ANNUAL REPORT
1981
INLAND WATERS DIRECTORATE
ONTARIO REGION

DEPARTMENT OF THE ENVIRONMENT

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Ontario Region

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DEPARTMENT OF THE ENVIRONMENT

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Summary

This report describes the activities and accomplishments of Inland Waters Directorate (IWD), Ontario Region during 1981. IWD, Ontario Region is a component of the federal Department of the Environment. As the lead federal agency for water management in the Ontario Region, IWD plans and participates in national and international water management programs to achieve economic and social benefits, while giving full consideration to environmental concerns.

Major accomplishments of IWD in Great Lakes matters included the presentation of the Lake Erie Regulation Study Report to the International Joint Commission, the successful completion of the first year of a two year intensive water quality study of Lake Ontario and the release of the "Environmental Baseline Report of the Niagara River - November 1981".

In the Flood Damage Reduction Program the final report of the Sturgeon River/Lake Nipissing/French River Study was officially released jointly by the provincial and federal Ministers in November, 1981. The important recommendation of the study and one which will be implemented in the spring of 1982, was the creation of a Watershed Advisory Board, responsible to the Ontario Ministry of Natural Resources.

April 1, 1981 marked the beginning of the seventh year of the Canada-Ontario Cost Share Agreement on Water Quantity Surveys. Under this Agreement IWD though its Water Resources Branch co-operates with provincial agencies in collecting and publishing streamflow, water level and sediment data on a shared cost basis.

A report entitled "Great Lakes Shore Management Guide" was completed in co-operation with Ontario Ministry of Natural Resources and the Department of Fisheries and Oceans. This guide was prepared to assist in the development of shore management plans aimed at reducing flooding and erosion damage, encouraging economic and social utilization of the shore zone and minimizing adverse environmental effects.

A preliminary integrated baseline study report on the Oshawa Second Marsh was completed in October 1981. The baseline study is designed to help in the evaluation of potentially adverse effects on the Marsh from developmental pressures such as the Oshawa Harbour Expansion.

In 1981 IWD, Ontario Region administered and managed resources amounting to 6.4 million dollars and 110.5 person years. The resources included operational funding under international and federal-provincial agreements as well as grants and contributions under similar agreements. Significant federal-provincial cost-shared funding administered in

Résumé

Le présent rapport décrit les activités et réalisations de la Région de l'Ontario de la Direction générale des eaux intérieures (DGEI) en 1981. Cette Dernière fait partie du ministère fédéral de l'Environnement; à titre d'organisme fédéral principal de gestion des eaux dans la Région de l'Ontario, la DGEI planifie des programmes nationaux et internationaux en la matière et y participe à des fins économiques et sociales sans négliger les questions environnementales.

Les principales réalisations de la DGEI en ce qui touche les Grands Lacs comprennent notamment le dépôt à la Commission mixte internationale du rapport d'étude sur la régularisation du lac Erié, une première année couronnée de succès sur les deux prévues pour l'étude intensive de la qualité de l'eau du lac Ontario et la publication du rapport "Environmental Baseline Report of the Niagara River- November 1981 (rapport environnental de base sur le Niagara -Novembre 1981).

En novembre 1981, en vertu du Programme de réduction des dommages dus aux inondations, les ministres provinciaux et fédéral ont publié conjointement et officiellement le rapport définitif de l'étude sur la riviére Sturgeon, le lac Nipissing et la rivière des Français. La constitution d'un comité consultatif du bassin hydrographique relevant du ministère des Richesses naturelles de l'Ontario constitue la proposition vraiment importante de l'étude et on y donnera suite au printemps de 1982.

Le 1er avril 1981 a marqué le septième anniversaire de l'Accord Canada-Ontario relatif aux relevés de la quantité d'eau. En vertu de cet accord, la DGEI, par l'intermédiaire de sa Direction des ressources hydrauliques et en collaboration avec des organismes provinciaux, recueille et publie des données sur l'écoulement, le niveau d'eau et les sédiments, selon le principe du partage des frais.

En collaboration avec le ministère des Richesses naturelles de l'Ontario et celui des Pêches et Océans, on a terminé un rapport intitulé "Great Lakes Shore Management Guide" (guide de gestion des rives des Grands Lacs). On a rédigé ce Guide pour faciliter l'élaboration de plans de gestion des rives visant à réduire les dommages dus aux inondations et à l'érosion, à encourager l'utilisation du rivage à des fins économiques et sociales et à réduire au minimum les effets environnementaux défavorables.

On a terminé en octobre 1981 le rapport préliminaire de l'étude de base intégrée sur le deuxième marais d'Oshawa. L'étude de base est conçue pour faciliter l'évaluation des effets d'ouvrages, telle l'expansion du port d'Oshawa, éventuellement préjudiciables au marais.

1981 included the Canada-Ontario Great Lakes Water Quality Agreement funding ($1,200,000) and the Canada-Ontario Flood Damage Reduction Agreement funding ($910,00 allocated for 1981-82).

A listing of 1981 publications and presentations by staff of IWD, Ontario Region is included in the report.

A French translation of this Annual Report is available upon request.

En 1981, la Région de l'Ontario de la DGEI a administré des ressources s'élevant à 6,4 millions de dollars et à 110,5 années-personnes. Ces ressources comprenaient des fonds d'exploitation prévus par des ententes internationales et fédéro-provinciales ainsi que des subventions et contributions prévues par des ententes semblables. Parmi les fonds fédéro-provinciaux importants affectés à des programmes à frais partagés et administrés en 1981, mentionnons ceux de l'Accord relatif à la qualité des eaux dan les Grands Lacs (1 200 000 $) et ceux de l'accord canado-ontarien de réduction des dommages dus aux inondations (910 000 $ en 1981-1982).

Une liste des publications de 1981 et des exposés faits par le personnel de la Région de l'Ontario de la DGEI est jointe au rapport.

La traduction française du rapport annuel est disponible sur demande.

1.0 INTRODUCTION

Inland Waters Directorate (IWD), Ontario Region, is a component of the federal Department of the Environment (DOE). As the lead federal agency for water management in the Ontario Region, IWD plans and participates in national and international water management programs to achieve economic and social benefits, while giving full consideration to environmental concerns.

The primary role of IWD, Ontario Region is related to the gathering and dissemination of water related information and to the explaining and predicting of the behaviour of the quantity and quality of the waters in Ontario with particular emphasis on the Great Lakes and their interconnecting channels. IWD plays a major role in water use planning and management investigations including flood damage reduction programs in cooperation with the province, and in addressing international water management problems along the Canada-United States boundary. In addition, IWD has a research role in relating water management policies and programs to social needs and issues.

The Directorate consists of three Branches: Water Planning and Management Branch; Water Resources Branch and Water Quality Branch.

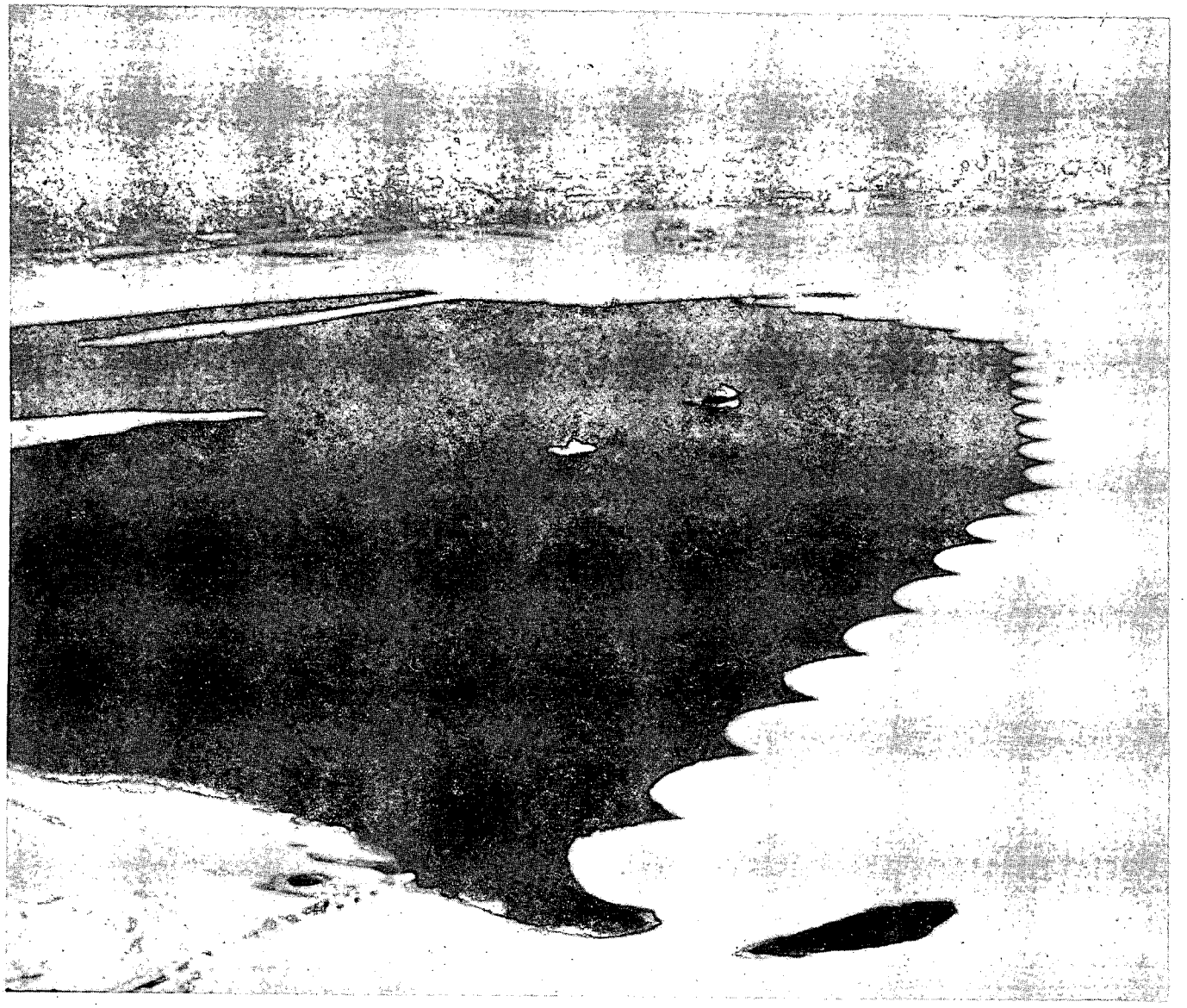
The Water Planning and Management Branch (WP&MB) administers and implements federal, federal-provincial, and international water management projects. The Branch provides technical support to all the International Joint Commission's (IJC) Great Lakes Boards of Control; carries out special studies for IJC Study Boards such as the recently completed Lake Erie Regulation and Great Lakes Diversions and Consumptive Uses Studies; implements federal-provincial water management projects under the Canada Water Act (CWA) relating to flood damage reduction, flood control, and shoreland management; reviews federally-initiated and federally-funded projects for environmental impact under the Environmental Assessment and Review Process; gathers and evaluates social and institutional information and researches the socio-economic implications of resource policies and programs.

The Water Resources Branch (WRB) operates and maintains a network of streamflow, water level, and sediment stations throughout Ontario and the Great Lakes systems jointly funded with the Province; publishes annual summaries of the data collected; and provides more detailed surface water and sediment information and technical advice for specific projects and programs in the region such as special requests from various IJC Boards of Control, baseline studies and environmental assessments.

The Water Quality Branch (WQB) carries out monitoring and surveillance activities in Ontario with particular emphasis on the Great Lakes and interconnecting channels. It maintains an analytical chemistry laboratory in support of the Directorate and of components of the Department of Environment and the Department of Fisheries and Oceans (DFO) in the region.

The following is a description of the major program activities and achievements of the Directorate during 1981.

2.0 Great Lakes and St. Lawrence River Basin Water Level Control Program



Lake Erie-Niagara River Ice Boom

Human activities and the ecosystem in the Great Lakes-St. Lawrence basin are affected significantly by water level fluctuations in the lakes and their interconnecting channels. The fluctuations of these levels and channel flows have been recognized by the Governments of Canada and the United States as an important boundary water issue, affecting shore erosion, hydro-electric power generation, navigation, recreation and water supply for domestic and industrial pur poses. The International Joint Commission was established in 1909 by the two governments to seek common solutions in their joint interest and in accordance with the agreed rules or principles set out in the Boundary Waters Treaty. This has since led to several international agreements relating to the levels and flows in the Great Lakes-St. Lawrence Basin.

The Inland Waters Directorate, Ontario Region, provides assistance and advice to the IJC and other bilateral entities in carrying out the terms of the various agreements between the two countries.

2.1 Great Lakes Boards of Control

The Water Planning and Management Branch continued to support the IJC's Lake Superior Board and St. Lawrence Board in regulating the outflows of Lake Superior and Lake Ontario. Throughout the year the Branch reviewed the various hydrologic factors which influence the regulation of Lake Superior and Lake Ontario and provided advice in their regulation. The Branch also supported the IJC's Niagara Board in water level control activities in the Lake Erie-Niagara River area. The significance of IWD's involvement is demonstrated by the fact that IWD provides the chairmen to two of the these IJC Boards and chairmen to two of the Boards' Working Committees in addition to Regulation Representatives, Secretaries and other technical support.

The water level of Lake Superior was slightly below normal in early 1981 and rose to slightly above normal during the early spring because of an early spring run-off in the Lake Superior basin. Following snowmelt, below normal precipitation resulted in below normal levels for the remainder of the year. Branch personnel continued to monitor the construction of the new Great Lakes Power Company power plant at Sault Ste. Marie. This monitoring included a water quality monitoring program. Advice to the Superior Board on Lake Superior outflows was formulated by taking into account the closure of the Great Lakes Power Company canal from October 1981 through June 1982. During 1981 the Superior Board monitored a testing program for determining the structural stability of the Canadian portion of the Compensating Works at the head of the St. Marys Rapids and reviewed a report on this subject. This report, and a similar report for the U.S. portion of the works, is under review by an international ad hoc technical committee formed by the Board. The Board has held discussions with the fisheries and power interests concerning proposals to reduce the frequency of adverse (for fisheries) flow conditions in the St. Marys Rapids.

The water level of Lake Ontario was near normal in early 1981. Following an early spring freshet the level rose to above normal. The level was below normal later in the spring and remained below normal until August. Greater than normal precipitation from August to October combined with above normal flows from the upper lakes resulted in above normal levels in the lake from August to the end of the year.

At the request of the IJC the Board reviewed a submission to the IJC from the St. Regis Band of Mohawk Indians concerning alleged effects of the International St. Lawrence Power and Navigation Project on their lands.

Lakes Michigan, Huron and Erie remained above their respective long-term means throughout 1981. The Water Planning and Management Branch provided technical support to the IJC's Niagara Board regarding water level control activities in the Lake Erie-Niagara River area. Commencing on April 1, 1981, a revised stage-discharge relationship was used to determine the flow over Niagara Falls. The new relationship is based on current meter measurement taken during 1973-78 and extensive study conducted by the Niagara Board. The use of this new relationship is expected to bring about hydro-electric power benefits of some 260 Giga-watt-hours annually or almost $10 million (in 1980 dollars) to the two countries. In November 1981, with the Governments' permission, the flows over Niagara Falls were reduced to those below Treaty requirements for the first time, to facilitate current-meter measurements. The purpose of these measurements was to verify the stage-discharge relationship at lower flow ranges.

The Branch also monitored the operation of the Lake Erie-Niagara River ice boom and carried out related studies. Advice was provided to the IJC which issues the regulations governing the installation and removal of the ice boom. Branch personnel also monitored land-fill activities in the Niagara River. Advice on landfill operations was provided not only to the IJC, but also to other federal and provincial agencies. Since landfilling in the Niagara River could affect the levels and flows of boundary waters, the Branch is working closely with IWD, Ottawa and other agencies with the aim of providing effective federal legislation to control the landfill operations. By year-end the Branch had developed a draft plan to study the impact of landfills.

The Water Planning and Management Branch assisted the International Niagara Committee, established by the Governments of Canada and the United States pursuant to the Niagara Treaty of 1950, in determining the amounts of water available and the amounts used for the various purposes of the Treaty.

2.2 Investigative - Engineering Boards

In May 1977, the IJC, at the request of the Governments of Canada and the United States established:

(a) the International Lake Erie Regulation Study Board to determine the possibilities for limited regulation of Lake Erie;

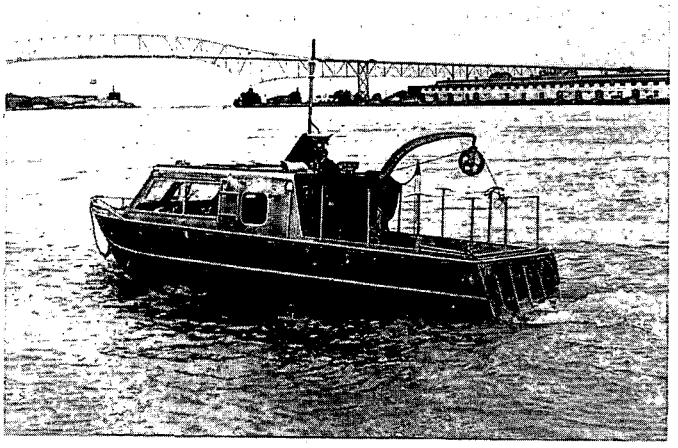
(b) The International Great Lakes Diversions and Consumptive Uses Study Board to examine the effects of existing and proposed diversions and consumptive uses on Great Lakes water levels and flows.

In early 1980, the IJC also established the International Great Lakes Technical Information Network Board to examine, provide advice and recommendations on unmet hydraulic, hydrologic and meteorological data needs in order to improve the data collection network in the Great Lakes region. The Water Planning and Management Branch and its headquarters in Ottawa, provided extensive support to these three Boards.

After 4 years of extensive study, the Lake Erie Board submitted its final report to the IJC in November 1981. The Board concluded that limited regulation of Lake Erie would not be economically feasible and that reduction in shoreline flood and erosion damage can best be achieved by proper coastal zone management and a better understanding by the public of the various factors causing lake level fluctuation. The Board's report was released by the IJC to the public in December, 1981. Public hearings on the Board's study findings are expected in 1982. The Diversions and Consumptive Uses Board also submitted its final report to the IJC, recommending against any means of manipulating the major Great Lakes diversions for regulation purposes. The Board also recommended that all diversions and consumptive uses be monitored and their impact studied.

During 1981, the Technical Information Network Board established Hydrologic, Hydraulic and Systems Evaluation Committees to assist in its study. All committees are at work and the Board is planning its principal report on the existing networks by December 1982.

2.3 Great Lakes and Interconnecting Channels Water Levels Monitoring



Measuring the discharge of the St. Clair River at Sarnia using the Moving Boat Technique

In co-operation with the Canadian Hydrographic Service, the Water Resources Branch operates 34 water level gauging stations on the Great Lakes and St. Lawrence River for navigation and water management purposes. Many of the stations are equipped with data acquisition and telemetry systems that provide data on a real-time basis. During the year, considerable progress was made between the agencies in formalizing an arrangement for the future operation of the network and the publishing of water level data. A draft Memorandum of Understanding between DOE and DFO was prepared and it is expected that it will be finalized and implemented by April, 1982.

Staff from the Water Resources Branch continued to provide technical support to the International Great Lakes Technical Information Network Board and the International Niagara Board of Control and their committees and working groups. In co-operation with the U.S. Corps of Engineers, 18 discharge measurements were taken to further verify the lower end of the rating curve for the Ashland Avenue Gauge on the Niagara River. The measurements further confirmed the newly adopted stage-discharge relationship which is used to regulate flows over the Falls as required by the Niagara River Treaty signed by Canada and United States in 1950.

A survey was conducted on the lower Niagara River to determine stream velocities and direction of flow at various depths and cross sections. Newly developed equipment, used in the moving boat method for measuring stream discharges, and staff were provided by Water Resources Branch Headquarters. The equipment performed up to expectations and produced results that will be used to design water quality sampling programs and to assess the potential for transboundary pollution.

Moving boat discharge measurements, using automated equipment, were carried out on the St. Clair River at Sarnia by Water Resources Branch Headquarters and Regional staff. Measurements were also taken by the United States Geological Survey, using the same method, and by the U.S. Army Corps of Engineers, using a modified conventional technique. The measurement program was undertaken to calibrate two current meters installed by the Great Lakes Environmental Research Laboratory, U.S. National Oceanic and Atmospheric Administration. The meters will be used as a flow index on the St. Clair River to gain a better knowledge of winter flow regimes in order to calibrate and verify mathematical flow models during ice conditions. The survey presented an excellent opportunity for equipment demonstration and comparison of results among the agencies using different techniques and equipment.

3.0 Great Lakes Basin Water Pollution Program

The Great Lakes represent 80 percent of North America's supply of surface freshwater. They sustain life, commerce, industry, and recreation for an estimated 7 million Canadians and 30 million Americans. One out of every three Canadians live in the basin and one-half of all manufactured goods of the country are generated there. The major urban centres of the basin are situated adjacent to the Great Lakes and rely on them for a ready source of water for domestic and industrial use and as assimilators of their wastes. The Great Lakes are thus a priceless resource of vital importance to all facets of life and activity in the Great Lakes basin. The quality of their waters is a basic concern to Canada in general and the Ontario Region in particular.

On April 15, 1972, the Canadian and U.S. governments signed the Great Lakes Water Quality Agreement which formalized the intent on behalf of both countries to prevent further deterioration of the Great Lakes and provided the basis for improving existing water quality. This intent was reaffirmed by the signing of a new agreement on November 22, 1978. The new Great Lakes Water Quality Agreement emphasizes control of pollution from toxic substances and the control and prevention of pollution from industrial sources. Numerical water quality objectives for some 40 substances have been specified in the new Agreement. The IJC has been given the responsibility to overview the progress of the two governments in the implementation of the Agreement. Inland Waters Directorate, Ontario Region provides extensive membership and scientific support to the Boards and Committees assisting the IJC in its responsibilities under the Agreement. Inland Waters Directorate activities related to the Agreement include:

(a) the defining and continual refining of water quality objectives;
(b) providing advice on the effectiveness of control policies and measures;
(c) monitoring and surveillance of pollution loadings to the lakes, conditions in the lakes, and lake-related activities to ensure the water quality objectives are being met and to determine the effectiveness of remedial measures; and
(d) identifying new and emerging pollution problems.

Within Canada, the Governments of Canada and Ontario signed the Canada-Ontario Agreement on Great Lakes Water Quality (COA) in 1971 which was extended in 1976 for a further five years. This Agreement provides the instrument for the cooperation of the two jurisdictions in clean-up efforts in the Great Lakes and for Ontario's coordination and cooperation with government agencies in the United States. The Canada-Ontario Agreement also provides for the cost-sharing of provincial surveillance activities on a 50-50 basis. In the 1980-81 fiscal year Canada's share of surveillance costs under the Canada-Ontario Agreement amounted to $1,200,000. The Director of IWD, Ontario Region is a member of the Review Board which is responsible for overseeing the implementation of the COA.

In recognition of the added responsibilities for Canada under the 1978 Canada-U.S. Agreement, Canada and Ontario initiated the renegotiation of the Canada-Ontario Agreement in 1979. The revised Canada-Ontario Agreement which will reflect the new requirements of the 1978 Canada-U.S. Agreement should be completed in 1982.

3.1 IJC Water Quality Board

Inland Waters Directorate continued to provide extensive support to the IJC Water Quality Board and its committees. Staff of IWD, Ontario Region serve on the Board, the Board's Water Quality Programs Committee and Surveillance Work Group. IWD, Ontario Region personnel were also extensively involved in the preparation of the Water Quality Board's Annual Report for 1981 which was presented to the IJC at its November, 1981 meeting with the Board in Cleveland, Ohio.

3.2 Canada-U.S. Open Lake Surveillance and Analysis

The Water Quality Branch carried out the first year of a two year intensive surveillance project on Lake Ontario during 1981. This project will provide a detailed assessment of water quality in Lake Ontario, as part of the IJC Great Lakes International Surveillance Plan.

Eleven water quality surveillance cruises were carried out in the period March-December, 1981, by the Canadian research ship CSS Limnos. The Water Quality Branch provided shipboard analytical support for four cruises and carried out the shore labs analysis for all eleven cruises. 1506 samples were analyzed on board ship by WQB and another, 5684 were brought back to the Branch's main laboratory in Burlington where, additional tests were performed.

3.3 Interconnecting Channels Water Quality

Water quality monitoring continued in the Niagara and St. Lawrence Rivers. Automatic water samplers at Niagara-on-the-Lake and Wolfe Island collected daily water samples to determine chemical loadings into and out of Lake Ontario. These loading estimates are provided annually to the IJC for inclusion in its Great Lakes Water Quality reports. The weekly sampling of suspended sediments for toxic contaminants at the Niagara-on-the-Lake site was continued. The first report summarizing these results to the end of 1979 was published.

A special survey of the Upper and Lower Niagara River was undertaken during the year. Samples of water, bottom sediments and suspended sediments were collected at 30 locations in the river during May, July and early November, in order to determine differences in contaminant concentrations between the upper and lower reaches of the river. The samples will be analyzed for PCB's, organochlorine pesticides, chlorobenzenes, phthalates, polynuclear aromatic hydrocarbons (PAH's), some trace metals and dioxins.

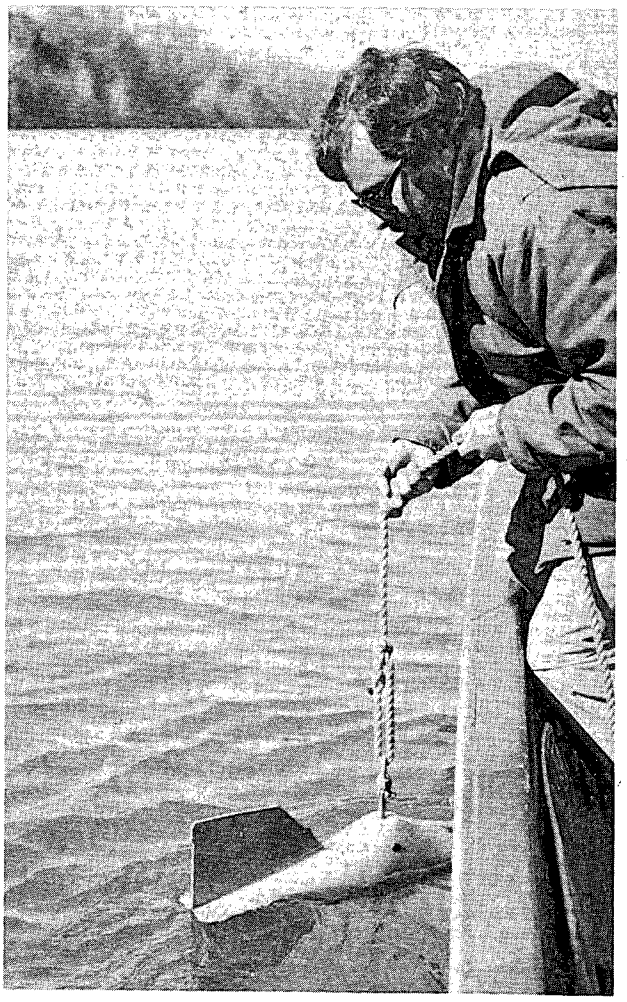
A similar survey was carried out on the St. Lawrence River in June. Fifteen locations were sampled between Wolfe Island and Cornwall. Here also, bottom sediments, suspended sediments and water samples were collected. The samples well be analyzed for the same parameters as in the Niagara River Survey.

3.4 Niagara River Toxic Contaminants

As part of its continuing commitment to the problem of toxic contaminants in the Niagara River, the Directorate provided a major contribution to a report entitled "Environmental Baseline Report of the Niagara River - November 1981 Update". The report, prepared for the Canada-Ontario Review Board, provides an update of water quality conditions in the Niagara River with respect to toxic contaminants, in the period 1980-1981.

A special two day survey was conducted in June to monitor the effects of the discharge of one of the holding ponds of SCA, an American industrial waste firm on the Niagara River. Results received to date indicate the discharge has produced no measurable adverse effect on the water quality of the river.

A Niagara River Toxics Workshop was held at the Canada Centre for Inland Waters on February 4, 1981. The purpose of the workshop was to exchange information and establish communication links among Canadian scientists working on toxics projects in the Niagara River area. Both federal and provincial scientists attended the workshop including representatives



Sampling for suspended sediment in the Niagara River

from National Water Research Institute, IWD/OR, Department of Fisheries and Oceans and Ontario Ministry of the Environment.

The bilateral Niagara River Toxics Committee, formed to coordinate Canadian and U.S. monitoring activities in the Niagara River, functioned well during the year. Detailed activity plans for the 1982 sampling year were coordinated, and through the efforts of this committee some new efforts were initiated by American agencies.

On July 17, 1981, a briefing on Canadian and U.S. activities in the Niagara River areas was presented to Senator Daley of New York and Commissioner Flack of the New York Department of Environmental Conservation (NYDEC) by the Co-chairmen of the Niagara River Toxics Committee. A number of Canadian MP's and MLA's attended the briefing which was held at the Buffalo offices of the NYDEC. The briefing was held at the request of the Senator and Commissioner.

A two-day Canada-U.S. meeting on the Niagara River contaminants problem was arranged by the

Department of External Affairs and took place July 21-22, 1981. The first day of the meeting took place in Washington, D.C. and focussed on the tentative agreement between the U.S. EPA and Hooker Chemical on the management of Hooker Chemical's Hyde Park Dump site. The general Niagara River contaminants issue was also discussed. The Director, IWD, Ontario Region in his role as Co-chairman of the Niagara River Toxics Committee presented the major findings of the Canadian Update Report on the Niagara River and reviewed the current ongoing Canadian program. The second day of the meeting was held in Buffalo and consisted of a tour of the Hyde Park Dump site, the Niagara Falls wastewater treatment plant, Love Canal, the Hooker "S" site and the 102nd Street Dump site.

3.5 Atmospheric Loadings

Inland Waters Directorate continued to fulfill its commitment to measure and report on atmospheric loadings to the Great Lakes as part of the IJC Great Lakes International Surveillance Plan, by maintaining its network of 15 precipitation chemistry stations on the Canadian side of the basin. This year, the sampling equipment at all stations was upgraded and standardized. Work was also initiated on the evaluation of a precipitation sampler capable of collecting representative samples for organic contaminants in a network type operation.

3.6 Stratford-Avon River Environmental Management

The Stratford-Avon River Environmental Management Project (SAREMP) was undertaken by Water Planning and Management Branch as an intensive water quality management demonstration project. The Avon River watershed was identified in earlier studies as having severe water quality problems as a result of both urban and rural inputs.

As part of this project, a study was designed to compare the relative importance of the three major sources of phosphorus (sewage treatment plant, urban storm runoff and agricultural runoff) for Biological Available Phosphorus (BAP). The BAP study was an extension of traditional water quality monitoring and should help to identify cost-effective phosphorus control strategies.

Sampling began in the spring of 1981 and is continuing through the spring of 1982. Routine sample collections were taken as well as storm and spring melt samples. Continuous flow centrifuges were used to collect suspended solids for chemical fractionations and biossays in order to determine BAP. The results of the one year study will be published in FY 82/83 upon completion of laboratory analyses.

3.7 Analytical Laboratory Support

The Water Quality Branch analytical laboratory provided analytical support to over 95 studies and projects relating to programs of the Department of the Environment, and other federal agencies.

A total of 25,500 samples consisting of water, precipitation, sediments, fish and other aquatic biota were analyzed for over 240,000 tests.

The staff of the Ship Support Laboratory participated in 4 full chemistry and 7 regular surveillance cruises on Lake Ontario, performing shipboard analysis on 1506 samples. In addition 5684 samples were analyzed in the main shore laboratory for a total of over 37,000 tests.

During the year the following analytical methods evaluation and adaptation work was carried out: (a) the application of ion chromatography, (b) automated titroprocessor for the analysis of precipitation samples, (c) capillary gas chromatography for improving the analysis of ultra trace organics, and (d) the inductively coupled plasma spectrometer for the determination of toxic trace metals. This work has added significantly to the overall laboratory analytical capability.

3.8 International and Interprovincial Rivers

The first results from the Ottawa River study were reported by WQB this year in a IWD Scientific Series report entitled "Ottawa River Water Quality, National Capital Region 1978". Regional Staff made a major contribution to the Federal Provincial Task Force charged with developing a monitoring proposal for the Ottawa River. The final report of the Task Force entitled "Monitoring Plan for the Ottawa River" was completed in September, 1981.

Water Quality Branch staff provide technical advice to the International Rainy River Pollution Control Board and, as part of its support to the Board, maintains a network of 4 sampling stations in Northwestern Ontario. Two stations are located on the Rainy River, one on the English River and one on the Winnipeg River. Water samples are collected every two weeks from these locations and are analyzed for major ions, nutrients and metals. Special samples were collected monthly between May to October. They will be analyzed for organochlorine pesticides and PCB's.

4.0 Great Lakes Shoreland Management and Damage Reduction Program

The high water levels and accompanying storms which occurred in the Great Lakes in 1972-73 caused considerable flood and erosion damage along much of the lower Great Lakes shoreland. Canada and Ontario carried out a major survey of the shoreland in 1972-73 to assess the nature and extent of this damage and to recommend remedial measures. The resulting Technical Report of the Canada-Ontario Great Lakes Shore Damage Survey, released in 1976, contained a number of recommendations for follow-up programs including: establishment of a public awareness program to better inform the public of the risks of building near the shore; establishment of a program to identify hazardous areas; and the development of shoreline management strategies to reduce future damages through land-use controls, land acquisition, and, where warranted, effective shore protection.

Following the release of that report, Canada and Ontario established a Task Force to implement these recommendations under a joint Canada/Ontario Agreement. WP&MB, along with the Department of Fisheries and Oceans and the Ontario Ministry of Natural Resources, provide the membership of this Task Force which has been carrying out these follow-up programs. Canada Water Act funds were provided through IWD for these activities over a five year period. With the termination of this Canada/Ontario Agreement on March 31, 1981, CWA funds were withdrawn from the program.

4.1 Public Awareness of Great Lakes Shoreland Hazards

Inland Waters Directorate provided funds and technical support to a public awareness program designed to increase awareness of the problems and hazards of living in the shore zone. In previous years, a number of brochures have been prepared on the many aspects of this subject. During the year, a number of these brochures were distributed to the public and reprints of one brochure were obtained.

Presentations utilizing information and slide-tape shows prepared for this program were made at one conference and one workshop during the year.

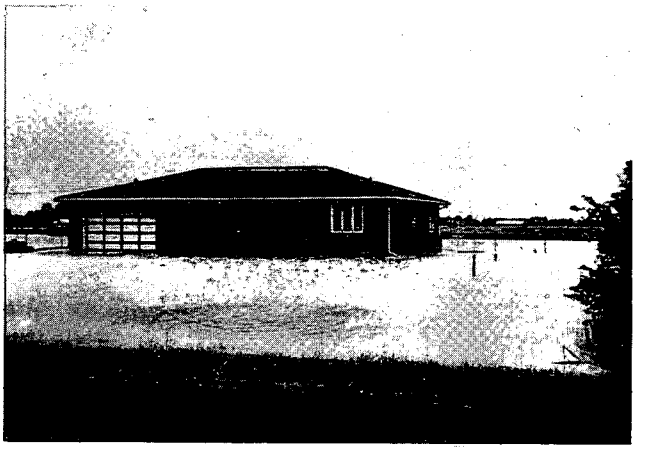
4.2 Great Lakes Shoreland Erosion Monitoring

Data collected with the assistance of CWA funding during previous years was analyzed by the Department of Fisheries and Oceans. A draft of the final report on the shore erosion data collected and the findings of the program has been prepared by DFO. It is expected that the final report will be printed in the first quarter of 1982, which will complete this portion of the program.

4.3 Great Lakes Shore Management Study

The objective of this study was to develop methodolgies that can be used in the preparation of Great Lakes shore management plans and strategies. These methodologies have been incorporated in a report entitled "Great Lakes Shore Management Guide". The completion and printing of this report in late 1981 concluded this portion of the program.

5.0 Flood Damage Reduction Program



Flooding in the Essex region, 1981

The federal government is committed to alleviating human suffering and minimizing damage caused by floods through strategies such as identifying high flood-risk areas, discouraging new investments in these areas, and participating in traditional flood reduction measures where these offer the best solution.

The Inland Waters Directorate, through its Water Planning and Management Branch, is involved with the Province of Ontario in a program to reduce flood damages. The Department, on behalf of the federal government, signed an Agreement with the Province of Ontario on March 31, 1978, to provide funding for flood damage reduction measures including the mapping of flood risk areas. The agreement is retroactive to April 1, 1977 and if revised as proposed will run until March 31, 1990. Costs are shared equally with a total cost for the program of $9.2 million. Of this amount, $8 million is to be spent on flood risk mapping and $1.2 million is for other measures. The total expenditure

under the program as of March 31, 1981 was $2,850,721; the federal share being $1,425,362. Projected expenditure for the fiscal year 1981-82 is $1.6 million.

In accordance with the Agreement, the program is administered by a Steering Committee, which includes representatives from IWD, Ontario Region and Headquarters. Technical aspects of the program are carried out by a Technical Subcommittee, which is supported by Water Planning and Management Branch.

5.1 Flood Risk Mapping

The mapping of the flood-risk areas is the primary activity undertaken by the Program. The majority of mapping studies are implemented through the local Conservation Authorities and organized municipalities. In 1981, projects were in progress in 17 Conservation Authorities, as well as several municipalities where no organized conservation authority exists.

Upon completion of flood risk mapping, the Ministers of Environment and Ontario Natural Resources sign the maps for designation. The policies of the Agreement come into effect upon designation. These policies include limitations on;

1) placing of federal or provincial government buildings or structures in the flood risk area;
2) funding from government sources for new buildings or structures placed in the flood risk area and subject to flood damage and;
3) eligiblity for flood disaster assistance of buildings or structures placed in the flood risk area after designation and are vulnerable to flood damage.

As well the two governments will encourage local municipalities to adopt Official Plan Policies and zoning restrictions on development in the flood risk area.

Flood risk maps for water courses within the Metropolitan Toronto and Region Conservation Authority may be the first to be designated under the Agreement. Public information Maps at a scale of 1:25,000 have been prepared and designation is scheduled for June 1982. Several additional designations are anticipated in the coming year.

An additional component of the Agreement is providing information to the public on the nature of the Flood Damage Reduction Program, extent of flood risk areas, and government policies that are applied to designated areas. The Steering Committee has prepared an information brochure on the Canada/Ontario Flood Damage Reduction Program entitled "A New Approach to an Old Problem", which will be available for distribution in 1982. In 1981, extensive use was made of the IWD brochure "Cutting Our Flood Losses", display panels, and audio-visual presentations.

5.2 Other Flood Damage Reduction Measures

The Sturgeon River/Lake Nipissing/French River study, which was initiated by the Steering Committee following extensive flooding in the spring of 1979, was completed in January 1981. The final recommendations of the study include several structural alternatives including reservoirs and control structures. Land use policies for several flood prone areas were also recommended.

On November 12, 1981, the federal and provincial Ministers jointly announced the results and recommendations of the study. The most important recommendation, which will be implemented in the spring of 1982, was the creation of a Watershed Advisory Board, responsible to the Ontario Ministry of Natural Resources. This Board will advise on and coordinate the implementation of the other recommendations which include flood risk mapping and designation, improving flood forecasting systems, reconstruction of Obabika and Matagamasi Lake dams and reintroduction of Lake Temagami discharges to the Ottawa system.

In 1981 the Steering Committee initiated flood risk mapping for flood prone areas identified in the Nipissing Study. Cost of the mapping project is estimated at $150,000 and mapping will be completed early in 1982.

6.0 Water Management Data Program

The systematic collection and compilation of water quantity and quality data is essential for the wise management of water resources. Such data are used for a wide variety of purposes, such as designing and operating hydraulic structures, identifying trends, flood forecasting, pollution control, navigation, environmental assessments, and for domestic and industrial water supplies. The objective of the Water Management Data Program is to provide this information on a timely, accurate and comprehensive basis to meet Canada's responsibilities under Federal-Provincial Agreements or serve the national interest. The Water Resources and Water Quality Branches in the Region are both involved in meeting this objective and ensuring that the data meets user needs.

The Great Lakes system is a vital part of the economy of Ontario, and variations in its levels affect many of its users. An important activity in the Water Management Data Program is the preparation by Water Planning and Management Branch of a six-month

forecast of Great Lakes water levels on a monthly basis for users of the system. Forecasts of ice formation in the St. Lawrence River are also made during the early winter of each year.

6.1 Hydrometric and Sediment Surveys

Streamflow measurement in the Oshawa Second Marsh area

One of the primary aims of the Water Management Data Program is to provide the basic water quantity and sediment data needed for the effective management of water resources in Ontario. Under the Federal-Provincial Cost Share Agreement on Water Quantity Surveys, IWD through its Water Resources Branch co-operates with the Ontario Ministry of the Environment, the Ontario Ministry of Natural Resources, and Ontario Hydro in collecting and publishing streamflow, water level, and sediment data. The purpose of the Agreement is to secure coordinated and standardized basic data to facilitate resource planning and management in general and the design and implementation of specific projects related to navigation, hydroelectric development, irrigation, drainage, flood control, recreation, as well as domestic and industrial water supply. As required by the Agreement, a Coordinating Committee, with the federal member as Chairman, implements the terms of the Agreement, which include maintaining national standards for field and office procedures, and for equipment and instrumentation. The Committee also reviews request for stations and designates the classification of all hydrometric stations based on nationally developed guidelines. The sharing of costs under the Agreement is based on this classification of stations.

The Water Resources Branch operated a hydrometric network of 370 stations in Ontario as of April 1, 1981, and continued its processing and publishing responsibilities for an additional 55 stations which are operated by other agencies. April 1 also marked the beginning of the seventh year of the Canada-Ontario Cost Share Agreement on Water Quantity Surveys. Of the 370 stations involved, 153 stations were designated as Federal, 37 stations as Federal-Provincial, and 180 stations as Provincial. During 1981, the Water Resources Branch took approximately 2,423 discharge measurements in Ontario.

Spring-like conditions arrived early in 1981 in southern and eastern Ontario. Starting on February 15th and continuing until the 24th, the average daily high temperature was 5°C - 7°C above normal. This sudden change of temperature, along with above normal rainfall, caused ice jams and flooding in a number of low lying areas. The City of Belleville experienced the worst flooding in forty years as a result of ice jams along the Moira River. Flooding, due to ice jamming, also occurred in the Crowe, Saugeen, Thames, Credit and Grand River basins. Extreme high water measurements were obtained on many rivers by Water Resources Branch personnel.

For the month of May, temperatures in Northern Ontario were generally below normal. Streamflows in northwestern Ontario for the Albany and Ogoki River basins were reported below normal, while further north the Severn and Winisk River basins' streamflows were in the medium to high medium range. A series of moving boat measurements were made on the Abitibi and Moose Rivers to verify the existing stage-discharge relationships for these two hydrometric sites.

The month of June was very wet in Northern Ontario, with over 125 mm of rain having fallen in Thunder Bay, compared to a normal mean of 82.8 mm. Although the discharge on most rivers was higher than normal and the forest fire hazard low, a forest fire occurred at the hydrometric site on the Sachigo River scorching the shelter and melting the orifice line.

Streamflow and precipitation were below normal for the months of August and September. Severe thunderstorms and high winds during the first part of August caused considerable crop damage in southwestern Ontario. Localized flooding was reported, including Ridgetown where 30 cm of water flooded the main street. In the Muskoka area, at the request of the Ministry of Natural Resources, a metering program

was completed on a number of rivers in the area in conjunction with the extensive flooding that occurred in the area in early September.

On October 1, 1981, extensive flooding was experienced throughout the City of Windsor and northwest Essex County. The flooding resulted from a rainstorm of about 6 hours duration with rainfall amounts averaging between 85 mm to 108 mm. These volumes of rainfall approximate a storm with a frequency of 1 in 100 years. The flooding was aggravated by substantial rainfall experienced in the days prior to the storm. Considerable damage was experienced primarily due to overflowing watercourses and sanitary and storm sewer back-up resulting in basement flooding. The impact of the flood probably was worsened by the predawn timing of the flood crest in many areas and by the lack of adequate advance warning.

In the Fall a number of extreme low water measurements were obtained in the north as a result of record low stages in the rivers.

The sediment laboratory was fully operatonal in Guelph during 1981. Approximately 1,640 suspended sediment and 43 bed material samples were analysed. Types of analysis included total sediment concentration, bottom withdrawal and bed material. Included in this total were 615 suspended sediment samples done in support of the study on Oshawa Second Marsh. A network of 16 sediment stations were operated during the year and an additional six northern stations continued to be sampled at random intervals.

In support of the sediment monitoring program undertaken by the Maitland Valley Conservation Authority on the Lucknow River Basin, the sediment laboratory analysed over 50 suspended sediment and bed material samples. Analysis support was also given to the Canadian Hydrographic Service on their study being carried out on the LaGrande River in Quebec.

6.2 Construction

The construction program for 1981 consisted of the installation of 10 hydrometric gauging stations with walk-in shelters, the upgrading of two hydrometric gauging stations with "Guelph" shelters to walk-in shelters, one gauging station shelter and well replacement (former one destroyed by ice and high water), removing one existing well and shelter and reinstalling two feet deeper (due to channel improvement) and replacing shelters at two hydrometric sites with uninsulated walk-in shelters. In addition, 28 field and site investigations were made for new hydrometric stations, relocation of hydrometric stations and major repairs and renovations. Minor repairs and maintenance such as updating and repairing electrical services; installing 36 thermostats to regulate the gauge house heating systems; repairing weirs and controls damaged during spring freshet; and repairs to cableways, intakes and damaged shelters were also completed.

6.3 Training

A Regional workshop was held in Guelph on November 2-6 for all Water Resources Branch, Ontario Region personnel. Several Water Resources Branch representatives from other Regions and Headquarters also attended. Agenda items included a sediment workshop, presentations re: Data Collection Platform (DCP) installations, Data Aquisition and Telemetry System (DATS) units, Canadian Hydrographic Service activities, Construction Section activities, and the Oshawa Second Marsh Baseline Study. The upcoming electronic data processing system for the Water Resources Branch was also discussed. A Supervisors' meeting, a Safety Committee meeting, a general Hydrometric Surveys Section meeting, and a general open discussion session with all Regional staff, were included in the workshop.

In the period April 22 - 30, Mr. Samuel Ndete of Kenya, who holds a World Meteorological Organization Fellowship to study in Canada, was briefed on the various techniques of hydrometric surveys, i.e., streamflow and sediment office computations, construction and instrumentation. Three employees of the Grand River Conservation Authority were also familiarized with the hydrometric field program in April.

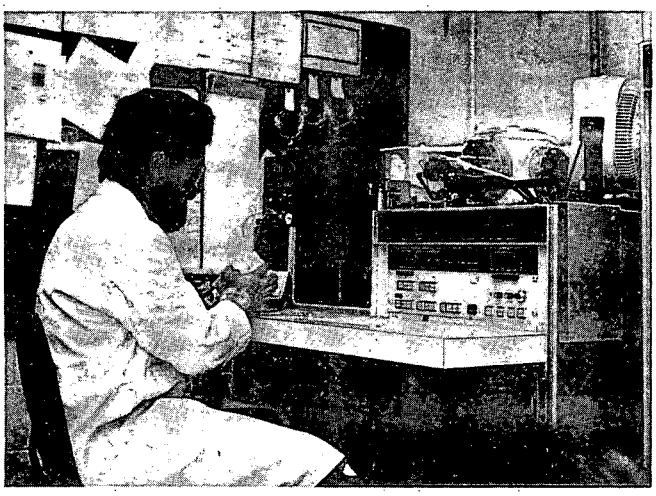
6.4 Data Control, Publication and Distribution

During 1981, over 570 information requests were answered, involving in excess of 4,040 stations years of record, comprising of 175 requests for historical data, 311 requests for current data, and 84 requests for other information.

The annual publication "Surface Water Data, Ontario - 1980" was published and distributed by IWD to the approximately 400 addresses on the mailing list.

A Reference Directory for the Water Resources Branch, Ontario Region, and a report on energy savings as a result of thermostat installation in gauge houses were completed and distributed. A correlation study was completed on the Severn River at Limestone Rapids, along with frequency analysis of maximum daily flows on other stream.

7.0 TOXIC CHEMICALS PROGRAM



Analysing for organic contaminants using a gas chromatograph-mass spectrometer

The deleterious effects of toxic materials such as mercury, lead and PCB's on the environment are of major concern considering the ultimate impacts on the socio-economic welfare and health of society. The presence of these substances in the environment may seriously affect plant and animal life, including humans. Contaminated water is limited in its use unless costly pretreatment is employed. Contaminanted fish, birds, and other animals may become unfit for human consumption resulting in unemployment and loss of revenue for some industries. There may also be serious adverse effects on recreational activities and industries, including sport fishing, swimming and hunting.

The federal government has recognized the importance and seriousness of the toxic substances problem and its national scope through the enactment of the Environmental Contaminants Act in December, 1975. The Act represented a major step forward for the federal government.

7.1 Special Projects

Two special projects related to Toxic Chemicals were initiated this year. In the first, Water Quality Branch conducted a detailed one week survey in June to determine the baseline levels of toxic contaminants in 5 major river systems in the Hudson Bay Lowlands. Samples of water, suspended sediments, bottom sediments and benthos were collected from the Moose, Albany, Attawapiskat, Winisk and Severn Rivers. Ten fish were also collected from each river by lay collectors. All samples except benthos will be analyzed for PCB's, organochlorine pesticides, chlorobenzenes, phthalates and polynuclear aromatic hydrocarbons (PAH's). The results from this study will give a baseline of information against which future changes can be measured.

A special grant from the Toxic Chemicals Measurement Program was given to Water Quality Branch in order to permit the sampling of the Ottawa River for toxic chemicals in 1982 or 1983. The money was used to purchase equipment so that toxic chemicals can be sampled more effectively in water. Once operative, this sampling device hopefully will be used routinely by WQB field staff across the country.

8.0 Long Range Transport of Airborne Pollutants Program

Precipitation chemistry sampler array at Niagara-on-the-Lake

The problem of long range transport of atmospheric pollutants (LRTAP) and the lack of related information has been identified as an issue of major concern to both Canada and the United States. Reports of studies conducted by two IJC reference groups, the Upper Lakes Reference Group and Pollution from Land Use Activities Reference Group (PLUARG) have indicated that the issue of long range transport of airborne pollutants with its transboundary pollution implications was one of great importance requiring immediate attention. Recognizing the importance of LRTAP to the Great Lakes Basin ecosystem, Article VI of the 1978 Canada-U.S. Great Lakes Water Quality Agreement specified the need to increase monitoring activities.

The long range transport of airborne pollutants such as acid rain is having serious adverse effects on both the aquatic and terrestial ecosystems in eastern North America. Acid precipitation has its greatest affect on the waters and soils of the Precambrian Shield region

which have only limited capacity for neutralizing the acid in the rain. Soil improverishment through leaching of important nutrient elements by acid precipitation has the potential of reducing the yield from forests in this region. Several lakes in the Haliburton - Muskoka area of south - central Ontario have lost up to 75% of their buffering capacity in the last 10 years. It has been estimated that there are about 48,000 susceptible lakes in Ontario that could be adversely affected if acid loadings remain constant or increase over the next 10 to 20 years. The resulting trend in aquatic environmental degradation poses serious threats to the social and economic well-being of Canadians. There is an urgent need for more complete ecosystem studies and data to enable better understanding and amelioration of this crucial problem and particularly in response to the requirements of bilateral negotiations between Canada and the United States.

The Water Quality Branch provided field assistance and laboratory analytical support to two national networks, the Canadian Network for Sampling Precipitation (CANSAP) and the Canadian Network for Sampling Organic Compounds (CANSOC). The 49 CANSAP stations are designed to provide information on the areal and seasonal variations in the concentration levels and deposition rates of inorganic chemical species in precipitation across Canada. The 12 CANSOC stations are aimed at identifying the presence of persistent organic contaminants in precipitation. About 700 precipitation samples from these networks were analyzed during the year for a variety of inorganic and organic chemicals. The WQB's computerized national water quality data bank (NAQUADAT) is being used to store the data from both networks.

9.0 Environmental Assessment Program

Under this program, IWD, Ontario Region provides direct support to the Federal Environmental Assessment and Review Process (EARP) in ensuring that environmental effects, and particularly effects on water resources, are taken into account early in the planning of projects involving federal interests and that appropriate measures are taken to minimize adverse environmental impacts of the projects. IWD usually assumes lead agency responsibilities for evaluation of predominantly water-related development projects and provides advice on water concerns to other lead services on other projects. IWD has membership on the Regional Screening and Coordinating Committee (RSCC) which provides the focus for EARP - related activities in Ontario Region.

During 1981, the Water Planning and Management Branch continued its involvement with Eldorado Nuclear Limited's uranium refinery proposal by participating in post-EARP Panel Interagency Review of the proposed uranium trioxide (UO_3) plant at Blind River and the uranium hexafluoride (UF_6) plant expansion at Port Hope. This activity entailed such aspects as site approvals, environmental monitoring program development, review of surface drainage collection, effluent monitoring and treatment systems and providing advice on outfall locations and current studies at Blind River. The Blind River plant is presently under construction.

IWD, Ontario Region maintained its active participation representing Environment Canada on the South Nation River Basin Development Subcommittee, one of a number of federal-provincial committees established to oversee the implementation of the Canada-Ontario Eastern Ontario Subsidiary Agreement. A major aspect of this involvement during 1981 was providing advice and guidelines for economic analysis of water management alternatives within the basin, reviewing and coordinating agency comments on completed component background studies, such as fish and wildlife, amenities, agriculture, residential/industrial land-use, erosion and sedimentation. Technical advice was also provided to the water resources study component. Based on earlier identified concerns over potential impacts of major outlet drainage projects being funded through the Agreement, IWD secured membership on the Drainage Petition Review Committee in order to ensure a more adequate and timely addressing of related concerns.

Water Planning and Management Branch was engaged in the analysis of the impact of dredging in the Keating Channel on the flood regime of the Don River in Toronto. With the assistance of Water Resources Branch, the investigation entailed study of low frequency flooding events, profile tracing for existing and post-dredging conditions, identification of control sections and possible causes for flooding. Environmental and damage assessment reports were also reviewed in conjunction with the province and the provincial Lorant Flood Inquiry. Staff also participated in Neighbourhood Committee meetings which discussed flooding and dredging issues in the Lower Don River.

Among the many other environmental assessment projects reviewed and evaluated during the year by IWD were: the Halton Region Revised Waterfront Plan, Port Maitland Harbour development proposal, Oshawa Harbour landfill/dredged material disposal, Sarnia and Dunnville marinas, Port Hope Flood Control Environmental Study, Shoal Lake Indian Band 39A sewage disposal for cottage development and snow-dumping on the Ottawa River. Gananoque Light and Power Company's proposal to divert up to

200 cfs from the Rideau River into the Cataraqui River system at Newboro has only recently received renewed attention following the consultant's responses to the many environmental concerns identified for the project.

In terms of other related work, WP&MB prepared a document summarizing Canadian environmental concerns associated with Winter Navigation Season Extension on the Great Lakes. Input was provided for the 1981/82 South-East Bend Cut-off (Lake St. Clair) dredging - monitoring program. In response to requests from IWD Headquarters and regional agencies, information on environmental assessment guidelines for flood control and structures and on South Nation River Basin activities was provided.

10.0 Baseline Studies Program

The baseline studies program is an integrated DOE program which endeavours to provide the information or knowledge base required for evaluating the effects of various activities on environmental resources of specific geographic areas or the effects of particular development cycles, such as the nuclear fuel cycle. IWD, Ontario Region participates together with other DOE services in baseline studies identified as priority areas by the Regional Director General-DOE/Ontario Region.

As in the previous year, the major baseline study component during 1981 continued to be the Oshawa Second Marsh Study. This baseline study is designed to provide the information required to allow management of the marsh as a viable habitat and natural area, as well as to help in the evaluation of potentially adverse effects on the marsh from developmental pressures, such as the Oshawa Harbour expansion now in the process of being formally unveiled.

All IWD, Ontario Region Branches participated in the water quality and quantity component studies at Oshawa Second Marsh (streamflow gauging, water quality and suspended sediment sampling and analysis, groundwater flow, marsh/lake level interaction). Preliminary investigations indicated that suspended sediment load into the marsh was a major problem. During the year, intensive sampling was undertaken during spring melt, and storm events to better quantify the relative contributions of upstream sources (primarily Harmony Creek watershed) and, thus, to more adequately assess the degree of remedial measures required and likely success of these measures. Sediment loads at the outlet of the marsh were also measured to quantify sediment retention within the marsh, although with considerable difficulty due to the highly transient nature of the flow regime. A preliminary integrated baseline study report was completed in October.

Towards the end of 1981, a new baseline study proposal was initiated within the region by Lands Directorate in cooperation with Inland Waters Directorate and the Canadian Wildlife Service: Wetland Conservation in Southern Ontario. The major thrust of this study will be the evaluation and classification of significant wetlands according to habitat characteristics and sensitivities to development pressures.

Water Quality Branch continued to operate a network of 5 stations in the Hudson Bay Lowlands for the purpose of maintaining long term baseline water quality information on each of the 5 major rivers in the region. Water samples are collected by lay collectors every two weeks from the mouths of the Moose, Albany, Attawapiskat, Winisk and Severn rivers. The samples are analyzed for major ions, nutrients and trace metals at the Water Quality Branch laboratory in Burlington.

11.0 Management and Administration

In 1981, the Directorate administered and managed resources amounting to 6.4 million dollars and 110.5 person years. The resources included operational funding under international and federal-provincial agreement as well as grants and contributions under similar agreements. Significant federal-provincial cost-shared funding administered in 1981 included the Canada-Ontario Great Lakes Water Quality Agreement funding ($1,200,000) and the Canada-Ontario Flood Damage Reduction Agreement funding ($910,000 allocated for 1981-82).

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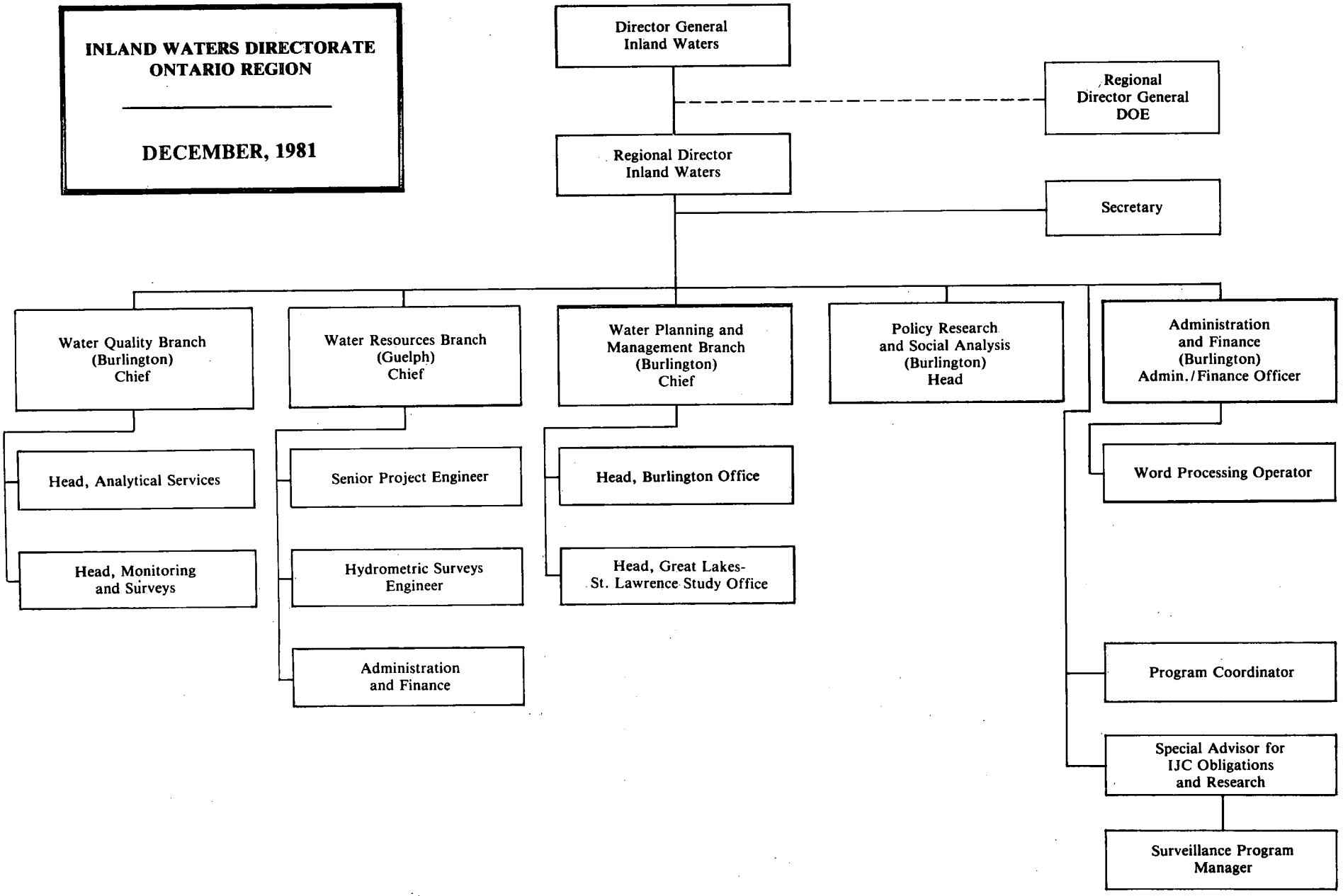
13.0 Organization Chart



Date Due
