Environment Canada Environnement Canada

Environment Canada

The Canada Water Act

Annual Report

2001-2002

Canada

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Her Excellency
The Right Honourable Adrienne Clarkson, C.C., C.M.M., C.D.
Governor General of Canada
Rideau Hall
Ottawa ON K1A 0A1

Your Excellency:

I respectfully submit to Your Excellency and to the Parliament of Canada the annual report on operations under the *Canada Water Act* for the fiscal year 2001-2002.

Yours sincerely,

David Anderson

David Anderson, P.C., M.P.

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PREFACE

The *Canada Water Act* (proclaimed on September 30, 1970) provides the framework for cooperation with provinces and territories in the conservation, development, and utilization of Canada's water resources. Section 38 of the *Revised Statutes of Canada (1985*) requires that a report on the operations under the Act be laid before Parliament after the end of each fiscal year. The report describes a wide range of federal activities conducted under the authority of the Act, including significant water research, participation in federal–provincial agreements and undertakings, and a public information program. This, the 30th report, covers progress on these activities to March 31, 2002.

SUMMARY OF PROVISIONS:

Provisions of the Canada Water Act

Part I, Section 4, provides for the establishment of federal-provincial consultative arrangements for water resource matters. **Sections 5, 6, and 8** provide the vehicle for cooperative agreements with the provinces to develop and implement plans for the management of water resources. **Section 7** enables the Minister, directly, or in cooperation with any provincial government, institution, or person, to conduct research, collect data, and establish inventories associated with water resources.

Part II provides for federal-provincial management agreements where water quality has become a matter of urgent national concern. It permits the joint establishment and use of federal or provincial incorporated agencies to plan and implement approved water quality management programs. The application of alternative cooperative approaches and programs has resulted in Part II never having been used.

Part III, which provided for regulating the concentration of nutrients in cleaning agents and water conditioners, was incorporated into the *Canadian Environmental Protection Act* (CEPA) in 1988 and later into Sections 116–119 (Part VII, Division I) of the new *Canadian Environmental Protection Act*, 1999, which came into force March 31, 2000. (See the CEPA annual report to Parliament.)

Part IV contains provisions for the general administration of the Act. In addition, Part IV provides for inspection and enforcement, allows the Minister to establish advisory committees, and permits the Minister, either directly or in cooperation with any government, institution, or person, to undertake public information programs.

HIGHLIGHTS, 2001–2002

COMPREHENSIVE WATER RESOURCE MANAGEMENT
(Part I of the *Canada Water Act*)

1. Federal–Provincial Programs

1.1 Data Collection and Use

Collection of Water Quantity Data

Background

Under hydrometric agreements administered since 1975 with the provinces and territories, government agencies have gathered, analyzed, and interpreted water quantity data to meet a wide range of client needs in the hydrologic community.

Following modifications to the hydrometric network, a federal–provincial working group was established in 1997–98 to analyze the existing agreements against a set of principles for a renewed partnership. Administrators achieved consensus on most outstanding issues related to the equitable sharing of costs; access to data, information, and services; national standards; and the decommissioning of hydrometric stations.

In April 1999, a Memorandum of Understanding was signed by Environment Canada and Indian and Northern Affairs Canada to address field infrastructure issues. By year-end, modernization of the field infrastructure had been completed for all of New Brunswick, Prince Edward Island, Newfoundland, Nova Scotia, Quebec, Nunavut, and the Northwest Territories.

Progress (to March 31, 2002)

The Water Quantity Survey Agreements continued in force. The Working Group, established the previous year to look at options for renewing the Agreements, presented nine models to the Administrators at its October annual meeting. The preferred option was selected and refined at a special meeting of the parties in February. All parties agreed to target March 31, 2003, for the signing of the new bilateral agreements.

Hydrometric data were collected, interpreted, and disseminated to meet a variety of needs in the hydrologic community. The federal and provincial networks funded under the agreements remained at about 2300 stations. Eighteen stations were constructed or reactivated and 21 stations were modernized and flood-proofed during the third and final year of the Red River Network Enhancement Project in Manitoba. Sixty-five new stations were constructed in Ontario as the first phase of a three-year network expansion project.

Joint federal and provincial efforts continued to address infrastructure issues. During the year, 46 mercury manometers were removed from operation, 239 gauging sites were assessed for spilled mercury and 186 sites were remediated. Modernization of the hydrometric gauging station equipment continued in Manitoba, Saskatchewan, Alberta, and British Columbia

Water Supply and Use Data

Background

In the fall of 2000, Environment Canada and the Province of Ontario initiated a joint federal–provincial water use and supply project for the Great Lakes basin. The primary objectives of this Canada–Ontario project are to gain baseline information, at the sub-basin level, on water supply, use, and demand; to identify the system's ecological sensitivities to water resources; and to make projections for the future, including the potential impacts of climate change.

Environment Canada and the Ontario Ministry of Natural Resources co-lead the project. The Project Management Team includes members from these two agencies along with the Ontario Ministry of Environment, Conservation Ontario and the Department of Fisheries and Oceans. There is an advisory committee made up of members from numerous agencies and organizations that have expressed an interest in

the project. Three technical Work Groups (Water Use, Water Supply, and Ecological Needs) conduct the work, which commenced in November 2000 and will conclude on March 31, 2005. The projected timeline consists of the following:

- Year 1: Data acquisition and assembly.
- Year 2–3: Data analysis and interpretation.
- Year 3–4½: Assessment of future scenarios and findings.

Progress (to March 31, 2002)

The Water Use Working Group completed an inventory of water use categories on a sub-watershed basis for Ontario. The Water Supply Working Group completed assessment of groundwater and climate interactions for sub-watersheds in south-western and south-central Ontario. The Ecological Needs Working Group held a successful indicators workshop and developed a draft framework for assessing ecological impacts.

Water Quality Monitoring Agreements

Background

Beginning in the early 1980s, federal–provincial agreements were negotiated with several provinces and territories, including British Columbia (1985), Manitoba (1988), New Brunswick (1988), Newfoundland (1986), the Northwest Territories (1995), Prince Edward Island (1989), Quebec (1983), and Yukon (1995).

The agreement with New Brunswick was modified in 1995 when the provincial government undertook to collect, analyze, and manage the data for the water quality monitoring program. The agreement with Quebec was terminated in 1995 because activities were similar to those in the St. Lawrence Action Plan. The agreement with Prince Edward Island was incorporated into the Canada-PEI Water Annex in 1996, but the Annex expired in 1999.

Environment Canada also participates in specific monitoring projects, for example, one in the Pockwock–Bowater watershed, Nova-Scotia, is designed to assess the impact of land use change on nutrient cycling.

Progress (to March 31, 2002)

British Columbia Ministry of Environment, Lands and Parks conducted biweekly water quality monitoring at 29 stream or river sites in British Columbia. A report on trends for these and other sites monitored since 1985 under the program was released in 2000–01.

Discussions continued with Manitoba on revisions to the Canada–Manitoba Water Quality Monitoring Agreement. Environment Canada continued to monitor five locations under the old Agreement until the new monitoring agreement is signed.

The Canada–Prince Edward Island Memorandum of Agreement on Water was signed in May 2001, replacing the earlier Annex, which expired in 1999. Water quality monitoring continued under the new agreement. A pilot study was initiated to investigate the usefulness of benthic macro-invertebrates as indicators of ecological health. Research was completed on a diagnostic assay tool that was used to identify the presence of pesticide residues in fish tissue and helped determine whether recent fish kills in rural Prince Edward Island streams were related to commonly used pesticides in runoff from farms. Results of this work were discussed in a public workshop on environmental and health issues and pesticides in Atlantic Canada. A project to test the effectiveness of grassy buffer strips in retaining pesticides from agricultural runoff was also continued.

In New Brunswick, 15 long-term surface water quality stations continued to be monitored in accordance with the federal–provincial agreement.

In Newfoundland and Labrador, several water quality sites continued to be sampled under the federal–provincial agreement. A study was conducted in an urban watershed that examined the occurrence of persistent organic pollutants, including PAHs, OCs, PCBs, and metals, in water, sediment, and fish. An investigation into the presence of pharmaceutical chemicals and endocrine-disrupting substances in selected municipal wastewater effluents was also initiated.

Active collaboration continued in specific water quality monitoring projects as follows.

In Nova Scotia and in Newfoundland and Labrador, lake monitoring sites served as an information source for Environment Canada's ongoing Long Range Transport of Air Pollutants (LRTAP) program. Interactive CD-ROMs of the LRTAP lakes monitoring data and a joint Canada–US study on mercury were released.

Water quality monitoring also continued in New Brunswick and Nova Scotia in support of long-term multi-agency research projects on Catamaran Brook, the Fundy Model Forest, and the Pockwock watershed study.

Water quality monitoring at a selected network of Labrador Ashkui sites proceeded during 2001–02. The project uses a cultural landscape approach, focusing on landscape elements of particular significance to the Innu people. The Ashkui, defined as the first open water area in the spring, is the first cultural landscape unit to be investigated. The Northern Ecosystem Initiative now includes, as part of the Canada–Newfoundland Water Quality Agreement, the Ashkui sites. The project was expanded in 2002 to incorporate caribou research at more northern sites. A new CD-ROM on the Ashkui project was developed and released during 2001–02.

Cooperative Modelling in the St. Lawrence River and the Great Lakes Connecting Channels

(i) St. Lawrence River

Background

In 1997–98, Environment Canada's Meteorological Service of Canada (MSC), Quebec Region, and the Institut National de la Recherche Scientifique (INRS–Eau) concluded a cooperation agreement for two-dimensional hydrodynamic modelling of the St. Lawrence River between Cornwall, Ontario, and Trois-Rivières, Quebec. The modelling project is aimed at developing a capability to forecast the transport of pollutants (from oil spills and industrial and municipal sewers) as well as developing applications in other areas such as bank erosion, dredging, and shipping activities. The project is also designed to understand the physical processes present in the river and to establish the connection between these processes and the flora and fauna habitat. INRS–Eau is an internationally recognized research institute of the University of Quebec that specializes in hydrology and hydrodynamic modelling.

MSC–Quebec Region contributes to emergency responses in the event of accidental spills into the St. Lawrence River and models the distribution of currents in the fluvial portion of the St. Lawrence. It has concluded agreements with various governmental agencies (e.g., Hydro-Quebec) to facilitate hydrometric data exchange.

Progress (to March 31, 2002)

During 2001–02, MSC–Quebec Region and INRS–Eau continued to work under a cooperation agreement for hydrodynamic modelling of the St. Lawrence River. Work continued on the development of a two-dimensional model for simulating river temperatures. Calibration and validation of the model began. In addition, the most recent bathymetric data were incorporated, and a terrain model of Lake Saint-Louis was created for purposes of hydrodynamic simulations.

(ii) Automated Control of Data

Background

The Meteorological Service of Canada, Quebec Region, participated in the implementation of a pilot project involving the automated, real-time application of quality-control algorithms to data from hydrometric and meteorological monitoring networks. Traditional methods of managing these data were also reviewed and optimized in accordance with the most up-to-date concepts and technologies in the field. Quality control algorithms were developed for the domain of variation, temporal variability, spatial variability, and inter-variable comparisons.

Progress (to March 31, 2002)

The data model as well as the bank of suitable data were reviewed and optimized. Quality control algorithms for the domain of variation and for temporal variability were applied at a large number of hydrometric and meteorological stations to assess the capacity of the system to handle large quantities of data in real time.

Various interfaces were also produced to assess the feasibility of using the Internet as the primary communication link between the system and the various users and clients.

Petitcodiac River and Estuary Restoration / Modelling Workshop

Background

In 1968, a 1-kilometre long causeway and dam with five sluice gates were built across the Petitcodiac River estuary in southern New Brunswick. While beneficial as a crossing, the causeway is also a barrier that impedes freshets and tidal flows. Over the years, this condition has created ecological issues related to fish passage, levels of nutrients and dissolved oxygen, pollution, and channel sedimentation.

As part of efforts to rehabilitate the estuary, Canada and New Brunswick signed an agreement to undertake a harmonized environmental impact assessment (EIA) for achieving a long-term solution to the fish passage and ecosystem.

The objective of the study is to undertake an Environmental Impact Study on the proposed modifications to the Petitcodiac River Causeway that meets both the requirements of the New Brunswick Clean Environment Act, Environmental Impact Assessment Regulation (87-83), and the screening level, under the *Canadian Environmental Assessment Act* (CEAA).

Progress (to March 31, 2002)

During March 3–5, a Petitcodiac Estuary/River Modelling Workshop was organized and sponsored by Environment Canada and Fisheries and Oceans Canada, with input from the New Brunswick departments of Transportation and Environment and Local Government. The workshop brought together engineers and scientists to share their knowledge on physical aspects of rivers and estuaries and to recommend how to study and predict water flows, sediment behaviour, and other physical processes under various scenarios.

The 60 workshop participants benefited from presentations made by groups including the Danish Hydraulics Institute, Rutgers University, Université de Laval, the Bedford Institute of Oceanography, the Southampton Oceanography Centre, Katholieke Universiteit Leuven (Belgium), the National Water Research Institute, the University of British Columbia, the University of Southern Mississippi, and several engineering firms. Considerable effort was also made to include stakeholders and key agencies representing the range of concerns on the causeway issue. The proceedings in the form of a workshop summary report were produced and posted on the Web page along with other documentation related to the harmonized EIA process (see www.petitcodiac.com).

Water quality monitoring was not repeated in 2001–02 as the federal and provincial agencies considered and negotiated a long-term environmental assessment process for river rehabilitation options. Ongoing water level monitoring at four locations around the causeway continued and the database made available for EA requirements.

Four water level recorders have been established on the Petitcodiac River for the purpose of studying the hydrodynamics of the estuary above and below the causeway as the gates are opened and closed during the tidal cycle.

1.2 Interjurisdictional Boards

Ottawa River Basin Regulation

Background

In 1983, Canada, Quebec, and Ontario concluded an agreement respecting the Ottawa River Basin Regulation. Under its terms, a board was constituted to plan and recommend regulation criteria for the 13 principal reservoirs of the basin, taking into account flood protection, hydroelectric power production, and other interests. Supported by a Regulating Committee and a Secretariat, the Ottawa River Regulation Planning Board endeavours to ensure that the integrated management of the reservoirs provides protection against flooding along the Ottawa River and its tributaries and along its channels in the Montreal region.

During the spring freshet, hydrometric and meteorological data are collected daily and are used to develop inflow forecasts. A simulation model is used to evaluate the effects of sub-basin inflows and regulation decisions on flows and levels throughout the basin. The Secretariat provides information on flows and levels to the public. Since 1986, flood reserves have been

implemented in three of the principal reservoirs (Quinze, Timiskaming, and Poisson Blanc) to improve downstream flood reduction. One of the main benefits of the reserves is to enable operation of the Grand Moulin dam to provide protection for residents along the Milles Iles River in the Montreal region.

Progress (to March 31, 2002)

A gradual and prolonged warm spell, along with some precipitation, produced peak flows from the middle and southern parts of the basin in mid April 2001. This peak was well below damage levels. The remainder of the spring was fairly dry, and at the end of April the peak flow from the northern section of the basin was less than the first peak. There was no flooding along the river or in the Montreal region, and the use of flood reserves was not required.

A summary of the plans for emergency measures for each of the major dams was prepared and the Board commenced preparation of a draft procedure for coordination and communications related to dam safety.

Prairie Provinces Water Board

Background

In 1969, Canada, Alberta, Manitoba, and Saskatchewan signed the Master Agreement on Apportionment, which provides for the equitable apportionment of eastward-flowing Prairie rivers and the consideration of water quality problems. Under Schedule C, the Prairie Provinces Water Board (PPWB) was reconstituted to administer the provisions of the Master Agreement.

The apportionment of the natural flow of Lodge, Middle, and Battle Creeks at the Alberta–Saskatchewan boundary is specified in Article 6, Schedule A, of the Master Agreement. Lodge and Battle Creeks are also subject to international apportionment under the 1909 Boundary Waters Treaty following the subsequent 1921 Order of the International Joint Commission. Since the inception of interprovincial apportionment monitoring in 1985, deficits in delivery to Saskatchewan have occurred in 1988, 1989, 1992, 1998, and 2000.

In 1992, the Master Agreement was amended to include a new Agreement on Water Quality (Schedule E) in response to concerns for protecting these water resources. Schedule E specified acceptable water quality objectives in each river reach and further defined the duties of the Board with respect to its water quality mandate.

In 1999, the apportionment period at the Saskatchewan–Manitoba border was made the calendar year in order to be consistent with the period at the Alberta–Saskatchewan border.

Progress (to March 31, 2002)

Although drought conditions existed in southern and central Alberta and southern Saskatchewan, these provinces met all apportionment requirements for interprovincial streams during 2001. With the use of Alberta's daily flow model, compliance with the minimum flow criteria on the South Saskatchewan River below the confluence of the Red Deer River was monitored. Data from 88 hydrometric and 21 meteorological stations were used to compute natural flows.

Since 1985, the Committee on Hydrology (COH) has sought ways to improve the effectiveness of apportionment monitoring of Lodge–Middle and Battle Creeks at the Alberta–Saskatchewan boarder. In 1999 and 2001, the Board approved four changes to the natural flow computation procedure recommended by the COH to improve the accuracy of apportionment monitoring in these two interprovincial streams. Because these waters are also shared with the United States and are subject to the 1909 Boundary Waters Treaty, the PPWB must consider how apportionment changes between Alberta and Saskatchewan affects the apportionment arrangement at the international boundary. Therefore, some recommended changes were postponed until similar changes are accepted in the international computations.

The Committee on Groundwater (COG) recommended specific tasks that should be completed before negotiating a groundwater apportionment agreement between the provinces including the mapping and assessment of transboundary aquifers, the definition of sustainable yield, and aquifer management plans. A pilot study to map and assess a transboundary aquifer is planned for 2003.

The Committee on Water Quality (COWQ) discussed the application of the Canadian Water Quality Index (CWQI) to basins that have PPWB monitoring sites. The COWQ agreed to include available provincial water quality data and run the index on a five-year period on certain groups of variables. The PPWB continued monitoring fish conditions and contaminant levels at PPWB monitoring sites on a five-year cycle. Specific biological pilot studies, which include benthic macro invertebrate communities and Periphyton measurements, continued in 2001–02.

Mackenzie River Basin Transboundary Waters Master Agreement

Background

The governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories, and Yukon signed the Mackenzie River Basin Transboundary Waters Master Agreement (Master Agreement) in July 1997. The Master Agreement endorses the principle of managing water resources for future generations in a manner consistent with the maintenance of the ecological integrity of the aquatic ecosystem. It provides for early and effective consultation on potential developments and activities in the basin that could affect the integrity of the aquatic ecosystem. It also contains provisions for seven sets of bilateral agreements between adjacent jurisdictions in the basin. These bilateral agreements identify scientific criteria for water quality, water quantity, and seasonal timing of flows at boundary crossing points required to maintain the integrity of the aquatic ecosystem of transboundary water bodies.

The Mackenzie River Basin Board administers the Master Agreement. Its members are appointed and represent all parties: Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories, and Yukon. Federal members include representatives of Environment Canada, Indian and Northern Affairs Canada, and Health Canada. There are five Aboriginal Board members nominated by Aboriginal organizations in each of the jurisdictions.

Under the Master Agreement, Environment Canada is responsible for managing the expenditures of the Board, which are cost shared equally by the Parties. Shareable costs include, among other things, the staffing and operation of a secretariat to support the Board at the working level. An Executive Director of the Secretariat is hired within Environment Canada, Prairie and Northern Region, to plan, direct, and manage Board operations. The Secretariat is located in the middle of the Mackenzie Basin in Fort Smith NWT, providing accessibility to the people who live in the basin.

Progress (to March 31, 2002)

A major initiative of the Mackenzie River Basin Board in 2001–02 was completion of the Board's draft Strategic Plan. A formal public information and consultation program was not possible with the existing budget. At the same time, the Board was committed to keeping the people who live in the Basin informed of its activities, and to soliciting their input as part of finalizing major initiatives such as the Strategic Plan.

Two thousand five hundred copies of the draft Strategic Plan were published and distributed, along with associated information brochures on the Mackenzie River Basin Transboundary Waters Master Agreement and the Mackenzie River Basin Board, to the Board members. The documents were directed to Aboriginal and stakeholder groups within their respective jurisdictions, and feedback was solicited through existing public involvement processes. The Board also distributed this package at public forums and placed it on the Web site. Once public feedback has been received from each jurisdiction, the Strategic Plan will be finalized.

The Web site was continually being refined, and in 2001–02, 21 different maps, which can be downloaded, were added as a precursor to an online library. Once complete, the Web site will play a major role in public information and consultation.

Initiation of work on the State of Aquatic Ecosystem Report (SOAER) for the Mackenzie Basin required every five years under the Master Agreement was also undertaken.

A SOAER literature review and an overview of existing water quality in the basin was completed. The Board established an SOAER Committee to prepare the report. A final report writer–editor was selected from one of the participating jurisdictions. A workshop was held on July 17 and 18 in Edmonton to address these matters. As a result of this workshop and

subsequent deliberations by the Board, it was decided to structure the SOAER by sub-basins. This format facilitated a focus on the aquatic ecosystem and tied in development of bilateral agreements and the interests of local people. It was also agreed to use the Environment Canada Pressure State Response Model with the addition of future predictions based on current trends. Climate change was also a major issue. The SOAER is scheduled to be completed early in 2003.

The year also marked completion of the first bilateral water management agreement between Yukon and the Northwest Territories. It is currently in the cabinet approval process.

1.3 Ecosystem Initiatives: Watershed and Water-Related Activities

During the year, Environment Canada continued the development and implementation of its major ecosystem initiatives, covering a wide variety of sensitive marine and freshwater systems across Canada. A five-year $122.5 million funding authorization, which began in 1998–99, has supported the program.

Although each initiative has unique features, common management principles are observed throughout. These principles stress ecosystem and precautionary approaches to pollution prevention; citizen and community involvement in the design and implementation of initiatives; long-term stewardship through partnerships and governments working together; and sound science combined with local and traditional knowledge as the basis for identifying and resolving issues.

The ecosystem approach itself takes into consideration complex interrelationships among water, land, air, wildlife, and human activities. The focus of this report is primarily on water-related activities and their interjurisdictional arrangements.

Atlantic Coastal Action Program

Background

The Atlantic Coastal Action Program (ACAP) was initiated by Environment Canada in 1991. It is centred on community-based leadership and delivery to address environmental and sustainable development issues in ecosystems involving watersheds and coastal areas throughout Atlantic Canada. With broad local support, non-profit organizations have been incorporated at 14 sites across Atlantic Canada. At these sites, Environment Canada contributes funding, technical and scientific expertise, and direct staff support with respect to four broad categories of projects relevant to the *Canada Water Act*:

- clean water (e.g., domestic sewage)
- atmospheric emissions
- toxics
- natural habitat

Over the past decade, some 500 projects have been undertaken. These projects have already resulted in significant water quality improvements in several coastal river systems. For example, the Bluenose Oil Spill Response Program, in operation since 1996, has played an instrumental role in cleaning up several small spills in the region. During 1999–2000, Bluenose ACAP hosted an Atlantic Region Sewage Workshop in Lunenburg, Nova Scotia, that resulted in recommendations to forge a regional consensus on giving sewage treatment top priority in infrastructure programs.

St. John's Harbour ACAP in Newfoundland presented a state-of-the-harbour report outlining an "at-source control" proposal for municipal wastewater in the St. John's–Mount Pearl area. Saint John ACAP in New Brunswick implements "Creek Sweeps" projects to restore several urban streams degraded by litter, untreated sewage, and toxic compounds.

Progress (to March 31, 2002)

As the partnership between Environment Canada-Atlantic Region and the community-based ACAP organizations approached its tenth productive year, the solid base of water quality monitoring, education, capacity building, awareness raising, and behavioural change in the 14 ACAP communities was strengthened. Long-standing issues around inadequate sewage treatment (an issue most severe in Atlantic Canada) were addressed through concerted efforts at the local and political level in St. John's, Newfoundland, and the construction of an artificial wetland for tertiary treatment of municipal waste in Annapolis, Nova Scotia.

Watershed resource inventory, mapping and monitoring in Bedeque Bay, Prince Edward Island, delivered reliable traditional and western scientific knowledge.

A stronger focus developed on the scientific dimensions of a shared water agenda, through the ACAP Science Linkages Initiative (a $250K fund available for projects proposed, developed, and implemented jointly by ACAP organizations and Environment Canada scientists from Atlantic and national institutes). This resulted in better understanding of water resources and the activities that impair them. For example, ACAP-Cape Breton conducted an investigation of an endangered freshwater mussel in the Sydney River, and in Pictou, Nova Scotia, immunological biomarkers of ecosystem health were developed. Ongoing monitoring of the mitigating effects of newly established buffer zones on agricultural runoff into Prince Edward Island waterways provided valuable information for farmers and regulators.

Additional studies identifying critical administrative, legislative, and economic barriers to effective pollution control and remediation were undertaken in Annapolis, Nova Scotia. Direct work with ATV users served to educate and establish working partnerships to mitigate impacts, rather than assigning blame and pursuing prosecution.

Remediation efforts in the heavily contaminated Marsh Creek in Saint John, New Brunswick, and working partnerships with land-use planners, were positive examples of effective change. Partnerships with local business and industries resulted in improved waste stream quality in the industrial, municipal, rural, and agricultural sectors in all four provinces. Eastern Charlotte Waterways Inc., in southwest New Brunswick has been given the lead role for water classification in that province.

Georgia Basin Ecosystem Initiative: Cooperative Arrangements in the Georgia Basin

Background

In December 1998, Environment Canada and the British Columbia Ministry of Environment, Lands and Parks announced their shared priorities of clean air, clean water, conserving and protecting habitat and species, and building sustainable communities, collectively known as the Georgia Basin Ecosystem Initiative (GBEI). The Georgia basin ecosystem encompasses most of the Georgia Strait, part of the Juan de Fuca Strait, and the waters that flow into these marine bodies.

Building on the success of earlier initiatives undertaken in the Fraser River and estuary,[*] GBEI provides an opportunity for community and watershed groups, Aboriginal peoples, industry, and business to participate with governmental agencies in stewardship projects to maintain the health of the ecosystem. The focus is on clean water and air, the conservation and protection of habitat and species, and the promotion of sustainable communities.

GBEI Clean Water focuses on reducing the impacts of urban growth and agricultural activities on stormwater, municipal sewage, and shellfish harvesting areas, and includes the following priorities:

- Identification and management of toxic substances.
- Management of sewage treatment operations, biosolids, and urban stormwater.
- Practices to reduce pollution from vessels and marine facilities (including pleasure craft).
- Management practices to reduce agricultural nonpoint source pollution.
- Water conservation practices and protection of drinking water sources.
- Pollution prevention programs for municipalities and small businesses.
- Management practices to maintain and restore shellfish harvesting areas.

In order to meet these priorities, a number of projects have been undertaken. For example, agreements were signed with Cowichan First Nations and Snuneymuxw First Nations to determine sources and levels of contamination

[*] Fraser River Action Plan and Fraser River Estuary Management Program

in shellfish harvesting areas. Samples to determine benthic community structure were collected from the Fraser Valley and Greater Vancouver continued in 2001. A Liquid Waste Management Plan (LWMP) has been developed to address wastewater pollution.

Two CD-ROMs are available: Urban Watershed Management, and Environmental Quality Benchmarks.

In January 2000, the Joint Statement of Cooperation on the Georgia Basin and Puget Sound Ecosystem was signed to develop annual plans and report progress to the public.

In May 2000, 14 new British Columbia water bodies were designated as no-discharge zones under the Pleasure Craft Sewage Pollution Prevention Regulations. Also, the Pleasure Craft Sewage Pump-Out Station Program was initiated. Since 1998, six stations have been constructed.

In February 2001, the report “Semiahmoo Bay Water Quality Project" was published and the Semiahmoo Shared Waters Round Table was formed to address the quality of water shared between Canada and the United States at Semiahmoo Bay.

Finally, the first Canadian Onsite Wastewater Training Centre was developed at Royal Roads University in Victoria to provide education on the principles and requirements for proper on-site sewage treatment and disposal.

Progress (to March 31, 2002)

British Columbia municipalities increased commitment to reducing the impacts of stormwater runoff on the health of watersheds in their jurisdictions. However, balancing the need to provide flood control and protect property with the need to safeguard fish habitat and preserve water quality can be a significant challenge, especially for municipalities with limited resources. A Stormwater Management Planning Guidebook has been developed. The Guidebook includes information on how to develop goals and objectives for a stormwater plan; how to undertake public consultation; how to assess watershed health and identify priority watersheds; how to select, implement, and monitor best management practices (BMPs) for stormwater; and how to implement and finance a stormwater management program. In addition, it provides an overview of the regulatory environment governing stormwater management in the province. A draft Stormwater Management Plan for the Regional District of Nanaimo (RDN) has been developed simultaneously to ensure that the recommendations contained in the Guidebook are practical and achievable when applied to municipalities and Regional Districts.

Environment Canada in partnership with the City of Burnaby, worked toward the reduction of aquatic impacts from toxic substances in the Byrne Creek watershed. This pilot program implemented a plan to reduce wastewater pollutants at the source. Commercial and industrial businesses within the watershed continued to be inspected, while toxic contaminates were profiled against business license records and industrial activity. Pamphlets on the effects of industry discharges to storm sewers and the ecology and history of Byrne Creek highlight the impacts on the creek from illegal dumping, spills, and various other sources of pollution.

Investigations on the effects of nonpoint source pollution from agricultural and urban activities on fish and crayfish, and other benthic populations in Fraser Valley streams continued. Benthic sampling of streams to assess stream condition was expanded from the Fraser Valley to streams in east Vancouver Island. Final experiments and sampling will be conducted in the fall of 2002; reporting is planned for 2003.

Through the Raspberry Growers Nutrient Management Soil Nitrate Survey, 44 raspberry fields in the Abbotsford–Sumas area, representing approximately 35 percent of the total raspberry hecterage were sampled in 2000. Sixty-one fields or 40 percent of total hecterage were sampled in 2001 for nitrates. This project promoted the use of fall nitrate soil testing to assess previous nutrient management practices. As well, the survey examined the effects of current management practices and the impacts on the Abbotsford–Sumas aquifer. Results indicated a reduction in the average fall soil nitrate levels in manured and non-manured land. However, additional years of testing are needed to verify the results.

Work has been done on the sources and loadings of selected toxic substances into the Georgia basin. Existing provincial permits and

published data on toxic substance concentrations in point and nonpoint discharges were compiled. In a follow-up study on the loading calculations for selected toxic substances, concentration and flow data from the initial study were analyzed. Work continued to assess toxicology and loading data for these selected toxics with summary profile reports for each substance recommended to the Puget Sound/Georgia Basin International Task Force.

The University of British Columbia (UBC) analyzed census data looking at agricultural practices in the Fraser Valley from 1991, 1996, and 2001. Results indicated that nutrient balances in some regions of the Fraser Valley remained high, and poultry numbers increased at approximately 2 million birds for every census period. The work will be presented on a multi-media CD-ROM.

Great Lakes Action Plan – Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem

Background

The Great Lakes Action Plan 2001-2006 is the third phase of Environment Canada's 1989 Great Lakes Action Plan (GLAP) initiative to manage and improve the ecosystem of the Great Lakes basin. It replaced the second phase, Great Lakes 2000, which ended in April 2001. The GLAP brings together the activities and responsibility of eight federal departments to deliver on Canada's commitments in relation to the protection of the Great Lakes basin ecosystem as defined by the Canada–United States Great Lakes Water Quality Agreement.

The GLAP reflects the need to meet the challenges that have been the focus of the Government of Canada's attention since the inception of the Great Lakes Program in 1989. In addition, the GLAP also addresses challenges of increasing importance, including the introduction of exotic species and the impacts of human health and development. Finally, the GLAP will address the causes of many environment stresses and human health in the Great Lakes basin ecosystem through tangible progress on sustainable development.

The efforts undertaken by the GLAP are organized in relation to three main goals: Healthy Environment, Healthy Citizens, and Sustainable Communities. These goals will be addressed with seven main objectives: Restore Areas of Concern, Conserve Ecologically Important Areas, Control Introduction of Exotic Species, Assess and Manage Ecosystem Health, Protect and Promote Human Health, Reduce Harmful Pollutants, and Advance Sustainable Use.

The vision of the new Agreement, shared between Canada and Ontario, is for a healthy, prosperous, and sustainable Great Lakes basin for present and future generations.

Progress (to March 31, 2002)

The Governments of Canada and Ontario share a common interest in rehabilitating, protecting, and conserving the Great Lakes basin ecosystem. The 2002 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA) came into effect on March 22, 2002. COA 2002 is a successful model of federal–provincial cooperation that recognizes the shared jurisdiction surrounding many of the issues in Great Lakes basin, establishes common goals and results, and coordinates actions to eliminate overlap and optimize use of resources for maximum results.

Through COA, both governments have set out environmental priorities and specific goals and actions for the enhancement and preservation of the basin's ecosystem. The 2002 COA focused on four major environmental priorities that will benefit from federal–provincial cooperation and coordinated action. For each major environmental priority, the 2002 COA set out a series of desirable goals and actions to be achieved over the five-year duration of the Agreement. The four major environmental priorities are the following:

- the clean-up of the remaining Areas of Concern within the basin
- the implementation of a series of bi-national lake-wide management plans to address problems unique to each of the Great Lakes
- the virtual elimination and significant reduction of harmful pollutants within the basin
- improved monitoring and information management

The details of actions and results for each priority are contained in the four annexes to the Agreement. The annexes articulate the specific responsibilities for Canada and Ontario as well as those that are shared and would benefit from collaboration.

Signatories to COA include eight federal departments and agencies (Agriculture and Agri-Food Canada, Canadian Heritage, Fisheries and Oceans Canada, Environment Canada, Health Canada, Natural Resources Canada, Public Works and Government Services Canada, and Transport Canada) and three provincial ministries (the Ontario Ministry of Agriculture, Food and Rural Affairs, the Ontario Ministry of Environment, and the Ministry of Natural Resources).

Canada and Ontario worked cooperatively to implement the Agreement. It will take considerable time, effort, and resources to achieve the results set out in COA. Both governments have set up secretariats to oversee the effective and efficient management and operation of the Agreement. Priorities included the development of work plans in support of the 2002 Agreement commitments and a mechanism to facilitate a broader Great Lakes constituency in the delivery of Agreement results.

St. Lawrence Vision 2000 Program

Background

Originally launched in 1988, the St. Lawrence Action Plan is a Canada–Quebec ecosystem initiative to protect, preserve, and restore the St. Lawrence River ecosystem. This five-year program has been renewed twice since 1988 and has achieved concrete results through concerted efforts on the part of federal and provincial departments aided by the private sector, universities, research centres, Priority Intervention Zone (ZIP) committees, non-government agencies, as well as riverside communities. Efforts are focused on most reaches of the St. Lawrence and its major tributaries, extending from Lake Saint-François at the Quebec-Ontario boundary to the eastern extremity of the Gulf of St. Lawrence.

Phase III of the St. Lawrence Vision 2000 Action Plan (SLV 2000) was initiated in 1998 and carries forward the efforts of the past ten years, in particular, the reduction of industrial and agricultural pollution, protection and conservation of biodiversity, and involvement of communities located along the St. Lawrence. A new component, related to shipping, was added to this third phase of SLV 2000.

Progress (to March 31, 2002)

The first 14 years of the plan have contributed to a 96 percent reduction in toxic effluent discharges from 106 major plants, as well as the improvement of water and sediment quality and the reduction of contaminant concentrations in plants and fish. In addition, 113,412 hectares of wildlife habitat were protected and 27 recovery plans were implemented for over 20 endangered species.

The construction and opening of a fish pass in 2001–02 on the Richelieu River enabled rehabilitation of breeding areas for 22 species of fish, including the copper redhorse, lake sturgeon, and eel.

Established to promote local initiatives and public participation, the 14 ZIP committees made significant progress in implementing their Ecological Rehabilitation Action Plans (ERAPs). Since the formation of these committees, 16 public consultations have been held to obtain public opinion concerning priority actions in each area. To date, 17 ERAPs have been developed and are in the implementation phase. A forum on community involvement held in September 2001 provided an opportunity for productive discussion and assessment.

In addition, some 30 local ERAP and community agency projects were made possible in 2001–02 through the Community Interactions Program. For example, the Centre d'interprétation du milieu écologique du Haut-Richelieu, undertook the manual eradication of the invasive, non-indigenous water chestnut plant from the Rivière du Sud and the Richelieu and St. Lawrence Rivers. In addition, the restoration of the Bédard River by the Alma-Jonquière ZIP Committee, improved aquatic and wildlife habitats and raised the awareness of the people living along the river of the importance of stream water quality to human health and ecosystems. The Corporation d'aménagement et de protection de la Sainte-Anne has also stabilized river banks, developed habitats in the Sainte-Anne River watershed, and helped with water clean-up in the area.

Other water-related activities associated with navigation and human health should be mentioned:

- **Navigation**: Significant progress was achieved in the development of the Sustainable Navigation Strategy for the St. Lawrence through a survey of the perspectives of targeted stakeholders. The survey identified issues of importance to the stakeholders as well as their shipping-related concerns. Following the survey, four sector consultations were held with the shipping industry, recreational boaters, riverside communities, and governments.

- **Human health**: A second survey of people living along the river was conducted in 2001–02 to assess changes in certain uses associated with the St. Lawrence River. The first survey was conduced in 1995. Results will be available in 2002–03.

The St. Lawrence Centre provides support to the St. Lawrence 2000 Program by undertaking research (see section 2.2). Other projects undertaken within the framework of this program include hydro-dynamic river modelling and assessment of the impacts of fluctuating water levels on the ecosystem and uses of the St. Lawrence (see section 1.1d).

Detailed reports of these and other achievements frequently appear in the newsletter *Le Fleuve* (www.slv2000.qc.ec.gc.ca/bibliotheque/lefleuve/accueil_a.htm).

Northern Ecosystem Initiative

Background

The Northern Ecosystem Initiative (NEI) was launched in 1998 and supports partnership-based efforts to improve understanding of how northern ecosystems respond to climate change, contaminants, and resource use activities, the development of indicators, and a network to monitor ecosystem changes. The NEI supports projects that address science and capacity building needs throughout the Canadian North, including Yukon, the Northwest Territories, Nunavut, the lowlands of northern Manitoba and Ontario, northern Quebec, and Labrador.

The initiative is guided by the principle of sustainable development and follows an interdisciplinary scientific approach that also seeks to assimilate local and traditional knowledge.

Environment Canada began development of a federal Northern Sustainable Development Strategy, which will be useful in guiding the initiative. In the mid-1990s, the Arctic Borderlands Ecological Knowledge Cooperative developed a community-based contaminants monitoring program in Yukon and the western Northwest Territories. Work began in 2000 on the development of a Cumulative Effects Assessment and Management Framework (CEAMF) for possible implementation in areas of the Canadian North experiencing rapid resource development.

Progress (to March 31, 2002)

The year 2001–02 represented the first year of full implementation for the NEI where a call for proposals was released on the four program priorities. Funding support was awarded to 30 projects, eight of which addressed contaminants including water quality issues. For example, mercury has emerged as a priority contaminant in the Arctic and in inland lakes of central and eastern Canada. The NEI supported a study where investigators collected lake sediment cores from strategic locations across the Canadian North to help complete knowledge of mercury loadings in lake sediments.

Great Bear Lake in the Northwest Territories is North America's fifth largest lake and the largest in Canada in terms of surface area; it has some of the world's largest lake trout. Investigators studied inorganic and organic contaminant levels in the lake's food web and the potential role of lake productivity and species composition in affecting contaminant levels.

The NEI supported the Labrador Contaminants Working Group, a partnership of Aboriginal organizations, government agencies, academia, industry, and environmental organizations, in its overall efforts to cooperatively develop a contaminants research and monitoring agenda for Labrador as well as develop a Web-based metadata inventory to share information on past and current contaminant projects.

NEI support enhanced efforts to assess and prioritize abandoned mining sites in Nunavik with

particular focus in the Labrador and Ungava Troughs. The project integrated data and information from both western science and traditional knowledge and will enable communities to better understand the nature and extent of residual contaminants present in the local environment.

Northern Rivers Ecosystem Initiative

Background

Undertaken pursuant to an agreement signed by Canada, Alberta, and the Northwest Territories in 1991, the Northern River Basins Study assessed the cumulative effects of industrial, agricultural, municipal, and other developments on the aquatic ecosystems of the Peace, Athabasca, and Slave River systems. The final report, with key findings and recommendations, was completed and transmitted to ministers in June 1996.

A joint governmental response to the recommendations was released in November 1997. In the response, a number of federal departments (Fisheries and Oceans Canada, Indian and Northern Affairs Canada, Health Canada, Heritage Canada, and Environment Canada), as well as Alberta and the Northwest Territories, made commitments to undertake follow-up activities. These activities included research to improve the understanding of the effects of nutrients and contaminants on the river system and work to understand the interrelationships of hydrology and climate on northern deltas.

Follow-up activities have been cooperatively undertaken by Canada, Alberta, and the Northwest Territories through the Northern Rivers Ecosystem Initiative (NREI). This five-year initiative began in April 1998 under the direction of a steering committee co-chaired by Environment Canada and Alberta Environment. The Northern Rivers Ecosystem Initiative is scheduled to conclude in 2003. A newsletter, *River News*, has been created to share progress with the public.

Progress (to March 31, 2002)

Approximately 15 research projects were under way in 2001–02. These projects focused on pollution prevention, drinking water, and research into contaminants, nutrients, endocrine disruption effects in fish, dissolved oxygen, and hydrology. Reporting on NREI activities is done through progress reports. The second progress report was released during the summer of 2001. Highlights from this report are listed below.

Contaminants and Monitoring

- New technology was adopted by the pulp and paper industry to reduce or eliminate the formation of dioxins and furans.
- Consumption bans for mountain whitefish were lifted on the Smoky/ Wapiti river system except for children and pregnant women as studies confirmed a major decline in dioxin and furan levels in burbot livers.

Endocrine Disrupting Substances

- Preliminary examination of wild fish collected from four locations on the Smoky/Wapiti River system, including two reference sites, have shown no difference with regard to gonadal development.

Nutrients and Dissolved Oxygen

- The City of Grande Prairie improved its wastewater treatment system.
- Nitrogen loadings from the five pulp mills on the Athabasca River have remained relatively constant between 1995 and 2000, but phosphorus loadings have continued to increase.
- Alberta has adopted the CCME dissolved oxygen guideline of 6.5 mg/L.

Human Health/Drinking Water

- The Infrastructure Canada–Alberta Partnership Agreement was signed providing a mechanism of funding "green" municipal infrastructure projects including water and wastewater systems.
- Workshops co-sponsored by First Nations Groups and the Government of Canada were held to develop strategies ensuring safe drinking water for First Nations of Alberta.

Models and Assessment Tools

- A regional-based Cumulative Effects Assessment model was developed as part of the NREI.
- Hydraulic and water balance models have been developed and tested for the

unique characteristics of the Peace–Athabasca Delta.

In many instances, initiatives undertaken by industry also addressed the recommendations, and, where possible, the results of these other initiatives have been included in the progress report.

With the NREI coming to a close in March 2003, planning efforts are currently under way for final reporting. Along with the final technical reports from the various research projects there will also be a final synthesis report outlining the overall results. To assist in the report planning, a science forum was being planned for the fall of 2002.

2. Water Research

2.1 National Water Research Institute

Background

The National Water Research Institute (NWRI) is Canada's largest freshwater research facility with centres in Burlington, Ontario, and Saskatoon, Saskatchewan, and regional network offices in Victoria, British Columbia, and Fredericton, New Brunswick. NWRI research is directed toward conservation and protection of Canada's water resources. NWRI scientists lead the way in recognizing new threats to the quality and quantity of fresh water and producing the scientific knowledge needed by policy makers and governments to act swiftly to confront them.

NWRI conducts ecosystem-based research in the aquatic sciences, focusing on the impacts of agriculture, industry, resource development, and urbanization on water quality; effects of contaminants in lakes, rivers, groundwater, and sediments; the extent of atmospherically transported persistent organic pollutants and metals in aquatic ecosystems; and the potential impact of climate change on water quantity and quality.

Progress (to March 31, 2002)

In 2001–02, NWRI researchers conducted research across Canada, working with partners to address local, regional, and national water-related issues.

British Columbia

- ***Impacts of Forestry***

NWRI began a five-year project with the Weyerhaeuser Company (the lead agency), British Columbia Ministry of Forests, Fisheries and Oceans Canada, and the University of British Columbia to investigate the effectiveness of alternative logging strategies in conserving the biodiversity and productivity of small streams. This is the largest research program in the province that included cooperation between the forest industry, government, and a university.

- ***Managing Water Availability***

NWRI modelling experts completed a water quality module for the Seymour Reservoir Management System.

Alberta

- ***Protecting Water Quality of the Wapiti River***

In September 2001, NWRI ran a major experiment to determine the cumulative effects of sewage and pulp mill effluents on the fish and benthic food webs of the Wapiti River at Grande Prairie, Alberta. The experiment used the large mesocosms or artificial streams developed during the Northern River Basins Study and provided the opportunity for their most extensive testing to date. Researchers evaluated nutrient guidelines for the river, environmental effects of a change in mill process, effects of increasing effluent concentration to the river to simulate the effect of an extreme low flow year, and the ability of the mesocosms to separate the effects of two effluent sources, normally problematic in field bioassessments.

- ***Assessing Impacts of Land Use Change and Climate Variability***

Working with the University of Saskatchewan and the Lethbridge Research Centre of Agriculture and Agri-Food Canada, NWRI developed and successfully tested a series of enhanced, quantitative indicators of hydrological response to evaluate the sensitivity of the prairie water balance to land use change and climate variability. The indicators focused on the hydrological processes of snow accumulation, snowmelt, evapotranspiration, and runoff generation, and were generated from output of the Cold Regions Hydrological Model, currently

in development at NWRI. They were tested using data from a sub-basin in the upper reaches of the Little Bow watershed located north of Lethbridge, Alberta, over a series of wet/cool and dry/warm years. Results of this research will be of value in making recommendations to improve land management practices.

- ***Remediating Contaminated Groundwater***

Working with Komex International and the University of Calgary, NWRI began a two-year research program to enhance in situ bioremediation of groundwater contaminated by hydrocarbons.

- ***Oil Sands Organics***

In late 2001, NWRI began collaboration with the Universities of Guelph, Waterloo, and Alberta in a Canadian Water Network project on surface water and groundwater management in the oil sands industry, applying a newly developed technique to analyze naphthenic acids by LC-MS. Results will be useful in developing management practices to minimize impacts of resource development on water resources.

Saskatchewan

- ***Pharmaceuticals in the Environment***

NWRI launched a new research program in the St. Denis National Wildlife Area and the South Saskatchewan River to determine the impacts of antibiotics in prairie aquatic ecosystems and gain a better understanding of their environmental effects. The origins of these antibiotics are thought to be incomplete metabolism in humans and animals and eventual excretion into sewage, runoff from agricultural sites to surrounding aquatic systems, and incorrect disposal.

- ***Rivers Biofilms and Herbicides***

NWRI completed a study of microbial biofilms using mass spectrometry, immunolocalization, and confocal laser microscopy. The study confirmed that both the parent compound and metabolites of diclofop methyl and atrazine could be detected in river biofilms when they were not detected in the water column. This indicated that biofilms and periphyton may provide a mechanism for the transfer of contaminants during grazing by invertebrates.

Manitoba

- ***Transport of Metals from Mine Tailings***

At a base-metal mine at Sherridon, Manitoba, field studies and supporting laboratory studies showed that after 70 years very high concentrations of metals were present throughout the porewaters in the waste piles, elevated concentrations were present in the groundwater, and several adjacent lakes were highly contaminated. These data will be used to develop predictive models to assist in planning the remediation of mine waste piles.

Ontario

- ***Management of Wastewater Pollution***

In continued work to develop better urban wastewater management methods, field tests were carried out in Etobicoke and North Toronto. Results indicated successful treatment by chemically aided settling using a polymeric flocculent at relatively low dosage rates and will be used in further work to reduce the risk of effluent toxicity.

- ***Algal Toxins and Avian Botulism***

NWRI researchers embarked on field and laboratory experiments designed to gain a better understanding of the environmental conditions that trigger the growth of algal blooms and the interactions between blooms and the surrounding ecosystem, particularly food–web interactions. Studies investigated how a warming climate and greater penetration of UV light could be affecting the environment of Lake Erie and what impact this had on the growth of toxic algae.

- ***Impacts of Exotic Mussels (Dreissena) on Contaminant Cycling***

Working with the Ontario Ministry of the Environment, researchers completed an investigation of potential impacts of *Dreissena* on the physical and chemical characteristics of nearshore Great Lakes sediments at three sites in Lakes Ontario and Erie, with emphasis on polychlorinated dioxins and furans and dioxin-like PCBs. The work clearly demonstrated the ability of these exotic mussels to influence the chemical and physical nature of benthic environments they colonize. It has also identified a largely unrecognized vector for transfer of contaminants through the benthic and detrital food chains to higher trophic levels. Results have also contributed to baseline knowledge of

contaminant burdens in nearshore areas of the Great Lakes and allowed comparison of sediments and biomass as contaminant sinks.

- ***Pharmaceuticals in the Environment***

In the Great Lakes basin, scientists began large-scale sampling of agricultural plots, sewage treatment plants, and receiving waters to determine whether selected human and veterinary pharmaceuticals and other therapeutic and cosmetic compounds were discharged to the aquatic environment in concentrations that may pose a risk to aquatic life.

- ***Endocrine-Disrupting Substances from Intensive Agriculture***

At several sites in southwest Ontario, NWRI led studies to evaluate and characterize compounds in animal wastes capable of entering waterways and causing estrogenic responses in fish. The phytoestrogen, equol, was found in high concentrations in tile and river water immediately after application and declined rapidly. Only during the initial peak, immediately after application, were natural estrogens, 17B-estradiol and estrone, detectable in tile water. The first post-rainfall sample was elevated three-fold over the previous samples. Studies continued to determine the potential for intensive agricultural practices to release endocrine disrupting substances into the environment.

Nova Scotia

- ***A Biomonitoring Network to Protect Canadian Water Quality***

Researchers initiated research collaboration with Environment Canada Atlantic Region and Atlantic Coastal Action Program community organizations to develop an Atlantic stream biomonitoring network. The benthic reference condition approach was used to monitor the health of aquatic ecosystems developed at NWRI and already used in British Columbia and Ontario.

Quebec

- ***Metal Toxicity and Aquatic Ecosystems***

Working at several small lakes, NWRI scientists examined the relationship between metal and organo-metal (tributyltin) bioaccumulation and toxicity in aquatic invertebrates to identify metal impacts and their cause in the environment.

The North

- ***Climate Change Impacts on Lakes, Rivers, Peatlands, Permafrost, and Snow***

In ongoing research on the impacts of climate change on the Mackenzie delta region, NWRI began a study of climate variability effects on water balance over the last 20 years, the role of climate in catastrophic lake drainage, and climate-related variability in the spring breakup flood.

Western Cordillera

- ***Climate Change and Snowcover***

Researchers studied the impact of climate change on snowpack conditions of the western Cordillera. Results from this work will add to information from ongoing studies of the impact of climate change on the major rivers of western Canada and implications to hydroelectric production.

2.2 St. Lawrence Centre

Background

The St. Lawrence Centre (SLC) has carried out a number of major studies since 1993 on the state of the St. Lawrence River ecosystem, including water quality monitoring and a mass balance study of chemical contaminants. In December 1998, a new strategic plan for research was approved and implemented.

Progress (to March 31, 2002)

Ongoing and new research programs include the following activities.

Impacts of Water Level Fluctuations

- Effects on the biodiversity and biological productivity of ecosystems.
- Effects of area and distribution of wetlands.
- Effects on different uses, including drinking water and recreational boating.
- Effects on zebra mussel colonization.
- Effects on migration duration and fish recruitment.

- Effects on the physical dynamics of the river, including erosion.
- Effects on contaminant transport.
- Effects of fish health through the study of parasites.

State of the St. Lawrence River

- Analysis of the short-term and long-term variation in the diversity and the structure of fish species in the St. Lawrence River.
- Analysis of the introduction assessment and transfer of exotic species between the Great Lakes and the St. Lawrence River.
- Chemical contamination levels in biota, sediments, and water.
- Development of bioindicators using biomarker responses.
- Presence and impacts of parasites.
- Chemical characterization and study of the transport and deposition of suspended matter in the Cornwall–Massena region.
- Study of the evolution of water bodies in the Montreal area and the impact on urban pollution.

Urban Pollution

- Toxicological aspects of urban sewage effluents.
- Impacts of urban sewage on fish and molluscs.
- Source, transport, and fate of endocrine-disrupting chemicals.
- Geochemical behaviour of metals in the plume of dispersion found in urban effluents.

Long-Range Transport of Airborne Pollutants

- Study of the rehabilitation of water courses and lakes damaged by acid precipitation in order to verify the effectiveness of programs to counter acid precipitation.
- Monitoring of water quality in approximately 40 lakes in Quebec and the assessment of acid deposition and its effects.

Partnerships

Biochemical, physiological, immunological, and genotoxicological measurements were performed on the tissue of bivalve molluscs from the Saguenay fjord in order to gain a better understanding of the impact of anthropogenic contaminants on water quality in the fjord and their impact on intertidal biota. SLC, the University of Quebec at Rimouski (UQAR), and the Berlin University of Technology carried out the project under a bilateral agreement between Canada and the Federal Republic of Germany. It culminated in 1998-99 with the publication of a scientific article summarizing four years of field studies.

The study appraised the health of the Saguenay fjord and enabled the three partners to develop and validate new biomarker measurements (e.g., those relating to endocrine disruption). One result indicated that impacts on clam populations at upstream stations were generally higher than those at downstream stations, probably due to contaminant discharges linked to industrial activities.

Since 2000, research undertaken with intertidal zone soft shell clams in the Saguenay fjord demonstrated anomalies linked to reproduction, thus indicating the presence and influence of (anti)estrogenic compounds. For example, the results from a joint SLC/UQAR study undertaken in a region of the Saguenay in May 2001 demonstrated a masculinization effect associated with the presence of anti-fouling agents found on the hulls of ships.

In general, the studies undertaken in partnerships have demonstrated that the water of the Saguenay is influenced by diffuse and varied pollution and that certain contaminants are capable of inducing effects that disrupt the hormonal system in bivalves. Other research in partnership are planned to better evaluate the long-term consequences of this type of contamination.

Under a program on the impacts of water level fluctuations, research projects were undertaken with the Quebec provincial government (Societé de la faune et des parcs du Québec), universities (University of Montreal and University of Quebec at Montreal), and regional components of Environment Canada (Meteorological Service of Canada and the Canadian Wildlife Service).

The structure and diversity of the fish community at a reference site in the St. Lawrence River were analyzed in collaboration with the Aquarium du Québec. Tagging studies were performed in order to describe the migratory movements and the spatial distribution of fish species within the St. Lawrence River corridor. An efficient anaesthetic for use when tagging and examining fish was developed.

A model to assess the effects of pesticides on amphibian physiology was validated. This project studied the effects of pesticides on development, enodcrine function, immune response, and parasitism in frogs. The project was funded by the Toxic Substances Research Initiative (TSRI) and involved partners from l'Institut National de Recherche Scientifique–Institut Armand Frappier and Concordia University.

The toxicity of municipal sewage effluents was determined as part of regional environmental protection activities. The urban effluent discharge program carried out at the St. Lawrence Centre included projects that were related to emerging environmental problems. These programs occurred in collaboration with the Communauté urbaine de Montréal, l'Institut national de recherche scientifique–Institut Armand Frappier, and the Quebec government (Ministère de l'environnement du Québec and Societé de la faune et des parcs du Québec).

Notably, recent research completed by the SLC has demonstrated that a one-year exposure of freshwater mussels to a municipal effluent led to the disruption of the hormonal system and produced feminizing effects. This research is continuing in order to better understand the long-term impacts of this phenomenon in bivalve populations.

2.3 Other Research Highlights

Environment Canada conducts many water-related investigations in addition to the research undertaken at the two major institutes. Inter-disciplinary endeavours are often fostered in partnership with educational institutions or with the institutes or agencies of other governments and federal departments.

This section highlights examples of water research activities not reported elsewhere in the text. Although not comprehensive, the selections are representative of some of these activities.

Atlantic Environmental Research Network—Freshwater and Estuarine Ecosystems

Background

Early in 2000, Environment Canada initiated the development of an Atlantic Environmental Research Network (AERN) in association with universities located in Atlantic Canada. Based on the successful model of the Atlantic Cooperative Wildlife Ecology Research Network (ACWERN), the broad focus of this research network is to increase the environmental science capacity in the Atlantic Region.

The AERN has three major themes; one is directly related to water research, with its focus on freshwater and estuarine ecosystems. The other themes target climate change and wildlife/biodiversity. In 2001, the Freshwater and Estuaries nodes of AERN had been developed and delivered through the Canadian Rivers Institute and the University of New Brunswick, and through the Estuarine Research Centre at Acadia University, respectively.

Progress (to March 31, 2002)

The development of an Atlantic Environmental Research Network (AERN) continued during 2001–02. The new research capabilities developed in the region by NWRI have resulted in initiatives in the areas of benthic invertebrate monitoring. The Canadian Rivers Institute continued to advance research on cumulative impacts in freshwater systems.

Integrated Modelling of the St. Lawrence River

Background

Since 1997, the Hydrology Section of the Meteorological Service of Canada, Quebec Region (MSC–Quebec Region), has been working with partners on numerical modelling of the St. Lawrence River between Cornwall and Trois-Rivières. The models provide a better understanding of the physical and biotic environment of the river and how it is used. This work is part of an effort to understand the interactions that exist among the following:

- Pressures resulting from climate change and from natural and anthropogenic changes (export of fresh water, construction of port infrastructures, etc.).

- Physical characteristics of the river environment (flows, levels, currents, temperatures, substrates, and banks).

- Chemical characteristics of the water (turbidity, colour, and presence of pollutants).

- Life in the river environment, whether it be human (social, economic, or recreational use), plant (aquatic or emergent vegetation), or animal (aquatic and riparian wildlife).

In the context of this approach, the physical environment of the river is considered the focal point of exchanges within the ecosystem. The approach lends itself well to quantification of the impacts of fluctuating flow and water levels on the various ecosystem components in the St. Lawrence River.

The research and development of the St. Lawrence River ecosystem, MSC–Quebec Region-Hydrology collaborates with several organizations, including the Société de la Faune et des Parcs du Québec, the Direction du milieu Hydrique du Ministère de l'Environnement du Québec, the regional branches of Environment Canada (Canadian Wildlife Service, Environmental Protection Branch, St. Lawrence Centre,; the Canadian Coast Guard universities (UQTR, INRS-Eau, Ecole Polytechnique), and the International Joint Commission.

Progress (to March 31, 2002)

Examples of integrated modelling activities carried out include the following:

- Modelling of the habitats of several fish species.

- Hydrodynamic modelling of Lake Saint-Louis.

- Quantifying of the impacts of fluctuating flow and water levels in the St. Lawrence River on certain aspects of recreational boating.

- Two-dimensional modelling of river temperatures.

- Modelling of the various water masses in the St. Lawrence River.

- Modelling of bank erosion along the St. Lawrence River.

WATER QUALITY MANAGEMENT
(Part II of the *Canada Water Act*)

Background / Progress (to March 31, 2002

No activities were conducted during the year pursuant to Part II of the *Canada Water Act.* Part II has never been used. (See summary of provisions, page v.)

PUBLIC INFORMATION PROGRAM
(Part IV of the *Canada Water Act*)

Background / Progress (to March 31, 2002)

The public education program continued to expand its presence on the Internet. The Freshwater Website, part of Environment Canada's Green Lane, provides basic information on a wide range of water-related topics, comprehensive educational materials (e.g., *A Primer on Fresh Water, Water Fact Sheets)*, and the full text of key water publications (e.g., *Federal Water Policy*, *Canada Water Act,* and the *Canada Water Act Annual Report*). Links to specific issues at other governmental and non-governmental sites across the country are regularly updated and expanded. The Freshwater Website can be accessed at *http://www.ec.gc.ca/water*.

Partnerships continued to play a major role in public information activities. With Environment Canada's assistance and data, Natural Resources Canada introduced new maps in the "Freshwater Resources" section of the online version of *The Atlas of Canada*. These maps can be accessed at *http://atlas.gc.ca/site/english/maps/environment/index.html*.

In addition, "Water" was one of the first themes to be covered in the Government of Canada cluster site, Sustaining the Environment and Resources for Canadians at *http://www.environmentandresources.ca*.

The launch of the CCME Source To Tap Website on protecting water quality was launched (*http://www.ccme.ca/sourcetotap*).

APPENDIX A

AGREEMENTS

Canada Water Act Agreements* Ongoing during 2001–2002

Apportionment and Monitoring Programs

- Agreements on water quantity surveys with all provinces and with Indian and Northern Affairs Canada for Yukon and the Northwest Territories
- Canada–Quebec Protocol on Administrative Arrangements under the Canada–Quebec Agreement on Hydrometric and Sedimentological Networks in Quebec
- Master Agreement on Water Apportionment in the Prairie Provinces (Prairie Provinces Water Board)
- Water quality monitoring agreements with British Columbia, Newfoundland, New Brunswick, Manitoba, Prince Edward Island, Yukon, and the Northwest Territories
- Agreement Respecting Ottawa River Basin Regulation

Water Management Programs

- Agreement Respecting Water Resource Management and Information Exchange in the Yukon and Alsek River Basins
- Mackenzie River Basin Transboundary Waters Master Agreement

Flood Damage Reduction Program

- Agreement on policies in designated flood-risk areas with British Columbia

* For which *Canada Water Act* authority exists (in most cases, by Order in Council)

APPENDIX B

FOR MORE INFORMATION

Selected Web Sites

Environment Canada

Freshwater Site (including *Canada Water Act* Annual Report)
www.ec.gc.ca/water

Clean Water
www.ec.gc.ca/envpriorities/cleanwater_e.htm

Weather and Meteorology
www2.ec.gc.ca/weath_e.html

Research Institutes

National Water Research Institute
www.cciw.ca/nwri/nwri.html

St. Lawrence Centre
www.qc.ec.gc.ca/csl/index_en.html

Ecosystem Initiatives

Atlantic Coastal Action Program
www.atl.ec.gc.ca/community/acap/index_e.html

Georgia Basin Ecosystem Initiative
www.pyr.ec.gc.ca/GeorgiaBasin

Great Lakes 2000 Program
www.on.ec.gc.ca/glimr

Northern Ecosystem Initiative
www.mb.ec.gc.ca/nature/ecosystemsnei-ier/dh00s00.en.html

Northern Rivers Ecosystem Initiative
www.pnr-rpn.ec.gc.ca/nature/ecosystems/nrei-iern/index.en.html

St. Lawrence Vision 2000 Program
www.slv2000.qc.ec.gc.ca/index_a.htm
Newsletter: *www.slv2000.qc.ec.gc.ca/bibliotheque/lefleuve/accueil_a.htm*

Other Federal Departments

Agriculture and Agri-Food Canada
www.agr.ca

Fisheries and Oceans
www.dfo-mpo.gc.ca

Health Canada
www.hc-sc.gc.ca

Indian and Northern Affairs Canada
www.ainc-inac.gc.ca

Natural Resources Canada
www.NRCan-RNCan.gc.ca

Federal–Provincial

Canadian Council of Ministers of the Environment (CCME)
www.ccme.ca/

Interprovincial River Boards

Mackenzie River Basin Boards
www.MRBB.ca

Ottawa River Regulation Planning Board
www.ottawariver.ca

Prairie Provinces Water Board
www.mb.ec.gc/water/fa01/index.en/html

International

Arctic Council
www.arctic-council.org/

International Joint Commission
www.ijc.org

United Nations Environment Programme: GEMS/Water Global Environment Monitoring System
www.cciw.ca/gems/gems.html

United Nations University: International Network on Water, Environment and Health
www.inweh.unu.edu/inweh

Associations, Networks, and Journals

Canadian Water Resources Association
www.cwra.org

Canadian Water and Wastewater Association
www.cwwa.ca

Ecological Monitoring and Assessment Network (EMAN)
www.cciw.ca/eman/intro.html

Federation of Canadian Municipalities
www.fcm.ca

Great Lakes Information Network (GLIN)
www.great-lakes.net/

Water Quality Research Journal of Canada (Canadian Association on Water Quality)
www.cciw.ca/wqrjc/intro.html

WaterCan
www.watercan.com

Enquiries

General Information

National Water Issues Branch
Ecosystems and Environmental
Resources Directorate
Environmental Conservation Service
Environment Canada
Ottawa, ON K1A 0H3
Tel.: (819) 997-2307
Fax: (819) 994-0237

Publications (Public Information Program)

Inquiry Centre
Environment Canada
Ottawa, ON K1A 0H3
Toll free: 1-800-668-6767
Local: 997-2800
Fax: (819) 953-2225
E-mail: enviroinfo@ec.gc.ca

National Water Research Institute

Science Liaison
Canada Centre for Inland Waters
867 Lakeshore Road P.0. Box 550
Burlington, ON L7R 4A6
Tel.: (905) 336-4675
Fax: (905) 336-6444

Science Liaison
National Hydrology Research Centre
11 Innovation Boulevard
Saskatoon, SK S7N 3H5
Tel.: (306) 975-5779
Fax: (306) 975-5143

Regional Offices

Environmental Conservation Branch
Environment Canada
Atlantic Region
17 Waterfowl Lane
Sackville, NB E4L 1G6
Tel.: (506) 364-5044
Fax: (506) 364-5062

Water Issues Division
Meteorological Service of Canada
Environment Canada
Ontario Region
867 Lakeshore Road
Burlington, ON L7R 4A6
Tel.: (905) 336-4712
Fax: (905) 336-8901

Environmental Conservation Branch
Environment Canada
Pacific and Yukon Region
700-1200 West 73rd Avenue
Vancouver, BC V6P 6H9
Tel.: (604) 664-9120
Fax: (604) 664-9126

St. Lawrence Centre
Environmental Conservation Branch
Environment Canada
Quebec Region
105 McGill Street, 7th Floor
Montreal, QC H2Y 2E7
Tel.: (514) 283-7000
Fax: (514) 283-9451

Environmental Conservation Branch
Environment Canada
Prairie and Northern Region
4999-48 Avenue, Room 200
Edmonton, AB T6B 2X3
Tel.: (780) 951-8700
Fax: (780) 495-2615

Prairie Provinces Water Board

Transboundary Waters Unit
Environment Canada
Prairie and Northern Region
2365 Albert Street, Room 300
Regina, SK S4P 4K1
Tel.: (306) 780-6042
Fax: (306) 780-6810