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Canada Water Act

Annual Report

for April 2012 to March 2013



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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, 2012, to March 31, 2013.

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Part III, which provided for regulating the concentration of nutrients in cleaning agents and water conditioners, was repealed.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/lcpe-cepa/default.asp?lang=En&n=64AAFDF1-1.)

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, 2012, to March 31, 2013.

During 2012–2013, Environment Canada's Water Survey of Canada (WSC), the federal partner in the National Hydrometric Program, continued to operate approximately 2100 hydrometric stations in Canada, measuring water flow and quantity. About 1000 of these are federal stations; the remaining stations are operated on behalf of the provincial and territorial partners and third-party interests. Work also continued on outreach, technology development and maintaining the program's International Organization for Standardization (ISO) certification.

The Water Quantity in Canadian Rivers Indicator was published in 2012 as one of the Canadian Environmental Sustainability Indicators (CESIs). This indicator shows that over the decade of 2001–2010, Canada's rivers typically contained a normal quantity of water. A companion indicator, the Water Quality Index, provides an overview of water quality in Canadian waters. An overview of the data that support this index is provided in this report.

During 2012–2013, Environment Canada completed the development of new and innovative risk assessment approaches and analytical tools needed to implement a risk-based approach to water quality monitoring activities, as recommended in the 2010 Fall Report from the Commissioner of the Environment and Sustainable Development. Once fully implemented, the risk-based approach will ensure that water quality monitoring, both where monitoring occurs and how often, is focused on the highest priorities (sites with higher risk of water quality impairment) and delivers the best value for the public resources invested.

Analysts from all levels of government used measurements from numerous water quality monitoring stations for groundwater, inland freshwater and transboundary waters to assess and report on status and trends, and to evaluate the progress of protection and remediation programs.

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) addressed issues such as the integrated management of reservoirs, flood protection, transboundary apportionment, water quality, relations between adjoining jurisdictions and development activities.

Work continued under various 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 September 2012, Environment Canada and the United States Environmental Protection Agency signed the newly amended Canada–U.S. Great Lakes Water Quality Agreement (GLWQA), which is aimed at facilitating U.S. and Canadian action on threats to Great Lakes water quality.

Work under the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem continued in 2012–2013, while negotiations to develop a new Canada–Ontario Agreement got underway.

Implementation of the new Canada–Quebec Agreement on the St. Lawrence (2011–2026) began, initiating 48 projects from its joint action program, along with activities under the Monitoring the State of the St. Lawrence River Program and the Numerical Environmental Prediction Program for the St. Lawrence.

In 2012–2013, the Atlantic Ecosystem Initiatives included 41 projects that dealt with water issues relating to water quality, biodiversity and climate change, including restoration, enhancement and improvement of water quality and watersheds through activities such as environmental education and outreach, water quality monitoring and research, and data collection.

Environment Canada's regional offices continued to coordinate the Department's work in priority ecosystems where neither formal agreements nor ecosystem initiatives exist. In the Pacific and Yukon Region, the Regional Director General's 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. The office also continued its productive association with the Fraser Basin Council, a government, First Nations and civil society organization helping to manage sustainability issues in the Fraser River Basin.

Under the Memorandum of Understanding (MOU) on Environmental Cooperation in Atlantic Canada, work focused on advancing the priorities of the MOU's Water Annex Work Plan.

As part of its Action Plan for Clean Water, the federal government established a renewed and expanded Lake Simcoe/South-eastern Georgian Bay Clean-up Fund for 2012–2017, including \$29 million in funding announced in Budget 2012.

Prime Minister Harper announced renewal of the Lake Winnipeg Basin Initiative (LWBI) (\$18 million, 2012–2017) in August 2012. The renewed initiative continues Environment Canada's work to address excess nutrients in Lake Winnipeg and its basin.

In 2012–2013, Environment Canada scientists carried out research projects on various current and emerging issues that directly support the various partnership-based ecosystem initiatives. Important areas of research included: improving the understanding of nutrient loads and harmful algal blooms outbreaks; measuring the status and trends of priority pollutants in sediment and water; quantifying and predicting local, regional and national sensitivities of aquatic ecosystems to climate variability and change; and conducting hydro-meteorological modelling and prediction.

Implementation of the Joint Canada–Alberta Implementation Plan for Oil Sands Monitoring is well underway. The Canada–Alberta Oil Sands Environmental Monitoring Information Portal was launched, providing online access to information about monitoring activities and scientific data and analysis.

Environment Canada continued to provide water-related public information and water awareness activities through its Water website (www.ec.gc.ca/eau-water).

COMPREHENSIVE WATER RESOURCE MANAGEMENT

(Part I of the *Canada Water Act*)

1 Federal-provincial/ territorial programs

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

Canadian provinces and 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. Some 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, laboratories, penitentiaries, military bases), First Nations reserves, and in Nunavut and the Northwest Territories.

The *Canada Water Act* provides an enabling framework for collaboration among the federal, provincial and territorial governments in matters relating to water resources. Joint projects involve the regulation, apportionment, monitoring or surveying of water resources, and the 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 also occurs on a federal, provincial and federal-provincial basis. Cost-sharing for the construction of works often includes a contribution from local governments.

The following *Canada Water Act* agreements were ongoing during 2012–2013.

Apportionment and monitoring programs

- 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

Water management programs

- Mackenzie River Basin Transboundary Waters Master Agreement
- Canada–Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin

Two other related agreements also address apportionment and monitoring programs: the 2007 Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem was made pursuant to the *Canadian Environmental Protection Act, 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*.

The subsections below describe federal, provincial and territorial collaboration in the following areas:

- data collection and use (1.1);
 - inter-jurisdictional water boards (1.2); and
 - partnership-based ecosystem approaches (1.3).

1.1 Data collection and use

1.1.1 The National Hydrometric Program

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 among researchers and decision makers.

Under the Partnership Renewal Process initiative, government partners have been reviewing, updating and revising the 1975 bilateral agreements. Canada has signed new bilateral agreements with four provinces (Manitoba, Alberta, Quebec and Ontario), and two agreements with Aboriginal Affairs and Northern Development Canada on behalf of Nunavut and the Northwest Territories. Throughout 2012–2013, negotiations continued with the remaining provinces and territory, and all but one of the remaining bilateral agreements are expected to be signed in fiscal year 2013–2014.

Governance

The National Hydrometric Program (NHP) is co-managed by the National Administrators Table and the National Hydrometric Program Coordinators' Committee, both of which met regularly throughout 2012–2013 to discuss program issues. The two groups met in September 2012 to discuss the recent review of federal station designation criteria and the development of a risk-based approach to network planning.

The Network

The national monitoring network of the NHP consists of just under 2800 hydrometric monitoring stations (see Figure 2). During 2012–2013, Environment Canada's Water Survey of Canada (WSC), the federal partner in the NHP, operated over 2100 of these hydrometric stations. Approximately 1000 of the WSC-operated stations are federal stations; the remaining are operated by

WSC on behalf of the provincial and territorial partners (see Table 1). For the province of Quebec, which is responsible for its own network, the ministère du Développement durable, de l'Environnement de la Faune et des Parcs operated 200 hydrometric stations under the NHP.

In 2012–2013, there were no significant changes to the size of the national hydrometric network, although the network did undergo some modest growth and other adjustments, including the following:

- In Yukon, two hydrometric stations were added to the network.
- In Northwest Territories, two federally designated stations were re-designated federal-provincial.
- In Nunavut, three third-party stations were closed.
- In British Columbia, seven hydrometric stations were added to the network and three gauging stations removed from the network.
- In Alberta, eight seasonal hydrometric stations were converted to annual operations as part of the Joint Oil Sands Monitoring initiative.
- In northern Saskatchewan, four new provincial stations were added to the network.
- In Manitoba, 22 provincial flood forecasting gauges were installed. One station previously designated as a provincial station was re-designated as a joint federal-provincial station. Eight provincial and six federal-provincial stations had their operating period extended from three or four months to eight months.
- In Ontario, one new station was installed at Troutlake River and one station, originally installed at Duffins Creek above Pickering in 1960 and closed in 1990 for bridge construction, was re-installed.
- In Quebec, there were no additions or closures of hydrometric stations. Water temperature sensors were added at some key hydrometric stations to provide useful information for water temperature modelling purposes.
- In New Brunswick, WSC operated 57 hydrometric stations and 9 ground water stations in partnership with the province.
- In Nova Scotia, the hydrometric network remained the same at 28 stations.
- In Newfoundland and Labrador, there was an increase of six provincial stations. One provincial station (Naskaupi River) was destroyed in a forest fire and there is no plan yet for reconstruction.

Figure 2: National Hydrometric Monitoring Network

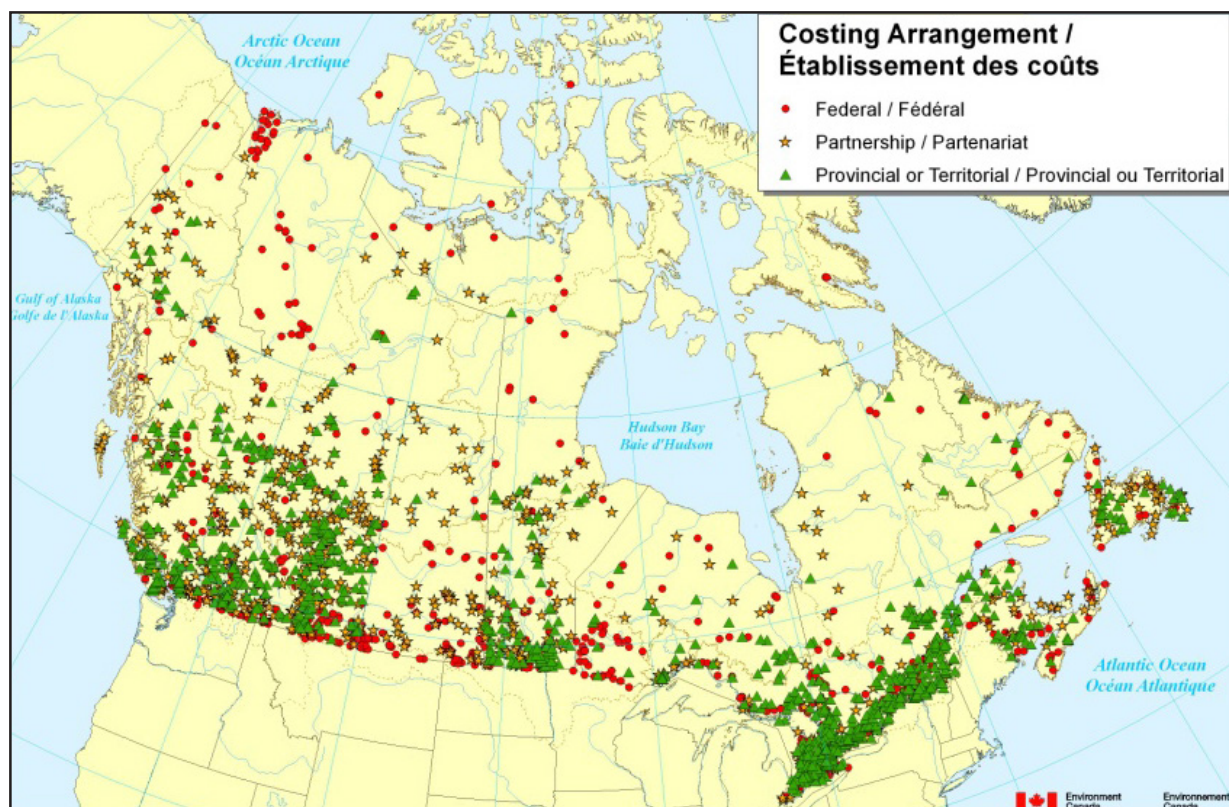


Table 1: Stations within the National Hydrometric Monitoring Network

PROVINCE/ TERRITORY	FEDERAL	PARTNERSHIP	PROVINCIAL/ TERRITORIAL	TOTAL BY PROVINCE
Alta.	77	156	155	388
B.C.	62	182	208	452
Man.	23	87	87	197
N.B.	14	18	25	57
N.L.	17	31	61	109
N.S.	10	10	8	28
N.W.T.	41	43	6	90
Nun.	19	18	2	39
Ont.	132	74	322	528
P.E.I.	0	9	0	9
Que.	16	2	0	18
Sask.	100	53	2	155
Y.T.	9	23	17	49
Total	520	706	893	2119

Outreach

In addition to its contribution to Environment Canada's Canadian Environmental Sustainability Indicators program (see section 1.1.4), the WSC developed a desktop tool that allows users to calculate water quantity indicators using WSC's HYDAT database. This tool provides users with the ability to visualize the data and statistics used to calculate the indicator, as well as a method to explore the sensitivity of the indicator's various parameters.

Technology

2012–2013 was the first full year of operation for the new national Hydrometric Work Station, a computer system for managing the National Hydrometric Program's entire data production process. The system aims to provide water level and flow data in near real-time.

The National Hydrometric Program continued its investment in 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.

Data dissemination

Environment Canada redesigned the National Wateroffice website (www.wateroffice.gc.ca) to improve its accessibility and usability. The transformation, as well as conversion of archived Web content, is intended to provide one integrated website for users to access both real-time and archived hydrometric information.

Work also began with the United States to create a North American Water Watch, which will result in a fast, easy to use, cartographic and tabular user interface.

WSC provided real-time and historical data for the Open Geospatial Consortium Water Pilot project. The objective of this project is to create a prototype of an interdisciplinary, interagency and international virtual observatory system for publishing water resources information collected from observations and forecasts in the United States and Canada.

ISO certification and audits

The National Hydrometric Program continued to maintain its ISO certification during 2012–2013, and five internal and five external audits were performed at various WSC offices throughout Canada as required under the ISO process. The results of the audits were positive and resulted in very few calls for corrective actions and/or opportunities for improvement within the program.

1.1.2 Water use and supply

1.1.2.1 Okanagan Basin Water Supply and Demand Project

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 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.

Following completion of the Okanagan Water Supply and Demand Project Report in July 2010, the project moved into Phase 3, focusing on ensuring the best use of available information for planning, adaptation, education and water management in the Okanagan Basin.

To help achieve these objectives, the Project has developed a public information Internet portal (Okanagan Water Supply and Demand Viewer) and a water-use reporting tool (www.obwb.ca).

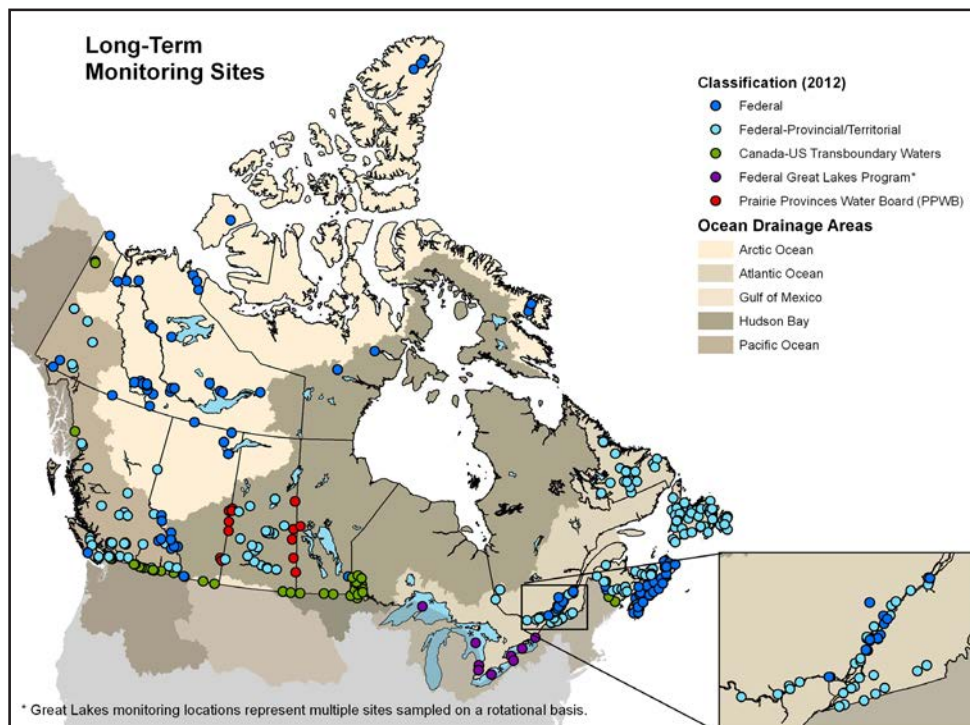
Environment Canada also continued to work in partnership with Agriculture and Agri-Food Canada, the Okanagan Basin Water Board, and the provincial government to expand groundwater monitoring in the Okanagan Basin. This included installing four new monitoring wells in priority aquifers in the Okanagan Basin over the 2012–2013 period.

1.1.3 Water quality

Freshwater quality monitoring has been a core program function of Environment Canada since the Department's inception in the early 1970s. The Department's monitoring and surveillance activities are critical for assessing and reporting on water quality status and trends, in fulfillment of many federal domestic and international commitments and legislative obligations. Much of the Department's monitoring is carried out through federal-provincial-territorial agreements, ensuring cost-effective and non-duplicative program delivery.

The objectives of the federal-provincial-territorial water quality monitoring agreements are to achieve a long-term commitment for the acquisition of water quality data; to obtain comparable, scientifically sound water quality data that are reliable for the

Figure 3: Long-term water quality monitoring sites



purposes of water resource management; and to disseminate timely information on water quality to the public, government agencies, industry and the scientific community. Six federal-provincial water quality monitoring agreements are active, including the recently signed Canada–Quebec Water Quality Monitoring Agreement. Other ongoing arrangements include the ecosystem-based Canada–U.S. Great Lakes Water Quality Agreement involving Ontario, and the Plan Saint-Laurent involving Quebec.

The long-term freshwater quality monitoring network consists of federal, federal-provincial and federal-territorial sampling sites across Canada (see Figure 3). Water quality samples are collected routinely at these sites for physical and chemical water quality parameters such as temperature, pH, alkalinity, turbidity, major ions, nutrients and metals. Pesticides and additional parameters of concern are also monitored where site-specific water quality issues exist.

The Freshwater Quality Monitoring Program is moving from a regional perspective to an alignment with Canada's major watersheds (Pacific, Arctic, Hudson Bay and Atlantic). This should strengthen water resource management across Canada.

The Program continued to enhance the Risk-Based Basin Analysis (RBBA), a geospatial approach to identifying relative risks and priorities in basins (sub-drainage areas) across Canada. Key stressor variables were identified, stressor intensities calculated, and relevant geospatial layers compiled. The RBBA will enable calculation of an aggregate measure of risks to water quality and aquatic ecosystems at a sub-drainage scale across Canada.

Other improvements included ongoing refinement of statistical tools for status and trend monitoring to ensure scientifically defensible methods and robust statistical analysis for network design. These tools will assist with sampling frequency evaluation and optimization, and ensure that important trends at all monitoring sites are identified. A Quality Assurance Framework was further documented to assure that water quality data disseminated by the Department meets common quality standards across Canada and is fit for its intended uses. These tools will continue to be implemented in the upcoming fiscal year.

Pacific Ocean Watershed

In the Pacific Ocean Watershed (British Columbia and Yukon), monitoring is conducted under the Canada–British Columbia Water Quality Monitoring

Agreement and the draft Canada–Yukon Water Quality and Aquatic Ecosystem Monitoring and Reporting Memorandum of Agreement. Under the B.C. agreement, originally signed in 1985, Environment Canada conducts joint monitoring with the provincial Ministry of Environment at 38 river sites (including 3 automated sites) in British Columbia.

In Yukon, six sites (including one automated site) were monitored on Yukon rivers in collaboration with Environment Yukon. The final draft of the Canada–Yukon Water Quality and Aquatic Ecosystem Monitoring and Reporting Memorandum of Agreement has been completed and is awaiting signature. This agreement will formalize a Canada–Yukon monitoring partnership that has been in effect for seven years.

In 2012–2013, the Department 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). The sites are relatively pristine and provide important reference information for comparison with sites influenced by human activities. Many of these sites are also located in important areas for assessing climate change.

Hudson Bay Watershed

In the Hudson Bay Watershed, monitoring is conducted in support of the Master Agreement on Apportionment between Canada, Alberta, Saskatchewan and Manitoba with regard to interprovincial water quantity sharing and water pollution. Water quality monitoring supports annual reporting on water quality objectives established for Cold Lake and 11 sites along the key rivers crossing provincial boundaries. In 2012–2013, analysis of sampling frequencies was completed and shared with provincial partners, and the monthly monitoring schedule confirmed for nutrients, metals and major ions parameters. The data and information is used by the Prairie Provinces Water Board and in support of the Lake Winnipeg Basin initiative. The Saskatchewan and Assiniboine River data were also shared in the context of the Lake Winnipeg Research Consortium involving the province of Manitoba, federal departments, universities and institutes working on Lake Winnipeg.

Environment Canada signed a science subsidiary agreement with the Manitoba Conservation and Water Stewardship in 2012. The agreement supports the development of science-related data, indicators and nutrient targets. In 2012–2013, a draft document was completed identifying a suite of water quality-related indicators for the Lake Winnipeg watershed. These indicators will be implemented following a peer and critical review evaluating their suitability for use in monitoring and surveillance.

Key transboundary monitoring sites are located on the Red, Pembina and Souris Rivers and on the Milk River–St. Mary River system. The Red and Souris rivers, in particular, have encountered many water quality problems over time (nutrients, metals, pesticides, salinity). All of these rivers are monitored regularly (8 to 12 times per year). The Red River was more intensively monitored in 2012–2013 (bi-weekly to weekly) during open water season to address increasing Devils Lake (North Dakota) water releases crossing the Canadian border, and improving the nutrient loading estimates for Lake Winnipeg. Additionally, on the Red River at Emerson, Manitoba, an automated station operates as an alert system in the context of transboundary flooding periods and water pollution monitoring. In 2012–2013, real-time data were used to assess water quality changes due to increased Devils Lake water releases. The real-time data has been provided to partners involved with or concerned by Devils Lake releases, including the International Red River Board and the Department of Foreign Affairs and International Trade.

There are two formal International River Boards that address water quantity and quality issues, the International Red River Board and the International Souris River Board. Regular monitoring updates have been provided to the Boards, and to a number of institutional partners.

As an international and interprovincial transboundary waterway, the Lake of the Woods is unique in the number of jurisdictions and international organizations, such as the International Joint Commission, that have a role to play for successful environmental management. Local and national concerns with noxious and potentially toxic cyanobacteria (blue-green algae) blooms and

declining water quality in Lake of the Woods prompted the formation of Environment Canada's Lake of the Woods Science Initiative as part of a larger program to assess and remediate deteriorating water quality in Lake Winnipeg. Environment Canada has worked with partners to develop a science-based nutrient and bloom management program within a viable socioeconomic framework, based on ecologically relevant targets and building upon work and expertise already in place. Research activities included development of remote sensing and whole-lake models, collection and evaluation of water quality samples to determine the frequency, severity and spatial-temporal patterns of the blooms and their toxicity, and examination of different elements of the lower aquatic food web to help gauge their responses to physical and chemical characteristics of their environment.

A draft report summarizing four years of science effort in the Lake of the Woods Basin (Lake of the Woods Science Initiative 2009–2012) has been completed and will be published in 2013–2014.

Environment Canada has also monitored water quality in the two national parks: Waterton Lakes and Jasper–Banff National Parks in collaboration with Parks Canada.

Atlantic Watershed

In the Atlantic Watershed, federal-provincial water quality monitoring is supported through the Great Lakes Water Quality Agreement, Canada–Quebec Water Quality Agreement, Canada–New Brunswick Water Quality Monitoring Agreement, Canada–Prince Edward Island Memorandum of Agreement on Water and the Canada–Newfoundland and Labrador Water Quality Monitoring Agreement.

As mandated by the 2012 Protocol to the Canada–United States Great Lakes Water Quality Agreement (see section 1.3.1.1), monitoring and surveillance of water quality is undertaken in the Great Lakes to provide information for measuring local and whole-lake responses to control measures and to assess the effectiveness of management decisions. Activities are also undertaken to determine the presence of new environmental problems in the Great Lakes Basin. Monitoring is conducted to determine the extent to which the General Objectives, Lake Ecosystem Objectives and

Substance Objectives, as set forth in the Protocol, are being achieved.

In 2012–2013, a broad range of monitoring activities were undertaken in the Great Lakes on water, sediment and fish. Monitoring activities focused on the status and trends of toxics and metals, in-use pesticides, compounds of emerging concern (perfluorinated compounds, bisphenol A and triclosan), phosphorus, nitrogen, organics, nutrients, major ions, dioxins, polybrominated diphenyl ethers (BDEs), legacy organochlorine pesticides and polychlorinated biphenyls (PCBs), and perfluoroalkyl contaminants (PFC).

Environment Canada reports on spatial distributions and temporal trends in surface water, sediment and fish indicated that the status of all lakes was “fair” with the exception of Lake Huron, which was assessed as “good.”

Measurements of total phosphorus by the Canadian and U.S. federal governments were compiled and analyzed to describe the nutrient status in each of the Great Lakes. In lakes Michigan, Huron and Ontario, offshore total phosphorus concentrations were below targets and may be too low, negatively impacting lake productivity. In Lake Erie, phosphorus targets were frequently exceeded and conditions were deteriorating. Only in Lake Superior were offshore targets being met and conditions acceptable during the reporting period.

To support further monitoring activities, Environment Canada scientists installed three automated wet-only precipitation collectors at separate sites in the Lake Erie watershed to enhance our understanding of the contribution of atmospheric inputs of nutrients (phosphorus and nitrogen) to the watershed.

A major accomplishment for the Department in 2012–2013 was the signing of the Canada–Quebec Water Quality Monitoring Agreement. This water quality monitoring agreement comprises 39 sites in the transboundary St. Lawrence River watershed. In addition to the sites covered by this agreement, Environment Canada operated 10 additional federal sites (including 6 automated) in the St. Lawrence River Basin. Together, these sites are important for tracking the effectiveness of actions taken under the St. Lawrence Action Plan. The sites were

sampled monthly for physicals, nutrients, metals and pesticides.

The Canada–New Brunswick Water Quality Agreement was signed in 1988 and updated in 1995. During 2012–2013, 10 federal-provincial sites were monitored under the Agreement. The sites are located on transboundary rivers or their tributaries. In addition, two real-time (automated) sites were maintained by Environment Canada at the borders of the Big Presquile and Meduxnekeag transboundary rivers.

The International St. Croix River Watershed Board, under the International Joint Commission (IJC), plays an important role in managing water levels, water quality and fisheries between Maine and New Brunswick. The Board works collaboratively with stakeholders within the watershed by preventing and resolving disputes. Environment Canada monitored water levels at seven stations in the watershed and real-time (automated) water quality at two stations and provided input to the Board's 2012 Annual Report to the IJC.

The Canada–Prince Edward Island Memorandum of Agreement on Water was originally signed in 1989 and renewed in 2001. Eleven sites were monitored under the agreement in 2012–2013. One real-time (automated) site was operated on the Wilmot River. The sites are distributed across the province, with data available on the Government of Prince Edward Island's website.

Environment Canada managed 24 federal sites (including 2 automated sites) in Nova Scotia in support of the Canadian Environmental Sustainability Indicators in 2012–2013. Nova Scotia Environment provided support on data collection. The sites are located across the province and cover major watersheds within the Maritime Major Drainage Area, including those flowing into the Bay of Fundy.

In Newfoundland and Labrador, 79 sites across the major drainage areas were sampled 4–8 times per year. Data from the sites is available on the Department's website, as well as on the Newfoundland and Labrador Water Resources website.

Arctic Watershed

Environment Canada is working with Alberta in implementing the Joint Oil Sands Monitoring Plan (see section 2.2). In addition to the monitoring activities under the Plan, Environment Canada also undertakes monitoring at over 40 sites within the Arctic Watershed and across the North. A majority of these sites are operated in cooperation with Parks Canada, with sites located in eight National Parks. Many of the High Arctic sites are considered relatively pristine, and over time provide an important baseline and reference for comparison with respect to long-range transport of atmospheric pollutants to high latitude areas as well as for any potential future influences from human activities in the North. For some National Parks, such as the Nahanni National Park Reserve, there are already anthropogenic activities that have the potential of impacting water quality (i.e., mining operations), and these sites continue to be monitored to track changes in water quality. Environment Canada also operates water quality stations on major rivers in the North, some of which are associated with transboundary basins (e.g., Mackenzie River, Slave River, Liard River) or are significant northern watersheds (e.g., Coppermine River, Thelon River, Great Bear Lake/River). Additional northern rivers are also monitored in Yukon (see Pacific Watershed section, above).

For more information, please consult the Department's Fresh Water Quality Monitoring & Surveillance website (www.ec.gc.ca/eaudouce-freshwater/Default.asp?lang=En&n=6F77A064-1).

CABIN

The Canadian Aquatic Biomonitoring Network (CABIN) is a water monitoring program for assessing the biological condition of freshwater ecosystems in Canada using standardized data collection and analysis methods (www.ec.gc.ca/rcba-cabin). This monitoring program, based on decades of research and development in many countries, has been adopted by multiple agencies and organizations across Canada.



Sampling of benthic invertebrate community by using a kick net in a wadeable stream
© Environment Canada

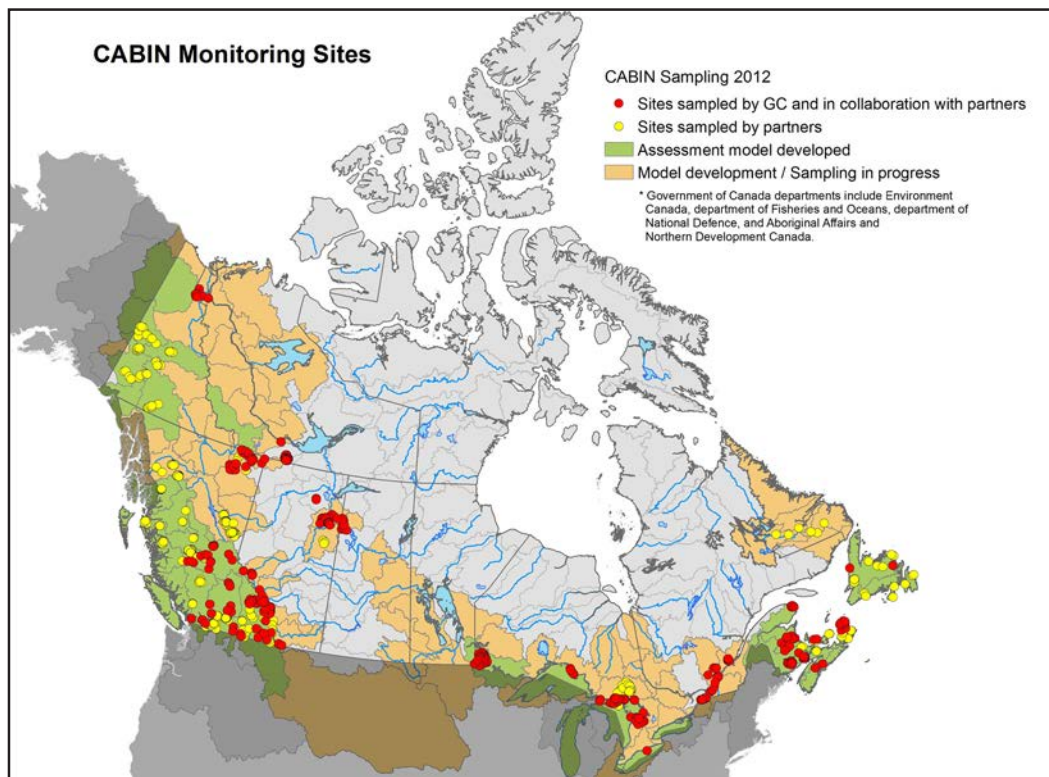
The success of CABIN results from interagency collaboration and data sharing. The program is led by Environment Canada's National CABIN Team, which provides online data management, assessment tools and models, field and laboratory analysis protocols, certification and training, and ecological research and development. Network partners share their observations within the national database. CABIN partners include federal, provincial and territorial government departments, industry, academia, First Nations, and non-governmental organizations such as community watershed groups. A CABIN Science Team consisting of Environment Canada and external scientists with expertise in large-scale ecological monitoring provides science advice and recommendations for the CABIN program.

Currently, 10 reference models are available to assess the biological health of freshwater bodies in Yukon, British Columbia, Nahanni National Park, Rocky Mountains National Parks, the Atlantic provinces and the Great Lakes. Additional reference models are in development for streams in the Boreal

ecoregion of central Canada and the St. Lawrence River. The CABIN program is also working towards the development of sampling and analysis protocols for other freshwater habitats such as large rivers and wetlands.

Since the early development of the CABIN monitoring strategy in the 1980s, data have been collected in over 7700 locations across the country. In 2012–2013, data were collected at 974 sites in several sub-basins across the country by Environment Canada and its partners (Figure 4). The development of a national training program in 2008, in partnership with the Canadian Rivers Institute of the University of New Brunswick, provided a means of promoting the use of national protocols and expanding data collection and knowledge of biological condition across the country. In 2012, participation in the online modules increased to 238 participants. As the number of CABIN-trained participants increases, the ability to generate new data across the country and assess water quality improves for Environment Canada and all network partners.

Figure 4: CABIN monitoring sites



In November 2012, a CABIN Users Science Forum was held in Fredericton, New Brunswick, to bring the network together to exchange information and build collaborations enhancing biological monitoring across the country. This event focused on expanding CABIN to different habitats and for other uses such as compliance monitoring, assessing long-term changes, and improving monitoring and assessment methodology and data quality. Key recommendations to ensure high-quality data and more accurate statistical analysis and reporting were implemented on the CABIN website. User forums are planned on a biennial basis with the next forum planned for Ontario in 2014.

Pacific Watershed

In British Columbia, CABIN monitoring is jointly conducted under the Canada–British Columbia Water Quality Monitoring Agreement. Under this agreement, Environment Canada and the provincial Ministry of Environment collaborate on data collection for reference model maintenance and development and site assessment. Nine reference models are available to all CABIN users to conduct biological assessments in watersheds in British Columbia and Yukon that were developed collaboratively by federal, provincial and territorial agencies (i.e., Department of Fisheries and Oceans, Parks Canada, BC Ministry of Environment and Yukon Territory Government). Models are available for the Yukon River Basin, Fraser River/Georgia Basin, Skagit River Basin, Columbia/Okanagan Basin, B.C. Coastal, Skeena Region and Rocky Mountains National Parks models. In 2012, Environment Canada collected CABIN data from 41 stream and river sites, 23 sites for reference model maintenance and development, and 18 sites for assessment of biological condition co-located at long-term physical-chemical monitoring sites.

A report on the Water Quality of Georgia Basin was completed, which integrates the physical-chemical and biological monitoring information through the reporting of a Water Quality Index and the CABIN indicator over a six-year period (2003–2008).

Arctic Watershed

CABIN activity in the Arctic Watershed has been focused in the Athabasca Basin. Under the Joint Canada–Alberta Implementation Plan for the Oil

Sands, CABIN protocols have been applied in Phase 2 of the integrated Monitoring Plan. The program consists of mainstem monitoring reaches along the Athabasca River with multiple stations within each reach representing over 100 sampling sites. There are also 42 tributary sampling sites consisting of a gradient design that includes sites extending from within the active oil sands development region to sites outside of the development area as well as beyond any natural exposures of the bituminous geologic formations in the region. In addition, comparative assessments are underway to develop comprehensive and compatible datasets that can be used to assess long-term cumulative effects on aquatic ecosystems. Details can be found on the Canada–Alberta Oil Sands Environmental Information Portal (www.jointoilsandsmonitoring.ca/pages/home.aspx?lang=en).

Hudson Bay Watershed

CABIN sampling has been focused on Lake of the Woods, conducted as part of the Lake of the Woods Science Initiative. A preliminary reference model for the lake has been developed and will continue to be revised and updated as additional sites are sampled. Located at the corner of Ontario, Manitoba and Minnesota, the Lake of the Woods is the largest lake in the drainage basin upstream of Lake Winnipeg, contributing ~6% of the total phosphorus load to Lake Winnipeg via the Winnipeg River. A literature review on the gradient approach has been completed in support of potential bio-monitoring development in the Red–Assiniboine sub-watershed.

Atlantic Watershed

In the Atlantic Watershed, 133 stream and river sites were monitored using CABIN protocols by Environment Canada and partners to support federal-provincial water quality monitoring agreements with Newfoundland and Labrador and Prince Edward Island, Canadian Environmental Sustainability Indicators, and to conduct assessments in transboundary watersheds (Saint John River, St. Lawrence River) and federal lands (i.e., National Parks, First Nations, CFB Valcartier). CABIN sampling using lake protocols was also conducted in the Great Lakes.

A reference condition approach model for use by watershed within the Atlantic provinces (except Labrador) and the Gaspé region, particularly Forillon National Park, was completed and published in collaboration with the University of New Brunswick and the province of New Brunswick. A model for Lake Saint-Pierre has been developed and is ready to undergo peer review.

In addition to stream assessments, monitoring activities have been conducted in the wetlands of the St. Lawrence River. An analysis of multi-scale effects of hydrology, landscape and environmental factors on macro-invertebrates in wetlands has been undertaken with the Université de Montréal.

1.1.4 Canadian Environmental Sustainability Indicators

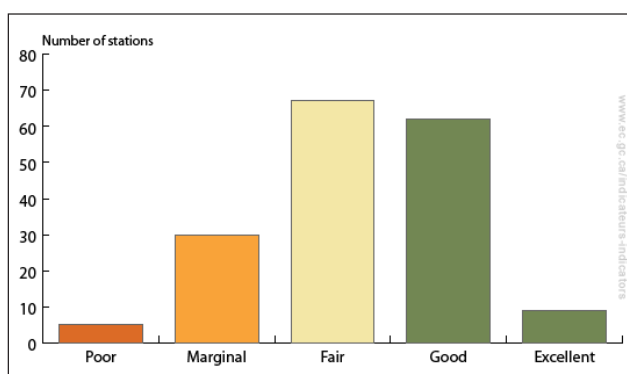
The Canadian Environmental Sustainability Indicators (CESI) program reports on the status and trends of key environmental issues (www.ec.gc.ca/indicateurs-indicators/default.asp). Indicators cover air quality, greenhouse gas emissions, water quality and quantity, and protecting nature. The program's freshwater quality indicator provides an overall measure of the ability of freshwater bodies to support aquatic life (plants, invertebrates and fish) at selected monitoring stations across Canada.

The freshwater quality indicator is calculated using the water quality index, endorsed by the Canadian Council of Ministers of the Environment, to summarize the status of surface freshwater quality in Canada. This indicator reflects the extent to which water quality guidelines for the protection of aquatic life are being met at selected river monitoring sites throughout Canada. Water quality at a monitoring station is considered excellent when ambient water quality does not exceed guidelines at any time for any selected parameter. When water quality is rated poor, water quality measurements usually exceed their guideline, and the exceedances may be large.

The latest freshwater quality indicator is based on data collected from 2008–2010 at 328 water quality stations across Canada and reflecting the diverse watersheds assembled from 23 federal, provincial, territorial and joint water quality monitoring programs. The national water quality indicator was calculated using a core national network of 172 river stations, selected to be representative of surface freshwater quality across Canada and the human pressure exerted on it (Figure 5).

Freshwater quality measured at these 172 river sites across Canada was rated excellent for the protection

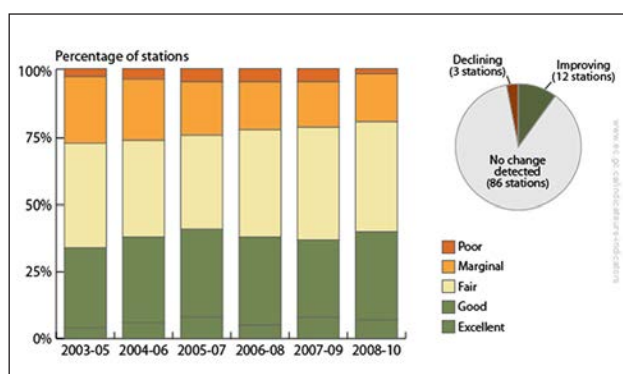
Figure 5: National freshwater quality indicator for the 2008 to 2010 period, Canada



Note: Freshwater quality was assessed at 172 stations throughout Canada's 16 drainage regions where human activity is most intensive, using the Canadian Council of Ministers of the Environment's Water Quality Index.

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

Figure 6: National freshwater quality indicator change between 2003–2005 and 2008–2010, Canada



Note: Change in the indicator between the 2003–2005 and 2008–2010 periods was assessed at 101 stations in 16 drainage regions across Canada where historical data were available. For each station, change in the indicator was assessed using a consistent set of water quality guidelines and parameters through time.

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

of aquatic life at 9 stations, good at 66 stations, fair at 67 stations, marginal at 28 stations, and poor at 2 stations. Overall, there has been little change in the national freshwater quality indicator between 2003 and 2010 at the 101 stations for which there are data for that entire period. During this period, no change was detected in the freshwater quality indicator rankings for 86 stations, while the ranking has significantly improved for 12 stations and declined for 3 stations (Figure 6).

The water quantity in Canadian rivers indicator summarizes annual trends in the hydrometric data at the national scale. Water quantity at a station is judged by comparing daily water flow or level data to the amount of water observed at water quantity monitoring stations from 1978–2007. Daily data are rolled up to annual patterns for a station, which are summarized by drainage regions.

The latest water quantity in Canadian rivers indicator was released in December 2012 and uses 2010 data at 1196 hydrometric stations across Canada rolled up to the drainage region scale.

In 2010, 16 drainage regions were classified as having normal water quantity; 4 had higher-than-normal water quantity; and 1 had lower-than-normal water quantity. Over the past decade (2001–2010), Canada's rivers typically contained a normal quantity of water. Higher-than-normal water quantity was observed in six drainage regions in 2005, a particularly wet year in central Canada. Five drainage regions had lower-than-normal water quantity in 2001, a year with lower-than-usual rainfall and snowfall in central Canada.

Other water indicators updated in CESI between April 1, 2012, and March 31, 2013, can be found online at www.ec.gc.ca/indicateurs-indicators.

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.

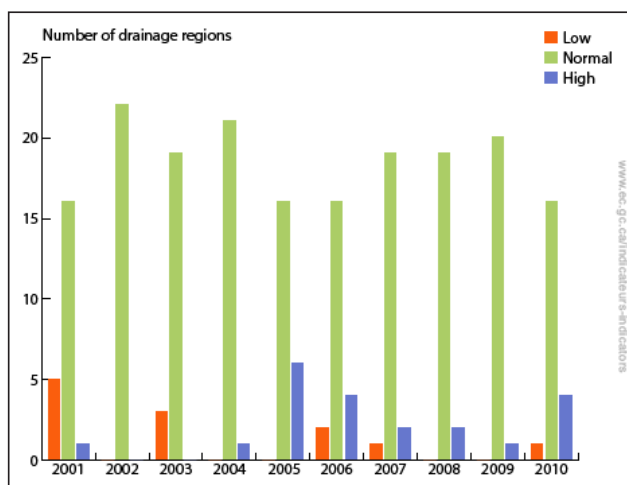
1.2.1 Ottawa River Regulation Planning Board

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.

At the beginning of the 2012 spring melt period, given the snow pack conditions, a close to normal flood volume was expected. A warm temperature anomaly in late March caused an early and completely exceptional freshet peak, which occurred approximately four weeks earlier than average for most sub-basins.

The early freshet, combined with below normal precipitation from April to July, resulted in a low flow period close to historical lows for the months of July and August on the main stem of the river and

Figure 7: Water quantity in Canada's drainage regions, 2001 to 2010



Note: Normal water quantity is based on the amount of water observed at water quantity monitoring stations from 1978–2007 for Canada's 25 drainage regions. For the period 2001–2007, there are not enough data to describe water quantity for three drainage regions. Data for four drainage regions are missing for 2008–2010. Normal water quantities are specific to each region and do not refer to the same amount of water in each drainage region (e.g., normal water quantity on the Prairies is different from normal water quantity in the Maritimes).

Source: Water Survey of Canada, Environment Canada (2012) HYDAT Database. Retrieved on 4 July 2012.

in the Montréal region. Near-normal precipitation in August and above-normal in September and October progressively raised flows and levels to above seasonal normal in the fall.

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 English and French, both of which provide information about water levels and flows at various locations in the Basin. The Secretariat recorded more than 26 000 visits to the website during 2012–2013. A total of 713 calls were made to the Secretariat, with approximately 40% of calls from the Ottawa–Gatineau area.

1.2.2 Prairie Provinces Water Board

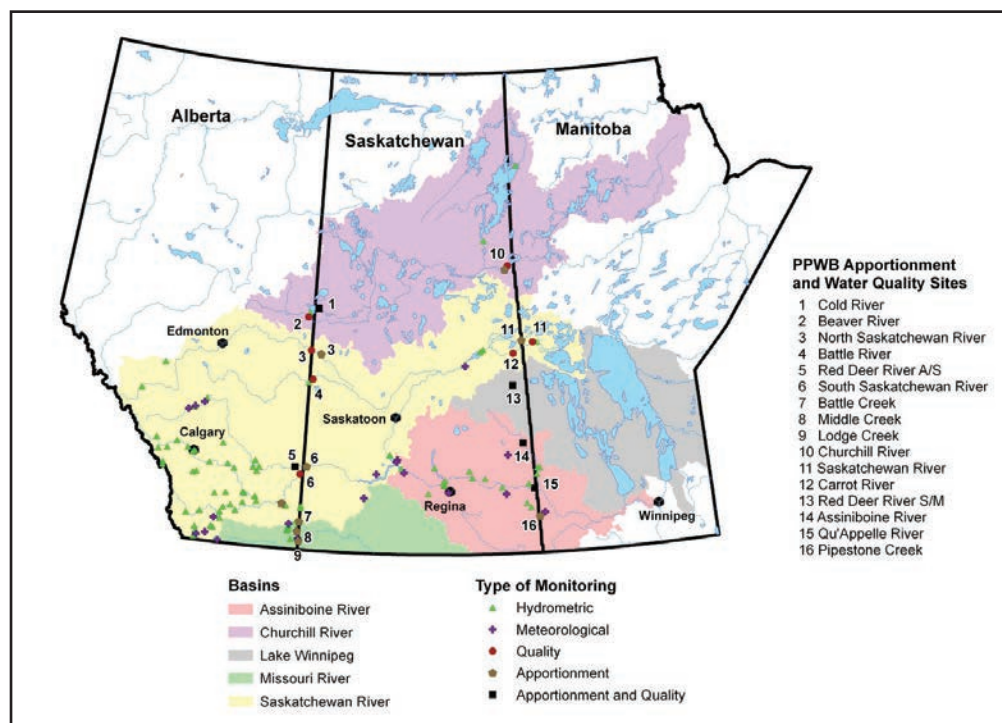
Recognizing that water use within one province may affect another province, and because federal and provincial governments have shared responsibility for water, the governments of Canada, Alberta, Saskatchewan and Manitoba signed the Master Agreement on Apportionment (MAA) in October 1969. The purpose of this Agreement is to

apportion water between the provinces of 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 terms of the MAA. 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.

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 8). 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 8: Prairie Provinces Water Board water quantity and quality monitoring stations and basins for 2012



Activities and accomplishments in 2012–2013 included the following:

- Apportionment requirements were met in the calendar year of 2011 on all eastward-flowing prairie streams. Interim flows indicated that 2012 apportionment requirements were likely met on the South Saskatchewan River. It is anticipated that there will not be any problems with meeting apportionment for 2012 on any transboundary stream.
- The Board approved the hydrometric and meteorological monitoring station list for 2013–2014. Two hydrometric stations were added on the Assiniboine River, three meteorological stations were changed and a new one was added on the South Saskatchewan River. Work continued to modernize the natural (apportionable) flow computation software programs.
- A guidance document was completed to support the development of a schedule to the MAA related to transboundary aquifers. The guidance document describes the concepts of groundwater management between two jurisdictions as development and risk increase.
- The Board approved the 2012 water quality monitoring program and the 2011 Water Quality Excursion Report. The overall adherence to interprovincial water quality objectives was very high, with an average of 95%, such that water quality continues to be protected. In October 2012, the PPWB passed a motion to request monthly sampling for acid herbicides on the Battle River and the South Saskatchewan River during the open water season to provide additional information on pesticides in those rivers.
- The Board continued to exchange information on 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. A Prairie Hydrology Workshop was held on January 29–30, 2013, in Winnipeg, Manitoba. Presentations from the workshop are available on the PPWB website (www.ppwb.ca/documents/217/index.html).
- The PPWB Charter, Strategic Plan and Communication Strategy were updated in 2012.

1.2.3 Mackenzie River Basin Board

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 3 provinces and 2 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.

Board members met twice during the year, and activities and accomplishments in 2012–2013 included the following:

- The Board published the *Mackenzie River Basin Board Report to Ministers April 1, 2007–March 31, 2012*. The report describes the activities of the Board during this period and is available on the MRBB website (www.mrbb.ca).
- Member jurisdictions continued to exchange information through agency reports.

- The Traditional Knowledge and Strengthening Partnerships Steering Committee commissioned a discussion paper entitled *Towards a New Current of Thought: Best Practices for Gathering and Incorporating Traditional Ecological Knowledge into Environmental Monitoring and Assessment*. The discussion paper is available on the MRBB website.

1.2.4 Lake of the Woods Control Board

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.

Basin conditions were very dry through the winter of 2011–2012. Spring came very early to the basin and snowmelt runoff was limited. Spring rainfall, however, led to two additional moderate inflow peaks to Lake of the Woods in May and June, leading to moderate lake level conditions through the summer. Dry conditions and below-normal lake levels prevailed from late summer through year-end. Lake of the Woods levels did not become subject to the approval of the ILWCB during 2012.

Heavy rainfall in late May and early June in the Lac Seul basin led to a maximum of record inflows the second week of June. Lac Seul levels rose quickly, but adequate storage in the lake, combined with sharply increased outflows, kept the lake within the upper range of normal levels. Outflows were managed to keep them just below the English River flows, which would begin to cause hardship downstream.

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 2012, despite the high summer outflows from Lac Seul, flows on the Winnipeg River in Manitoba stayed within the high normal range, declining to below normal by late summer.

The Board held three meetings with stakeholder representatives in the basin during the year to set regulation strategy. In addition, the Board held public meetings in Ear Falls, Sioux Lookout and Kenora, hosted a workshop at the International Lake of the Woods Water Quality Symposium in International Falls and staffed an information booth at the Lake of the Woods District Property Owners annual meeting and cottage show in Winnipeg. The secretariat maintains the Board's website, which provides the public with near-real-time lake levels and river flows, as well as forecast historic conditions and other basin management information. During 2012, the site recorded more than 56 000 visits from over 15 000 unique visitors.

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.

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

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 Great Lakes Water Quality Agreement (www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=45B79BF9-1), which is the key mechanism for protecting water quality and the health of the aquatic ecosystem in the Great Lakes. An amended Great Lakes Water Quality Agreement was signed in 2012 (see Canada–U.S. cooperation in this section, below).

Work under the Canada–Ontario Agreement Respecting the Great Lakes Basin Ecosystem continued in 2012–2013, while negotiations to develop a new Canada–Ontario Agreement got underway.

Remedial Action Plans

Coordination of Remedial Action Plan (RAP) activities continued, including assessing and reporting on the success of past actions and on the status of remaining actions in Canadian Areas of Concern (AOCs). Some examples of these activities are as follows:

- All restoration actions identified in the St. Lawrence River (Cornwall) AOC RAP have been carried out. A decision is expected in 2013–2014 on whether to delist the AOC or recognize it as an Area in Recovery.
- The Hamilton Harbour RAP Stakeholder Forum was convened to re-examine the objectives and develop a work plan for delisting Hamilton Harbour as a Great Lakes AOC. A major step in the process to restore Hamilton Harbour was the Government of Canada announcement in December 2012 of \$138.9 million in funding to clean up contaminated sediment at Randle Reef in Hamilton Harbour. This sediment remediation project will be led by Environment Canada in partnership with the Province of Ontario, the City

of Hamilton, the Hamilton Port Authority, U.S. Steel Canada, the City of Burlington and the Regional Municipality of Halton.

- The Toronto and Region RAP completed the evaluation of two beneficial use impairments, “restrictions on dredging activities” and “degradation of benthos,” and recommended that these beneficial uses be considered “not impaired” in the AOC. Redesignation reports have been finalized for these two beneficial use impairments and will be released shortly for public review and comment.
- The Bay of Quinte AOC RAP Science Forum was held on October 10–11, 2012, with over 40 technical experts from 10 different agencies currently involved in developing and assessing the AOC delisting criteria. The forum resulted in a comprehensive assessment of the ecological health of the AOC, and the development of a detailed work plan that will contribute to delisting of the Bay of Quinte AOC.
- The Bay of Quinte AOC Natural Heritage System was digitally mapped, categorized, prioritized and modelled in partnership with municipalities and other stakeholders from around the bay. The model identifies significant terrestrial and aquatic features and ecological connections, and critical wildlife and aquatic habitat areas. A strategy is now in the final stages of development, which provides recommendations to inform municipal planning policy and initiatives.
- The St. Clair River AOC Revised Delisting Criteria report was completed. This report provides environmental end targets that will signal restoration of the AOC. A symposium was held in June 2012 to release the St. Clair River Area of Concern Canadian Remedial Action Plan Implementation Committee Work Plan 2007–2010 Report of Accomplishments. In 2012, the beneficial use impairment “Added Cost to Agriculture and Industry” was removed.
- In the St. Clair River AOC, Environment Canada in partnership with the Ontario Ministry of the Environment and the St. Clair Region Conservation Authority continued to evaluate sediment management.
- In 2012, the Peninsula Harbour Remedial Action Plan Stage 2 report was completed and marks completion of all Canadian Stage 2 reports. The

report provides a comprehensive review of the remaining four beneficial uses; identifies locally defined goals and the remedial actions required to enable delisting of the AOC; and the monitoring efforts that will continue—even post-delisting.

- Long-term monitoring of the Jackfish Bay AOC in Recovery is ongoing through a number of federal and provincial monitoring programs. Results indicate that fish populations are recovering; however, conditions in Blackbird Creek, a small meandering waterway receiving mill effluent, remain impaired.
- A number of activities were completed in the Detroit River AOC, including several assessments of environmental conditions in the AOC, a survey of Detroit River aesthetics, development of an approach to assess the benthic quality of the AOC, and an assessment report on the “Tainting of Fish and Wildlife Flavour” beneficial use impairment, which indicated that this impairment could be removed from the list.
- In the St. Marys River AOC, the investigation of the magnitude and extent of sediment contamination continued in 2012–2013.
- In the Thunder Bay AOC, an ecological health risk assessment and a human health risk assessment were conducted in support of the development and evaluation of sediment management options.

Great Lakes Sustainability Fund

In 2012–2013, Environment Canada’s Great Lakes Areas of Concern program and the associated Great Lakes Action Plan 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 first focus is improving point and non-point source water quality. 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 to encourage rural farming and non-farming landowners to adopt 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 projects to reduce loadings of phosphorus and other nutrients to the bay. This includes projects such as the Town of Napanee inflow and infiltration study, Algae Watch—a project to monitor algae growth and facilitate public education, and a project to support implementation of the Bay of Quinte remedial stormwater management plan.

In the Toronto and 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 2012–2013, the fund supported a number of projects to restore habitat in AOCs, including projects to implement habitat management plans in the Bay of Quinte AOC; habitat restoration projects along the Detroit River, in the tributaries of the Niagara River, and in the St. Clair River AOC; projects to monitor and assess fish populations in the Thunder Bay AOC; and six projects to restore fish and wildlife habitat and populations in the Toronto and Region AOC.

In the Toronto and Region AOC, a third wetland was created on the Toronto Islands in 2012–2013, completing a one-hectare wetland complex. On Tommy Thompson Park, Embayment D was isolated with an earthen berm and a series of islands to

restore approximately seven hectares of wetland and to exclude carp. The restoration of coastal wetlands in the Toronto and Region AOC remains a priority in achieving the restoration objectives for the beneficial use of fish and wildlife. The fish acoustic tagging project to monitor the success of the Toronto and Region RAP's wetland and aquatic habitat restoration projects continued in 2012–2013. Since 2010, transmitters have been implanted in 181 fish in Toronto Harbour, with 55 in Largemouth Bass, 55 in Northern Pike, 37 in Common Carp, 10 in Walleye, 14 in Brown Bullhead and 10 in Yellow Perch.

Developing plans and strategies to remediate contaminated sediments is the third focus area of the Great Lakes Sustainability Fund. In 2012–2013, work continued to advance the management plan for mercury-contaminated sediments in the St. Clair River with a project to complete the contaminated sediment management options report; carry out public, stakeholder and First Nations consultation on sediment management options; and complete a legal review of water lot ownership where contaminated sediments are to be remediated.

Science and monitoring

Environment Canada undertakes science and monitoring projects to support decision making in the Great Lakes AOCs in Canada and in binational AOCs. In 2012–2013, projects focused on understanding and managing nutrient loading and harmful algal blooms outbreaks and developing models that help in their prediction and reduction.

In 2012–2013, research work continued to provide valuable information on the biogeochemistry of major nutrients in Hamilton Harbour to aid in the restoration of this AOC. Hamilton Harbour RAP activities also included speaking at a Bay Area Restoration Council public forum on physical processes and cyanobacteria blooms; contributing to RAP water quality and beach monitoring committees (both as a member and a resource); and collaborating with the Department of Fisheries and Oceans and the Ontario Ministry of Natural Resources for aquatic habitat suitability studies.

Other research activities in AOCs focused on identifying sources of sewage contamination and

supporting the measurement of aquatic ecosystem health status.

Canada–U.S. cooperation

On September 7, 2012, the Honourable Peter Kent, Canada's Minister of the Environment, and the United States Environmental Protection Agency's (EPA) Administrator, Lisa P. Jackson, signed the newly amended Canada–U.S. Great Lakes Water Quality Agreement (GLWQA). The revised Agreement facilitates U.S. and Canadian action on threats to Great Lakes water quality. New provisions address aquatic invasive species, habitat degradation and the effects of climate change, and support continued work on existing threats to people's health and the environment in the Great Lakes Basin such as harmful algae, toxic chemicals and discharges from vessels.

The development of binational committees and work plans was initiated through the Great Lakes Executive Committee established under the amended GLWQA. Canadian and U.S. leads have been appointed for each of the Agreement's 10 Annexes: Areas of Concern, Lakewide Management, Science, Climate Change, Habitat and Species, Chemicals of Mutual Concern, Groundwater, Nutrients, Aquatic Invasive Species, and Discharges from Vessels.

Environment Canada, in collaboration with the U.S. EPA, regularly reports on the ecological health of the Great Lakes ecosystem. In 2012–2013, this included drafting of a State of the Great Lakes report, planning for the first GLWQA Public Forum in 2013, alignment of indicators with the amended GLWQA, and a review of communicating science to the public.

Under the GLWQA, lakewide management actions are undertaken through the development and implementation of Lakewide Action and Management Plans (LaMP) for each of the four Great Lakes shared between Canada and the United States. In 2012–2013:

- The LaMP 2012 Annual Reports were published and are available for each of the Great Lakes (<http://ec.gc.ca/eau-water/default.asp?lang=En&n=F2BDD611-1&parent=24BE1763-855D-481D-9A79-BC188F09>).

- In Lake Huron, implementation of the Canadian Framework for Community Action continued with partners on the Bruce Peninsula, Manitoulin Island, Georgian Bay and the North Channel. The Healthy Lake Huron initiative continued work in priority watersheds along the Southeast Shore, and progress was made on the Southern Georgian Bay Shoreline Management Strategy. Progress on the biodiversity conservation strategy continued, and a science and monitoring synthesis report was completed for South-eastern Georgian Bay. Field work was conducted under the binational Cooperative Science and Monitoring Initiative, the results of which will inform the development of future priorities and actions.
- The 6th biennial Lake St. Clair binational conference was held November 29–30, 2012. It convened over 140 participants to build partnerships, strengthen collaboration and advance the environmental economic health of Lake St. Clair.
- In Lake Erie, a binational Biodiversity Conservation Strategy was developed, the signing of the Western Lake Erie Watersheds Priority Natural Areas Agreement was formally announced, the Binational Nutrient Management Strategy was released, and work continued with partners in key watersheds including the Grand River and Thames River.
- In Lake Superior, the Zero Discharge Demonstration Program chemical milestones report was finalized, a biodiversity conservation assessment initiated, climate change adaptation actions identified, and aquatic invasive species prevention activities continued.

The GLWQA calls for the development of an integrated nearshore framework to be implemented collaboratively through the lakewide management process for each Great Lake. In 2012–2013, a federal-provincial Steering Committee initiated a review of existing coastal zone management approaches, engagement and consultation needs, and the development of a project charter.

In 2012–2013, additional details of the Great Lakes Nutrient Initiative (GLNI) were announced, including a \$16 million investment over four years. Under the GLNI, science and monitoring efforts are focused on developing targets for the reduction of phosphorus loading in the near shore that will help

control the occurrence of toxic and nuisance algae. Work began with a focus on Lake Erie, the smallest and shallowest of the Great Lakes and the most susceptible to nearshore quality issues.

Other accomplishments in 2012–2013 included the drafting of Great Lakes science priorities and a climate change impacts synthesis report that summarizes published literature and highlights observed climate trends and future climate change scenarios for the region on parameters associated with water quality.

1.3.1.2 St. Lawrence Action Plan

The St. Lawrence Action 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 cooperative 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 mouths of its main tributaries, from Lake Saint-François, straddling the border between Quebec and Ontario, to the eastern reaches of the Gulf of St. Lawrence.

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

In 2012–2013, various components of the Action Plan were initiated in early 2012, including 48 projects from its joint action program, where a number of research activities were undertaken, including:

- A study in the Richelieu River where parasite species composition and richness in spottail shiners was affected by climatic conditions in the form of precipitation;
- Publication of models that predict the risk of proliferation of cyanobacteria in a 250-km section of the St. Lawrence;

- Separate studies of the physiological effects and impact on the immune system for mussels fed with *Anabena flos-aquae* or exposed to the benthic algae *Lyngbya wollei*;
- Development of a new method as a rapid screening tool to generate information on the fate of widely prescribed benzodiazepines residues in wastewater; and
- An evaluation of the effects of antibiotics on the endemic snail species *Lymnaea sp.* and comparison of the results with responses to effluent from Montréal.

Community involvement and awareness

The ZIP Program supports Stratégies Saint-Laurent and its members (the 13 Areas of Prime Concern committees) in their efforts to continue working with local communities to protect, conserve and develop the St. Lawrence ecosystem. In 2012–2013, activities included collaboration between communities to highlight local environmental issues related 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, ZIP committees contributed significantly to the St. Lawrence integrated management approach at the local level, notably through the development of Regional Integrated Management Plans.

Under the auspices of the St. Lawrence Action Plan 2011–2026, Environment Canada and Quebec's Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs are also implementing the Community Interaction Program (CIP), which supports non-governmental organizations that implement projects that benefit the St. Lawrence. During 2012–2013, Environment Canada funded 11 projects under this program, which were carried out throughout the program intervention area extending up the south shore of the St. Lawrence from Cornwall to Gaspé, including the Magdalen Islands, and up the north shore from Carillon to Blanc-Sablon, including Anticosti and the Saguenay region. They involve key players from riverside communities, including municipalities, First Nations, academia, industry, agriculture, local communities and the relevant provincial and federal

departments. Projects completed include the restoration of a salt marsh in a major bird conservation area in Rimouski, implementation of a conservation management plan in the Cacouna–Isle Verte corridor, and the creation of a suitable fish habitat in Lake Saint-Louis around the Îles-de-la-Paix archipelago. A total of 37 new project proposals were submitted under the CIP in 2012–2013 for activities to be implemented in the summer of 2013.

Finally, the second Forum on the St. Lawrence was held in Québec City in November 2012, focusing on areas of ecological significance. At the local level, regional round tables were organized by the Quebec government and supported by the federal government through the Areas of Prime Concern (ZIP) Program of the St. Lawrence Action Plan.

The State of the St. Lawrence River Monitoring Program

The network of governmental and non-governmental partners and collaborators continued to collect scientific data, disseminating the information gathered through the State of the St. Lawrence River Monitoring Program. Environment Canada collected data on water levels and flow rates; water and sediment quality; benthic communities at Lake Saint-Pierre; the area covered by wetlands; seabird populations, the Northern Gannet and the Great Blue Heron; and shellfish water quality.

During 2012–2013, Environment Canada prepared four new fact sheets on environmental indicators in the St. Lawrence River, on the subjects of polybrominated diphenyl ethers (PBDEs), benthic macroinvertebrate communities, contaminant transport, and changes in water level and flow. These fact sheets are scheduled for publication during 2013–2014.

The Rendez-vous Saint-Laurent 2013 event took place March 12–13 and brought together over a hundred stakeholders from non-governmental organizations, river user groups, universities, and federal, provincial and municipal governments to discuss program results and areas for improvement. The proceedings were recorded for publication on the St. Lawrence Action Plan website.

Finally, a technical and scientific report on monitoring sediment quality in Lake Saint-François, as well as a comparative study of inventory methods for benthic macroinvertebrates conducted in cooperation with the province of Quebec, were also distributed in 2012.

Numerical Environmental Prediction Program

The Working Group on Numerical Environmental Prediction for the St. Lawrence is a new group formed under the St. Lawrence Action Plan with the goal of having a better understanding of the ecosystem in the St. Lawrence as a whole and to provide a tool for supporting decisions about its integrated management. In 2012–2013, the group formally launched its activities, notably through three specific projects focused on the atmosphere–surface schema–hydrology coupling, integration of hydrodynamic modelling tools into the Montréal Archipelago, and hydrologic and hydraulic modelling of the Richelieu River watershed.

1.3.1.3 Atlantic Ecosystem Initiatives

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, 14 multi-stakeholder community organizations and 5 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. ACAP-funded initiatives support the use of 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, and 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.

In 2012–2013, 41 projects (representing almost 80% of all projects funded) addressed water issues

related to water quality, biodiversity and climate change. Environment Canada committed over \$960,000 for these projects with an anticipated commitment of over \$1.8 million from other sources. The bulk of project activities pursued restoration, enhancement and improvement of water quality and watersheds through proactive initiatives such as environmental education and outreach, water quality monitoring and research, and data collection. The following examples demonstrate the type of projects that were carried out.

In Prince Edward Island, the Bedeque Bay Environmental Management Association and Environment Canada scientists are working together on a long-term research project to assess the effectiveness of provincial legislated buffers to reduce contaminated waterways. In 2012–2013, the research focused on the role of riparian vegetation in filtering out contaminants, and how streams respond differently to storm events.

In New Brunswick, Eastern Charlotte Waterways worked to identify the current status and trends in historically contaminated coastal waters in southwest New Brunswick, and to identify persistent sources of contamination for future remedial activities. The sampling activities undertaken for this project specifically targeted rainfall events to improve understanding of local coastal contamination.

In Nova Scotia, ACAP Cape Breton studied the negative impacts of coastal and stream erosion in and around the Bras d'Or Lakes Biosphere Reserve. They also highlighted to landowners the importance of increasing buffer zones between developed land and the coast to reduce biodiversity loss, improve water quality and raise awareness of the impacts of climate change on the coastal environment.

Other Atlantic Ecosystem Initiatives project activities included development of riparian best management practices and integrated watershed management plans in two communities, bio-diversification in a tidal marsh, a wetlands survey, and an investigation of leachate flow from a local dumpsite.

1.3.2 Other partnership-based ecosystem approaches and activities

1.3.2.1 Pacific and Yukon Region

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 Regional Director General's 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 provided to the Board to study the economic benefits of the remaining natural reach of the Okanagan River, which, among many benefits, hosts vital habitat for salmon and other fish, and contributes to downstream water quality.

The regional office continued to support planning for the 2014 Salish Sea Ecosystem Conference through the Fraser Basin Council, a charitable non-profit organization devoted to advancing sustainability in the Fraser Basin and across British Columbia.

The regional office supported the process of sunseting the Burrard Inlet Environmental Action Program and the Fraser River Estuary Management Program, which had brought 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. The partners had concluded that other mechanisms had emerged to ensure the continued effective management of environmental issues in these areas.

1.3.2.2 Memorandum of Understanding on Environmental Cooperation in Atlantic Canada

The Memorandum of Understanding (MOU) on Environmental Cooperation in Atlantic Canada (signed in 2008) is a 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 Associate Regional Director General of Environment Canada's Atlantic and Quebec Regions 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, and has been instrumental in fostering stronger federal-provincial relations in Atlantic Canada. Under the MOU, 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.

Efforts in 2012–2013 focused on advancing priorities under the MOU's Water Annex Work Plan, and included:

- Increasing communication and coordination between existing hydrometric and water quality monitoring networks through a Federal-Provincial Water Monitoring Working Group;
- Establishing a Federal-Provincial Emerging Issues Task Team to undertake research to identify potential new and emerging federal-provincial water priorities in the region (e.g., blue green algae in lakes, climate change impacts); and
- Continuing work with New Brunswick and Prince Edward Island on community funding optimization activities related to water through Environment Canada's EcoAction Funding Program.

The MOU is up for renewal in June 2013. A commitment has been made by Environment Canada to continue cooperation with the Atlantic provinces either under a renewed agreement or through other collaborative arrangements.

1.3.3 Action Plan for Clean Water

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

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.

In August 2012, all remedial actions were completed for the Peninsula Harbour AOC, including the implementation of the sediment management plan—a thin layer cap—to manage sediment contaminated with mercury and PCBs. This successful \$7-million project, led by Environment Canada in cooperation with the province of Ontario, was the first of its kind to be completed in the Canadian Great Lakes. The project involved the placement of 15 to 20 cm of clean sand on top of the area of highest sediment contamination. The thin layer cap creates a clean fish habitat, stops the spread of contaminated sediment and reduces risk to fish, fish-eating birds, mammals and people.

Research and Monitoring

In 2012–2013, a number of research activities were achieved to measure the status and trends of priority pollutants in sediment in several AOCs. This work is an important contribution to restoring the "Degradation of Benthos" beneficial use impairment, and eventual AOC designation delisting, and the tracking of restoration progress. Key activities included sediment characterization in the Spanish Harbour and Thunder Bay AOCs, and continued monitoring of sediment quality in the St. Lawrence River AOC to assess trends in recovery of benthic conditions along the Cornwall waterfront. Field studies were also undertaken in the Peninsula Harbour AOC to assess any physical disturbance of sediments used as capping materials, and in the St. Mary's River AOC to determine the chemical quality and stability of new sediment being deposited.

Lake Simcoe/south-eastern Georgian Bay

Following the completion of the Lake Simcoe Clean-up Fund in March 2012, the Government of Canada announced in Budget 2012 \$29 million in funding to establish a renewed and expanded Lake Simcoe/South-eastern Georgian Bay Clean-up Fund for 2012–2017. The geographic scope of the initiative will expand beyond the Lake Simcoe drainage basin, to include the adjacent drainage basins emptying into south-eastern Georgian Bay, including the watersheds and bays of Nottawasaga Valley, Severn Sound, and the targeted coastal regions west of Highway 400/69, north of Port Severn to the French River. The extension and expansion of the program will reduce phosphorus inputs into Lake Simcoe and south-eastern Georgian Bay, improve water quality, and conserve critical aquatic habitat and associated species in these waters.

Efforts in 2012–2013 included the development of a comprehensive science plan that addresses a number of gaps identified in a synthesis of existing science in Georgian Bay. Eight projects were designed, covering sediment characterization, nutrient source tracking, surface water quality and associated harmful algal blooms, groundwater quality and its role in nutrient loading, as well as some hydrodynamic modelling.

As well, fieldwork was completed for two ongoing groundwater projects in the Nottawasaga River watershed. The first project is an investigation of nitrate sources and cycling in the Lake Algonquin Sand Aquifer. The second project is focused on identifying the sources of high groundwater sulfate concentrations at the same site.

The Lake Winnipeg Basin Initiative

In August 2012, Phase II of the Lake Winnipeg Basin Initiative (LWBI) was launched with a five-year (2012–2017), \$18-million investment through the Action Plan for Clean Water that will focus on improving water quality in the region. The renewal of the Stewardship, Science, and Transboundary Partnerships pillars of the LWBI builds on the five-year (2007–2012) \$18-million investment of Phase I of the initiative.

Phase II of the LWBI increases focus on community stewardship actions that measurably reduce

nutrients and improve Lake Winnipeg's water quality, while continuing a strong foundation of science and environmental monitoring. Science efforts during Phase II focus on watershed and in-lake research and monitoring to help further target and measure actions on the land to improve water quality in the lake.

Some key highlights from 2012–2013 include:

- Implementation of 13 new research and monitoring projects in Lake Winnipeg and its watershed;
- Transfer of the Lake Winnipeg Basin Water Analysis Simulation Program to Manitoba Conservation and Water Stewardship;
- Continued work with Manitoba to evaluate priority performance indicators that will measure changes in the lake; and
- Work to finalize a framework for establishing nutrient objectives.

The LWBI continues to provide annual funding support to the Lake Winnipeg Research Consortium, which operates the MV Namao vessel, the only research and monitoring platform operating on Lake Winnipeg.

The Government of Canada also continues to provide support for community-based projects through the Lake Winnipeg Basin Stewardship Fund with an increased funding envelope for Phase II. Funding for Round 6 of the Lake Winnipeg Basin Stewardship Fund was initiated in 2012–2013.

Since its inception, the Stewardship Fund has provided over \$2.4 million in federal funding for 41 projects throughout the watershed. For every dollar provided by the fund, approximately \$2.25 in additional partner funds and in-kind contributions were generated. Examples of funded stewardship projects include wetland restoration, riparian zone improvements, benefit management practices on agricultural lands and research projects investigating innovative nutrient management processes.

The third pillar of the LWBI emphasizes collaborative work with other governments (provincial, state, federal) and organizations within the Lake Winnipeg transboundary watershed. Domestic and international water management boards play a key role in managing nutrients in

the Lake Winnipeg Basin. Environment Canada participates on a number of water science and water management boards to facilitate coordination of efforts across the watershed and to help address nutrient loading originating from outside of Manitoba's jurisdiction.

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. A science subsidiary arrangement was finalized under the MOU, and will assist to coordinate federal-provincial scientific monitoring and research.

Research and monitoring activities during 2012–2013 focused on the identification of the sources and impacts of nutrient loadings to Lake Winnipeg. Work has started in a number of areas, including monitoring core transboundary sites and related main rivers; assessing nutrient sources and transport in runoff from agricultural fields specifically; snowmelt and rainfall runoff; seasonal variability in stream-water nutrients; nutrient production associated with human activities; fate and effect of nutrients; groundwater impact on streamflow; model development; nutrient fluxes; nutrient retention; bloom conditions; and on the bioavailability of nutrient inputs.

Health of the Oceans Initiatives

In 2012–2013, the Health of the Oceans Initiatives (HOTO) received a one-year renewal. As part of its involvement in HOTO, Environment Canada received \$400,000 to support continued 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 Environment Canada's Atlantic and Quebec Regional Director General's Office, provided 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 to allow for sustainable resource use by existing and future generations. In 2012–2013, HOTO provided support to the GOMC for activities associated with the GOMC's Gulfwatch chemical contaminants monitoring program, the Ecosystem Indicator Partnership (ESIP) (a committee of the GOMC) and the State of the Gulf Report.

Support for Gulfwatch included a review of the existing program and identification of new and emerging contaminants (which represent a potential threat to the long-term health of the Gulf of Maine) for consideration as part of an expanded program. ESIP continued its work in the identification and development of ecosystem indicators to monitor and track ecosystem health within the Gulf of Maine, and particularly its indicators on tracking contaminants. Support of ESIP also enabled an assessment of interdependencies between existing indicators (with contaminants as a focus), and recommendations for future indicators for more effectively measuring interdependencies. Funding for the GOMC's State of the Gulf Report supported development of a theme paper focused on the state of land use and coastal development. HOTO funding also enabled a preliminary assessment of the value of natural capital and ecosystem goods and services in the Bay of Fundy (Canadian portion of the Gulf of Maine).

2 Water research

Environment Canada water scientists conduct an array of research across Canada. Much of the research work is described in the previous sections. This section describes additional research activities not included earlier in the report.

2.1 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 initiated in 2009, 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). A Science Forum was held in May 2012 in Abbotsford, B.C., to present research results achieved to date and discuss potential applications to agricultural management practices. Environment Canada provided an update on groundwater quality conditions in the transboundary Abbotsford–Sumas aquifer at this Forum. Presentations and other information from this Forum are available online (www.ucalgary.ca/ryan/node/34).

Other research undertaken during 2012–2013 on agriculture can be found within the Ecosystems Initiatives section (see section 1.3.1).

2.2 Oil sands monitoring

On February 3, 2012, the Government of Canada and Government of Alberta announced the Joint Canada–Alberta Implementation Plan for Oil Sands Monitoring. Implementation will enhance the monitoring of water, air, land and biodiversity by sampling more sites for more substances more frequently. It will provide an improved understanding of the long-term cumulative effects of oil sands development.

Implementation is well underway, with full implementation expected by the end of fiscal year 2014–2015. By the time the three-year plan is reviewed by experts in 2015, the number of sampling sites will be higher and over a larger area; the number and types of parameters being sampled will increase; the frequency (how many times) that sampling occurs each year will be significantly increased; the methodologies for monitoring for both air and water will be improved; and an integrated, open data management program will be created.

Governments committed that data will be made publicly available to allow independent scientific assessments and evaluations. As a result, Environment Canada's Minister Kent and Alberta Minister of Environment and Sustainable Resource Development Diana McQueen launched the Canada–Alberta Oil Sands Environmental Monitoring Information Portal. The Portal (www.jointoilsandsmonitoring.ca/pages/home.aspx?lang=en) provides access to information related to the Joint Canada–Alberta Implementation Plan for Oil Sands

Monitoring, including maps of the monitoring region, details of the monitoring sites, the most up-to-date data collected by scientists in the field, and scientific analysis and interpretation of the data and results.

2.3 Northern Canada

In 2012–2013, Environment Canada undertook a number of activities to quantify and predict local/regional and national sensitivities of aquatic ecosystems to climate variability and change, including:

- Developing a freshwater biodiversity monitoring plan for the Circumpolar Biodiversity Monitoring Program (Arctic Council);
- A study to identify the effects of permafrost thaw on tundra lakes, particularly the effects of shoreline retrogressive slumping producing a shift in tundra lake nutrient, light and phytoplankton relationships;
- Two projects focused on quantifying and predicting vulnerability and sensitivity of high-latitude and -altitude cryospheric systems to climate variability and change—one focused on quantifying northern-hemisphere freshwater ice and the other looked at ecological and hydro-climatic impacts of river ice jams;
- Continued research related to extreme hydrologic events focused on changes in peak runoff events to the Arctic Ocean and on understanding and defining stream flow and water chemistry regimes in the subarctic Canadian Shield, with a focus on the Baker Creek Research Catchment, in order to define subarctic Canadian Shield stream flow and water chemistry regimes in support of responsible northern resource development;
- Publication of two scientific journal articles on various aspects of extreme hydro-climatic events affecting Canadian water resources—one on Canadian Prairie drought occurrence over three distinct time periods and the other on North American Great Plains hydro-climatic extremes with a focus on droughts; and
- Hydro-climatic analysis and impact studies in western and northern Canada continued, focusing on the impact of climate variation on water availability, hydrologic and aquatic ecosystems.

2.4 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 2012–2013, Environment Canada, in collaboration with the Global Water Institute, completed their involvement in hydro-meteorological model development programs, including finalizing an Improved Processes and Parameterization for Prediction in Cold Regions program and the Drought Research Initiative. Work focused on land-surface hydrological prediction systems and Environment Canada operational modelling platforms.

Environment Canada also invested in further development and automation of the Green Kenue application, a pre- and post-processing application for hydrologic modellers. This year's enhancements enable users to import, visualize and analyze meteorological forecast and analysis information published on the Canadian Meteorological Centre's datamart (<http://weather.gc.ca/grib>).

Throughout 2012–2013, Environment Canada contributed internationally through its leadership as the Canadian hydrological advisor to the World Meteorological Organization's Committee on Hydrology (CHy). This entails providing input and advice to the CHy on all matters related to hydrometric monitoring and hydro-meteorology. Specifically, the Department contributed expertise toward the development of techniques for uncertainty analysis in hydrometric measurements and on basic systems. The Department continues to co-lead, with the Russian Federation, the Arctic Hydrological Cycle Observing System initiative, which focuses on stream-flow assessment in the Arctic Ocean.

Great Lakes

In 2012–2013, Environment Canada continued to improve methods for coupled hydro-meteorological

modelling and prediction under an expanded environmental prediction framework. The model enables an improved understanding of interactions between the atmosphere and land surface, and supports improved water management using the Modélisation environnementale de surface et hydrologie (MESH) system and the international Hydrologic Ensemble Prediction Experiment. Partnering with the U.S. Army Corps of Engineers, Environment Canada operationalized the MESH modelling system for historical analysis of the water balance in the upper Great Lakes. Products developed in this modelling system are being analyzed and used to assist in understanding recent changes and low-water levels in the Great Lakes.

Prairies

Ongoing studies have focused on improved understanding of water availability in Canada through the development of new methods for modelling the hydrological cycle at a variety of scales, from small basins to large rivers. Research continued on developing models for large-scale simulation of the Saskatchewan River Basin with the Global Institute for Water Security at the University of Saskatchewan. Initiatives focused on lateral flow of water through prairie landscapes including dealing with no-contributing area, frozen soils and blowing snow.

St. Lawrence River

The environmental predictions working group was activated in 2012–2013. The main activities of the group are modelling and assimilation of surface data covering the watersheds of St. Lawrence River tributaries; hydrological modelling and routing of waters entering via the watersheds of St. Lawrence tributaries; 2D hydrodynamic modelling of the St. Lawrence River, Lac des Deux-Montagnes, Rivière des Mille-Îles, Rivière des Prairies and the Sainte-Anne and Vaudreuil channels, modelling of the dynamics of the major St. Lawrence River ecosystems and modelling of ocean ice in the St. Lawrence Estuary and the Gulf of St. Lawrence. These activities are done through the collaboration of federal and provincial partners under the St. Lawrence Action Plan, and they support the main priorities of the plan (biodiversity and water quality and uses).

The hydrodynamic model of the St. Lawrence River between the Port of Montréal and Trois-Rivières was successfully migrated to operations in experimental mode at the Canadian Meteorological Centre in 2012–2013. Though currently operating in “experimental mode,” the models are in fact operational and produce one simulation per day (nowcasting). The products from these models are available online (<http://collaboration.cmc.ec.gc.ca/cmc/cmoi/SHOP>) and will eventually be published on Environment Canada’s Wateroffice website.

Other activities

Environment Canada has been involved with numerous other partners in the development of the plan of study for the Lake Champlain/Richelieu River watershed that was submitted to the International Joint Commission in early 2013.

Environment Canada has provided support to the International Joint Commission for the development of hydrodynamic and ecohydraulic models in the Namakan/Rainy Lakes Basin.

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.

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.

Environment Canada's Water website was visited 480 678 times in 2012–2013, an average of 1316 times per day.

www.ec.gc.ca

Additional information can be obtained at:

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