Environment Canada Environnement Canada

Canada Water Act

Annual Report

for April 2011 to March 2012

Canada

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Print version
Cat. No.: En1-20/2012
ISSN 0227-4787

PDF version
Cat. No.: En1-20/2012E-PDF
ISSN 1912-2179

Website: www.ec.gc.ca/eau-water

Aussi disponible en français

Foreword

The *Canada Water Act*, proclaimed on September 30, 1970, provides the framework for cooperation with the provinces and territories in the conservation, development and use of Canada's water resources. Section 38 of the Act requires that a report on operations under the Act be laid before Parliament after the end of each fiscal year. This annual report covers progress on these activities from April 1, 2011, to March 31, 2012.

The report describes a wide range of federal activities conducted under the authority of the Act, including participation in federal-provincial/territorial agreements and undertakings, significant water research, and public information programs. A map depicting Canada's major drainage areas and drainage flows is provided in Figure 1.

Provisions of the *Canada Water Act*

The following is a summary of the major provisions of the Act:

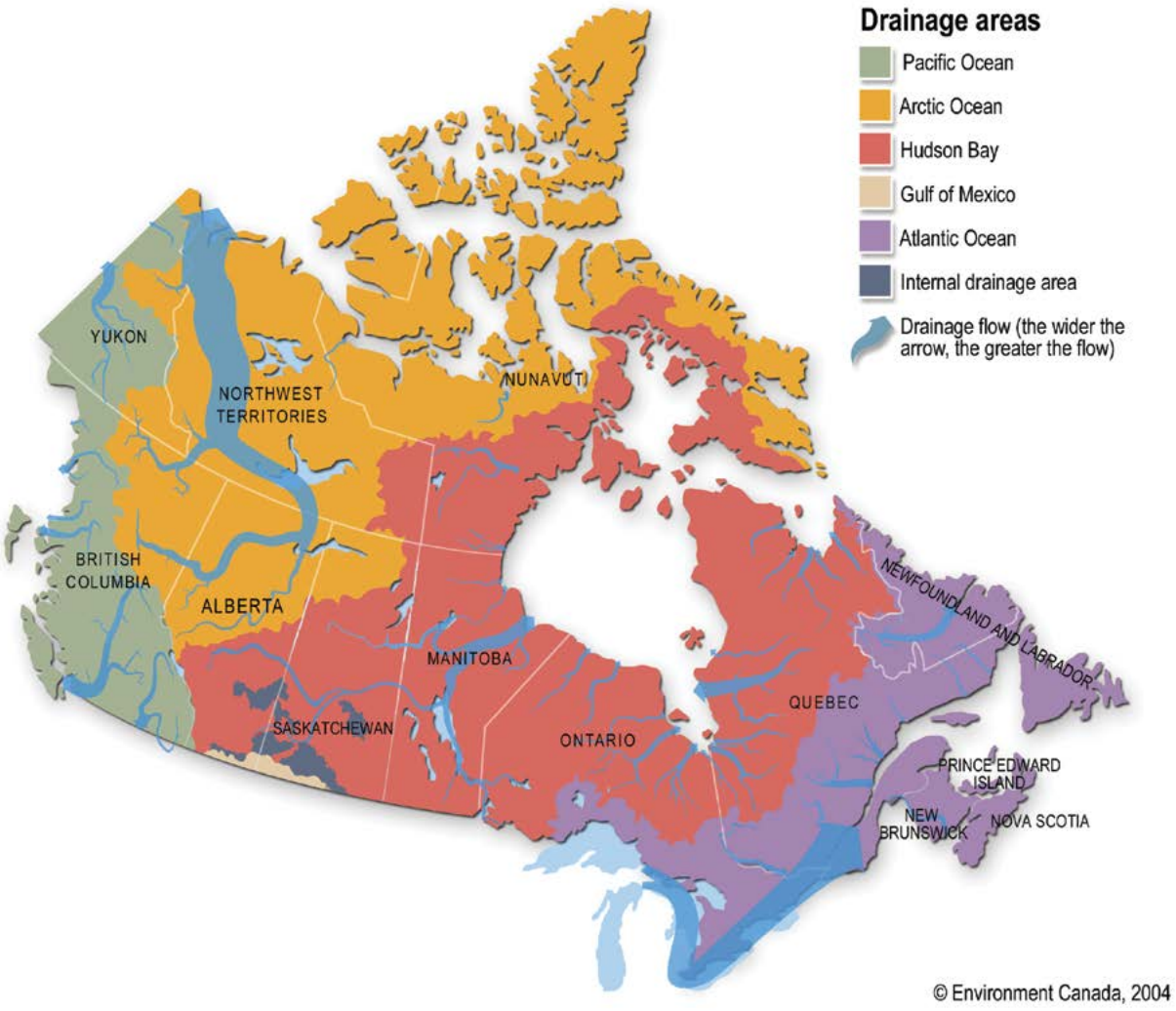
Part I, section 4, provides for the establishment of federal-provincial arrangements for water resource matters. **Sections 5, 6 and 8** provide the vehicle for cooperative agreements with the provinces to develop and implement plans for the management of water resources. **Section 7** enables the Minister, either 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Part III, which provided for regulating the concentration of nutrients in cleaning agents and water conditioners, was repealed. It was incorporated into the *Canadian Environmental Protection Act* in 1988 and later into sections 116–119 (Part VII, Division I) of the *Canadian Environmental Protection Act, 1999*, which came into force on March 31, 2000. (See the *Canadian Environmental Protection Act, 1999* annual reports to Parliament, available at www.ec.gc.ca/CEPARegistry/gene_info.)

Part IV contains provisions for the general administration of the Act, including annual reporting to Parliament. 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.

Figure 1: Major drainage areas and drainage flows in Canada



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Executive summary

The *Canada Water Act* provides an enabling framework for collaboration among the federal and provincial/territorial governments in matters relating to water resources. This annual report highlights Environment Canada's activities under the Act from April 1, 2011, to March 31, 2012.

During 2011–2012, Environment Canada's Water Survey of Canada (WSC), the federal partner in the National Hydrometric Program, continued to operate approximately 2300 hydrometric stations in Canada, of which approximately 1000 are federal stations; the remaining stations are operated on behalf of the provincial and territorial partners and third-party interests. There were no significant changes to the size of the national hydrometric network, although the network did undergo some adjustments. Work also continued on outreach, technology development and maintaining the program's International Organization for Standardization (ISO) certification. Notably, the Department implemented the Hydrometric Work Station, a computer system for managing the National Hydrometric Program's entire data production process.

The Okanagan Basin Water Supply and Demand Project developed online tools to help ensure availability of information for planning, adaptation, education and improved water management in the basin.

The second nationwide results of the Water Availability Indicator (WAI) initiative were released using 2009 survey data and included a comparison with historical data that indicates while the majority of areas remained the same, there were changes in the WAI for seven different drainage areas across Canada.

Measurements at numerous water quality monitoring stations for groundwater, inland freshwater and transboundary waters were used to assess and report on status and trends, and to evaluate the progress of protection and remediation programs. Environment Canada developed a Risk-Based Assessment tool to help prioritize monitoring activities based on threats to water quality and ecosystem health.

The 2011 Freshwater Quality Indicator was published as one of the Canadian Environmental Sustainability Indicators (CESIs); it is based on data collected from 2007 to 2009. Freshwater quality measured at 173 river stations across Canada was rated as "good" or "excellent" at 41% of sites, "fair" at 39%, and "marginal" or "poor" at 20%. Overall, there has been little change in the national freshwater quality indicator between 2003 and 2009. At the 80 stations for which there are data, no change was detected at 69 stations, while ranking improved for seven stations and declined for four.

Four inter-jurisdictional water boards (the Ottawa River Regulation Planning Board, the Prairie Provinces Water Board, the Mackenzie River Basin Board, and the Lake of the Woods Control Board) tailored their activities to the needs in each region, addressing issues such as the integrated management of reservoirs, flood protection, transboundary apportionment, water quality, relations between adjoining jurisdictions and development activities.

Work continued on a variety of partnership-based, ecosystem approaches to ensure that Canadians have access to clean, safe and healthy water, and that the country's water resources are used wisely, both economically and ecologically. These approaches include three ecosystem initiatives (Great Lakes Program, St. Lawrence Plan, and Atlantic Ecosystem Initiatives), the Action Plan for Clean Water, and the Memorandum of Understanding on Environmental Cooperation in Atlantic Canada.

In 2011–2012, negotiations continued between the federal governments of Canada and the United States to amend and strengthen the Canada–U.S. Great Lakes Water Quality Agreement. Through the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem, actions in 2011–2012 included a wide range of research, monitoring and restoration in the Great Lakes Areas of Concern through the Great Lakes Action Plan and the Cooperative Science and Monitoring Initiative; projects to reduce the amount of nutrients, solids and bacteria entering watercourses; and research in support of Canada–U.S. Lakewide Management Plans.

A new Canada–Quebec Agreement on the St. Lawrence (2011–2026) was signed in 2011. The Monitoring the State of the St. Lawrence River Program was renewed and two new programs were created—one for numerical environmental prediction, and one for joint actions aimed at promoting biodiversity conservation, sustainable use, and water quality improvement.

In 2011–2012, the Atlantic Ecosystem Initiatives included 42 projects (representing almost 45% of all projects under the Initiatives) that dealt with water issues, including restoration, enhancement and improvement of water quality and watersheds through proactive activities such as environmental education and outreach, water quality monitoring and research, and data collection.

In Environment Canada's regional offices, work is under way to coordinate the Department's work in priority ecosystems when neither formal agreements nor ecosystem initiatives exist. In the Pacific and Yukon Region, the Ecosystem Coordination Office works with the Okanagan Basin Water Board, a water governance body tasked with identifying and resolving critical water issues at the scale of the Okanagan watershed. Funding was also provided to the Squamish First Nation for the Coast Salish Gathering, the Burrard Inlet Environmental Action Program, and the Fraser River Estuary Management Program.

Under the Memorandum of Understanding (MOU) on Environmental Cooperation in Atlantic Canada, the Water Annex Work Plan was revised in 2011–2012, reducing the original 13 priority projects to five priority projects in order to ensure more streamlined efforts.

The federal government's Action Plan for Clean Water supported various projects, through Contribution Agreements totalling $6.5 million in 2011–2012, to reduce point-source and non-point-source pollution and to enhance research and monitoring in the Lake Simcoe basin.

In 2011–2012, projects were funded in the Canadian Great Lakes Areas of Concern towards the implementation of remedial plans for contaminated sediment.

Work during the last year of the four-year, $18-million Lake Winnipeg Basin Initiative (LWBI) included initiation of projects under the fifth and final round of the Lake Winnipeg Basin Stewardship Fund, further implementation of research, information and monitoring activities under the LWBI science plan, and continued inter-jurisdictional work to support implementation of the Canada–Manitoba Memorandum of Understanding on Lake Winnipeg (September 2010).

As part of its involvement in the Government of Canada's Health of the Oceans Initiative, funding in 2011–2012 supported the Gulf of Maine Council on the Marine Environment and activities associated with its five-year action plan, which focuses on protecting and restoring habitat, fostering environmental and human health, and supporting vibrant communities.

In 2011–2012, Environment Canada scientists carried out research projects on various current and emerging issues, including the following: assessing impacts of municipal wastewater effluents; determining factors controlling the extent of pathogens and parasites; quantifying the fate of agricultural and industrial runoff; assessing aquaculture impacts; investigating algal blooms and the health of aquatic ecosystems; examining water-related issues in northern Canada; and conducting hydro-meteorological modelling and prediction.

In response to the recommendations made by the federal Oil Sands Review Panel in its report to the Minister of the Environment in December 2010, the Government of Canada and Government of Alberta announced the Joint Canada–Alberta Implementation Plan for Oil Sands Monitoring in early 2012.

Environment Canada continued to provide water-related public information and water awareness activities through its Water website (www.ec.gc.ca/eau-water). In addition, the Biosphere Environment Museum (www.biosphere.ec.gc.ca) offered interactive exhibitions and guided activities designed to help visitors better understand major environmental issues, including those related to water. As well, Environment Canada has partnered with the U.S. Environmental Protection Agency to promote the use by provinces and municipalities of WaterSense, a voluntary partnership program that seeks to promote water efficiency and enhance the market for water-efficient products, programs and practices.

COMPREHENSIVE WATER RESOURCE MANAGEMENT

(Part I of the *Canada Water Act*)

1 Federal-provincial/ territorial programs

In Canada, each level of government has different jurisdictional roles related to the management of water resources. As well, there are many areas of shared commitment.

Canadian provinces and one of the territories (Yukon) have the primary jurisdiction over most areas of water management and protection. Most of these governments delegate some authority to municipalities, in particular drinking water treatment and distribution, and wastewater treatment operations in urban areas. They may also delegate some water resource management functions to local authorities that are responsible for a particular area or river basin.

The federal government has responsibilities for managing water on federal lands (e.g., national parks), federal facilities (e.g., office buildings, labs, penitentiaries, military bases), First Nations reserves, and two of Canada's three territories (Nunavut and the Northwest Territories).

The *Canada Water Act* provides an enabling framework for collaboration among the federal and provincial/territorial governments in matters relating to water resources. Joint projects involve the regulation, apportionment, monitoring or survey of water resources, and the pre-planning, planning or implementation of sustainable water resource programs.

Agreements for specific water programs require participating governments to contribute funding, information and expertise in agreed ratios. For ongoing activities such as the water quantity survey agreements with each province, cost-sharing is in accordance with each party's need for the data. For study and planning agreements, generally the federal government and the specific provincial government each assume half of the costs. The planning studies encompass interprovincial, international or other water basins where federal interests are important.

Implementation of planning recommendations occurs on a federal, provincial and federal-provincial basis. Cost-sharing for the construction of works often includes a contribution from local governments. A list of current agreements can be found in Appendix A of this annual report.

This section describes federal, provincial and territorial collaboration in the following areas:

- data collection and use
- inter-jurisdictional water boards
- partnership-based ecosystem approaches

1.1 Data collection and use

On December 7, 2010, the Commissioner of the Environment and Sustainable Development (CESD) tabled his 2010 Fall Report, which included the recommendations from the audit on Environment Canada's Water Monitoring Programs. Specifically, the CESD examined how the Department manages its Freshwater Quality Monitoring program and the National Hydrometric Program, and how it measures and reports on the programs' performance.

The report provides the CESD's recommendations to the Department for improving its management of these two programs, and includes Environment Canada's response to these recommendations. The report recommends that Environment Canada:

- work with other federal departments and authorities to determine where, on federal lands, water quality and quantity monitoring is needed and who will carry out the long-term monitoring at these locations, and to formalize arrangements to clarify roles and responsibilities for long-term water monitoring on federal lands;
- determine the optimum number of water monitoring stations across Canada and apply a risk-based approach to establish new monitoring stations;

- apply a quality assurance framework to assure that the data disseminated under the Freshwater Quality Monitoring program meet common quality standards across Canada and are fit for their intended use;
- monitor a common set of core water quality parameters at each of its stations, and communicate variances from thresholds and trends so that appropriate actions can be taken in a timely manner; and
- apply a risk-based model to manage its water monitoring activities for each program by defining scope of responsibilities, identifying client needs and key risks, identifying performance gaps, establishing and ranking program priorities, and developing and implementing an action plan to close identified gaps.

Environment Canada accepted and responded to the recommendations for improving its management of these two programs and has implemented an Action Plan to fulfill its commitment to meet these recommendations. The report, including the Department's response, is available at www.oag-bvg.gc.ca/internet/English/parl_cesd_201012_e_34435.html.

During 2011–2012, the Department began to address the recommendations from the CESD 2010 Report. Actions taken to date include the following:

- The development of a spatial inventory and coordinates of all federal lands and waters of federal interest in Canada; compilation of monitoring activities and data holdings; identification of monitoring arrangements and key federal and provincial water quality monitoring contacts.
- The development of a *draft* National Quality Assurance (QA) Framework to ensure data reliability and quality. Additionally, a national three-year strategic plan for scientific data management is being implemented.
- A national Network Planning Team was established and is addressing several additional audit recommendations. The team developed a risk-based assessment tool to ensure a risk-based approach for water quality monitoring, and will be identifying a core set of water quality parameters for national monitoring. Additionally, the team is developing a risk-based basin approach that will address the spatial aspects of the audit recommendations. Additional information is provided on these approaches in the following section.
- A document clarifying Environment Canada's roles and responsibilities for water quality monitoring is in the final stages of completion.
- A *plan-do-check-improve* framework and action plan is being developed to continually improve performance measurements and address performance gaps within the Freshwater Quality Monitoring program.

1.1.1 The National Hydrometric Program

Background

Formal bilateral hydrometric agreements between most provincial/territorial governments and the federal government have been administered cooperatively since 1975. These agreements provide for the collection, analysis, interpretation and dissemination of water quantity data, in order to meet a wide range of needs in the hydrology community.

Under the Partnership Renewal Process initiative, government partners have been reviewing, updating and revising the 1975 bilateral agreements. New bilateral agreements have been signed between Canada and four provinces (Manitoba, Alberta, Quebec and Ontario), and by Aboriginal Affairs and Northern Development Canada on behalf of Nunavut and the Northwest Territories. Throughout 2011–2012, negotiations continued with the remaining provinces and territory, with all of the remaining bilateral agreements expected to be signed in fiscal year 2012–2013.

Progress to March 31, 2012

Governance

The National Hydrometric Program (NHP) is co-managed by the National Administrators Table and the National Hydrometric Program Coordinators' Committee, which met regularly throughout

2011–2012 to discuss program issues. As part of their commitment to the principle of co-management under the NHP, a meeting was held between the two groups in September 2011 in Winnipeg, Manitoba. There was significant discussion regarding the 2011 Manitoba–Saskatchewan and Richelieu River floods and, in particular, the NHP's ability to respond to the provinces' data needs. There was also dialogue around the need to increase the NHP's "visibility" in both the private and public sectors, and to educate decision makers and end-users about the important role of quality water quantity data in responsible water resources management.

The Network

During 2011–2012, Environment Canada's Water Survey of Canada (WSC), the federal partner in the National Hydrometric Program, continued to operate 2300 hydrometric stations in Canada (see Figure 2), of which approximately 1000 are federal stations; the remaining are operated on behalf of the provincial and territorial partners. For the Province of Quebec, which is responsible for its own network, the ministère du Développement durable, de l'Environnement et des Parcs operated 200 hydrometric stations under the NHP.

In 2011–2012, there were no significant changes to the size of the national hydrometric network, although the network did undergo adjustments, including the following:

- Although there were no changes to the stations or network operations in the Northwest Territories and Nunavut, the separate Cost-Share Agreements signed for both territories in 2010 were implemented in 2011–2012. Network planning remained integrated for operational purposes.
- In the Yukon Territory, one hydrometric station was added to the network.
- In British Columbia, four hydrometric stations were added to the network and five gauging stations were removed from the network.
- In Alberta, there was no change in network size.
- In Saskatchewan, two duplicate stations were discontinued and two other stations had their operating periods increased from periodic to continuous on a seasonal schedule.
- In Manitoba, funding was provided to add 22 stations to the network. The funding was provided to enhance flood forecasting/monitoring abilities as a result of the 2009 flood. These stations will be installed in the summer of 2012. The operation of one station was taken over by a cost-share partner (MB Hydro). The operating period of 42 seasonal stations was again extended (for the second time, and likely permanently) from 3 and/or 4 months to 8 months.
- In Ontario, there was no overall change in station numbers in 2011–2012. Three water-level stations in northwestern Ontario were discontinued and switched to new locations in the immediate vicinity. Four new International Hydrometric Stations (on the St. Marys River, St. Clair River, Detroit River and Niagara River), implemented in cooperation with the U.S. Geological Survey in 2010–2011, are up and running. They provide data on water quantity movement between the Great Lakes, and generate data that increase the accuracy of water balance calculations and hydrological modelling for Great Lakes water science, leading to improved system predictions.
- In Quebec, calibration data were collected for the operation of the Ottawa River Acoustic Doppler Velocity Meter station. The Baie Mississquoi station was reinstalled on Lake Champlain after it was destroyed during the 2011 flood. Research is underway to explore the possibility of establishing a gauging station that uses hydroacoustic technology to obtain estimates of the continuous flow of the St. Lawrence River leading into Quebec. Support was provided to the International Joint Commission (IJC) for the finalization of the water levels and flows regulation plan for Lake Ontario/St. Lawrence River. This included an analysis of impacts on environmental performance indicators so as to minimize the potential for negative impacts on downstream ecosystems.
- In 2011–2012, five new stations were added in the Atlantic Region and are classified as provincial: four in Newfoundland and Labrador and one in Nova Scotia. This brings the number of stations in Newfoundland and Labrador to 109 (30 in Labrador) and in Nova Scotia to 29. No stations were discontinued in 2011–2012. Significant federal investment in life cycle management was made in 2011–2012.

Figure 2: National Hydrometric Monitoring Network

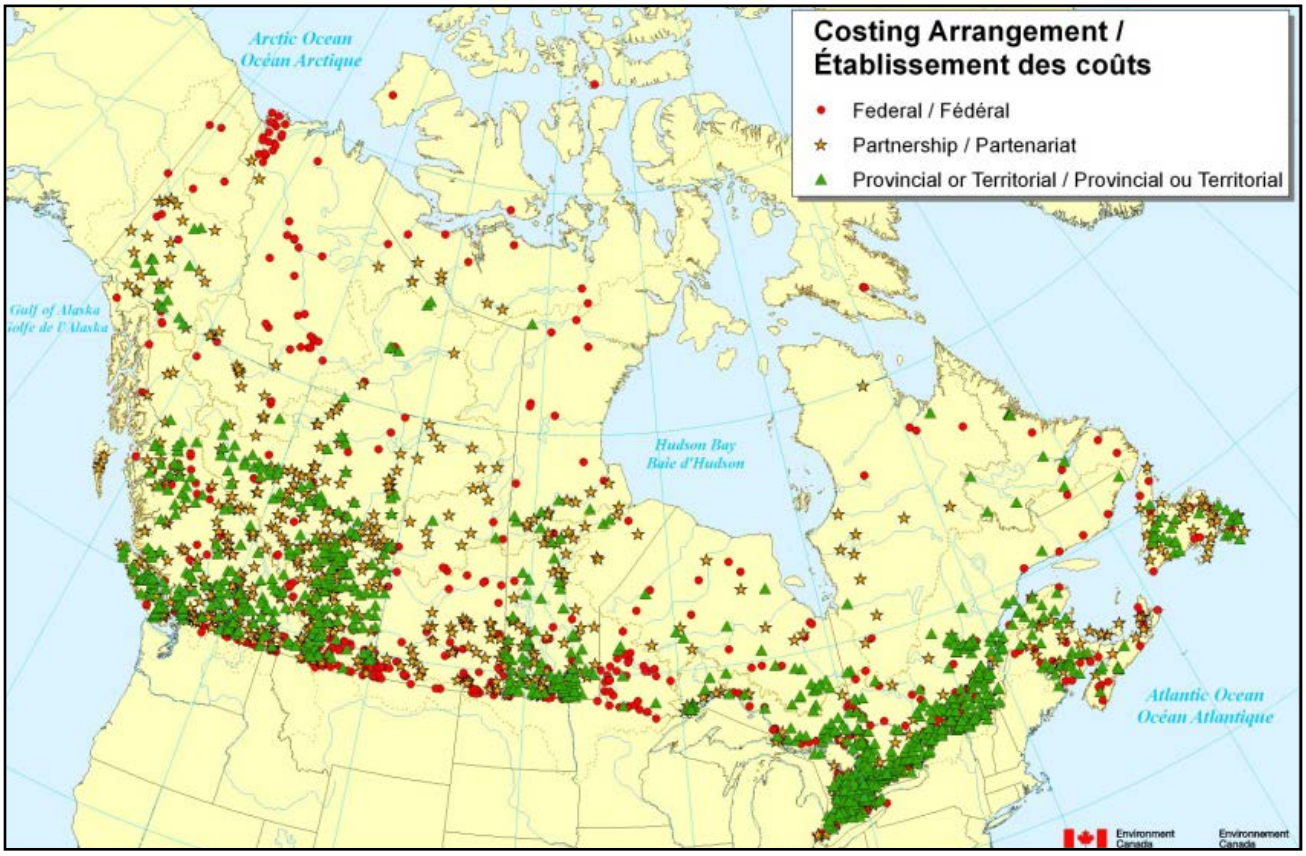


Table 1: Stations within the National Hydrometric Monitoring Network

PROVINCE/ TERRITORY	FEDERAL	PARTNERSHIP	PROVINCIAL/ TERRITORIAL	TOTAL BY PROVINCE
AB	77	156	155	388
BC	62	182	208	452
MB	23	87	87	197
NB	14	18	25	57
NL	17	31	61	109
NS	10	12	8	30
NT	41	43	6	90
NU	19	18	2	39
ON	132	74	322	528
PE	0	9	0	9
QC	16	2	0	18
SK	100	53	2	155
YT	9	23	17	49
Total	520	708	893	2121

Outreach

In June 2011, the WSC participated in the annual Canadian Water Resources Association conference in St. John's, Newfoundland and Labrador, to showcase the National Hydrometric Program and bring attention to its products and services. The overall feedback indicated that the information was well received and that participants continue to gain a better understanding of the National Hydrometric Program and its products.

The new Common Look and Feel–compliant web service and updates to the Water Survey Data archive were completed in 2011–2012. Migration of the "Water-office" portal was completed in 2010–2011 and was made operational as of May 2011. This is a dedicated website that provides real-time estimates of flow and water level conditions at the majority of the hydrometric stations operated by the WSC.

The WSC also contributed to Environment Canada's CESI program. A water-level indicator website was successfully launched by CESI in the summer of

2010. Flow indicators were developed this past year and appeared on the CESI website in the summer of 2011.

Technology

During 2011–2012, Environment Canada implemented the Hydrometric Work Station, a computer system for managing the National Hydrometric Program's entire data production process. Implementation of the new system and training of staff began in the spring of 2011 and continued throughout the year. While the previous system required servers in 17 locations across Canada, the new Work Station has been centralized in Winnipeg and Toronto. The system was designed to meet ISO quality management and program objectives, including enhanced production and real-time capabilities.

The National Hydrometric Program continued to expand the testing, evaluation and implementation of new field technologies (particularly hydroacoustic equipment) in all regions of Canada, in order to improve the measurement of stream velocity and the estimation of flow data.

ISO certification

The National Hydrometric Program continued to maintain its ISO certification during 2011–2012, and several internal and external audits were performed at various offices throughout Canada as required under the ISO process.

Throughout 2011–2012, the program also continued to address the findings of an extensive external audit conducted by the CESD in 2009–2010 regarding federal water resource monitoring programs.

Hydrological conditions and extreme events

Northwest Territories and Nunavut

High flows on the Peace and Slave rivers in the summer of 2011 restored water levels in Great Slave Lake to near normal, up from the record lows experienced over the winter of 2010–2011. Minor ice jam flooding occurred in the town of Hay River during breakup in spring 2011. A research team from the University of Alberta, led by Faye Hicks with assistance from Aboriginal Affairs and Northern Development Canada Water Resources in Yellowknife, was present during breakup to monitor water levels and flows in the Hay River and Delta, for input into the University of Alberta ice jam forecast model.

Yukon and British Columbia

In Yukon Territory, record winter snowfalls in the Carmacks region led to above-normal spring snowpack in the south-central Yukon region and Richardson Mountains. Although the Carmacks region was put under an elevated flood risk, no significant flooding was encountered during the spring freshet.

Above-normal snowfall conditions occurred throughout British Columbia during the winter of 2011, followed by a cooler and wetter than normal spring. The cooler than normal conditions helped to attenuate the freshet flows and reduce flood potential. The Fraser River had an unusually long freshet period in which flows exceeding 8000 m^3/s persisted for over 60 days. During this period, the high sustained flows caused a BC Hydro tower to collapse at a crossing of the Fraser River near Surrey, leaving 2500 residents without power. Hydrometric managers and technologists, along with warning preparedness meteorologists, maintained close contact with the British Columbia River Forecast Centre, Provincial Emergency Program, and BC Hydro, to ensure water quantity data and weather updates were made available in a timely manner.

In September 2011, high flows were experienced in northwest British Columbia. There was localized flooding and road closures in New Aiyansh and Greenville communities. Hydrometric technicians were deployed during the flood event to capture high flow measurements.

The Prairies

There were no major hydrologic events in southern Alberta during 2011–2012, but three major rain events from mid-June to mid-July in the Peace River area resulted in some site damage and the need to increase the number of staff visits to the affected sites.

Record-high snowfall conditions combined with above-normal soil moisture conditions and precipitation produced record flood conditions in southern Saskatchewan and southern Manitoba.

In contrast to 2009, when the spring flooding was largely limited in area, 2011 flooding was much more widespread and lasted well into July.

Portions of the Lake Manitoba, Lake St. Martin, Dauphin River areas in Manitoba were still experiencing above-normal water levels as of April 2012, resulting in the continued evacuation of residents from these areas. Hydrometric managers and field staff maintained close contact with, and provided continuous water quantity information to, the Manitoba Flood Forecast Centre during the flood period. Field crews from Saskatchewan were brought in to assist the Manitoba-based staff. These field crews were assigned to target flow measurements in the flooded areas.

Real-time hydrometric data and associated reports provided by the Water Office website and WSC staff were critical in the decision-making process for the provincial flood forecasting agency. An event of this magnitude provided a better understanding of the resources required, and reinforced the importance of this approach for managing flood situations.

Ontario and Quebec

In Ontario, as in many areas of the country, the very warm March of 2012, combined with a distinct lack of precipitation, meant that no flooding occurred anywhere in the province.

In Quebec, hydrological conditions varied significantly with field and weather conditions. In the spring of 2011, an unlikely suite of events led to a record-breaking flood in the Lake Champlain–Richelieu River Basin: the second-highest snowfall on record for Lake Champlain Basin fell during the 2011 winter; a sudden warm-up in late April–early May and the rainiest spring on record combined to raise Lake Champlain to record levels. On May 23, 2011, the Richelieu River rose to 1560 cm at the Environment Canada hydrometric station of Fryers Rapids, a once every 1100 years event. More than 3000 homes were evacuated and the water remained above minor-flood threshold levels for 70 days.

Atlantic provinces

In March 2012, there was severe ice jam flooding on the upper Saint John River in the Perth Andover region of New Brunswick. Environment Canada does not have any hydrometric gauging stations in this area.

1.1.2 Water use and supply

1.1.2.1 Okanagan Basin Water Supply and Demand Project

Background

Initiated in 2006, the Okanagan Basin Water Supply and Demand Project estimates present and future water needs and availability, to inform water management and planning decisions in the Okanagan Basin of British Columbia. This assessment uses available data on a multitude of relevant factors, including hydrology, climate and land use. The project also assesses the potential effects of climate change, regional growth and water conservation measures on water use and availability under different scenarios.

The Okanagan Basin Water Board currently leads the project in collaboration with British Columbia's Ministry of Environment, Ministry of Forest, Lands and Natural Resource Operations, and Ministry of Agriculture. Environment Canada, Agriculture and Agri-Food Canada, and Fisheries and Oceans Canada also participate in the project, along with the University of British Columbia (Okanagan), the BC Agriculture Council, and several local and regional stakeholders.

Progress to March 31, 2011

Following completion of the Okanagan Water Supply and Demand Project Report in July 2010, the project moved into Phase 3. This phase has thus far enabled better access to information gathered in previous phases of the project's Okanagan Basin Water Supply and Demand Study, and allowed for the continued refinement of water resource models. Environment Canada actively supports collection of data on lake evaporation in the Okanagan, to contribute to better estimates on this important component of the

Okanagan water balance. Environment Canada's field study of lake evaporation in the basin uses on-lake and shoreline meteorological monitoring equipment to provide more accurate estimates of evaporative losses from the main Okanagan lakes. The intent of Phase 3 is to ensure the best use of available information for planning, adaptation, education and improved water management in the Okanagan Basin.

To help achieve these objectives, a public information Internet portal (Okanagan Water Supply and Demand Viewer) and a water-use reporting tool have been developed (www.obwb.ca). The Department also continued to work in partnership with Agriculture and Agri-Food Canada, the Okanagan Basin Water Board and the provincial government to expand groundwater monitoring in the Okanagan Basin. Environment Canada was directly involved in the installation of four new monitoring wells installed in priority aquifers in the Okanagan basin over the 2011–2012 period.

1.1.2.2 Water Availability Indicator Initiative

Background

The sustainability of freshwater supplies is a growing concern worldwide. Pressures—including rapid urbanization, industrial expansion, agricultural intensification, and the impacts of climate change—stress water supply and affect the health of aquatic ecosystems. To ensure continued sustainability of freshwater for human use and ecosystem support, it is important to track the status of water availability in Canada.

Following a recommendation of the National Round Table on the Environment and the Economy, a federal interdepartmental working group was established in 2006 to develop the Water Availability Indicator (WAI) to describe the availability of water across Canada. The working group, led by Environment Canada, included members from Statistics Canada, Natural Resources Canada, Fisheries and Oceans Canada, Agriculture and Agri-Food Canada, the Canadian Water Resources Association, and the International Institute for Sustainable Development.

The WAI is derived by calculating the ratio of water demand (the amount of water being used) to water availability (the volume of water in rivers) at the sub-drainage-area scale (representing 164 watersheds across Canada), on an annual basis. To calculate the ratio, a geographical information system is used to analyze water use data from several federal water use surveys and stream-flow values from the WSC's HYDAT stations. Other available sources of data are used for validation purposes.

The WAI is presented in maps and graphs to obtain a large-scale view of water availability across the country. As well, the indicator is intended to be regionally relevant. Sub-drainage areas that have existing or potential water scarcity problems, such as the southern Prairies, were the initial focus of the project.

Progress to March 31, 2011

The second nationwide results of the WAI initiative were produced using 2009 survey data, which were divided into four categories based on the Organisation for Economic Co-operation and Development (OECD) classification scheme:

- High (more than 40% of available water is used): severe water stress.
- Medium (between 20% and 40% of available water is used): both water supply and water demand need to be managed; conflicts among competing uses will need to be resolved.
- Moderate (between 10% and 20% of available water is used): water availability becomes a constraint on development; significant investment is needed to provide for adequate water supply.
- Low (less than 10% of available water is used): low water stress.

Northern Canada

In Northern Canada (Yukon, Northwest Territories, Nunavut, Labrador and northern parts of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec), some sub-drainage areas were merged for data analysis because of the low levels of human activity and the large surface water supply produced by the rivers. In this region, the WAI is below 10%, indicating that the threat to water availability is "low," and that there was ample water to meet needs. Because of extreme climatic conditions and the region's hydraulic regime (e.g., frozen streams),

it was decided that the WAI initiative's methodology could not be applied to the extreme northern part of the country.

British Columbia

In British Columbia as a whole, the WAI ratio is low (below 10%). Since water availability is a concern in the Okanagan Valley, it was evaluated at the sub-sub-drainage-area scale. Results for 2009, based on the OECD classification, indicate a "high" threat to water availability for this area, indicating severe water stress.

Prairie region

The southern part of the Prairies (southern regions of Alberta, Saskatchewan and Manitoba) is a dry, arid area where low precipitation leads to a smaller water supply compared with other parts of the country. In this region, the agricultural and industrial sectors are large users of surface water, and as a result the WAI shows a moderate to high threat to water availability. For the northern part of the Prairies, WAIs are below 10%, indicating a low threat to water availability.

Ontario

In the urbanized southwestern part of Ontario, the threat to water availability is moving from "moderate" to "high" owing to heavy industrial and municipal water use and a low inland surface-water supply. According to the OECD classification scheme, this region was under water stress in 2009. In other parts of the province, the results of the indicator calculations show a low threat to water availability.

Quebec

In Quebec, the threat to water availability is considered low in most of the province, meaning that there was ample water during 2009 to meet users' needs. Because of the lack of available historical data, water availability was not evaluated in the northern part of the province.

Atlantic region

In Atlantic Canada, the presence of large rivers and relatively low water demand means that the threat to water availability is ranked as being low (below 10%). This region has ample water to meet the different demands placed on the resource at the sub-drainage-area level.

Historical comparison

Annually, the surface water supply changes based on climatic conditions, such as temperature, precipitation and humidity. This change in supply results in variations in the ratio of water demand to water availability from year to year. In order to evaluate the 2005, 2007 and 2009 WAI results from an historical perspective, a historical ratio was calculated. In this ratio, the yearly average surface water supply is based on a 30-year period between 1980 and 2009 or on as many consecutive years for which data are available until the year 2009. The water used is based on an average value for the survey years 2005, 2007 and 2009. Table 2 represents the variations of the WAI ratio between 2005, 2007 and 2009 and the 30 years historical analysis (1980 to 2009) for seven different drainage areas in Canada.

Table 2: Water Availability Indicator ratio variations

Drainage Area	2005	2007	2009	30 Years (1980 to 2009)
Okanagan Valley	Medium	Medium	High	Medium
Upper South Saskatchewan/ Oldman	Moderate	Moderate	Medium	Moderate
Bow	Moderate	Medium	Medium	Medium
Red Deer	Moderate	Moderate	Medium	Moderate
Qu'Appelle	Medium	Medium	High	High
Assiniboine	Low	Low	Moderate	Moderate
Northern Lake Erie	High	High	Moderate	High

When comparing the resulting 2009 and historical ratios, the majority of the sub-drainage areas remain in the same category of threat to water availability. There are three exceptions: two sub-drainage areas in the southern part of the Prairies (Upper South Saskatchewan/Oldman and Bow), the drainage area covering the Okanagan Valley, and the Northern Lake Erie sub-drainage area in Ontario. In these drainage areas, the historical ratios indicate a higher threat to water availability in 2009 compared to the 30 years historical ratio in all of the areas except for the Northern Lake Erie sub-drainage area where the opposite is true. These results are indicative of the fact that 2009 was a drier-than-average year in the western part of the country and a wetter-than-average year in the eastern part of Canada.

Figure 3: Water Availability Indicator for 2005

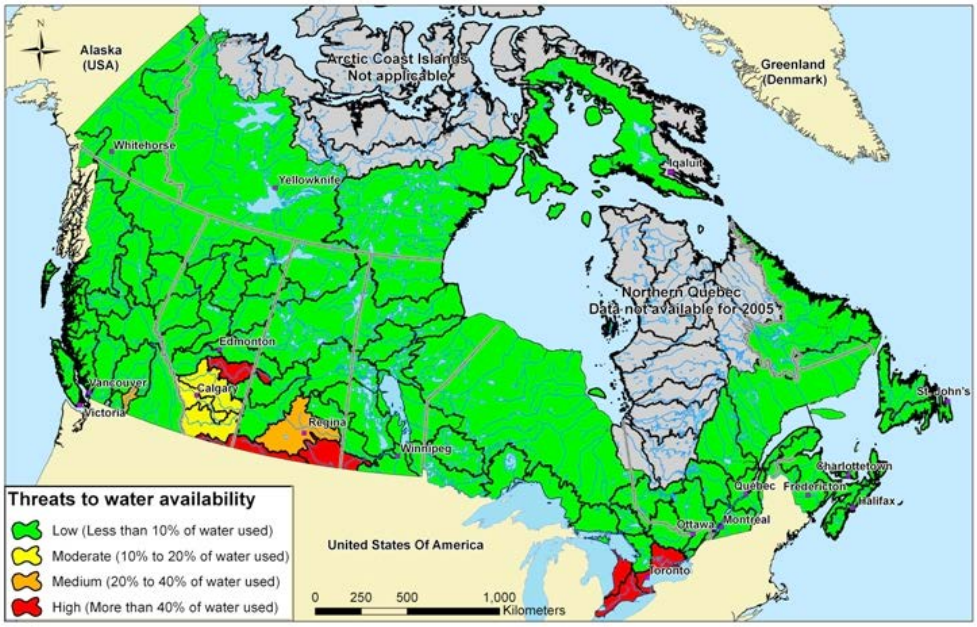


Figure 4: Water Availability Indicator for 2007

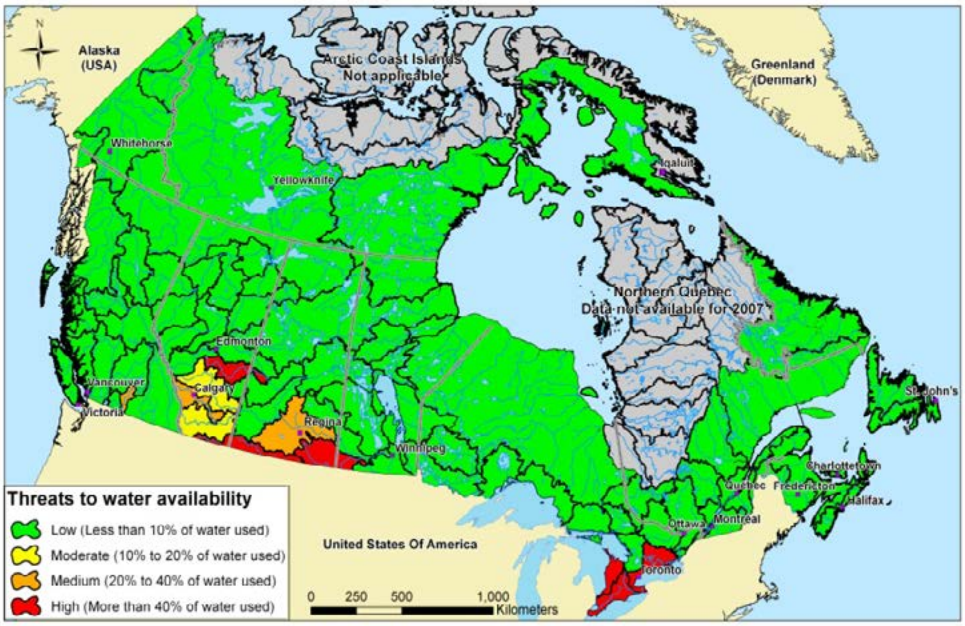


Figure 5: Water Availability Indicator for 2009

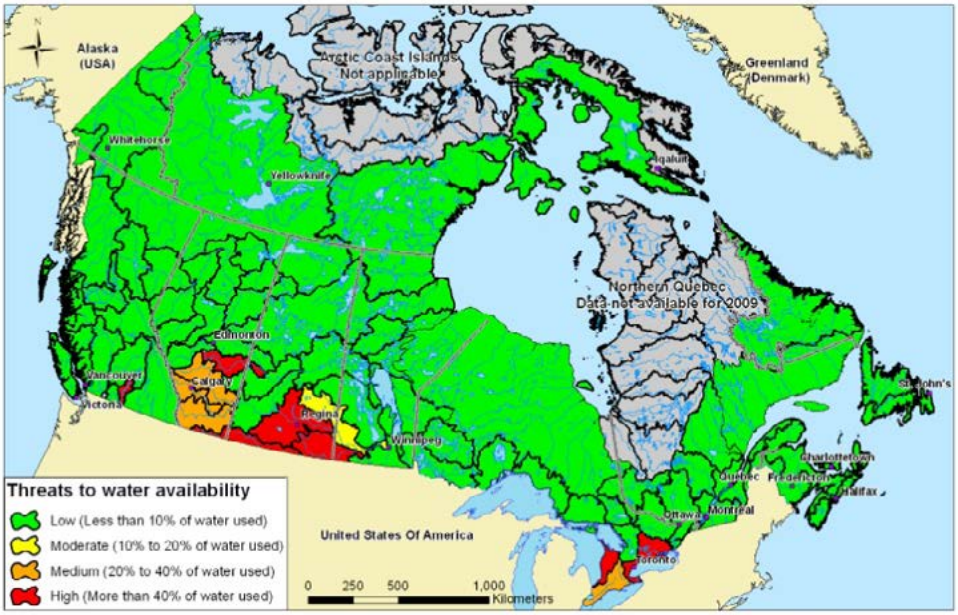
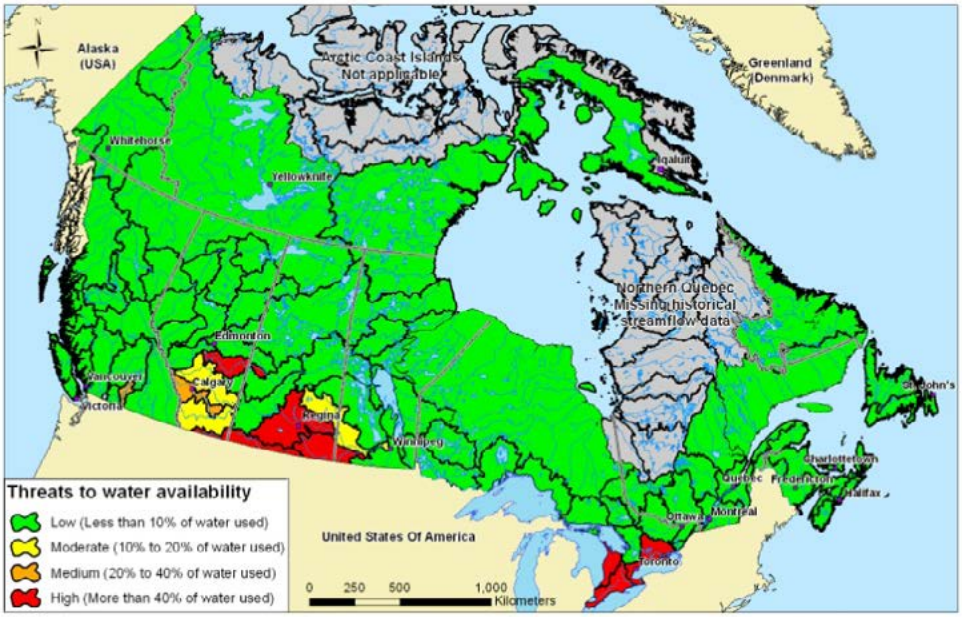


Figure 6: Water Availability Indicator based on the 30-year long-term yearly average water supply (1980 to 2009 or best number of years available to 2009)



1.1.3 Water quality

Background

Water quality monitoring has been a core program function of Environment Canada since the Department's inception in the early 1970s. The Department's activities in this area focus on the assessment and reporting on status, trends and surveillance, in fulfillment of many federal and international legislative obligations. Much of the Department's monitoring is carried out through federal-provincial agreements.

The objectives of federal-provincial water quality monitoring agreements are to achieve a long-term commitment for the acquisition of water quality data; obtain comparable, scientifically sound water quality data that are reliable for the purposes of water resource management; and disseminate timely information on water quality to the public, government agencies, industry and the scientific community. Five federal-provincial water quality monitoring agreements are currently active, as are ecosystem-based agreements such as the Canada–U.S. Great Lakes Water Quality Agreement (GLWQA) involving Ontario, the Plan Saint-Laurent involving Quebec, and targeted agreements on CESI.

Key federal-provincial water quality monitoring agreements:

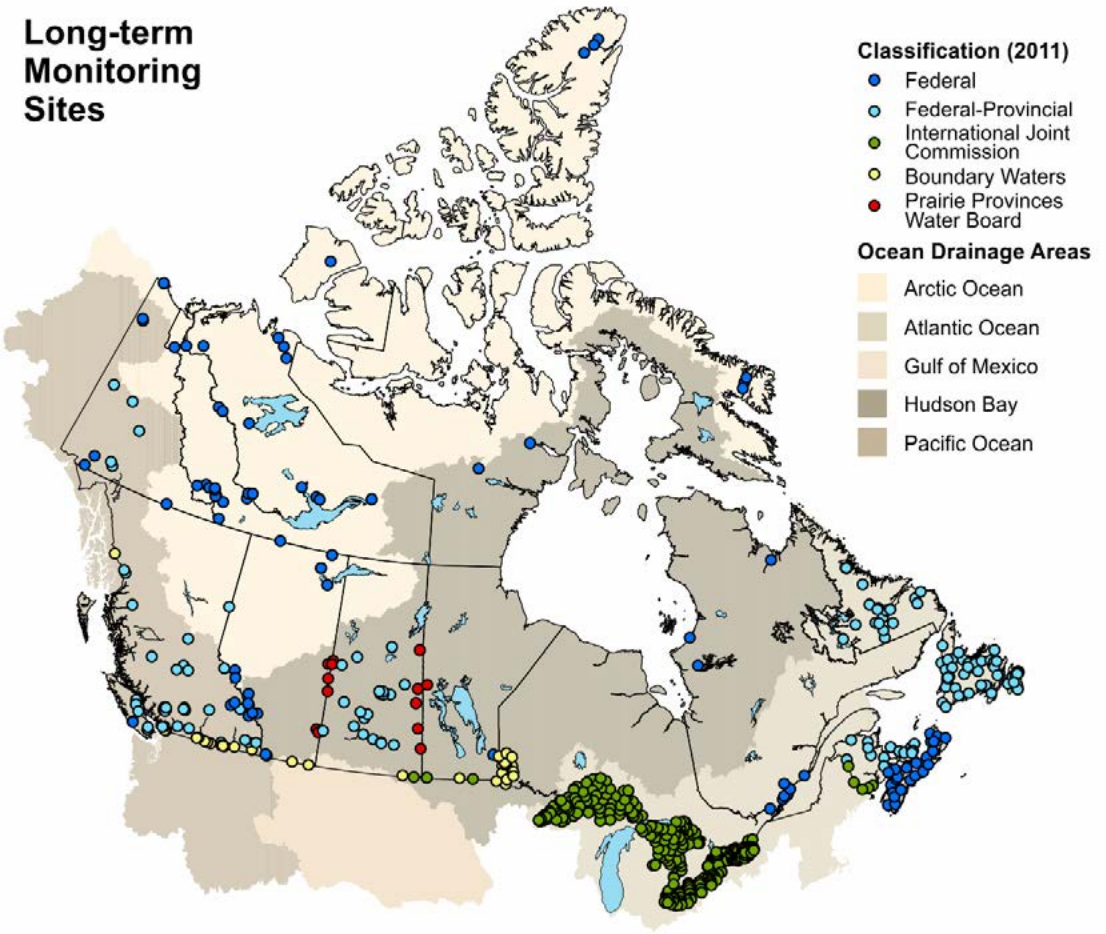
- the Canada–British Columbia Water Quality Monitoring Agreement, signed in 1985;
- the Canada–Manitoba Water Quality Monitoring Agreement, signed in 1988;
- the Canada–New Brunswick Water Quality Monitoring Agreement, signed in 1988 and harmonized in 1995;
- the Canada–Newfoundland Water Quality Monitoring Agreement, signed in 1986; and
- the Canada–Prince Edward Island Memorandum of Agreement (MOU) on Water, signed in 1989 and renewed in 2001.

Progress to March 31, 2011

National

The long-term freshwater quality monitoring network consists of federal and federal-provincial sampling sites at numerous locations (see Figure 7: Long-term water quality monitoring sites map). Measurements regularly include physiochemical parameters such as temperature, pH, alkalinity, major ions, nutrients and metals. The network is, for the most part, managed through federal-provincial-territorial, international and inter-provincial agreements.

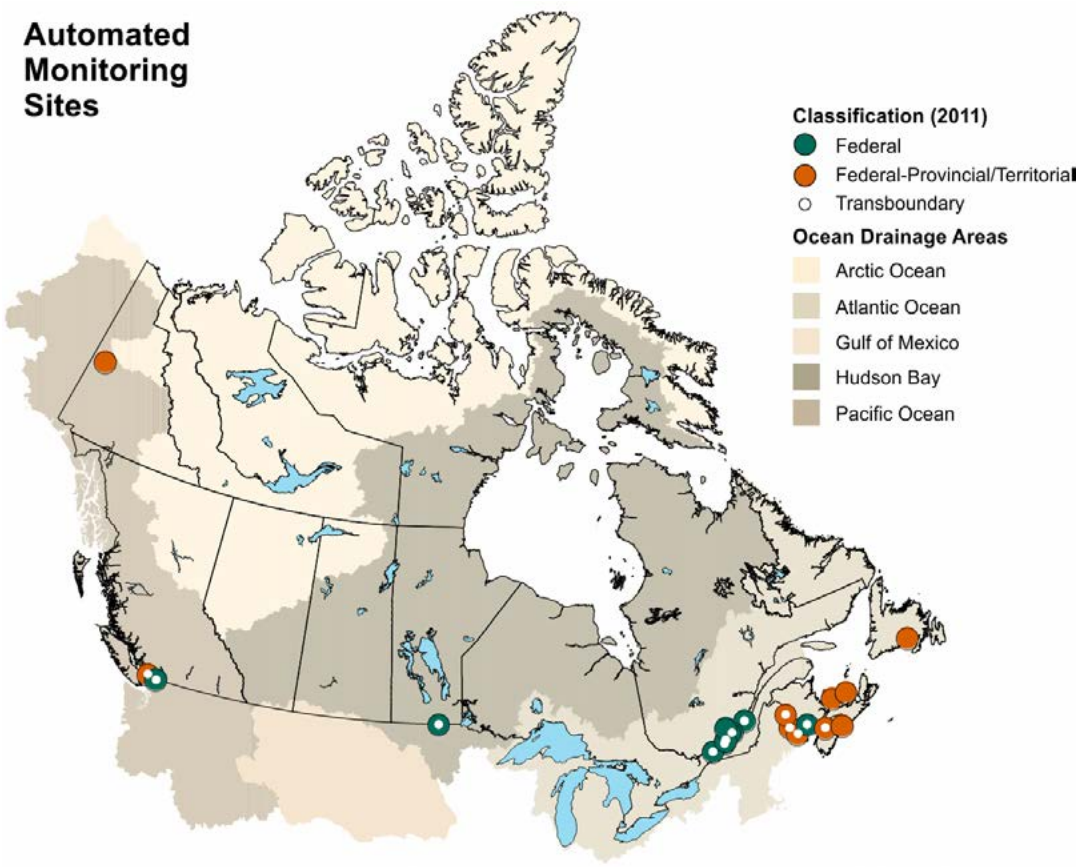
Figure 7: Long-term water quality monitoring sites



In addition to the long-term water quality network, the Automated Water Quality Monitoring Network works in partnership with provinces and territories, and federal departments (see Figure 8: Automated Water Quality Monitoring Network sites map). Most stations monitor hourly for temperature, dissolved oxygen, pH, specific conductance and turbidity.

Surveillance objectives are intended to enable the detection of spills and to react accordingly, to determine specific events and trends in water quality (especially at transboundary sites in support of the International Joint Commission), or to report on the status of aquatic ecosystems of interest to the federal government.

Figure 8: Automated Water Quality Monitoring Network sites



Considerable progress has been made on the Action Plan to address the CESD Office of the Auditor General of Canada audit recommendations related to water quality monitoring (summarized in Section 1.1). Some of the key recommendations relate to prioritization of monitoring in relation to risk. To this end, Environment Canada has developed a Risk-Based Assessment (RBA) tool to determine risks to water quality and aquatic ecosystem health. The risk-based assessment is composed of three components (Activities/Sources of Contamination to Water Quality, Impacts on Water Quality and Aquatic Life, and Vulnerability of the Aquatic Ecosystem) that include key criteria to evaluate risk. The RBA tool produces a final value that indicates the relative risk to water quality and the aquatic ecosystem at a national monitoring site or area. To date, 257 water quality monitoring sites across the country have been assessed using the RBA, and a draft RBA manual has been developed. The RBA approach is being used to help prioritize water quality monitoring activities.

An additional approach currently under development is the Risk-Based Basin Assessment (RBBA). This is a geospatial approach to identifying relative risks and priorities in basins (sub-drainage areas) across Canada. To date, a broad-scale literature search to identify and assess similar approaches has been carried out to develop appropriate risk criteria for Environment Canada's national monitoring program. Geospatial data layers are being assembled into a geo-database, to allow the calculation of individual risk indices for the criteria based on spatial analysis, allowing an overall risk index to be developed for each basin. The RBBA will continue to be developed through 2012–2013, and will identify spatial gaps in existing coverage, as well as the optimum number of water quality monitoring stations across Canada. In relation to this, statistical methods are being assessed and developed to determine optimum sampling frequencies for all water quality monitoring sites across Canada. This will ensure that the sampling strategy at all national monitoring sites enables detection of important changes to water quality over time relative to site information requirements.

Materials published online concerning fresh water quality monitoring and surveillance were redefined and streamlined in order to bring attention to scientific results. In 2011–2012, efforts focused on evaluating the site in accordance with the Treasury Board's standards on accessibility, overhauling the information architecture, and entering publications into the online version of the Environment Canada catalogue. In 2012–2013, information published on the overhauled site will include a mapping application that will incorporate results on water quality at the national level.

For more information, please consult the following website: www.ec.gc.ca/eaudouce-freshwater/Default.asp?lang=En&n=6F77A064-1.

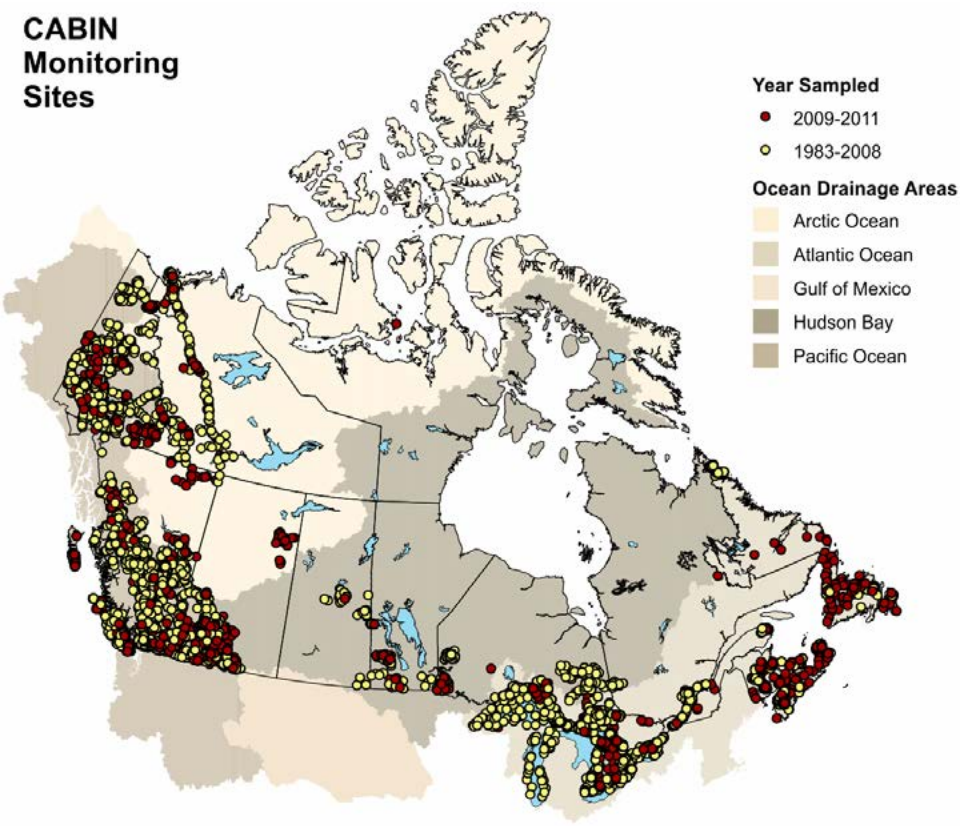
CABIN

The biological condition of freshwater in Canada is assessed through the Canadian Aquatic Biomonitoring Network (CABIN) (www.ec.gc.ca/rcba-cabin), a monitoring program that has been adopted by multiple agencies and organizations across Canada. CABIN is based on inter-agency collaboration to achieve consistent and comparable data collection and sharing, and yields considerable cost-efficiencies for all partners. The program is led by Environment Canada, which supports online data management and access, assessment tools and models, field and laboratory analysis protocols, certification and training, and ecological research and development, in addition to monitoring activities. CABIN allows partners to submit and share their observations and make a formalized scientific assessment using nationally comparable standards. During 2011–2012, CABIN, in partnership with the Canadian Rivers Institute of the University of New Brunswick, continued to provide an online program that trains partners to implement the network's standardized protocol. In addition, 144 students from across the country participated in the online training course. Twelve in-person field certification courses for 97 people were held in several locations across Canada. As the number of CABIN-trained participants increases, the ability to generate new data and water quality assessments for all partners improves.

In addition to sampling areas with upstream human activities, data were collected across the country at sites where anthropogenic effects are minimal, to build reference models that will be used to assess the biological health of freshwater bodies. Reference models are available for watersheds in Yukon, British Columbia and the Great Lakes. In 2011–2012, Environment Canada and the Canadian Rivers Institute completed a preliminary model for Atlantic Canada, Environment Canada updated the Fraser River/Georgia Basin model with contributions from the British Columbia Ministry of Environment, and Parks Canada completed the Rocky Mountains National Park Model.

Since the early development of the CABIN approach in 1987, data have been collected in over 7000 locations across the country. In 2011–2012, data were collected at 686 sites by Environment Canada and its partners (Figure 9). In March 2012, a group comprising 12 academic and government monitoring experts and researchers, known as the CABIN Science Team, was formed to provide scientific and technical advice to Environment Canada on the CABIN program with respect to long-term development of biomonitoring science.

Figure 9: CABIN network stations by year



British Columbia and Yukon

Under the Canada–British Columbia Water Quality Monitoring Agreement, Environment Canada and the provincial Ministry of Environment jointly conducted water quality monitoring at 41 stream and river sites in British Columbia. As a result of the risk-based analyses in collaboration with the provincial government, three lower-risk sites were discontinued in September 2011. Data and information from all of these sites are available on Environment Canada's website.

The majority of the Canada–British Columbia water quality monitoring sites are transboundary or located on significant tributaries to transboundary waterways; or are important for other Environment Canada activities (e.g., major fisheries rivers, sites on Canadian Heritage Rivers). Twenty-two of the 38 sites are used for national CESI reporting on freshwater quality in Canada.

Through CABIN, biological sampling was also conducted at water quality sites partnered under the Canada–British Columbia Water Quality Monitoring Agreement. There are four CABIN reference models used in British Columbia to evaluate biological conditions at monitoring sites.

Environment Canada also operated six long-term water quality monitoring sites in national parks, in partnership with the Parks Canada Agency (four in British Columbia and two in Yukon). These sites are considered relatively pristine, and provide important baseline and reference information that is compared with sites influenced by human activities. Moreover, many of these pristine sites are in key locations for assessing climate change.

An additional six sites were monitored on northern Yukon rivers, primarily in collaboration with Environment Yukon. All of the sites are located on transboundary rivers or significant tributaries to transboundary waterways. A final draft of the Canada–Yukon Water Quality and Aquatic Ecosystem Monitoring and Reporting Memorandum of Agreement has been completed in order to formalize the Canada–Yukon monitoring partnership. The data generated under this partnership have recently been used in

the *Yukon State of the Environment Interim Report: An Update for Environmental Indicators*, issued in May 2012.

Cooperative federal-provincial arrangements to test groundwater quality were discontinued in British Columbia following changes to regional operations by the British Columbia Ministry of Environment. Sampling of groundwater monitoring wells that were previously installed through cost-sharing with the provincial government was continued by Environment Canada, as the 12 monitoring wells implicated in this previous program already formed part of Environment Canada's groundwater monitoring network in the transboundary Abbotsford–Sumas aquifer. A subset of approximately 30 wells is sampled on a monthly basis, with an annual sampling event of the full network (approximately 60 wells). This work also supports Environment Canada's groundwater research projects that investigate the potential occurrence and persistence of nitrates, pathogenic bacteria and pesticides in groundwater, in collaboration with scientists from Agriculture and Agri-Food Canada and several Canadian universities. Additional cooperative groundwater monitoring is conducted on a semi-annual basis in the transboundary Osoyoos aquifer (southern Okanagan), where a combination of provincial and Environment Canada monitoring wells form the basis of the Environment Canada groundwater monitoring network for this transboundary area.

Alberta, Saskatchewan and Ontario

A multi-year agreement, signed between Environment Canada and Saskatchewan Environment, has been completed and funded by the CESI program. This has supported ongoing data collection and analysis as well as water quality indicator calculation for Saskatchewan's network of water quality monitoring sites in order to better represent the geography of the Lake Winnipeg basin.

Ontario has no formal agreements with the federal government to monitor the quality of inland waters; most of the surface water monitoring for inland lakes and streams is performed by the provincial government. The province contributes its water quality data to the CESI report in collaboration with Ontario Conservation Authorities.

Environment Canada's water quality monitoring in Ontario focuses on areas of federal jurisdiction, namely, the Great Lakes and Lake of the Woods in Ontario as well as interprovincial rivers.

Alberta is also supporting national water quality monitoring reporting (under CESI), and has been intensively involved in developing enhanced monitoring plans with Environment Canada for the oil sands area (see Section 2.5 on oil sands monitoring).

Manitoba

Water quality sampling continued at two sites identified as part of the Canada–Manitoba Water Quality Monitoring Agreement and in support of the Lake Winnipeg Initiative. The water quality station on the Red River at Emerson, which is located on the international boundary with the United States, supports the work of the International Red River Board and represents an essential tributary of Lake Winnipeg. An automated station is now fully operational (as of March 2011) and is used on a regular basis to complement grab sampling at the same site.

In 2011–2012, Environment Canada completed a surveillance study on nutrients sequestration at major dams and reservoirs, looking at their capacity to retain nutrients. Preliminary results show that the capacity to retain nutrients was more than 80% for Lake Winnipegosis and Lake Manitoba. Also, a review of the sampling strategy on rivers has been initiated in consultation with the Prairie Provinces Water Board, for the purposes of network optimization and instituting a risk-based approach to Lake Winnipeg interprovincial sites.

Quebec

In 2011–2012, Environment Canada operated ten sampling stations in Quebec as part of its water quality monitoring activities. A risk-based assessment was done at these stations in order to evaluate the environmental risks posed to the aquatic ecosystem at each of the sites. The sampling frequency varied from one to four times per month (depending on the season) for the different parameters analyzed, such as metals, nutrients and pesticides. Three of these stations are situated at the mouth of the main tributaries of Lake Saint-Pierre (Yamaska,

Saint-François and Nicolet). These tributaries have a significant influence on the quality of water in this fragile ecosystem, given that the lake is a Ramsar site (under the Convention on Wetlands of International Importance) and a UNESCO Biosphere Reserve.

The agreement with La Mauricie National Park was renewed to ensure the continuation of water quality monitoring activities at the Rivière-à-la-Pêche reference station. This agreement also helped harvest fish necessary for the Clean Air Regulatory Agenda program (in connection with CEPA 1999). Thanks to the renewal of an agreement with the Parks Canada Agency, water quality monitoring activities were also continued at the Ottawa River in Carillon. Given its large flow rate, the Ottawa River, one of the St. Lawrence River's main tributaries, has a significant impact on the St. Lawrence River's water quality.

Environment Canada and the Ministère du Développement durable, de l'Environnement et des Parcs continued to work toward formalizing an agreement on implementing a common water quality monitoring network in Quebec. This federal-provincial agreement covers watercourses that fall under the jurisdiction of the provincial ministry and are of federal interest, notably the St. Lawrence and Ottawa rivers, and eight watercourses that cross the Canada–United States border. Thirty-nine stations operated by the Ministère du Développement durable, de l'Environnement et des Parcs du Québec were selected to become part of the network. In accordance with this agreement, analysis samples will be taken each month in order to closely monitor 13 physical and chemical parameters. Over half of these stations (23) will provide data to calculate the water quality index presented in the CESI report.

Atlantic provinces

Bilateral annual meetings were held by representatives for the Canada–New Brunswick, Canada–Prince Edward Island, and Canada–Newfoundland and Labrador water quality agreements, to discuss and review the previous year's accomplishments and to plan and prioritize workloads for cost-shared and work-shared projects. Most monitoring sites were used to report on water quality on federal lands or to report on freshwater quality in the 2011 CESI report.

In New Brunswick, five federally designated, 10 federally-provincially designated, and 47 provincially designated surface water quality stations were monitored under the federal-provincial agreement. Fifty-seven stations were used to report on freshwater quality in the CESI report. Three real-time water quality stations were operated on international rivers: two on the St. Croix River (at Milltown and Forest City) and one on a tributary of the Saint John River (at Red Bridge Road on the Meduxnekeag River). Eleven sites were monitored by Environment Canada through the CABIN biomonitoring program, and 14 were monitored by the Parks Canada Agency (in New Brunswick).

In Prince Edward Island, 28 water quality (physical and chemical) monitoring sites were sampled, including four groundwater stations, 10 marine or estuarine stations, and 14 freshwater streams. Data from 11 stream stations were used to report on freshwater quality in the CESI report. As well, three real-time water quality stations were active under a federal-provincial partnership, and eight sites were sampled under the CABIN program.

In Newfoundland and Labrador, 80 water quality sites continued to be sampled four to six times per year under the federal-provincial agreement. Sixty-seven stations were used to report on freshwater quality in the CESI report. Eighteen sites were monitored through the CABIN program under the water quality agreement.

In Nova Scotia, although no official water quality agreement exists between the federal government and provincial government, a network of 24 water quality monitoring stations continued to be operated by Environment Canada throughout the province, with assistance from Nova Scotia Environment. Data from 29 stations were used to report on freshwater quality in the CESI report. Two real-time water quality stations continued to operate—one on the Little Sackville River and another on the upper reaches of the Annapolis River. Seventeen were sampled by Environment Canada and 23 were sampled by other partner organizations under the CABIN program.

1.1.4 Canadian Environmental Sustainability Indicators (CESI)

Background

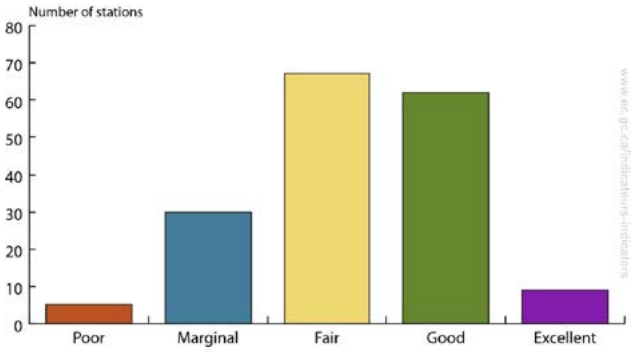
As part of a broader commitment to transparency in environmental decision making, the CESI program provides reporting on the status and trends of key environmental issues (www.ec.gc.ca/indicateurs-indicators/default.asp). Indicators cover key themes, including air quality, greenhouse gas emissions, water quality and availability, and protecting nature. The program's freshwater quality indicator uses the Water Quality Index, endorsed by the Canadian Council of Ministers of the Environment (CCME), to summarize the status of surface freshwater quality in Canada. This Index assesses water quality by examining the extent to which water quality guidelines for the protection of aquatic life (plants, invertebrates and fish) are being met at selected lake and river monitoring sites throughout Canada.

Progress to March 31, 2012

The latest freshwater quality indicator was released in March 2012, and is based on data collected from 2007–2009 at 334 water quality stations across Canada. For this report, the national water quality indicator values were calculated using a core national network of 173 river stations.

Freshwater quality measured at these 173 river sites across Canada was rated excellent for the protection of aquatic life at nine stations, good at 62 stations, fair at 67 stations, marginal at 30 stations, and poor at five stations. Overall, there has been little change in the national freshwater quality indicator between 2003 and 2009 at the 80 stations for which there are data. During this period, no change was detected in the freshwater quality indicator rankings for 69 stations, while the ranking has significantly improved for seven stations and declined for four stations.

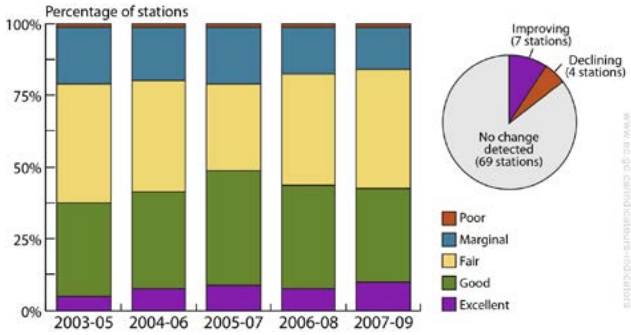
Figure 10: National freshwater quality indicator for 2007–2009, Canada



Note: Freshwater quality was assessed at 173 stations throughout Canada's 16 drainage regions where human activity is most intensive, using the CCME's Water Quality Index. Data from 2006–2008 were used for 24 Quebec stations, because 2009 data were not available.

Source: Data assembled by Environment Canada from federal, provincial, territorial and joint water quality monitoring programs.

Figure 11: National freshwater quality indicator change between 2003–2005 and 2007–2009



Note: The change in the indicator between the 2003–05 and 2007–09 periods was assessed at 80 stations in 13 drainage regions across Canada where historical data were available. For each station, a change in the indicator was assessed using a consistent set of guidelines and parameters through time.

Source: Data assembled by Environment Canada from federal, provincial, territorial and joint water quality monitoring programs.

1.2 Inter-jurisdictional water boards

Inter-jurisdictional water boards have been established to focus on specific water issues that have implications for more than one province or territory.

1.2.1 Ottawa River Regulation Planning Board

Background

In 1983, Canada, Quebec and Ontario concluded the Agreement Respecting 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 secretariat, the 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 Montréal region.

Progress to March 31, 2012

In early March 2011, the snow results survey over the Ottawa River drainage basin indicated a snowpack depth that was slightly below average, which indicated that the spring peak flows may be below mean levels. During March and April, precipitation was significantly higher, particularly in the lower part of the basin. While the volume of water during the freshet was near normal in the northern section of the basin, the volume was significantly above normal in the southern part due to the late season precipitation.

Although the total volume of runoff during the spring melt was the largest in 15 years, the flood peaks were in the range of the mean annual flood values. There were no major flooding problems along the main stem of the Ottawa River. The threshold for the start of minor flooding was slightly exceeded on Lac Coulonge, Chats Lake and Britannia Lake. The spring peak flow at Carillon, at the beginning of Lake of Two Mountains, did not exceed the water level for the start of flood damages. Carillon is considered to be at the end of the drainage basin, and high water levels on Lake of Two Mountains affects flooding around Montréal.

The board supported a number of public information initiatives through the Ottawa River Regulation Secretariat. The secretariat, which is housed at Environment Canada, maintains a website and a recorded message on toll-free telephone services in French and English, both of which provide information about water levels and flows at various locations in the basin. There were approximately 36 000 visits to the website in 2011–2012 for flow and level information, and over 1400 phone calls were placed to the toll-free information lines.

1.2.2 Prairie Provinces Water Board

Background

Recognizing that water use within one province may affect another province, and because federal and provincial governments have shared responsibility for water, the governments of Canada, Alberta, Saskatchewan and Manitoba signed the Master Agreement on Apportionment (MAA) in October 1969. The Agreement's purpose is to apportion water between Alberta, Saskatchewan and Manitoba, and to protect surface water quality and transboundary aquifers. The MAA also provides for cooperation between governments with respect to transboundary water management, and for the establishment of the Prairie Provinces Water Board (PPWB) to administer the Agreement (see www.ppwb.ca).

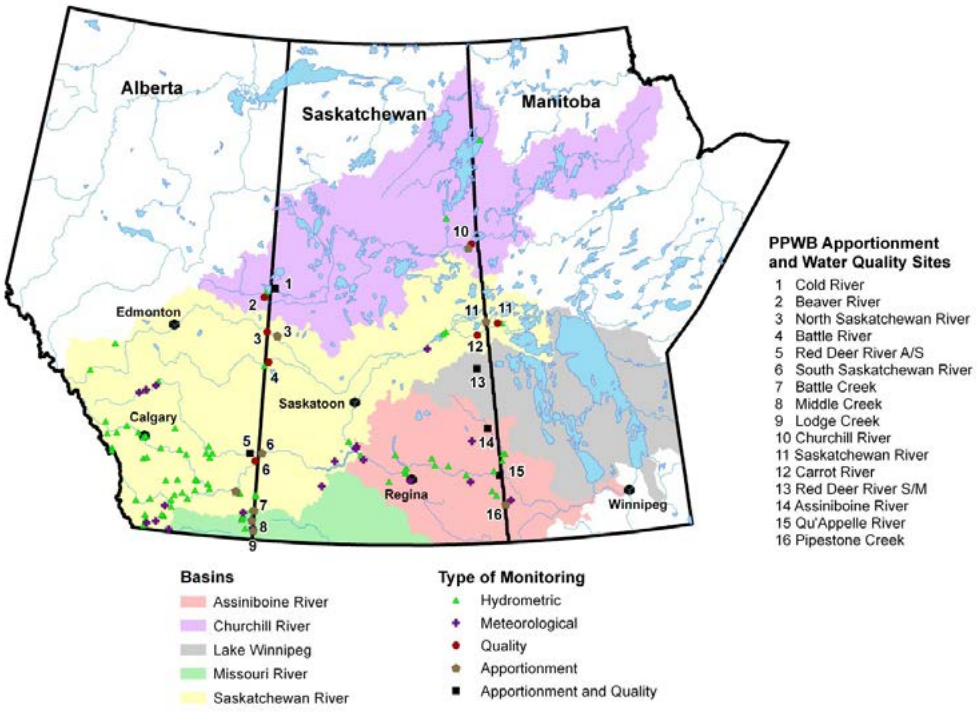
The overarching deliverable for the PPWB is to report on achievement of the MAA's terms. The MAA provides for an equitable sharing of available waters for all eastward-flowing streams, including transboundary lakes, crossing provincial boundaries. The schedules to the Agreement describe the role of the board, and stipulate the amount and quality of water that shall pass from Alberta to Saskatchewan and from Saskatchewan to Manitoba. The PPWB interprets its core duties to be:

- foster and facilitate transboundary surface management and use that encourages the protection and restoration of the aquatic environment;
- facilitate cooperative management and use of transboundary aquifers to ensure their protection and sustainable use and consider groundwater matters that have transboundary implications;

- promote and facilitate a cooperative and consensus-based approach to prevent, and where necessary, resolve concerns related to transboundary water issues;
- exchange information and consult on transboundary water development amongst governments;
- make recommendations to governments on transboundary surface and groundwater quantity and quality issues referred to the board; and
- report to governments on the achievements of the terms of the MAA.

In support of the MAA, Environment Canada monitors stream flows, water quality and meteorological conditions on eastward-flowing streams on the provincial borders (see Figure 12). The PPWB computes apportionable flows based on the natural flow on a river if that river had never been affected by the activities of people. Excursions to the MAA water quality objectives are calculated annually.

Figure 12: Prairie Provinces Water Board water quantity and quality monitoring stations and basins



Progress to March 31, 2012

Activities and accomplishments in 2011–2012 included the following:

- Apportionment requirements were met in the calendar year of 2010 on all eastward-flowing prairie streams. Interim flows indicated that 2011 apportionment requirements were likely met on the South Saskatchewan River and Middle and Lodge creeks.
- The board approved the hydrometric and meteorological monitoring station list for 2012–2013. Work continued to modernize the natural (apportionable) flow computation software programs. A project to review apportionment methods used in the basins on a 10-year rotational basis has started; review criteria are being developed using the North Saskatchewan River as a pilot.
- Work continued on the development of a schedule to the MAA related to transboundary aquifers. An environmental scan was done, which suggested that current risks to groundwater are low for transboundary aquifers, but potential pressures may increase in the future. A document is being drafted to provide guidance on developing the proposed schedule.

- The board approved the 2012 water quality monitoring program and the 2010 Water Quality Excursion Report. Percent adherence to water quality objectives was very high (94%) for all rivers, such that water quality continues to be protected.
- A four-step process to review all water quality objectives for each of the 11 rivers is ongoing, with a priority on nutrient objectives.
- The board continued to exchange information on issues of common interest, including water quality issues related to Lake Winnipeg, Saskatchewan–Manitoba drainage issues, the Montana–Alberta St. Mary and Milk Rivers Water Management Initiative, and invasive species.
- The board and each of its three standing committees on hydrology, water quality and groundwater held at least one meeting and additional conference calls.
- The PPWB Charter, Strategic Plan and Communication Strategy are being updated. The 5-year Work Plan was renewed until the fiscal year 2016–2017.
- The four member governments were informed about board activities through distribution of minutes, quarterly reports and an annual report. The secretariat responded to a number of public inquiries.

1.2.3 Mackenzie River Basin Board

Background

The governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories and Yukon signed the Mackenzie River Basin Transboundary Waters Master Agreement in July 1997. The Master Agreement endorses the principle of managing water resources for future generations such that the ecological integrity of the aquatic ecosystem is maintained. 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.

The 13-member Mackenzie River Basin Board (MRBB), which represents all parties to the Master Agreement, administers the provisions of the agreement. Federal members include representatives from Environment Canada, Aboriginal Affairs and Northern Development Canada, and Health Canada. The three provinces and two territories in the basin are represented by 10 members, including an appointee from provincial and territorial government water management agencies, and an Aboriginal board member nominated by Aboriginal organizations.

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 the staffing and operation of the secretariat office in Yellowknife, Northwest Territories, to provide working-level support for the board. The Executive Director of the secretariat, hired by Environment Canada's Prairie and Northern Region, plans, directs and manages board operations.

Progress to March 31, 2012

Activities and accomplishments in 2011–2012 included the following:

- MRBB members met once during the year and held two conference calls.
- The board developed an Issues Report focusing on the state of knowledge related to impacts in the Mackenzie River basin from oil sands development, hydroelectric development, and climate change. The *Mackenzie River Basin 2012 Issues Report: oil sands development, hydroelectric development, and climate change* is scheduled for publication in early 2012–2013.
- The board developed a new website (www.mrbb.ca).
- The MRBB Technical Committee held a workshop in December 2011 focused on a hydraulic/hydrologic model for the basin that has been developed. Jurisdictional representatives received instruction on how to use the model. The workshop also provided the opportunity to assess the model and better understand its capabilities and limitations. Workshop participants were able to recommend actions that, when undertaken, should improve model performance.
- Member jurisdictions continued to exchange information through agency reports.
- Aside from board meetings, Aboriginal board members also met through the MRBB Traditional Knowledge and Strengthening Partnerships

Steering Committee, which is mandated to explore ways of strengthening the use of traditional knowledge in board activities and to encourage the board's engagement of Aboriginal peoples in the Mackenzie River Basin. Through this committee, Aboriginal board members reported that, as board members, the question they are most often asked is, "How is the water?" Members reported that it was often difficult to find the information they needed to answer that question. Aboriginal members reported that traditional knowledge is starting to build traction in decision making within the Mackenzie River Basin, but that more work is needed.
- The board relocated the secretariat office from Fort Smith to Yellowknife and reduced the secretariat to one staff member in order to manage operating costs.
- The board tracked the progress of British Columbia, Alberta, Saskatchewan and the Northwest Territories, as these jurisdictions gathered information and prepared to initiate bilateral water resource management negotiations in the Peace, Athabasca, and Slave River watersheds. The negotiations are expected to conclude by mid-2013. The secretariat has retained facilitators on contract to work with the jurisdictions, in order to guide the negotiations and ensure that agreements are consistent across the basin. The facilitators are funded by the negotiating parties, and these funds are not considered part of the board's operating budget.

1.2.4 Lake of the Woods Control Board

Background

The Lake of the Woods Control Board (LWCB) does not fall under the *Canada Water Act*, but it is included in this report to provide a more complete picture of federal-provincial water management in Canada. The LWCB is a Canadian board consisting of four members, each with an alternate, who represent Canada (one member), Ontario (two members) and Manitoba (one member). Appointments are made by orders in council of the appropriate government, and each appointee must be a professional engineer.

The LWCB, established in 1919, is responsible for the regulation of levels in Lake of the Woods and Lac Seul, and flows in the Winnipeg and English rivers downstream from these lakes to their junction. In addition, when the level of Lac Seul exceeds certain specified levels, the LWCB controls the diversion of water from Lake St. Joseph (Albany system) into Lac Seul.

The LWCB's authority is defined by concurrent Canada–Ontario–Manitoba legislation (*Lake of the Woods Control Board Act*; 1921, 1922, 1958), and is further mandated by a Canada–U.S. treaty (Convention and Protocol for Regulating the Level of the Lake of the Woods, 1925), since Lake of the Woods is an international boundary body of water. This treaty also created a second board, the International Lake of the Woods Control Board (ILWCB). Although Lake of the Woods is normally regulated solely by the LWCB, the outflow from the lake is subject to the approval of the ILWCB whenever the level of the lake rises above or falls below certain levels specified in the treaty.

The board maintains a full-time secretariat that monitors conditions in the basin, provides information and analysis, and recommends regulating strategies or specific outflows. It also implements strategy when so directed, conducts studies, and maintains communications with basin users.

Progress to March 31, 2012

Basin conditions in 2011 were characterized by a strong spring freshet, followed by progressively drier conditions through the summer and fall. There was a brief period of higher inflows in July, but by year-end the entire basin was very dry, with concerns about drought conditions going into 2012. Lake of the Woods levels remained well below the level at which regulation would become subject to the approval of the ILWCB.

The integrated management of the Lake of the Woods and Lac Seul basins by the LWCB is a very important part of its function, due to the impacts of the combined flows of the two systems on the Winnipeg River in Manitoba. During 2011, flows in Manitoba reached moderately high conditions during May, but declined to the very low range by early fall, where they remained through the winter of 2012.

1.3 Partnership-based ecosystem approaches

Federal and provincial governments have jointly developed and implemented basin-wide action plans in collaboration with communities and other stakeholders. These action plans are designed to help resolve complex environmental issues, particularly deteriorating water quality that threatens human and ecosystem health.

During the late 1980s, the St. Lawrence River and Great Lakes basins were the focus of the first large action plans to clean up, restore and protect ecosystems. Each of these plans involved extensive collaborative actions at the community level to prevent pollution and restore polluted ecosystems. Although each plan was designed to meet specific regional needs and priorities, all were based on an ecosystem approach, promoting partnerships that involve all sectors, encouraging community involvement, and ensuring a sound scientific basis for decision making.

Recent examples of similar collaborative efforts include the Lake Winnipeg Basin Initiative and Lake Simcoe Clean-Up Fund initiated under Canada's Action Plan for Clean Water, and the MOU on Environmental Cooperation in Atlantic Canada.

This section describes a number of key partnership-based ecosystem approaches through which Environment Canada works to ensure that Canadians have access to clean, safe and healthy water, and that the country's water resources are used wisely, both economically and ecologically.

1.3.1 Ecosystem Initiatives

Environment Canada's Ecosystem Initiatives are cooperative, place-based programs designed to deliver environmental results in targeted ecosystems. The objective of the Ecosystem Initiatives is to enhance or maintain ecosystem sustainability by addressing a range of local or regional environmental challenges through partnership-based work. Local activities are coordinated by Environment Canada and undertaken in collaboration with a range of local partners and stakeholders that may include other federal departments, provinces and territories, regional, municipal and local governments, Aboriginal peoples, federal and state governments in the United States, businesses, non-governmental and community organizations, and colleges and universities.

Ecosystem Initiatives achieve their objectives by relying on measurable environmental results, aligned and coordinated efforts, collaborative governance mechanisms, integrated science and monitoring, community and stakeholder involvement, sharing of information and experiences, and informed decision making.

1.3.1.1 Great Lakes Program

Background

The Great Lakes Program is a partnership of federal departments (Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada, Natural Resources Canada, Public Works and Government Services Canada, Transport Canada, and Infrastructure Canada) and one federal agency (the Parks Canada Agency), whose goals are a healthy environment, healthy citizens and sustainable communities. This program significantly bolsters Canada's efforts to protect and restore the Great Lakes Basin ecosystem (www.ec.gc.ca/grandslacs-greatlakes).

The Great Lakes Program also provides the framework for working toward Canada's commitments under the GLWQA (www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=88A2F0E3-1), which is the key mechanism for protecting water quality and the health of the aquatic ecosystem in the Great Lakes. Negotiations continued between the federal governments of Canada and the United States to amend and strengthen this agreement.

Federal partner departments' activities are integrated with those of Ontario through the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem, which contributes to meeting Canada's obligations under the GLWQA. The Canada–Ontario agreement outlines how the two levels of government will cooperate and coordinate their efforts to restore, protect and conserve the Great Lakes Basin ecosystem. It builds on the actions taken through previous agreements, and focuses priorities for future actions. Federal signatories to this agreement

include Agriculture and Agri-Food Canada, Environment Canada, Fisheries and Oceans Canada, Health Canada, Infrastructure Canada, Natural Resources Canada, the Parks Canada Agency and Transport Canada. Provincial signatories include Ontario's ministries of the Environment, Natural Resources and Agriculture, Food and Rural Affairs. In 2011–2012 the two governments continued their work under the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem, including delivery of the six new commitments added in 2010–2011.

Progress to March 31, 2011

In May 2011, Canada and Ontario declared the Jackfish Bay Area of Concern (AOC) to be an area in recovery. An AOC may be designated an Area in Recovery when all remedial actions have been completed in the AOC, but additional time is needed for the recovery of beneficial uses. The status report on the Jackfish Bay AOC, prepared by Lakehead University, confirmed that significant improvement has occurred since the area was originally listed as an AOC. However, additional time is needed for recovery to occur in the ecosystem, which will be measured by ongoing monitoring. Three beneficial uses continue to be impaired (Degradation of Benthos, Degradation of Fish and Wildlife Populations, and Loss of Fish and Wildlife Habitat), two require further assessment to fully ascertain their status relative to the delisting criteria (Degradation of Aesthetics, Restrictions on Fish and Wildlife Consumption), and two beneficial uses have been restored and are now considered not impaired (Bird (or other animal) Deformities or Reproduction Problems, Fish Tumours or Other Deformities). In fulfillment of Canada's and Ontario's commitment for a long-term monitoring plan in the 2007–2012 Canada-Ontario Agreement, and in response to the recommendations from the Jackfish Bay Public Area in Recovery Review Committee, a long-term monitoring plan to track recovery in the Jackfish Bay AOC is being implemented. The plan was developed by Environment Canada and the Ontario ministries of the Environment and Natural Resources.

Remedial action plans

Support continued for the coordination of Remedial Action Plan (RAP) activities, which included assessing and reporting on the success of past actions and on the status of remaining actions in Canadian AOCs. Some examples of these activities are as follows:

- All work identified in the St. Lawrence River (Cornwall) AOC RAP has been carried out. The Stage 3 report, describing the results of monitoring and the restoration of beneficial uses, is being produced, and a decision is expected in 2012–2013 on whether to delist the AOC or recognize it as an Area in Recovery.
- The Stage 2 RAP report for the Canadian portion of the Detroit River AOC was released in January 2012. The report contained a comprehensive assessment of the current status of beneficial-use impairments in the AOC, an evaluation of the remedial actions to restore beneficial uses that were undertaken from 1998–2008, and recommendations regarding the remaining remedial actions, their priority, the proposed timelines, and the agency or organization that should be responsible for implementing the remedial actions. The report was reviewed by Canadian and U.S. agencies, stakeholders, the public, and the IJC.
- In May 2011, Canada and Ontario published the Beneficial Use Impairment (BUI) Status Report on Canadian Areas of Concern. This report provides a detailed review of the status of BUIs as well as an overview of the history, RAP collaborators, and key remedial and restoration actions completed and remaining in each of the AOCs to September 2010.
- Delisting objectives have been reviewed for the Hamilton Harbour AOC. Three beneficial uses have been determined to be not impaired, three require further assessment, and the eight for which impairment exists are having delisting objectives updated. Determining reasonable, achievable and measurable delisting objectives guides action necessary to restore water quality to ecosystem health in AOCs.

Great Lakes Sustainability Fund

In 2011–2012, Environment Canada's Great Lakes Areas of Concern program and the associated Great Lakes Action Plan (Budget 2010 renewed funding at $8 million per year) continued to fund multi-stakeholder projects to restore beneficial uses in Great Lakes AOCs, through the Great Lakes Sustainability Fund.

In partnership with local and provincial stakeholders, the Great Lakes Sustainability Fund provides funds for projects in three key areas: (1) improving point- and non-point source water quality; (2) rehabilitating and protecting fish habitat and wildlife habitat; and (3) characterizing contaminated sediment and developing contaminated sediment management plans in AOCs (section 1.3.3 also describes sediment remediation work being conducted in the AOCs through the Action Plan for Clean Water).

The fund continued to support work in the Bay of Quinte, Niagara River, St. Lawrence River (Cornwall), Hamilton Harbour, Toronto, St. Clair River and Detroit River AOCs, to develop and implement stewardship initiatives and deliver programs that reduce nutrient inputs to watercourses from urban and rural non-point sources. Initiatives included outreach and education programs, which were directed at rural farming and non-farming landowners to encourage the adoption of best-management practices, and studies leading to improved water quality through improved management of municipal wastewater.

In the Bay of Quinte AOC, the fund continued to support the development of an integrated pollution prevention and control plan for municipalities bordering the bay, including the development of plans to upgrade wastewater treatment plants in Trenton and Frankford.

In the Toronto Region AOC, the fund continued to support the Sustainable Technologies Evaluation Program, which evaluates the effectiveness of technologies that mitigate impacts of stormwater, promotes the adoption of low-impact development approaches and best practices, provides information on sustainable technologies to rural and urban landowners, and transfers green technologies to municipalities and the development industry.

Restoration of fish and wildlife habitat is the second focus of the Great Lakes Sustainability Fund. In 2011–2012, the fund supported a number of projects to restore habitat in AOCs, including wetlands and habitat in Cootes Paradise in the Hamilton Harbour AOC, fish habitat on the Canard River in the Detroit River AOC, new stream habitat and headwater wetlands in the Toronto Region AOC, and shoreline habitat in the Niagara River and St. Clair River AOCs.

Developing plans and strategies to remediate contaminated sediments is the third focus area of the Great Lakes Sustainability Fund. The following work was undertaken in 2011–2012 in support of managing contaminated sediment in Great Lakes AOCs:

- Peninsula Harbour: Public engagement in the development of a plan to manage contaminated sediments in Jellicoe Cove using a thin-layer capping technique.
- St. Marys River: Work continued on the development of a management strategy on the ecological and human health risks of contaminated sediments in the river.
- St. Clair River: A risk assessment of the mercury-contaminated sediment in the Canadian side of the St. Clair River continued, and results were communicated to stakeholders (St. Clair Remedial Action Plan Committee, Binational Public Advisory Committee, Sarnia–Lambton Environmental Association), First Nations (Aamjiwnaang, Walpole Island) and the general public. This site is downstream of a site that was formerly the property of a chemical company, and was remediated in 2004. The results of geotechnical/geophysical studies undertaken to help delineate priority zones for cleanup were incorporated in the draft Sediment Management Options report.

Science and monitoring

Environment Canada undertakes science and monitoring projects to support decision making in the Great Lakes AOCs in Canada and to support decision making in binational AOCs (see Section 2 for additional research projects related to the Great Lakes). In 2011–2012, projects included the following:

- Through a collaboration with the University of New Brunswick, University of PEI and University of Waterloo, Natural Sciences and Engineering Research Council funding helped focus work on the recovery of wild fish populations following the closure of pulp mills in Canada. The mill discharging into Jackfish Bay, Lake Superior, has been selected as one of those mills that was closed at the time of the proposal. White sucker have been collected from this site and at corresponding reference locations to follow fish for recovery, in comparison to the long-term database from this location. Fish were collected during the spring and fall of 2011 and analysis is ongoing. In collaboration with the United States Environmental Protection Agency (U.S. EPA) and using earlier data from Jackfish Bay, a manuscript on the implications of previous impacts on reproductive success to population status was produced. Currently, similar data are being collected to compare with earlier data from before process changes, after process changes and following the closure of the mill. This will allow prediction of how long it may take for recovery in wild fish populations at this AOC. It is hoped that this population model may then be applied to other AOCs that are less data rich, to understand population-level impacts at these sites and allow predictions in recovery, following implementation of recovery strategies. Additionally, studies are evaluating dioxin levels in white sucker liver samples collected following closure of the mill, to be compared to studies conducted in 1991. Sediment cores will also be examined to evaluate changes in dioxin discharges over the last several years in implementation of secondary treatment, chlorine dioxide substitution, process changes and mill closure.
- New monitoring projects implemented in the Great Lakes AOCs and/or Areas in Recovery included assessing the levels of dioxins, furans and metals in Spanish Harbour and Whalesback Channel. Sediment traps and sediment cores, including cores for dating, were taken to assess the volume of contaminated sediment and to determine the deposition rate. The data indicate that there are different rates of deposition in the harbour, which accounts for a sub-surface maxima in the central harbour versus a surface maxima in areas around Aird Island where deposition is lowest. Levels of dioxins overall in harbour/channel sediment range from 24–200 ng/g TEQ (Toxicity Equivalent), exceeding the federal probable effects level of 21.5 ng/g TEQ.
- In support of the Randle Reef remediation project, Environment Canada implemented a three-year study to determine background levels of polycyclic aromatic hydrocarbons (PAHs) in Hamilton Harbour water.
- Through collaborative work with the Ontario Ministry of the Environment and Fisheries and Oceans Canada, analysis was conducted on historic plankton samples as part of a line of evidence approach in assessing the plankton BUI. This work is ongoing.
- Through collaborative work with U.S. experts specializing in fish tumours, data from Canadian AOCs were used to assess the incidence of fish tumours as an indicator of BUI. Data from the lower Great Lakes were used to establish a reference tumour incidence in Brown Bullhead, and this reference incidence is being used to determine BUI within AOCs. The incidence of liver tumours in fish in the St. Lawrence AOC was compared with the reference incidence, and based on the results, the liver tumour BUI was removed from that AOC. Continued work on the liver tumour BUI was conducted at the St. Marys River AOC. White sucker liver samples initially collected during the fall of 2009 are currently being processed in collaboration with the Freshwater Research Institute of Fisheries and Oceans Canada in Winnipeg. Data are now being compared to additional white sucker reference fish in order to determine the state of this BUI at this AOC. In collaboration with the Great Lakes Institute of Environmental Research at the University of Windsor, additional brown bullhead liver samples were also collected from the Detroit River AOC. Additional samples are still required to achieve the desired sample size; this work will continue in 2012.

Science and monitoring programs in support of Lakewide Management Plans

Environment Canada continued to conduct world-class monitoring programs throughout the Great Lakes in support of annexes 1, 11, 12 and 15 of the GLWQA and Annex 2 of the Canada–Ontario

Agreement Respecting the Great Lakes Basin Ecosystem. These monitoring programs are described below.

The Great Lakes Open Lakes Surveillance Program samples the offshore waters of the Great Lakes, to provide status and trends information for water quality, report on compliance with established guidelines, and identify new and emerging issues. In 2011–2012, this surveillance program included the following activities:

- The long-term water quality monitoring data from each of the Great Lakes were compiled and assessed to determine the current nutrient status and long-term trends for each of the lakes as part of the State of the Lakes Ecosystem Conference (SOLEC). SOLEC, held every two years as a reporting requirement for the GLWQA, provides an analysis of the state of the ecosystem for decision makers in all sectors (government, corporate and not-for-profit). The Great Lakes Surveillance Program provided the data for the Nutrients in Lakes and the Toxic Chemicals in Offshore Waters ecosystem indicators.
- The Nutrients indicator uses targets for total phosphorus set forth in the 1978 GLWQA, to indicate if loadings (discharges) from anthropogenic sources are near specified targets. It is used to assess the ecosystem response to current loadings, to indicate the current status, and to assess long-term nutrient trends. The results indicate that total phosphorus targets are being met in Lake Superior and the eastern basin of Lake Erie, but that concentrations remain elevated (above targets) in the west and central basins of Lake Erie and offshore concentrations are too low (too far below targets) in lakes Huron and Ontario. In many nearshore areas, particularly in lakes Erie and Ontario, elevated nutrient concentrations are causing algal fouling. The focus of future nutrient management will need to examine land use activities that contribute nutrients to the Great Lakes nearshore, and improve understanding of how invasive species may be changing nutrient cycling in the lakes, resulting in the nearshore/offshore imbalance.
- The toxic chemicals indicator found that concentrations of many compounds (organochlorine pesticides, PAHs, chlorinated benzenes, currently used pesticides and mercury) are still detectable, although they are at very low (trace) concentrations. Some variation was detected between the lakes, including higher concentrations of some compounds found in the lower Great Lakes (Erie and Ontario) compared with the upper Great Lakes, and some historically used compounds found at higher concentrations in Lake Superior due to greater atmospheric deposition and slow rates of environmental degradation in that region. The temporal trends for toxic chemicals in the Great Lakes are mixed, with the majority of trends showing declining concentrations (e.g., for many organochlorine compounds and mercury). The trends for in-use pesticides indicate increasing water concentrations or no change over time. Continued monitoring for toxics in water is recommended for certain compounds, with refinements to focus on those that are of greatest risk and in concert with the Canadian federal Chemicals Management Plan.

The Great Lakes Fish Contaminants Surveillance Program measures and reports on the status and trends of legacy and emerging contaminants in top predator and forage fish species, and maintains an archive of historical fish samples to allow retrospective analyses in support of an early warning system for contaminants entering waters. In 2011–2012, this surveillance program included the following activities:

- Environment Canada and the U.S. EPA Great Lakes National Program Office produced the latest ecosystem indicator report on Contaminants in Whole Fish presented at the SOLEC (www.solecregistration.ca/en/indicator_reports.asp). This indicator report, published once every three years, presents the latest data on status and trends of contaminant conditions, using fish as biological indicators, in the Great Lakes. The reports are used to support decisions about beneficial uses, provide information about the degradation of fish populations, and support the objectives of the GLWQA annexes 1 (Specific Objectives), 2 (Remedial Action Plans and Lakewide Management Plans), 11 (Surveillance and Monitoring) and 12 (Persistent Toxic Substances). Overall, the concentrations of most legacy persistent organic pollutants (e.g., DDTs and PCBs) continue to decline in Lake Trout and Walleye, although mercury is the exception. Levels of mercury measured in Lake Trout and Walleye

across the Great Lakes, although still below target concentrations of 0.5 µg/g, have stopped declining and appear to be increasing in fish from lakes Superior, Huron and Erie.

- Mercury was also the focus of a collaborative initiative supported by the U.S. EPA and spearheaded by the Biodiversity Research Institute (www.briloon.org), that involved more than 170 scientists and managers working in the Great Lakes Region. Environment Canada provided mercury concentrations measured in Lake Trout and Walleye from the Great Lakes, which were used in a synthesis of more than 300 000 measurements to conduct new modelling and analyses of mercury in the Great Lakes Region. The major findings of these analyses were published in the report *The Extent and Effects of Mercury Pollution in the Great Lakes Region* (www.briloon.org/mercuryconnections/greatlakes). The findings from this binational scientific study indicate that efforts to control mercury pollution in the Great Lakes region have resulted in substantial and measurable improvements, and that additional emissions control will have multiple benefits for fish, wildlife, and people who consume fish from the Great Lakes region. However, mercury pollution remains a concern in the Great Lakes watershed.
- Environment Canada also continued collecting and preserving biological samples in the National Aquatic Biological Specimen Bank (NABSB) (www.ec.gc.ca/inre-nwri/default.asp?lang=En&n=D488F7DE-1). The specimen bank originated in the 1970s and contains mostly fish tissues collected as part of Environment Canada's National Fish Contaminants Monitoring and Surveillance Program. The NABSB is an integral component of Environment Canada's science and monitoring activities, providing tissues for assessing the health of fish populations in Canada, investigating the fate and behaviour of contaminants in the environment, and providing retrospective analyses of chemicals of emerging concern. The specimen bank currently holds more than 84 000 fish tissue samples, and is one of the world's longest running and largest repositories of frozen environmental specimens.
- Environment Canada reported on concentrations and trends of organics, trace metals, nutrients and major ions in the St. Lawrence River at Wolfe Island from 1989–2007. In addition, this report provided comparisons between water quality in the St. Lawrence and upstream measurements in Lake Ontario and the Niagara River. The results indicate that while there has been much progress during the monitoring period, with a decreasing trend for many contaminants, a number of compounds (particularly in the neutral herbicide, trace metal, nutrients, and major ion classes) have increased over this time period. At the same time, concentrations continue to exceed the strictest agency guidelines set by the New York State Department of Environmental Conservation (dieldrin & PCBs) and the IJC (phosphorus).

The Great Lakes Surveillance Program samples the nearshore and within the watershed, to provide status information on threats to water quality, report on compliance with established guidelines, and identify new and emerging issues. Activities in 2011–2012 included the following:

- Environment Canada reported on a study on the occurrence and distribution of sulfonylurea and related herbicides in central Canadian surface waters. Surface water sampling in 2006–2008 measured the occurrence of sulfonylurea and related herbicides (SUs) during base flow conditions and wet weather events. Flumetsulam (29.2%), diuron (36.5%) and fomesafen (25.3%) were most frequently detected over the course of the study. Typical SU concentrations were in the low parts per trillion range, but maximum concentrations of fomesafen (870 ng/L), linuron (860 ng/L) and diuron (2900 ng/L) approached or exceeded 1 ug/L. In general, detection of SUs was more frequent where rotation of row crops was more intense. Sampling during wet-weather events indicated potential for a range of SUs to be flushed into surface waters at relatively high concentrations.
- The Department also reported on the results of a national survey designed to monitor eight commonly used herbicides in urban rivers and streams across Canada, in response to public and scientific concerns over the cosmetic use of pesticides in urban centres. It was the first time that a national survey of pesticides in urban rivers was carried out in a standardized world-class fashion across Canada. Concentrations of 2,4-D, mecoprop, dicamba, glyphosate and AMPA

(a metabolite of glyphosate) were linked to urban use, and were frequently detected in all geographic areas. However, geographic differences in concentration suggested differences in usage or stream connectivity patterns among urban centres. None of the herbicide concentrations measured exceeded existing Canadian Water Quality Guidelines for the protection of aquatic life.

The Integrated Atmospheric Deposition Network, a binational program involving Environment Canada and the U.S. EPA, reports on spatial and temporal trends in concentrations and loadings of priority toxic chemicals in the Great Lakes. In 2011–2012, Environment Canada continued to measure priority toxic substances, conduct data analysis, and develop and refine methods (more information on the program and results for 2011–2012 can be found in the *Canadian Environmental Protection Act, 1999 Annual Report for April 2011 to March 2012*).

Great Lakes and Regional Environmental Quality Monitoring and Surveillance Program

The binational Cooperative Science and Monitoring Initiative (CSMI) is a five-year rotational program that coordinates research and monitoring, from planning through to data synthesis and reporting. Coordinated field activities occur on each lake once every five years. The complete cycle for each lake involves two years of planning, one year of field activity and two years for analysis, synthesis and reporting.

In 2011–2012, fieldwork was coordinated and conducted in Lake Superior. Priority issues identified include the status of chemicals of concern and chemicals of immediate concern in Lake Superior's ecosystem, the status of the lower food web, the early detection of aquatic invasive species, and a study of native fish species in the lake, including a lakewide juvenile Lake Sturgeon index survey.

In 2011–2012, the Lake Ontario Lakewide Management Plan (LaMP) held a binational workshop in Burlington, Ontario, to review results from the 2008 CSMI field year, specifically the lower food web status, lakewide fishery assessment, and understanding nearshore-offshore nutrient transport. Two project planning meetings were held in the spring of 2012 to review and update binational priorities, which include tributary monitoring and research to better understand nutrient loading impacts on nearshore and open waters, and to improve the understanding of nutrient cycling within the lake in order to inform and direct management action.

Canada–U.S. cooperation

A commitment to facilitate the sharing of information between Canada's and Ontario's respective chemicals management plans under a 2011–2012 extension of the Canada–Ontario Agreement was implemented. Quarterly meetings have been held in support of this. Toxics reduction efforts previously undertaken through the Great Lakes Binational Toxics Strategy (GLBTS) have now been integrated into federal Chemicals Management Plan risk management strategies.

After over ten years of binational effort, 2011–2012 marked a transition year for the GLBTS, as negotiations continued on an amended GLWQA. It is expected that this will create a new process for the selection, identification and development of control strategies for existing and emerging chemicals of concern.

Progress to March 31, 2012

Environment Canada, in collaboration with the U.S. EPA, regularly reports on the ecological health of the Great Lakes ecosystem. In October 2011, the SOLEC was held—the 9th SOLEC since 1994. The conference and associated report continues to be an effective means of developing binational agreement on the state of the lakes and of communicating this information to stakeholders and the public.

More than 230 delegates from Canadian and American federal, state, provincial and local agencies and universities, as well as stakeholders, were in attendance, along with over 100 individuals participating via Internet broadcast.

Over 50 draft indicator reports and a draft Great Lakes ecosystem status and trends summary report were presented at the conference. When finalized, these indicator reports will form the basis of the 2012 Canada–United States State of the Great Lakes Report, which will be released in 2012.

Environment Canada, in cooperation with the U.S. EPA, co-chairs binational LaMPs under the GLWQA. The plans identify binational ecological objectives

and management strategies, including science priorities for data collection to fill knowledge gaps in ecosystem status and trends. In 2011–2012, a number of LaMP reports and activities were undertaken:

- The 2011 annual LaMP reports were published for each of the Great Lakes, and are available at www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=0CB6DFA3-1.
- Implementation of the draft Lake Superior Aquatic Invasive Species Complete Prevention Plan was initiated.
- Environment Canada continued to participate in a number of key Canadian watershed coastal initiatives, including the Lake Huron Southeast Shore and Southern Georgian Bay Coastal initiatives, and the Grand River Water Management Plan. These initiatives seek to develop mechanisms for the protection and restoration of Lake Huron and Lake Erie, respectively.

In 2011–2012, the Western Lake Erie Watershed Priority Natural Area Inter-agency Collaborative Agreement was signed between Environment Canada, the Department of Fisheries and Oceans, the Ontario Ministry of Natural Resources, the Essex Region Conservation Authority, and Ducks Unlimited Canada. The Agreement's purpose is to enhance collaboration and coordination of resource management programs and projects that protect and restore natural heritage features in the Canadian waters and watershed of the Detroit River and Western Lake Erie, including Point Pelee and Pelee Island.

The Great Lakes Nutrient Initiative program was announced in Budget 2011 to improve nearshore water and ecosystem health and better address the presence of phosphorus in the Great Lakes. The program has since been approved by Cabinet and the Treasury Board of Canada.

1.3.1.2 St. Lawrence Plan

Background

Launched in 1988, the St. Lawrence Plan (www.planstlaurent.qc.ca/index_en.html) is a collaborative effort between the Canadian and Quebec governments to protect, conserve and enhance the St. Lawrence ecosystem. This multi-year program, which has been renewed four times since it was first signed in 1988, has helped produce concrete results through the concerted efforts of the two governments. Their efforts have benefited from participation by the private sector, universities, research centres, Areas of Prime Concern committees (known as ZIP committees), non-governmental organizations and riverside communities. The program focuses on all of the St. Lawrence River's ecosystems and on the mouth of its main tributaries, from Lake Saint-François, situated on the border between Quebec and Ontario, to the eastern reaches of the Gulf of St. Lawrence. A new agreement was signed on November 29, 2011, by the two governments after more than a year of negotiations, and continues the work of the previous phases of the agreement, while proposing a long-term approach.

The new Canada–Quebec Agreement on the St. Lawrence 2011–2026 covers a span of 15 years with five-year planning cycles.

Progress to March 31, 2012

The 2011–2012 year marked the launch of the new St. Lawrence Action Plan 2011–2026 agreement. This agreement contains the implementation of an integrated management approach for the St. Lawrence River, and the creation and continuation of key programs for the conservation and enhancement of the ecosystem. Notably, the Monitoring the State of the St. Lawrence River Program was renewed for 15 years, along with the Community Interaction Program and the Areas of Prime Concern Program. Two new programs were created, one for the numerical environmental prediction of the St. Lawrence River and the other containing a program of joint actions aimed at promoting biodiversity conservation, sustainable use, and water quality improvement. The activities linked to each element of the St. Lawrence Action Plan were launched at the start of 2012.

With the signing of the agreement in November 2011, the majority of 2011–2012 falls into the transition period that began in 2010–2011, where some key programs were maintained in order to fill the period between the expiration of the previous agreement and the signing of the new agreement. Following the signing of the new agreement, the process of implementing the agreement's projects

was initiated. These projects fall under the jurisdiction of the monitoring committees on biodiversity, water uses and water quality, as well as that of the Monitoring the State of the St. Lawrence River working group and the new Environmental Prediction working group, which has become an integral part of the agreement.

Community involvement and awareness

Stratégies Saint-Laurent and its members (the 14 Areas of Prime Concern committees) have continued to work with local communities to protect, conserve and enhance the ecosystem of the St. Lawrence. Projects carried out in 2010–2011 include the launch of a new community Web portal providing information on the St. Lawrence River and the issues surrounding it, the management of watercourses to promote conservation of fish habitats, monitoring of erosion and invasive alien species, activities aimed at raising awareness and protecting species at risk, the characterization of watercourses and riparian areas, and the development of natural environments.

The Areas of Prime Concern (ZIP) Program supports Stratégies Saint-Laurent and its members (the 14 Areas of Prime Concern committees) in their efforts to continue working with local communities to protect, conserve and develop the St. Lawrence ecosystem. Activities carried out in 2011–2012 include collaboration between communities to highlight local environmental issues related to the St. Lawrence, such as contributions to reducing the pollution load of wastewater to the St. Lawrence, participation in community projects related to adapting to climate change, shoreline erosion and the sustainable development of coastal environments, and habitat conservation and the enhancement of natural environments. Furthermore, the ZIP committees have been identified as contributing significantly to the St. Lawrence integrated management approach at the local level, especially with the creation of Regional Integrated Management Plans.

The Community Interaction Program continues to support non-governmental organizations that implement projects that benefit the St. Lawrence River. At the time of the signing of the St. Lawrence Action Plan, 13 projects were underway. These projects cover the St. Lawrence River, the Estuary and the Gulf of St. Lawrence, from the Montréal area to the Magdalen Islands via Lake Saint-Pierre and Québec region. They involve key players from riverside communities, whether they be municipalities, First Nations, academia, industry, the farming community, local residents or the provincial and federal departments affected. These collaborations allow them to address environmental issues covered by the agreement, including the improvement of water quality, biodiversity conservation and sustainable use. Successful projects include the installation of nesting box networks for fragile wetlands species, the protection of riparian strips by reshaping and planting in order to improve water quality, and raising user awareness of canoeing and kayaking to protect sensitive areas in the Parc de la Rivière-des-Mille-Îles. Thirteen other proposals were being evaluated in anticipation of 2012 summer activities.

Monitoring the State of the St. Lawrence River Program

The network of governmental and non-governmental partners and collaborators continued to carry out its scientific activities and disseminate information under the Monitoring the State of the St. Lawrence River Program. Five new information and fact sheets based on the environmental indicators, as well as a report published by Environment Canada, were created over the course of the year and will be released in 2012–2013. These include:

- Scientific and technical report: *Sediment quality monitoring in Lake Saint-François*
- Scientific fact sheet: *Polybrominated Diphenyl Ethers (PBDE) in suspended matter and sediment in the St. Lawrence River*
- Information sheet: *Polybrominated Diphenyl Ethers (PBDE) in suspended matter and sediment in the St. Lawrence River*
- Information sheet: *Organotins in sediments in the St. Lawrence River*
- Information sheet: *Menthic Macroinvertebrates communities: an indicator of water quality in Lake Saint-Pierre*
- Information sheet: *Monitoring Marine Water Quality in Shellfish Areas*

The publication of a scientific/technical report on changes in the wetlands of the St. Lawrence from 1970 to 2002 is also part of the information

published in 2011, and can be found at www.ec.gc.ca/Publications/default.asp?lang=En&xml=E7C22846-04FE-4D8C-96BA-4E8DF853101D.

Environmental prediction working group

One new aspect of the latest Canada–Quebec agreement on the St. Lawrence 2011–2026 is the establishment of an environmental prediction working group that aims to develop tools to support decisions made on atmosphere, surface, hydrology, hydraulics and ecohydraulics models, as well as integrated monitoring. It helps support the monitoring committees (biodiversity, water uses and water quality) and the Monitoring the State of the St. Lawrence River working group. In 2011–2012, meetings were held for the purpose of establishing the group's work plan for 2012–2013, at which time the group's activities will begin.

1.3.1.3 Atlantic Ecosystem Initiatives

Background

The Atlantic Ecosystem Initiatives implements an ecosystem-based approach to environmental management through internal engagement, external engagement and the Atlantic Coastal Action Program (ACAP), a community-based partnership program between Environment Canada and 14 multi-stakeholder community organizations and seven regional coalitions in the Atlantic provinces. The work of these partners has a positive impact on the health of watershed ecosystems across the region, and on larger ecosystems in the Gulf of Maine, the southern Gulf of St. Lawrence and the Bay of Fundy. Initiatives that receive support through ACAP use local and regional expertise, and support people who work in their own communities and regions, in order to help build a better environment for Canadians.

Environment Canada contributes funding, technical and scientific expertise, as well as direct staff support, with respect to four broad categories of projects relevant to the *Canada Water Act*: clean water, pollution sources, toxics and natural habitat.

Progress to March 31, 2012

In 2011–2012, 42 projects (representing almost 45% of all projects) dealt with water issues. The bulk of project activities were restoration, enhancement and improvement of water quality and watersheds through proactive activities such as environmental education and outreach, water quality monitoring, and research and data collection.

Annual monitoring, restoration and enhancement of watersheds remain high priorities for many organizations working within Atlantic Canada.

In New Brunswick, elevated levels of fecal coliform bacteria in surface waters pointed to contamination that could pose direct health risks to the local residents, as well as indirect environmental harm to aquatic ecosystems through excessive nutrient loading. To research this occurrence, ACAP Saint John partnered with the New Brunswick Community College in Saint John through the Community Environmental Monitoring Program. Together, they aimed to pinpoint the potential physical or biological origin(s) of the elevated levels of fecal coliform bacteria and subsequently develop recommendations for remediation.

In Nova Scotia, the Bluenose Coastal Action Foundation and an Environment Canada scientist are monitoring the LaHave River watershed. Monitoring and water sampling have created a much-needed record of the river's health, with the added benefit of forming networks and engaging the local community. The LaHave River watershed encompasses an area of approximately 1700 kilometres, and provides a diversity of habitats for freshwater and terrestrial species. The watershed hosts a high level of residential, industrial and recreational activity. Water quality also suffers due to three sewage treatment plant outflows and some direct pipes from dwellings that are discharged into the river. These pressures have taken their toll on the watershed and are gaining the attention of local communities.

After three years of sampling and building partnerships within the LaHave River watershed, the project is gaining momentum and addressing important issues within the watershed area. The project now has a solid baseline of water quality parameters for the system as well as a formal advisory

committee made up of various stakeholders within the watershed community. The committee believes that the LaHave River Watershed Project is a model of cooperation for watershed stewardship groups throughout the province.

An exciting new partnership was formed this fiscal year with the Community-Based Environmental Monitoring Network on a project called CURA (Community-University Research Alliance) H_2O. In this first of five years, the project is focused on community-based water quality monitoring, and standardizing data collection at the community level. One of the most prevalent challenges in integrating environmental data gathered by volunteers is a lack of consistency in the collection methods, which results in uncertainty regarding accuracy of the data. This project seeks to address this lack of consistency by standardizing the data collection process at the community level. This standardization will occur through a water monitoring training and certification course, and an accompanying toolkit that will provide all the necessary monitoring equipment.

CURA H_2O will also facilitate the integration of the data into governmental decision-making processes. This project will contribute to a more comprehensive inventory of water quality across Nova Scotia than is currently available from government monitoring programs alone, and will help to ensure effective province-wide watershed management. In addition to the implementation of this project throughout Nova Scotia, CURA H_2O aims to expand both nationally and internationally. A partnership was established with the Canadian Water Resources Association (CWRA) to explore potential for national dissemination of CURA H_2O training through CWRA provincial branches.

1.3.2 Other partnership-based ecosystem approaches and activities

1.3.2.1 Pacific and Yukon Region's Ecosystem Coordination Office

Environment Canada's regional offices coordinate the Department's interventions in identified priority ecosystems where a formal Ecosystem Initiative is not established. In the Pacific and Yukon Region, the Ecosystem Coordination Office works with the Okanagan Basin Water Board, a water governance body tasked with identifying and resolving critical water issues at the scale of the Okanagan watershed. Its Board of Directors includes representatives from the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC, and the Okanagan Water Stewardship Council (a multi-stakeholder group established by the board to provide independent science-based advice on water issues). The overall objective of the Okanagan Basin Water Board is to undertake strategic projects and programs at the basin scale that meet the needs of Okanagan citizens for long-term sustainable water supply, while supporting the capacity of member jurisdictions to meet their water management goals. Funding was provided to the board to help enhance decision and reporting tools for water purveyors, undertake a second round of scenario developments for the Water Supply and Demand Project (see Section 1.1.2.1), and develop additional map layers identifying sensitive and riparian habitat areas for a Web-based atlas.

Funding was also provided to the Squamish First Nation for the Coast Salish Gathering (www.coastsalishgathering.com), an annual meeting convening First Nations Chiefs, U.S. tribal leaders, the U.S. EPA and Environment Canada to share information and address environmental issues facing the Salish Sea transboundary ecosystem. A component of the funding included support for the Coast Salish Water Quality Project, a joint initiative (between the Coast Salish First Nations from the Canadian and U.S. sides of this shared ecosystem and the U.S. Geological Survey) to measure and report on water quality in Puget Sound and the Strait of Georgia.

In 2011, Environment Canada hosted the Salish Sea Ecosystem Conference in Vancouver. The Ecosystem Coordination Office acted as the co-chair of the conference along with the Puget Sound Partnership, an arm's-length state agency that has received significant funding from the U.S. EPA. Over 900 delegates heard over 350 presentations on research, science and policy issues in the Salish Sea region. Numerous other Canadian and U.S. federal, provincial, state, Aboriginal and regional/ municipal government organizations participated in the planning and financing of the conference.

The Ecosystem Coordination Office also continued to support the Burrard Inlet Environmental Action Program and the Fraser River Estuary Management Program, which are key governance mechanisms that bring together federal departments (Environment Canada, Fisheries and Oceans Canada, and Transport Canada), Port Metro Vancouver, Metro Vancouver, the British Columbia Ministry of Environment and various municipalities to discuss and act upon environmental management issues of the Burrard Inlet and Fraser River Estuary.

1.3.2.2 Memorandum of Understanding on Environmental Cooperation in Atlantic Canada

Background

The MOU on Environmental Cooperation in Atlantic Canada (signed in 2008) is a significant federal-provincial collaborative effort to preserve, protect and enhance the environment in Atlantic Canada. This MOU outlines broad principles of environmental cooperation, indicates that annexes will be developed, and establishes a Management Steering Committee to oversee its governance. The committee consists of the Regional Director General of Environment Canada's Atlantic Region and the deputy ministers of the environment from the four Atlantic provinces.

The MOU has created opportunities for closer intergovernmental collaboration on several Environment Canada priorities, including water, has been instrumental in fostering stronger federal-provincial relations in Atlantic Canada, and is helping the parties achieve the intended objectives in regards to water management. Environment Canada contributes technical and scientific expertise and direct staff support, including secretariat support to the Management Steering Committee and chairing the Water Annex Working Group.

Progress to March 31, 2012

During 2011–2012, efforts focused on continuing to advance the priorities under the 2010–2012 Water Annex Work Plan, hosting the Federal-Provincial Atlantic Water Workshop and Science Exchange Forum, and developing the 2012–2013 Water Annex Work Plan.

A key deliverable of the 2011–2012 Water Annex Work Plan was the organization of the Federal-Provincial Atlantic Water Workshop, held on November 8 and 9 in Halifax, Nova Scotia. The event was well-attended, by 49 participants from the four Atlantic provinces and several key federal departments (Environment Canada, Fisheries and Oceans Canada, Agriculture and Agri-Food Canada, Health Canada, Natural Resources Canada, and Aboriginal Affairs and Northern Development Canada). It was agreed that the original 13 priority projects would be reduced to 5 priority projects to ensure more streamlined efforts. The priorities to be pursued in 2012-2013 under the Water Annex Work Plan include:

1. Community Funding Optimization
2. Climate Change Impacts and Adaptation
3. Water Availability Indicators
4. Federal-Provincial Water Monitoring Working Group (Environment Canada and Atlantic provinces)
5. Federal-Provincial Emerging Issues

While 2012–2013 will continue to see progress on Community Funding Optimization, Climate Change Impacts and Adaptations, and Water Availability Indicator initiatives, efforts will also be focused on two new initiatives: the Federal-Provincial Water Monitoring Work Group will be established to optimize the design of the hydrometric and water quality networks, and the Federal-Provincial Emerging Issues function will be established as a mechanism to address new and emerging federal-provincial issues as required. Given the significant progress made in negotiations on the Water Quality Monitoring and Hydrometric Agreement, the five priorities will no longer be tracked or reported under the Water Annex Work Plan.

Participants were supportive of these five priorities, since they reduce overlap and duplication between projects, minimize administrative burden, and focus on areas where cooperation between the MOU signatories (and other agencies) would benefit regional water management. Participants indicated the importance of placing an increased emphasis on producing products to inform Atlantic Canadians on the state of water resources in order to facilitate more informed water management decisions. Two Water Annex progress reports were prepared for the

Management Steering Committee during 2011–2012 (mid-year and year-end), and the 2012–2013 Water Annex Work Plan was presented to the committee in March 2011. The Work Plan received endorsement by all parties.

1.3.3 Action Plan for Clean Water

Background

Environment Canada is carrying out its work under the Government of Canada's Action Plan for Clean Water, through $96 million in cleanup funding to restore Lake Simcoe and Lake Winnipeg and to implement remediation plans for contaminated sediment in eight Canadian AOCs in the Great Lakes.

The Action Plan for Clean Water also encompasses the Health of the Oceans Initiatives (HOTO). HOTO provides five years of funding to support various programs and activities that protect fragile marine environments, counter pollution and strengthen preventive measures. Although Fisheries and Oceans Canada is the formal federal lead for HOTO, five federal departments and agencies, including Environment Canada, receive funding to advance the goals and objectives of HOTO.

Progress to March 31, 2012

Wastewater

Cleaning up the nation's largest source of water pollution is a priority. Currently in Canada, over 150 billion litres of untreated and under-treated wastewater (sewage) is dumped into our waterways every year. This is an environmental, human health and economic issue. The Government of Canada worked with the provinces and territories, and engaged municipalities, Aboriginal communities and organizations, and other interested parties, to establish the country's first national standards for wastewater treatment.

The *Wastewater Systems Effluent Regulations*, being developed under the *Fisheries Act*, would include mandatory minimum effluent quality standards that can be achieved through secondary wastewater treatment. The Regulations, once finalized and in force, would fulfill a federal commitment in an agreement reached through the CCME in 2009.

The Government of Canada will continue working with provinces and other stakeholders to streamline administration of the Regulations and to avoid duplication wherever possible. Work is also ongoing to establish an electronic wastewater regulatory reporting system.

Great Lakes Areas of Concern

The Government of Canada's Action Plan for Clean Water is providing $48.9 million to implement contaminated sediment management projects in eight AOCs: Detroit River, Bay of Quinte, Niagara River, Peninsula Harbour, St. Marys River, Thunder Bay, St. Clair River (by 2012), and Hamilton Harbour (by 2016). The Action Plan funds project implementation, while the planning and design of the sediment remediation projects are funded by the Great Lakes Action Plan (GLAP). The 2011–2012 status of sediment remediation work at each of the sites is as follows:

- The final year of a four-year sediment transport monitoring study in the Trent River (which flows into the Bay of Quinte) was completed. Monitored natural recovery was selected as the preferred sediment management option by the Trent River Mouth Investigation Steering Committee, because the risk to humans and wildlife was found to be minimal. An administrative controls protocol (to restrict development of activity that might disturb sediments in the river) was developed with provincial and local agencies, and implemented in 2011.
- In the Niagara River AOC, the preferred option of monitored natural recovery was implemented in 2010, and an administrative controls protocol was adopted in 2011.
- In Peninsula Harbour, the proposed sediment remediation option is thin-layer capping. Development of the project design and environmental assessment was completed in 2011–2012 (supported by GLAP funds), and agreements were negotiated with Ontario to fund the project. Project implementation, using Clean Water Action Plan funds, is scheduled for the spring of 2012.
- In the St. Marys River AOC, the investigation of the magnitude and extent of sediment contamination continued in 2011–2012, using GLAP funds. It is expected that a determination

will be made in 2012–2013 regarding whether sediment remediation is required.
- In the Thunder Bay AOC, investigations have revealed that the mass of contaminated sediment in the north harbour is much larger than originally thought, with characteristics that will potentially make the sediments more difficult and expensive to manage. The development and evaluation of sediment management options continued in 2011–2012, with most efforts being made towards re-establishing the multi-stakeholder project steering committee following the bankruptcy of Abitibi-Bowater, a former owner of the paper mill.
- In the St. Clair River AOC, sediment management options continue to be evaluated by Environment Canada in partnership with the Ontario Ministry of the Environment and the St. Clair Region Conservation Authority. The sediment options study, funded through GLAP, is expected to be completed in 2013–2014.
- In the Hamilton Harbour AOC, the proposed sediment remediation option, which was developed through a community stakeholder advisory group, is to contain the sediments in a facility to be constructed within Hamilton Harbour. The project design and environmental assessment were completed in 2010–2011, using GLAP funds, and an independent peer review of the design was to be completed in March 2012. High-resolution models were developed to assess the impact of wastewater discharges from sewage treatment plants and tributaries. Models were also developed to assess the source water characteristics at drinking water intakes.

Lake Simcoe

The Lake Simcoe Clean-up Fund completed its five-year program in 2011–2012. Projects for the year were managed effectively through Contribution Agreements totalling $6.5 million. All projects met at least one of the fund priorities:

- Reducing pollution from point sources and reducing excessive nutrients from non-point sources (e.g., surface water runoff from urban areas, fertilized fields, pastures, livestock holding areas, runoff from non-fertilized lands, atmospheric deposition, and groundwater seepage).
- Enhancing research and monitoring essential to making progress in the restoration of the Lake Simcoe basin, and to assisting in decision making and rehabilitating priority habitats in order to restore the health of the aquatic ecosystem and coldwater fishery in Lake Simcoe.

In total, over the 2007–2012 program period:

- $22.87 million (the grants and contributions portion of the fund) was allocated to 47 different recipients through 158 successful projects supported by 195 different partners, leveraging $28.5 million that included $6 million in cash and in-kind investments from individual property owners.
- 91 habitat and non-point source improvement projects were funded, supporting implementation of over 350 agricultural and urban best management practices (BMPs), which included third-party agreements completing over 600 additional restoration projects.
- Initial estimates of the total phosphorus reduction achieved are 2.2 tonnes/year.

Some specific accomplishments of the projects supported by the Clean-up Fund included:

- Over 20 000 metres of fencing was installed to restrict 1296 livestock from water courses.
- Ten manure storage facilities were constructed to manage waste from 718 livestock.
- Over 5000 kilometres of stream/lake bank were stabilized, and erosion control structures covered 230 metres.
- Over 72 000 native trees/shrubs/grasses were planted in the watershed to stabilize shorelines and reduce phosphorus runoff.
- 110 septic systems were improved or upgraded.
- A sewage treatment plant optimization manual was developed, which will be used across Ontario.
- Stormwater pond retrofits using wetlands and innovative technologies were implemented in several municipalities.

The Lake Winnipeg Basin Initiative

Work continued throughout 2011–2012 on Environment Canada's four-year, $18-million Lake Winnipeg Basin Initiative (www.ec.gc.ca/doc/eau-water/winnipeg_e.html), intended to help restore the ecological integrity of Canada's sixth-largest

lake. Lake Winnipeg is recognized as one of Canada's most eutrophic lakes, with widespread and recurrent harmful algal blooms. In addition, the lake has a highly complex and fragmented transboundary watershed spanning almost one million square kilometres. The Lake Winnipeg Basin Initiative encompasses three areas of focus: facilitating governance throughout the watershed; the administration of the Lake Winnipeg Basin Stewardship Fund to support projects that reduce nutrient levels in the lake; and a science program encompassing research, monitoring and information management.

In September 2010, pursuant to section 4 of the *Canada Water Act*, Environment Canada signed the five-year, Canada–Manitoba MOU Respecting Lake Winnipeg and the Lake Winnipeg Basin, providing for the establishment of a steering committee and a collaborative and coordinated approach between the two governments. The steering committee, with representatives from key federal and provincial departments, provides oversight for the MOU, and met semi-annually during 2011 to coordinate efforts to improve the health of Lake Winnipeg. Work also continued toward finalizing a science subsidiary arrangement under the MOU, in order to coordinate federal-provincial scientific monitoring and research.

Round 5 of the Lake Winnipeg Basin Stewardship Fund was implemented in 2011–2012. Since its inception, the fund has provided over $2.4 million in federal funding for 41 projects throughout the watershed. Projects encompass agricultural BMPs, wetland and riparian restoration, and demonstration projects related to nutrient abatement.

Research, information and monitoring activities continued in 2011–2012 on Lake Winnipeg and major sub-basins, in order to understand the gaps related to ecology and nutrient cycling, and the sources and transport mechanisms for nutrients. Federal scientists, along with external research partners, used remote sensing to analyze algal blooms, and developed models to explore water circulation, simulate flood events and explore the role of landscape hydrology, climate variability and climate change on nutrient inputs into Lake Winnipeg. They collected and analyzed toxin, sediment and biological samples from the lake and watershed, traced nutrients in the food web, and analyzed agricultural and other rural nutrient contributions. The role of reservoirs and small lakes in storing nutrients was investigated. A monitoring program was conducted on tributaries, the marshes, shorelines, eastside rivers, and on the lake itself. The results of a number of the research projects conducted under the Lake Winnipeg Basin Initiative were submitted for the special Lake Winnipeg edition of the *Great Lakes Journal of Research* for publication in 2012.

Further refinements and data acquisition were undertaken for the online Lake Winnipeg Basin Initiative Information Portal. The portal compiles and promotes data sharing with key participants and ensures consistent, relevant and reliable access to information about the Lake Winnipeg Basin. The portal will be transferred to the University of Manitoba in 2012, where it will continue to develop over the longer term as a comprehensive source of information and resource for students, scientists and the public.

A comprehensive *State of Lake Winnipeg 1999–2007* report was published in partnership with Manitoba and other organizations, describing Lake Winnipeg's physical, chemical and biological characteristics and providing a baseline for scientific information and research on the lake. Work is underway with Manitoba to evaluate priority performance indicators that will measure changes in the lake. Work is also ongoing with Manitoba on finalizing a framework for establishing nutrient objectives.

Health of the Oceans Initiatives (HOTO)

As part of its involvement in HOTO, Environment Canada received $8 million over five years (2007–2012). Of that, $750 000 was designated to support activities in the Gulf of Maine, a transboundary watershed and marine ecosystem off the coast of New Brunswick and Nova Scotia. This funding, administered by the Atlantic Ecosystem Initiatives, provides support to the Gulf of Maine Council on the Marine Environment (GOMC) (www.gulfofmaine.org/default.asp). The GOMC is a Canada–United States partnership of governmental and non-governmental organizations working to maintain and enhance environmental quality in the Gulf of Maine in order to allow for sustainable resource use by existing and future generations, through the implementation of a five-year action plan. In particular, HOTO supports GOMC activities associated with the Climate Change

Network, the GOMC's Gulfwatch chemical contaminants monitoring program, the Ecosystem Indicator Partnership (ESIP) (a committee of the GOMC), and the GOMC's education and outreach program.

In 2011–2012, Environment Canada's HOTO support for the Gulf of Maine focused primarily on Gulfwatch and ESIP. Support for Gulfwatch enabled continuation of its sampling and analysis activities of blue mussels, contributing to the long-term tracking of the status and spatial and temporal trends of select contaminants within the transboundary region. ESIP continued the identification and development of ecosystem indicators to monitor and track ecosystem health within the Gulf of Maine for six theme areas: fisheries/aquaculture, contaminants, climate change, coastal development, eutrophication and aquatic habitats. Specifically, ESIP presented hands-on training to decision makers to familiarize them with the ecosystem indicators data and analysis tools.

2 Water research

This section describes research activities conducted by Environment Canada's Water Science and Technology Directorate in support of *Canada Water Act* activities. Environment Canada water scientists conduct an array of research across Canada, including on wastewater and wastewater technologies, pathogens and parasites, algal blooms, and the health of the aquatic ecosystem; the impacts of agricultural and industrial runoff; oil sands–related water research; water issues specific to the North; and hydro-meteorological modelling and prediction.

2.1 Wastewater

Activities related to the research of wastewater included studies on impacts of urban runoff and stormwater management measures, wastewater treatment technologies and the effects of effluents on aquatic organisms.

Phosphorus is a major contributor to the deterioration of water quality in Lake Simcoe and Great Lakes AOCs. Urban stormwater has been identified as a significant source of nutrients in receiving waters, particularly to the nearshore areas of these heavily populated regions. In order to develop knowledge to assist municipalities and program managers in phosphorus management and delisting activities, studies of stormwater management processes, including phosphorus removal from stormwater, continued in 2011–2012. A lab-scale study was initiated to develop the understanding of stormwater filtration with adsorptive media, which can be used to remove both particulate and dissolved forms of phosphorus. The aquatic habitat conditions that are created in stormwater management facilities were also evaluated, using benthic assessment methods and water and sediment quality measurements. This information will be used to inform remediation efforts for such facilities.

A recent review of road salt use and management activities suggests that further research on road salt controls and impacts is still needed. A special road salts issue of the *Water Quality Research Journal of Canada* was published in 2011 with a number of contributions from Environment Canada scientists, including reports on studies of chemistry and toxicity of highway runoff, chloride transport from a municipal snow disposal site, and measurement of cyanide compounds in snowmelt and urban runoff resulting from their use as anti-caking agents in road salts. In partnership with the Ontario Ministry of Transportation and GO Transit, samples of winter runoff were collected in 2011–2012 from a commercial parking lot and the Skyway Bridge in Burlington, for analysis of road salts and associated cyanide species. Samples of road salts were also collected from a number of municipal and provincial partners for analysis of trace constituents. Results from these activities will be used to support decision making on road salt risk management and monitoring.

Research continued into methods for removing antibiotics from wastewater, and focused on the development of new filtration treatment technologies. In this respect, Environment Canada concluded a multi-year grant and contribution agreement with Queen's University to further research micellar-enhanced ultrafiltration wastewater treatment technologies. It was shown that partitioning the antibiotics into aggregates (micelles) enhanced the removal of contaminants from wastewater streams. In addition, further insights were gained into the impact of sediments on the removal process where, by using sediments of varying organic matter

content, it was found that the affinity of the antibiotic for the sediment increased with increasing organic matter content. Overall, this research has improved understanding of the binding process with micelles and sediments.

In 2011–2012, Environment Canada scientists continued partnerships on several research studies to assess the effects of municipal wastewater effluents in wild fish and mussels and in laboratory fish. Pharmaceutical substances, like anti-depressant and anti-convulsive drugs, are now being frequently measured in municipal wastewaters. These substances, however, undergo major transformation at the treatment plant and again in the receiving waters, and thus their bioavailability and toxicity may be modified considerably.

The influence of different wastewater treatment processes on pharmaceutical products was investigated. To reach this goal, a novel analytical method for the trace detection of these pharmaceuticals in solid samples was developed. Analyses of treated biosolids samples enabled the calculation of experimental sorption coefficients and revealed that most antidepressants were found to be generally difficult to remove from sewage by partitioning to solids. Results showed strong evidence that primary treatment and trickling filter/solids contact has limited capacity to remove antidepressants from sewage, while activated sludge, biological aerated filter, and biological nutrient removal processes yielded moderate results (mean removal rates: 30%). Parent compounds were removed to a greater degree than their metabolites. The target antidepressants were also detected in samples taken from effluent receiving waters (i.e., surface waters), but at lower concentrations (0.41 to 69 ng/L).

Environment Canada scientists examined the effect of urban inputs (road runoff and municipal wastewater effluents) on wild freshwater mussels in the Grand River, Ontario. Mussels living downstream of an urban centre (Kitchener–Waterloo) had impaired health and reduced longevity. Also, wild mussels accumulated incrementally more metals (copper and lead) with additional urban inputs, resulting in significantly higher tissue metal concentrations in downstream mussels compared to mussels living upstream of the urban area. These results indicate that freshwater mussels living downstream of urban areas experience cumulative negative effects that can translate into population-level effects. In addition, in partnership with the Canadian Water Network, Environment Canada scientists found that freshwater mussels deployed immediately downstream of municipal wastewater effluent outfalls displayed alterations in immune function.

Environment Canada scientists continued assessing the effects of several classes of pharmaceuticals on organisms in the lab, including sulfonamide antibiotics, which are discharged at very low levels in municipal effluents. Environment Canada scientists have exposed aquatic invertebrates to low levels of these compounds, and found some of them to be toxic.

The presence of chemical stressors such as contaminants or pharmaceuticals in an aquatic organism's environment can influence its gene expression. Understanding this linkage provides enormous opportunity to characterize the effects of environmental pollutants. Applications of recently developed high-throughput genomic tools can assist in development of targeted, faster and less costly screening methods for environmental risk assessments. Environment Canada scientists, in collaboration with University of Waterloo researchers, have developed a high-throughput method for the analysis of the expressed proteome in fish plasma samples by means of time-of-flight mass spectrometry. In a successful proof of concept, white sucker from two sites within the Thunder Bay AOC and a nearby reference site were analyzed. Female white sucker exhibited significant site-specific changes in the number of plasma proteins that were related to tumour formation, reproductive system disease, and neurological disease, suggesting a possible link between contaminant exposure and tumour formation. These high-throughput proteomics methods will be adaptable and applicable to a larger set of environmental conditions and organisms.

2.2 Pathogens and parasites

In 2011–2012, Environment Canada scientists researched a variety of water-borne pathogens and parasites that have a detrimental impact on Canadians' quality of life and economic well-being. For example, Environment Canada continued to

investigate the occurrence of waterborne pathogens like *Cryptosporidium*, *Giardia* and viruses at offshore drinking water intakes in Lake Ontario. This partnership with the Region of Peel and the City of Toronto is guiding risk assessments of offshore water quality; source water protection needs to ensure that water treatment plants continue to provide safe drinking water. Environment Canada also collaborated with the Ontario Ministry of Environment to investigate the occurrence of the bacterial pathogen *Campylobacter* at Lake Simcoe beaches.

Environment Canada scientists investigated applications of microbial source tracking techniques to identify the sources of fecal pollution affecting beaches in the Niagara, Hamilton, Toronto and Bay of Quinte AOCs. These studies are guiding more targeted and cost-effective remediation efforts to reduce beach postings and BUIs at these AOC beaches. In partnership with the U.S. EPA, Environment Canada scientists applied a new DNA marker for seagulls to identify the widespread occurrence of fecal pollution from seagull droppings at beaches, stormwater outfalls, and parking lot runoff in urban waters in southern Ontario.

2.3 Algal blooms and health of the aquatic ecosystem

Environment Canada has an extensive history of partnering on research into algal blooms, and is engaged in highly targeted work to characterize the key mechanisms that control the severity, toxicity and harmful impacts of algae in freshwaters. The work is aimed at the development of sustainable risk management and long-term mitigation and management, in partnership with local, municipal, provincial, national and international governments as well as private and academic sectors. Studies of selected lakes (the Great Lakes, Lake of the Woods, Lake Winnipeg) using satellite imagery have enabled frequent large-scale views of these lake processes, allowing analysis of the evolution of water quality issues over time, the detection of lakewide changes over time, and the identification of areas of persistent or recurring water quality concern.

During 2011–2012, work continued on understanding nutrient dynamics in the Great Lakes and other large lake ecosystems (Lake Simcoe, Lake Winnipeg), using various tools to track sources of nutrients and the corresponding ecosystem responses. This work will provide information on the bio-geochemical cycling of nutrients, furthering our understanding of nearshore ecosystem processes and our ability to manage these large lakes under changing climate conditions.

Environment Canada has worked with local and U.S. partners over the past decade to measure toxin levels in some water bodies, and in some areas has collected a valuable long-term database of toxin levels and associated taxa and water quality. This is undergoing analysis to characterize long-term trends in these parameters, and evaluate linkages with climate and in lake physical/chemical conditions.

During 2011–2012, Environment Canada continued to partner with the binational multi-disciplinary Microbial Ecology of the Lake Erie Ecosystem research group, which has been identifying the key processes involved in the ecosystem's microbial ecology. This important work will help to further the understanding of chemical, biological and physical controls that influence the cycling of carbon, nitrogen, phosphorus and trace metals in the Lake Erie water column, which, in turn, affect aquatic ecosystem health. Partnered field measures on these and other Erie surveys are being combined with molecular work to identify the role of phosphorus, nitrogen and light in bloom development and toxicity; this work will be continued in the next field year. Winter ship surveys on this lake have reported significant under-ice blooms of lipid-rich diatoms, and characterized some of the factors contributing to these blooms and their effects on the annual nutrient cycling and sequestering and to the risk of severe summer cyanobacterial blooms. This work on ice ecology is being extended to other water bodies in the upcoming year, notably Lake Winnipeg.

While general levels of impairment are not as severe as seen in the western basin of Lake Erie recently, Lake Ontario also experiences severe blooms in some of the more eutrophic embayments, most of which are listed AOCs (Bay of Quinte, Hamilton Harbour, Oswego). As part of Environment Canada's ongoing work on harmful algal blooms, the Department worked with RAPs, conservation agencies, water treatment plants and U.S. partners in intensive seasonal and spatial sampling efforts for biota, toxins and taste/odour. New methods were evaluated to

monitor these blooms, including commercially available toxin kits. This information is currently submitted for publication and has been disseminated in workshops and reports.

2.4 Agricultural and industrial runoff

Environment Canada, Agriculture and Agri-Food Canada, and academic research partners from the University of Calgary and University of Waterloo continued, through a four-year study, to collaboratively research agricultural impacts on groundwater quality in the transboundary Abbotsford–Sumas aquifer (the study area is located on the Canadian side of the aquifer, in British Columbia's Lower Fraser Valley). This study, initiated in 2009, evaluates factors that bring about rapid nitrate leaching from the soil zone to the aquifer. Ongoing Environment Canada groundwater monitoring shows long-term nitrate contamination of groundwater in the study area. The study includes soil-water and groundwater sampling, and assessment of groundwater quality data in relation to seasonal factors, fertilizer and manure application practices, and other agricultural management practices. The Department also collected groundwater samples bi-monthly to study potential influences of and seasonal variations in different sources of nitrate contamination that could be affecting groundwater quality in the aquifer. A Science Forum is being planned for May 2012 in Abbotsford, B.C., to present research results achieved to date and discuss potential applications to agricultural management practices.

In another groundwater study, Environment Canada has partnered with the Canada–Manitoba Crop Diversification Centre, the University of Manitoba and Alberta Innovates to evaluate the vulnerability of the Assiniboine Delta aquifer to contamination by pesticides and to develop a risk assessment model. The Assiniboine Delta aquifer, which underlies an area of approximately 4000 km^2 near Carberry, Manitoba, is a valuable source of high-quality water for drinking, industrial uses and irrigation. Pesticide usage data analyzed in 2009–2010 were used to design a program for monitoring key active ingredients in strategically located groundwater wells. During the 3-year monitoring period 2009–2011, the persistent herbicide atrazine was consistently detected at low levels at one site, and the widely used herbicide glyphosate was detected in approximately 10% of samples. All detections were at levels below CCME Canadian Water Quality Guidelines.

Environment Canada continued to partner on studies assessing the impacts of agricultural management practices on water resources. In collaboration with researchers from Agriculture and Agri-Food Canada, the University of Saskatchewan, the University of Manitoba, and provincial agencies, the effectiveness of several agricultural BMPs is being evaluated at the edge-of-field and small-watershed scales. Several practices were studied in 2011–2012, including conversion of cropland to forage, yard-site runoff water-retention ponds, nutrient management, riparian buffers and use of extensive beef cattle overwintering sites. A suite of practices, including yard-site runoff retention, forage conversion, nutrient management and riparian buffers, reduced nitrogen and phosphorus in runoff. Evaluation of the impacts of the individual practices is ongoing.

In partnership with industry and academia, Environment Canada is investigating the causes of and solutions to pulp and paper effluent's impact on aquatic life and water quality. During the last fiscal year, an in-depth examination of a number of mill effluents (by process type) was conducted. This work found that the reproductive effects in exposed laboratory fish were correlated to oxygen availability (biological oxygen demand [BOD]) in mill effluent. These results will now help identify BMPs at mills to reduce reproductive effects of their effluent on fish in the receiving environment. These studies are being conducted as part of the Environmental Effects Monitoring requirements under the *Pulp and Paper Effluent Regulations*.

2.5 Oil sands monitoring

The Government of Canada recognizes that action is needed to ensure that oil sands development takes place in an environmentally sustainable way that protects not only our water, but our air and biodiversity for generations to come. In this regard, on February 3, 2012, the Government of Canada and Government of Alberta announced the Joint Canada–Alberta Implementation Plan for Oil Sands Monitoring, which commits the two governments to a scientifically rigorous, comprehensive, integrated

and transparent environmental monitoring program for the region. The Plan outlines the path forward to enhance the monitoring of water, air, land and biodiversity in the oil sands, by sampling more sites for more substances more frequently. It is designed to provide an improved understanding of the long-term cumulative effects of oil sands development.

The three-year Implementation Plan began in early 2012 with increased sampling frequency, parameters and locations. The Implementation Plan will integrate relevant parts of existing monitoring efforts, and will give government and industry the scientific foundation necessary to continue to promote the environmentally sustainable development of the oil sands.

The Implementation Plan reflects the Integrated Oil Sands Environment Monitoring Plan released by Environment Canada in July 2011, and will be consistent with the Government of Alberta's plans for a province-wide environmental monitoring system. The Water Survey of Canada (WSC) is supporting the Monitoring Plan, and in this regard Environment Canada's hydrometric program is providing expert advice on water quantity and sediment monitoring to ensure that data and information produced by the WSC meet the needs of other research and monitoring groups involved in the Monitoring Plan. The federal-provincial partnership involved in this work, in conjunction with other organizations, will ensure that resources are applied as efficiently as possible to accommodate changes in the monitoring network and support the goals of the Plan.

Data from the new Monitoring Plan, and the methods on which it is based, will be transparent, supported by necessary quality assurance, and will be made publicly available to allow independent scientific assessments and evaluations. This will encourage informed discussions and analysis on the impacts of oil sands development, based on high-quality scientific information.

As the process continues to move forward, implementation of the monitoring program will be jointly managed by the Government of Canada and the Government of Alberta. Annual progress reports on implementation will be prepared for the first three years, with an external scientific peer review of the program at the end of the third year. Following that, a full external scientific review of the new program will be conducted every five years.

Monitoring in the oil sands will be managed in an adaptive manner, with plans and activities evolving to reflect experience gained from initial work. Details in years two and three will be finalized, refined and adjusted based on this adaptive approach, while continuing to reflect the comprehensive, integrated approach of year one.

More detailed information can be found at: www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=BC73B2E3-F93C-4294-A6BF-22C9DC689F7C.

2.6 Northern Canada

During 2011–2012, a team of international authors led by an Environment Canada researcher finalized a chapter entitled Changing Lake and River Ice Regimes: Trends, Effects, and Implications, for the Arctic Monitoring and Assessment Program's report *Snow, Water, Ice and Permafrost in the Arctic* (SWIPA). The report is to be used by the Arctic Council in framing its future activities in the Arctic. Environment Canada authors also contributed to several other chapters in the SWIPA report which were subsequently published in a special issue of the international journal *Ambio*.

A field program investigating the effects of thawing permafrost in the Arctic on aquatic ecosystems continued work on small basins, and expanded the program to larger lake systems, including the deployment of a unique lake buoy system designed in Canada that permits remote monitoring (via satellite link) of physical and ecological states in northern lakes. This program established that permafrost thaw can produce shifts in plankton, nutrient and light relationships in small tundra lakes.

Work investigating the morphology and genesis of deep scour holes in the Mackenzie Delta was concluded in 2011–2012. Concern was previously raised about how such holes might cause a hazard to potential development activities within the delta. Initially it was believed that river-ice jamming could be causing the holes, but this has now been

discounted and their genesis is now believed to be related to other disturbances, such as from the thawing of permafrost.

A study of extreme water levels at over one hundred hydrometric stations on rivers in the northern latitudes of Canada has revealed that, for approximately one third of these stations, the backwater created during river-ice breakup is responsible for the largest annual floods rather than high discharge during the open-water period. Such results have strong implications for water management of extreme events on such northern river systems.

Increasing autumn rainfall in the Canadian subarctic has also had implications for the quality, quantity, distribution and use of northern Canadian waters. In 2011–2012, research continued into the impacts of changing stream flow regimes on water chemistry at a research catchment near Yellowknife. Preliminary results from sampling programs show enhanced winter stream flow is accompanied by increased loads of dissolved organic carbon, solutes and metals. Lake sediment cores were obtained in order to establish if these changes are unique, or part of longer-term climatic cycles.

2.7 Hydro-meteorological modelling and prediction

For several years, researchers and scientists at Environment Canada and many partner organizations have used atmospheric and weather data as input for day-to-day operational forecasting models, and hydrologic data collected under the hydrometric agreements as input for hydrologic models. These models demonstrate how regional hydro-meteorological modelling can help improve water resources management.

In collaboration with university partners, ongoing studies have focused on improving the understanding of water availability in Canada through the continued development of new methods for modelling the hydrological cycle at a variety of scales, from small basins to large rivers. In 2011–2012, research continued on developing physically based models for frozen soils, sub-surface water movement, blowing snow, and variable contributing areas in the prairies. Large- and small-scale simulations are progressing on sub-watersheds of the Saskatchewan River Basin, the Upper Assiniboine River Basin, the Athabasca River Basin, and the Great Lakes watershed. A variety of methods of model parameterization are being investigated, with the goal of determining the level of complexity required to achieve optimal stream flow predictions. In particular, initial results using Agriculture and Agri-Food Canada's eco-district classification provide a promising approach to systematically and easily parameterizing the Modélisation environnementale de surface et hydrologie system.

The development of the Hydrological Ensemble Prediction System (H-EPS) continues on the Great Lakes. The H-EPS has progressed to the point of being able to characterize a number of sources of uncertainty, including precipitation uncertainty through the atmospheric Regional Ensemble Prediction System, model parameter uncertainty, and initial condition uncertainty in soil moisture and soil temperature.

Due to the importance of precipitation for these modelling studies, various configurations of the precipitation fields being produced by Environment Canada's Numerical Weather Predictions system are being examined on a watershed basis.

In addition, work is ongoing to catalogue the flood events that occurred in the three prairie provinces from 2000 to 2010. In particular, the focus has been on understanding the meteorological conditions leading up to the plethora of prairie flood events that occurred in 2010. Work will be ongoing to characterize the meteorological conditions leading to the flood events that occurred in 2011.

As in years past, throughout 2011–2012 the WSC's international contributions were ongoing through its leadership as the Canadian hydrological advisor to the World Meteorological Organization (WMO). This entails providing input and advice to the WMO on all matters related to hydrometric monitoring and hydro-meteorology. Specifically, it included the contribution of departmental expertise toward the development of techniques for the estimation of uncertainty in stream flow gauging. The Department continued its engagement in the Arctic Hydrological Cycle Observing System initiative, which it co-leads

with the Russian Federation through hosting a meeting of member states, where it was instrumental in the development of a plan for the program.

The WSC continues to contribute to Environment Canada's CESI program, through the calculation of water level and water flow indicators. In December 2011, the CESI website (www.ec.gc.ca/indicateurs-indicators/default.asp) was updated to include water level and flow indicators that include 2009 hydrometric data.

The development and implementation of Environment Canada's eco-hydraulic modelling system for major portions of the St. Lawrence River continued during 2011–2012, including work toward the operationalization of hydrodynamic models. A prototype of the operating system is currently being run at Environment Canada and at the Canadian Meteorological Centre. Simulations of water level, currents and water bodies are carried out automatically and on a daily basis.

The Department continued to develop water supply indicators in support of the National Water Atlas project, and contributed to ecosystem trends studies focusing on the availability of water resources.

PUBLIC INFORMATION PROGRAM

(Part IV of the *Canada Water Act*)

Responsible decision making and widespread engagement of the public are critical to successful water resource management. With respect to the latter, education and outreach are complementary instruments that are used to encourage water conservation and water quality protection measures. In this regard, informational and educational materials can promote responsible behaviour and inform Canadians about the status of water resources and the health of aquatic ecosystems. Public awareness campaigns, comprehensive websites, information workshops, dissemination of educational programming and materials, and a wide range of field activities are among the many ways in which Canadians and their communities receive information and learn how to act upon it. This section describes a number of ways in which Environment Canada and its partners engage Canadians to learn more about the country's water resources and provide information on its sustainable use and conservation at a national level. Public information campaigns are also undertaken at the project level and within specific regions. These activities are discussed throughout the annual report, including in the section on ecosystem initiatives.

1 Environment Canada's Water website

Environment Canada's Water website (www.ec.gc.ca/eau-water) continued to provide general information on a wide range of water-related topics, comprehensive educational materials (such as *A Primer on Fresh Water* and various fact sheets), and the full text of key water publications (such as the *Canada Water Act Annual Report*, the Federal Water Policy, and reports on municipal water use and pricing). In addition, the site provides content on Environment Canada's water-related activities and program areas.

During the reporting period, information on the *Phosphorus Concentration Regulations* was added to the Water Pollution section of the site, and the Water Availability page was updated with national information for 2005 and 2007, as well as an historical comparison.

Environment Canada's Water website was visited 457 375 times in 2011–2012, an average of 1250 times per day.

2 Biosphere Environment Museum

The only environment museum of its kind in North America, the Montréal-based Biosphere offers enjoyable, educational exhibitions and guided activities to help visitors better understand major environmental issues and learn about living a green lifestyle, whether they live in an urban or rural area. The museum covers areas such as water, air, biodiversity, climate change, transportation, responsible consumption and sustainable development, among others.

In 2011–2012, more than 125 000 people toured the museum's exhibits and/or took part in its off-site activities.

The Biosphere's regular programming includes a number of water-related activities:

- Drop by Drop, an interactive video conference aimed at high schools across Canada, focusing on water chemistry, pollution, the water cycle and ideas on how to conserve water.
- Adopt-a-River, an awareness-raising program for youth aged 11 to 18, coordinated by the Education and Water Monitoring Action Group and supported by the Biosphere and a broad network of coordinators in five provinces.
- Sur la piste de l'eau, a guided tour on the St. Lawrence River for 10- and 11-year-olds.

- All the Water in the World, a scientific activity on the world's water resources.
- The eight modules at the Water Wonders! exhibition invite visitors to participate in a number of games, experiments and challenges, such as walking on water.
- The scientific animation, Oceans, Drivers of Climate, shows the major role that oceans play in the climate system.

3 WaterSense partnership

WaterSense is a voluntary, market-based partnership program sponsored by the U.S. EPA. It works to promote water efficiency and enhance the market for water-efficient products, programs and practices, by helping consumers identify products and programs that meet certain water efficiency and performance criteria.

In January 2011, Environment Canada signed a Promotional Partnership Agreement with the Agency that identifies the roles and responsibilities of each jurisdiction in promoting WaterSense in Canada. The agreement opens the door for other levels of government in Canada (provincial, territorial and municipal) and other Canadian organizations (trade associations and non-governmental organizations) to secure individual partnership agreements with the Agency in order to promote WaterSense in their jurisdictions and to their clients.

Appendix A: Agreements

The following *Canada Water Act* agreements[1] were ongoing during 2011–2012:

- Agreements on water quantity surveys with all provinces, and with Aboriginal Affairs and Northern Development Canada for the territories
- Canada–Quebec Protocol on Administrative Arrangements under the Canada–Quebec Agreement on Hydrometric and Sedimentological Networks in Quebec
- Master Agreement on Apportionment in the Prairie Provinces (Prairie Provinces Water Board)
- Water quality monitoring agreements with British Columbia, Newfoundland and Labrador, New Brunswick and Manitoba
- Canada–Prince Edward Island Memorandum of Agreement on Water
- Agreement Respecting Ottawa River Basin Regulation
- On behalf of the federal government, the 2007 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem was made pursuant to CEPA 1999, and the Canada–Quebec Agreement on the St. Lawrence (2011–2026) was made pursuant to the *Department of the Environment Act* and the *Department of Fisheries and Oceans Act*
- Mackenzie River Basin Transboundary Waters Master Agreement
- Canada–Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin

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

www.**ec.gc.ca**

Additional information can be obtained at:

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Inquiry Centre
10 Wellington Street, 23rd Floor
Gatineau QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-997-2800
Fax: 819-994-1412
TTY: 819-994-0736
Email: enviroinfo@ec.gc.ca