological data for this report.

Objectives: To indicate from these data, areas of non-compliance, possible trans-boundary pollution and potential problem areas with regard to microbiology.

- Scope:
- 1) Approximately six surveys will be carried out on the Niagara River.
 - 2) Samples will be collected at various survey stations and analyzed for various bacteriological parameters.
 - 3) Data will be processed and tabulated for preparing reports for the Ontario Region.
 - 4) Because of the proximity of the Niagara River, the bacteriological samples will be shipped to the CCIW Microbiology Lab for analysis.

Output: A report will be prepared at year end documenting areas of non-compliance, possible trans-boundary pollution and potential problem areas with regard to microbiological parameters.

Coordination with Other Agencies: Consultation with Water Quality Branch of IWD Ontario Region will be ongoing.

Resources Required: MY 0.95
\$K 56.0

PROJECT TITLE: AN EVALUATION OF THE APPLICATIONS OF THE NIMBUS G COASTAL COLOUR SCANNER TO GREAT LAKES RESEARCH

Background: Remote Sensing has provided valuable inputs to the classification of groundwater and surface water regimes, and thus has shown potential in the delineation of water movements within a basin. Models are required to relate the multispectral energy return from basin networks to the hydrogeological parameters conventionally utilized to describe lake/basin interactions. This type of activity parallels the spirit of the Canada-U.S. Water Quality Agreement and is a logical extension of the thermal grid network established by the Remote Sensing Section of the 1978/79 field year.

Objectives:

- 1) To assess the application of remote sensing techniques to the determination of the hydrogeological regime of lake basins (1979-82).
- 2) To apply airborne and satellite digital apparent radiance data to the modelling of hydrological flow and pollutant transport to lakes (1984).

Scope:

- 1) Winter and summer airborne thermal scans of Southern Ontario basins will be initiated in conjunction with the Canada Centre for Remote Sensing.
- 2) Where appropriate, digital data from the LANDSAT vehicles will be analyzed, hopefully with the aid of the recently acquired NORPAK display system.
- 3) A feasibility study of the applicability of digital data from the recent NASA Heat Capacity Mapping Mission (HCMM) to such hydrological areas as snow melting and runoff will be initiated at NWRI.
- 4) Factor analysis techniques will be applied to all forms of remotely and locally acquired spectro-optical data (including data from the thermal network).

Some field work will be required on a periodic basis through the year.

Output: Output will consist of data processing, evaluation and pattern recognition analysis directed towards understanding of the surface hydrobiological characteristics of the Great Lakes.

Resources Required: MY 1.0
\$K 28.0

PROJECT TITLE: METHODOLOGY DEVELOPMENT AND ANALYTICAL SUPPORT TO CWS RELATED TO TOXIC CONTAMINANTS OF WILDLIFE

Background: The need to develop analytical techniques capable of detecting and identifying low levels of trace organics in water, sediment and herring gull abstracts is essential in light of current concern with these compounds and their affects on the environment.

Objectives: To develop quantitative analytical methodologies using multiple ion selection and employing both modes of operation such as electron impact and chemical ionization with up to eight ions in picogram and eventually femmtogram levels. The methodology will be based on the high efficiency and separation of WCOT columns and will be applied to organic trace analysis of pollutants in water and herring gulls.

Scope: Single and multiple ion detection techniques, in electron impact and chemical ionization modes, will be applied to standards and samples for quantitative determination of persistent organic contaminants.

In co-operation with WQ and CWS, the applicability of M.I.S. methods will be investigated and applied to the determination of chlorinated phenols and chlorinated benzenes.

Both standard solutions - calibration curve method and sample of fish, sediment and herring gull extracts will be examined to determine the overall reliability of the methodology.

Output: The results of this study will enable decisions to be made regarding the effectiveness of newly-developed analytical techniques towards the analysis of trace organics in water, sediments and herring gull extracts.

Resources Required: MY 1.0
\$K 35.0

GREAT LAKES BIOLIMNOLOGY LABORATORY (GLBL)

SURVEILLANCE AND RELATED

RESEARCH ACTIVITIES

1979/80

PROJECT TITLE: THE BIOAVAILABILITY OF PHOSPHORUS AND CONTAMINANTS FROM GREAT LAKES SEDIMENTS

Background: Initial experiments were completed in 1978/79. These indicated that apatite phosphorus was not a readily available source of phosphorus to algae. Algal growth was directly related to the non-apatite inorganic phosphorus content of the various geological materials tested. Sediment derived from urban watersheds, and known to be polluted with heavy metals and organic compounds, were shown to be significantly inhibitory to algal growth.

Objective: To sample representative fluvial sediments entering the lower Great Lakes and perform algal bioassays on these sediments. The objective is to estimate, where possible, the bioavailable fraction of phosphorus and both organic and inorganic contaminants.

Scope: Several rivers and streams in southern Ontario will be sampled during the spring melt of 1979. Sediments will be collected by centrifuge and will be deep frozen in small aliquots. Algal bioassays will be performed with a number of test organisms. Physiological response will be measured in a variety of ways, including growth, pigment production, ¹⁴C uptake, ATP production.

Output: This project will answer specific questions regarding bioavailability of sediment borne pollutants. It should give an indication of what type and how much P is available to living organisms from the sediments.

Resources Required: MY 0.5
\$K 27.0

Resources included in Fish Contaminants component of Surveillance.

PROJECT TITLE: BIOLOGICAL SURVEILLANCE: ASSESSMENT DESIGN - CONTAMINANTS

Background: Preliminary analysis of 1977 contaminants data is completed. This information will be utilized in selecting the sampling sites for 1979. A study to describe the temporal dynamics of contaminants in the eastern basin of Lake Ontario is partially completed. A survey to describe the levels of chlorinated phenols and chlorinated benzenes in lake trout populations of Lake Ontario is complete.

Objectives: To describe levels of trace persistent contaminants in selected species of Great Lakes fish together with other biota and to coordinate this program with existing or proposed programs of other Federal, State, and Provincial agencies monitoring contaminant levels in the biota of the Great Lakes. The specific purpose of this program will be to determine trends in contaminant levels and where possible to relate these trends to sources of pollution, the effectiveness of remedial actions and to determine the potential implications to Great Lakes fish stocks.

Scope: Project will involve sampling fish at selected locations in the Great Lakes (see GLISP) and analyzing them for non-routine organic contaminants and trace inorganic contaminants.

Output: Annual input to surveillance subcommittee of IJC and writing scientific reports as they are warranted.

Resources Required: MY 2.0
\$K 105.7

Resources included in Fish Contaminants component of Surveillance.

PROJECT TITLE: EARLY WARNING OF CONTAMINANTS IN THE GREAT LAKES

Background: Many contaminants are discharged into the Great Lakes via municipal and industrial effluents. For the most part the source, quantity and dispersion, as well as any adverse environmental effects, are known.

This program, by estimating contaminant loadings and monitoring environmental concentrations, will assess the relative importance of suspect contaminants in the Great Lakes and identify those requiring in-depth toxicological testing and surveillance monitoring.

Objective: To investigate the source, loading, environmental concentration and potential hazard of persistent, bioaccumulable substances known or suspected to be in the Great Lakes. Initial emphasis will be on polychlorinated styrenes, particularly octachlorostyrene (OCS) and possibly the hexa and penta forms.

Scope: Analysis of fish tissue from contaminant archives. Analysis of fish, sediment, sewage and water from selected locations.

Output: Reports to be published regarding:

- survey sources of styrene and possible chlorination mechanisms
- effects of polychlorinated styrene (OCS) on egg/larval stages of indigenous fish.

Resources Required: MY 1.1
\$K 27.4

Resources included in Fish Contaminants component of Surveillance.

PROJECT TITLE: PHYTOPLANKTON POPULATION DYNAMICS AND NUTRIENT STATUS OF LAKE ERIE

Objective: To develop a program of indicator species surveillance to assess and relate changes of characteristic plankton associations to nutrient status.

Scope: Phytoplankton samples (integrated and vertical) will be collected on the U.S. Lake Erie surveillance cruises, at representative stations. Phytoplankton identification, enumeration, along with physiological state study will be carried out according to GLOB standards to generate consistent data for long range comparison.

Output: Results of the work will be transmitted to the IJC surveillance subcommittee and scientific papers will be prepared.

Resources Required: MY 0.9
\$K 28.5

Resources included in Open Lake component of Surveillance.

PROJECT TITLE: PHYTOPLANKTON POPULATION DYNAMICS AND NUTRIENT STATUS OF LAKE ONTARIO

Background: Phytoplankton species and populations change with the nutrient state of the lake. As a result of this study it is hoped -

- 1) To relate established indicator species to nutrients in Lake Ontario
- 2) To detect new indicators, sensitive to water quality conditions
- 3) To provide an indication of long term trends in Lake Ontario trophic status by relating to historical data base gather at GLOBL.

Objectives: To develop an inexpensive, routine and reliable method of assessing lakewide phytoplankton population response to changing trophic conditions in Lake Ontario.

Scope: Phytoplankton samples (integrated and vertical) will be collected on the routine surveillance cruises at representative stations which have been selected based on the classification of the lake into zones indicating nutrient conditions of the lake. Phytoplankton identification, enumeration, along with physiological state study will be carried out according to GLOBL standards to generate consistent data for long range comparison. Chlorophyll a and nutrient analysis will be done by Water Quality Branch, CCIW.

Output: Results of the work will be transmitted to the IJC surveillance subcommittee and scientific papers will be prepared.

Resources Required: MY 1.1
\$K 31.5

Resources included in Open Lake component of Surveillance.

PROJECT TITLE: GREAT LAKES WATER QUALITY SURVEILLANCE-EUTROPHICATION

Background: Analyses of one year's data (34 sets of observations collected at five selected nearshore stations) has indicated that a significant difference in the seasonal pattern of chlorophyll a is obtained from weekly sampling versus monthly sampling. It was also shown that a simple predictive model can be established between chlorophyll a and the easily measured parameters of temperature and solar radiation.

Objectives: As part of an overall surveillance program lake-wide cruises will be carried out on the Great Lakes to measure eutrophication related parameters, (chlorophyll a, particulate organic carbon, total particulate nitrogen and plankton community structure). The data will provide information on trophic conditions of the Great Lakes on a year to year basis for the purpose of providing state of the lake reports, trend data, and input to scientific research. Past data will be used to provide statistical reliability to the program with respect to delineation of zones of non-compliance, detecting potential zones of degradation, yielding estimates on frequency of measurement and on station location.

Scope: It is proposed to carry out a sampling program similar to the 1978 one, on Lake Ontario for eutrophication parameters with a continuing effort at developing a rational statistical basis for sampling density, data analysis and reporting. More effort at obtaining time dependent data at selected stations to assist in the development of a predictive equation with respect to chlorophyll a is planned.

Output: An effort to determine the effectiveness of nutrients as a biomass estimate will be carried out on data collected from two nearshore stations in 1978. The nutrient measurements obtained were TP, SRP, DOC-F, NH₃-F, NO₃-NO₂-F, RSiO₂. In 1979 data will be collected from an offshore station to determine if the model developed for the inshore region is applicable to offshore regions.

Resources Required: MY 1.5
\$K 33.0

Resources included in Open Lake component of Surveillance.

TABLE 1. SURVEILLANCE COSTS 1979-80.

June 1979.

ENVIRONMENT CANADA AND FISHERIES AND OCEANS CANADA

COMPONENT	NWRI		IWD/OR		GLBL/OAS		CWS		TOTALS	
	MY	\$K	MY	\$K	MY	\$K	MY	\$K	MY	\$K
Open Lake	14.5	518.6	11.0	487.1	6.0	591.0 ^a			31.5	1596.7
Connecting Channels	0.7	32.6	4.5	194.4					5.2	227.0
Atmospheric Loadings	1.1	23.4	2.5	119.9					3.6	143.3
Fish Contaminants					3.6	160.1			3.6	160.1
Wildlife Contaminants	1.0	35.0					3.0	140.4	4.0	175.4
Data Quality			1.5	48.6					1.5	48.6
Data Management	3.3	74.0							3.3	74.0
Surveillance Subcommittee	0.6	36.0	2.5	63.7					3.1	99.7
Radioactivity	1.0	23.0							1.0	23.0
TOTALS	21.9	742.6	22.0	913.7	9.6	751.1	3.0	140.4	56.8	2447.8

^a Includes estimate of ship costs not discussed in text.

SECTION 2

ONTARIO MINISTRY OF THE ENVIRONMENT

GREAT LAKES SURVEILLANCE PROGRAMME

1979/80

PREPARED BY THE

SURVEILLANCE COMMITTEE

FOR THE

CANADA/ONTARIO AGREEMENT REVIEW BOARD

LAKE SUPERIOR

PROJECT TITLE: THUNDER BAY - COA REGULAR

Background: Studies carried out by the Ministry in 1973 and 1974 identified a number of problems in Thunder Bay associated with industrial and municipal discharges. These included bacterial contamination, oxygen depletion, nutrient enrichment and mercury accumulation in fish and sediments. A survey of the area in 1977 indicated similar water quality conditions.

The City of Thunder Bay has completed a new primary sewage treatment plant and interceptor sewer. The new plant replaces two plants and the interceptor corrects problems of discharge of untreated combined flows which existed in some areas. Included in these are domestic and industrial wastes from Canada Malting Company and Industrial Grain Products Ltd.

The Ministry issued a control order to Abitibi Paper on November 24, 1977 requiring the company to improve treatment at the three Thunder Bay mills. As a result of this action a sulphide mill at the plant was shut down in 1978. A final conversion from Kraft to Rapson process is planned for 1982.

Objectives: Determine the effectiveness of these abatement measures in correcting water quality problems.

Maintain surveillance of nutrient trends in the harbour.

Scope: The programme will utilize a Thunder Bay grid which represents an expansion of a transect system established in 1977. Emphasis will be placed on nutrient and bacterial parameters. In addition, oxygen profiles will be taken in the inner harbour to assess the areal extent of oxygen depletion. In conjunction with the water quality programme, a biomagnification study will be initiated to assess accumulations of trace contaminants in the biota.

Output: Report to regional staff, industry and general public on progress in correcting water quality problems. Final report expected in the spring of 1980.

Resources Required: MY 4.0
\$K 60.0 COA Regular

LAKE HURON

PROJECT TITLE: ST. MARYS RIVER - COA REGULAR

Background: Phenol levels in June, 1978 exhibited a decrease from those observed in previous years. Levels downstream from the Algoma Steel main trunk sewer averaged 18 µg/L and approached 4 µg/L near Little Lake George. These levels are in non-compliance with the Water Quality Agreement Objectives. Total ammonia and cyanide levels were generally in compliance with the Agreement Objective with exception of locations just downstream from the effluent. Under an Amending Control Order issued by the Ministry, phenol and cyanide levels in Algoma Steel effluent will be reduced to 20 µg/L and 0.1 mg/L respectively, by June 1980.

Great Lakes Power Corporation Limited is currently preparing a major redevelopment of the hydroelectric generating facility on the river. The first stage of the construction will start in May 1979. These construction activities will affect the river water quality and may reduce the dilution capacity of industrial effluents in the area. A monitoring program is necessary to provide a feedback for any possible modifications. Acres, a consultant services company, will provide the Ministry with a detailed sampling programme.

Objectives: To assess the adequacy of current abatement measures and the need for additional remedial programs.

To determine the fate of industrial pollutants in the river during the construction phase and to monitor the impact of construction activities on river quality.

To estimate the total phosphorus loading coming from Lake Superior.

Scope: In conjunction with the monitoring program proposed by Acres, the Ministry will undertake two cruises during May and July. Analysis will focus on heavy metals, phenols, cyanide, bacterial parameters, turbidity, pH, and temperature.

Output: A progress report outlining water quality conditions will be prepared and further recommendations for abatement developed as necessary by March, 1980.

Resources Required: MY 1.5
\$K 26.0 COA Regular

PROJECT TITLE: SERPENT HARBOUR - COA REGULAR

Background: The water quality issue of acidification in Serpent Harbour has been noted during previous studies. Water quality non-compliance in Serpent Harbour is reported in Appendix B of the 1977 and 1978 annual reports of Surveillance Subcommittee to Water Quality Board, IJC. The problem of acidification results primarily as a result of bacterial oxidation of sulphide from upstream mine tailings ponds. The problem is further affected by the low natural buffering capacity of river waters.

Previous information indicates that the problem is most dramatic during the spring snowmelt period and during periods of low water levels in the harbour. The areal extent for non-compliance with the MOE objective for alkalinity in the harbour is typically less than 11 km from the river mouth.

Objectives: This study is to provide compliance information for the IJC annual reports and to support Environmental Assessments currently underway for proposed mine expansions in the Elliot Lake area.

Scope: Concurrent with two cruises for radioactivity monitoring in the harbour outlined elsewhere in this review, conventional water quality sampling will be undertaken. Sampling will focus on the determination of pH, alkalinity, nitrogens and sulphate in harbour waters using a station grid of 20 stations located up to 10 km from the river mouth. Cruise timing will consist of one survey in the spring after ice breakup and one during late summer/early fall.

Output: A progress report on current water quality conditions and input to the IJC annual report by March 1980.

Resources Required: MY 1.5
\$K 26.0 COA Regular

PROJECT TITLE: PENETANG-MIDLANDCOA REGULAR

Background: Previous investigations by the Ministry indicated significant enrichment problems in Penetang and Midland Bays. Remedial measures have been undertaken including phosphorus removal facilities at the four local sewage treatment plants. Improvements are expected to occur over a long term due to the confined nature of the bays which hinders mixing with Georgian Bay waters.

Objectives: Assess rate and degree of improvement in bay water quality as a result of remedial measures.

Scope: Sampling will be undertaken bi-weekly throughout the ice-free portion of the year. Based on assessments of past water quality data, an efficient grid of 10 stations will be sampled for a variety of nutrient enrichment parameters, including detailed phytoplankton enumerations.

Output: Summary report to Regional staff and Head Office.

Resources Required: MY 1.0
\$K 21.5 COA Regular

PROJECT TITLE: MARY WARD SHOALS *CLADOPHORA* PROJECT - COA ENHANCED

Background: A proposed sewage treatment plant outfall planned for Collingwood Township will potentially affect the local aquatic environment in Georgian Bay by promoting growth of *Cladophora* on an area of limestone shoal (Mary Ward Shoals). The 67 km area is also presently well known as an important habitat for smallmouth bass and several other fish and fish-food organisms. The future of the Mary Ward Shoals as a valuable spawning area for whitefish could be jeopardized if *Cladophora* becomes established in this area. Nothing is presently known of the potential for *Cladophora* growth on the shoals given the expected elevated nutrient concentrations resulting from the sewage treatment plant outfall. Several aspects of the ecology of *Cladophora* in the Upper Great Lakes are poorly understood. In particular there is a need to understand the nutrient requirements of the alga as they may relate to the siting of new sewage treatment plant outfalls.

Objectives: To determine the growth potential of the Mary Ward Shoals for *Cladophora* production given a sewage treatment plant discharge in the area.

Scope: Ten sites showing a wide range in *Cladophora* growth will be monitored along the Georgian Bay shoreline from Collingwood to Owen Sound during June-September 1979. Sites are selected with substrate types and water depths similar to those of the Mary Ward Shoals. *Cladophora* biomass and growth rates will be measured weekly at all sites and related to water and tissue nitrogen and phosphorus contents. Surplus P in plant tissue will also be determined using boiling extraction in Gorham's medium. The mixing zone associated with the proposed sewage treatment plant outfall in the Mary Ward Shoals area will be delineated and permit an estimate of the areal extent of potential *Cladophora* development on the shoals to be predicted from empirical and experimental nearshore data sets.

Output: Report (1980)

Resources Required: \$K 11.0 COA Enhanced

LAKE ERI E

PROJECT TITLE: ST. CLAIR RIVER - COA REGULAR

Background: In recent years there have been significant improvements in the river quality. Reductions in levels of chloride, total dissolved solids and mercury in fish and sediment have occurred.

Variety and number of organisms in the benthic fauna communities along the Canadian shoreline exhibited improvement since 1968. Remedial measures undertaken at municipal and industrial sources are major contributions to the recovery of the river.

Further improved treatment at Polysar, Dow Chemical of Canada Ltd. and Imperial Oil Enterprises are currently underway.

A report is currently being prepared on the impact of dissolved organics in water supplies and fish tainting. This report was undertaken as a separate program by Southwestern Region of MOE. An outfall dispersion model for conservative substances in the river has been completed as part of this project. An intensive water quality monitoring program 'gas undertaken during 1978 which will supplement the St. Clair organics study.

Objective: Maintain surveillance of mercury levels in sediments of the St. Clair River system.

Scope: The bi-annual monitoring program for mercury in sediment will be continued for this year. Sampling will take place along 6 transects across the river, 2 stations in Chenal Ecarte and 4 stations in the Canadian sector of Lake St. Clair.

Output: A detailed Ministry report for mercury trends in sediments will be prepared.

Resources Required: MY 1.0
\$K 20.0 COA Regular

PROJECT TITLE: NEARSHORE LAKE ERIE - COA REGULAR

Background: The intensive International Surveillance Plan for Lake Erie is currently in the second year of implementation.

Previous investigations in the nearshore areas of the lake indicated that the Eastern basin of Lake Erie is greatly affected by the Grand River discharge during spring where the impacted area extends from Port Maitland to as far as Fort Erie. The Grand River mouth area exhibited high nutrient and dissolved solids concentrations.

The western basin of Lake Erie experienced significant reduction in total phosphorus levels which coincided with significant reduction in total phosphorus loading from the Detroit River. Total biomass in the Kingsville Water Intake however, showed an increase in levels in 1977 and 1978. This phenomenon is under further investigation. Mercury levels in fish declined significantly and concentration in some fish species approached the federal guideline for safe human consumption.

- Objectives:
- 1) maintain surveillance of the impact of increased municipal and industrial development in the Haldimand and Norfolk area.
 - 2) to search for, monitor, and quantify violations of both the 1978 Agreement and MOE Objectives.
 - 3) assess local and whole lake response to abatement measures and identify emerging problems.
 - 4) to determine the cause-effect relationship between water quality and inputs in order to develop the appropriate remedial/preventative actions and predictions of the rate and extent of local/whole lake responses to alternative abatement proposals.
 - 5) to determine the long-term trophic state of Lake Erie.

Scope: General nearshore studies will consist of 7 cruises in the western and eastern basins and 3 cruises in the central basin. A system of transects extending 3 to 5 km from the shore will be used to monitor water quality characteristics in the lake. Emphasis will be focused on the eastern basin of Lake Erie where 10 transects will be employed to detect effects of the Grand River input and industrial activities in Nanticoke area, namely Texaco and Stelco. In the Central and Western basins 3 transects are designed to verify 3 intake sites currently used for trend evaluation.

Five stations on each transect will be monitored for nutrients, biomass indicators, optical characteristics and public health indicators. Depth sampling for nutrients and chlorophyll a will be based on thermal structure of the nearshore zone.

Additional studies in Western Lake Erie and Long Point Bay will include sediment sampling for trace contaminants and bottom fauna identification. The latter will be a joint study with Regional staff. A joint study between the Ministry and Environment Canada (NWRI) will be undertaken at the Grand River mouth area to determine bacterial parameters related to enrichment and the areal extent of the river plume during spring. Fixed current meters will be set in the river mouth area and current measurements will be undertaken upstream from the mouth. The sediments of inner Long Point Bay will be sampled to derive a quantitative mass balance of pesticide residues. This will be a joint study with MOE West Central Region.

Output: A detailed inter-agency state-of-the Lake Assessment report is proposed for completion by 1981.

Summary Ministry reports will be forwarded to the Regional Offices.

Resources Required: MY 12.0
\$K 335.0 COA Regular

PROJECT TITLE:	LAKE ERIE HARBOURS AND EMBAYMENTS - COA REGULAR				
Background:	Water quality assessment of embayments and harbours is a major component of the surveillance strategy currently being addressed by the implementation of the Lake Erie International Surveillance Plan. Embayments and harbours usually exhibit water quality characteristics different than general nearshore areas due to localized point and diffuse source inputs as well as confined mixing conditions. Wheatley harbour is a current IJC problem area for bacteria and dissolved oxygen.				
Objectives:	<ol style="list-style-type: none"> 1) To delineate the nature and extent of non-compliance; if any, with the 1978 Agreement and MOE water quality objectives. 2) If water quality degradation is noted, determine the cause and forward recommendations for appropriate remedial measures. 3) For Wheatley harbour, the effectiveness of recent remedial measures will be assessed. 				
Scope:	<p>Harbour and embayment areas to be studied include: Wheatley, Kingsville, Eriean-Rondeau Harbour, Port Stanley, Port Burwell, Port Dover, and Port Colborne.</p> <p>These areas will be sampled concomitantly with the nearshore cruise outlined under the nearshore section (i.e. 7 cruises in the western and eastern basins, and 3 cruises in the central basin). Major water quality issues to be addressed include compliance with the 1978 Agreement and MOE objectives, nutrient enrichment, and public health microbiology.</p>				
Output:	Input to the IJC Annual report and to the detailed assessment report of Lake Erie (early 1980).				
Resources Required:	<table border="0"> <tr> <td>MY</td> <td>3.5</td> </tr> <tr> <td>\$K</td> <td>50.0 COA Regular</td> </tr> </table>	MY	3.5	\$K	50.0 COA Regular
MY	3.5				
\$K	50.0 COA Regular				

Lake Erie Continued

Enhanced Programs: The outline of the following programs are provided to enhance the understanding of nearshore processes. These programs call for additional resources and their implementation depend on the availability of additional funds. It is imperative that these programs be carried out during the intensive International Surveillance Plan for Lake Erie in order to facilitate co-ordination with activities in the open Lake and along the U.S. shore.

I. PROJECT TITLE: PHOSPHORUS LOADINGS FROM LAKE HURON - COA ENHANCED

Background: In conjunction with Annex 3 of the 1978 Water Quality Agreement, the Ministry will determine accurate total phosphorus loadings from Lake Huron. This study coupled with the DOE program of monitoring total phosphorus loading at the Niagara head range should determine the phosphorus mass balance for Lake Erie.

Objective: To estimate total phosphorus loading from Lake Huron for the mass balance of the Lake Erie basin.

Scope: Under a contract to a consultant the head range of the St. Clair River will be sampled intensively once a week throughout the ice-free portion of the year. This will include 1 station sampled at three depths for a variety of mass balance parameters including phosphorus, nitrogens, and conservative substances. Laboratory analyses will be performed by the Ministry. This study will also investigate the feasibility of using the Lambton Intake sampling site as a long-term economic sampling location for trends and mass balances estimates.

Output: Study findings and recommendations will be forwarded to Surveillance Subcommittee and Southwestern Region. A report on the evaluation of the feasibility of the Lambton Intake as a long-term monitoring site is anticipated by 1980.

Resources Required: \$K 6.0 COA Enhanced

II. PROJECT TITLE: PHYTOPLANKTON BIOMASS AND SPECIES COMPOSITION IN THE NEARSHORE AREA OF EASTERN LAKE ERIE - COA ENHANCED

Background: With the exception of the Nanticoke phytoplankton studies, little is known about plankton biomass and species composition in the nearshore areas of Eastern Lake Erie. Previous water quality investigations in the eastern basin indicated that the effect of the Grand River establishes distinct plankton regimes on either side of the river mouth.

Objectives: 1) To determine to what extent the Grand River influences the plankton regimes in Eastern Lake Erie.
2) To provide input to total phosphorus loading allocations and compliance schedules proposed in the 1978 Water Quality Agreement.

Scope: Sampling for phytoplankton analyses will be carried out during general nearshore cruises.

Samples from 1 and 5 m depths will be mixed together in equal parts and preserved. At selected stations, where optical characteristics are determined, samples at 1 m intervals will be taken. Identification of living organisms particularly motile phytoflagellates will be undertaken.

All samples will be identified and enumerated using an inverted microscope. Cell volume will be computed from average cell dimensions measured in each sample and the geometrical shape that closely resembles the shape of the species.

Output: Information from this study will be included in the Assessment of "State-of-the Lake" report to be submitted to the IJC.

Resources Required: \$K 9.6 COA Enhanced

III PROJECT TITLE: LAKE ERIE *CLADOPHORA* SURVEILLANCE - ONTARIO COMPONENT - COA ENHANCED

Background: At a December 8, 1978 meeting of representatives of several agencies (EPA, University of Michigan, New York, ERI - Michigan, Centre for Lake Erie Res., MOE, NEWI etc.), the Ontario Ministry of the Environment and Canada Centre for Inland Waters agreed that monitoring shoreline growths of *Cladophora* should be a component of the Lake Erie Surveillance Plan. A data base at several sites on the U.S. and Ontario sides of the lake is needed to adequately assess the long term trends in growth rates and biomass of *Cladophora*, especially as they relate to changing nutrient and contaminant concentrations in the nears shore zone.

Objectives:

- (a) to monitor growth rate, density and distribution of *Cladophora* at selected sites in Lake Erie.
- (b) to determine the relationships among nutrients (esp. N and P) and *Cladophora* growth.
- (c) to establish a systematic data base for lakewide comparison of future change.

Scope: Four *Cladophora* sampling sites have been established on the U.S. side and one on the Ontario side of Lake Erie east of the Grand River. Samples will be collected bi-weekly at four depths for analysis of wet and dry weight, bulk density and tissue nutrient content. A photographic record of shoreline accumulation of the algae will be kept. Studies will be conducted under contract to a consultant.

Output: Annual report to the I.J.C. (through the Surveillance Sub-Committee) to be prepared from data gathered at all five Lake Erie sites.

Resources Required: \$K 10.0 COA Enhanced

LAKE ONTARIO

PROJECT TITLE: NIAGARA RIVER - COA REGULAR

Background: The input of many persistent toxic contaminants from industry and waste disposal sites in New York State and their possible effects on Ontario water users has received much attention over the last year. The effect of this contaminant load on the Niagara River requires in-depth investigation.

Objectives: Determine sources of persistent toxic contaminants in the area.

Assess the impact of these discharges on sediment quality in the Niagara River.

Investigate biomagnification of persistent toxic contaminants in local biota including macroinvertebrates, fish and algae.

Scope: One cruise will be carried out by M.O.E. in the Niagara River with emphasis on sediment, benthic, and algal investigations. This study will be carried out in conjunction with the Ministry's young-of-the-year fish sampling programme as well as in cooperation with the Canada D.F.E. suspended sediment study and the Niagara-on-the-Lake water intake programme. Assessment of sources will be coordinated with the Ministry's Regional office and with the New York State D. E.C.

Output: Ministry reports, including findings and recommendations, will be forwarded to regional staff and concerned agencies by early 1980. A joint M.O.E./Canada D.F.E. report is planned for 1980.

Resources Required: MY 1.5
\$K 30.0 COA Regular

PROJECT TITLE: LAKE ONTARIO NEARSHORE - COA REGULAR AND ENHANCED

Background: Previous studies have indicated that nutrient levels in the nearshore zone of Lake Ontario are sufficiently high to induce localized phytoplankton blooms and prolific *Cladophora* growth where suitable substrate exists. Recent analyses have shown the existence of regional differences in water quality of the nearshore. Five statistically different regions were indentified between the Niagara River mouth and Port Hope. In addition, recent investigations have identified a pronounced inshore-offshore gradient in water quality, a distinct vertical partitioning of nutrients and phytoplankton under stratified conditions and a potentially significant contribution of nutrients from sediments and/or littoral drift to the overlying waters. These findings have a significant bearing on future assessments of shoreline developments and on the interpretation of phosphorus management models.

Objectives: Define regional differences in water quality of the nearshore with emphasis on trophic status definition.

Detect trends in nutrient levels and algal biomass in response to phosphorus abatement measures.

Provide a continuing data base to aid in early detection of emerging problem areas.

Scope:

Regular: One cruise (consisting of triplicate sampling) will be undertaken in the spring of 1979 in the nearshore zone between the Niagara River mouth and Kingston. A system of transects extending from shore to the 50 m depth contour will be monitored for nutrients and associated water quality parameters. This component will define regional differences in nearshore water quality and detect emerging problem areas.

In addition, two of the five recently documented water quality regions will be monitored weekly throughout the ice-free period, along representative transects.

In order to interpret water quality information in terms of the dynamics of the nearshore zone, a system of *in-situ* continuous

temperature recorders will be installed at one station of each transect to monitor upwelling-downwelling frequencies throughout the year. All stations along each transect will be monitored weekly, with depth, for nutrients and associated parameters. This component of the programme will provide long-term assessment of the nearshore and detect trends in water quality and trophic status.

Program Enhancement: A plankton component will be introduced into the programme to assess the potential of the nearshore zone for phytoplankton production in relation to nutrient availability and to detect long term changes in phytoplankton zooplankton population structure. Selected stations will be sampled for plankton which will be speciated and enumerated. In addition, concurrent primary productivity studies will be carried out to detect differences in nutrient assimilation between the two regions under study and between inshore-offshore regimes. Findings of these investigations will allow an evaluation of management models currently used to assess the relationships of phytoplankton production and nutrient availability. In conjunction with the water quality investigations, a baseline study documenting sediments and benthos located along the transects will be initiated. In addition, the sediment-water interface will be studied in order to assess the degree of nutrient contribution from sediments and/or littoral drift to the water column.

Output: Information from these investigations will be used to update the problem area and general assessment of Lake Ontario in the 1979 Water Quality Board Report. A Ministry report on the potential of nearshore zone for phytoplankton production is expected in 1980.

Resources Required:	MY	10.5	
	\$K	280.0	COA Regular
	\$K	58.4	COA Enhanced

PROJECT TITLE: HAMILTON HARBOUR - COA REGULAR

Background: Previous intensive studies of Hamilton Harbour have identified a number of problems associated with past and present industrial and municipal discharges.

The sediments in the harbour are heavily contaminated and act as a potential source of heavy metals, trace organics and nutrients. A severe oxygen depletion problem occurs during the summer months. This oxygen depletion process appears to have been partially offset by artificial mixing conducted by M.O.E. during the 1975 - 1978 period and vortex mixing initiated by McMaster University in 1977.

The aeration project will be discontinued in 1979 in order to assess its effectiveness.

Objectives: Determine trends in water quality of the harbour.

Determine the relative magnitude of loadings discharged into the harbour.

Assess the importance of ammonia and dissolved organic carbon in the process of oxygen depletion.

Scope: A major study will be undertaken of the loadings to the harbour from municipal and industrial outfalls and from combined sewers after storm events. A three-dimensional numerical predictive model will be operational and verified by means of special studies in the harbour. The process of oxygen depletion in water and in sediments will be investigated, especially the roles played by ammonia and dissolved organic carbon. Regular surveys of the general chemical conditions, primary productivity and zooplankton will be continued.

Output: Ministry reports including findings and recommendations to be forwarded to regional abatement staff and other involved agencies. A summary report by March 1980 summarizing all data and findings gathered since the study began in 1973.

Resources Required: MY 5.0
\$K 150.0 COA Regular

PROJECT TITLE: TORONTO HARBOUR

Background: Intensive studies conducted in 1978 and 1971 have delineated the extent of water quality impairment associated with the Don River and the city storm and combined sewer overflows. Substantial reduction in loadings to the inner and outer harbours is anticipated in 1979 as a result of the installation of a mid-town interceptor sewer in Toronto and a new sewer system on the Toronto Islands. Preliminary analysis of 1978 data suggests that these remedial measures already have had some impact on water quality in the harbours.

A potential problem of heavy metals and trace organic contamination still exists in the sediments of the harbour. The effect of these contaminants on resident biota is largely unknown.

(1) Objectives: Assess the effectiveness of remedial measures on water quality in the harbour.

Document further changes as a result of anticipated reduction in loadings.

Scope: Three stations (representing inner harbour, outer harbour and Island Filtration Plant intake area) will be monitored daily during the ice-free period to detect seasonal changes in water quality.

Specific point source discharges will be monitored twice weekly throughout the year to assess their loading contribution to the harbour. This study is done in cooperation with the Central Region, City Public Works Department, and the City Public Health Department.

Output: Ministry reports will be prepared by mid-1980, including findings and recommendations, to be forwarded to regional abatement staff and other involved agencies. A joint M.O.E./Canada D.F.E. report on bacteriological status of the Toronto area, based on 1977 - 1978 findings is planned for mid-1979 publication.

(2) Objectives: Assess the effectiveness of remedial measures by monitoring the response of the macroinvertebrate community to loading reductions.

Scope: The distribution of macroinvertebrate species in Humber Bay will be determined in cooperation with Canada N.W.R.I.

Output: Joint MOE/Canada N.W.R.I. report will be completed by 1980 with copies being sent to the Region, and concerned agencies.

(3) Objectives: Investigate the degree of biomagnification of heavy metals and organic trace contaminants in the biota of the harbour and establish accumulation ratios for, plankton, sediments, invertebrates, fish and macrophyte components of the food web.

Scope: Selected stations in the Humber Bay, inner harbour, Island Lagoons, outer harbour and Main STP outfall will be investigated in order to assess the relative severity of the contaminants problem in the Toronto area. At each station, water, plankton, sediments, benthos, fish and macrophytes will be analyzed for heavy metal and organic trace contaminant content. Body burdens will be established for affected biota.

Output: The results of this study and recommendations will be communicated to the Region and concerned agencies. A ministry report will be prepared by March 1980.

(4) Objectives: Investigate layered flow in the Eastern and Western gaps to calibrate a mass exchange model for Toronto Inner Harbour.

Scope: Layered flow in the Eastern and Western gaps will be investigated using a Bendix current meter to determine current profiles under conditions when layered flow is most expected.

Data collected in previous years will be used in the development of a numerical three-dimensional predictive model for the inner harbour.

Output: A ministry report with be prepared by early 1980.

Resources Required: MY 5.5
\$K 150.0 COA Regular

PROJECT TITLE: PICKERING-DUFFIN CREEK AREA - COA REGULAR

Background: The pattern of water use in the Pickering-Duffin Creek area of Lake Ontario will change significantly commencing in late 1979. The York-Durham regional sewer will begin operation late in 1979 with the first phase consisting of the elimination of existing Ajax, Pickering and Bay Ridges STP's and their incorporation into the York-Durham STP located just west of Duffin's Creek. This new STP will gradually increase treatment capacity through 1980 and 1981 to include sewage from Markham, Unionville, Thornhill, Richmond Hill and adjoining areas. In addition, the Pickering B nuclear power plant, scheduled to begin operation in late 1981, will introduce a new thermal effluent to the area.

Recent early spring studies have suggested that the Pickering A waste heat discharge may act to create a thermal bar effect during winter.

Objectives: To determine the nature and extent of winter thermal plumes from the Pickering G.S.

To assess the zone of influence associated with York-Durham STP discharge.

To provide baseline data necessary to predict potential impingement of discharges on water intakes during winter.

Scope: Continuous plume tracking studies will be carried out in conjunction with M.O.E. water quality surveys and with the Ontario Hydro Hydraulics Division. Winter studies will also be conducted to delineate the effect of inshore entrainment of wastewater discharges behind the thermal bar created by the Pickering G.S. A variety of experiments will be conducted during winter to verify the nature, extent magnitude and orientation of the Pickering winter plume. Experiments will be designed to delineate thermal plumes, define ambient current regimes and verify the frequency of plume entrainment at municipal intakes. This will be a joint study with Ontario Hydro and NWRI with MOE undertaking the lead role.

Output: Ministry reports by early 1980, including findings and recommendations to regional staff and concerned agencies.

Resources Required: MY 3.0
\$K 40.0 COA Regular

PROJECT TITLE: LAKE ONTARIO - EASTERN SECTOR OXYGEN DEPLETION STUDY
- COA REGULAR

Background: In the past few years, routine main lake surveillance has detected an oxygen depletion problem in the area of Lake Ontario east of Prince Edward County. Oxygen levels have been observed to drop below 6 mg/L in the hypolimnion by mid-August and to persist until early September. The areal extent of the problem is insufficiently documented, since it was based on only two stations.

Objectives: Define the areal extent of the oxygen depletion problem.
Determine the rate of oxygen depletion in the area.

Scope: Six cruises will be undertaken between early August and mid-September in the deeper portions of the basin east of Prince Edward County and in Adolphus reach. A total of 90 stations will be profiled for temperature and oxygen levels.

Output: Information from these investigations will be used to update the problem area assessment of Lake Ontario for the 1979 Water Quality Board Report.

Resources Required: MY 1.5
\$K 30.0 COA Regular

PROJECT TITLE: BAY OF QUINTE - COA REGULAR

Background: Most water users in the Bay are being adversely affected by nutrient enrichment. There have been occasions where little or no dissolved oxygen was present in the deep waters of the Bay. A number of steps have been taken to improve municipal treatment facilities. Trenton and Picton have completed plant expansions, Belleville is planning to expand facilities in the near future, and an expansion at Napanee is under construction. Phosphorus removal is now on line at all municipal plants. Significant reductions in phosphorus concentrations and algal densities in 1978 suggest a response to these abatement measures. Earlier problems of bacterial contamination in recreational areas have also responded favourably to upgraded municipal treatment.

Objective: Monitor the changes in water chemistry and phytoplankton in the Bay of Quinte in response to phosphorus reductions.

Scope: This is a joint study with Canada D.F.E., Ministry of Natural Resources and the Universities of Guelph and Queen's. Virtually all aspects of Bay of Quinte limnology are under investigation, including trophic status determinations and biomagnification of heavy metals and organic trace contaminants.

Output: Annual reports will be published, incorporating material from all study team members.

Resources Required: MY 2.0
\$K 50.0 COA Regular

PROJECT TITLE: ST. LAWRENCE RIVER: CORNWALL - COA REGULAR

Background: Previous Ministry studies in the Cornwall area of the St. Lawrence River have detected elevated levels of mercury in sediments and fish. These levels were attributed largely to local sources and as a result of these studies, major sources of mercury were eliminated from the area by 1970. Mercury is now considered to be a residual problem at Cornwall.

Recent discovery by Canada D.F.E. of elevated PCB levels and other organic trace contaminants in waters along the New York shore, coupled with the Ministry findings of high PCB levels in important fish species of the St. Regis area, show that organic trace contaminants are a problem. Distribution of these compounds in water and sediments, bioaccumulation in biota and the possibility of transboundary movement requires investigation.

Objectives: Detect anticipated changes in mercury levels in sediments as a result of curtailment of discharges.

Assess distribution of organic trace contaminants in water and sediments, and bioaccumulation in resident biota.

Document existing sources of contaminants in the Cornwall area.

Scope: A survey will be carried out in the area utilizing an expanded historical station grid. All major components of the aquatic system will be sampled including water, sediments, benthos and fish. This work will be carried out in cooperation with M.O.E. regional staff, New York State D.E.O and D.F.E. Quebec Region who are conducting a similar study in Lake St. Francis area.

Output: Ministry reports will be prepared in cooperation with regional staff, and possibly D.F.E., and will be forwarded to concerned agencies. This work will provide a basis for problem area assessment to be reported in the 1978 Great Lakes Water Quality Board Annual Report.

Resources Required: MY 2.5
\$K 40.0 COA Regular

General

PROJECT TITLE: LIMITED USE ZONE DESIGNATION - COA ENHANCED

Background: The Great Lakes Water Quality Agreement of 1978 requires all jurisdictions to designate and report to the IJC the details of "limited use zones" (LUZ). These will apply for all industrial and all municipal discharges greater than 1 mgd. This is the zone within which one or more of the Agreement objectives cannot practicably be met but where a minimum quality must be ensured as prescribed in Annex 2. The designation of these is consistent with the "mixing zone" policy of the Ministry as specified in the publication, "Water Management in Ontario".

Objectives: (1) To designate and report to the IJC the "LUZ" for all existing discharges by January 1980 as required by the Agreement and (2) to refine existing procedures for the determination and monitoring of allowable "LUZ".

Scope: (1) The "LUZ" for the 30 - 40 "major" discharges will be determined from a combination of effluent and receiving water quality data, current velocities, outfall characteristics, decay coefficients and dispersion models. The selection of major discharges will be based on discharge rate, effluent characteristics' potential for water use conflict and potential for transboundary movement. Results from these studies will be extrapolated to the remaining less significant discharges. The early deadline will permit the use of existing data only; however, refinements are planned in subsequent years when follow-up field investigations will be undertaken. Zones will be designated on the basis of expected effluent quality once the remedial programs required under the Agreement are complete i.e., by the end of 1982 for municipalities and the end of 1983 for industries.

(2) Plume tracking studies measuring in-situ conductivity and temperature will be done at each of these locations: Lakeview STP, Humber River and STP, Metro Toronto Main STP, Grand River Mouth and selected Lake Ontario refinery outfalls. In conjunction with the in-situ work, water samples will be taken in the effluent and in the plume areas and analysed for associated conservative and non-conservative variables. In particular, phenols will be sampled at refinery

outfalls and chlorine residuals and bacteriology will be sampled at SIP outfalls.

- Output:
- (1) A report to the IJC containing the detailed description of each limited use zone.
 - (2) A series of data summaries for each study location and a summary report on suggested guidelines and procedures for optimally determining the boundaries of a limited use zone.

Resources Required: \$K 30.00 COA Enhanced

PROJECT TITLE: MEASUREMENT OF BIOLOGICALLY AVAILABLE PHOSPHORUS - COA ENHANCED

Background: Phosphorus has been shown to control the biomass of phytoplankton in most Ontario lakes. It is recognized as the biomass-limiting nutrient in the Great Lakes and almost all management strategies proposed for these lakes are based on control of phosphorus inputs.

Of the total phosphorus entering a lake, an unknown fraction is biologically available. The portion of phosphorus that is in the true orthophosphate form is available to algae and bacteria but it is a) very difficult to measure and b) represents only a portion of the total biologically available nutrient. Thus, it is imperative that a valid measure of biologically available phosphorus (BAP) be developed. This will result in phosphorus loading lake response models that allow improved predictions of the effects of changes in phosphorus inputs. It will also permit a better assessment of the relative importance of sources of phosphorus (urban runoff, rivers, rainfall, etc.) which will indicate where control measures should be directed. Finally, an evaluation of the availability of the phosphorus remaining in the effluent of treatment plants will give some indication as to whether additional chemical treatment (eg. lowering TP from 1 mg L⁻¹ to 0.3 mg L⁻¹) will be effective.

Objectives: This project will develop and improve measurement methods for BAP using a kinetic technique that was first explored 4 years ago. Once developed, the availability of phosphorus in some samples collected in the Lake Ontario, in precipitation samples collected in the Lake Ontario watershed, and in treatment plant effluents discharging to the lake will be assessed.

Scope: The kinetic technique for measurement of BAP is still in the development stage.

Extensive laboratory work will be required to standardize the procedure. It should be possible to carry out preliminary tests for BAP within 6 months of the start of the project.

Resources Required: \$K 15.0 COA Enhanced

PROJECT TITLE: WATER INTAKE PROGRAMME - COA REGULAR

Background: Weekly sampling of nearshore water for nutrient and mineral chemistry and phytoplankton analyses have been in effect at eleven municipal water treatment plants in Ontario since 1976. Phytoplankton has been monitored at several locations for more than 10 years. The use of municipal water intakes as a sampling tool permits frequent and year-round collection of samples at little cost.

Objectives: To measure seasonal and year-to-year changes in phytoplankton and water chemistry in nearshore areas of the Great Lakes.

Scope: Sampling at three intakes in Lake Huron, one in the Detroit River, four in Lake Erie, two in Lake Ontario and two in the St. Lawrence River will continue as in past years. Chemical analyses are co-ordinated with MOE Regional laboratories in London, Toronto and Kingston. Phytoplankton analyses will be completed at the MOE Toronto laboratory or by trained treatment plant personnel.

Output: Data summarized annually; significant findings are published (MOE reports, Water Quality Board Annual Report, journals).

Resources Required: MY 2.2
\$K 57.5 COA Regular

Water Intakes (continued)

I PROJECT TITLE: WATER INTAKE PROGRAMME - EXPANSION - COA ENHANCED

Background: See description of present Intake Programme.

Objectives: See description of present Intake Programme.

Scope: Weekly samples from three additional municipal intakes, Grimsby and Cobourg in Lake Ontario and Terrace Bay in Lake Superior, are needed to adequately monitor these areas of the Great Lakes.

Output: See description of present Intake Programme.

Resources Required: \$K 12.0 COA Enhanced

PROJECT TITLE: NUTRIENT AND CONTAMINANT ASSOCIATION WITH SUSPENDED SEDIMENT - COA ENHANCED

Background: Results of recent investigations under PLUARG and other studies have shown that a significant portion of the contaminant loading to the Great Lakes from runoff, both agricultural and urban, enters in association with suspended material. This has important implications in terms of the range in transport and availability of nutrients and contaminants for uptake by biota. Additionally, the levels of many contaminants in runoff and receiving waters are below routine detection limits and can only be measured by concentrating the sample.

Objective: To support other investigations where knowledge of nutrient and contaminant inputs and availability is desirable but where normal sampling techniques cannot provide this information.

Scope: A portable continuous-flow centrifuge will be purchased for short-term installation and operation at a number of sites around the Great Lakes. Possible sites include, the St. Clair River, the Grand River mouth, the Humber and Don Rivers and Centre Creek (Nanticoke). The suspended material and, where possible, the supernatant will be analyzed for selected nutrients and contaminants. Attempts will be made to identify nutrient and contaminant forms and to determine potential availability.

Output: Study results will be interpreted as part of the young of the year fish project. Consideration will be given to a special report on the usefulness and application of this technique to other areas.

Resources Required: \$K 11.2 COA Enhanced

PROJECT TITLE: DATA ANALYSIS - COA ENHANCED

Background: In recent years the applicability and benefits of computerized analysis of Great Lakes Water Quality Data has been well demonstrated in the water quality information reporting cycle. The accrued benefits relative to previous methodologies include: 1) reduction in manpower cost relative to alternative manual compilation techniques; 2) more technically sophisticated and detailed analyses; 3) reduction in time scales for report preparation; and 4) increased access and utilization of the SIS data base. Data analysis is a constantly evolving activity wherein a variety of analytical tools are used to support the reporting cycle. These tools includes statistics, computer mapping, graphics and modelling. These activities can be grouped into two general categories: 1) production data analysis using proven analytical methodologies and software, 2) developmental data analysis including the testing and development of new techniques and software. In the past several years a large component of data analysis time has been dedicated to development with recent success in the conversion to production oriented methodologies including: 1) two-way analysis of variance for the spatial and temporal segmentation of coastal, harbour and embayment water quality characteristics, 2) application of SYMAP for computer mapping of water quality characteristics in coastal zones, embayments and harbours.

This component has been designed to ensure timely reporting of data collected under the auspices of the International Surveillance Plans.

Objectives:

- 1) to provide fiscal and resource support for computer time, software (support, development, maintenance and purchase) and enhancement to computer input/output hardware as required for data analysis support for reporting.
- 2) to provide technical support for data analysis including statistics, modelling, mapping and graphic methodologies both for production and development associated with reporting.

Scope: A wide variety of tasks are encompassed in this component including; 1) production data analysis using such tools as 2WAY-ANOVA, SYMAP, REGRESSION, SPSS, etc; 2) budget review and planning; 3) development and implementation of new statistical methodologies including a) factor analysis, b) multivariate analysis; 4) implementation of the TEKTRONIX and ASPEX interactive graphics software packages; 5) on demand case applications computer programming; 6) development and implementation of software for non-linear exponential regression analysis; 7) participation in technical meetings and report preparation for the Data Management and Interpretation Work Group of Surveillance Subcommittee; 8) development of a digital cartographic data base for the Canadian coastal zone of the Great Lakes; 9) existing analysis software maintenance, optimization and documentation; 10) maintenance and aquisition of computer input/output hardware.

Output: Tabular and graphic input to a variety of MOE reports on water quality; software documentation; seminars; and technical reports. Co-authorship of the data management interpretation work group plan for the Great Lakes Surveillance Plans.

Resources Required: \$K 30.0 COA Enhanced

PROJECT TITLE: DATA MANAGEMENT - COA REGULAR & NON-COA

Background: Data management is a fundamental component of any water quality surveillance programme with resource requirements that are just being realized. Data management pertains to those collective activities involved in the systematic editing, storage, retrieval, updating and cataloguing of data collected from the implementation of M.O.E.'s portion of the International Great Lakes Surveillance plans. Data management pertains to both non-electronic and electronic storage systems. Due to the scale of current and projected data holdings in the Great Lakes (currently estimated at greater than 150 million characters) the Province took the early initiative in 1967 in developing a computerized storage and retrieval system formerly known as the Water Quality Information System (WQIS) and the current system known as the Sample Information System (SIS).

Objectives: To provide fiscal and resource support for the maintenance, quality control, and operation of the Great Lakes component of the Sample Information System and to provide data and information retrieval services to a wide client base; including members of the international water quality surveillance community.

Scope: This is an ongoing component of the Great Lakes Programme including:

- 1) input and update of current Great Lakes Water Quality Data to the Sample Information System (SIS) (15,000 to 20,000 records/a).
- 2) editing and update of current and historical data for verification purposes.
- 3) provision of software services for the maintenance of and/or enhancements to the SIS operating system.
- 4) provision of data and information retrieval services in a variety of formats including paper hardcopy station and parameter summaries, computer output microfilm and reformatted computer tapes.

New projects anticipated to be initiated this year include:

- 1) input of historical sediment, Toronto Harbour point source, radioactivity and water intake data to the SIS
- 2) implementation of computer output microfiche station level retrieval of all historical Great Lakes water quality data from 1967 to 1978.
- 3) technical assessment of data base management software, data structures and alternatives. Review of storage/retrieval methods including systems optimization and reduction of computer costs.

Output: On demand retrievals including station and parameter summaries, computer output microfilm, and magnetic tape. As well as software and feasibility study documentation.

Resources Required: MY 1.0
\$K 25.0 NON COA
\$K 15.0 COA Regular

PROJECT TITLE: REMOTE SENSING - COA REGULAR

Background: The utility and benefits of remote sensing has been proven for a variety of cases including infrared mapping of waterborne thermal plumes from nuclear power plants. The potential use of remote sensing for mapping a variety of waterborne plume types, primarily for non-conservative substances such as turbidity and temperature, has been qualitatively explored in-house, and a great potential exists for quantitative analysis using digital computer techniques.

Objectives: The development of digital analysis techniques for remotely sensed data with particular emphasis on surveillance planning, discharge assessment and dimensional plume analyses.

Scope: This project will involve the development of digital computer software and algorithms for thermal plume analysis using digital low altitude infrared line scanner data collected from previous studies (1975-78) of thermal plumes off the Bruce Nuclear Power Development site on Lake Huron. Further study may involve plume analysis of selected digital LANDSAT data. The bulk of funding for this project is for computer time and software development. A minimal amount of airborne data acquisition is anticipated this year.

Output: A report on digital thermal plume analysis is anticipated during summer 1980. Map products will be available on an interim basis throughout the year.

Resources Required: MY 1.0
\$K 10.0 COA Regular

-66-

PROJECT TITLE: ENHANCED TRIBUTARY MONITORING - COA ENHANCED

Background: Tributary loading information is an essential component for mass balance calculations as well as providing input for modelling the phosphorus remedial measures programme in the Great Lakes Basin. The information, provided annually to the Surveillance Subcommittee, has been traditionally derived from a marginal data base.

This programme will provide improved precision for tributary input components of pollutant contributions from selected tributaries to the Great Lakes and assist in enhancing the loading allocation scheme under the 1978 Great Lakes Water Quality Agreement.

Objectives: To enhance the precision of tributary loading estimates for "major" significant tributaries by the use of an improved sampling strategy.

Scope: Stratified sampling techniques will be employed at approximately 10 downstream stations on the tributaries of major significance through the use of local contract samplers with technical backup from regular staff.

Output: Improved annual tributary loading estimates will be calculated using a computerized multi-strata loading programme with results provided annually to the Surveillance Subcommittee.

Information obtained will be used to optimize the allocation of sampling in the future.

Resources Required: \$K 50.0 COA Enhanced

PROJECT TITLE: RADIOACTIVITY MONITORING - COA REGULAR & ENHANCED

Background: There are six known locations in the Ontario coastal zone of the Great Lakes where radioactive releases exist or potentially exist. These areas by type of processing include:

- Uranium Mining - Serpent Harbour-North Channel.
- Uranium Refining - Port Hope - Lake Ontario, Port Granby Lake Ontario (ENL Dump), Welcome - Lake Ontario (ENL Dump).
- Heavy Water Reactor- Bruce Nuclear Power Development (BNPD) Lake Huron, Bruce A G.S. Lake Huron, Douglas Point G.S. - Lake Huron.
 - Pickering G.S. - Lake Ontario, Pickering A G.S. Lake Ontario, Pickering B G.S. - Lake Ontario.

Previous monitoring for the Serpent Harbour/North Channel area has indicated that ^{226}Ra levels frequently approach or exceed the Ministry criterion for public water supply (3pCi/L).

In recent years the Radioactivity Subcommittee of Water Quality Board, IJC has addressed the issue of co-ordinated surveillance of waterborne radionuclides in the Great Lakes. A proposed radioactivity surveillance plan has been prepared which is outlined in Appendix D of the 1975, 1976 and 1977 annual reports of the Subcommittee and the International Great Lakes Surveillance Plans currently being prepared by Surveillance Subcommittee. More recently the 1978 Canada-US Agreement on Great Lakes Water Quality outlines a specific objective for radioactivity based on whole body dose to man (Annex 1, 4).

Objectives: To provide surveillance information for specific radionuclides for the source control area (SCA) component of the proposed International Radioactivity Surveillance Plan for those areas of potential or existing radioactive releases in the Ontario Coastal Zone of the Great Lakes.

Scope: Radioactivity surveillance of source control areas in the Ontario Coastal Zone of the Great Lakes is an ongoing programme. This review consists of the current programme and the proposed enhanced programme. These programmes differ primarily in sample frequency and sample type. The enhanced programme for additional frequency is required primarily for the calculation of dose under the 1978 Agreement objective. The following table and budget estimates contrast the current and enhanced programme for variety of operational parameters.

A specialized study of sediment and biota in Port Hope Harbour will be conducted to determine the affect of a spill which occurred at Eldorado last winter.

	Current Programme	Enhanced Programme
No. of stations	47	52
No. of sites	6	6
No. of specific radionuclides	2 - 3	4 (min)
Sample frequency	2 to 3/a	monthly grab quarterly composite year round
Sample type	2 L grab	17 L monthly grab/stn 50 L quarterly composite/stn

Output: Radioactivity surveillance data will be compiled for dose calculations and reported in the annual report of Radioactivity Subcommittee (Appendix D) as well as being circulated within M.O.E. and M.O.L. for review.

Resources Required: MY 2.3
\$K 40.0 COA Regular
\$K (under review) COA Enhanced

PROJECT TITLE: CONTAMINANTS IN YOUNG OF THE YEAR FISH - COA REGULAR & ENHANCED

Background: Fish analyses by the Ministry and other agencies have shown unacceptable accumulations of PCB's, mirex and mercury in Great Lakes fish. These discoveries have led to restrictions on human consumption in a number of areas. The sources of some contaminants and uptake mechanisms by fish are only partially understood.

Objective: Maintain surveillance of known contaminant levels and identify specific sources of contaminant inputs by utilizing resident fish species.

Scope: Young of the year fish from the lower Great Lakes, Georgian Bay and Lake Superior will be used to aid in determining ongoing contamination sources and possible changes in contaminant uptake due to remedial work or increased contaminant loadings.

Fish will be collected from 21 sites on the lower Great Lakes and Georgian Bay to evaluate persistent contaminant loadings from selected watersheds. Costs include analytical services and a contract field crew for about six weeks.

Fish from 5-6 Lake Superior sites will be collected and analyzed on a contract basis.

In addition to satisfying the Province's own needs the programme has been developed to provide input to the International Fish Contaminant Surveillance Program.

Output: Annual summaries of the analytical results will be prepared, evaluated and periodic reports prepared on fish residue trends, as well as findings on source identification.

Resources Required: MY 1.0
\$K 15.0 COA Regular
\$K 25.0 COA Enhanced

PROJECT TITLE: ORGANIC CONTAMINANTS IN MUNICIPAL WASTEWATERS - NON-COA

Background: The available data base for PCB inputs to the Great Lakes from. Sewage Treatment Plant operations generally covers the pre-restrictive period of PCB usage. Virtually no information is available that could be related to post-restrictive waste water treatment operations.

Objective: Monitor PCB levels in selected municipal sewage effluents in order to determine present inputs to the Great Lakes.

Scope: Municipal waste waters will be collected from five major industrial centres (Windsor, Hamilton, Toronto, Oshawa, Kingston) for PCB residue analyses. The sampling will encompass two one-week periods at each site, utilizing composite effluent sampling techniques.

Output: PCB residue levels will be compared to published data for the pre-restrictive period, present loadings determined and a report prepared.

Resources Required: \$K 5.0 NON-COA

PROJECT TITLE: MASS-SPECTROSCOPY ANALYSES OF FISH FOR "NEW" CONTAMINANTS - NON COA

Background: While the existing data base is small, mass-spectroscopy analyses of St. Clair River water, industrial effluents and fish have identified several potentially dangerous compounds that are presently not considered in routine organics analyses.

Objective: Identify, quantify and evaluate persistent organic contaminant residues in fish from areas of high industrial activity. A single age group of localized species will be used to enhance spatial and temporal comparability.

Scope: While the intent of this programme is to include other collection sites, the present objective is to analyze existing fish collections from Lake St. Clair, Niagaraon-the-Lake and Toronto-Humber. Selection of chemicals tested will be based largely on EPS Priority Listing of Toxic Chemicals.

Output: Annual summaries will be prepared, results evaluated and reports prepared at suitable intervals.

Resources Required: \$K 22.0 NON-COA

PROJECT TITLE: CONTAMINANTS IN SPORT AND COMMERCIAL FISH - COA PARTIALLY FUNDED

Background: Since the late 1960's the Ontario Government has been monitoring fish from Ontario watercourses.

In July 1977, the Ontario Government compiled and published comprehensive information on lakes monitored since the programme began.

Fish collections are continuing and data on fish species from many lakes are available in reports entitled "Guide to Eating Ontario Sport Fish".

Objectives: Maintain surveillance of known contaminant levels and identify sources of contaminants inputs by utilizing resident fish species.

Scope: Fish collection and testing is a joint program of the Ministries of Environment and Natural Resources. Fish will be collected from sites on the Ontario shoreline of the Great Lakes and Ontario's inland waters. Whenever possible the collection includes 15 to 30 fish of each species representative of the size range from the lake being tested. Length, weight and sex are recorded.

Output: Environmental Health Bulletins are issued on a monthly basis. Annual publication of the "Guide to Eating Ontario Sport Fish" will continue.

Resources Required: MY 2.8
\$K 70.0 COA Partial Funding

PROJECT TITLE: DREDGING AND SPOILS DISPOSAL - COA ENHANCED

Background: Concern for environmental effects of the disposal of contaminated dredged spoils in open water caused Ontario and other Great Lakes jurisdictions to require careful selection of disposal sites and in many cases to require contained disposal. Because of the much higher costs involved in developing and operating a contained disposal area, and because such sites are often not immune to their own set of adverse environmental effects, support is growing among dredging proponents and others for a reanalysis of costs/benefits of contained vs. open-water disposal.

Research by the U.S. Corps of Engineers has suggested that the effects of open-water dumping may not be as great as earlier thought. However, much of this earlier work, is not directly applicable to the Great Lakes environment.

Objectives: To provide the basis for the Ontario position on continuation or modification of its contained disposal requirements through *in-situ* investigation of a limited number of both open-water and contained disposal operations.

Scope: *In-situ* investigations on the effects of suspended and settleable solids, nutrients and contaminants on water quality and phytoplankton.

In-situ investigations will include the assessment of the impact of spoils disposal on water chemistry, light transmission, phytoplankton, sediment chemistry and benthos. An attempt will be made to determine the cause of observed detrimental effects (i.e., whether they relate to physical mechanisms such as screening or blanketing, or to the presence of dissolved contaminants or nutrients). Study locations will be determined upon receiving public and private dredging proposals for 1979.

Output: A single report synthesizing the findings at the various sites under investigation and recommending any changes to existing Ministry policy and guidelines for dredged spoils disposal as may be warranted.

Resources Required: \$K 15.0 COA Enhanced

PROJECT TITLE: REQUESTS FOR INFORMATION - COA REGULAR

Background: The need for information on the suitability of Great Lakes waters for municipal and industrial water supply, recreation and fishing etc., and growing concern for pollution problems has resulted in an extraordinary number of requests for data, information and advice. Requests come from the public, industry, consultants and other government departments.

Objectives: To meet the information needs of the requester in an efficient and timely manner.

Scope: It is anticipated that some 300 plus requests will be received in 1979/80 and that these will be dealt with using existing data and information.

Resources Required: MY 1.5
\$K 17.0 COA Regular

PROJECT TITLE: I.J.C. SUPPORT - COA REGULAR

Background: The Canada/Ontario Agreement commits the Ministry to providing continuing scientific and technical staff support to the International Joint Commission and its advisory boards and committees.

Objectives: To fulfill commitments made under C.O.A.

Scope: Ministry staff employed in the Great Lakes Programme will sit on, and/or provide scientific, technical, secretarial and clerical support to, the following:

Water Quality Board
 Science Advisory Board
 Surveillance Subcommittee
 Lake Work Groups
 Data Interpretation and Management Work Group

Activities include preparation of the International Surveillance Plan, writing the WQB Annual Report and computing special assignments requested by the I.J.C. or by the boards.

Resources Required: MY 3.0
 \$K 90.0 COA Regular

COA REGULAR PROGRAMME

SUMMARY

Project	Manpower		Budget (x10 ³ \$)
	Regular	Casual	
Thunder Bay	3	1.0	60
St. Marys River	1	0.5	26
Serpent River	1	0.5	26
Penetang-Midland	1	--	21.5
St. Clair River	1	--	20
Lake Erie Nearshore	9	3	335
Lake Erie Embayments	2	1.5	50
Niagara River	1	0.5	30
Hamilton Harbour	4	1.0	150
Lake Ontario	8	2.5	280
Toronto Harbour	4	1.5	150
Pickering-Duffin	2	1.0	40
Cornwall	2	0.5	40
O ₂ Depletion in			
Eastern Lake Ontario	1	0.5	30
Bay of Quinte	2	--	50
Radioactivity	2	0.3	40
Remote Sensing	1	--	10
Water Intake Program	2.2		57.5
Fish Contaminant	2.8	--	70
Contaminant in the			
Young-of-the-Year Fish	1.0	--	15
IJC Support	3.0	--	90
Data Management	1.0	--	15
Request for Information	1.0	0.5	17
	56.0	14.8	1623.0

