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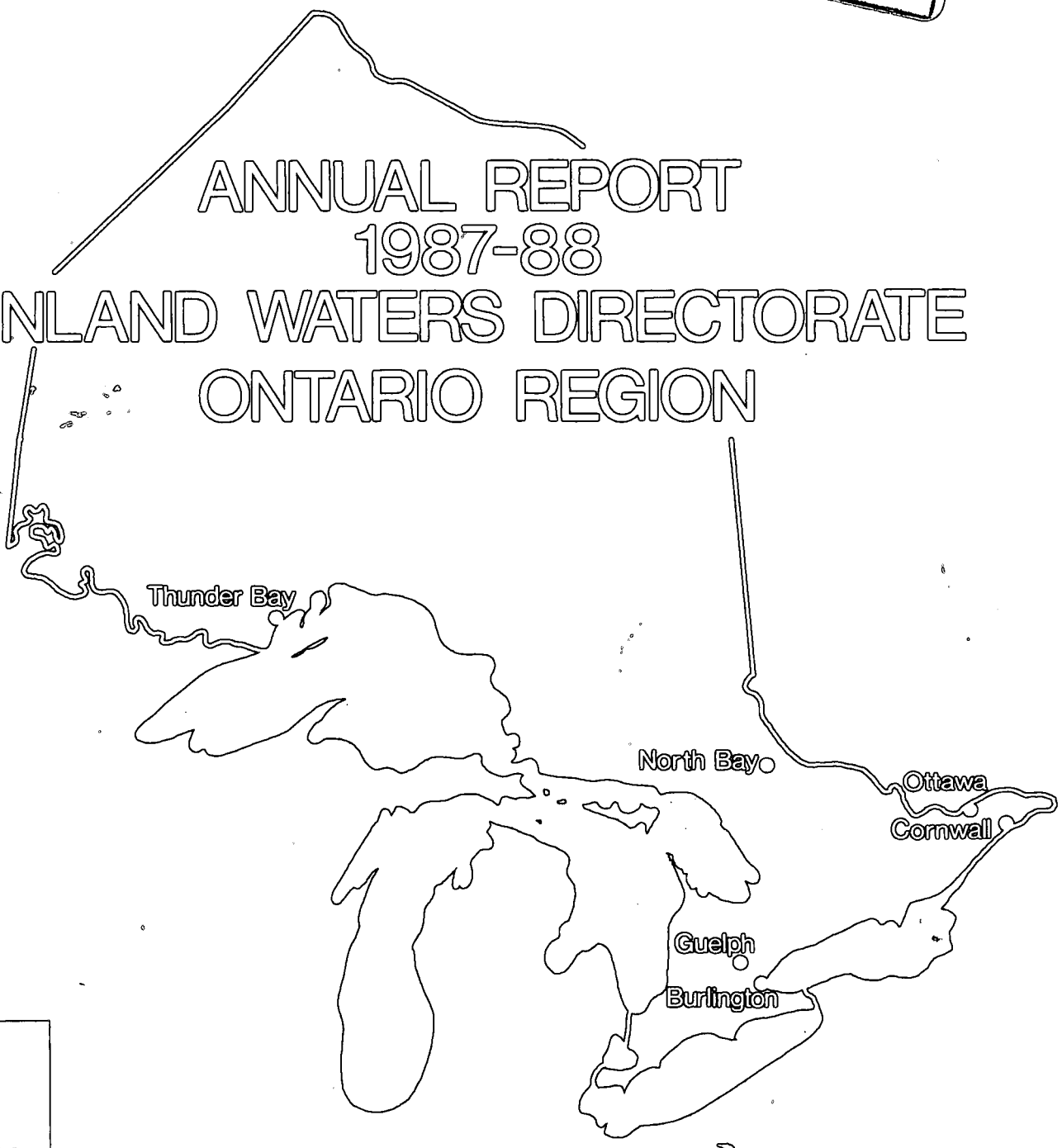
ANNUAL REPORT 1987-88 INLAND WATERS DIRECTORATE ONTARIO REGION



Canada

Inland Waters Directorate
Ontario Region

ANNUAL REPORT
1987-88

DEPARTMENT OF THE ENVIRONMENT

TABLE OF CONTENTS

SUMMARY

This report describes the activities and accomplishments of Inland Waters Directorate (IWD), Ontario Region during the fiscal year April 1, 1987 to March 31, 1988. 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. It also has an important role in monitoring land use changes and assessing their impact on renewable resource lands in the region.

In 1987 there was a dramatic downward trend in Great Lakes water levels from their record highs of 1985 and 1986. By the end of 1987 Lake Ontario and Lake Superior were at levels slightly below their long term averages for that time of year. By that same time, the middle lakes, Michigan, Huron, St. Clair and Erie were about 0.2 - 0.4 metres above average. The International Joint Commission's (IJC) Great Lakes Water Levels Task Force completed its short term water levels study by the Fall of 1987. A Program Management Team was established by the IJC in 1987 to direct the longer term water level study aspect of the 1986 Reference to the IJC on Great Lakes Water Levels.

Another important Great Lakes event in 1987 was the signing of the Protocol to the 1978 Canada-U.S. Great Lakes Water Quality Agreement in November. The Protocol strengthens the programs in the 1978 Agreement and increases the accountability of the Parties to that Agreement. With respect to the Niagara River, the first joint four party report on the water quality of the Niagara River was released in January, 1988.

The Ministers for Environment Canada and Ontario Natural Resources signed Amending Agreement No. 1 to the Canada-Ontario Flood Damage Reduction Agreement in 1985, providing an additional $8.4 million ($7.4 million for mapping and $1.0 million for other measures) to the agreement which was also extended to 1995. To date, in excess of 90 streams and 120 communities have been mapped under the Canada-Ontario agreement since its beginning in 1978. Of these, 67 communities along 47 streams accounting for almost 47% of Ontario's population have been designated. Two floodline mapping projects, the Root River and Garden River studies, under the Indian Lands Mapping Program with the Department of Indian and Northern Affairs were nearing completion by the end of the reporting period.

April 1, 1987 marked the beginning of the thirteenth year of the Canada-Ontario Cost Share Agreement on Water Quantity Surveys. Under this agreement IWD through its Water Resources Branch cooperates with provincial agencies in collecting and publishing streamflow, water level, and sediment data on a cost shared basis. As of April 1, 1987, the Water Survey of Canada Division of the Branch operated a network of 380 hydrometric stations and 34 tides and water level stations in the Province. For the fiscal year ending March 31, 1987 $951,300 was recovered from the Province for work done on their behalf. The Branch distributed a questionnaire to users of hydrometric data regarding their present and future requirements. A report on the analysis of the more than 200 responses received was completed in 1987.

As part of the Directorate's public information program in 1987, IWD staff participated in the organization and staging of several successful events in the Hamilton/Burlington area for Environment Week, June 1-7. Activities included visits to schools by the Environmental Minstrels, Johnny Biosphere and the Portable Theatre Company; a Concert-by-the-Lake at Spencer Smith Park (Burlington); a two night Environmental Festival in the Burlington Central Library; an area-wide Clean-up Your Environment Day and picnic at LaSalle Park (Burlington); and a literature and art competition.

In the fiscal year 1987-88 IWD, Ontario Region administered and managed resources amounting to 8.2 million dollars and 95.5 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 1987-88 included Canada-Ontario Flood Damage Reduction Agreement funding ($700,000 for 1987-88) and Canada-Ontario Great Lakes Water Quality Agreement funding ($1,875,000 for 1987-88). Approximately $1,000,000 is expected to be cost recovered from the Province in 1987/88 under the Canada-Ontario Cost Share Agreement on Water Quantity Surveys.

A list of 1987-88 publications and presentations by staff of IWD, Ontario Region is included in this report.

A French translation of the Annual Report is available on request.

Résumé

Le présent rapport décrit les activités et les réalisations de la Direction générale des eaux intérieures (DGEI), région de l'Ontario, pour l'année financière 1987/88. La DGEI, région de l'Ontario, est une composante du ministère fédéral de l'Environnement. La DGEI, principal organisme fédéral en matière de gestion des eaux dans la région de l'Ontario, planifie et participe à des programmes nationaux et internationaux de gestion des eaux de façon à procurer des avantages économiques et sociaux, tout en prêtant une attention particulière aux questions environnementales. La DGEI joue aussi un rôle important relativement à la surveillance des changements d'utilization des terres et l'évaluation de leur impact sur les terres de choix de la région.

L'année 1987 a été marquée par une dramatique tendence à la baisse des niveaux d'eau dans les Grands lacs comparativement aux niveaux records maximum de 1985 et 1986. A la fin de 1987 les niveaux des lacs Ontario et Supérieur étaient légèrement inférieures à leurs moyennes à long terme pour ce temps de l'année. Au même moment, les niveaux des lacs intermédiaires, sait les lacs Michigan, Huron, Sainte-Claire et Érié, étaient de 20 à 40 cm au-dessus de la moyenne. Le Group de travail sur les niveaux d'eau des Grands lacs de la Commission mixte internationale (CMI) a complété son étude à court terme sur les dit niveaux d'eau à l'automne de 1987. En 1987 le Commission mixte internationale a aussi mis sur pied une Équipe de gestion de programme pour diriger l'étude à plus long terme sur ce sujet, en conformité avec le Renvoi des gouvernements Américains et Canadiens de 1986 à la CMI.

Une autre évènement importante concernant les Grands lacs en 1987 a été la signature, en novembre, du Protocole de l'accord sur la qualité de l'eau des Grands lacs intervenu entre le Canada et les États-Unis en 1978. Le Protocole renforce les programmes contenue dans l'Accorde de 1978 et augmente la responsibilité des parties qui s'y sont liées. Par ailleurs, le premier rapport sur la qualité de l'eau de la rivière Niagara préparé conjointment par quatre intervenants a été publié en janvier 1988.

Au cours de l'année, le ministre fédéral de l'Environnement et celui des Richesses naturelles de l'Ontario, ont signés un premier amandement à l'Accord Canada-Ontario sur réduction des dommages causés par les inondations, augmentant ainsi le budget de 8,4 millions de dollars (7,4$ millions pour les travaux de cartographie et 1,0$ million pour d'autres mesures). De plus, l'échéance des termes de l'entente a été reculée jusqu'à 1995. A ce jour plus de 80 cours d'eau et 120 communautés ont été cartographiés selon les termes de cet accord depuis le début de son application en 1978. Par ailleurs 67 de ces communautés situées le long de 47 cours d'eau representant presque 47% de la population de l'Ontario sont situées dans des zones désignées. En collaboration avec le Ministre des affaires indiennes et du nord et en comformité avec le Programme de cartographie des terres indiennes, deux (2) projects de cartographie de zones inondables, ceux des rivières Root et Garden, étaient sur le point d'être achèvés vers la fin de la période couverte par ce rapport.

Le 1er avril 1987 a marqué le début de la treizième année de l'Accord Canada-Ontario à frais partagés sur les relevés hydrométriques. En vertu de l'Accord, la DGEI par l'intermédiaire de sa Direction des ressources en eau, collabore, avec des organismes provinciaux à la collecte et à la publication, à frais partagés de données sur les débits, les niveaux d'eau et les sédiments. Au 1er avril 1987, la Direction exploitait dans la province, 380 stations hydrométriques et 34 stations de mesure des marés et du niveau de l'eau. Pour l'année financière se terminant le 31 mars 1987, 951 000$ ont été récupérés de la Province pour le travail effectué en son nom relativement à cet accord. La Direction des ressources en eau a distribué à l'intention des usagers des données hydrométriques, un questionnaire sur leurs besoins présents et futurs. Un rapport sur l'analyse de plus de 200 réponses reçues a été achèvé pendant l'année 1987.

Dans le cadre du programme d'information au public de 1987 de la DGEI, le personnel de la DGEI a participé a l'organisation et au montage de plusieurs évènements qui eurent beaucoup de succès lors de la Semaine de l'environnement tenue du 1er au 7 juin dans la région de Hamilton/Burlington. Les activités qui se sont déroulées comprenaient entre autres des visites dans les écoles par les Troubadours de l'environnement, "Johnny Biosphere" et "the Portable Theatre Company", un concert en plein air au parc Spenser Smith de Burlington, un festival de L'environnement de 2 soirées tenu à la "Burlington Central Library", une participation à l'échelle de la région de Hamilton/Burlington à une journée "nettoyer votre environnement" avec un pique-nique au parc Lasalle de Burlington, ainsi qu'une compétition d'art et de littérature.

Pendant l'année fiscale 1987-88, la DGEI, région de l'Ontario, a administré et geré des resources totalisant 8,2 millions de dollars et 95,5 année-personnes. Ces resources incluaient des fonds d'exploitation versés en vertu d'accords internationaux et fédéral-provicial de même que des subventions et des contributions accordées en vertu d'autres accords semblables. Une partie importante des fonds fédéral-provicial à frais partagés administrés en 1987-88 incluaint celui de l'Accord Canada-Ontario sur la réduction des dommages causés par les inondations (700 000$ pour 1987-88) et celui de l'Accord Canada-Ontario sur la qualité de l'eau des Grands lacs (1 875 000$ pour 1987-88). Enfin, on s'attend à récupérer approximativement 1 000 000$ de la Province en 1987-88 en vertu de l'Accord Canada-Ontario sur le partage des frais des relevés hydrométriques.

Une liste des publications et des réalisations du personnel de la DGEI, région de l'Ontario pour l'année financière 1987/88 fait partie de ce 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. Another important role of the Directorate is the monitoring of land-use changes and their impacts on the renewable resource lands in the region.

The Directorate consists of four Branches: Water Planning and Management Branch, Water Resources Branch, Water Quality Branch and Lands Branch.

The Water Planning and Management Branch (WP&MB) administers and implements federal, federal-provincial, and international water management activities. The Branch provides technical support to all the International Joint Commission's (IJC) Great Lakes Boards of Control in the regulation of the water levels and outflows of Lakes Superior and Ontario and water levels at Niagara Falls. In addition, the Branch carries out special studies for IJC Study Boards, such as the current Great Lakes Water Levels Reference and other studies aimed at further improvements in Great Lakes regulation and water management. WP&MB also implements federal-provincial water management projects under the Canada Water Act (CWA) relating to flood damage reduction, flood control, and shoreland management. WP&MB reviews federally-initiated and federally-funded projects for environmental impact under the Environmental Assessment and Review Process. The Branch also gathers and evaluates social and institutional information and investigates the socio-economic implications of resource policies, programs and management activities.

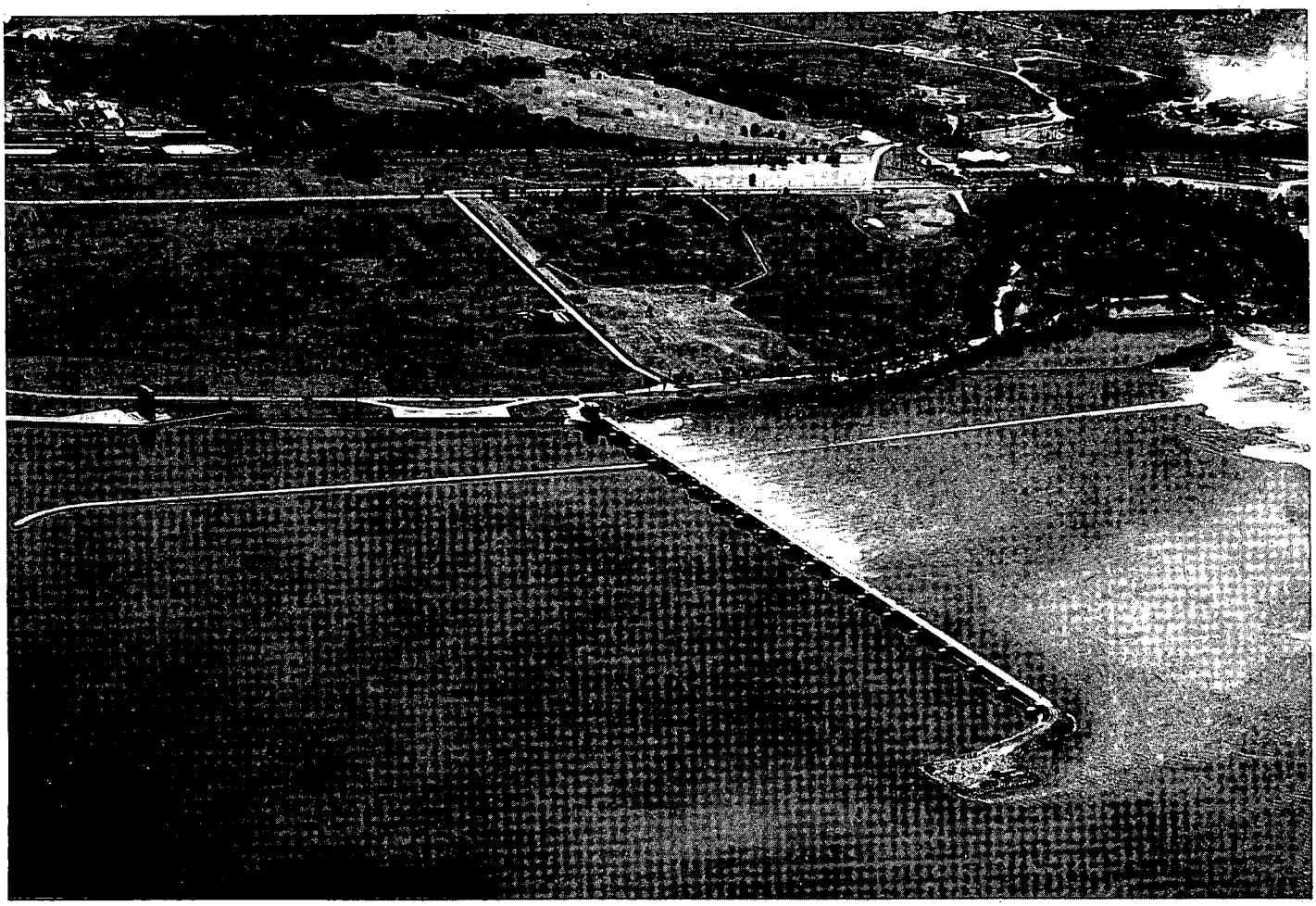
The Lands Branch (LB) monitors land use changes in the region and evaluates their impact on renewable resource lands in the region. The branch also participates in diffuse source phosphorus management studies in the Great Lakes Basin.

The Water Resources Branch (WRB) operates and maintains a network of streamflow, water level, and sediment stations throughout Ontario and the Great Lakes system jointly funded with the Province. The Branch 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 Branch also complements its data collection activities with network evaluation and planning activities, as well as data interpretation studies.

The Water Quality Branch (WQB) collects, interprets and disseminates information about the quality of the surface waters of federal interest in Ontario including the Great Lakes-St. Lawrence River System, the Ottawa River, major rivers tributary to Hudson Bay and James Bay and the Rainy and Winnipeg Rivers. The Branch provides technical advice and support to the Water Quality Board of the International Joint Commission and carries out special studies for other international bodies such as the Niagara River Monitoring Committee. In addition, water quality studies are carried out in support of the National Water Quality Assessment Program, the Toxic Chemicals Program, and Environmental Assessment Program.

The following is a description of the major program activities and achievements of the Directorate during the fiscal year 1987-88.

2.0 GREAT LAKES AND ST. LAWRENCE RIVER BASIN WATER LEVEL CONTROL PROGRAM



Flow control structure at Niagara Falls

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, water supply for domestic and industrial purposes and the environment. 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 River System.

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 (WP&MB) continued to support the IJC's International Lake Superior Board of Control and International St. Lawrence River Board of Control in regulating the outflows of Lake Superior and Lake Ontario. The Branch also supported the IJC's International Niagara Board of Control in water management 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 these IJC Boards and two of the Boards' Working Committees. Other support includes secretarial duties and technical studies and operations.

Throughout 1987, WP&MB reviewed the various hydrologic factors including ice and snow cover conditions and provided advice to the Boards and the IJC in the regulation of Lake Superior and Lake Ontario. Notwithstading the improved lake level condition in 1987, extensive effort was

still needed in dealing with this serious problem through activities on the IJC Boards and the Great Lakes Water Level Communications Centre (see Section 2.3).

The 16-gate Lake Superior Compensating Works on the St. Marys River at Sault Ste. Marie was constructed more than sixty years ago and is a main component in the facilities used to regulate the outflow of Lake Superior. Other facilities at Sault Ste. Marie include the navigation locks and hydro-electric power plants on both sides of the border. These facilities operate in unison to discharge the Lake Superior outflow specified by Regulation Plan 1977. The completion of the St. Lawrence Seaway and Power Project thirty years ago by Canada and the United States makes it possible to regulate as well the outflows of Lake Ontario. The Robert Moses Power Dam and the Robert H. Saunders Generating Station form one single international control structure near Cornwall, Ontario and is the main facility used in regulating Lake Ontario's outflow.

Water levels on the Great Lakes followed a remarkable downward trend in 1987 from their record highs of 1985 and 1986. The exceptionally dry spell in late 1986 and early 1987, especially in the Lakes Superior, Michigan and Huron basins, was the main cause for the improvement. Instead of the usual seasonal rise in water levels in the spring, levels actually declined and continued to do so for much of the rest of the year—a process that is rarely seen. Slightly above-average precipitation returned to the basin in the second half of the year, thus moderating the decline. By year end, levels on Lake Superior fell to about 0.1 metre below average, whereas those of the middle (non-regulated) lakes-Michigan, Huron, St. Clair and Erie were about 0.2-0.4 metres above average.

Water levels on Lake Ontario also underwent an unusual change. The record high inflows of water from Lake Erie in 1985 and 1986 had raised the levels on Lake Ontario to about 0.5 metre above average by early 1987. At that time, expectations were that these high inflows would continue and would raise Lake Ontario's level to new record highs by the middle of the year. To mitigate the anticipated serious situation, the St. Lawrence River Board took advantage of the mild winter and favourable ice cover conditions in the St. Lawrence River to discharge record maximum flows out of Lake Ontario. High outflows were maintained until July after which flows were returned to those specified by Lake Ontario Regulation Plan 1958-D. Levels on Lake Ontario went from above average in early 1987 to slightly below average for much of the rest of the year, and by year end had returned to average levels.

Since the development of Lake Superior Regulation Plan 1977, several significant events have occurred. These include the increased discharge capacity of the facilities at Sault Ste. Marie as a result of the construction of a new Canadian power plant, the changed hydraulic characteristics of the St. Marys Rapids area due to the construction of the low level dyke to protect the fishery habitat, and most significantly, the record high water supplies to the upper Great Lakes (Superior, Michigan and Huron) in 1985 and 1986. As a result, the Superior Board has initiated a review of the regulation plan with the objective of updating and improving it.

In early 1982, the Superior Board completed a report on the structural stability of the Compensating Works. In response to the report's findings, repairs to the Compensating Works are continuing and being monitored. Other ongoing Board activities include regular inspections of the facilities at Sault Ste. Marie, and periodic flow measurements conducted by Water Resources Branch to ensure accurate recording of the Lake Superior outflows.

High outflows from Lake Ontario could affect adversely users of the river located both upstream and downstream of Cornwall. WP&MB monitored the conditions in the river closely in the regulation of Lake Ontario throughout 1987. The extremely high outflows in 1987 revealed one problem not encountered before—complaints from boaters in the Thousand Islands area about low water level conditions. To address this issue along with the record high supplies to Lake Ontario in recent years, the St. Lawrence River Board initiated a review of Lake Ontario Regulation Plan 1958-D with the objective of updating it and providing safeguards to boaters in the area against unduly low water level conditions.

The International Niagara Board of Control was established in 1953 by the IJC following the signing of the 1950 Niagara Treaty between Canada and the United States. The Treaty established flow requirements for Niagara Falls in order to preserve their scenic beauty as well as regulations regarding the diversion of water from the Niagara River for power purposes. To meet the objectives and requirements of the Treaty, the IJC in 1953 authorized the design and construction of the necessary control and remedial works at Niagara Falls. The principal feature of the works is the 18-gate control structure located a short distance upstream of the Falls and extending part-way across the river from the Canadian shore. Completed in 1963, this control structure is jointly operated by Ontario Hydro and the New York Power Authority under the supervision of the Niagara Board. During 1987, WP&MB monitored its operations for compliance with the instructions of the IJC and the Niagara Board.

The recent record high Niagara River flows have drastically increased the occurrences of high water levels in the river—a problem and concern to local riparians. As a result, the Niagara Board initiated a study to examine closely the operation of the control structure at Niagara Falls along with power diversion operations, with the aim of updating the Niagara Board's instructions issued in 1973. The study was completed in early 1988.

The Niagara Board continued to advise the IJC on the operation of the Lake Erie-Niagara River Ice Boom. The boom is installed by Ontario Hydro and the New York Power Authority each winter at the head of the Niagara

River to protect their power intakes from ice. Local residents have in the past opposed the use of the boom, alleging that its presence prolongs the ice season in the area. Following the completion of a study of the boom and its effects by the United States National Academy of Science, the IJC issued a new order in early 1984 governing the operation of the boom, and directed the Niagara Board to monitor the operation. WP&MB staff carried out periodic reconnaissance flights over Lake Erie and the Niagara River to survey ice conditions and coordinated the timing of the boom's removal with the power entities.

The Water Resources Branch continued to support Board activities by undertaking discharge measurement programs to verify gauge or control structure ratings. Such measurements are scheduled on a regular basis to ensure flow and water level data for water management and regulation purposes are accurate. During the past year, conventional discharge and moving boat measurements were conducted at the upper end of the Niagara River in June and December to verify stage-discharge relationships of gauges at Fort Erie and Buffalo Harbour. In the fall, conventional measurements were also taken at the Lake Superior Compensating Works on the St. Marys River at Sault Ste. Marie. Each survey was done jointly with the U.S. Army Corps of Engineers and reported to the Niagara and Lake Superior Boards.

To complement the existing data base for the upper part of the Niagara River, IWD, through arrangements with the Netherlands firm, Stork Servex, initiated a demonstration of the FLOW 2000 system. The system, which measures the travelling times of acoustic pulses upstream and downstream and converts the difference into a stream velocity, provides real time flow data. The system was installed on a temporary basis with the assistance of the U.S. Army Corps of Engineers and began operating on Sept. 24. Because of the temporary nature of the installation and river conditions, problems were experienced with support structures for transducers, cabling and connectors and repairs and modifications were necessary. The unit operated for a total of about 9 weeks however and provided useful information, particularly in December, when tests were conducted on the Chippewa Grass Island Pool to determine if pool levels affected outflows from Lake Erie. These tests were requested by the IJC and were the basis of a report prepared by the Niagara Working Committee. After the tests, a decision was made to remove the FLOW 2000 system and to prepare a report summarizing Environment Canada's experiences with the installation and operation of the system. This report is now at a draft stage.

Landfills in the upper Niagara River in the past have been a subject of concern to the IJC and Environment Canada, as they have the effect of restricting river flows and affecting lake levels. In recent years, WP&MB staff have stepped up their effort in monitoring the situation and provided advice to the IJC and IWD-Ottawa. Although landfilling activities have stopped, pressure to develop and build on the Niagara River shoreline continued. In 1987, in response to a proposal to build a marina-condominium complex at Fort Erie, WP&MB conducted an extensive hydraulic analysis of this proposal with assistance from IWD-Ottawa. The results of the analyses were provided to the Province of Ontario which has jurisdiction over developments on the Niagara River. WP&MB also provided extensive assistance to the Great Lakes Water Levels Task Force in identifying and evaluating the effects of obstructions placed on the upper Niagara River.

WP&MB 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. Branch staff carried out weekly power inspections at the Niagara power plants to ensure accuracy in the reporting of power diversions. Branch staff also investigated the causes of Treaty violations as a result of insufficient flows over Niagara Falls, and made recommendations on appropriate steps to minimize the reoccurrence of the violations.

In order to monitor the flows over Niagara Falls, a water level gauge is operated a short distance downstream of the Falls. Flows are computed from the water level data and a stage-discharge relationship. Water Resources Branch and the U.S. Army Corps of Engineers jointly carry out a regularly scheduled measurement program to check the accuracy of the rating. Results of the October 1986 measurements verify the existing rating used, and were reported to the Niagara Board in 1987.

WP&MB monitored the existing water transfer arrangement at Niagara between Ontario Hydro and the New York Power Authority. During 1987, some 20 million cfs-hours (provisional) of Canada's share of Niagara River water were directed to the U.S. power plant to maximize energy production. Since 1982 when the U.S. plant announced its plan to expand its installation, the Branch has followed the proposal closely and provided advice to the Niagara Board and the International Niagara Committee. Since two of the power plants in Canada are not as efficient as the U.S. plant, the expansion could further increase the existing water transfer. The recent fall in world oil prices and other changing economic conditions have altered the proposed expansion. Present plans call for upgrading the existing installations in lieu of constructing additional units on a site formerly occupied by a chemical plant. Branch staff will continue to monitor this proposal and related development.

In 1985, WP&MB staff assisted the Niagara Board in preparing a background paper on the New York State Barge Canal Diversion. The canal diverts water from the upper Niagara River for navigation and other uses in western New York State. The report was subsequently forwarded to the IJC and the Governments of Canada and the United States. One of the report recommendations calls for the establish-

ment of a monitoring program to measure, on a continuing basis, the amount of water being diverted from the Niagara River. IWD worked with the U.S. Army Corps of Engineers in seeking alternatives to implement the report's recommendations. The possibilities of using an acoustic velocity meter similar to the one used in the Niagara River are being explored.

IWD supported the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data, by undertaking chairman, secretarial and technical duties. Established in 1953, the Committee develops uniform procedure to be used in the development of Great Lakes data for study and regulation purposes. In 1987, WP&MB developed and coordinated with the U.S. officials, the water level, river flow and water supply data in a manner prescribed by the Committee. These data are currently being used in the IJC's water level study (see Section 2.2).

Following completion of all field surveys in 1983, the Committee commenced the development of techniques and procedures to re-calculate elevations for the benchmarks in the Great Lakes-St. Lawrence River System on the International Great Lakes Datum (IGLD). The datum defines a reference plane for the water levels of the Great Lakes relative to sea level at the Gulf of St. Lawrence. The datum was last established for the year 1955, but requires updating because of the continuous but uneven movement of the earth's crust. Preliminary results have shown that very little crustal movement has taken place since 1955, suggesting that a revision of the datum is not warranted at this time. Experts in the U.S. and Canada continued to analyze the survey data with the objective of calculating the elevations for all benchmarks on the IGLD for the year 1980. A report on this subject is expected in 1988.

WRB continued work on a Committee report entitled "Discharge Measurement Procedures on the Great Lakes Connecting Channels and the International Section of the St. Lawrence River." The report documents methods, procedures and equipment used in the past in discharge measurements for the waterways indicated and will be used to plan future surveys as well as explain and interpret any data trends or variances that might be attributed to different methods, procedures and equipment.

In 1984, IWD joined in a study led by the Atmospheric Environment Service of Environment Canada on the effect of doubling of carbon dioxide (greenhouse effect) in the earth's atmosphere on Ontario's climate and economy. The primary IWD contribution to the study was a detailed hydrologic analysis of the potential impacts on the water levels and flows of the Great Lakes, carried out by WP&MB. The WRB also carried out a study on the potential impacts on watersheds in Ontario, using a sample watershed in southern Ontario. All IWD inputs to the study were completed in 1986. The subject of climate change continued to draw attention in 1987/88. IWD's effort in this area continued as part of the IJC's Great Lakes water level study in 1987-88.

2.2 Investigative and Engineering Boards

The record high Great Lakes water levels in 1985 and 1986 caused extensive flood and erosion damage to the Great Lakes shoreline. In August 1986, Canada and the United States requested the IJC to re-examine the issue of Great Lakes water levels and to identify means to alleviate the problems associated with their extreme fluctuations. Among other tasks, the IJC was asked to update the economic and engineering analysis conducted in the last Lake Erie Regulation Study (1977-1981). In order to address the concerns raised in the Governments' Reference, the IJC established the Great Lakes Water Levels Task Force and the Project Management Team (PMT).

The Task Force completed its study in the Fall 1987 and provided the IJC with technical information on possible "crisis actions" that could be taken to alleviate the problems of high lake levels. Extensive membership was drawn from IWD-Ottawa and the Ontario Region. A report on the Task Force's work is expected to be forwarded to the Governments in mid-1988 by the IJC.

The Project Management Team was given the responsibility of identifying and evaluating long-term structural and non-structural solutions to the problems of fluctuating lake levels. Again, extensive membership has been drawn from IWD, Ontario Region on the PMT and its five functional groups. By the end of the year, a detailed plan of study was prepared along with some of the preliminary studies related to further Great Lakes regulation. The overall study is expected to be completed in 1991.

2.3 Great Lakes Water Level Communications Centre

In March of 1986, the Great Lakes Water Level Communications Centre was opened as a result of the situation of extremely high water levels on the Great Lakes.

At the beginning of 1987, the levels of Lakes Huron, St. Clair and Erie were at the highest recorded this century for that time of the year, and the potential for flood damage was acute. Levels of Lakes Superior and Ontario were somewhat below previous record highs, but there was concern that their situation could worsen.

In February, 1987 the combination of high lake levels and a severe storm caused damage along the shores of Lakes Huron and Michigan. A second storm in April caused extensive damage along the southern Lake St. Clair shoreline. The damage was the most severe in this area since 1973.

A combination of below normal precipitation and above average evaporation resulted in a rapid decline of lake levels during 1987. By the end of the year, levels were 20 to 50 centimetres lower than one year earlier. This decline in levels greatly reduced the risk of storm damages to shoreline property. It did, however, lead to another problem. By late

summer difficulties were being experienced by recreational boaters in the St. Lawrence River and Lake Ontario due to insufficient water depth in some locations.

The Centre was a primary source of information to the public and media on the causes of high lake levels and forecasts of future levels. The GLWLCC handled about 600 telephone enquiries from the public. Approximately 300 additional enquiries were received from the media, including numerous appearances in television and radio interviews.

In the spring the Centre sent a letter to all 270 communities along the Great Lakes shoreline, with an offer to hold a meeting with elected officials and/or the public on the causes of high lake levels. In response to this letter as well as other contacts, approximately 40 presentations were given to concerned groups and the public.

A survey of the damage potential from fluctuating levels to commercial and industrial properties along the Lake Superior shoreline was undertaken and a report on the findings was completed early in 1988. A similar survey of damages to residential properties is being undertaken by a consultant.

A final report on the high levels of 1986 was completed and an interim report on the levels situation of 1987 was prepared. Reports were also prepared on a shoreline survey conducted in 1986.

2.4 Lake Superior Shore Property Damage Evaluation and Social Impact Assessment

During 1987, Water Planning and Management Branch together with the Ontario Ministry of Natural Resources contracted a study to survey residential properties along the Canadian shoreline of Lake Superior to determine potential damages and impacts resulting from various lake levels. The study combined an engineering survey of 2800 properties to determine lowest opening elevations and the distribution of a questionnaire to gather information from shore property owners and users on past damages and shore protection measures. No such data were previously available for Lake Superior.

In conjunction with the completion of the study, the Branch organized a two-day discussion seminar for some 26 officials from federal and provincial agencies, conservation authorities, the IJC, and the U.S. Army Corps of Engineers to review the study methodology, findings, and potential application to the IJC Great Lakes Water Levels Reference Study.

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 in the basin rely on the Great Lakes for a ready source of water for domestic and industrial use. 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 to prevent further deterioration of the Great Lakes and to provide a basis for improving existing water quality. A new agreement was signed on November 22, 1978. Whereas the 1972 Agreement placed its emphasis on the control of phosphorus, the new Great Lakes Water Quality Agreement emphasizes control of pollution from toxic substances and the control and prevention of pollution from industrial and municipal 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.

In November, 1987 a Protocol Amending the 1978 Agreement was signed by our Minister on behalf of Canada and by the Administrator of the U.S. Environmental Protection Agency on behalf of the United States. The aim of the Protocol is to strengthen the programs, practices and technology laid out in the 1978 Agreement and to increase accountability for their implementation. Timetables are set out for implementation of specific programs and governments are required to meet semi-annually to discuss progress and report biennially to the IJC.

The Protocol adds new annexes to the Agreement to address atmospheric deposition of toxic pollutants; contaminated sediments and groundwater; and non-point sources of pollutants. In addition new annexes are established to incorporate the development and implementation of remedial action plans for Areas of Concern and lakewide management plans to control critical pollutants.

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. It also is a major participant in the federal response to the requirements of the Agreement. Inland Waters Directorate activities related to the Agreement include:

(a) 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;

(b) providing advice on the effectiveness of control policies and measures;

(c) defining and continual refining of water quality objectives; and

(d) identifying new and emerging pollution problems.

The Governments of Canada and Ontario signed the Canada-Ontario Agreement on Great Lakes Water Quality (COA) in 1971. That Agreement provided 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. Since 1971 the Agreement has been extended (1976), revised to reflect the new requirements of the 1978 Canada-U.S. Agreement (1982) and was renegotiated in 1985. The latest version of the Agreement was signed in 1986 and will be effective from 1985 to 1991. The Canada-Ontario Agreement provides for the cost-sharing of provincial surveillance activities on a 50-50 basis. In the 1986-87 fiscal year Canada's share of surveillance costs under the Agreement amounted to $1,600,000. In addition, the 1986 Agreement provides for the completion of the construction of municipal sewerage facilities pursuant to the 1982 Agreement. The Director of IWD, Ontario Region is a member of the Review Board which is responsible for overseeing the implementation of the COA.

3.1 IJC Water Quality Board

Inland Waters Directorate continued to provide extensive support to the IJC Water Quality Board and its committee. Staff of IWD, Ontario Region serve on the Board, the Board's Water Quality Programs Committee and the Surveillance Work Group. IWD, Ontario Region personnel were also extensively involved in the preparation of progress reports to the Great Lakes Water Quality Board.

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

Lake Ontario

One full-chemistry spring and three limited-chemistry surveillance cruises were conducted in 1987 by the Canadian research ship CSS Limnos. Nutrient and major ion samples were collected at 100 stations throughout the lake during these cruises. In addition, during spring, large-volume (37L), surface whole water samples were collected at 39 sites for the analysis of trace organic contaminants (organochlorines (OC), Polychlorinated Biphenyls (PCB), chlorobenzenes (CB) and polynuclear aromatic hydrocarbons (PAH)). This was a repeat of a survey conducted last year so that confirmed baseline data for the open water could be established.

A paper entitled "Response of Lake Ontario to Reductions in Phosphorus Load 1967-1982" was presented at the Symposium on Large Lakes held in Konstanz, Germany.

Lake Huron

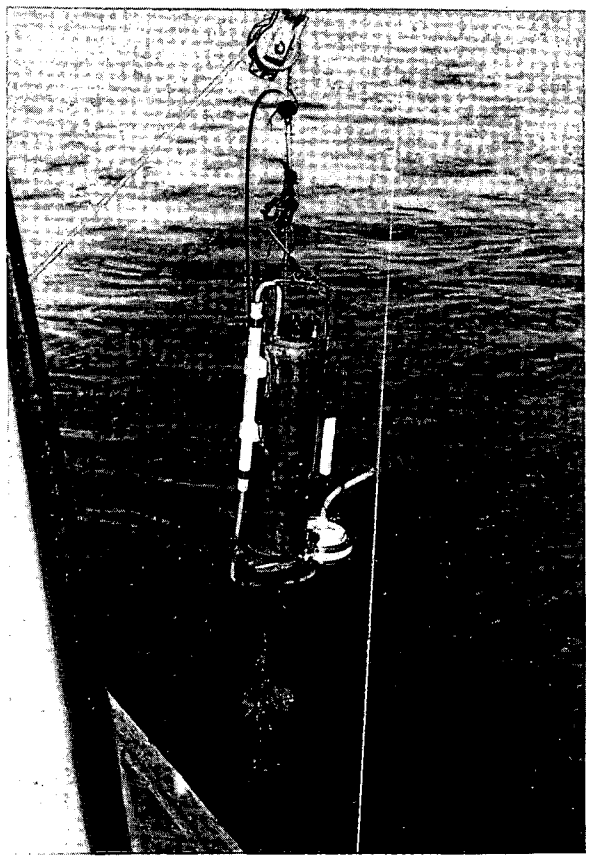
One spring and one summer open lake surveillance cruise, sampling approximately 90 stations, were conducted on Lake Huron-Georgian Bay for nutrients and major ions. Similarly, 72 stations on Lake Superior were sampled during the spring period. Twenty-five and 19 large-volume (56L) samples were collected from Lakes Huron and Superior, respectively, and extracted on-site using the Goulden extractor for OC's, PCB's, CB's and PAH's.

A comprehensive analysis of Lake Superior water chemistry data (1973-1986) was completed. A report summarizing the data and recommending future sampling strategies for the open lake component of GLISP is in progress.

A report summarizing the 1986 Lakes Superior, Huron/-Georgian Bay, Erie and Ontario trace organic contaminant surveys was completed. The report "Inter- and Intralake Distributions of Trace Organic Contaminants in Surface Waters of the Great Lakes" has been accepted for publication in the Journal of Great Lakes Research. As well, the results will be presented at the International Association for Great Lakes Research conference held at McMaster University, Hamilton in May 1988 and at the Society for Environmental Toxicology and Chemistry conference in November, 1988.

The design, operation and performance of the Goulden large-volume extractor was described in the IWD publication "A Large-Sample Extractor for Determining Organic Contaminants in the Great Lakes".

3.3 Niagara River Toxic Contaminants



The Seastar Sampler being deployed on the Niagara River

The Niagara River Toxics Committee (NRTC) report released in November, 1984 assessed toxic contaminants and their sources in the Niagara River, reviewed toxic chemical control programs, recommended improvements to those programs and proposed a long term monitoring program. In late 1985, a Niagara River Monitoring Committee (RMC) was formed with the Director, IWD, Ontario Region as chairman to develop a monitoring plan based on the Report's recommendation. The committee has three objectives: the assessment of the degree of compliance with jurisdictional control requirements; the assessment of trends to determine response to control measures, the effectiveness of those measures and emerging problems; and the identification of sources of toxic substances inputs to the Niagara River. In addition to supporting the work of the Monitoring Committee, IWD, Ontario Region maintained its ongoing surveillance and monitoring activities on the Niagara River.

The Niagara River Toxics Committee (NRTC), in its report of 1984, recommended that 57 Group I chemicals of concern should be monitored in the Niagara River and that differential loading estimates of each of these chemicals should be determined. A new sampling protocol was established at Niagara-on-the-Lake (NOTL) and Fort Erie beginning in April 1987. A new liquid-liquid counter current extractor (GLSE), developed by the late Dr. Peter Goulden of the National Water Research Institute (NWRI) was used to extract large volumes of centrifuged water (approx. 50 L.) on a continuous basis over a 24 hour period at the two stations. At the same time, suspended sediments are collected for a 24 hour period. The flow through period of the river (approx. 15 hours) has been taken into account so that samples at Fort Erie are collected 15 hours in advance of those at NOTL. All samples are spiked with surrogate spikes so that field and lab extraction recoveries are known.

Analyses for most of the 57 chemicals in the Group I list were completed. These included several groups; volatiles (water only), chlorophenols, organochlorine pesticides and PCB's, polynuclear aromatic hydrocarbons, 2,3,7,8-TCDD, phthalates and chlorobenzenes.

A joint four party report, on the first data set collected from April 1986 to March 1987 under the four party agreed to Sampling and Analytical Protocols and the new agreed to Maximum Likelihood Estimate Statistical Procedures was jointly prepared by DOE (WQB and NWRI) New York State Department of Environmental Conservation (NYDEC), U.S. Environmental Protection Agency (USEPA) Ontario Ministry of the Environment (MOE). It was submitted to the RMC, approved and released in January 1988.

A list of persistent toxic chemicals of concern was prepared by DOE(WQB) and Fisheries and Oceans Canada (DFO) for the Niagara River. This list was used as the preliminary list from which those chemicals as candidates for 50% reduction by 1996 would be selected. A joint four party selection procedure for developing this procedure was developed.

An unsolicited proposal "Determination of Contaminant Concentrations Across the Niagara River Using Automatic *in situ* Water Samplers" was completed in November 1987 and a preliminary report was received in March 1988. The main objectives of this proposal were to compare and validate the results and field test the Seastar *in situ* resin samplers with the GLSE sampler at NOTL and to measure the cross stream homogeneity at the NOTL station location.

Two papers on the performance of the GLSE, were presented at the AWRA Symposium in Syracuse in May and at the "Preconcentration of Trace Organics from Large Volumes of Water" workshop at CCIW in June. Also, a draft report, "Design and Operation of a Multi-Intake Water Quality Monitoring Station at Niagara-on-the-Lake" and an internal WQB report entitled "Comparison of Continuous Daily and Weekly Sampling of Organic Contaminants" were prepared.

Support was provided at the NOTL site during November 1987 for the field testing of the Zenon large volume extractor which has been developed under an Unsolicited Proposal with NWRI.

Extensive coordination activities were carried out with each of the agencies involved with the Niagara River Toxics Management Plan ie. USEPA, MOE and NYDEC. Membership on each of the following groups: Sampling Protocol Group, Analysis Protocol Group, Data Interpretation Group, and chairmanship of the RMC was maintained.

As part of the activities of the "Sampling Protocol Group", the Niagara River Sampling Protocol Document was revised to reflect any changes which were implemented since it was originally drafted. It was approved by the members and sent to the RMC for its approval.

Membership was also maintained on the Niagara-St. Lawrence River Task Force. Numerous tours were given of the sampling stations at NOTL and Fort Erie during the year. Visitors included delegates from the United States Geological Survey (USGS), the Tennessee Valley Authority, the Deputy Minister for DOE and the Regional Director General, Conservation and Protection, Ontario Region.

3.4 St. Clair River Toxic Contaminants

WQB established head and mouth water quality monitoring at the St. Clair River in 1987. Water and suspended sediment samples were collected at Point Edward and Port Lambton on a bi-weekly interval. These samples were analyzed for a variety of inorganic and organic chemicals. A preliminary report is planned for the coming year once chemical analyses are completed.

3.5 *Interconnecting Channels Water Quality*

Niagara River

Construction at the Niagara River sampling station at Fort Erie

During May 1987, WQB-OR marked the 12th anniversary of collecting water quality samples at the Niagara-on-the-Lake station. Automatic water quality samplers at Niagara-on-the-Lake and Fort Erie collected samples three times a week for nutrients and weekly samples for major ions, trace metals and radionuclides in order to determine chemical loadings from Lake Erie and to Lake Ontario. Results of these analyses are provided annually to the IJC (1986 draft report prepared) for inclusion in the Great Lakes Water Quality Report. A report, "Recent Trends in Water Quality of the Niagara River" which summarized water quality trends observed at the Niagara-on-the-Lake station during the 1976-83 period was published in the IWD Report series.

During the year, significant improvements have been made to both the NOTL and Fort Erie stations. At Fort Erie a stilling well and shed were installed with the assistance of Water Resources personnel and the trenching for the three lines system was completed by the Technical Operations Dive Unit in July. At NOTL, after several changes in plans, the sampling equipment was finally moved to the new lighthouse installation in March 1988. The trenching was completed from the lighthouse to the old pumphouse as well.

The Niagara River input to the IJC Appendix B was completed and reviewed for the Niagara-St. Lawrence River Task Force.

St. Lawrence River

Water quality monitoring continued in the St. Lawrence River at the Wolfe Island station. Twice weekly samples for nutrients, weekly samples for major ions, trace metals and radioactivity were collected with a new automatic water quality sampler, designed by WQB-OR. The main objective was to determine chemical exit loadings from Lake Ontario.

Monthly large volume samples (40 L) of whole water and suspended sediments were also collected and analyzed for trace organic contaminants. Results of the analysis are provided annually to the IJC for inclusion in their Great Lakes Water Quality Report. Three reports; "Water Quality at the Inlet to the St. Lawrence River, 1977-83", detailing changes in the water quality at the Wolfe Island station; "Contamination in the Bottom Sediments of the St. Lawrence River in June 1975", showing levels of bottom sediment contamination in a survey carried out between Kingston and Cornwall in 1975; and "Organochlorine and Polyaromatic Hydrocarbons in the St. Lawrence River at Wolfe Island, 1982/84" were published in the IWD report series.

Internal draft reports which summarized material loadings from Lake Ontario to the St. Lawrence River in 1985 and 1986 were prepared for distribution to the IJC.

Contributions which summarized eutrophication and toxic chemical loading and trends observed at the Wolfe Island station since 1976 were also made to the Appendix B report on the St. Lawrence River for the Water Quality Board Report.

A new project in which a series of transects on the North and South Channels of the St. Lawrence River at Wolfe Island were sampled was initiated. The main objectives of the study were to measure the cross channel homogeneity at these locations and make a comparison with Wolfe Island data. Nine surveys, on an approximately monthly basis and a preliminary report describing the sample collection methods used were completed.

A report entitled "An Assessment of Existing Information Regarding PCBs in the Cornwall-Massena Section of the St. Lawrence River" was prepared and presented at a Canada-U.S. meeting held in New York City in January.

3.6 *Atmospheric Loading*

WQB continued to operate a network of 16 precipitation stations in support of the IJC Great Lakes International Surveillance Plan to estimate atmospheric loadings in the Great Lakes Basin. The Branch also operated a small network of four organic precipitation stations, one in each lake basin, (Sibley Park, Manitoulin Island, Pelee Island, and Wolfe Island), to measure trace organic contaminants in wet precipitation. A draft report on the results of the first year of study was completed. WQB also participated in the IJC Atmospheric Deposition Monitoring Task Force in preparing "A Plan For Assessing Atmospheric Deposition to the Great Lakes". Plans are being undertaken in conjunction with the Atmospheric Environment Service to implement some of the activities in support of Annex 15 of the Great Lakes Water Quality Agreement.

3.7 *Phosphorus Management*

Annex III of the 1978 Canada/U.S. Great Lakes Water Quality Agreement specifies total phosphorus target loads

for each of the Great Lakes. These loads were confirmed by the October, 1983 signing of the Phosphorus Load Reduction Supplement to the Annex. The supplement forms the basis for the establishment of load allocations and compliance schedules for the two countries. A federal/provincial task force was established in January 1984 to develop a "Canadian" phosphorus load reduction plan for the Great Lakes in accordance with the supplement.

Major emphasis in the Phosphorus Load Reduction Plan is being placed on agricultural sources which could be reduced by approximately 10% through the adoption of improved soil management and conservation practices on farms located in priority management areas. WP&MB has been involved in the identification of priority management areas for several years. During 1987, WP&MB in cooperation with the Essex Region Conservation Authority completed a three-year study which verified and calibrated the LANDS sediment yield model for identifying priority non-point source erosion areas in Essex County. Sediment and phosphorus delivery were monitored weekly and during high runoff events from 12 small watersheds. Analysis of the study's results revealed that the water quality data supported LANDS' predictions.

Another important component of the phosphorus management plan is the question of phosphorus retention, transformation, and export in rivers. An understanding of phosphorus dynamics in river ecosystems is essential for the development of effective strategies for the reduction of phosphorus loadings to the Lower Great Lakes. The effectiveness of phosphorus control at point/non-point sources on tributaries is currently subject to considerable uncertainty, particularly with regard to how much reaches the open lake and in what time frame. In 1986, WP&MB completed a thorough state-of-the-art review and analysis of phosphorus dynamics in Great Lakes river ecosystems which will form the basis for resolving several specific phosphorus management related issues. In 1987, WP&MB completed phase 2 of the study in which information gaps were identified and historical water quality and flow data were used to develop a phosphorus transport model for the Grand River.

IWD continued to provide management and scientific support to the Environmental Monitoring and Modelling Committee (EMMC) and its Technical Committee and Sub-Committee. The COA Review Board has directed that this committee oversee the development of a plan to determine the effectiveness of point and non-point source phosphorus reduction measures. An integral part of the Committee's work relates to the Soil and Water Environmental Enhancement Program (SWEEP) in southwestern Ontario. This program is aimed at reducing phosphorus loadings in the Lake Erie basin from cropland run-off by 200 tonnes per year and at improving the productivity of southwestern Ontario agriculture by reducing or arresting soil erosion.

IWD representatives serve on the Management Committee and various other committees associated with SWEEP. Under the SWEEP Agreement, IWD has been assigned the responsibility of installing and operating 6 water quantity stations at pilot watersheds in the Basin. These watersheds will study the effectiveness of introducing comprehensive soil and water conservation practices on all farms within a small watershed. During the year, Agriculture Canada hired a contractor to select watersheds and construction of the stations by WRB was scheduled to begin in May, 1988.

WP&MB chaired the Modelling Task Force of the EMMC. An inventory of all phosphorus studies undertaken in Ontario and available monitoring and modelling data was completed. In addition, an agricultural modelling approach was developed to evaluate the effectiveness of the SWEEP Program and presented to SWEEP and COA.

In 1987, the Lands Division of WP&MB participated in a study of crop residue in southwestern Ontario as part of the SWEEP program. This study, which analyzed data on crop residue from over 10,000 farm fields, provides the most thorough look at crop residue to date in Ontario.

Seven percent of the fields in the study had crop residue exceeding 30% cover of the soil. This level of crop residue cover is associated with marked reductions in soil loss and sediment/phosphorus transport. Eight percent of fields had 15-30% crop residue cover which would tend to provide some erosion protection, while 85 percent of fields were found to have 0 to 15% crop residue cover. This lower level leaves the soil vulnerable to the erosive effects of wind and water.

3.8 Remedial Action Plans

Water Planning and Management Branch provided socio-economic expertise on the Remedial Action Plan (RAP) Steering Committee and drafted a set of guidelines for socio-economic work in the RAP process. Assistance was also provided in the development and implementation of public consultation programs for the 17 Canadian RAPs.

At the request of the Hamilton Harbour Remedial Plan Writing Team, a study was undertaken by WP&MB to estimate the cost of dredging and disposal of contaminated sediment from Hamilton Harbour. The estimated costs were calculated based on mapping of sediment toxicity, sediment surveys, and current dredging and disposal practices.

4.0 FLOOD DAMAGE REDUCTION PROGRAM

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 damage reduction measures where these offer the best solution.

The Inland Waters Directorate, through its Water Plan-

ning and Management Branch, is involved with the Province of Ontario in a program to reduce flood damages. Environment Canada on behalf of the federal government, signed an Agreement with the Province of Ontario on March 31, 1978, to provide funding to map flood risk areas and other flood damage reduction measures. The Agreement provided for $8.50 million over a 5 year period and $1.2 million for other measures over 10 years.

The Ministers for Environment Canada and Ontario Natural Resources signed Amending Agreement No. 1 to the Canada-Ontario Flood Damage Reduction Agreement in 1985, providing an additional $8.4 million ($7.4 million for mapping and $1.0 million for other measures) to the agreement which was also extended to 1995.

4.1 Flood Risk Mapping

The identification and mapping of the flood risk area and its designation are the primary functions of the Program. The majority of mapping studies are implemented through the local Conservation Authorities (CA) and Municipalities. In 1987, projects were in progress in Conservation Authorities, as well as several municipalities where no organized Conservation Authority exists. The policies of the Agreement come into effect upon designation. These policies put limitations on:

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

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

Where a two-zone flood risk area has been designated, including the floodway and flood fringe, the above policies will apply to the floodway zone only. Development would be allowed within the flood fringe provided it is adequately protected from flood damage. Any significant additions or enlargements made to the existing buildings in the flood fringe, however, would require flood proofing to be eligible for future disaster assistance.

Existing development would continue to be eligible for government flood disaster assistance and other government funded programs such as CMHC mortgage insurance. Normal maintenance of existing structures can continue as before.

The Steering Committee recommended and the Ministers for Environment Canada and Ontario Natural Resources agreed to designate the flood risk areas along Hanlon's Creek in Guelph, Galt and Irish Creek in Aberfoyle and Cambridge, fourteen streams and fourteen communities in an Authority wide basis in the Lower Trent Region Conservation Authority, eleven streams and fourteen communities in the Nickel District Conservation Authority area, Wahuapitac River at Wanup, three communities and several streams in the Ottawabee Region Conservation Authorities, Spanish River and Darkie Creek in Espanola, Thessalon River at Thessalon and several communities on the Goulais River. Flood and associated erosion risk areas along Lake Huron in the Maitland Valley Conservation Authority were designated. The erosion risk line was for information only and not designated. This brought the total number of designations in Ontario to fifteen. To date in excess of 90 streams and 120 communities have been mapped under the Agreement. Of these, 67 communities along 47 streams accounting for over 47% of the province's population have been designated.

Work towards designation of a number of flood risk areas was finalized. The Steering Committee agreed to recommend the designation of flood risk areas in the Town of Dresden along the Sydenham River, the City of Kingston along the Little Cataraqui Creek, the City of Belleville and adjoining townships along the Moira River and Bell Creek, and several communities along the Nith and Conestogo Rivers in the Grand River Conservation Authority. Open houses, an integral part of the designation process were held in these communities. Several projects, for which open houses were held in previous years continued to be on hold to resolve the implementation of a two-zone floodway-flood fringe policy. Public information meetings were held in two locations prior to the Steering Committee making recommendation for the designation of flood risk areas along the Lake Ontario shoreline within the jurisdiction of the Metropolitan Toronto and Region Conservation Authority. However, as the shoreline policies are being developed in Ontario, this project was also put on hold. Public meetings were also held in conjunction with the official plan meeting for the flood risk areas in Dryden and Schrieber. Designations will now follow in late 1988.

Procedures were initiated for the public information maps and open houses for the Township of Homepayne (Little Jackfish River), the Village of Elk Lake (Elk Lake), and the Townships of Anson, Hindon and Minden and Lutterworth (Gull River). Plans were put in place to initiate public information map preparation by compiling flood history, community development profile, etc. for over fifteen Conservation Authorities and communities.

During this reporting period a total of 52 projects were funded under the Program with a budget of about $2.0 million. As a major redirection in the Agreement, the Steering Committee initiated a comprehensive mapping program of the Great Lakes shorelines from Christian Island in Lake Huron to Grimsby in Lake Ontario. This component is estimated at about $1.6 million. The implementation of the Project Administration Team continued to pay dividends to the Program in terms of improved quality, timeliness of the

product delivery and studies completing within budgets.

WP&MB was actively involved in negotiations with the staff of the Cities of Brantford and Chatham. Both these communities have large sections of their area in the floodplain and without adequate and quality information on flood risk. WP&MB staff also participated in the controversial issue of the requirement for municipal resolutions prior to initiating the mapping projects. The Branch staff jointly with the province arranged a mapping seminar aimed at Project Team members, CA/Municipal/Regional Offices responsible for mapping, consultants, technologists, technicians and mapping contractors. The Technical Sub-Committee introduced the project status forms for ongoing projects which are updated routinely by the Project Teams.

An integral component of the Flood Damage Reduction Program is the provision of information to the public and other government departments and provincial ministries. This information is focussed on explaining the nature of the Program, the extent of flood risk areas and government policies that apply to the designated area. The Branch participated in and staffed the Program displays at the Canadian Real Estate Association Conference and the Toronto International Boat Show. A guest lecture on the technical aspects of the Program was made to the final year civil engineering class at McMaster Uiversity. An updated and much revised Program brochure was published and distributed at the public meetings and to all Conservation Authorities. During the year, extensive use was made of the public information brochure, flyers, display panels and audio-visual presentations.

4.2 Other Flood Damage Reduction Measures

A comprehensive hydrology study, "Antecedent Precipitation Index" was completed by MacLaren Plansearch at a cost of $60,000. The project aimed at improving the flood forecasting capabilities of the Streamflow Forecasting Centre in Toronto. The project developed aids to compute the volume of precipitation available for runoff.

A second project in the series aimed at improving flood forecasting procedures was nearing completion. The categorization of watersheds for operational flood forecasting was 85% complete. A seminar was held in June to present the proposed categorization technique to the end user, receive input and modify procedures. An expert system is being developed to assist in the process. The project will cost $100,000.

The Nottawasaga Valley and Muskoka System comprehensive hydrology studies were completed at costs of $101,000 and $72,000 respectively. These studies have provided design flows for five mapping projects in Nottawasaga and three in the Muskoka area. Work is nearing completion on the Damage Centre Analysis Study for the Niagara Peninsula Conservation Authority. The policy development guideline study for delineating floodway project was completed. The project addressed various topographic, social, technical, cultural and political constraints imposed in properly assessing the floodway/flood fringe concepts.

The Steering Committee approved a major project aimed at the Lake Superior Shore Property Damage Economic Evaluation and Social Impact Assessment. The project has been completed by Marshall, Macklin, Monaghan Ltd at a cost of $107,800. The study is evaluating potential flood damages to residential structures along the Canadian shoreline of Lake Superior.

Three comprehensive hydrology studies were initiated during the year. The hydrology studies in the Niagara area are aimed at providing quality and consistent estimates of design flows for the revised floodplain criteria in the Authority. The Spencer Creek hydrology study will address the politically sensitive issue of design flows from a number of past studies. The Grand River hydrology study project will use information from past studies and employ a single hydrologic model for consistency and estimates for future studies.

4.3 Indian Lands Mapping

The two floodline mapping projects initiated last year with the Department of Indian and Northern Affairs namely the Root River Study for the Rankine Indian Reserve No. 14 and Garden River for the Garden Indian Reserve are nearing completion. A comprehensive historical flood review was initiated for the Indian Reserves located north of 50 degrees North Latitude. This study estimated at $94,500 is being carried out by L. Kriwoken. The review will provide a qualitative estimate for flooding in the northern communities and may provide the only means of flood level estimation in such areas.

5.0 WATER QUANTITY MANAGEMENT DATA PROGRAM

Basic water quantity data is one of the fundamental building blocks that leads to wise and informed decisions for virtually all water management purposes and activities. Whether decisions are local, regional, national or international, the systematic collection and compilation of water resources data is vital for such activities as monitoring and enforcement of regulations, irrigation, hydro-electric power generation, flood forecasting and environmental assessment. Long term records are important to consultants and designers in designing structures to withstand extreme hydrologic events over the life of structure and to provide adequate protection for water quality purposes. Important global and national environmental issues such as acid rain, climate change and toxic substances require good water inventory information to assess trends and determine impact on the nation's water resources. Again, long term records that are representative

of actual conditions are vital to this assessment.

The objective of the Water Quantity Management Data Program is to provide this basic water quantity information to meet Canada's responsibilities as described in legislation and in agreements. IWD is extensively involved in meeting this objective and ensuring that data user needs are met through collecting, processing and distribution of surface water quantity data, directly or indirectly, from a network of some 3500 stream gauging sites across Canada. The analysis and interpretation of data is also a necessary part of the program to enhance services and products for clients as well as for network planning and evaluation.

5.1 Hydrometric and Sediment Surveys

The collection of water quantity information in Canada began on an isolated and informal basis at the turn of the century. The network grew over the years and in 1975 an important step was taken by the federal and provincial governments to improve the management and coordination of surface water data collection in Canada. That step was the signing, by the Minister of Environment, of Cost Sharing Agreements for Water Quantity Surveys with each of the 10 provinces and with the Department of Indian Affairs and Northern Development on behalf of the Northwest Territories and the Yukon. Besides appropriate cost-sharing arrangements, the agreements have provided for operational efficiencies; a standardized approach to data collection and compilation; assurance of a standardized, national data base; and benefits of new technology to both parties.

In Ontario, as per the terms of the Cost Share Agreement, construction and operating costs for Federal stations are funded entirely by Canada, Federal/Provincial stations are cost shared at 50/50 and Provincial stations are funded by the Province. Canada, as the operating party in Ontario, is responsible for providing and paying the total cost of the primary water level recording equipment while the requesting agency pays for the purchase, installation and operation of specialized equipment such as meteorological sensors and real-time data collection units.

Schedule A of the Agreement is prepared each year and specifies the stations to be operated, their classification, and the operating party. There were 380 active hydrometric stations operated by IWD Ontario Region as of April 1, 1987 (shown in figure 1). The stations are distributed throughout Ontario Region with the majority of stations in southern Ontario. The stations measure the flow and/or water level resulting from watersheds varying in size from less than one square kilometre to the watershed of the Great Lakes (ie. St. Lawrence River).

The Winnipeg office of the IWD, Western and Northern Region, operates an additional 47 stations in the extreme northwest part of Ontario because of the office's proximity to the stations. The network is also made up of a number of contributed data stations whose data are provided by other

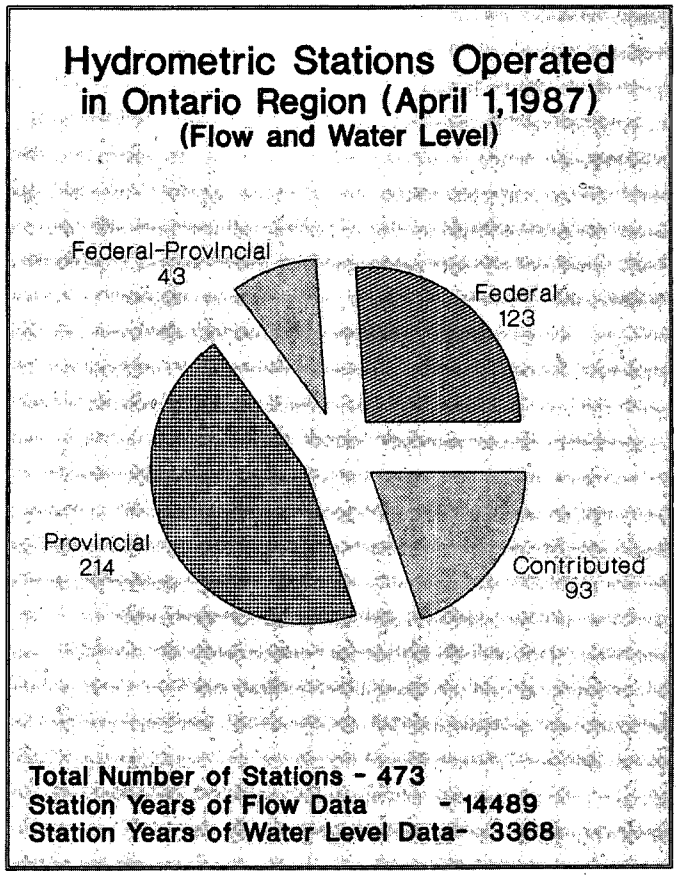


Figure 1.

agencies but published by IWD in annual data publications. There were 128 such stations in the province and the total Ontario network therefore consisted of 555 gauging stations as of April 1, 1987.

Proper operation of a gauging station requires that regular visits be made to the station for general maintenance and to specifically check and maintain instruments, replace recorder charts, check stream conditions, check actual stream levels with those recorded, and to take discharge measurements to verify relationships used to determine discharge at any given water level. During the year, hydrometric field staff in the Ontario Region made 4,128 visits to stations and took 2,272 discharge measurements by cableway, boat, wading or through ice cover. Streamflows in the Elliott Lake, Sudbury and Sault Ste. Marie areas were at extremely low levels during October, 1987 and a number of discharge measurements were taken below the existing stage-discharge curves. As a result, a number of curves had to be revised or extended downwards.

The WRB operated a network of 7 continuous and 3 seasonal sediment stations. Five northern and 32 southern stations were also sampled on a miscellaneous basis. Five miscellaneous sediment stations were added during the year for sampling under high discharge events. During the year, an automatic sediment sampler at the Don River at Todmorden site continued to assist in providing more complete

data on suspended sediment loads in this reach of the river.

A fully operational sediment laboratory in Guelph supported the sediment data collection activities. A total of 1,025 suspended sediment samples, 1 bed material sample, and 384 dissolved solids samples were completed and analyzed.

For the fiscal year ending March 31, 1987, the shareable cost for construction, maintenance and operation of the hydrometric and sediment networks in Ontario was $1,843,000, of which $951,300 was paid by the Province. Additional information on network costs is available in the 1986/87 Annual Report on the Canada/Ontario Cost Sharing Agreement for Water Quantity Surveys.

About 63% of the stations in Ontario are equipped with devices that allow users to access data from off-site on a real time basis. These devices not only improve services to users but allow technicians to plan their trips to improve data quality. In this regard a number of other projects and services were carried out over the year to improve network operations and the collection of data in the field. One data collection platform (DCP) was installed at the remote hydrometric station on the Albany River above Nottick Island for the re-transmission of data via satellite. Three more units will be installed in May, 1988 to complete the 5 year program. In addition, a number of real-time data units were installed at Southern stations at the request of clients and WRB made arrangements with 2 additional Conservation Authorities to service such equipment. This brings the total number of such arrangements with Provincial and other Federal agencies to 14.

Lightning arrestors which were installed in 1986/87 at all gauging stations with data logging equipment, to protect real-time data units against over voltages and malfunctions during electrical storms, resulted in a major improvement in servicing and percentage data capture in 1987/88.

5.2 Run-off Conditions and Events

Run-off conditions during the 1987 Spring Freshet were below normal, caused by low precipitation and resulted in only medium flows. Continued low precipitation and high temperatures resulted in extreme low discharge measurements being obtained during the summer months. Localized thunder storms occurred frequently during the summer. For example North Bay received a record 50.6 mm of rain on August 15. Flows remained low until the late fall and early winter. Above normal temperatures and precipitation then caused several drainage basins to reach their maximum discharge for the year.

5.3 Construction and Maintenance

A successful construction program was completed for the hydrometric network during 1987/88. The WRB Construction Unit constructed or assisted Conservation Authorities with the construction of 13 new stations.

Some of these projects involved the relocation of existing stations to more suitable sites to improve quality of data. Upgrading of stations which includes replacement of shelters from the Guelph type look-in shelter to aluminum shelters or Armco walk-in shelters, installation of artificial controls such as sheet steel and concrete controls, and placement of gabion baskets and rip rap to prevent bank erosion, was carried out at 12 sites. Twenty-seven maintenance projects were also completed. The projects ranged from modification and repair of cableways to repair of shelters and intakes.

A large number of field investigations were conducted to select sites for new stations, to plan major upgradings and maintenance and identify problems. A total of 31 such investigations were carried out.

Further details on the construction program are available in the Annual Construction Report which is prepared by WRB each fiscal year.

5.4 Data Processing, Publication and Distribution

During 1987/88, the WRB answered 640 requests for technical data, advice, and information related to the hydrometric and sediment network. Approximately 3,680 station-years of data were distributed, comprised of 206 requests (3,200 station-years) for historical data, 308 requests (480 station-years) for current-year data and 126 requests for other related information. The WRB completed the processing of 1986 hydrometric data on June 25, 1987 and the 1986 sediment data on October 9, 1987.

The streamflow data for two hydrometric stations (Saugeen River near Port Elgin and Missinaibi River at Mattice) continued to be reported on a monthly basis to the United States Geological Survey (USGS). The USGS incorporates these data in their regional hydrologic analyses and publishes the results in the "National Water Conditions Bulletin". Monthly reporting of streamflow at 17 stations in the Canadian portion of the Great Lakes Basin continued as part of the Great Lakes and St. Lawrence River Basin Water Level Control Program.

Several data publications were printed and distributed during 1987/88, including:

— Surface Water Data—Ontario 1986
— Surface Water Data Reference Index—1986
— Surface Water Data Reference Index Map Supplement—Ontario 1986
— Historical Streamflow Summary—Ontario 1986
— Historical Water Level Summary—Ontario 1985
— Sediment Data—Ontario 1985
— Sediment Data—Ontario 1986
— Sediment Data Reference Index—1984
— Miscellaneous Sediment Data—Canada 1966-1983

Under the WRB Quality Assurance Program the Regional Evaluation Team examined selected stations for conformance to the WRB National Standards for water

quantity data collection, computation and processing. Under a mutual agreement between the WRB Regional Chiefs of Ontario and Atlantic Regions, the Data Control Engineer, Guelph and the Regional Engineer, Dartmouth, sat as observers to each other's adult program to facilitate the exchange of ideas and techniques.

Expansion of the WRB Ontario Region EDP system during 1987/88 included the purchase of Ethernet internal communications equipment, seven graphics terminals, two Microvax II's, one Compaq 286 PC, one desk top plotter and several A/B switches to facilitate equipment sharing for non-networked equipment. This expansion will significantly improve the efficiency of the WRB operations and permit Branch to offer a higher level of service to data users.

A number of data users are utilizing interactive access to the WRB Guelph mini-computer for the downloading of data to their own terminals and/or computers. By year's end, 16 user accounts resided on the system, including 7 consultants, 6 provincial agencies, 2 federal agencies, and one educational institution. As an added service to the data user, procedures were developed to download the data from the DEC mini-computer to a Compaq 286 and then onto floppy diskettes for use in the users' IBM-type units.

5.5 Network Evaluation/Planning and Other Studies

Hydrometric

Network evaluation and planning studies are carried out under the terms of the Canada/Ontario Cost Share Agreement to ensure the hydrometric network provides the required data at lowest cost. Due to ever-changing data requirements and costs, network evaluation and planning is an on-going activity.

The history of the hydrometric network is depicted in figure 2. The graph shows the number of stations operated in Ontario Region since 1905. It shows an increase in the number of stations between 1907 and 1915 and between 1937 and 1975. The size of the network has remained relatively constant from 1975 to the present. Some of the stations begun around the turn of the century are still in operation and provide very useful long-term data sets.

Since 1975 changes to the network have continued although the total size has remained relatively the same. There has been a general increase in the number of project type stations and a decrease in the portion of the network referred to as the regional hydrology network. The regional hydrology network is used to estimate streamflow characteristics (e.g. mean annual flow) at gauged and ungauged sites in a particular region.

During 1987/88, the WRB continued its role of chairing the Network Evaluation and Planning Sub-Committee which coordinates the network studies of the four member agencies (Environment Canada, Ontario Hydro, Ontario Ministry of Environment, and Ontario Ministry of Natural Resources).

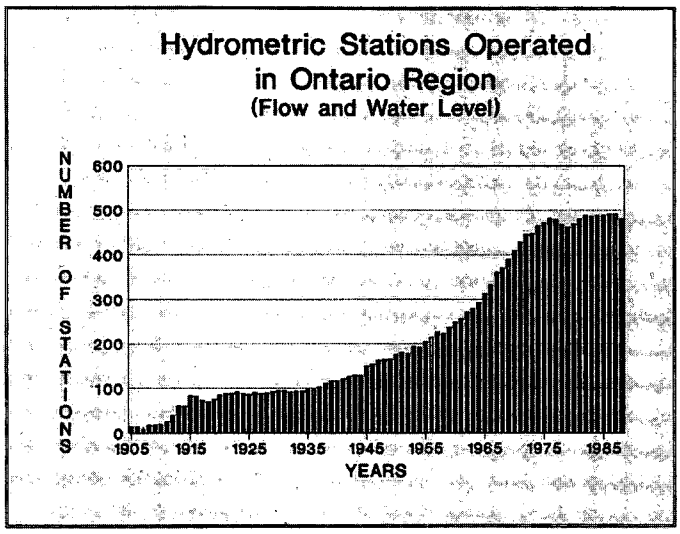


Figure 2.

The WRB completed the analysis of more than 200 responses to a questionnaire that was distributed to users of Ontario hydrometric data. The results show extensive use of Ontario data, particularly streamflow and water level data. The many users cited a wide variety of projects and activities that require hydrometric data, such as the design and operation of water control structures, flood warning and water quality monitoring. The results also show parts of Ontario where more data is required and the WRB will be upgrading the network, as resources permit, to meet as many of those requirements as possible. A report on the questionnaire results is now available.

During 1987 the WRB received a significant reduction in its manpower resources for IWD network operations. Therefore, an extensive review of IWD interest in each Ontario Region hydrometric station was carried out and any IWD-funded stations which could possibly be discontinued were identified. After discussion with the major users of the data, it was decided to discontinue 14 stations; another 11 stations were continued, but only because of increased funding by other users.

Hydrologic studies are carried out under the Water Quantity Management Data Program in order to make the hydrometric data more useful for the data users. Various hydrologic techniques can be used to estimate or improve the accuracy of hydrometric data, to simulate data for missing periods of record, simulate data for ungauged sites, and to identify hydrologic characteristics of a watershed.

The historical streamflow data for the two stations (Saugeen River near Port Elgin and Missinaibi River at Mattice) are analyzed on an annual basis to determine long-term normals (maximum, minimum, and mean flows) for use in the WRB monthly "Water Resources Review" report and the USGS monthly publication "National Water Conditions Bulletin". Comparing the current-year's flow with the long-term normals gives the data user an indication of the relative magnitude of the current-year runoff in Ontario.

The WRB continued to produce a monthly report "Streamflow Conditions in the Canadian Portion of the Great Lakes Basin". The report compares present streamflows at 17 selected sites with previous streamflows and long term normals. The levels of the Great Lakes are strongly affected by incoming streamflow from the Canadian portion of the basin and the monthly "Streamflow Conditions" report is therefore very useful in explaining the extreme changes which have been occurring in the water levels.

A number of activities were carried out to enhance the Sediment Surveys Program in the Region. Several recommendations provided in National and Regional Action Plans were carried out.

Reports entitled "Ontario Sediment-Related Literature: annotated Bibliography" and also "Sediment Data Reference Index for Ontario" were completed under contract.

A sediment station analysis report was completed for the Humber River at Elder Mills station.

A three-day workshop, jointly sponsored by the Ministry of the Environment and the Water Resources Branch was held Oct. 28-30, 1987 at CCIW, Burlington. Staff of both agencies were provided with demonstrations and explanations of various Water Quality and Quantity techniques and methodologies used in surveys and their inter-relationships. Tours of the Hydraulics and Water Quality laboratories were provided. Better understanding of each others agencies functions and field surveys was the theme of the workshop.

5.6 Tides and Waters Levels Network

In addition to the regular hydrometric stations operated under the Canada/Ontario Cost Share Agreement, WRB continued to operate 34 water level gauges on the Great Lakes and St. Lawrence River System on behalf of the Canadian Hydrographic Services (CHS) of the Department of Fisheries and Oceans (DFO). These gauges are part of the DFO network of tides and water level gauges which provide data for navigation and water management purposes. Under the terms of a Memorandum of Understanding (MOU) with DFO, IWD operates and maintains these gauges and publishes the data from them in its surface water data publications. DFO retains ownership of the gauges, operates and maintains specialized equipment for navigational applications, processes the data, and publishes weekly and monthly reports and bulletins on water levels.

The Regional Tides and Water Level Coordinating Committee met once during the year to review network operations and requirements for the coming year as per the terms of the MOU between DOE and DFO. Major maintenance projects were carried out at 2 stations.

Data entry units (DEU's) were installed at several sites by CHS. This brings to 16 the number of Tides and Water Level stations equipped with data loggers and DEU's. The units permit gauge attendants and Water Survey of Canada staff to enter observed data into the data logger memory on each visit. When the data is accessed by DFO, a comparison between logged data and observed data that was entered can be made to confirm data reliability.

The Water Resources Branch cooperated with the CHS, the National Ocean Survey of the National Oceanic & Atmospheric Administration of the U.S., and the Detroit District of the U.S. Army Corps of Engineers to document at the request of the Coordinating Committee on Great Lakes Basic Hydraulic & Hydrologic Data the history of the operation of water level gauges on the lower Great Lakes and their outflow rivers in the report titled "History of Water Level Gauges—Lower Great Lakes & International", March 1987.

5.7 Training

A 3-day course on the "Transportation of Dangerous Goods" was arranged during September, 1987 for all WRB hydrometric field staff. The contractor which presented the course also produced a reference manual for the WRB.

For the Hydrometric Technician Career Development Program (C.D.P.), the staff of the WRB prepared 4 draft lesson packages on "Site Selection", "Daily Discharge (Winter)", "Annual Records" and "Gauge Height Computations" at the request of WRB Headquarters. Combined with the lesson packages produced by the other Regions and HQ's of WRB, these lesson packages will be an invaluable training tool for the technicians within the C.D.P.

6.0 WATER QUALITY AGREEMENT PROGRAM

By the late 1970's and early 1980's it had become clear to Environment Canada that more coordination and cooperation was required in the collection of water quality data in Canada. Water quality data collection had evolved over the years at federal, provincial and local levels to meet specific agency data requirements with limited inter-agency and inter-governmental coordination. This had resulted in the development of parallel federal and provincial data collection and processing systems leading in some cases to gaps and overlaps in surveys and networks and duplication of some facilities. In the same way water quality data banks proliferated with means of linking them not always available. With the increasing squeeze on funding of government programs at both the provincial and federal levels the time was ripe for an initiative to eliminate duplication and increase efficiencies in data gathering programs through formal cooperation and coordination links.

In January 1982, the Federal Cabinet gave approval to Environment Canada to negotiate water quality agreements with the provinces for the collection of water quality data and information. These agreements when completed will provide for long term commitment for the acquisition of water quality data; comparable scientifically sound water quality data that are reliable for water resources manage-

ment purposes; and dissemination of timely information on water quality to the public, government agencies, industry and the scientific community. The output from these agreements will provide an ongoing national inventory of existing water quality conditions in a number of specific river basins across the country, generate the data required to assess the state of those aquatic ecosystems of federal interest in both regional and national scales, and to indicate changes in water quality that might be damaging to those ecosystems. Agreements have already been signed with Quebec, British Columbia and Newfoundland and negotiations with most other provinces and the Territories were continuing.

Six negotiation meetings were held between Ontario and Canada during 1987. Progress was made in determining what the network would consist of (i.e. the river basins of interest, the number of stations, the parameters to be sampled, how existing Provincial monitoring compares with the required national program etc.) and how much it would cost to implement; however, no agreement has been reached yet.

On a national basis, no new agreements were signed, although agreements with both New Brunswick and Manitoba have been successfully negotiated, and are awaiting approval by the new governments in these provinces before they are signed.

6.1 International and Interprovincial Rivers

Northwestern Ontario

The Water Quality Branch continued to sample four stations in northwestern Ontario as part of its commitment to monitor international and interprovincial waters. Monthly samples were collected at two sites on the Rainy River, and at one station each on the Winnipeg and English Rivers. This year, the suite of organic parameters analyzed was increased to include chlorobenzenes (CB's) and polyaromatic hydrocarbons (PAH's) as well as organochlorine pesticides (OC's) and PCB's.

A summary report was prepared on results obtained from the two Rainy River stations and submitted to the International Rainy River Water Pollution Board for inclusion in their annual report to the IJC. Results from these sites showed some detections of OC's such as alpha-BHC, lindane, dieldrin, total PCB's, dichlorobenzenes and trichlorobenzenes. All variables that were detected fell below the water quality guidelines established for the protection of aquatic life except for PCB's which were in exceedence. Previous work has indicated that the PCBs are largely adsorbed to the particulate matter in the water and are not available for uptake.

Findings of a special study carried out on the Rainy River in 1986, showed 2,3,7,8-TCDD to be present in the pulp and paper mill final effluent solids and in the suspended solids of the Rainy River downstream of the mill discharge. Further sampling of fish by other government agencies has also shown the presence of 2,3,7,8-TCDD but in concentrations below the National Health and Welfare consumption guideline.

Ottawa River

WQB staff provided input and advice to the Ottawa River Coordinating Committee and its Technical Subcommittee. The committee is responsible for coordinating the monitoring activities of the two provincial environment ministries as well as those of Environment Canada. A second annual report is presently being prepared and will be released to the Ministers in 1988.

Work carried out by WQB on the lower Ottawa River in 1986 on pesticide distribution in the river was written up in a report entitled "Pesticide Distribution, Lower Ottawa River" and submitted to IWD for publication in its Technical Series. Findings from the study showed that organochlorine pesticides and chlorophenol levels in the water were very low and fell well below the recommended guidelines for the protection of freshwater aquatic life. Higher concentrations of some pesticides were found in the South Nation River which reflects the agricultural land use patterns for that basin.

6.2 Arctic Watershed

A report entitled "Water Quality Investigations in Ontario's Arctic Watershed" was published in the IWD, Technical Workshop Series No. 6. The report summarizes water quality data based on sampling in the Moose, Albany, Attawapiskat, Winisk and Severn Rivers basins, fr 1977 to 1985.

A review was undertaken to determine sites which would be suitable for both the WQB National Index Station Network and the proposed Canada-Ontario Water Quality Agreement. Two basins which are characteristic of the Hudson Bay Lowland were chosen; they are the Kwataboahegan and Shamattawa Rivers.

In view of elevated PCB concentrations found in the Arctic Watershed, arrangements were made with NWRI to verify sampling and analytical protocols and/or establish new procedures, if required, for the determination of trace organic contaminants in humic waters. To this end, a large volume sample was collected from the Kwataboahegan River. It will be subjected to various extraction techniques as a first step in the analytical review.

6.3 National Parks

An agreement was reached with the Parks Service to undertake a cooperative water quality monitoring program detailed in "A Plan to Assess the Water Quality of the Surface Waters of Pukaskwa National Park". The plan consists of a number of studies to (1) assess baseline water

Trace metal water sampling on the Pukaskwa River

quality and provide an inventory of organic and heavy metal contaminants in the White, Pukaskwa and East Pukaskwa Rivers; (2) establish a long term monitoring plan for the three rivers; (3) provide user information regarding bacteriological water quality at the major campsites and information on the edibility of fish; and (4) assess the susceptibility of the headwater lakes to acidification. The program is scheduled to be implemented over a five year period commencing in 1987 with an annual review to assess its effectiveness.

A reconnaissance trip was carried out in the spring to determine the on-going monitoring and contaminant survey sites on the three rivers. Tailings ponds and discharge sites of the Hemlo gold developments, which drain into the White River Basin, were visited and input was received from industry and other agencies to finalize the monitoring plan.

Campsites were established in June along the White and Pukaskwa Rivers for collection of the contaminant samples, which included, bottom sediment grabs, suspended sediment samples by continuous flow centrifugation and extraction of large volume aqueous samples (500L) with a Goulden Extractor. The samples were later analyzed for PCB's, organochlorine pesticides, chlorobenzenes, polyaromatic hydrocarbons and were subjected to GC/MS scans for non-target analyses. In addition, a set of four sediment traps were deployed at four hydrologically different sites on the White River. In September, several species of juvenile fish were collected from the three rivers and submitted for OCs and PCBs analyses; tissue extracts were forwarded to NWRI for investigative contaminant analyses.

Bottom sediment samples were collected and forwarded to NWRI for toxicity screening. Arrangements for microbiological testing of river water were also completed.

A stringent water sampling protocol, which included a comprehensive QA/QC component was adopted for monitoring of the White, Pukaskwa and East Pukaskwa River. New sampling equipment, designed to maintain the integrity of trace metal samples was developed jointly with NWRI. Park Warden staff were trained in all aspects of collection and processing with sampling commencing in September. All water sample processing (splitting, filtering and preserving) was carried out at the Park in a clean-air workstation. Initial results of the blank, duplicate and replicate sampling indicated that the data were of very good quality.

The sediment traps were retrieved on a monthly basis from the White River; composite suspended sediment samples were later submitted for trace organic and heavy metal contaminant analyses. The recovery of seston at each site was reviewed at year's end to determine the preferred sites for deployment of the traps in 1988.

Retrieving sediment traps on the White River

7.0 TOXIC CHEMICALS PROGRAM

The deleterious effects of toxic materials such as mercury, lead and PCBs on the environment are of major concern considering the ultimate impacts on the 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. Contaminated 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.

Under this program, WP&MB completed its report on Toxic Chemicals in the Great Lakes Ecosystem. The report generated much media attention and was subjected to extensive interdepartmental review, particularly by Health and Welfare Canada. The study synthesized a broad scope of analytical investigations and data to illustrate evolved patterns for pollution sources, ecosystem contamination, and

states of health.

In response to the IWD Pesticides Plan (1987-88), WQB-OR received funding to hire a consultant to assess and evaluate the present situation regarding pesticides and their impacts on surface water in Ontario.

Work commenced in October, and a report was produced entitled "A strategy for monitoring pesticides in surface waters of Ontario." The report examines the jurisdictional responsibilities and policies of Agriculture Canada, Environment Canada and the Water Quality Branch regarding pesticides. It outlines pesticide research initiatives and pesticides of concern, and suggests pesticide monitoring programs that WQB could pursue in 1988/89. These include:

1) Pesticide (herbicide) monitoring of runoff in Kintore Creek. A pilot study was undertaken in the Thames River Basin to determine the impacts of agricultural pesticides on surface water. The effects of conventional tillage practices versus conservation tillage practices on herbicide levels in a paired watershed will be investigated. Water and sediment samples will be analyzed for major herbicides including Atrazine and Metolachlor. Sediments will be analyzed for Organochlorine pesticides and PCB's.

2) Monitoring of agricultural pesticides in precipitation. This pilot study will determine the technological feasibility of measuring herbicide concentrations in rainfall from Pelee Island in Southern Ontario. Major herbicides including Atrazine, Cyanazine, Metribuzin, Metolachlor, 2,4-D ad MCPA will be monitored.

3) Investigating the impacts of pesticides on selected wetlands in Southwestern Ontario. A pilot project was initiated in 87/88 to identify and map wetlands/watersheds in Southern Ontario for possible pesticide monitoring. The project examined the relationship between soil types, sediment loss rates, land use activities (cropping) and wetlands. Additional work will be carried out in 88/89 including field verification of results and evaluation of other possible data sets.

8.0 LONG RANGE TRANSPORT OF AIRBORNE POLLUTANTS PROGRAM

The problem of long range transport of airborne pollutants (LRTAP) is 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 of great concern requiring immediate attention. Recognizing the problems LRTAP could bring 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 recently signed Protocol to the 1978 Agreement has added a specific annex relating to Airborne Toxic Substances. The annex (Number 15) calls for the conduct of research, surveillance and monitoring and implementation of control measures by the Parties to the Agreement.

The long range transport of airborne pollutants such as acid rain is having serious adverse effects on both the aquatic and terrestrial ecosystems in eastern North America. Acid precipitation has its greatest effect on the waters and soils of the Precambrian Shield region which have only limited capacity for neutralizing the acid in the rain. Soil impoverishment through leaching of important nutrient elements by acid precipitation has the potential of reducing the yield from forests in this region. A recent study has linked substantially slower growth of forests in Ontario and Quebec with trends in air pollution. Several lakes in the Haliburton-Muskoka area of south-central Ontario have lost up to 75% of their buffering (neutralizing) capacity in the last 10 years. It has been estimated that there are about 48,000 lakes in Ontario that have been or could be adversely affected if acid loadings remain constant or increase over the next 10 to 20 years. This trend in aquatic environmental degradation poses serious threats to the social and economic well-being of Canadians.

The Water Resources Branch continued to collect hydrometric data from six hydrometric stations in the Turkey Lakes area in support of the National Water Research Institute and the Turkey Lakes Watershed Program. The objective of this latter study is to determine how an acid sensitive lake system responds to acidic precipitation.

9.0 ENVIRONMENTAL ASSESSMENT

Under this integrated program, IWD, Ontario Region provides direct support to the Federal Environmental Assessment and Review Process (EARP) in ensuring that environmental effects, particularly effects on water resources, are taken into account early in the planning of projects involving federal interests and funding and that appropriate measures are taken to minimize 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 1987, IWD acted as lead agency and provided input to the review and evaluation of such projects as the Initial Environmental Evaluation (IEE) for Thunder Bay's South Channel dredging and landfill project and the Environmental Impact Statement (EIS) for the U.S. Army Corps of Engineer's east-west breakwater, Mackinac Island Harbour. Included among other projects were: the Sioux Lookout Waterfront Development, Oshawa Harbour industrial

subdivision plan, Kettle Point Indian Reserve #44 breakwater and retaining wall, proposals for remedial work to reduce flooding and drainage problems in the South Nation River Basin, Burlington Beach Waterfront Park Master Plan, and Tomlinson salt handling and storage project.

In broader scope, IWD provided input to the review of the Draft Enforcement and Compliance Policy of the Canadian Environmental Protection Act, the discussion paper on reforming federal environmental assessment, the DOE Siting Task Force Report on Low Level Radioactive Waste, MNR cottage lot development program, and the proposed rehabilitation program for water distribution and sewage collection system in Ontario. WP&MB participated in reviews of geotechnical reports related to monitoring of the stability of shore bluffs fronting the Port Granby low level radioactive waste dump and the draft monitoring and response plan for the waste dump.

Sections pertaining to jurisdictions, public participation, and environmental assessment were contributed by WP&MB to the Hamilton Harbour Remedial Action Plan report. The Branch also provided regional information on the use of environmental impact assessment guidelines in project reviews to Headquarters.

10.0 CANADA LAND USE MONITORING PROGRAM

In November 1986, the Lands Directorate Regional Offices were re-organized as part of Water Planning and Management Branch of IWD in the regions. The Lands program in the region consists of two major program areas, the Canada Land Use Monitoring Program (CLUMP) and the Soil and Water Environmental Enhancement Program (SWEEP). Lands contribution to SWEEP is outlined in the section on phosphorus management (see Section 3.7).

The objective of the Canada Land Use Monitoring Program is to promote the wise use of land in Canada. Since Canada comprises a vast area, the landscape is subdivided into a number of components which are more manageable for program purposes. Two of these, the Urban Centred Region component and the Prime Resource Land component are monitored in Ontario.

The Urban Centred Region (UCR) component monitors, both spatially and temporally, changes in land use around 13 urban centres in Ontario having population of 100,000 or more. The monitoring is comprehensive in that all land use changes are considered.

In 1987 digital data-bases were produced for Toronto, Niagara, Hamilton, Kitchener and Thunder Bay. The data-bases which contain land use, vegetative cover and land capability information for 1981 and 1986 are useful in a variety of ways relating to Remedial Action Plans, lake level studies, and studies of the configuration of both the hydrometric and water quality networks as they relate to surrounding land watersheds. In 1988, a number of the data-bases will be available for the SPANS analysis system.

SPANS is a geographic information system used to display and analyze environmental information. The system has the capability to overlay 14 map coverages at a time. There is also a built-in modelling capability through which the environmental impacts of various different development scenarios can be assessed. The ability of SPANS to draw together information from existing geographic information systems, satellite image analysis systems, and digitized information allows data from diverse sources to be drawn together.

11.0 MANAGEMENT AND ADMINISTRATION

In 1987/88, the Directorate administered and managed resources amounting to 8.2 million dollars and 95.5 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 1987/88 included the Canada-Ontario Great Lakes Water Quality funding ($1,875,000 for 1987-88) and the Canada-Ontario Flood Damage Reduction Agreement funding ($700,000 for 1987-88). Approximately $1,000,000 is expected to be cost recovered from the Province in 1987-88 under the Canada-Ontario Cost Share Agreement on Water Quantity Surveys.

WP&MB staff chaired the CCIW Environment Week Committee which organized and staged a wide range of successful events in the Burlington/Hamilton area for Environment Week, June 1-7, 1987. These events included: a Concert-By-The-Lake at Spencer Smith Park (Burlington), a two-night Environmental Festival in the Burlington Central Library, and an area-wide Clean-up Your Environment Day and picnic in LaSalle Park. In addition, a greatly expanded environmental school program (40 performances) was staged in Halton Region Schools. Four different productions, featuring the Environmental Minstrels, the Portable Theatre Company, and Johnny Biosphere (Jack Vallentyne), toured area schools to promote environmental

Flooding and erosion display at the Toronto Boat Show

awareness. An area-wide literature and art competition, with winners appearing on a local radio station, rounded out the Environment Week program.

12.0 PUBLICATIONS AND PRESENTATIONS

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3. Marshall, Macklin, Monaghan, "Lake Superior Shore Property Damage Economic Evaluation and Social Impact Assessment". Study report prepared under contract to IWD/OR and the Ontario Ministry of Natural Resources, Toronto, March, 1988.
4. Moulton, R.J. and D.R. Cuthbert, "Great Lakes Water Levels: Man and Nature in the Shore Zone". Presentation and Proceedings Paper for the Canadian Coastal Conference, Quebec, July, 1987.
5. Muir, T. and A. Sudar, "Toxic Chemicals in the Great Lakes Ecosystem", Unpublished Report, Burlington, November 1987.
6. Rivers, R. and W. Bien, "Federal Water Policy and Interests". Presentation at Canadian Water Resources Association Workshop on Managing Ontario's Streams, Toronto, September, 1987.
7. Stewart, C.J., "Long Point, Lake Erie: A Review of Geomorphic and Public Response to the High Water Levels of 1985-1987". Presentation at Canadian Association of Geographers, Ontario Division Conference, Windsor, October, 1987.
8. Stewart, C.J. and R.J. Lloyd, "Observations of Past and Present Shoreline Damage on Western Lake Erie Following the December 1, 1986 Storm". Unpublished Report. Burlington, 1987.
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10. Stewart, C.J. and P.P. Yee, "Report on the 1986 High Water Levels of the Great Lakes". Unpublished Report. Burlington, 1987.
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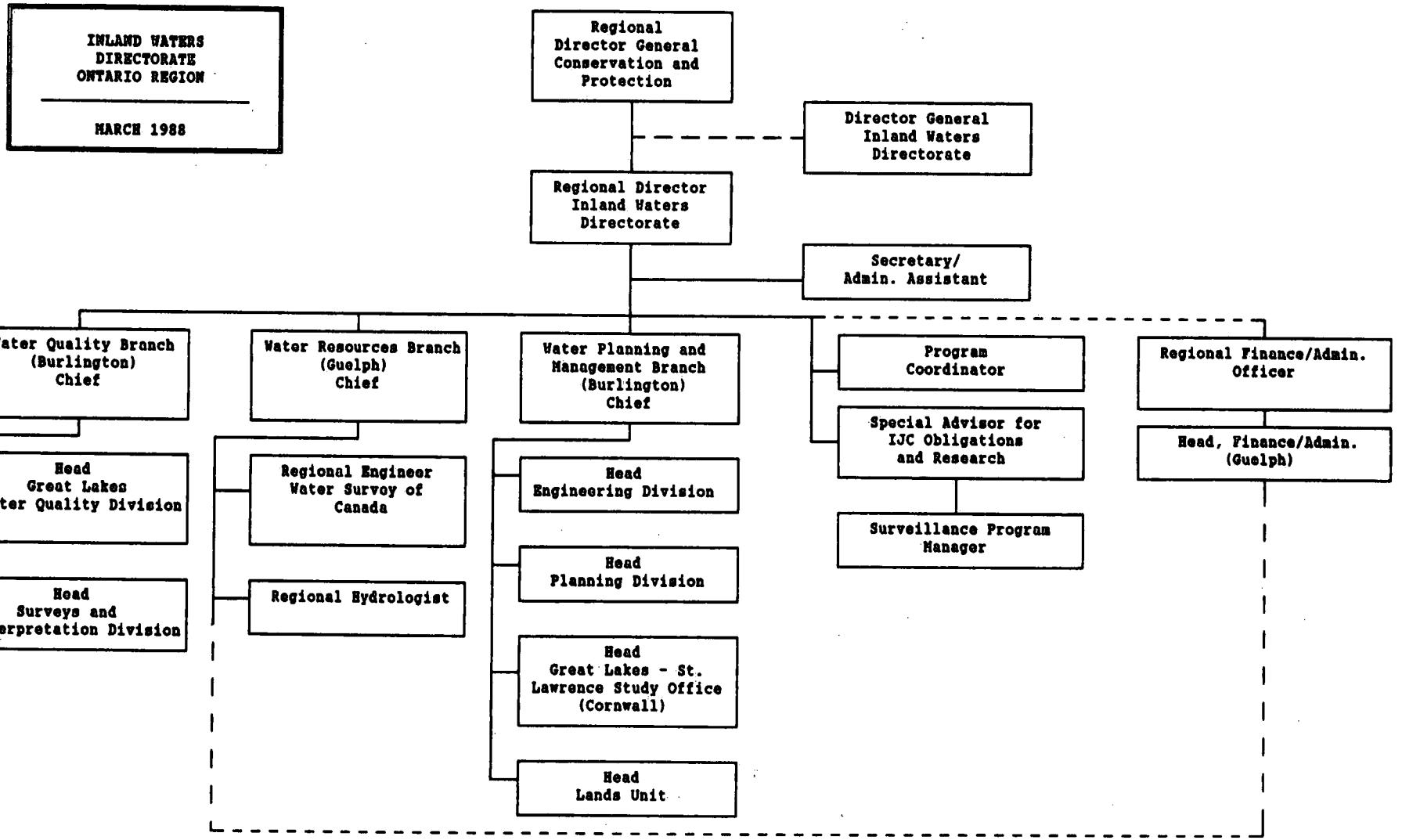
13.0 ORGANIZATION CHART



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