Environment and Climate Change Canada
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WATER QUALITY IN CANADIAN RIVERS

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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JANUARY 2020

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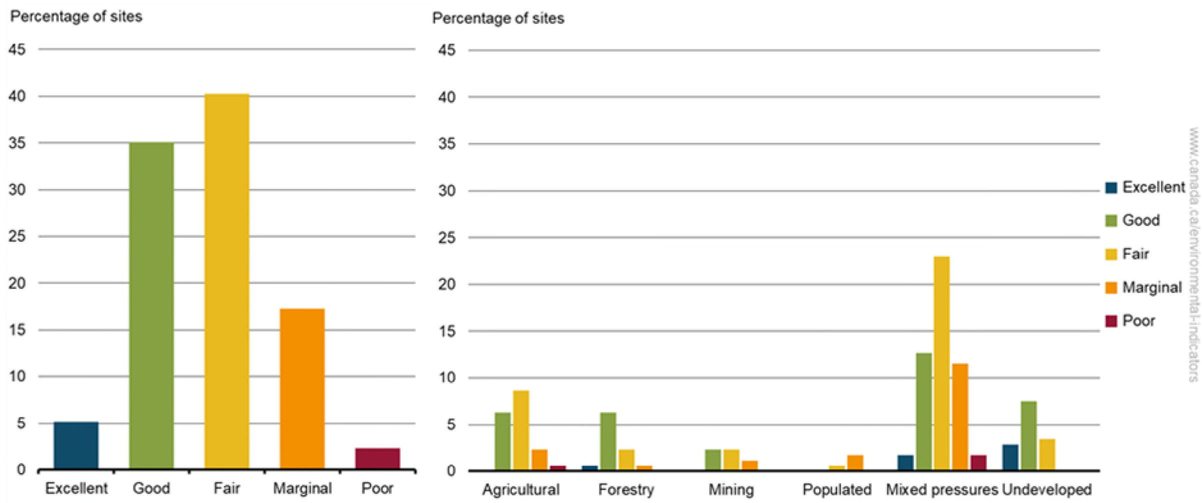
Water quality in Canadian rivers

Healthy river ecosystems rely on clean water. The quality of water, and the health of rivers, depends on how people develop and use the surrounding land. These indicators measure the ability of river water to support plants and animals.

Key results

- For the 2016 to 2018 period, water quality in rivers in Canada was rated fair to excellent at 80% of the monitored sites
- Land development through agriculture, mining, forestry, high population density or a combination of these (mixed pressures) tends to have a negative impact on water quality

Figure 1. Water quality in Canadian rivers, national and by land use category, 2016 to 2018 period



Data for Figure 1

Note: Water quality was evaluated at 174 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification and monitoring sites selection, consult the Data sources and methods section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

For the 2016 to 2018 period, water quality at 174 monitoring sites in southern Canadian rivers[1] was rated:

- excellent or good at 40% of monitoring sites
- fair at 40% of sites
- marginal at 17% of sites
- poor at 2% of sites

By world standards, Canada has abundant, clean freshwater resources. The water in Canada's rivers varies naturally across the country based on the rocks and soil in the area and the climate. For example, water that flows through the rocky landscape of northern Ontario and Quebec is naturally different from water flowing through the deep soils of the Prairies. However, it is how people have developed the land around lakes and rivers that has the largest impact on water quality at each site.

[1] The indicators focus on the regions in Canada where human activity is more prevalent, as it is usually the main factor for water quality deterioration. Monitoring sites were selected based on whether there was data available for a sufficient number of years and whether the sites were representative of the drainage region. Northern Canada is underrepresented; this is due partly to the challenges related to sampling in these remote locations. For more information on site selection, please see the Data sources and methods section.

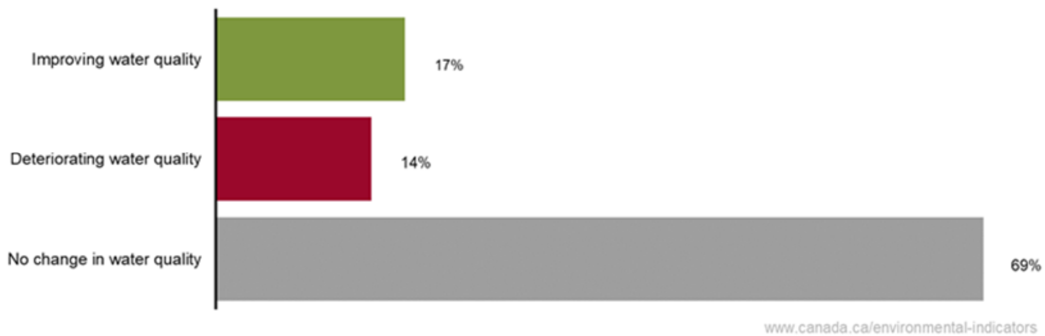
Water quality is generally good or excellent in undeveloped areas where native plants, trees and soils purify the water before it reaches the river. Adding development such as manufacturing and cities puts pressure on the landscape and increases the amount of chemicals being released into rivers every day. As well, many contaminants make their way into rivers after being released into the air through burning. Fertilizers and pesticides used to help crops grow and manure from livestock can wash into nearby rivers or seep into groundwater, impacting water quality in these areas. Some forestry activities, such as removing trees and other vegetation that would otherwise reduce the flow of surface water into rivers, may increase run-off of nutrients and contaminants into rivers. All of these developments change water quality in a river and put pressure on the plants and animals that live there.

Trends in water quality in Canadian rivers

Key results

- Water quality has not changed between 2002 and 2018 at a majority of sites across southern Canada
- Where it has changed, it has improved more often than it has deteriorated

Figure 2. Trends in water quality, Canada, 2002 to 2018



Data for Figure 2

Note: The trend in water quality between the first year that data were reported for each site and 2018 was calculated at 174 sites across southern Canada. A Mann-Kendall test was used to assess whether there was a statistically-significant increasing or decreasing trend in the annual guideline deviation ratios at a site. The trend was calculated at each site using parameters specific to the site. Therefore, an improving or a deteriorating water quality does not necessarily imply a change in water quality category. For more information on the trend, consult the Data sources and methods section.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

The average water quality in a river tends to change slowly. Natural factors, such as snow and rainfall, affect water quality by washing pollution that builds up on the surface of roads and fields into the river. A dry year could mean better water quality, because less pollution is washed into the river. On the other hand, a drought could lead to worse quality as there is less water to dilute pollution from point sources like urban sewage outflows. A changing climate that results in longer or more frequent wet or dry periods will affect water quality depending on the region.

How the landscape is developed also impacts how quickly water quality changes. Altered landscapes, industrial and sewage effluents, and atmospheric deposition[2] can all affect water quality. Water quality in a river can be improved by modernizing wastewater treatment plants and factories, adopting environmental farming practices, or planting native vegetation along river banks, among other actions.

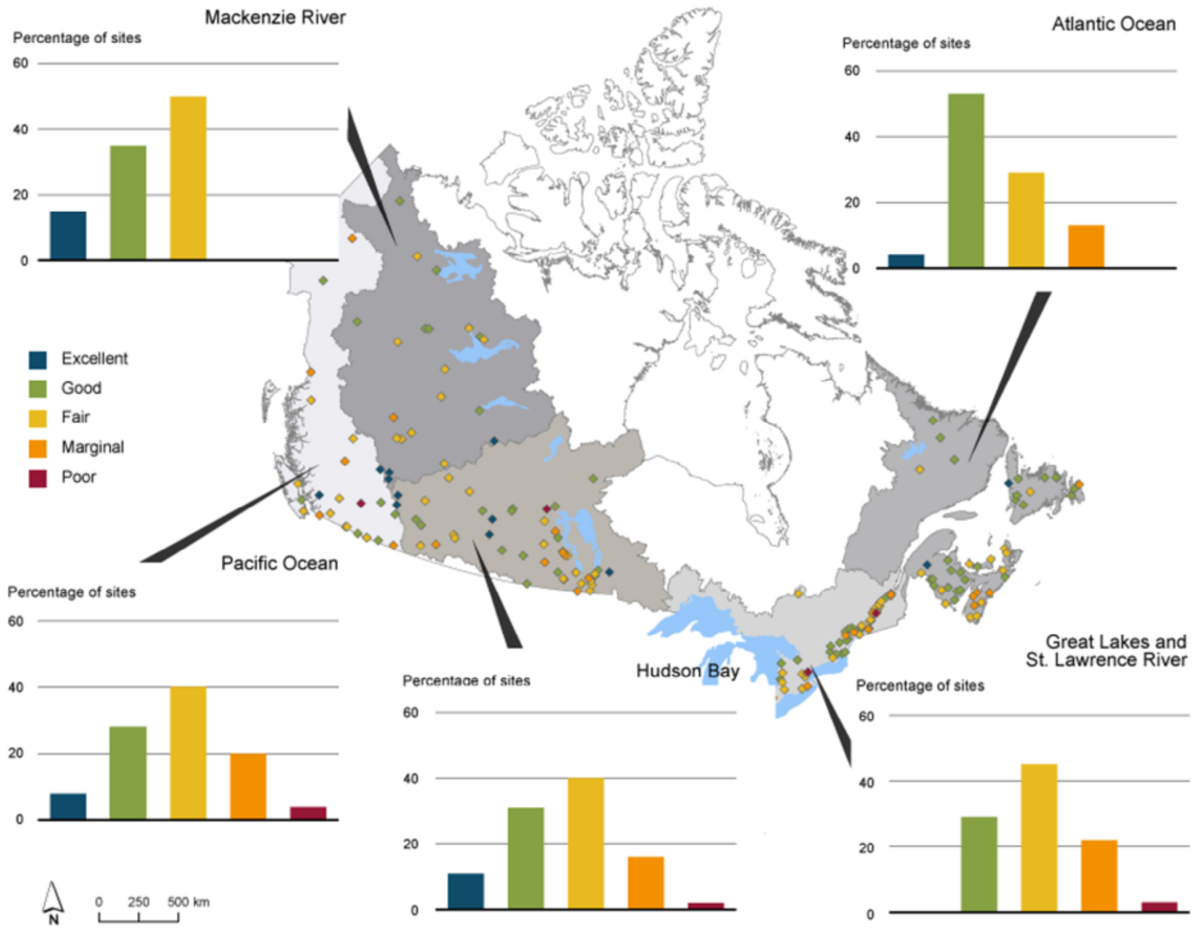
[2] Atmospheric deposition refers to the phenomenon through which pollutants, including gases and particles are deposited from the atmosphere in the form of dust or precipitation, ultimately entering fresh water systems.

Regional water quality in Canadian rivers

Key results

- The Atlantic Ocean, Mackenzie River and Hudson Bay regions had the highest proportion of sites with good or excellent water quality (58%, 50%, and 42% respectively)
- The Great Lakes and St. Lawrence River, Pacific Ocean and Hudson Bay regions had the highest proportion of sites with marginal or poor water quality (26%, 24% and 18%, respectively)
- Water quality at the majority of sites across Canada was rated fair

Figure 3. Regional water quality, Canada, 2016 to 2018 period



Data for Figure 3

Note: For the Regional water quality in Canadian rivers indicator, water quality was assessed at 193 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. Compared to the national indicator, the Regional water quality in Canadian rivers indicator uses 19 additional monitoring sites and includes more sites in the northern portions of the Mackenzie River and Pacific Ocean regions.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial, territorial and joint water quality monitoring programs.

Water quality varies widely across Canada. For the 2016 to 2018 period:

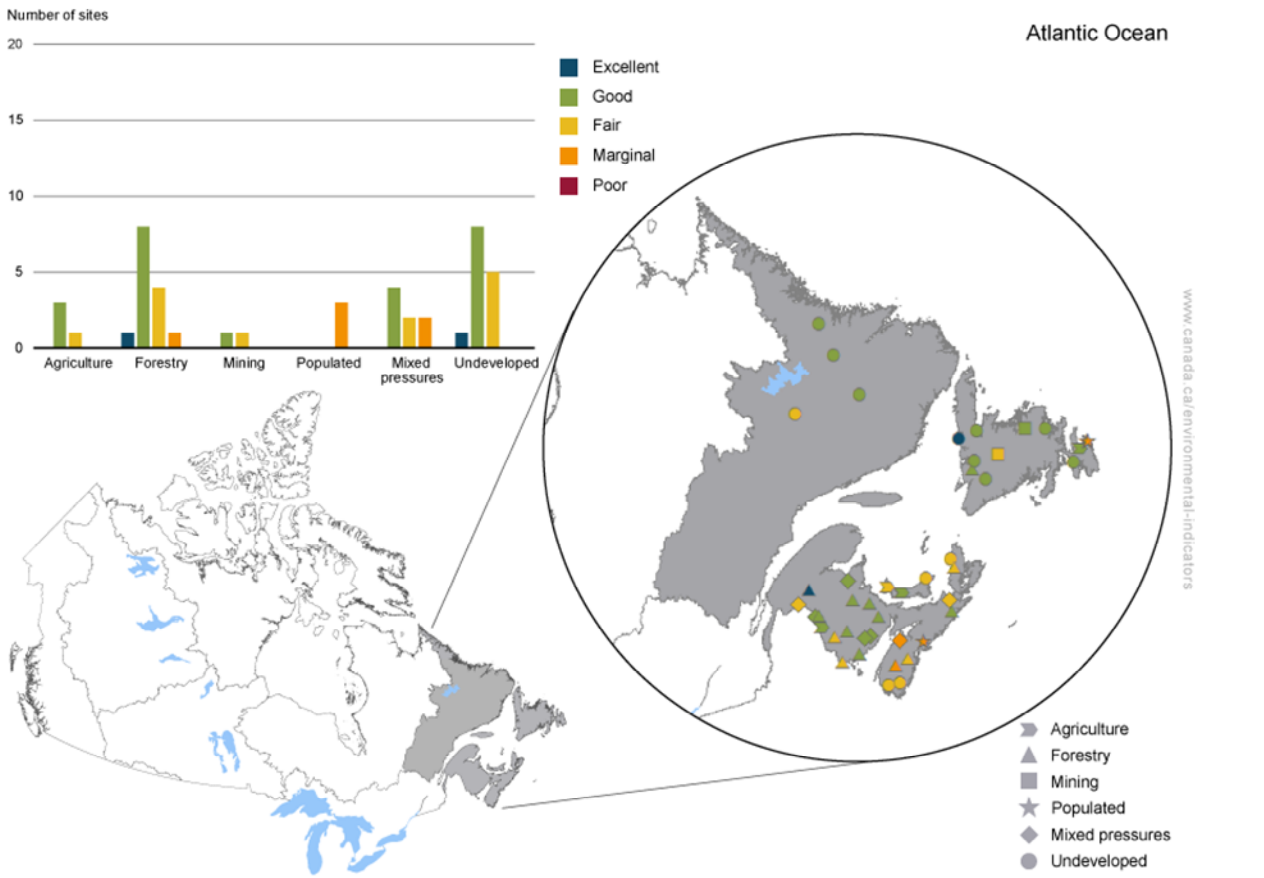
- The highest proportion of sites rated good or excellent was found in areas where there was very little human development upstream. The Atlantic Ocean and Mackenzie River regions have the highest proportion of undeveloped sites in Canada
- The highest proportion of sites rated marginal or poor was found in areas where there was urban development or mining, combined with agriculture, forestry or a combination of all 4

Atlantic Ocean

Key results

- Most sites in the Atlantic Ocean region are in areas with forestry or in undeveloped areas and have good or excellent water quality
- Monitoring sites in high population density areas and with agriculture or forestry (mixed pressures) usually have worse water quality

Figure 4. Water quality by land use category, Atlantic Ocean region, 2016 to 2018 period



[Data for Figure 4]

Note: Water quality was assessed at 45 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Along the east coast of Canada, all rivers drain into the Atlantic Ocean. This region includes Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador, along with part of eastern Quebec.

The region is home to approximately 2.3 million people, or 7% of Canada's population. The majority live in Nova Scotia, New Brunswick and on the island of Newfoundland.

Agriculture is mainly found in Prince Edward Island, Nova Scotia's Annapolis Valley, and New Brunswick where the soil and climate are suitable.

Mining and forestry are 2 of the region's largest industries. In Newfoundland and Labrador, iron ore, nickel, copper, cobalt and gold are mined. New Brunswick and Nova Scotia have many active aggregate, limestone, gypsum, coal and gold mines. Forestry, the largest industry in New Brunswick, is composed of solid wood and pulp production. Water pollution from mining and pulp and paper industries effluent is regulated, but limited releases to rivers and leaching from tailings and waste rock enclosures can have a local impact on water quality. Closed or abandoned metal mines may still be releasing harmful substances to the water.

For the 2016 to 2018 period, water quality for 45 sites on rivers draining into the Atlantic Ocean was rated:

- excellent or good at 58% of monitoring sites
- fair at 29% of sites
- marginal at 13% of sites

Water quality tends to be good to excellent in this region of Canada because large areas are undeveloped, and therefore not subject to impact from human activity, particularly in Labrador.

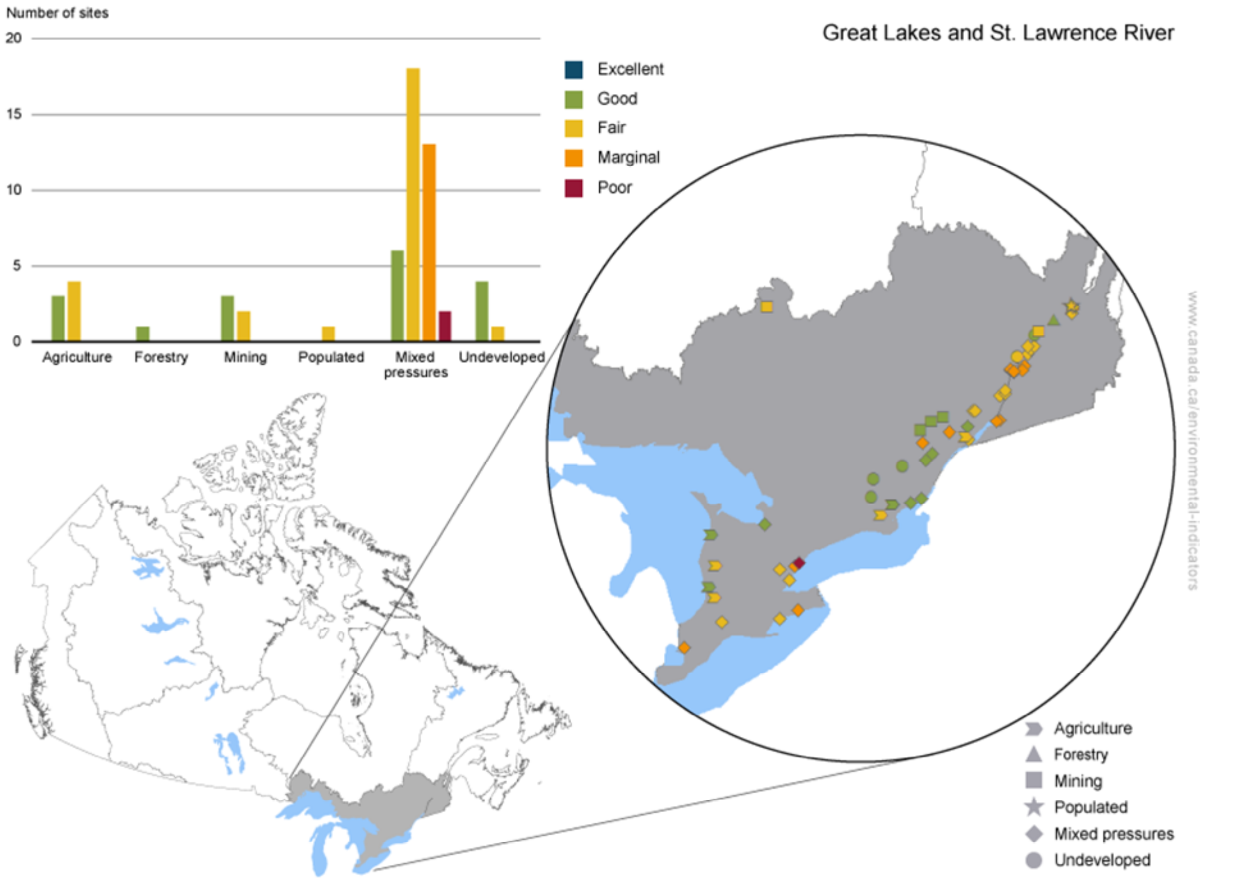
Between the first year of data collection and 2018, water quality has improved on the Terra Nova River, the Exploits River, the Goulds Brook, the Atikonak River, the Naskaupi River and the Gander River in Newfoundland and Labrador, and on the Roseway River, the Tusket River, and the Mersey River in Nova Scotia. These 9 sites have very little development around them. Water quality has deteriorated at 8 sites in the region: 3 sites on the Saint John River (Saint John River below St. Basile, Saint John River at Evandale and Saint John River below Upper Queensbury), the Nashwaak River and the Aroostook River in New Brunswick, the Mill River, and the Bear River in Prince Edward Island and the Annapolis River in Nova Scotia in areas where there is agriculture and industrial development. There has been no change in water quality at the remaining 28 sites.

Great Lakes and St. Lawrence River

Key results

- Water quality in rivers in the Great Lakes and St. Lawrence River region
    - ranges from fair to poor in southwestern Ontario and along the St. Lawrence River between Montreal and Quebec City
    - is good in eastern Ontario
- Monitoring sites in areas where there are mixed pressures tend to have worse water quality

Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, 2016 to 2018 period



[Data for Figure 5]

Note: Water quality was assessed at 58 sites on rivers draining into the Great Lakes or St. Lawrence River using the [Canadian Council of Ministers of the Environment's water quality index]. For more information on land use classification, consult the [Data sources and methods] section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Home to almost 60% of Canadians, close to 20 million people, the Great Lakes and St. Lawrence River region contains 6 of the country's 10 largest cities: Toronto, Montreal, Ottawa, Mississauga, Brampton and Hamilton. Most human activity in this area is associated with urbanization. The impact of increasing population density can be seen in the diminished water quality at sites on rivers.

Fertile soils and a relatively mild climate combine to create productive agricultural land in the Great Lakes and St. Lawrence River region. Agricultural land is steadily being covered by cities changing the stresses on water quality in the region.

Mining in the region is dominated by feldspar and quartz mines. Forestry is an important industry in Quebec and Ontario. Pulp and paper mills are mainly located near the Great Lakes and the St. Lawrence River or near their tributaries. Water pollution from mining and pulp and paper industries effluent is regulated, but limited releases to rivers and leaching from tailings and waste rock enclosures can have a local impact on water quality. Closed or abandoned metal mines may still be releasing harmful substances to the water.

For the 2016 to 2018 period, water quality for 58 sites on rivers in the Great Lakes and St. Lawrence River region was rated:

- good at 29% of monitoring sites
- fair at 45% of sites
- marginal at 22% of sites
- poor at 3% of sites

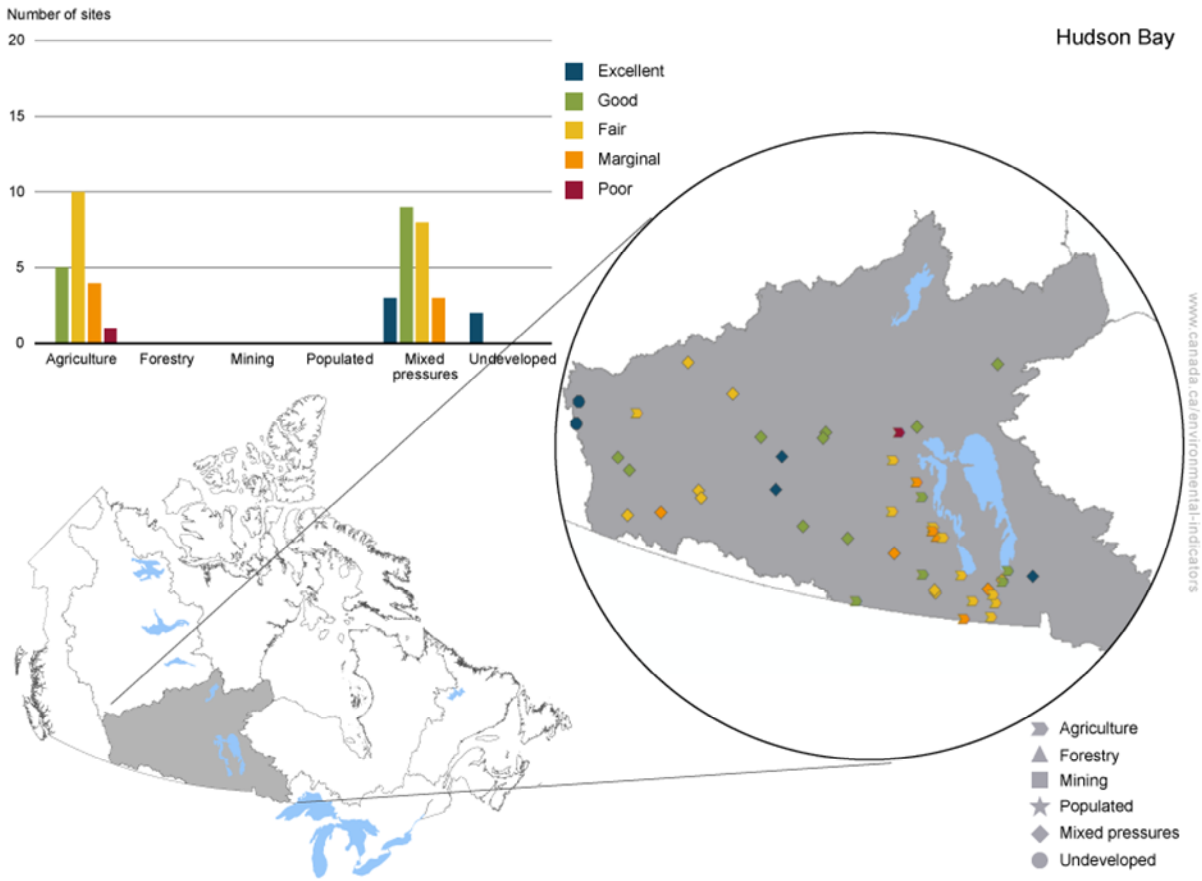
Between the first year of data collection and 2018, water quality has improved on the Rivière du Nord, the Rivière des Mille Îles, the Rivière l'Assomption, the Rivière Bayonne, the Rivière du Loup and the Saint-Charles River, in Quebec. Water quality has deteriorated on the Credit River, the Nottawasaga River, the Gananoque River, the North Raisin River, the South Raisin River, the Humber River, the Ausable River, the Delisle River, the Bayfield River, the Saugeen River, and the Fall River in Ontario. Land use at these sites is either agriculture or a mix of agriculture forestry and high population density (mixed pressures), except at Fall River, where the land use is undeveloped. There was no change in water quality at the remaining 41 sites.

Hudson Bay

Key results

- Water quality in rivers close to the Rocky Mountains and north of Lake Winnipeg in the Hudson Bay region tends to be good or excellent. There is very little development in these areas
- Water quality tends to be worse in areas where there is agriculture, or a mixture of agriculture and mining

Figure 6. Water quality by land use category, Hudson Bay region, 2016 to 2018 period



[Data for Figure 6](#)

Note: Water quality was assessed at 45 sites on rivers draining into the Hudson Bay using the [Canadian Council of Ministers of the Environment's water quality index](#). For more information on land use classification, consult the [Data sources and methods](#) section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

The Nelson River originates at the northern tip of Lake Winnipeg and flows into the south-western corner of Hudson Bay. Its tributaries drain over 1 million km^2 of land starting in the Rocky Mountains running through the Prairies and into Lake Winnipeg. Most of the 5.5 million people in the region live in its 5 major cities (Calgary, Edmonton, Winnipeg, Saskatoon and Regina).

Water quality in this region reflects the extensive human development. Agriculture covers almost all the land in the Prairies. Mining, particularly the production of potash and fuels, is the second most important industry. Water quality tends to be worse where rivers run through agricultural and mining areas.

For the 2016 to 2018 period, water quality for 45 sites on rivers in the Hudson Bay region was rated:

- excellent or good at 42% of monitoring sites
- fair at 40% of sites
- marginal at 16% of sites
- poor at 2% of sites

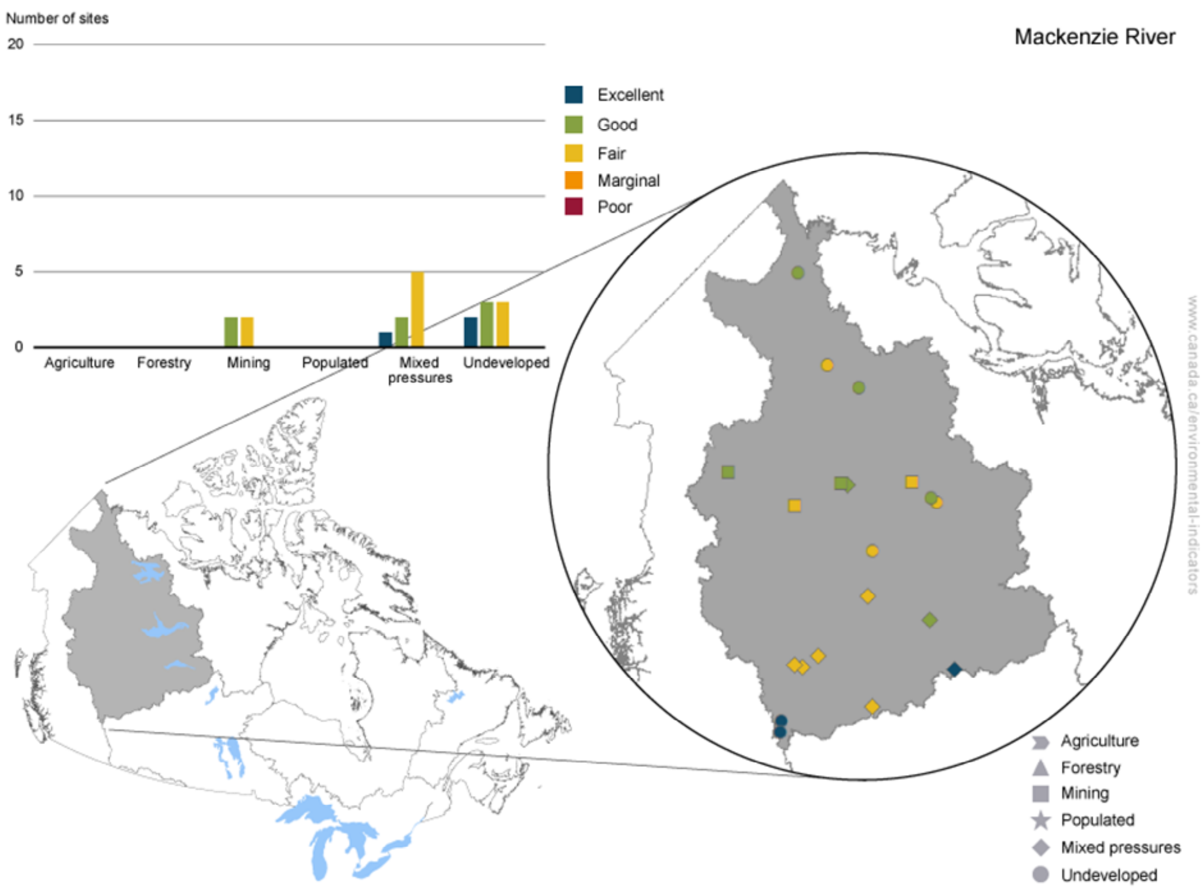
From the first year of data collection to 2018, water quality has improved on the North Saskatchewan River and the Elbow River in Alberta, and at 2 sites on the Assiniboine River (at Headingley and North-West of Treesbank), the Souris River, the La Salle River, Pembina River, Cooks Creek and the Burntwood River in Manitoba. Land use at these sites is either agriculture or a mix of agriculture and mining (mixed pressures). Water quality has deteriorated on the Carrot River in Saskatchewan. This watershed has extensive agriculture in the upstream reaches. There has been no change in water quality at the remaining 35 sites.

Mackenzie River

Key results

- Water quality in the Mackenzie River region is generally good to excellent in areas where there is little development
- Water quality tends to be lower where there are multiple pressures

Figure 7. Water quality by land use category, Mackenzie River region, 2016 to 2018 period



Data for Figure 7

Note: Water quality was assessed at 20 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

The Mackenzie River watershed is the largest in Canada, covering nearly 20% of the country and is one of the least developed. Its 2 largest tributaries, the Peace River and the Athabasca River, drain much of north-central Alberta and the Rocky Mountains in northern British Columbia. The majority of the 450 000 people living in the watershed live in the southern portions of the watershed.

Much of the watershed consists of unbroken wilderness. The heaviest land use in the region is oil and gas extraction in central Alberta. This land use along with forestry and agriculture result in water quality in these areas being degraded relative to water in the undeveloped parts of the watershed.

For the 2016 to 2018 period, water quality for 20 sites on rivers draining into Mackenzie River was rated:

- excellent or good at 50% of monitoring sites
- fair at 50% of sites

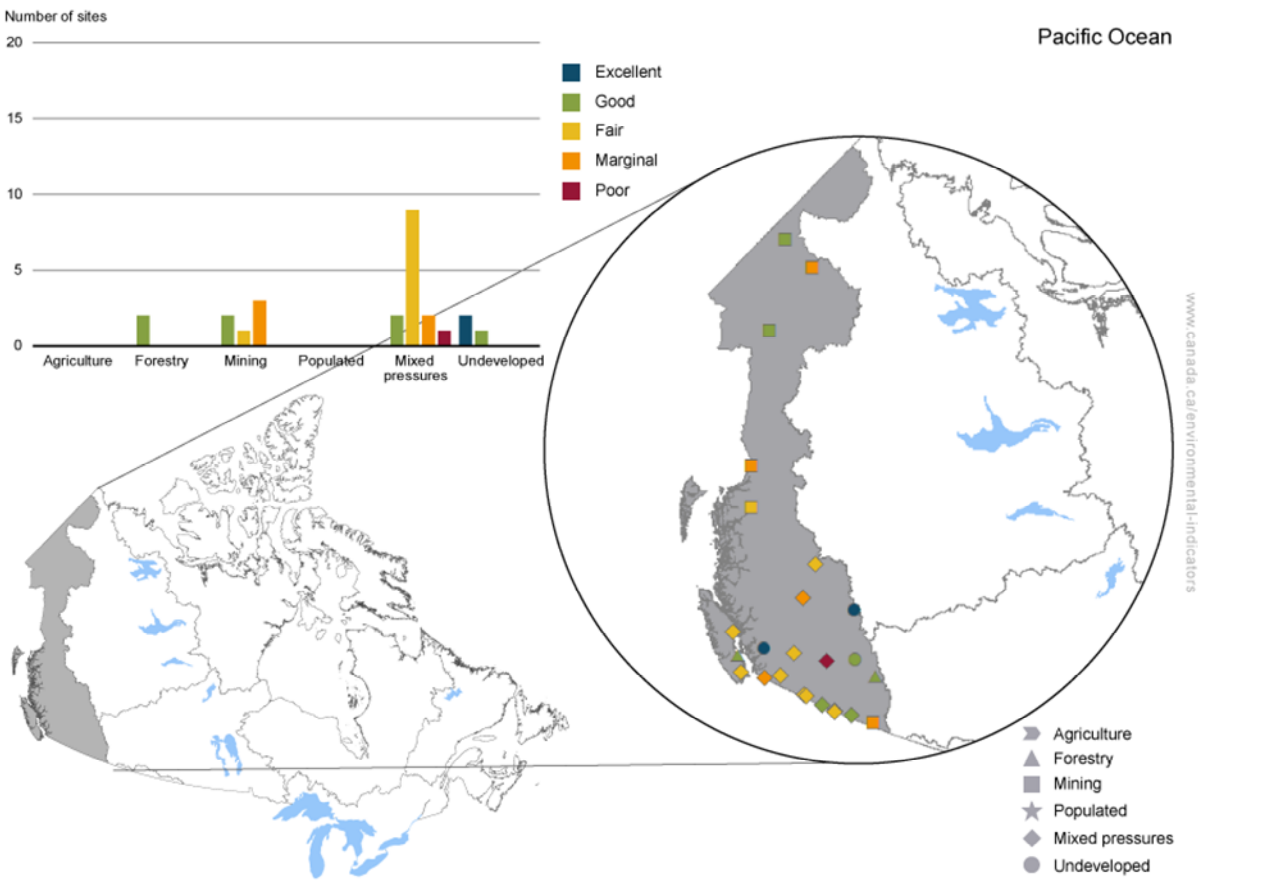
Between the first year of data collection and 2018, water quality has not changed in this region.

Pacific Ocean

Key results

- Water quality in the Pacific Ocean region is generally fair to good
- Marginal or poor water quality is found where there is mining or a combination of mining, forestry activities and high population density

Figure 8. Water quality by land use category, Pacific Ocean region, 2016 to 2018 period



Data for Figure 8

Note: Water quality was assessed at 25 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Rivers draining into the Pacific Ocean flow through varied landscapes, from large areas with little development to one of Canada's largest cities: Vancouver. Roughly 4.4 million people, or 16% of Canadians, live in the Pacific Ocean watershed.

In the Okanagan Valley and Fraser Valley, soil conditions and climate are favourable for orchards, vineyards and cash crops. Cattle ranching is dominant throughout much of the other interior plateau and valley lands.

Mining and forestry are 2 of the region's largest industries. Coal, lead, zinc, copper, gold, silver, molybdenum and other precious metals are actively mined within the Pacific Ocean watershed. Forestry industry consists of pulp and paper and wood product manufacturing as well as logging. Soil erosion, water pollution from mine and pulp and paper effluent released to rivers, and seepage from tailings and waste rock impoundments may have an impact on water quality.

For the 2016 to 2018 period, water quality for 25 sites on rivers draining into the Pacific Ocean was rated:

- excellent or good at 36% of monitoring sites
- fair at 40% of sites
- marginal at 20% of sites
- poor at 4% of sites

Between the first year of data and 2018, water quality has improved at the Cheakamus River, the Kootenay River, the Thompson River, Columbia River, and the Kettle River in British Columbia. These rivers are in relatively undeveloped areas, or in areas with forestry and mining industry. Water quality has deteriorated at the Quinsam River, the Elk River, the Nechako River and at Marguerite and Red Pass on the Fraser River. These sites are in areas where there are mines, forestry activities or cities, except for Red Pass, which is in an undeveloped area. There has been no change in water quality at the remaining 15 sites.

About the indicators

What the indicators measure

These indicators provide a measure of the ability of river water across Canada to support plants and animals. At each monitoring site, specific water quality data are compared to water quality guidelines to create a rating for the site. If measured water quality remains within the guidelines, it can maintain a healthy ecosystem.

Water quality at a monitoring site is considered excellent when parameters in a river almost always meet their guidelines. Conversely, water quality is rated poor when parameters usually do not meet their guidelines, sometimes by a wide margin.

Why these indicators are important

Clean freshwater is an essential resource. It protects aquatic plant and animal biodiversity. We use it for manufacturing, energy production, irrigation, swimming, boating, fishing and for domestic use (for example, drinking, washing). Degraded water quality damages the health of all freshwater ecosystems, such as rivers, lakes, reservoirs and wetlands. It can also disrupt fisheries, tourism and agriculture, and make it more expensive to treat to drinking water standards.

These indicators provide information about the state of surface water quality and its change through time, to support water resource management. They are used to provide information about the status and trends in water quality for the *Canada Water Act* report and Environment and Climate Change Canada's annual departmental performance reports.

Pristine lakes and rivers

These indicators support the measurement of progress towards the following 2019 to 2022 Federal Sustainable Development Strategy long-term goal: Clean and healthy lakes and rivers support economic prosperity and the well-being of Canadians.

In addition, the indicators contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. They are linked to the 2030 Agenda's Goal 6, Clean water and sanitation and Target 6.3, "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally".

The indicators also contribute towards reporting on Target 10 of the 2020 Biodiversity target for Canada: "By 2020, pollution levels in Canadian waters, including pollution from excess nutrients, are reduced or maintained at levels that support healthy aquatic ecosystems."

Related indicators

The Nutrients in the St. Lawrence River, Reductions in phosphorus loads to Lake Winnipeg, and Nutrients in Lake Winnipeg indicators report the state of phosphorus and nitrogen levels in those 2 ecosystems.

The Phosphorus levels in the offshore waters of the Great Lakes indicator reports on the state of and trends in phosphorus levels in the open waters of the Canadian Great Lakes.

The Household use of chemical pesticides and fertilizers indicator reports on how many people in Canada use pesticides and fertilizers on their lawns and gardens.

Data sources and methods

Data sources

Water quality data are collected by federal, provincial and territorial monitoring programs from across Canada. The complete list of data sources from Federal and Provincial monitoring networks can be found in Annex B.

Water quality guidelines for the protection of aquatic life are used to calculate the indicators. They come from the Canadian Council of Ministers of the Environment, the United States Environmental Protection Agency, and provincial and territorial government sources. Where these guidelines do not exist, other guidelines, such as irrigation guidelines, are used. A complete list of water quality guidelines used by each jurisdiction can be found in Annex C.

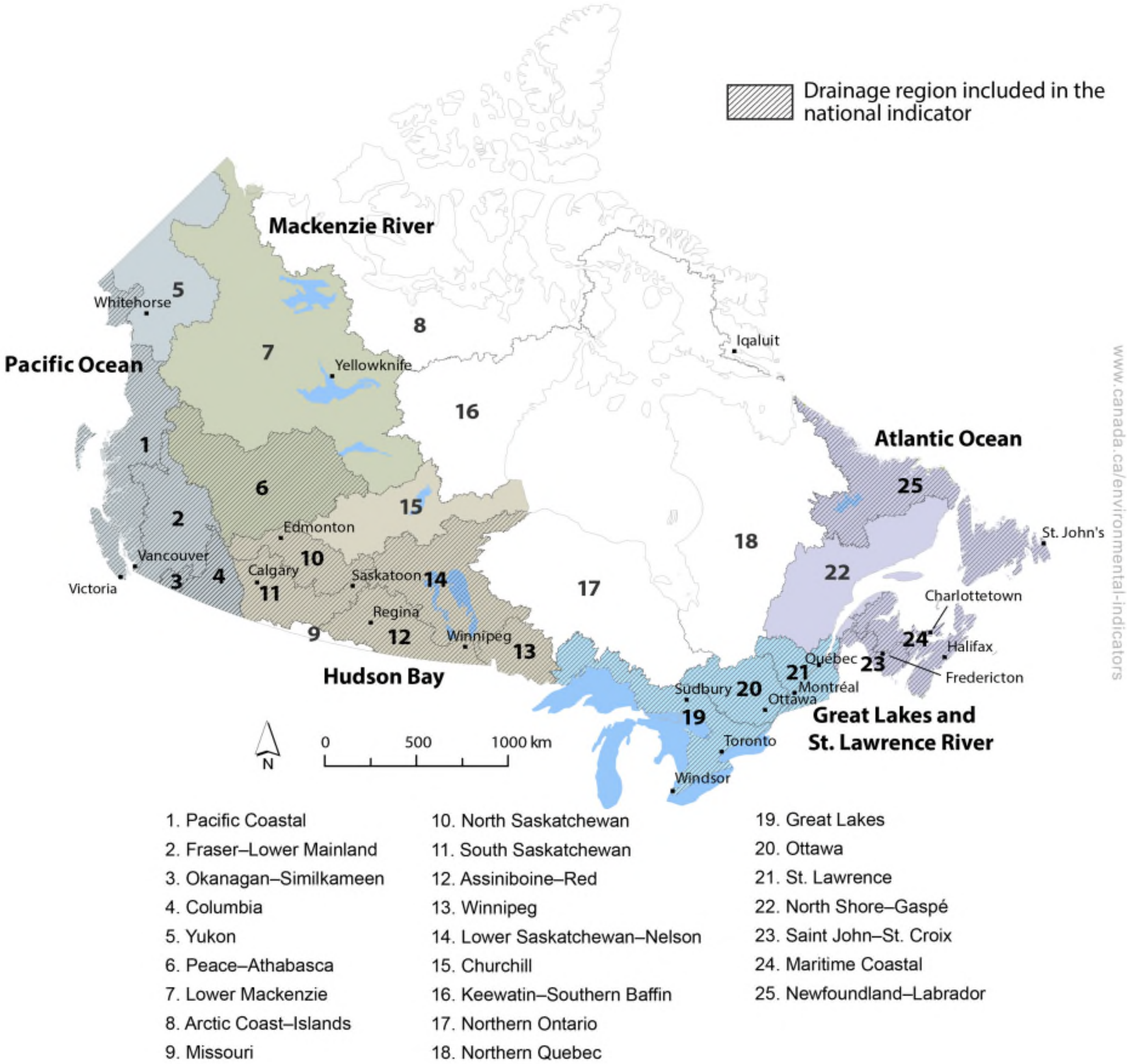
Additional information from Statistics Canada, Natural Resources Canada, Agriculture and Agri-Food Canada, and Environment and Climate Change Canada are used to assess land use.

More information

For the 2016 to 2018 period, water quality data from 174 sites were used to compile the national indicator. These data were drawn from monitoring sites in Canada's 16 southernmost drainage regions. The 16 regions were selected based on population and land use to create the water quality indicator core network for national water quality reporting.

Parts of the Mackenzie River and Pacific Ocean regions fall outside of the 16 drainage regions (Figure 9). In order to ensure proper coverage of these regions in the regional indicator, data for 4 additional sites in Yukon, 4 sites in Alberta, 1 site in Saskatchewan, and 10 sites in the Northwest Territories were used. These additional 19 sites were not included in the national indicator nor the trend analysis. In the Atlantic Ocean region, the North Shore-Gaspé drainage region is not included in the Freshwater Quality Monitoring and Surveillance program.

Figure 9. Geographic extent of the 16 drainage regions selected for the national water quality indicator



Water quality is evaluated at an additional 130 monitoring sites across Canada. Although these additional sites were not used to calculate the indicators, water quality results for all 323 sites can be explored using the interactive water quality map. These additional sites are not included in the calculations because they do not meet the minimum data requirements, detailed in the section below or because including them would over represent the region.

Data used to calculate the indicator include up to a total of 40 measured parameters. These include major ions, physical parameters, trace metals, nutrients and pesticides, as well as pH, temperature and hardness, required to calculate certain guidelines. Sample timing and frequency are set by monitoring programs and vary among sites.

Each data record is tagged with the site name, the date the sample was collected, the name and chemical form of the parameter. Land use and ecological information are also collected for each site. Water quality data, along with water quality indicator scores and site information from the monitoring programs, are stored in a central water quality indicator dictionary housed within a larger database at Environment and Climate Change Canada.

Land use characterization for all monitoring sites was updated in 2019. Land use at each site was determined using:

- population density from Statistics Canada, Population 2016 by dissemination block level
- mine locations using Natural Resources Canada's 2018 Map 900A: Principal Mineral Areas, Producing Mines, and Oil and Gas fields in Canada, Sixty-Eight Edition
- advanced mineral projects locations using Natural Resources Canada’s Advances mineral projects inventory released in February 2019
- oil sands locations using data provided by Alberta Energy, Government of Alberta 2011
- pulp and paper locations using the Environment and Climate Change Canada's National Pollutant Release Inventory (NPRI): Geographic Distribution of NPRI-Reporting Facilities
- forest loss estimated by time-series analysis of 654 178 Landsat 7 ETM+ images in characterizing global forest extent and change from Global Forest Change 2000 to 2012
- agricultural activity locations using Natural Resources Canada's Land Cover 2010, Cropland class
- estimation of livestock using the "Agri-Environmental Indicator (AEI): Livestock Emissions from Agriculture" dataset estimating net emissions produced by livestock from Soil Landscapes of Canada agricultural areas for census years from 1981 to 2011
- land cover using Natural Resources Canada's Land Cover 2010

Data quality assurance and quality control

Data quality assurance/quality control is performed by the monitoring program providing data for the water quality indicators. Each monitoring program follows standardized methods for sample collection in the field. Chemical analyses are performed in Canadian laboratories accredited by the Canadian Association for Laboratory Accreditation or the Standards Council of Canada.

Environment and Climate Change Canada performs further quality assurance/quality control to ensure datasets meet minimum data requirements for the analysis and that calculation standards are respected. This process verifies the number of samples, sample timing, location of monitoring sites, and calculations. It can lead to the removal of water quality data due to low sampling frequencies, erroneous measurements, or where analytical detection limits are higher than the guidelines used in the calculation. Unusually high or low values in the monitoring datasets are double-checked and confirmed through consultation with the data provider.

Minimum data requirements

Calculating the water quality status for most sites requires a minimum of 4 samples per year collected over 3 years. A minimum of 3 samples per year is permitted for northern and remote sites, as access during winter months can be difficult, dangerous and costly. A sensitivity analysis found that there was no significant difference in the water quality index score when mid-winter samples were excluded.[3]

Minimum sampling requirements for the 2016 to 2018 period were not met at 1 site in Newfoundland Labrador and 1 site in Ontario for the national and regional indicators. These sites were excluded.

For a parameter to be included in the calculation of the indicators, a sample value must be available for each year for at least 33% of the total number of samples.

Data timeliness

The indicators were calculated using data from 2016 to 2018, the most recent data available from all monitoring programs.

[3] Statistics Canada (2007) Behaviour Study on the Water Quality Index of the Canadian Council of Ministers of the Environment. Retrieved on September 23, 2019.

Methods

Water quality is reported in these indicators by measuring a number of chemical and physical properties (parameters) in water. The results for each parameter are compared to its water quality guideline.[4]

These indicators are calculated using the water quality index as endorsed by the Canadian Council of Ministers of the Environment.[5] For each site, 5 to 15 water quality parameters are compared to their guideline value using the index calculation. An index score between 1 and 100 is calculated based on these selected parameters. Sites are assigned a water quality category based on the score. The frequency and amplitude by which a parameter does not meet its guideline negatively impacts the water quality score for a given site. The results are grouped into 5 geographical regions for presentation in the Regional water quality in Canadian rivers indicator.

Trends in water quality at each site are evaluated using a guideline deviation ratio. This ratio is calculated by dividing each water quality parameter result by its guideline. Ratios from all parameters are summed, and then averaged annually from 2002 to 2018. The ratios are then multiplied by -1, so that improving water quality will show a positive slope. A Mann-Kendall test is used to assess whether there is a statistically significant increasing (improving water quality) or decreasing (deteriorating water quality) trend in the annual guideline deviation ratios at a site.

Annex C contains a complete list of parameters and guidelines used in each jurisdiction. Information on water quality parameters and guidelines used at individual sites can be found in the interactive water quality map.

More information

Parameter selection

Federal, provincial and territorial water quality experts select the parameters to be assessed at each site based on their knowledge of local water quality stressors. Selected parameters typically include at least one form of the following parameter groups: nutrients (for example, phosphorus, nitrate, nitrite, total nitrogen), metals (for example, zinc, copper, lead), and physico-chemical parameters (for example, pH, turbidity), as well as 2 to 4 regionally specific parameters (for example, chloride, ammonia, dissolved oxygen, pesticides). The water quality index score is based on these selected parameters.

Water quality guideline selection

Water quality guidelines for the protection of aquatic life are recommended limits or statements for a variety of chemical substances and physical parameters, which, if exceeded, may impair aquatic life. These guidelines are based on existing knowledge of a substance's environmental fate, behaviour, and chronic or acute toxicity.

Federal, provincial or territorial water quality experts select the guidelines to use in the calculation of the water quality indicator based on their local relevance. The Canadian Freshwater Quality Guidelines for the Protection of Aquatic Life are recommended if locally relevant. Annex C provides a complete list of guidelines used by provinces and territories and their source.

Background concentrations of naturally-occurring substances and other local river characteristics can impact the measured concentration and toxicity of some substances. In these cases, site-specific guidelines are developed using procedures based on background concentrations[6] or a rapid assessment approach. The rapid assessment approach uses long-term monitoring data and adjusts for natural events, such as high flows, that may influence results.[7]

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[4] Water quality guidelines are thresholds designed to indicate when a chemical or physical property may become harmful to plants and animals.

[5] Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 User's Manual (PDF; 84.3 kB). Retrieved on September 23, 2019.

[6] Canadian Council of Ministers of the Environment (2003) Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives (PDF; 1.25 MB). Retrieved on September 23, 2019.

[7] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Retrieved on September 23, 2019.

Selection of national core sites for the development of the national indicator

Among Canada's 25 drainage regions (Figure 9), 16 were selected based on population and land use to create the water quality indicator core network for national water quality reporting. Within the 16 selected drainage regions, core sites were selected to ensure site drainage areas do not overlap and are independent of one another. The upstream drainage area of each monitoring site was delineated by Statistics Canada using the National Hydro Network.[8] Where the upstream drainage areas of monitoring sites overlapped, the site furthest downstream was retained for the core network, as the downstream site is impacted by the maximum area in the river basin and, to some degree, reflects the cumulative impact of all upstream stresses. For 14 large rivers, core sites were chosen in the upper, mid and lower portions of the main river and at the most downstream sites on each tributary, when available. Additional core sites were included on these rivers, because water travels thousands of kilometres from the source to the mouth of these rivers. Water quality changes along the way and cannot be summarized by a unique downstream monitoring site. The final selection of core sites ensures monitoring sites are well distributed among provinces and drainage regions.

The number of core sites changes from year to year because samples are missed or lost and, as a result, the site may not have the minimum data required to be reported.

Classification of sites

Land use was assessed in the drainage area of core sites and classified according to the criteria presented in Table 1 using the drainage area of each monitoring site.[9] Even if a site’s land use classification is Agriculture, Forestry, Mining or Populated, it does not mean that these are the only activities taking place at that site. These land use classifications were determined to be the most representative of the environmental pressures on each site's drainage area, based on the data available at the time the analysis was done.

[8] Henry M et al. (2009) Canadian Environmental Sustainability Indicators: Water Quality Index Representivity Report, Statistics Canada.

[9] For more information about land cover classes, please see Natural Resources Canada (2017) 2010 Land Cover of Canada. Retrieved on September 23, 2019.

Table 1. Criteria for the classification of land use at monitoring sites

Classification	Agriculture[A]		Forestry[A]		Mining[A]		Populated
	Cropland (percentage)	Livestock intensity[B]	Forest loss (percentage)	Number of pulp, paper or saw mills	Number of mines[C]	Number of advanced mineral projects	Population density (people/km²)
Undeveloped	<1	<0.1	<5	0	0	0	<10
Agriculture (low)	>20	>0.1	<10	0	0	0	<25
Agriculture (medium)	>35	>0.5	<10	0	0	0	<25
Agriculture (high)	>50	>1	<10	0	0	0	<25
Forestry	<1	<0.1	>5	>0	0	0	<25
Mining	<10	<0.1	<5	0	>0	>0	<25
Populated	<10	<0.1	<10	0	0	0	>25
Mixed (agriculture, forestry)	>10	>0.1	>5	>0	0	0	<25
Mixed (agriculture, mining)	>10	>0.1	<5	0	>0	>0	<25
Mixed (agriculture, forestry, mining)	>10	>0.1	>5	>0	>0	>0	<25
Mixed (mining, forestry)	<10	<0.1	>5	>0	>0	>0	<25
Mixed (populated, agriculture)	>10	>0.1	<5	0	0	0	>25
Mixed (populated, agriculture, mining)	>10	>0.1	<5	0	>0	>0	>25
Mixed (populated, forestry, mining)	<10	<0.1	>5	>0	>0	>0	>25
Mixed (populated, agriculture, forestry)	>10	>0.1	>5	>0	0	0	>25
Mixed (populated, forestry)	<10	<0.1	>5	>0	0	0	>25
Mixed (populated, mining)	<10	<0.1	<5	0	>0	>0	>25
Mixed (populated, agriculture, forestry, mining)	>10	>0.1	>5	>0	>0	>0	>25

Note: [A] Either criteria must be met. [B] Livestock intensity was calculated by dividing the total estimated emissions of greenhouse gas by the basin area. The lower value was attributed an intensity value of 0 and the highest value, an intensity value of 1. [C] Mines includes metal mines and mills, non-metal mines, quarries, coal mines, and oil sands mines.

Calculating water quality status

The water quality indicators are calculated using the water quality index, as endorsed by the Canadian Council of Ministers of the Environment. The water quality index calculation considers 3 factors to summarize water quality at a site: scope, frequency and amplitude (Equation 1).

- Scope (F_1) is the percentage of parameters for which the water quality guidelines are not met.
- Frequency (F_2) is the percentage of samples for which the water quality guidelines are not met.
- Amplitude (F_3) refers to the amount by which the water quality guidelines are not met.

The score is normalized to yield a score between 1 and 100.[10] The full set of equations for the water quality index is described in Canadian Council of Ministers of the Environment Water Quality Index 1.0 Technical Report (PDF; 1.40 MB).

Equation 1.

$$\text{Water quality index} = 100 - \sqrt{\frac{F_1^2 + F_2^2 + F_3^2}{3}}$$

Water quality scores are grouped into 5 categories following the Canadian Council of Ministers of the Environment's water quality index (Table 2).

Table 2. Score rankings for the Canadian Council of Ministers of the Environment's water quality index

Ranking	Interpretation
Excellent (95.0 to 100.0)	Water quality is protected with a virtual absence of threat of impairment; conditions are very close to natural.
Good (80.0 to 94.9)	Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.
Fair (65.0 to 79.9)	Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.
Marginal (45.0 to 64.9)	Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.
Poor (0 to 44.9)	Water quality is almost always threatened or impaired; conditions usually depart from natural or desired levels.

Three (3) years of data is used to calculate the indicator. This is to dampen temporal variability in the results caused by annual fluctuations in weather and hydrology, to make the water quality indicators more representative of how humans are impacting water quality in rivers.[11]

Calculation of trends in the water quality

The water quality index formulation can only detect change once parameter values exceed their guidelines, making it a metric that is much less sensitive to change over time. In order to increase trend detection sensitivity, a separate set of calculations and metrics were carried out. This trend analysis allows for the detection of improving or deteriorating trends in water quality status at a site, whether they occur above or below guideline values.

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[10] Canadian Council of Ministers of the Environment (2001) CCME Water Quality Index 1.0 Technical Report (PDF; 1.40 MB). Retrieved on September 23, 2019.

[11] Government of Canada (2008) Technical Guidance Document for Water Quality Indicator Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008, p.15-16. Retrieved on September 23, 2019.

For each year a guideline deviation ratio was calculated by dividing each parameter concentration (C) by its guideline value (G) for each sampling date. The logarithm of the ratios was calculated and averaged for each year to produce a mean annual value (Equation 2). The ratios were multiplied by -1 to invert the values so that improving water quality will show a positive slope to match how water quality is portrayed with the water quality index.

Equation 2.

For each year:

$$\text{guideline deviation ratio} = -1 * \frac{\sum_{j=1}^{n} \sum_{i=1}^{p} \log_{10}\left(\frac{C_{ij}}{G_i}\right)}{T}$$

where,

i = parameters

j = samples

n = total number of samples

p = total number of parameters

C = measured concentration

G = guideline value

T = total number of samples per year

As the parameter concentrations get closer to their guidelines, the guideline deviation ratio gets closer to zero. A guideline deviation ratio below zero means the parameter concentrations are above their recommended guidelines. When parameter concentrations are well below the guidelines, the ratio is above 1.

3 parameters were exceptions:

- Dissolved oxygen and total alkalinity have guidelines for which measurements must be above, rather than below like the majority of parameters. The ratio for dissolved oxygen was calculated by dividing the guideline by the concentration.
- pH measurements must lie within a range of generally 6.5 and 9. The ratio for pH values less than 6.5 was calculated by dividing the lower guideline (6.5) by the concentration (measured pH). For pH values greater than 9, the ratio was calculated by dividing the concentration by the upper guideline (9).
- Where temperature was used as a parameter, the absolute value of the ratio was used if temperatures were below zero.

Current parameters and guidelines at each site were used through the entire record to avoid mistaking methodological changes in the water quality indicator for water quality change. When historical data were missing for a parameter, the parameter was dropped from the trend analysis. Where there was a change in the analytical form of a parameter, and there was no way of converting to the new form, the old dataset was used.

A Mann-Kendall test using the zyp (version 0.10-1.1, 2019) and Kendall packages (version 2.2, 2011) of the statistical software R (version 3.5.2, 2018) was used to detect the presence of statistically-significant trends in the guideline deviation ratios. A count of sites with increasing, declining and no trends in the water quality indicator was compiled for the indicator of change through time.

The trend was calculated using different starting years for each site based on data availability. For this year's calculation, the starting year was: 2002 for 70 sites, 2003 for 54 sites, 2004 for 12 sites, 2005 for 7 sites, 2006 for 28 sites and 2007 for 3 sites.

Recent changes

Updated information and new categories were used to assess land use in the monitored drainage areas.

Caveats and limitations

These indicators reflect the state of water quality in rivers in southern Canada. Northern Canada is under-represented.

An additional 19 non-core sites were included in the regional indicator to allow for coverage of the Mackenzie River region and the Pacific Ocean region, which are not included in the national water quality indicator.

The indicators only use data for a subset of variables where guidelines exist. They do not cover all potential water quality issues in Canada.

The indicators are based on the impacts of a number of parameters at each site. These concentrations do not show the effect of spills or other transient events unless samples were collected right after the spill happened or their effect on water quality is long-lasting.

More information

Water quality guidelines are derived from laboratory studies that do not consider, among other things, the impact of flow on sediment loads in a river. Although site-specific guidelines try to take into account the impact of elevated flows on parameter concentrations, elevated levels of naturally-occurring substances, such as minerals, nutrients, glacier deposits and soils, can lower water quality ratings.

The water quality indicators do not directly measure biological integrity; it measures whether physical and chemical characteristics of freshwaters are acceptable for aquatic life. Although physical and chemical measurements provide good proxies of biological integrity, only biological information provides a direct measurement of conditions for aquatic life.

The water quality indicators only assess the quality of surface waters. Groundwater is not considered in these indicators.

The trends reported are based on annual ratios that aggregate parameter data. In the aggregation, negative and positive trends may cancel each other out. The trends may be different from analyses performed on a parameter by parameter basis.

It can be difficult to compare water quality index scores among sites due to flexibility in the selection of parameters and guidelines to reflect local and regional water quality concerns. The water quality categories assigned based on the scores, however, are comparable. A site classified as marginal has water quality guidelines that are being exceeded frequently and/or by a considerable margin, even if the parameters and guidelines used to make that classification are not exactly the same at all sites.

Only parameters for which water quality guidelines exist can be included in the indicators. The absence of a water quality guideline for a parameter does not mean the parameter is unimportant.

The water quality indicator scores are sensitive to the number of parameters and samples used in their calculation. The number of parameters used in the indicators varies from 5 to 15 depending on the monitoring site, and between 9 and 36 samples can be used for a given parameter. In general, as the number of parameters, or samples, used to calculate the index increases, the score decreases because there is a greater chance of a guideline exceedance.[12]

Water quality varies naturally with weather and hydrological cycles. Although the Water quality in Canadian rivers indicators use a 3-year average to dampen the influence of specific rain fall and snow melt events on the water quality scores, care must be taken in comparing one period to another.

[12] Painter S and Waltho J (2004) Canadian Water Quality Index: A Sensitivity Analysis. Environment and Climate Change Canada.

Resources

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Related information

Navigate data using the interactive map

Access data files

Annexes

Annex A. Data tables for the figures presented in this document

Table A.1. Data for Figure 1. Water quality in Canadian rivers, national and by land use category, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	11	6	15	9	4	2	1	1
Forestry	1	1	11	6	4	2	1	1	0	0
Mining	0	0	4	2	4	2	2	1	0	0
Populated	0	0	0	0	1	1	3	2	0	0
Mixed pressures	3	2	22	13	40	23	20	11	3	2
Undeveloped	5	3	13	7	6	3	0	0	0	0
Total	9	5	61	35	70	40	30	17	4	2

Note: Water quality was evaluated at 174 sites across southern Canada using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification and monitoring sites selection, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.2. Data for Figure 2. Trends in water quality, Canada, 2002 to 2018

Change	Number of sites	Percentage of sites
Improving water quality	29	17
Deteriorating water quality	25	14
No change in water quality	120	69
Total	174	100

Note: The trend in water quality between the first year that data were reported for each site and 2018 was calculated at 174 sites across southern Canada. A Mann-Kendall test was used to assess whether there was a statistically-significant increasing or decreasing trend in the annual guideline deviation ratios at a site. The trend was calculated at each site using parameters specific to the site. Therefore, an improving or a deteriorating water quality does not necessarily imply a change in water quality category. For more information on the trend, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial and joint water quality monitoring programs.

Table A.3. Data for Figure 3. Regional water quality, Canada, 2016 to 2018 period

Water quality category	Atlantic Ocean (number of sites)	Atlantic Ocean (percentage of sites)	Great Lakes and St. Lawrence River (number of sites)	Great Lakes and St. Lawrence River (percentage of sites)	Hudson Bay (number of sites)	Hudson Bay (percentage of sites)	Mackenzie River (number of sites)	Mackenzie River (percentage of sites)	Pacific Ocean (number of sites)	Pacific Ocean (percentage of sites)
Excellent	2	4	0	0	5	11	3	15	2	8
Good	24	53	17	29	14	31	7	35	7	28
Fair	13	29	26	45	18	40	10	50	10	40
Marginal	6	13	13	22	7	16	0	0	5	20
Poor	0	0	2	3	1	2	0	0	1	4
Total	45	100	58	100	45	100	20	100	25	100

Note: For the Regional water quality in Canadian rivers indicator, water quality was assessed at 193 sites across Canada using the Canadian Council of Ministers of the Environment's water quality index. Compared to the national indicator, the Regional water quality in Canadian rivers indicator uses 19 additional monitoring sites and includes more sites in the northern portions of the Mackenzie River and Pacific Ocean regions. Percentages may not add up to 100 due to rounding.
Source: Data assembled by Environment and Climate Change Canada from federal, provincial, territorial and joint water quality monitoring programs.

Table A.4. Data for Figure 4. Water quality by land use category, Atlantic Ocean region, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	3	7	1	2	0	0	0	0
Forestry	1	2	8	18	4	9	1	2	0	0
Mining	0	0	1	2	1	2	0	0	0	0
Populated	0	0	0	0	0	0	3	7	0	0
Mixed pressures	0	0	4	9	2	4	2	4	0	0
Undeveloped	1	2	8	18	5	11	0	0	0	0
Total	2	4	24	53	13	29	6	13	0	0

Note: Water quality was assessed at 45 sites on rivers draining into the Atlantic Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.5. Data for Figure 5. Water quality by land use category, Great Lakes and St. Lawrence River region, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (Percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	3	5	4	7	0	0	0	0
Forestry	0	0	1	2	0	0	0	0	0	0
Mining	0	0	3	5	2	3	0	0	0	0
Populated	0	0	0	0	1	2	0	0	0	0
Mixed pressures	0	0	6	10	18	31	13	22	2	3
Undeveloped	0	0	4	7	1	2	0	0	0	0
Total	0	0	17	29	26	45	13	22	2	3

Note: Water quality was assessed at 58 sites on rivers draining into the Great Lakes or St. Lawrence River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.6. Data for Figure 6. Water quality by land use category, Hudson Bay region, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	5	11	10	22	4	9	1	2
Forestry	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed pressures	3	7	9	20	8	18	3	7	0	0
Undeveloped	2	4	0	0	0	0	0	0	0	0
Total	5	11	14	31	18	40	7	16	1	2

Note: Water quality was assessed at 45 sites on rivers draining into the Hudson Bay using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.7. Data for Figure 7. Water quality by land use category, Mackenzie River region, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	0	0	0	0	0	0	0	0
Mining	0	0	2	10	2	10	0	0	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed pressures	1	5	2	10	5	25	0	0	0	0
Undeveloped	2	10	3	15	3	15	0	0	0	0
Total	3	15	7	35	10	50	0	0	0	0

Note: Water quality was assessed at 20 sites on rivers draining into the Mackenzie River using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Table A.8. Data for Figure 8. Water quality by land use category, Pacific Ocean region, 2016 to 2018 period

Land use category	Excellent (number of sites)	Excellent (percentage of sites)	Good (number of sites)	Good (percentage of sites)	Fair (number of sites)	Fair (percentage of sites)	Marginal (number of sites)	Marginal (percentage of sites)	Poor (number of sites)	Poor (percentage of sites)
Agriculture	0	0	0	0	0	0	0	0	0	0
Forestry	0	0	2	8	0	0	0	0	0	0
Mining	0	0	2	8	1	4	3	12	0	0
Populated	0	0	0	0	0	0	0	0	0	0
Mixed Pressures	0	0	2	8	9	36	2	8	1	4
Undeveloped	2	8	1	4	0	0	0	0	0	0
Total	2	8	7	28	10	40	5	20	1	4

Note: Water quality was assessed at 25 sites on rivers draining into the Pacific Ocean using the Canadian Council of Ministers of the Environment's water quality index. For more information on land use classification, consult the Data sources and methods section. Percentages may not add up to 100 due to rounding.
Source: Water quality data were assembled by Environment and Climate Change Canada from existing federal, provincial, territorial and joint water quality monitoring programs. Population, forestry, mining and land cover statistics for each site's drainage area were provided by Statistics Canada, Natural Resources Canada, Environment and Climate Change Canada, Agriculture and Agri-Food Canada, the Government of Alberta and the University of Maryland.

Annex B. Monitoring programs providing data on ambient water quality

Table B.1. Monitoring programs providing data on ambient water quality

Province/territory	Monitoring program	Organization(s)
All Canada	Environment and Climate Change Canada's water quality monitoring network (NWT, YK, BC, AB, SK, MB, ON, QC, NS, transboundary and interprovincial monitoring sites, federal lands)	Environment and Climate Change Canada
Alberta	Long-term river network monitoring program	Alberta Environment and Parks
British Columbia	Canada–British Columbia Water Quality Monitoring Agreement	British Columbia Ministry of Environment, Environment and Climate Change Canada
Manitoba	Ambient water quality monitoring network	Manitoba Sustainable Development
New Brunswick	Canada–New Brunswick Water Quality Monitoring Agreement	Environment and Climate Change Canada, New Brunswick Department of Environment and Local Government
New Brunswick	Long-range Transport of Atmospheric Pollutants Program	Environment and Climate Change Canada
New Brunswick	Surface water monitoring network	New Brunswick Department of Environment and local government
Newfoundland and Labrador	Canada–Newfoundland and Labrador Water Quality Monitoring Agreement	Environment and Climate Change Canada, Newfoundland and Labrador Department of Municipal Affairs and Environment
Nova Scotia	Long-range Transport of Atmospheric Pollutants Program	Environment and Climate Change Canada
Nova Scotia	Nova Scotia Automated Surface Water Quality Monitoring Network	Nova Scotia Environment
Ontario	Provincial Water Quality Monitoring Network	Ministry of Environment, Conservation and Parks
Prince Edward Island	Canada–Prince Edward Island Memorandum of Agreement on Water	Environment and Climate Change Canada, Prince Edward Island Department of Environment, Water and Climate Change

Province/territory	Monitoring program	Organization(s)
Quebec	Canada–Quebec Water Quality Agreement	Environment and Climate Change Canada, Ministère de l'Environnement et de la Lutte contre les changements climatiques du Québec
Quebec	Réseau-Rivières	Ministère de l'Environnement et de la Lutte contre les changements climatiques du Québec
Saskatchewan	Saskatchewan Water Security Agency Water Quality Monitoring Program	Saskatchewan Water Security Agency
Northwest Territories and Nunavut	Parks Canada Western Arctic parks water quality monitoring program (Aulavik and Tuktut Nogait); Environment and Climate Change Canada-Parks Canada water quality monitoring program in Eastern Arctic parks (Quttinirpaaq and Auyuittuq); Environment and Climate Change Canada-Parks Canada water quality monitoring program in Nahanni National Park; Government of Northwest Territories water quality programs in the Northwest Territories basins (North Slave region); Environment and Climate Change Canada Longterm Water Quality Monitoring Network (sites not within National Parks)	Environment and Climate Change Canada, Parks Canada, Government of Northwest Territories (Environment and Natural Resources)
Yukon	Canada–Yukon Water Quality Monitoring Network; Parks Canada Western Arctic parks water quality monitoring program (Ivvavik National Park)	Yukon Environment, Environment and Climate Change Canada, Parks Canada

Annex C. Water quality guidelines used by each province and territory

Abbreviations used in the following tables:

- 2,4-dichlorophenoxyacetic acid (2,4-D)
- 2-methyl-4-chlorophenoxyacetic acid (MCPA)
- calcium carbonate ($CaCO_3$)
- hexavalent chromium (Cr(VI))
- litre (L)
- microgram (µg)
- milligram (mg)
- nephelometric turbidity unit (NTU)
- nitrogen (N)
- site-specific guidelines (SSG)

Table C.1. Water quality guidelines used in Alberta

Parameter	Form	Guideline	Source
2,4-D[A]	n/a	4 µg/L	1
Aluminium[A]	dissolved	0.1 mg/L for pH ≥ 6.5	1
Ammonia	un-ionized	19 µg/L	1
Arsenic	total	5 µg/L	1
Cadmium[A]	total	$e^{1.0166*\ln[hardness]-3.924}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Chloride[B]	dissolved	120 mg/L	1
Copper[A]	total	7 µg/L	3
Copper[B]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	4
MCPA[A]	n/a	2.6 µg/L	1
Mercury[A]	total inorganic	0.026 µg/L	1
Nickel[B]	total	$e^{0.76*\ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	4
Nitrogen	total	1 mg N/L	3
Oxygen	dissolved	6.5 mg/L	1 3
pH[B]	n/a	between 6.5 and 9	1
Phosphorus	total	0.05 mg/L	3 5
Selenium[A]	total	1 µg/L	4

Parameter	Form	Guideline	Source
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4

Note: n/a = not applicable.
[A] Applies to sites monitored under provincial monitoring programs.
[B] Applies to sites monitored under federal monitoring programs, including the Prairie Provinces Water Board.

Alberta Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001. Retrieved on September 20, 2019.

3 Alberta Environment (2018) Environmental Quality Guidelines for Alberta Surface Waters (PDF; 704 kB). Retrieved on September 20, 2019.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

5 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on September 20, 2019.

Table C.2. Water quality guidelines used in British Columbia

Parameter	Form	Guideline	Source
Alkalinity	n/a	20 mg [$CaCO_3$]/L	1
Arsenic	total	5 µg/L	2
Cadmium	total	$10^{(0.83(\log10[\text{hardness}])-2.46)}$ µg/L for hardness > 50 mg [$CaCO_3$]/L 0.09 µg/L for hardness < 50 mg [$CaCO_3$]/L SSG[A] (certain sites)	2 3
Chloride	total dissolved	120 mg/L	2
Chromium	total	SSG[A]	2 3 4 5 6 7
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2{*}e^{0.8545{*}\ln[\text{hardness}]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L SSG[A] (certain sites)	3 6 8 9 10
Cyanide	total	5 µg/L	2
Fluoride	total	[-51.73+92.57$\log_{10}$(hardness)] X 0.01 ug/L (BC08NM001)	11

Parameter	Form	Guideline	Source
		0.35 mg/L (BC08NN0021)	
Iron	total	0.3 mg/L	9
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L SSG[A] (certain sites)	3 9 10
Manganese	total dissolved	50 µg/L	12
Molybdenum	total	50 µg/L 73 µg/L (BC08MH0027)	2
Nickel	total	$e^{0.76*\ln[\text{hardness}]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	9
Nitrate	total dissolved	2.93 mg N/L	9
Nitrite	total	0.02 mg N/L	9
Nitrogen	total, total dissolved	1.1 mg N/L	13
Oxygen	dissolved	SSG[A]	2 10 14 15 16
pH	n/a	SSG[A]	2 3 14
Phosphorus	total and total dissolved	0.025 mg/L	9 17
Selenium	total dissolved	SSG[A]	11
Silver	total	0.05 µg/L for hardness ≤ 100 mg [$CaCO_3$]/L 1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L SSG[A] (certain sites)	9
Sulphate	dissolved	309 mg/L (BC08MH0027) 218 mg/L (BC08NM0001)	9
Temperature	n/a	SSG[A]	18
Thallium	total	0.8 µg/L	2
Uranium	total	10 µg/L	1
Zinc	total	7.5 µg/L SSG[A] (certain sites)	3 4 6 12 19

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. For details on the derivation of site-specific guidelines, consult BCMOE (1997).

British Columbia Water Quality Guideline Sources:

1 British Columbia Ministry of Environment (2017) British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (PDF; 990 kB). Retrieved on September 20, 2019.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

3 Butcher GA (1992) Lower Columbia River, Hugh Keeleyside dam to Birchbank water quality assessment and objectives: Technical appendix (PDF; 10.2 MB). British Columbia Ministry of the Environment, Lands and Parks. Retrieved on September 20, 2019.

4 British Columbia Ministry of Environment and Climate Change Strategy (2000) Ambient Water Quality Assessment and Objectives for the Lower Columbia River Birchbank to the US border (PDF; 231 kB). Retrieved on September 20, 2019.

5 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2019.

6 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Skeena River at Usk for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2019.

7 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Kootenay River at Kootenay Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2019.

8 British Columbia Ministry of Environment (2019) Copper Water Quality Guideline for the Protection of Marine Aquatic Life (PDF; 592 kB). Retrieved on September 20, 2019.

9 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

10 Obee N (2011) Water Quality Assessment and Objectives for the Cowichan and Koksilah Rivers: First Update. British Columbia Ministry of Environment, Environmental Protection Division and Environmental Sustainability and Strategic Policy Division. Victoria, BC. (PDF; 4.64 MB). Retrieved on September 20, 2019.

11 British Columbia Ministry of Environment and Climate Change Strategy (2018) British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report (PDF; 1.02 MB). Retrieved on September 20, 2019.

12 Swain LG (1990) Ambient Water Quality Objectives for the Similkameen River Okanagan Area Overview Report. British Columbia Ministry of Environment. Retrieved on September 20, 2019.

13 Nordin RN and Pommen LW (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment (PDF; 509 kB). Retrieved on September 20, 2019.

14 British Columbia Ministry of Water, Land and Air Protection (1998) Water Quality Assessment and Recommended Objectives for the Salmon River. MacDonald Environmental Sciences Ltd. Retrieved on September 20, 2019.

15 Swain LG (1987) Takla-Nechako Areas, Nechako River Water Quality Assessment and Objectives. British Columbia Ministry of Environment and Parks. Retrieved on September 20, 2019.

16 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Sumas River at the International Boundary for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on September 20, 2019.

17 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on September 20, 2019.

18 British Columbia Ministry of Environment (2001) Water Quality Guidelines for Temperature: Overview Report (PDF; 222 kB). Retrieved on September 20, 2019.

19 British Columbia Ministry of Environment (1999) Ambient Water Quality Guidelines for Zinc: Overview Report (PDF; 191 kB). Retrieved on September 20, 2019.

Table C.3. Water quality guidelines used in Manitoba

Parameter	Form	Guideline	Source
2,4-D	n/a	4 µg/L	1
Ammonia	total as N	Calculation based on pH and temperature	2 3
Ammonia	un-ionized	19 µg/L	1 4
Arsenic[A]	extractable, total	150 µg/L	5
Arsenic[B]	total	5 µg/L	1
Cadmium[A]	extractable, total	$e^{1.0166*\ln[hardness]-3.924}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	6
Chloride[B]	dissolved	120 mg/L	1
Copper[A]	extractable, total	[$e^{0.8545*\ln[hardness]-1.702}$]*(0.96) µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Copper[B]	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L 0.2*[$e^{0.8545*\ln[hardness]-1.465}$] µg/L for hardness > 90 mg [$CaCO_3$]/L	4
Iron[A]	total	0.3 mg/L	4
Lead[A]	extractable, total	($e^{1.273*\ln[hardness]-4.705}$) * (1.46203 - (ln[hardness]*0.145712)) µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Lead[B]	Total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L where hardness is measured as mg [$CaCO_3$]/L	4
MCPA	n/a	2.6 µg/L	1
Nickel[A]	extractable, total	$e^{0.8460*\ln[hardness]+0.0584}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	5
Nickel[B]	total	$e^{0.76*\ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	4
Nitrate[A]	total dissolved	2.9 mg N/L	4
Nitrogen[B]	total	1 mg N/L	7
Oxygen[A]	dissolved	5 mg/L	4
Oxygen[B]	dissolved	6.5 mg/L	1
pH	n/a	between 6.5 and 9	1
Phosphorus	total	0.05 mg/L	2 7

Parameter	Form	Guideline	Source
Suspended sediments[A]	total	Maximum increase of 25 mg/L for high flow and turbid waters above background levels	4
Zinc[A]	total	$e^{(0.8473*\ln[hardness]+0.884)}*0.986$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2 6
Zinc[B]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	4

Note: n/a = not applicable.
[A] Applies to sites monitored under provincial monitoring programs.
[B] Applies to sites monitored under federal monitoring programs (Prairie Provinces Water Board).

Manitoba Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Manitoba Water Stewardship (2011) Manitoba Water Quality Standards, Objectives, and Guidelines (PDF; 905 kB). Retrieved on September 20, 2019.

3 United States Environmental Protection Agency (1999) Update of Ambient Water Quality Criteria for Ammonia. Document EPA 822-R-99-014. Retrieved on September 20, 2019.

4 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

5 United States Environmental Protection Agency (2019) National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Retrieved on September 20, 2019.

6 United States Environmental Protection Agency (2001) 2001 Update of Ambient Water Quality Criteria for Cadmium. Document EPA 822-R-01-001 (PDF; 10.7MB). Retrieved on September 20, 2019.

7 Prairie Provinces Water Board (1992) Master Agreement on Apportionment. Schedule E: Agreement on Water Quality. Retrieved on September 20, 2019.

Table C.4. Water quality guidelines used in New Brunswick

Parameter	Form	Guideline	Source
Ammonia	un-ionized	19 µg/L	1
Arsenic	total	5 µg/L	2
Chloride	total	120 mg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Iron	total	0.3 mg/L	1
Nitrate	total	2.9 mg N/L	1
Oxygen	dissolved	6.5 mg/L	2
pH	n/a	between 6.5 and 9	2
Phosphorus	total	0.03 mg/L	1

Parameter	Form	Guideline	Source
Turbidity	n/a	10 NTU (SSG[A])	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

New Brunswick Water Quality Guideline Sources:

1 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

Table C.5. Water quality guidelines used in Newfoundland and Labrador

Parameter	Form	Guideline	Source
Chloride	dissolved	120 mg/L	1
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	2
Iron	total	SSG[A]	2 3
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	2
Nickel	total	$e^{0.76*\ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	2
Nitrate	total dissolved	3 mg N/L	2
Oxygen	dissolved	between 5.5 and 9.5 mg/L	1
pH	n/a	SSG[A]	1 3
Phosphorus	total	0.03 mg/L	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness >90 mg [$CaCO_3$]/L	2

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Newfoundland and Labrador Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. September 20, 2019.

3 Khan AA et al. (2005) Application of CCME Procedures for Deriving Site-specific Water Quality Guidelines for the CCME Water Quality Index (PDF; 288 kB). Water Quality Research Journal 40(4):448-456. Retrieved on September 20, 2019.

Table C.6. Water quality guidelines used in the Northwest Territories

Parameter	Form	Guideline	Source
Ammonia	un-ionized, dissolved	SSG[A] (mean + 2 standard deviations)	1
Arsenic	total	SSG[A]	2
Chloride	dissolved	Lentic-lotic sites: 150 mg/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 2
Copper	total	Lentic-lotic sites: 2 µg/L for hardness < 90 mg $[CaCO_3]$/L $0.2*e^{0.8545*\ln[\text{hardness}]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Iron	total	Lentic-lotic sites: 0.3 mg/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Lead	total	Lentic-lotic sites: 1 µg/L for hardness < 50 mg $[CaCO_3]$/L $e^{1.273*\ln[\text{hardness}]-4.705}$ µg/L for hardness ≥ 50 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	1 3
Nitrate and nitrite	total dissolved	SSG[A]	1
Oxygen	dissolved	5 mg/L	2
pH	n/a	Lentic-lotic sites: between 6.5 and 9 Lotic sites: SSG[A] (mean + 2 standard deviations)	1 2
Phosphorus	total	Lentic-lotic sites: 0.03 mg/L Lotic sites: SSG[A] (mean + 2 standard deviations)	2 3
Zinc	total	Lentic-lotic sites: 7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness >90 mg $[CaCO_3]$/L Lotic sites: SSG[A] (mean + 2 standard deviations)	2 3

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Northwest Territories Water Quality Guideline Sources:

1 Lumb A et al. (2006) Application of CCME Water Quality Index to Monitor Water Quality: A Case Study of the Mackenzie River Basin, Canada (PDF; 668 MB). Environmental Monitoring and Assessment 113:411-429. Retrieved on September 20, 2019.

2 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

Table C.7. Water quality guidelines used in Nova Scotia

Parameter	Form	Guideline	Source
Chloride	total	120 mg/L	1
Copper	extractable	2 µg/L for hardness < 90 mg $[CaCO_3]$/L $0.2*e^{0.8545*\ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L	2
Iron	extractable	0.3 mg/L	2
Lead	extractable	1 µg/L for hardness < 60 mg $[CaCO_3]$/L $e^{1.273*\ln[hardness]-4.705}$ µg/L for hardness ≥ 60 mg $[CaCO_3]$/L where hardness is measured as mg $[CaCO_3]$/L	2
Nitrate	dissolved	3 mg N/L	2
Oxygen	dissolved	6.5 mg/L	1
pH	n/a	between 6.5 and 9	1
Phosphorus	total	0.03 mg/L	2
Zinc	extractable	7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg $[CaCO_3]$/L	2

Note: n/a = not applicable.

Nova Scotia Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

Table C.8. Water quality guidelines used in Ontario

Parameter	Form	Guideline	Source
Ammonia	un-ionized	19 µg/L	1 2
Chloride	total	120 mg/L	1
Chromium	total	2 µg/L guideline for Cr(VI) adjusted to total chromium	1
Nickel	total	$e^{0.76*\ln[hardness]+1.06}$ µg/L where hardness is measured as mg $[CaCO_3]$/L	2
Nitrate	total dissolved	2.93 mg N/L	2
Phosphorus	total	0.03 mg/L	2 3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg $[CaCO_3]$/L	2

Ontario Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

3 Ontario Ministry of the Environment and Energy (1994) Water Management Policies, Guidelines, Provincial Water Quality Objectives. Retrieved on September 20, 2019.

Table C.9. Water quality guidelines used on Prince Edward Island

Parameter	Form	Guideline	Source
Chloride	total	120 mg/L	1
Copper	extractable	2 µg/L for hardness < 90 mg $[CaCO_3]$/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg $[CaCO_3]$/L	1
Nitrate	total dissolved	SSG[A]	2
Oxygen	dissolved	6.5 mg/L	1
pH	n/a	between 6.5 and 9	1
Phosphorus	total	SSG[A]	3
Suspended sediments	total	29 mg/L (SSG[A])	1
Zinc	total	7.5 µg/L for hardness ≤ 90 mg $[CaCO_3]$/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg $[CaCO_3]$/L	1

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Prince Edward Island Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Bugden G, Jiang Y, van den Heuvel MR, Vandermeulen H, MacQuarrie KTB, Crane CJ and Raymond BG (2014) Nitrogen Loading Criteria For Estuaries In Prince Edward Island. Canadian Technical Report of Fisheries and Aquatic Sciences 3066 (PDF; 1.14 MB). Fisheries and Oceans Canada. Retrieved on September 20, 2019.

3 Van den Heuvel MR (2009) Site Specific Guidelines for Phosphorus in relation to the Water Quality Index Calculations for Prince Edward Island (PDF; 1.49 MB). Canadian Rivers Institute, University of Prince Edward Island. 35pp. Retrieved on September 20, 2019.

Table C.10. Water quality guidelines used in Quebec

Parameter	Form	Guideline	Source
Ammonia	un-ionized	0.05 mg/L	1
Ammonia[A]	un-ionized	19 µg/L	1 3
Atrazine[A]	n/a	1.8 µg/L	1
Bentazone[A]	n/a	0.51 mg/L	2

Chlorophyll a	n/a	8 mg/L	3
Copper[A]	extractable	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	3
Dicamba[A]	n/a	10 µg/L	1
Mercury[A]	total	0.026 µg/L	1
Metolachlor[A]	n/a	7.8 µg/L	1
Nickel[A]	total	$e^{0.76*ln[hardness]+1.06}$ µg/L where hardness is measured as mg [$CaCO_3$]/L	3
Nitrate and nitrite	total dissolved	2.9 mg N/L	1 3
pH	n/a	between 6.5 and 9	1 2
Phosphorus	total	0.03 mg/L	2
Turbidity	n/a	10 NTU	3
Zinc[A]	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	3

Note: n/a = not applicable.
[A] Only applies to sites monitored under federal monitoring programs.

Quebec Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Ministère du Développement durable, Environnement et Lutte contre les changements climatiques (2017) Critères de la qualité de l'eau de surface (in French only). Retrieved on September 20, 2019.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

Table C.11. Water quality guidelines used in Saskatchewan

Parameter	Form	Guideline	Source
2,4-D	n/a	4 µg/L	1
Ammonia	N	0.0156 mg N/L	3
Arsenic	total	5 µg/L	1
Chloride	dissolved	120 mg/L	1
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	2
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness ≥ 50 mg [$CaCO_3$]/L	2
MCPA	n/a	2.6 µg/L	1
Nickel	total	$e^{0.76*ln[hardness]+1.06}$ µg/L	2

		where hardness is measured as mg [$CaCO_3$]/L	
Nitrate	N	3 mg N/L	3
Oxygen	dissolved	5.5 mg/L	1
pH	n/a	between 6.5 and 9	1
Phosphorus	total	Northern sites: 0.035 mg/L Southern sites: 0.1 mg/L	4
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	2

Note: n/a = not applicable.

Saskatchewan Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

3 Prairie Provinces Water Board (2015). Review of the 1992 Interprovincial Water Quality Objectives and Recommendations for Change. Technical Report to the PPWB Committee on Water Quality, Report #174, Regina. Retrieved on September 20, 2019.

4 Canadian Council of Ministers of the Environment (2004). Canadian Water Quality Guidelines for the Protection of Aquatic Life: Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems. In: Canadian environmental quality guidelines, 2004, Canadian Council of Ministers of the Environment, Winnipeg. Retrieved on September 20, 2019.

Table C.12. Water quality guidelines used in the Yukon

Parameter	Form	Guideline	Source
Arsenic	total	5 µg/L	1
Chromium	total	2.3 µg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	3
Lead	total	1 µg/L for hardness < 50 mg [$CaCO_3$]/L $e^{1.273*ln[hardness]-4.705}$ µg/L for hardness > 50 mg [$CaCO_3$]/L	3
Nitrate	total dissolved	2.93 mg N/L	3
Nitrite	total	0.02 mg N/L	4
Nitrogen	dissolved	0.7 mg N/L	3
Oxygen	dissolved	8 mg/L	5
pH	n/a	between 6.5 and 9	1
Phosphorus	total	0.025 mg/L	3
Selenium	total	1 µg/L	3
Silver	total	0.05 µg/L for hardness < 100 mg [$CaCO_3$]/L	3

		1.9 µg/L for hardness > 100 mg [$CaCO_3$]/L	
Temperature	n/a	SSG[A]	3
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	3

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

Yukon Water Quality Guideline Sources:

1 Canadian Council of Ministers of the Environment (2018) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2019.

2 Environment and Climate Change Canada (2005) Site-specific Water Quality Guidelines for the Liard River at Upper Crossing for the Purpose of National Reporting. Tri-Star Environmental Consulting. Retrieved on December 6, 2016.

3 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2019.

4 Nordin RN and Pommen LW (2009) Water Quality Criteria for Nitrogen (Nitrate, Nitrite, and Ammonia): Overview Report. British Columbia Ministry of Environment and Parks (PDF; 509 kB). Retrieved on September 20, 2019.

5 British Columbia Ministry of Environment (1997) Ambient Water Quality Criteria for Dissolved Oxygen (PDF; 852 kB). British Columbia Ministry of Environment, Water Protection and Sustainability Branch. Victoria, BC. Retrieved on September 20, 2019.

Additional information can be obtained at:

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