CANADA WATER ACT

ANNUAL REPORT TO PARLIAMENT FOR APRIL 2018 TO MARCH 2019

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1. INTRODUCTION

The *Canada Water Act* (CWA) administered by the Minister of Environment and Climate Change (ECCC) enables a framework for collaboration among federal, provincial and territorial governments in matters relating to water resources. Each level of government has a different role related to the management of water resources. Joint projects involve the regulation, apportionment, monitoring or surveying of water resources, and the planning and implementation of programs relating to the conservation, development and utilization of water resources. As well, there are many areas of shared responsibility.

Section 38 of the Act requires that a report on operations under the Act be laid before Parliament as soon as possible after the end of each fiscal year. This annual report covers progress on these activities from April 1, 2018, to March 31, 2019.

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

- Part I provides for the establishment of federal-provincial/territorial arrangements for the establishment of intergovernmental committees or other bodies in relation to water resource management. It also provides the vehicle for cooperative agreements with the provinces and territories to develop and implement comprehensive water resource management programs. Finally, Part 1 enables the Minister, either directly or in cooperation with any provincial/territorial government, institution or person, to conduct research, collect data and establish inventories associated with water resources.
- Part II provides authority for the establishment of federal-provincial/territorial management agreements where water quality has become a matter of urgent national concern. It also allows the Minister to name an existing corporation that is an agent of Her Majesty or that performs a function or duty on the federal government's behalf 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, is now part of the *Canadian Environmental Protection Act, 1999*.
- 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.

This report describes a wide range of federal operations conducted under the authority of the Act, including participation in federal-provincial/territorial agreements and arrangements, significant water monitoring and research, and public information programs. It also includes work done under the Act to safeguard the water quality and quantity of Canada's watersheds.

Canadian provinces and territories have significant responsibility over areas of water management and protection within their borders, including water allocation and use, drinking water and wastewater services, source water protection, and thermal and hydroelectric power development. Most of these governments delegate some authority to municipalities, in particular drinking water treatment and distribution, and wastewater treatment operations in urban areas. In certain cases, local authorities responsible for a particular area or river basin take on some water-resource management functions when requested by government.

The federal government has strong pollution prevention authorities and is responsible for managing water on federal lands (e.g. national parks), Indigenous lands, in federal facilities (e.g. office buildings, laboratories, penitentiaries, military bases) and in Nunavut. The federal government also has jurisdiction to make laws in relation to fisheries and navigation, both of which play a role in water management.

Formal bilateral hydrometric agreements between most provincial/territorial governments and the federal government provide for the collection, analysis, interpretation and dissemination of water quantity data. These agreements have been administered cooperatively since 1975 and, with the exception of Newfoundland and Labrador, New Brunswick, and Saskatchewan have been renewed since 2008.

CWA agreements that were ongoing during 2018-2019 included the following.

- Hydrometric agreements with nine provinces, Yukon and Northwest Territories, and with Crown-Indigenous Relations and Northern Affairs Canada for Nunavut
- *Master Agreement on Apportionment in the Prairie Provinces (Prairie Provinces Water Board)*
- Water quality monitoring agreements with British Columbia, Newfoundland and Labrador, New Brunswick, Manitoba, and Quebec
- *Canada-Prince Edward Island Memorandum of Agreement on Water*
- *Agreement Respecting Ottawa River Basin Regulation*

Arrangements and agreements related to water management, intergovernmental cooperation or programs:

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

Agreements for specific water programs require participating governments to specify the amount of funding each will pay and the information and expertise they will provide, in agreed ratios. For ongoing activities such as the hydrometric monitoring agreements with each provincial and territorial government, 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 or territorial government each assumes half of the costs. The planning studies encompass interprovincial, international or other water basins where federal interests are important. Cost-sharing for infrastructure often includes a contribution from local governments.

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

- monitoring
- research
- inter-jurisdictional water boards
- ecosystem-based approaches to water quality management

2. MONITORING

2.1 Water quantity monitoring

The National Hydrometric Program (NHP), a cooperative endeavour between federal, provincial and territorial governments, is responsible for providing critical hydrometric data, information, and knowledge that Canadians and their institutions need to make informed water management decisions to protect and provide stewardship of fresh water in Canada. These data are available on Environment and Climate Change Canada's (ECCC) Wateroffice website. The Water Survey of Canada, which is part of ECCC's National Hydrological Service (NHS), is the federal partner and primary operator of the NHP network in Canada.

The NHP is co-managed by the National Administrators Table (NAT) and the NHP Coordinators' Committee, both consisting of members responsible for the administration of hydrometric monitoring agreements in each province or territory and one national administrator designated by Canada. Both groups met regularly throughout 2018-2019 to discuss program issues. Regular input from both groups and an annual survey by NAT provide valuable input on program operations, documentation and dissemination practices, and available training resources for the NHP.

In Budget 2018, the Government of Canada committed $89.7 million in new investments over five years to revitalize and modernize the hydrometric program. The funding will focus on four main areas that address deteriorating infrastructure, increase engineering and technical capacity to deal with Boundary Waters Treaty obligations and other transboundary requirements, contribute to technological advancement and innovation, and development of predictive capabilities.

2.1.1 National hydrometric monitoring network

During 2018-2019, the national hydrometric monitoring network of the NHP in Canada consisted of 2,826 hydrometric monitoring stations (see Figure 1 and Table 1). During this period, ECCC operated 2,191 of these hydrometric stations. Of the ECCC-operated stations, 1,134 were fully or partially federally funded. The remaining stations were operated by ECCC on behalf of provincial and territorial governments or a third-party interest, and cost-sharing was based on specific needs and requirements (see Table 1). In Quebec, the Ministry of Sustainable Development, Environment and the Fight against Climate Change operated 227 stations, some funded in whole or in part by the Government of Canada.

In 2018-2019, more than 40 of the 336 cableways have been addressed either by repairing, repurposing or replacing the cableways through this new investment. Several cableways have been replaced with alternative technologies. In addition to the cableways, there are 480 known stations across Canada that have creosote stilling wells and require decommissioning. In 2018-2019, 40 of the 480 stations with creosote stilling well sites were decommissioned. Environmental checklists and best management practices have been prepared to ensure environmental compliance with all construction and decommissioning projects.

Figure 1. National Hydrometric Monitoring Network

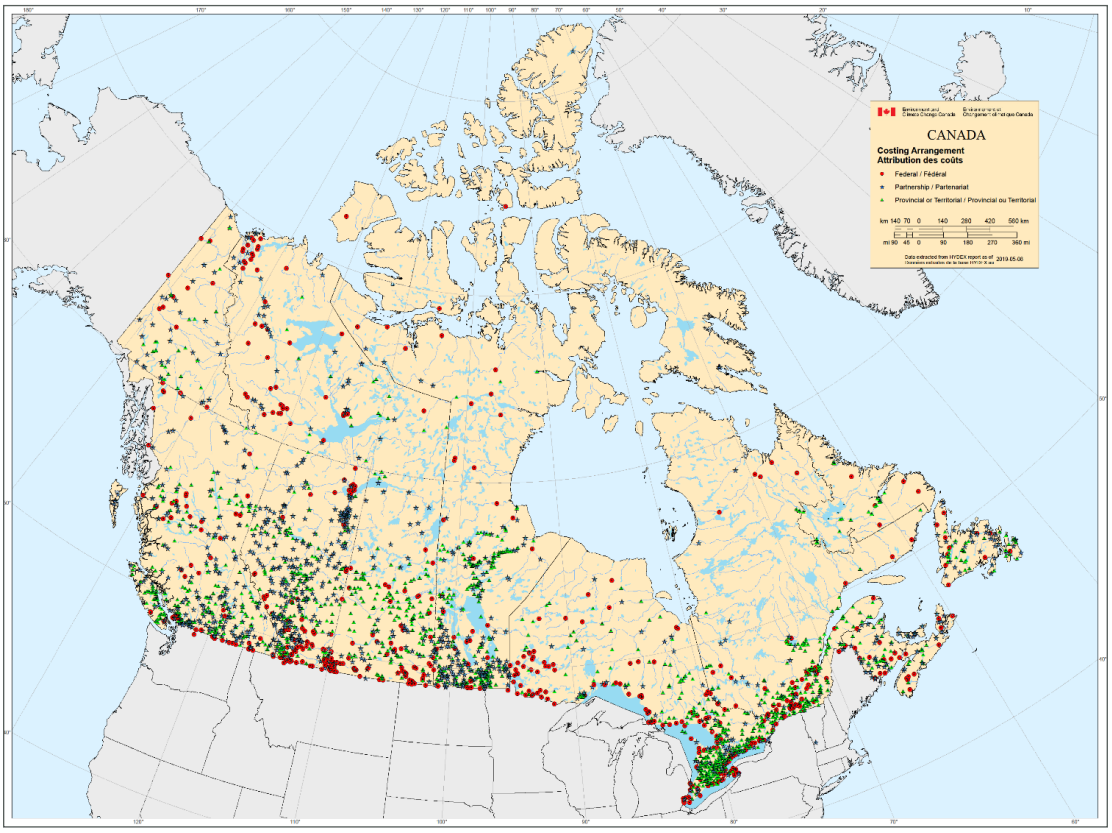


Table 1. Stations within the National Hydrometric Monitoring Network

Province/ Territory[a]	ECCC-operated (by cost arrangement)				Non-ECCC-operated (various cost arrangements)	Total by province or territory
	Federal	Cost-shared[b]	Province/ Territory	Third party		
Alberta	76	158	160	34	54	**482**
British Columbia	47	181	206	0	7	**441**
Manitoba	22	82	111	2	175	**392**
New Brunswick	17	17	18	0	0	**52**
Newfoundland	16	32	66	0	0	**114**
Nova Scotia	11	6	13	0	0	**30**
Northwest Territories	46	23	20	13	0	**102**
Nunavut	8	2	13	2	0	**25**
Ontario	126	68	338	10	46	**588**
Prince Edward Island	0	5	1	3	0	**9**
Quebec	16	0	0	0	227	**243**
Saskatchewan	90	50	13	0	126	**279**
Yukon	11	24	34	0	0	**69**
Total	**486**	**648**	**993**	**64**	**635**	**2 826**

[a] Hydrometric monitoring stations located within the boundaries of each province, no matter which office operates them.

[b] Cost-shared stations are those that are partially funded by the federal government, provincial/territorial governments, and third parties. The cost-share ratio varies by station.

Note: The network also includes a small number of designated International Gauging Stations located in the United States that are not included here as they support International Joint Commission activities not covered under the CWA.

There were no significant changes to the size of the national hydrometric monitoring network in 2018-2019, although the network did undergo a number of adjustments, including the following:

Yukon (69 stations)

- Two stations had their operating period increased to year-round upon the agreement of both parties.
- Yukon-based Water Survey staff operated nine gauges in northern British Columbia for operational efficiencies as part of the British Columbia Hydrometric Agreement.
- Kluane Lake continues to experience significantly lower peak water levels because of a 2016 river piracy event, where the Slims River, which drains into Kluane Lake, had its flow diverted as a result of the retreat of the Kaskawulsh Glacier. Opportunistic measurements were collected at the outlet of the lake on the Kluane River as the hydrometric gauge had been discontinued as part of program review in the mid nineties. Both the Yukon government and Water Survey of Canada have agreed to reinstate the Kluane River gauge in 2019-2020 and cost-share the operating expenses.

Northwest Territories (102 stations)

- One new station was added to the NWT network - Camsell River above Lac St. Croix.
- Remote cameras were or are scheduled to be installed at 17 remote stations.
- Tipping bucket precipitation gauges were or are scheduled to be installed at 11 remote stations.
- One water temperature probe was installed at the Camsell River site.
- NWT Water Survey staff operated stations in northeastern British Columbia (Petitot River) and Northeastern Alberta (several stations within the Peace-Athabasca Delta) for operational efficiencies.

Nunavut (25 stations)

- Twenty-four hydrometric stations were operated within Nunavut by ECCC in accordance with the established cost-share agreement.
- Plans for network expansion in Nunavut were discussed by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and the Water Survey of Canada, with potential expansion occurring in 3 to 5 years.
- Operational funds are apportioned in accordance with a specific cost-share arrangement between ECCC, CIRNAC, Parks Canada Agency and the City of Iqaluit.

British Columbia (441 stations)

- Five stations were added to the network:
  - Douglas Lake at Spaxomin
  - Nicola River at the outlet of Douglas Lake
  - Nordic Creek at the outlet of Nordic Glacier
  - Revelstoke Reservoir at Martha Creek
  - Nechako Reservoir at Skins Lake Spillway
- Three stations were discontinued:
  - Guichon Creek at the mouth
  - Ksedin Tributary No. 2 Creek near New Aiyansh
  - Nicola River above Nicola Lake
- Three hundred ninety-four stations reported in real time.
- Six automated remote cameras were installed at hydrometric stations to report daily images of stream conditions.

Alberta (482 stations)

- Water Survey of Canada North office was opened in Edmonton on March 1, 2019, in an effort to consolidate northern operations. The transition over the next few years will result in two equal-sized offices in Calgary and Edmonton.
- Three gauging stations were upgraded and added to the Oil Sands Monitoring network. Land use dispositions were obtained from the province of Alberta to allow for construction of infrastructure on public lands.
- Operational efficiencies were gained through the installation of submersible pressure transducers at unpowered well stations.
- Shelters were upgraded to a more efficient style to address safety concerns.
- Procurement of hydroacoustic instrumentation enabled the increased usage of remotely controlled boats to attain high water measurements from sites including those with cableways that are not functional.

- Operations continued to be suspended at 88 of 91 manned cableways in Alberta, leaving only functional sites at:
  - North Saskatchewan River at Whirlpool Point
  - St. Mary River at International Boundary
  - Berland River near the Mouth
- Bank-operated cableways were installed at 3 additional locations:
  - Western Irrigation District Canal near Headgates
  - Threehills Creek near Carbon
  - Milk River at Western Crossing of International Boundary.
- In conjunction with the City of Calgary, the Elbow River at Sarcee Bridge gauge was engineered and rebuilt to a high level of resiliency to enable data collection during extreme high-water events.
- Various levels of decontamination measures continued to be taken at all stations in the province to deal with whirling disease[1].

Saskatchewan (279 stations)

- Generally, normal spring flows were observed, with dry to very dry conditions for the remainder of the year.
- A large decommission project to remove older infrastructure at active and inactive sites began. Three sites were relocated to tilting mast set-ups.
- Investments made in technology, expanded capacity through use of radio-controlled measurement platforms, electronic field notes, and site cameras.

Manitoba (392 stations)

- Spring flows were normal to above normal but then quickly moved into dry to very dry conditions for much of the summer. Fall brought normal to above normal precipitation bringing water levels generally into their normal ranges.
- The Red River Floodway was not operated in 2018.
- A large decommission project to remove older infrastructure at active and inactive sites began.
- Three gauges were relocated to improve safety, record quality, and operational efficiencies.
  - Red River near Ste. Agathe
  - Red River at Emerson
  - Fisher River North of Dallas
- Investments were made in technology and capacity was expanded through radio-controlled measurement platforms, electronic field notes, site cameras, and backup internet based data collection.

Ontario (588 stations)

- There were few extreme hydrologic events, with notable high water in the lower Thames and in southwestern Ontario highlighting the need for redundant telemetry technologies.
- A set of seven stations in the Turkey Lakes study area near Sault Ste. Marie (centered on Norberg Creek) was discontinued.
- A gauging station on the Magpie River previously operated for the Department of Fisheries and Oceans was discontinued.
- New stations were added in three locations:
  - The Ottawa River Main Channel below Chaudière Dam used to monitor water levels below a public roadway bridge owned by Public Service Procurement Canada. This gauge proved valuable during the historic highwater of spring 2019, when the bridge was closed to traffic due to safety concerns.

[1] Whirling disease is an infectious disease of finfish. The causal agent of whirling disease is not a risk to human health.

- Larches Creek near Elmira, as part of a 10 gauge locations study concerning small watersheds and nutrient loading in southern Ontario, referred to as the Southern Ontario Multi-Watershed Nutrient study (SOMW).
- Montreal River at Latchford was installed to monitor water level and discharge.

o Operations at the 10 gauge stations that were part of the SOMW were suspended for several months in midyear while priorities were reviewed provincially.

o A significant effort was conducted by the provincial partnership to analyze the full scope of hydrometric network utilization by various provincial authorities.

o Infrastructure activities ranged from station and cableway decommissioning to control structure improvements and gauge house replacements.

Quebec (243 stations)

o In Quebec, 227 stations are run by the provincial government and data are provided to the NHP database. An additional 16 stations are run by ECCC in Quebec to address federal data requirements.

Atlantic region (205 stations)

o No major changes to the network in New Brunswick or Nova Scotia.

o One provincial station was closed in Newfoundland and Labrador.

2.1.2 Technology development

Hydrometric instrumentation and data collection

The NHP continued investment in new field technologies, including hydroacoustic equipment and advanced deployment platforms, such as bank-operated cableway systems and remote control boats, as manned cableways across the country are being decommissioned.

There were also new investments in the use of site cameras for monitoring site conditions, including the ice effected period. The NHP now operates more than 30 satellite cameras (and a handful of cell modem cameras) at remote stations, typically transmitting one image a day, along with more than 200 time-lapse cameras, from which images are downloaded periodically at the time of a field visit.

The use of electronic Hydrometric Survey Notes (eHSN) to document and upload field visit information and data has become routine; the percentage of eHSN uploads increased from 26% of all field visits uploaded in 2017 to 59% in 2018. The eHSN provides greater quality assurance and consistency of hydrometric information and data.

The NHP is also exploring the possibility of using non-contact technology, such as radars and cameras, for improved water level and flow monitoring, particularly in challenging (high water) conditions, or where the accuracy and timeliness of flow data are critical. The exploration of innovations in hydrometric monitoring is a component of the investment in the NHP. It will accelerate efforts to explore and adapt innovations in hydrometric monitoring, hydrology and hydraulics both in the field and in the office. In 2018-2019, the focus of the innovation component was mainly on the development of project proposals and securing the equipment to test new field technologies such as: large-scale particle velocimetry (LSPIV), radar, drones, dilution gauging and discharge apps.

Surface Water from Space Project

ECCC continued collaboration on the development of space-based monitoring technologies for hydrological monitoring in Canada with the Canadian Space Agency (CSA), the National Aeronautics and Space Administration (NASA), the University of Sherbrooke, the University of California, Los Angeles and other organizations in the United States. Work focused on the Surface Water Ocean Topography (SWOT) hydrology mission, scheduled for launch by NASA in 2021. ECCC continued hydraulic model development in the Peace-Athabasca Delta, as part of the overall strategy in the hydrology plan. Synthetic SWOT images were developed as an operational product for the St. Lawrence River and data assimilation techniques using SWOT in operational models are being looked at. ECCC also presented a plenary at the Canadian Remote Sensing Symposium and continued working with the international SWOT team on satellite calibration and validation issues.

In 2018-2019, ECCC continued to be heavily involved with the University of Saskatchewan, University of Waterloo, Wilfrid Laurier University and McMaster University through the Global Water Futures Program. This program explores ways to improve hydrometric program delivery through innovative technology such as drones and cameras. This year, NHS working in collaboration with ECCC's Water Science and Technology Directorate and the University of Saskatchewan, completed development of a new facility, which is designed to develop and test new water sensors and drones for improved monitoring of Canadian water resources.

Data dissemination

After-hour support was provided during the 2018 spring freshet to ensure real-time hydrometric data were available 24/7 during high water periods.

Beginning in July 2018, NHS disseminated real-time images for some stations via the Wateroffice. This enables provincial and territorial partners to view the site situation online for stations that have a real-time camera installed.

The offline historical databases were released four times over the year in April 2018, July 2018, October 2018, and January 2019.

2.1.3 Program development

Quality assurance

In December 2018, a routine surveillance audit was conducted against the Meteorological Service Canada (MSC) Quality Management System (QMS) under the International Organization for Standardization's ISO 9001:2015 standard, following a series of external audits including two hydrometric offices in New Brunswick and Newfoundland. No major non conformances were identified at either location. This follows the recertification of the MSC's QMS to the ISO 9001:2015 standard, which is valid for a three-year period.

Updating of the Water Survey of Canada's Standard Operating Procedures (SOPs) continued in 2018-2019, in an effort to keep pace with changes in technology in the operational program. This year, work focused on developing new Data Correction and Data Estimation SOPs for the data production process.

Improvements to the quality of real-time data have been developed through the Continuous Data Production Project. Three hydrometric offices piloted the new procedures in 2018-2019, with targeted implementation across Canada by 2021. This innovative approach is also a component of the investment in the NHP.

Hydrometric science and development

Collaboration on hydrology modelling to improve the ability of the NHS to predict flows as part of its federal water management obligations continued. ECCC also continued collaborations with university colleagues in Quebec (L'Institut national de la recherche scientifique) in operationalizing hydrodynamic and ecohydraulic models in rivers of federal significance. The prediction component of the hydrometric investments involves developing the capacity to predict water quantity in five of Canada's major water basins: the Great Lakes-St. Lawrence River Basin, the Saskatchewan-Nelson River Basin, the Mackenzie River Basin, the Columbia River Basin, and the Churchill River Basin. The NHS will work in partnership with provinces and territories to develop new flow predictions systems. As an initial step in this effort, the NHS hosted a national workshop on flow forecasting, in which federal, provincial and territorial representatives gathered together with industry and academic experts to discuss development of state-of-the-art flow forecasting systems.

ECCC, in cooperation with the University of Manitoba, University of Victoria, and InnoTech Alberta, continued to support a national pilot project for an operational isotope network, in conjunction with the hydrometric network, which is similar to the existing isotope-hydrometric network in the United States. The goal is to demonstrate the value of systematic collection of river discharge, in tandem with analysis for oxygen-18 (^{18}O) and deuterium (^{2}H) across Canada, since the stable isotope ratios can be used to improve understanding of water sources. ECCC also supported a project with the University of Ottawa investigating the use of remote sensing for characterization of ice conditions.

Outreach

NHS supports openness and interoperability of information and data access across various systems. In September 2018, NHS working with ECCC's Geospatial Web Service team completed its project to make historical hydrometric data available in Open Geospatial Consortium compliant standards. Historical hydrometric data is now available via the Meteorological Service of Canada's GeoMet Geospatial web services.

2.1.4 Hydrometeorological modelling and studies

For several years, researchers and scientists at ECCC 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 hydrometeorological modelling can help improve water resources management.

Great Lakes

ECCC collaborated with the U.S. Army Corps of Engineers, the National Oceanographic and Atmospheric Administration (NOAA), and the U.S. Geological Survey to operationalize various modelling systems for historical analysis of the water balance in the upper Great Lakes. In 2018-2019, ECCC continued to improve methods for coupled hydrometeorological 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 in the region. After years of development by NOAA, in consultation with ECCC, a statistical model that determines the most likely values for the water balance components is now run every month using input from ECCC MSC and other Canadian and U.S. agencies. It is expected that this technique will lead to improved coordinated values of the components of the Great Lakes net basin supply, increase our understanding of the hydrological functions and improve forecasting of Great Lakes water levels.

Hydrological and atmospheric modelling experts in ECCC continued to develop models to estimate possible scenarios of river flow through ensemble flow forecasting. The operational forecast model is being shared with provincial flood forecasting agencies and initial testing of the model in the Great Lakes continues as researchers strive for a 10-day forecast model. A pilot project was continued in 2018-2019 that provides forecasted flows to Water Survey of Canada staff. The forecasted flows are expected to provide advance information for efficient planning of fieldwork to capture important data for high flow events.

Under the Coordinating Committee on Great Lakes Basin Hydraulic and Hydrologic Data, a comprehensive plan to update the International Great Lakes Datum of 1985 (vertical datum) for the Great Lakes-St. Lawrence system was developed and the first year of work completed with the deployment of seasonal gauges by the Canadian Hydrographic Service and U.S. National Oceanic and Atmospheric Administration. This project will take until 2025 to complete.

International rivers

ECCC, in collaboration with U.S. Army Corps of Engineers, Detroit District, worked on an Integrated Ecosystem Response Model for the St. Marys River rapids. The bi-dimensional ecohydraulic model is being used to improve the spawning success of several fish species that use the swift water of the rapids for reproduction. This prototype will be extended to the entire St. Marys River.

ECCC played a lead role in the Lake Champlain-Richelieu River Study, examining the cause of and possible mitigation measures to flooding issues in the Lake Champlain-Richelieu River Basin. Activities in 2018-2019 focused on the development of possible flood mitigation measures, both structural and non-structural, and flood inundation maps for the entire bi-national watershed. Other work included the refinement of a water balance model and net inflow to Lake Champlain, the assembly of a digital elevation model for the Lake Champlain Richelieu River system based on several data sources, flow and ice data collection, and the development of several two-dimensional hydrodynamic simulations of potential flood mitigation solutions.

ECCC also continued to play a lead role in the Souris River Study, examining potential improvements to the operation of several dams in Saskatchewan and North Dakota for both flood control and water supply purposes. The workplan for the Study was finalized in 2018-2019 based on an independent review managed through the International Joint Commission, and feedback received from the public. Data collection tasks were completed and included a summary of projects completed since 2013, updated lidar and bathymetry data for the reservoirs, an analysis of the hydrometeorological data network, and data collected for the development of performance indicators. Work began on developing the computer models being used for the study, and a number of workshops and meetings were held to engage the public, regulatory agencies, and indigenous nations. Dam safety was identified as a major issue that will complicate the management of the reservoirs as well as the development of recommendations for improved operations going forward.

Arctic

ECCC leads the Arctic Hydrological Cycle Observing System (HYCOS) initiative, which focuses on assessing freshwater fluxes into the Arctic Ocean. In 2018-2019, work continued to finalize the public web portal, which will display streamflow and other data for all hydrometric stations in the Arctic-HYCOS network, and allow filtering and downloading of the data according to extended metadata criteria. The first phase of the Arctic-HYCOS Project is almost complete.

Global

ECCC contributed internationally as the Canadian hydrological advisor to the World Meteorological Organization's Commission for Hydrology. This entails providing input and advice to the Commission on all matters related to hydrometric monitoring and hydrometeorology. Specifically, the Department contributed expertise toward the development of techniques for uncertainty analysis in hydrometric measurements and on basic systems.

2.2 Water quality monitoring

2.2.1 Freshwater quality monitoring

Freshwater quality monitoring has been a core ECCC program 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 addition to fulfilling federal domestic and international commitments and legislative obligations. Much of the program's monitoring is carried out through federal-provincial/territorial agreements, ensuring cost-effective and non-duplicative program delivery.

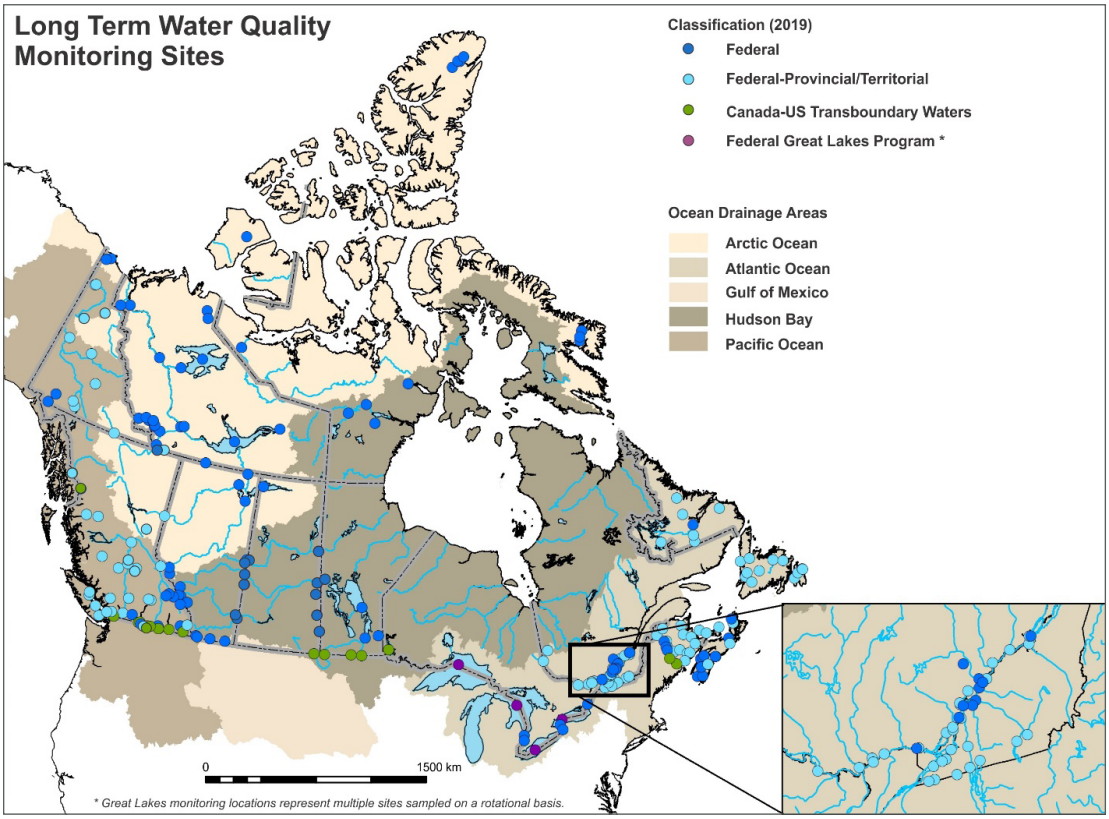
The objectives of the federal-provincial/territorial water quality monitoring agreements are to:

- achieve a long-term commitment for the acquisition of water quality data
- obtain comparable, scientifically sound water quality data that are reliable to inform water resource management
- disseminate water quality information in a timely manner to the public, government agencies, industry and the scientific community

Data are also used to support the freshwater quality indicator in the Canadian Environmental Sustainability Indicators.

The Long-Term Freshwater Quality Monitoring Network consists of federal, federal-provincial and federal-territorial sampling sites across Canada (see Figure 2). Water quality samples are routinely collected 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 National Long-Term Water Quality Monitoring Data are published online.

Figure 2. Long-term water quality monitoring sites



Since 2010, ECCC's Water Quality Monitoring and Surveillance Division has utilized the Risk Based Adaptive Management Framework (RBAMF) to optimize its monitoring activities. The RBAMF is defined through a set of established pillars that guide its various components. These pillars include defining monitoring responsibilities, identifying risks to water quality at monitoring sites and across Canada's drainage basins, optimizing monitoring operations, and ensuring data quality and data access, all of which improves reporting outcomes.

In 2018-2019, existing long-term monitoring sites (Figure 2) were classified under a series of national scale networks, namely Large Rivers, Large Lakes Priority, Transboundary Rivers, Reference, and High Stress where each network included a set of specific national monitoring objectives. Each network was developed to improve comparability of monitoring data, resulting in more effective reporting on water quality issues on a national scale.

ECCC's Freshwater Quality Monitoring Program is aligned with Canada's major watersheds (Arctic/Athabasca, Pacific, Hudson Bay and Atlantic watersheds). This program promotes robust water resource management across Canada.

For more information, please consult the ECCC Freshwater Quality Monitoring website.

Arctic/Athabasca watershed

ECCC monitored 49 sites within the Arctic watershed and across the North: 23 in the Northwest Territories, 14 in Nunavut, 2 in Yukon and 10 in Northern Alberta. The majority of these sites were operated in cooperation with Parks Canada and included eight national parks (Auyittuq, Quttinirpaaq, Ukkusiksalik, Aulavik, Ivvavik, Tuktut Nogait, Nahanni, and Wood Buffalo National Parks). Many of these sites were co-located with ECCC's gauge stations.

Ten stations in Northern Alberta and one in the Northwest Territories are monitored under the Oil Sands Monitoring Program in partnership with Alberta Environment and Parks. The monitoring work done under this plan was designed to track the cumulative effects of oil sands development in air, water, wildlife, and biodiversity to help inform government and industry decision-making processes.

Many of the high Arctic sites are considered relatively pristine and 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. ECCC also operates water quality sites on major rivers in the North, some 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).

Pacific watershed

Monitoring was conducted in the Pacific watershed (which includes parts of British Columbia and Yukon) under the *Canada-British Columbia Water Quality Monitoring Agreement* and under operational schedules agreed with the Yukon Government.

In British Columbia, ECCC conducted joint monitoring with the provincial Ministry of Environment at 41 river sites, including 2 automated stations, and 2 lake sites where 1 was automated. The annual water monitoring activities were negotiated and documented in the *Canada British Columbia Water Quality Monitoring Agreement Business Plan (2018-2019)*.

In Yukon, 13 sites were monitored on rivers in collaboration with Environment Yukon, including one automated site.

The Canada-British Columbia automated monitoring site located in the Fraser River Estuary is a monitoring buoy platform providing real-time water quality, meteorological, and grab-sample data to the public on ECCC's Freshwater Quality Monitoring and Surveillance website. In addition, ECCC in collaboration with the Department of Fisheries and Oceans, the Okanagan First Nation Alliance and the British Columbia Ministry of Environment, deployed two real-time water quality monitoring buoys in Osoyoos Lake in 2018. Data generated from these automated sites were used to identify important trends and emerging water quality issues from urban, agricultural and industrial activities in the lower Fraser and Okanagan Basins.

In 2018-2019, ECCC, in cooperation with Parks Canada, operated five long-term water quality monitoring sites in the Glacier, Yoho, and Kootenay National Parks in British Columbia and Kluane National Park in Yukon. These relatively pristine sites provide important reference information for comparison with sites influenced by human activities. Many of these sites are also located in key areas for assessing climate change.

Hudson Bay watershed

As part of the National Long-Term Freshwater Quality Monitoring Network and in support of the *Prairie Provinces Water Board Master Agreement on Apportionment*, ECCC monitored 12 sites along the main rivers crossing between the Alberta, Saskatchewan, and Manitoba provincial boundaries. This work supported annual reporting on water quality objectives for nutrient, metal, major ion, and pesticide parameters established by Canada, Alberta, Saskatchewan, and Manitoba. The water quality data and information obtained was also used to support the Lake Winnipeg Basin Program. Water quality data are routinely shared with partners and collaborators involved in the Lake Winnipeg Research Consortium, including the Manitoba government, other federal departments, universities and institutes working on Lake Winnipeg.

ECCC worked with Manitoba Sustainable Development under the Science Subsidiary Arrangement made pursuant to the *Canada-Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin*. The agreement, signed in 2012, supports the development of science-related data, indicators, and nutrient targets. Other key transboundary monitoring sites are located on the Red River, Pembina River, Winnipeg River, and Souris River, and on the Milk River-St. Mary River system. The Red River and Souris River, in particular, have encountered many water quality issues over time (nutrients, metals, pesticides, salinity). Water quality and water quantity issues on these rivers are addressed formally through the International Red River Board and the International Souris River Board under the International Joint Commission (IJC). Regular monitoring updates were provided to these boards and to a number of institutional partners in 2018-2019.

All of the transboundary rivers in the watershed were monitored regularly (8 to 12 times per year). During the 2018-2019 open water season, the Red River was monitored more intensively (biweekly to weekly) to address concerns related to increased water releases from Devils Lake (North Dakota) crossing the Canadian border, and to improve the nutrient loading estimates for Lake Winnipeg. Additionally, ECCC operated an automated station on the Red River at Emerson, Manitoba as a real-time alert system to support water quality and transboundary

flood monitoring. Real-time data were used to assess water quality changes and episodic precipitation events. In addition, the Red River was also monitored for a suite of pesticides, including neonicotinoids, carbamates (fungicide) and sulfonyl urea (herbicide) to assess transboundary contamination.

As an international and interprovincial transboundary waterway, Lake of the Woods is relatively unique in the number of jurisdictions and international organizations, such as the IJC, that have a role to play for successful environmental management. Given the continued local and national concerns with noxious and potentially toxic cyanobacteria (blue-green algae) blooms and declining water quality in Lake of the Woods, ECCC continues to intensify its efforts in science and monitoring in the watershed.

Finally, under a Memoranda of Understanding with Parks Canada, sites in Banff, Jasper, and Waterton National Parks were also sampled by ECCC. These sites provided water quality information to Parks Canada and were used as reference sites as part of ECCC's Long-Term Water Quality Monitoring Program.

Atlantic watershed

In the Atlantic watershed, federal-provincial water quality monitoring is supported through:

- *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health*
- *Canada-Quebec Water Quality Agreement*
- *Canada-New Brunswick Water Quality Monitoring Agreement*
- *Canada-Newfoundland and Labrador Water Quality Monitoring Agreement*
- *Canada-Prince Edward Island Memorandum of Agreement on Water*
- *Canada-US Great Lakes Water Quality Agreement*

Monitoring results generated by ECCC contribute to indicators assessing the status of the Great Lakes ecosystem for toxic chemicals in water, sediments and fish, as well as indicators on the status of nutrients, water quality and algae.

The *Canada-Quebec Water Quality Monitoring Agreement* was renewed in 2018 and covers 39 sites in the transboundary St. Lawrence River and its tributaries. In addition to the sites covered by this agreement, ECCC operated 10 additional federal sites (including 2 automated sites) in the St. Lawrence River Basin. The sites were sampled monthly in 2018-2019 for physical parameters and nutrients, plus metals, pesticides, and polybrominated diphenyl ethers (PBDEs) at some of them.

Under the *Canada-New Brunswick Water Quality Agreement* during 2018-2019, 10 federal provincial sites were monitored on international and interprovincial transboundary rivers or their tributaries in the Saint John River (Wolastoq) and Restigouche River watersheds. Four additional real-time automated sites in the Saint John River (Wolastoq) watershed were also maintained by ECCC at the borders of the transboundary Big Presque Isle Stream, Aroostook River and Meduxnekeag River and in the main channel at Evandale.

The International St. Croix River Watershed Board, under the 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. ECCC 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 2018 annual report to the IJC.

In 2018-2019, 11 sites were monitored under the *Canada-Prince Edward Island Memorandum of Agreement*, including one real time (automated) site on the Wilmot River. In addition, pesticide surveillance was conducted during the growing season. The sites are distributed across the province, with data available on the Government of Prince Edward Island's website.

In 2018-2019, ECCC managed 13 federal sites (including 2 automated sites) in Nova Scotia in support of the Canadian Environmental Sustainability Indicator for water quality. 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, 72 sites across the major drainage areas were sampled 4 to 8 times in 2018-2019. Data and station information from the sites are available on the Newfoundland and Labrador Water Resources website.

2.2.2 Water quality indicator

Water quality

The water quality indicator is reported as part of the Canadian Environmental Sustainability Indicators (CESI) program at ECCC. It provides an overall measure of the ability of river water to support aquatic life (plants, invertebrates and fish). The 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 substances in a river are very rarely measured above their guidelines. Conversely, water quality is rated poor when measurements are usually above their guidelines, sometimes by a wide margin.

WATER QUALITY CATEGORIES

Excellent - Water quality is protected with a virtual absence of threat of impairment; conditions are very close to natural or pristine levels.

Good - Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.

Fair - Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.

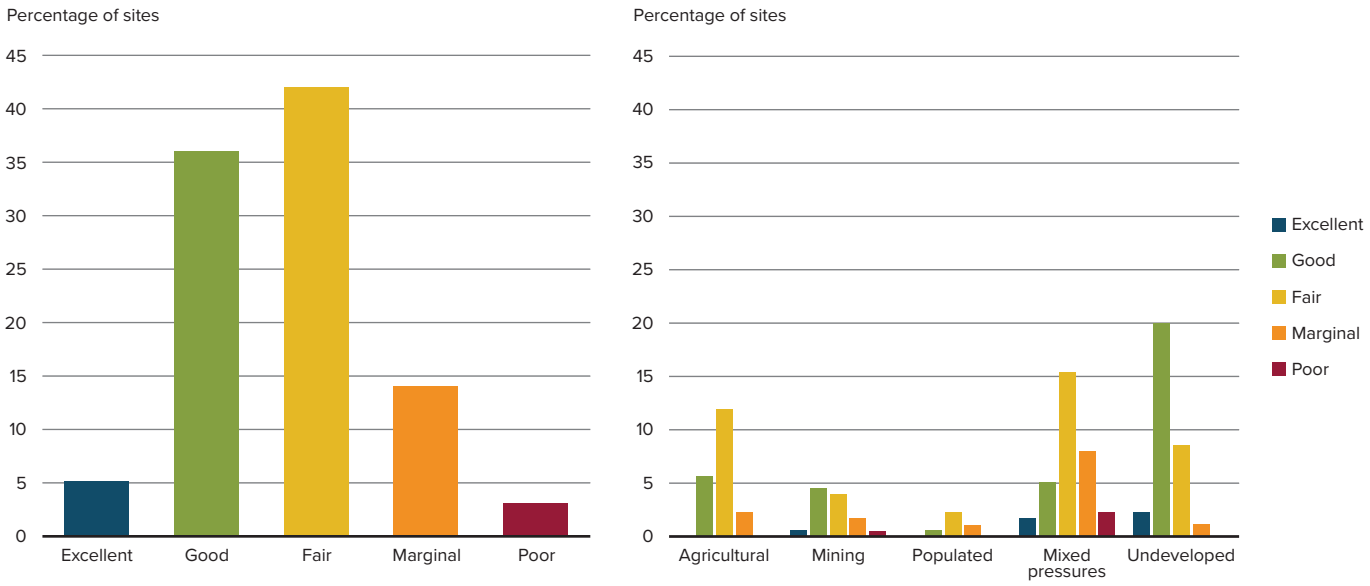
Marginal - Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.

Poor - Water quality is almost always threatened or impaired; conditions usually depart from natural or desired levels.

The water quality indicator released in January 2019 is based on data collected from 2002 to 2017 at 318 water monitoring stations across Canada and reflects the diversity of watersheds in the country. The data were assembled from 16 federal, provincial, territorial and joint water quality monitoring programs. The national water quality indicator was calculated using a core national network of 175 river sites, selected to be representative of surface freshwater quality across southern Canada where human pressure is most intense (Figure 3a).

For the 2015 to 2017 period, water quality in rivers in Canada was rated fair to excellent at 83% of the monitored sites. More specifically, water quality measured at these river sites across southern Canada was rated as excellent for 8 sites, good for 63 sites, fair for 74 sites, marginal at 25 sites, and poor at 5 sites (Figure 3a). Water quality tends to be worse where there is agriculture, mining, high population density or a combination of these (mixed pressures) (Figure 3b).

Figures 3a and 3b. Water quality in Canadian rivers, 2015 to 2017 period

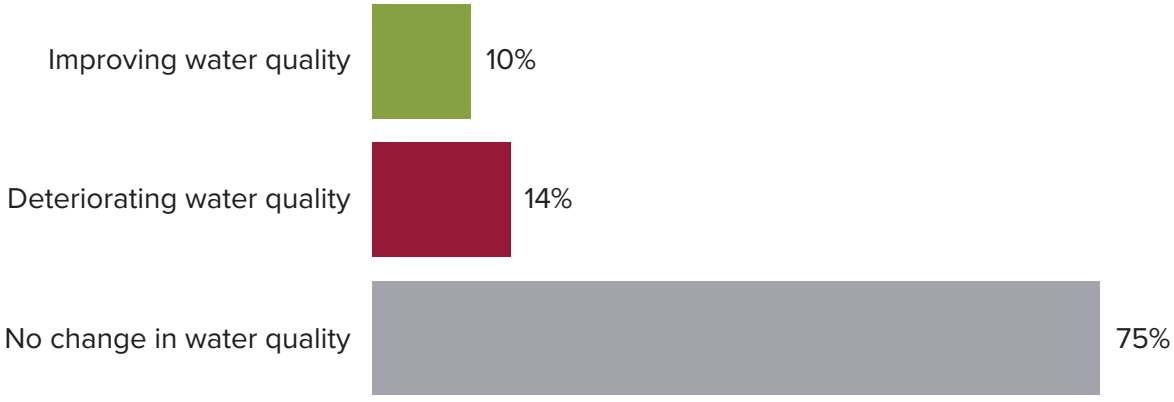


Note: Water quality was evaluated at 175 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the CESI Water quality indicator's Data sources and methods.

Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, mining, and land cover statistics for each site's drainage area were provided by Statistics Canada and Natural Resources Canada.

Overall, water quality has not changed at a majority of sites across southern Canada between 2002 and 2017. Out of the 175 sites, there was improvement in water quality at 10% of sites, deterioration at 14%, and no change in water quality at 75% of the sites (Figure 4).

Figure 4. Trends in water quality, Canada, 2002 to 2017



Note: The trend in water quality between the first year that data were reported for each site and 2017 was calculated at 175 sites across southern Canada. A uniform set of water quality guidelines and parameters were used through time at each site for the trend analysis.

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

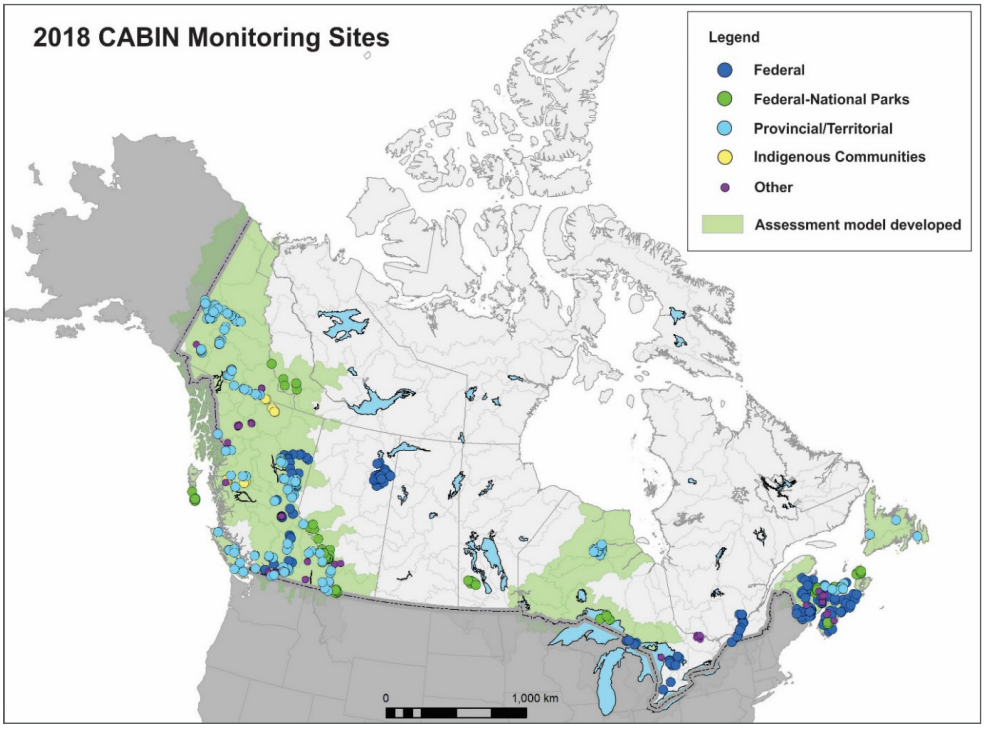
2.3 Biological monitoring

In addition to the physical-chemical water quality monitoring detailed above, ECCC also undertook biological monitoring using benthic macroinvertebrates to assess the health of aquatic ecosystems.

The Canadian Aquatic Biomonitoring Network (CABIN) is a component of the Freshwater Quality Monitoring Program for assessing the biological condition of freshwater ecosystems in Canada using standardized data collection and analysis methods. This component, based on decades of research and development in many countries, has been adopted by multiple organizations across Canada. The continued success of CABIN was a direct result of collaboration and data sharing. It is led by ECCC'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, Indigenous communities, and non governmental organizations, such as community watershed groups. The CABIN Science Team, consisting of ECCC and external scientists with expertise in large-scale ecological monitoring, provides science advice and recommendations.

Since the early development of the CABIN Monitoring Strategy in the 1980s, data have been collected in over 10,000 locations across the country. In 2018-2019, data were collected at 836 sites in several sub-basins across the country by ECCC and its collaborators (see Figure 5).

Figure 5. CABIN monitoring sites



Pacific watershed

In British Columbia, CABIN monitoring is conducted jointly under the *Canada-British Columbia Water Quality Monitoring Agreement*. Under the Agreement, ECCC and the provincial Ministry of Environment collaborate on data collection for reference model maintenance as well as development and site assessment.

The 11 reference models available to all CABIN users to conduct biological assessments in watersheds in British Columbia and Yukon were developed collaboratively by federal, provincial and territorial agencies (i.e. Department of Fisheries and Oceans, the Canadian Coast Guard, Parks Canada, British Columbia Ministry of Environment, and Government of Yukon). Models are available for the Yukon River Basin, Fraser River/Georgia Basin, Skagit River Basin, Okanagan Basin, British Columbia Central/North Coast, Northeastern British Columbia and Rocky Mountains national parks models. In 2018-2019, ECCC collected CABIN data from 58 stream and river sites in British Columbia: 39 sites for reference model maintenance and development, and 19 sites for assessment of biological condition, co-located at long-term physical-chemical monitoring sites.

Arctic/Athabasca watershed

In the Athabasca watershed, under the Joint Canada-Alberta Implementation Plan for the Oil Sands, CABIN sampling was conducted at 55 sites in the tributaries of the Lower Athabasca River. The Plan also included biomonitoring sampling at 10 sites with 5 replicates in the mainstream of the Athabasca River using a modified CABIN approach for large rivers. Sampling sites in the Lower Athabasca River and its tributaries range from within the active oil sands development area (potentially impacted sites) to outside the development area as well as beyond any natural exposure of the bituminous geologic formations in the region (reference sites). In 2018-2019, CABIN sampling was also conducted at 3 sites on tributaries of the Peace River as part of an expanded oil sands biomonitoring program that included the Peace River Oil Sands area.

Hudson Bay watershed

In 2018-2019, ECCC revisited five sampling sites in southern Ontario as part of a comparative study with Ontario Ministry of Environment and Climate. CABIN sampling was also conducted by ECCC in the Great Lakes using the CABIN Open Water Protocol. Five reference sites for the Great Lakes Reference Study were sampled, as well as 12 sites in the Cornwall Area of Concern (AOC).

Atlantic watershed

In the Atlantic watershed, 212 stream and river sites were monitored by ECCC and certified partners in 2018-2019. Of the 191 sites in the Atlantic Provinces, 48 were monitored by ECCC, 115 by other federal departments or Parks Canada, 12 by provincial governments, and 16 by non-governmental organizations. The 21 sites in Quebec (11 in the St. Lawrence River, 4 in La Mauricie National Park and 6 in the Forillon National Park) were monitored using CABIN sampling protocols. This work supported federal-provincial water quality monitoring agreements with New Brunswick, Newfoundland and Labrador, and Prince Edward Island. The monitoring allowed partners to conduct assessments in transboundary watersheds (Saint John River [Wolastoq River], St. Lawrence River) and federal lands (i.e. national parks, Indigenous communities, and the Meaford and Gagetown Canadian Forces Bases).

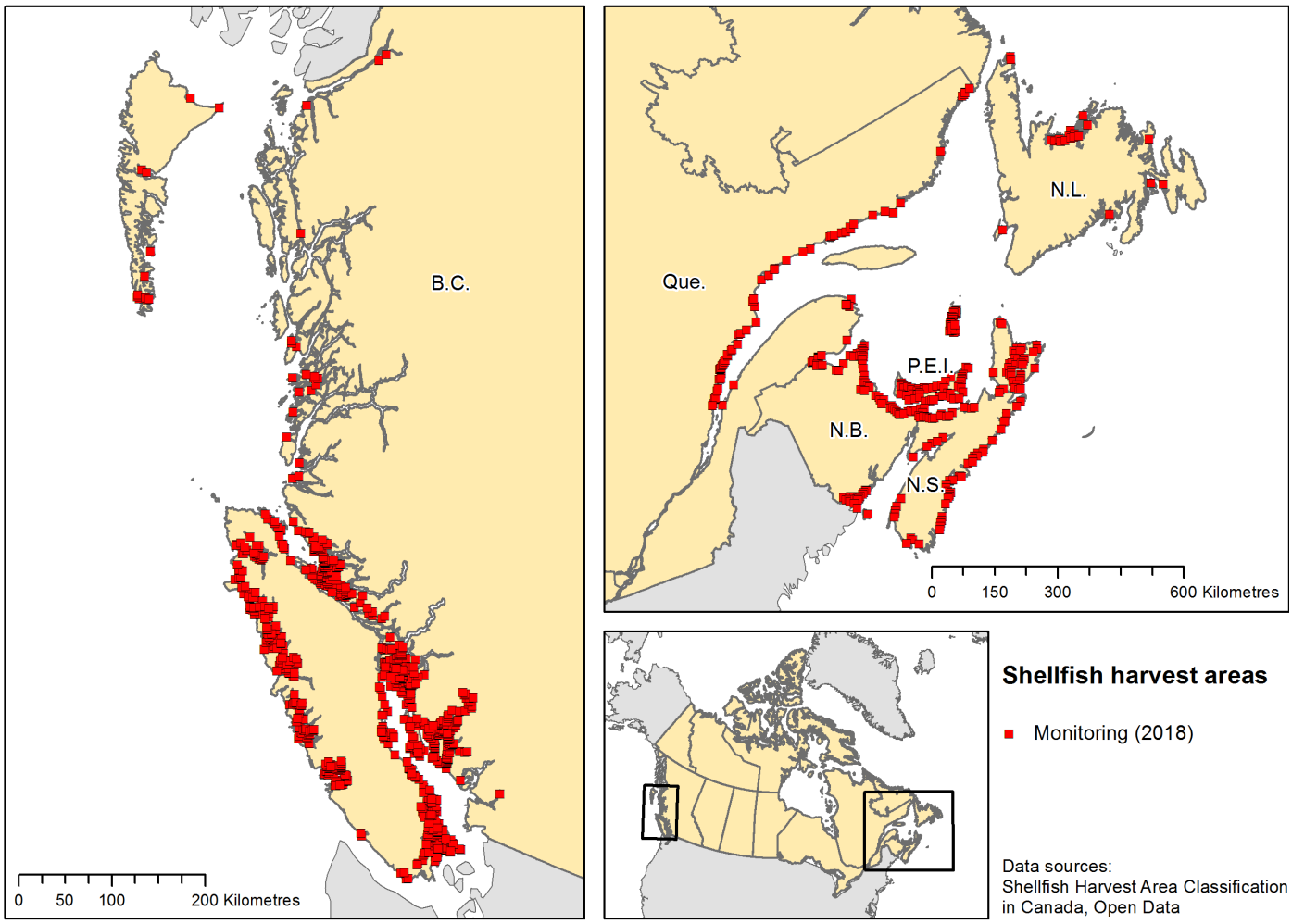
Monitoring data also informed the Canadian Environmental Sustainability Indicators: Freshwater Quality Indicator. Research in the use of new techniques for assessing the suitability of aquatic habitat to support aquatic life, based on DNA collection was also conducted as part of a collaborative project with the Genomic Research and Development Initiative. In 2018, 167 samples were collected and analyzed for DNA sequencing: 99 from New Brunswick, 34 from Nova Scotia, 28 from Prince Edward Island and 6 from Quebec (Forillon National Park).

2.4 Shellfish Water Classification Program

The Canadian Shellfish Sanitation Program (CSSP) is a federal program administered jointly pursuant to a Memorandum of Understanding (MOU) between the Canadian Food Inspection Agency, ECCC, and the Department of Fisheries and Oceans (DFO).

The CSSP objective is to provide reasonable assurance that molluscan shellfish are safe for consumption by controlling the harvesting of all molluscs (e.g. oysters, mussels, clams, scallops) within Canadian tidal waters. The mutual concerns of Canada and the United States to protect the public from the consumption of contaminated bivalve molluscs led to the signing of the Canada-United States Bilateral Agreement on Shellfish Sanitation on April 30, 1948, to deal with sanitary practices in the shellfish industries of both countries. This agreement remains in effect to maintain open trade; Canada is subject to periodic audits by the United States Food and Drug Administration.

Figure 6. Monitored shellfish growing areas



In 2018-2019, 508 shellfish growing areas were monitored in Canada (see Figure 6). Marine water sampling was undertaken through a combination of delivery methods in different portions of each province, including internal ECCC resources, outsourcing to private-sector contractors, federal-provincial water monitoring agreements under the CWA and voluntary agreements with First Nations and stakeholders. Analyses for fecal coliform and salinity content determination were performed in ISO 17025 accredited laboratories. Across Canada, 29,325 marine water samples were collected at 6,800 stations in the Atlantic region, Quebec and British Columbia (see Table 2).

Table 2. Number of shellfish growing areas, stations and marine water samples, along with the number of investigations, evaluations and assessments that occurred in the Atlantic region, Quebec and British Columbia.

Region	Shellfish growing areas in Canada	Sampling stations	Marine water samples	Growing areas with sanitary shoreline investigation	Wastewater systems evaluations	Environmental emergency events assessed
Atlantic	236	3,519	17,684	78	6	**802**
Quebec	113	1,190	3,964	74	4	**91**
British Columbia	159	2,091	7,677	119	2	**1,909**
TOTAL	**508**	**6,800**	**29,325**	**271**	12	**2,802**

In addition to marine water quality determinations, sanitary shoreline investigations of point and non-point pollution sources were performed in 271 shellfish growing areas. Twelve wastewater treatment plants were evaluated or re-evaluated. Work also included the review and assessment of 2,802 environmental emergency events and significant incidents to determine the need for emergency harvest area closures (see Table 2).

For more information, consult the Canadian Shellfish Sanitation Program.

3. RESEARCH

3.1 Research on the impacts of climate change on aquatic systems

In 2018-2019, ECCC undertook a number of activities to quantify and predict local, regional, and national sensitivities of hydrological regimes and aquatic ecosystems to climate change, including:

- The production of Canada's first comprehensive report on Canada's Changing Climate covering: changes in temperature, precipitation and related extremes across Canada; changes in snow, ice and permafrost; changes in freshwater availability; and, changes in oceans surrounding Canada.
- The compilation of a river-ice data set from hydrometric archives that can be used to identify several river-ice event timing and magnitude-related variables including those associated with fall freeze-up, winter low flow, mid-winter break-up, maximum annual ice thickness, and spring break-up.
- The collection of data to assist in the development of next generation climate permafrost-hydrology models.
- The collaboration with universities, provincial and territorial agencies to build components of a Pan-Canadian network capable of determining the impacts of permafrost thawing on water resources.
- The assessment of river-ice break-up and ice-jam characteristics in the Peace Athabasca Delta.
- The assessment of the sediment and water quality characteristics in the Lower Athabasca River.
- The examination of the linkage between terrestrial flow pathways and sediment sources with changes in moisture content or condition (permafrost thaw, rainfall).
- The research at the Baker Creek Research Catchment to evaluate the impact of permafrost degradation on water cycling and chemistry in the subarctic Canadian Shield.
- The assessment of the climate variability and change on prairie wetlands and hydrology including resultant impacts on the water quality in the Prairie's watershed.
- The assessment of the vulnerability of Western Canadian watersheds reliant on water from mountain headwaters to increasing drought risk and diminishing snow packs, in collaboration with international and national academic organizations.

4. 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. Domestic inter-jurisdictional boards include the Mackenzie River Basin Board (MRBB), the Prairie Provinces Water Board (PPWB), the Lake of the Woods Control Board (LWCB) and the Ottawa River Regulation Planning Board (ORRPB). The 2018-2019 activities of each are described below.

There are also many international transboundary and inter-jurisdictional water boards in which Canada participates, most of which are led by the International Joint Commission (IJC). While work of the IJC is not pursuant to the CWA, ECCC reports on progress under the *Environment and Climate Change Canada-International Joint Commission Memorandum of Understanding*.

ECCC, through its National Hydrological Service contributes to the management of international and domestic transboundary water by carrying out the orders of the IJC under the Boundary Waters Treaty and managing inter provincial regulations, in partnership with the provinces.

In 2018-2019, ECCC provided support to many IJC water boards, committees and special studies. This included engineering and technical support for special studies and development, testing and implementation of hydrologic and ecosystem models, and an adaptive management framework for the ongoing review of lake regulation plans.

ECCC continued to support the IJC's Lake Ontario-St. Lawrence River Board in the operation of Plan 2014, which was implemented in January 2017 and is designed to provide for more natural variations of water levels of Lake Ontario and the St. Lawrence River to restore ecosystem health.

Following a year of record-high water levels in 2017 and associated flooding and erosion around Lake Ontario and much of the St. Lawrence River, ECCC provided considerable support to the IJC's Lake Ontario-St. Lawrence River Board and the Great Lakes-St. Lawrence River Adaptive Management Committee. This support informed the assessment and documentation of the causes of the record high water levels, including an analysis of the contributing hydrologic conditions.

4.1 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 states that the waters of the Mackenzie River Basin should be managed to preserve the ecological integrity of the aquatic ecosystem and to facilitate reasonable, equitable, and sustainable use of this resource for present and future generations. The Master Agreement provides for early and effective consultation on potential developments and activities in the basin that could affect the integrity of the aquatic ecosystem and contains provisions for seven bilateral agreements between adjacent jurisdictions in the basin.

The Mackenzie River Basin Board (MRBB) represents all parties to the Master Agreement and administers the provisions of the Master Agreement. Federal members include representatives from ECCC and Crown-Indigenous Relations and Northern Affairs Canada. Health Canada also participates, providing support and expertise on human health issues. Ten members represent the three provinces and two territories in the basin, including an appointee from each provincial and territorial water management agency, and an Indigenous board member representing Indigenous peoples in each of the five jurisdictions.

Under the Master Agreement, ECCC is responsible for managing the expenditures of the MRBB, which are cost-shared equally by the parties. Cost-shared expenditures include the staffing and operation of the Secretariat Office to provide working-level support for the Board. The Secretariat has an executive director hired by ECCC and who is responsible for planning, directing and managing Board operations.

Key activities and accomplishments in 2018-2019

- The MRBB monitored the implementation of bilateral water management agreements that have been signed between Alberta and Northwest Territories, British Columbia and Northwest Territories, British Columbia and Yukon, and Yukon and Northwest Territories.
- The MRBB monitored the progress of bilateral water management negotiations between British Columbia and Alberta, Alberta and Saskatchewan, and Northwest Territories and Saskatchewan.
- The MRBB State of the Aquatic Ecosystem Committee and the Traditional Knowledge and Strengthening Partnerships Steering Committee worked jointly to advance the next *Mackenzie River Basin State of the Aquatic Ecosystem Report*. This report will describe the state of the aquatic ecosystem via the use of indicators and will give equal weight to western science and traditional knowledge.

4.2 Prairie Provinces Water Board

The purpose of the Agreement is to apportion water between the provinces of Alberta, Saskatchewan, and Manitoba, and to protect surface water quality and transboundary aquifers. The Master Agreement on Apportionment (MAA) also provides for cooperation among governments with respect to transboundary water management and for the establishment of the Prairie Provinces Water Board's (PPWB) responsibility to administer the Agreement.

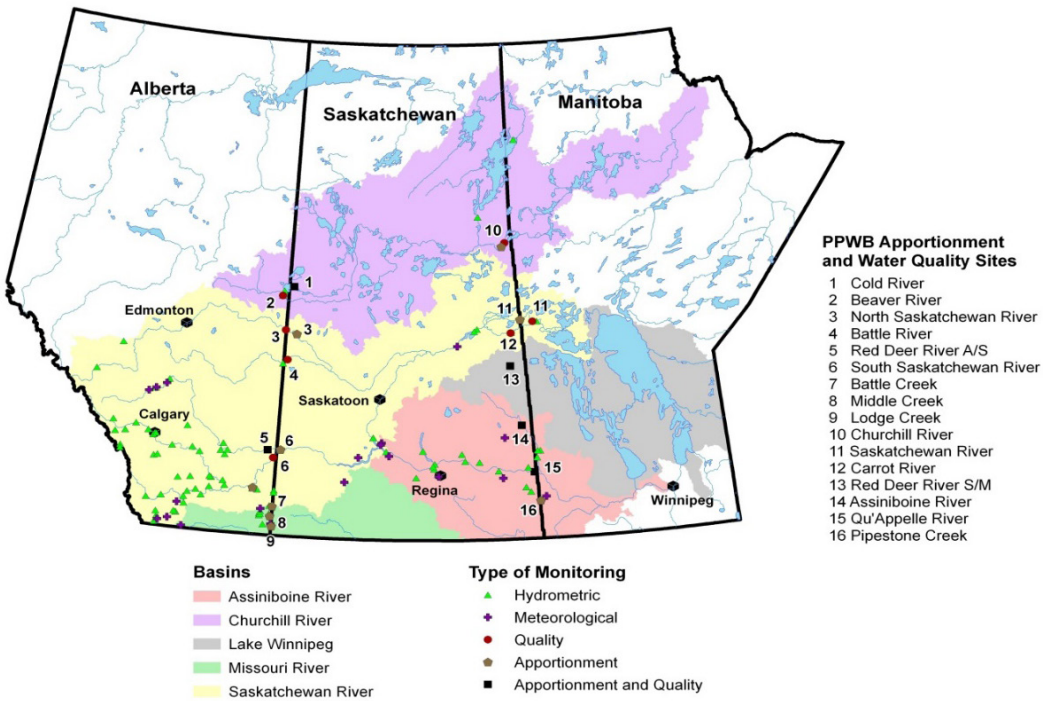
2019 MARKS 50 YEARS OF COLLABORATIVE WATER MANAGEMENT IN THE CANADIAN PRAIRIE REGION

Recognizing that water use within one province may impact 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 overarching deliverable for the PPWB is to report on the achievement of the terms of the MAA. The MAA provides for an equitable sharing of available waters for all eastward flowing streams, including lakes that cross provincial boundaries. The Schedules to the Agreement describe the role of the PPWB 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, ECCC monitors stream flows, water quality and meteorological conditions on eastward flowing streams on the provincial borders (see Figure 7). The PPWB computes apportionable flows based on the natural flow of a river as if that river had never been affected by human activity. Excursions (i.e. deviations) to the MAA water quality objectives are calculated annually.

Figure 7. PPWB water quantity and quality monitoring stations and basins for 2018



Activities and accomplishments of the PPWB and its four standing technical committees on hydrology, water quality, groundwater, and flow forecasting in 2018-2019 include:

- The apportionment requirements were reviewed and determined to have been met in the calendar year of 2017 on all eastward flowing Prairie streams.
- A project to review apportionment methods continued.
- A review of the Qu'Appelle River Basin at the Saskatchewan/Manitoba boundary was mostly completed in 2019, and is expected to be finalized in 2020. This review study is looking at all aspects of the apportionable flow calculation and options for improvements.
- An initial review of the Assiniboine River Basin on the Saskatchewan/Manitoba boundary began in 2019.
- The Committee on Hydrology is developing criteria to support how the PPWB determines which transboundary basins are subject to apportionment monitoring, and the frequency of that monitoring. The Committee began evaluating basins using this classification system in 2018.
- The PPWB approved the 2017 Water Quality Excursion Report prepared by the Committee on Water Quality. The overall adherence to Interprovincial Water Quality Objectives was on average 96.1% in 2017, such that water quality continues to be protected in the 12 transboundary rivers monitored under the MAA. The adherence rate was based on the comparison of 5,583 water quality results to water quality objectives for a range of water quality parameters including nutrients, metals, major ions, pesticides, and bacteria.
- In October 2018, the 2019 Water Quality Monitoring Program was approved. The most significant change to the monitoring program from the previous year was the addition of monitoring of glyphosate and its primary metabolite AMPA (aminomethylphosphonic acid) at those river sites with acid herbicide monitoring, as this pesticide is widely used throughout the Prairie region.
- The work of the Committee on Groundwater continued on the development of a proposed schedule to the MAA related to transboundary aquifers. The objective of the schedule is to establish a cooperative framework for effective and efficient management and sustainable use of groundwater and aquifer systems by the Parties of the MAA.
- The Committee on Flow Forecasting worked on a number of items including a project to harmonize spring runoff mapping.
- The PPWB exchanged information on issues of common interest, including water quality issues related to Lake Winnipeg, Saskatchewan-Manitoba drainage issues, Carrot River Sediment issues, and invasive species.
- The PPWB and each of its four standing committees held at least one face-to-face meeting and additional conference calls.

4.3 Lake of the Woods Control Board

The Lake of the Woods Control Board (LWCB) does not fall under the CWA, but it is included in this report to provide a more complete picture of federal-provincial water management in Canada. The LWCB is a 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 CELEBRATES 100 YEARS OF WORK IN 2019!

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 a transboundary 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 LWCB 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 the LWCB's operating strategy, conducts studies, and maintains communications with basin users.

In 2018, the Winnipeg River basin was notable for its unseasonable swings in flow supply. Following a typical winter, April had little to no rainfall across the watershed. The snowpack had the potential to support a strong spring freshet response, but instead provided a meagre bump in flows to the major lakes in the region resulting in a slow refill. In May, the more seasonable weather coupled with below normal outflows from the major lakes allowed for lake levels to build. The remainder of the spring and summer was relatively dry and water levels across the region remained lower than normal until mid-September. Conditions changed in late September and throughout October, as higher than normal rainfall caused stream flows and lake inflows across the basin to rise quickly to the upper normal range. The LWCB responded by staging a series of frequent outflow increases from Lake of the Woods and Lac Seul with the intention of limiting lake level rise ahead of freeze-up. High lake levels at freeze-up pose a risk to docks and shoreline infrastructure during the overwinter drawdown period as heavy ice may be left clinging to the structures after the water recedes. Outflows were gradually reduced beginning in mid November to allow for a stable, high-normal winter flow on the English and Winnipeg Rivers.

For Lake of the Woods, total inflow to the lake in 2018 was at the bottom of the normal range. The summer peak level for Lake of the Woods was 18 cm (7 in), which is below the median peak level and slightly below the target level the LWCB set in its June operating strategy, but is within the larger acceptable level range. By targeting a lower peak summer level, the LWCB maintained its commitment to reduce the risk of high summer water levels for property protection around the lake. However, the low inflows to the lake resulted in generally lower levels for most of the summer as the LWCB balanced limited water supply on the lake and the river.

The LWCB carried out its regular series of regulation meetings in March, June, and October, where, in discussion with First Nations advisors, specific interest group representatives and resource agencies adopted seasonal regulation strategies. March and October meetings were held in Kenora, while the June meeting was held in Ear Falls. The LWCB participated in the Lake of the Woods District Stewardship Association's annual Cottage Show in Winnipeg in May, and held a public open house in Sioux Lookout in June. The LWCB met with the Chief and members of Lac Seul First Nation in June, visiting sites of concern around the lake as well as hosting a question and answer session. Members and staff also visited sites along the English River below Lac Seul and Pakwash Lake.

4.4 Ottawa River Regulation Planning Board

In 1983, Canada, Quebec, and Ontario concluded the *Agreement Respecting Ottawa River Basin Regulation*. Under its terms, the Ottawa River Regulation Planning Board (the Planning Board) was constituted to ensure the integrated management of the flows from the 13 principal reservoirs of the basin in order to minimize the impacts of floods and droughts along the Ottawa River and in the Montreal region, while maintaining beneficial water uses within the watershed. Under the 1983 Agreement, the governments also established two other entities that report to the Planning Board, namely the Ottawa River Regulating Committee (the Regulating Committee) and the Ottawa River Regulation Secretariat (the Secretariat).

The 2018 freshet was characterized as being late with significant peak flow contributions from the central part of the Ottawa River watershed. Record high flow rates were observed on some tributaries due to a large amount of water contained in the snow pack, which melted rapidly when temperatures remained above 25°C for several consecutive days. Combined with a lower than normal freshet volume from the south part of the watershed, the overall freshet volume was just slightly above average conditions. Moderate precipitation was received in the following weeks, which led to a rapid decrease in water levels and a return to near normal river flows in early June.

Flood reduction measures are undertaken annually in preparation for the spring runoff. Typically, this involves emptying the principal reservoirs during the winter period with reservoirs being at their lowest levels before the spring snowmelt begins. This available storage volume is then used as the spring melt progresses to reduce downstream flows. Throughout the 2018 spring freshet, the Regulating Committee, which is made up of representatives from all the major dam operators in the system, held several conference calls to perform integrated management of the system, wherein the observed and forecast hydrological conditions are analyzed and a regulation strategy to maximize the use of the available storage volume is developed. Because of storage optimization, it was possible to keep flooding to a minimum from Fort-Coulonge down to Lac Deschenes during the first two weeks of May.

Except for years when there is little snow and precipitation, it is not possible to hold back the entire spring runoff volume in the reservoirs since runoff during spring flooding generally exceeds their capacity to store water. However, using integrated management, the Regulating Committee can develop a regulation strategy to achieve maximum peak flow reductions downstream, at the right time, while maintaining safe and secure conditions for the public and dam structures.

Apart from ensuring the integrated management of the system, the Planning Board also ensures that the hydrological forecasts are made available to government agencies that are involved in issuing flood-related messages and the deployment of emergency measures. This includes providing hydrological forecasts to the Great Lakes-St. Lawrence Regulation Office given that the flow of the Ottawa River can have a considerable effect on the flows of the St. Lawrence River in the vicinity of the Montreal Archipelago.

The Planning Board uses its website as the main tool for issuing hydrological forecasts to the public. The website was utilized extensively with close to 125,000 page views during the 2018 spring freshet period. The Regulating Committee issued two press releases in 2018, on April 29 and May 1. The Secretariat also participated on multiple conference calls with provincial and municipal authorities responsible for responding to the flooding.

5. ECOSYSTEM-BASED APPROACHES

This section describes a number of key cooperation-based ecosystem approaches through which ECCC 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. While these initiatives are not formalized under the Act, they do contribute to the objectives of the Act through improving the management of water resources in Canada.

ECCC'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 ECCC 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, Indigenous peoples, federal and state governments in the United States, businesses, non-governmental and community organizations, and colleges and universities.

5.1 Lake Winnipeg Basin Program

The Lake Winnipeg Basin Program (LWBP) is the Government of Canada's response to addressing water quality issues in Lake Winnipeg. The LWBP aims to engage citizens, scientists, and domestic and international partners in actions to restore the ecological health of Lake Winnipeg, reduce nutrient pollution and improve water quality.

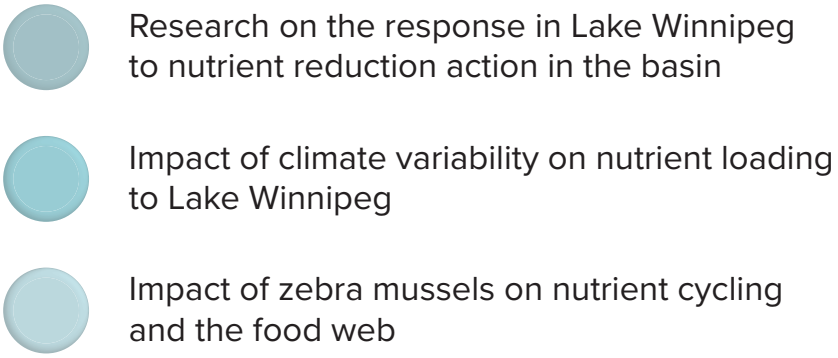
- In 2018-2019, Lake Winnipeg experienced large and frequent algal blooms due to high nutrient levels from multiple transboundary sources, including agriculture, industry, municipal wastewater and surface runoff.

- In 2018-2019, ECCC conducted and supported research through the LWBP, which also incorporated a targeted approach for nutrient reducing actions and support for collaborative efforts and Indigenous engagement throughout the basin on freshwater issues.

ECCC also collaborated with regional stakeholders through the *Canada-Manitoba Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin* (MOU). The MOU facilitates a cooperative and coordinated approach to improve the ecological health of Lake Winnipeg and its basin, and includes efforts such as the development and reporting of lake indicators and preparation of the next *State of the Lake* report scheduled to be released in 2020.

Lake Winnipeg Basin Program Science Plan

The Lake Winnipeg Basin Program Science Plan focuses on the following three key areas.



The LWBP also supports the Lake Winnipeg Research Consortium, which operates and maintains the in-lake science platform on Lake Winnipeg, and the Canadian Watershed Information Network (CanWIN), a web-based open access data and information network.

Scientific projects in 2018-2019 focused on:

- nearshore sampling program for water quality parameters including benthos, phytoplankton, and zooplankton at 12 locations within the lake
- assessment of impacts of climate variability on nutrient export to Lake Winnipeg
- quantification of nutrient sources and transport processes to Lake Winnipeg tributaries
- development of in-stream biological indicators to track nutrient loading to streams
- implementation of monitoring activities in Lake Winnipeg and its key tributaries
- quantification of in-lake processes affecting lake ecology

Nutrient reducing actions

Through application-based funding, the LWBP supports targeted stakeholder delivered projects in key geographic areas within the Lake Winnipeg Basin that demonstrate an effective means of reducing phosphorus loading and increasing public knowledge and engagement on water quality issues.

Indigenous engagement

The water quality in Lake Winnipeg and its basin affects the cultural, social, spiritual, and economic well-being of Indigenous peoples. The LWBP supports opportunities to build capacity and increase engagement of Indigenous governments, organizations and communities on Lake Winnipeg basin water quality issues, including the incorporation of traditional knowledge in discussions on the ecosystem health of Lake Winnipeg.

Some key highlights from 2018-2019 include the following:

- Twenty-three new contribution agreements were signed with non-governmental organizations to provide $3.8 M in support of nutrient-reducing actions, advancements in science, information sharing, Indigenous engagement, and collaboration. All of the projects being funded will be completed by March 31, 2022.
- $2.1 M was expended on stakeholder-driven projects in 2018-2019.
- Lake Winnipeg Basin Symposium was held in March 2019. A summary report and presentations from the symposium are posted on CanWIN.
- Three Indigenous students were employed to build capacity in water quality expertise and support Indigenous engagement on Lake Winnipeg water quality issues. These students provided valuable science and policy support.
- The Lake Winnipeg Basin Initiative Phase II (LWBI) final report was published and posted on the Government of Canada website.

5.2 Great Lakes Protection Initiative

The Great Lakes Protection Initiative is ECCC's primary program targeting federal water quality and aquatic ecosystem priorities in the Great Lakes. Through the Initiative, ECCC combines science and action to address the most significant threats to Great Lakes water quality and ecosystem health. Its current priorities for action include: working with others to protect the Great Lakes, restoring water quality and ecosystem health in Areas of Concern, preventing toxic and nuisance algae, improving the health of coastal wetlands, identifying at-risk nearshore waters, reducing releases of harmful chemicals, engaging Indigenous Peoples in addressing Great Lakes issues, and engaging the public through citizen science.

Freshwater management of the Great Lakes is a responsibility shared by multiple levels of government. To coordinate efforts on water management, restoration and protection, ECCC works in close collaboration with other implicated federal departments, the governments of Ontario and the United States, local governments, Indigenous peoples and many other organizations, and individuals. This is accomplished through leading and coordinating implementation of the *2012 Canada-U.S. Great Lakes Water Quality Agreement* (GLWQA) and the *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* (COA), an agreement under the *Canadian Environmental Protection Act, 1999*. The GLWQA establishes long-term bi-national objectives for the restoration and protection of the Great Lakes, while the COA provides the governments of Canada and Ontario with a shared short-term (five-year) action plan for achieving Canada's commitments under the GLWQA.

Key actions completed for the reporting period include:

- Canada and the United States finalized Binational Strategies for reducing Hexabromocyclododecane (HBCD) and Polychlorinated Biphenyls (PCBs) in the Great Lakes and completed public reviews of the Polybrominated Diphenyl Ethers (PBDEs) and mercury Binational Strategies.
- Canada and the United States began implementation of six domestic action plans for achieving phosphorus reductions to Lake Erie.
- Work was initiated through a Canadian federal and provincial effort to develop an inventory and map for southern Ontario of potential point sources of groundwater contamination.
- The Binational 2018 Annual Climate Trends and Impacts Summary for the Great Lakes Basin was completed to provide an overview of the climate trends and impacts in the basin for the 2018 reporting year for managers and practitioners at the federal, state, provincial, regional, and local levels, as well as stakeholders and the public.
- *Approaches for Conducting Vulnerability Assessments in the Great Lakes Basin: A Review of the Literature* was released to help inform and assist members of the Great Lakes research community, resource managers, practitioners and decision makers undertaking vulnerability assessments in the Great Lakes Basin.

- Canada continued implementation of the Great Lakes Nearshore Framework, which is a systematic, integrated and comprehensive approach for assessing the nearshore health of the Great Lakes and identifying and communicating cumulative impacts and stresses. In 2018-2019, the draft Canadian assessment was prepared for Lake Ontario.
- The Governments of Canada and the U.S. completed development of the draft Lakewide Action and Management Plan (LAMP) for Lake Ontario, which provides an assessment of the state of the lake and priorities for action.

ECCC also continued its program to assess the vulnerability of coastal wetlands to projected climate change and other stressors, identify best approaches to increase wetland resilience, and work with others to develop priorities for action. ECCC developed a draft framework to assess coastal wetland vulnerability to climate-related impacts with metrics for climate exposure, wetland sensitivity and the capacity of wetlands to adapt to climate change, and conducted monitoring at 24 wetland sites around the Great Lakes. In addition, ECCC also convened an expert workshop with a wide range of wetland conservation practitioners to increase awareness of wetland vulnerability to climate change impacts, to discuss the wetland vulnerability assessment approach, and to discuss partner needs and considerations for future use of project results to enhance wetland resilience.

To support others in taking action to protect the Great Lakes, Canada provided application-based funding for partner-led projects on priorities, such as:

- cleaning up Areas of Concern (see below)
- preventing toxic and nuisance algae in Lake Erie
- reducing releases of harmful chemicals
- engaging the public through citizen science
- enhancing local Indigenous capacity

Restoring water quality and ecosystem health in Great Lakes Areas of Concern (AOCs)

Areas of Concern (AOCs) are specific locations, such as harbours and embayments, where water quality and ecosystem health have been severely degraded by human activity.

In 1987, Canada and the United States designated 43 AOCs, 12 of which were in Canada and 5 are shared between Canada and the United States. To date, 4 of Canada's AOCs have had all impaired beneficial uses restored and the AOC designation for 3 of these sites has been removed, with re-designation of the 4th site pending.

There are 14 beneficial uses that are assessed in each AOC. Environmental monitoring and studies determine whether beneficial uses in an AOC are impaired and require restoration. Remedial Action Plans to restore beneficial uses are developed and implemented in cooperation with the Government of Ontario with input from First Nations, Métis, municipal governments, watershed management agencies, other local public agencies, and the public. Canada removes a beneficial use impairment designation when criteria established in the Remedial Action Plan have been met.

Of the 157 beneficial uses initially identified for remedial actions or further study, 78 have been restored since the beginning of the program. Efforts continue to restore the remaining 79 impaired beneficial uses.

Through the Great Lakes Protection Initiative, Canada provides funding and technical support to partners at the local level to implement remedial actions to advance the restoration of beneficial uses in AOCs. Examples of activities in 2018-2019 led or supported by ECCC to restore water quality and ecosystem health in Canadian Areas of Concern include:

- As part of the Randle Reef Sediment Remediation Project in the Hamilton Harbour AOC, Canada and partners completed construction of a six hectare engineered (containment facility) around the most severely contaminated sediment in the harbour. With approximately 695,000 cubic metres of sediment

contaminated with polycyclic aromatic hydrocarbons (PAHs) and other toxic chemicals, Randle Reef is the largest and most severely contaminated sediment site on the Canadian side of the Great Lakes. ECCC is collaborating with Ontario Ministry of Environment, Conservation and Parks, Stelco Inc., the Hamilton Oshawa Port Authority, the City of Hamilton, the City of Burlington, and Halton Region to restore this area.

- In the Port Hope AOC, where the Government of Canada has committed $1.28 billion over 10 years under the Port Hope Area Initiative, the cleanup and safe long-term management of 1.7 million cubic meters of historic low-level radioactive waste is underway.
- In the Peninsula Harbour AOC, environmental monitoring has shown the effectiveness of the thin-layer cap restoration strategy. Contaminant concentrations have declined since its implementation.
- In the Toronto Region AOC, a 9.3 hectare wetland was created in Tommy Thompson Park. This unique restoration project improves fish and wildlife habitat and provides new opportunities for nature-based recreation in the city and further enhances Tommy Thompson Park's reputation as an International Birding Area.
- Efforts to reduce the need for wastewater treatment plant bypasses during wet weather events and to ensure the long-term protection of water quality and ecosystem health were taken in three AOCs: the Bay of Quinte, the Detroit River, and the St.Lawrence.
- In the St. Marys River AOC, design plans to naturalize waterways and create underwater reefs to enhance fish spawning and nursery habitat were completed and community consultation is underway.
- In the St. Lawrence River (Cornwall) AOC, open water fish habitat was created in Cooper Marsh, a local provincially significant coastal wetland.

Science and monitoring

ECCC undertakes research and monitoring to support decision-making in the Great Lakes. In 2018-2019, ECCC conducted a broad range of monitoring activities targeting water, sediment and aquatic biota to support decision-making in the Great Lakes. Science related work included ongoing monitoring surveys on the Great Lakes, the review and update of binational Lakewide Action and Management Plans, and ongoing data collection to support binational State of the Great Lakes environmental indicators and reporting.

In addition, ECCC conducted scientific studies of fish, wildlife, benthos, algae and plankton in AOCs, to assess the current status of beneficial use impairments within Canadian AOCs. These assessments help direct remedial actions and to confirm when delisting criteria have been met allowing for the removal of Beneficial Use Impairment designations. A few recent examples include monitoring and assessment of:

- Water quality, plankton and algae in Hamilton Harbour
- Sediment chemistry and benthic community in St. Marys River
- Phosphorus levels in the Bay of Quinte on Lake Ontario
- Near shore flow conditions in parts of the St. Lawrence River
- Water quality and nutrients near Toronto beaches, and
- Dioxin and furan levels and indicators of fish health in Jackfish Bay on Lake Superior

ECCC undertook numerous scientific activities in 2018-2019 in partnership with the Governments of Ontario and the United States to support implementation of the Canada-Ontario Lake Erie Action Plan with the goal of reducing annual phosphorus loading into Lake Erie by 40% from a 2008 baseline. This included improved calculation of phosphorus loads and issuing of the first annual report on phosphorus loadings and algal conditions in Lake Erie.

In 2018-2019, an ECCC contribution agreement with Swim Drink Fish Canada allowed them to engage Canadians in a citizen science project to conduct water quality monitoring of beaches and other recreational waters. Swim Drink Fish Canada established two monitoring hubs in the Great Lakes. The first monitoring hub was established in downtown Toronto through its Lake Ontario Waterkeeper Initiative. The second hub was launched in the fall of 2018 on Manitoulin Island and is hosted by Zhiibaahaasing First Nation. Volunteers help hub coordinators collect water samples in places where people swim, boat, and hold ceremonial activities.

Monitoring of polycyclic aromatic hydrocarbons (PAHs) in water was conducted in Hamilton Harbour in support of the Randle Reef remediation project, as well as in the Detroit River for organic contaminants in support of assessment of several beneficial use impairments. Monitoring in the Detroit River identified source areas in the watershed. However, levels have declined in the last decade reflecting efficacy of management actions.

In addition, watershed models were developed for various beneficial management practice scenarios to assess the impact on nutrients, sediment, and flow for the Thames River and Sydenham watersheds. Modelling work was also initiated to assess climate change impacts on the delivery of nutrients to Lake Erie.

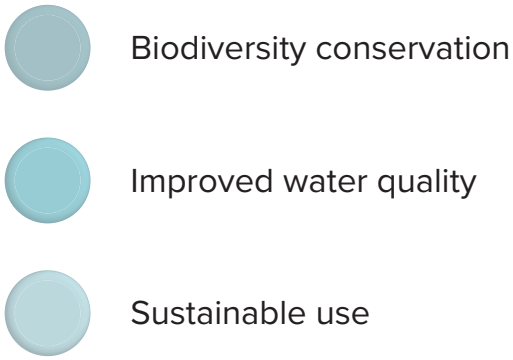
Research tools were developed to provide daily satellite imagery to map algal blooms extent and for assessing the spatial/temporal trends of these blooms in Lake Erie.

Research efforts continued to develop predictive tools for understanding catchment inputs to local water quality and benthic algae (*Cladophora*) conditions and improve our understanding of major drivers of variation. Integrated watershed-lake models were implemented for Lake Erie to improve our understanding of the factors responsible for hypoxia and periodic wash-up of algae on shorelines.

5.3 St. Lawrence Action Plan

The *Canada-Quebec Agreement on the St. Lawrence 2011-2026*, also known as the St. Lawrence Action Plan, covers a span of 15 years, with 5-year planning cycles.

The St. Lawrence Action Plan is a platform for collaboration between the Canadian and Quebec governments intended to strengthen collective efforts for the integrated management of the St. Lawrence Basin, and to carry out joint actions to conserve and enhance its ecosystem. These efforts focus on three priorities:



This multi-year program, which has been renewed five times since it was first signed in 1988, has helped produce concrete results through the cooperative efforts from the private sector, universities, research centres, Areas of Prime Concern committees (zones d'intervention prioritaire, 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.

For 2018-2019, 37 projects were carried out as part of the Joint Action Plan, for which a number of research projects, fieldwork activities, and decision-making tools were developed, including:

- the identification of important fish and interconnected habitat for protection and restoration
- an Integrated Biodiversity Conservation Plan for the Lowlands and Coastal Areas of the Estuary and Gulf of St. Lawrence
- a study of the potential for re-establishing the functional connectivity of biodiversity hotspots in the St. Lawrence lowlands, including tools for knowledge transfer
- wetland rehabilitation guidance for the St. Lawrence

- the promotion of recreational fishing along the St. Lawrence, including the implementation of an incentive program
- the quantification of the contribution of dissolved and particulate organic matter to hypoxia and the acidification of the deep waters of the St. Lawrence estuary
- a study of the impacts of hydrocarbons and dispersants on aquatic freshwater organisms
- a study of the use of retention ponds to capture pesticides and nutrients in surface water and agricultural runoff in the Lake Saint-Pierre area
- a study of the current state and evolution of the weed beds and plant ecosystems of Lake Saint-Pierre, including the impacts of algal blooms and the presence of cyanotoxins
- a study of the eco-toxicological effects of sewage discharge from the city of Montreal after its disinfection treatment by ozonation (tertiary wastewater treatment)
- a study of the risk associated with the presence of the cytostatics (new pharmaceutical products/ anti-cancer substances) in the St. Lawrence river

Activities under the St. Lawrence Action Plan's numerical environmental predictions working group continued in 2018-2019. These activities are done through the federal-provincial collaboration under the St. Lawrence Action Plan. The main activities of the group were:

- hydrological modelling and routing of waters entering via the watersheds of St. Lawrence tributaries
- two-dimensional hydrodynamic modelling of the St. Lawrence River, lac des Deux-Montagnes, lac Saint-Louis, the LaPrairie Basin, rivière des Mille-Îles, rivière des Prairies, and the Sainte-Anne and Vaudreuil channels

Community involvement and awareness

Under the St. Lawrence Action Plan, ECCC and Quebec's Ministry of Sustainable Development, Environment and Fight against Climate Change are implementing the Community Interaction Program (CIP), which provides funding to non-governmental organizations and Indigenous communities for projects that aim to conserve and enhance the ecosystem of the St. Lawrence.

In 2018-2019, ECCC distributed $422,062 in funding for 13 projects. These projects involved key players from riverside communities, including municipalities, First Nations, academia, industry and agriculture, local communities, and relevant provincial and federal departments. Specifically, the projects funded were intended to:

- implement measures to improve the biodiversity of the littoral zone of Lake Saint-Pierre
- preserve the integrity of a brackish water marsh of great ecological value in the Chaleur Bay area through stabilization work, including sediment recharge and the planting of vegetation
- restore a site in order to improve fish movement between a branch of the Saint-François River (Tardif Channel) and a marsh in the Odanak community
- protect the ecological diversity of the St. Lawrence shoreline in urban and periurban areas of Montreal by preventing the spread of Japanese knotweed
- promote behavioral change of boaters in order to protect the biodiversity on islands in the St. Lawrence River situated near the Island of Montreal

Moreover, the Areas of Prime Concern Program supports Stratégies Saint-Laurent and its 12 ZIP committees in their cohesive actions to engage and support local stakeholders working to improve the quality of the surrounding environment. ECCC provided $1.1 million in funding under this program.

5.4 Gulf of Maine Initiative

The five-year Gulf of Maine Initiative (GMI) marked its final year in 2018-2019. This initiative enabled ECCC to work collaboratively with other federal departments, provincial governments, United States governments, and community groups to help advance efforts that enhance conservation and promote responsible development in the Gulf of Maine transboundary ecosystem, which includes watersheds and coastline in New Brunswick and Nova Scotia.

The GMI focused on enhancing collaborative efforts to build knowledge of the transboundary ecosystem (watershed and coast) to better understand its current condition and identify stressors and threats, which will ultimately help inform decisions.

ECCC contributed funding, technical and scientific expertise, and direct staff support for water quality projects. These contributions improved assessment, monitoring, and modeling of the area and led to the mitigation of multiple stressors and their cumulative effects on water quality in the Gulf of Maine ecosystem.

In 2018-2019, four multi-year projects addressed water quality issues in the Gulf of Maine ecosystem:

- Building upon data from two previous GMI projects, the Gulf of Maine Council created data-based action plans for six Bay of Fundy estuaries. The action plans provide local watershed organizations with a basis to create targeted environmental management strategies to ensure there is a cohesive, science-based strategy for environmental management at the watershed level.
- The Nature Conservancy of Canada classified the biological and ecological diversity within watersheds by developing a seamless aquatic ecosystem classification and stress index across the Canadian portion of the Gulf of Maine and prioritized watersheds and stressors within watersheds for conservation and restoration.
- Eastern Charlotte Waterways Inc., in partnership with Dalhousie University, completed a baseline assessment of pH in the estuarine environments of the Bay of Fundy.
- Eastern Charlotte Waterways Inc. received funding in 2018-2019 to address nutrient runoff in Bay of Fundy watersheds. The project connected eutrophication indicator data collected in the estuarine environment to land use decisions in the Bay of Fundy watershed.

In 2018-2019, GMI also supported efforts to better understand the current status of coastal wetlands and their potential to sequester and store carbon as a mechanism to mitigate atmospheric CO_2 emissions. In addition, information generated over the duration of the GMI was assembled and made publically available through a common website to ensure on-going access following completion of the initiative. Partners were engaged in evaluating the success of the program and in identifying emerging issues and future opportunities for conservation and sustainable development of the ecosystem.

Overall, between 2014 and 2019 GMI provided grant and contribution funding to 13 organizations and undertook 11 contracts to address program objectives. A final report will be available to summarize project accomplishments and highlight lessons learned that would help inform future programs and other activities in the Gulf of Maine and elsewhere.

5.5 Atlantic Ecosystems Initiatives

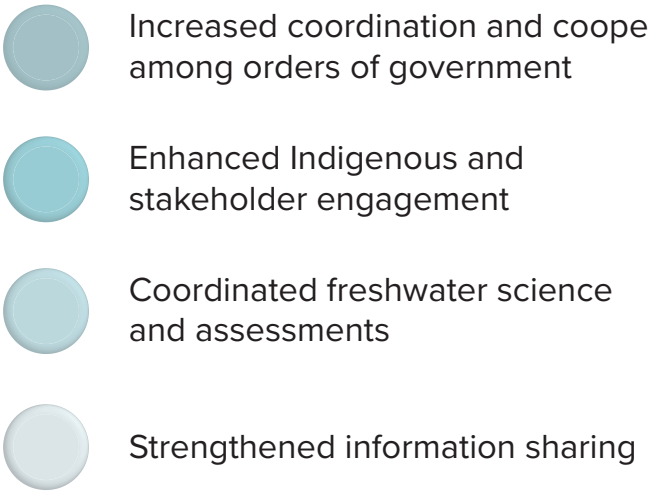
The Atlantic Ecosystems Initiatives (AEI) program provides grants and contributions funding for projects that improve the health, productivity, and long-term sustainability of ecosystems in Atlantic Canada. The program supports projects that use an ecosystem-based approach and include broad collaboration and cooperative action resulting in positive environmental impacts throughout Atlantic Canada. The program funds Atlantic Canadian organizations, including non government organizations, coalitions and networks of organizations, research and academic institutions, and Indigenous governments and organizations to deliver projects that address one or more of the three program priority issues of water quality, habitat and biodiversity, and the impacts of climate change. For 2018-2019, a place-based approach was piloted to support projects in two priority ecosystems of concern: the Saint John River Watershed, and the Southern Gulf of St. Lawrence Watershed. ECCC contributed funding, technical and scientific expertise, and direct staff support for water quality projects to improve the assessment, monitoring, modeling, and mitigation of multiple stressors and their cumulative effects on water quality in Atlantic Canada from headwaters to estuaries.

In 2018-2019, a total of 19 AEI projects addressed water quality, habitat and biodiversity, and impacts of climate change. ECCC committed over $1.2 million dollars for these projects. The following multi-year projects are ongoing and represent the type of projects that received funding:

- In New Brunswick, The Saint John River Society is working to better understand the human uses and needs of the Saint John River as it relates to the ecological goods and services, with particular attention to water quality. The project aims to provide recommendations to the Government of New Brunswick, NB Power and other river users on the ecological and human needs for water in the river and inform the development of a watershed wide management plan.
- In Nova Scotia, Dalhousie University's Centre for Water Resources Studies is developing modeling and monitoring tools to understand and improve microbial water quality in the Southern Gulf of St. Lawrence watershed. The project is investigating the sources and pathways of fecal pollution, nutrients, and sediments in a representative coastal ecosystem with the goal of developing best practice guidelines for coastal land use management.
- The Southern Gulf of St. Lawrence Coalition on Sustainability is conducting research and implementing mitigation actions related to eelgrass beds in the Atlantic region. Eelgrass is a highly productive habitat and provides important ecosystem services in the coastal zone, such as coastal erosion and carbon and nutrient sequestration. This project increases climate resiliency by mitigating stressors affecting eelgrass health and restoring eelgrass in the region to encourage widespread recolonization.

5.6 Wolastoq/Saint John River Watershed

In 2018-2019, ECCC continued to focus on four key commitments for the Wolastoq/Saint John River under the Freshwater Action Plan.



Various efforts were taken toward a coordinated and integrated management approach for the watershed, including working with federal, provincial, Indigenous, and non-government partners to advance shared priorities and objectives. ECCC facilitated internal and external meetings to further discussions on common areas for coordination and collaboration, including water quality monitoring, data management and access, freshwater assessment, citizen science, and funding arrangements.

Progress continued under the Wəlastəkw Interim Statement of Cooperation signed in 2017 by ECCC, DFO, Wolastoqey (Maliseet) Chiefs, and several U.S. Federal Agencies. International summits were held in the spring and fall of 2018, focused on defining a collaborative watershed governance model, as well as advancing ecosystem science initiatives. ECCC enhanced stakeholder engagement through training and providing access to tools to support citizen science activities and information sharing.

ECCC collaborated with Nature Conservancy of Canada and the US Environmental Protection Agency (EPA) to produce a Watershed Stress Index, covering both the Canadian and U.S. portions of the Wolastoq/Saint John River watershed. The assessment tool evaluates 16 stressors to water quality and aquatic connectivity. The Index will inform monitoring, management, conservation and restoration activities in the watershed.

6. ADDITIONAL INFORMATION

The Government of Canada's Water website provides content on ECCC's water-related activities and program areas as well as general information on a wide range of water-related topics and the full text of key water publications (such as the *Great Lakes-St. Lawrence River water levels*). In addition, the site provides links to laws and regulations.

ECCC's Wateroffice provides public access to real-time and archived hydrometric data collected in Canada. In 2018-2019, the Wateroffice website received over 66 million hits and nearly 2.2 million visits.

To obtain further information or publications and to submit questions or comments concerning the *Canada Water Act*, please contact ECCC's Inquiry Centre.

Environment and Climate Change Canada
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The following media relations contact is also available to provide information.

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