

Human Activity and the Environment 2016

Human Activity and the Environment: Freshwater in Canada

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- | | |
|----------------|--|
| . | not available for any reference period |
| .. | not available for a specific reference period |
| ... | not applicable |
| 0 | true zero or a value rounded to zero |
| 0 ^s | value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded |
| ^p | preliminary |
| ^r | revised |
| x | suppressed to meet the confidentiality requirements of the <i>Statistics Act</i> |
| ^E | use with caution |
| F | too unreliable to be published |
| * | significantly different from reference category ($p < 0.05$) |

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Highlights

Human Activity and the Environment 2016: Freshwater in Canada provides up-to-date statistics on freshwater supply and demand and includes maps, charts and tables for each of Canada's 25 [drainage regions](#). The following bullets present selected highlights from the report:

- Canada is rich in [freshwater](#) resources. It has the third largest [renewable freshwater](#) supply worldwide and the second largest amount per capita among developed countries, at 103,899 m³ per person.
- The average annual [water yield](#)¹ for Canada from 1971 to 2013 was 3,478 km³ or 0.349 m³/m², equivalent to a depth of 349 mm across the extent of the country.
- The annual water yield in southern Canada fluctuated over time, from a high of 1,544 km³ in 1974 to a low of 1,165 km³ in 1987. The water yield decreased from 1971 to 1987 and then began a gradual recovery to 2012, with a dip in the late 1990s to early 2000s.
- The Pacific Coastal drainage region in British Columbia had the highest water yield per unit area in the country at 1.5 m³/m². The lowest yields were found in the Missouri, Assiniboine–Red, South Saskatchewan and North Saskatchewan drainage regions in the Prairies, which had an average annual water yield per unit area of 0.05 m³/m².
- Water yield varies throughout the year, with the highest flows generally in spring and early summer. The median monthly water yield for southern Canada from 1971 to 2013 peaked at 218 km³ in May, but dropped to 76 km³ in August, with a low of 50 km³ in February.
- Water yields in the Okanagan–Similkameen and the Assiniboine–Red drainage regions are the most heavily dominated by spring flows—in these areas the median water yields for April, May and June accounted for 75% and 77% respectively of the annual flows over the 1971 to 2013 period. In contrast, the peak median water yields occurred later in the year and declined more gradually in the South and North Saskatchewan drainage regions.
- In 2013, monthly maximum [turbidity](#) values for surface water sources were highest in the Lower Saskatchewan–Nelson, North Saskatchewan and Assiniboine–Red drainage regions in the Prairies and in the St. Lawrence drainage region, while the lowest levels were seen in drainage regions in British Columbia and the Atlantic provinces.
- In 2013, water withdrawals for economic and household activities totaled 37,892 million m³ (37.9 km³). Industry or households withdrew 87% of this water directly from rivers, lakes and groundwater, while the remainder was supplied by drinking water plants. Although some of this water was consumed—for example, lost to evaporation, transpiration or included in products—the majority was returned back to the environment after use.
- The main water users in 2013 were electric power generation, transmission and distribution (68%); manufacturing (10%); households (9%); agriculture (5%) and mining and oil and gas extraction (3%).
- Total household water use was 3,239 million m³ in 2013, down 16% compared to 3,875 million m³ in 2005, while on a per capita basis water use has dropped from approximately 330 L/person/day to 250 L/person/day.
- Looking at water use from the final demand perspective, which attributes water use related to the production of goods and services to the end-user of that product rather than to the producer, households were responsible for 53% of total water use in 2013, followed by the production of goods and services for export at 30%.
- Challenges in balancing water supplies to water demand tend to peak in late summer. The highest surface [water intake](#) to water yield ratios for August 2013 occurred in the Assiniboine–Red and in the Great Lakes drainage regions, followed by the South Saskatchewan and Okanagan–Similkameen. Higher intake to yield ratios point to a higher possibility for water shortages, conflicts between competing uses and the potential for insufficient [instream flows](#) for ecosystem requirements.

¹ Water yield estimates are derived from data on the monthly volume of unregulated flows in Canada's rivers and streams. Although the water yield provides an estimate of renewable freshwater, it can include some water that is considered non-renewable (e.g., melt water from receding glaciers). A more complete discussion of the methodology for estimating water yield is presented in [Appendix D](#) and in Statistics Canada, 2009, "The water yield for Canada as a thirty-year average (1971 to 2000): Concepts, methodology and initial results," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no. 16-001-M, no.7, www.statcan.gc.ca/pub/16-001-m/16-001-m2009007-eng.htm.

Section 1: Introduction

Canada's natural environment produces an abundance of [freshwater](#) that sustains ecosystems and supplies many benefits to people. This freshwater provides vital supplies of drinking water, supports food and timber production, dilutes and carries our wastes, and allows for a myriad of other activities such as hydro-electric production, manufacturing, mining, transport and recreation. Water is also an integral part of [aquatic ecosystems](#), providing habitat for fish and other organisms.

The amount and quality of freshwater supplied to ecosystems varies from year to year, but also according to seasons and across the different regions of the country. This freshwater supply function can be altered and degraded by human activities—for example, climate and land cover change influence aspects of the water cycle (Textbox 1.1), while [runoff](#) and [wastewater discharge](#) from urban areas and from agriculture, forestry, mining and other activities will affect [water quality](#).

Human Activity and the Environment 2016: Freshwater in Canada provides up-to-date statistics on freshwater supply and demand and includes maps, charts and tables for each of Canada's 25 [drainage regions](#). It also provides data on some of the factors that influence the supply and quality of freshwater. The report relies on [hydrometric data](#) tracking streamflow, survey data on drinking water plants, industrial and agricultural water use, as well as data drawn from numerous other sources to characterize some of the pressures affecting the provision of freshwater.

The report is organized as follows:

[Section 2: Freshwater supply and demand](#) provides updated statistics on [water yield](#), water quality and [water use](#).

[Section 3: Drainage region profiles](#) provides highlights, maps, tables and charts characterizing water supply, demand and various factors affecting the provision of freshwater for each of Canada's 25 drainage regions.

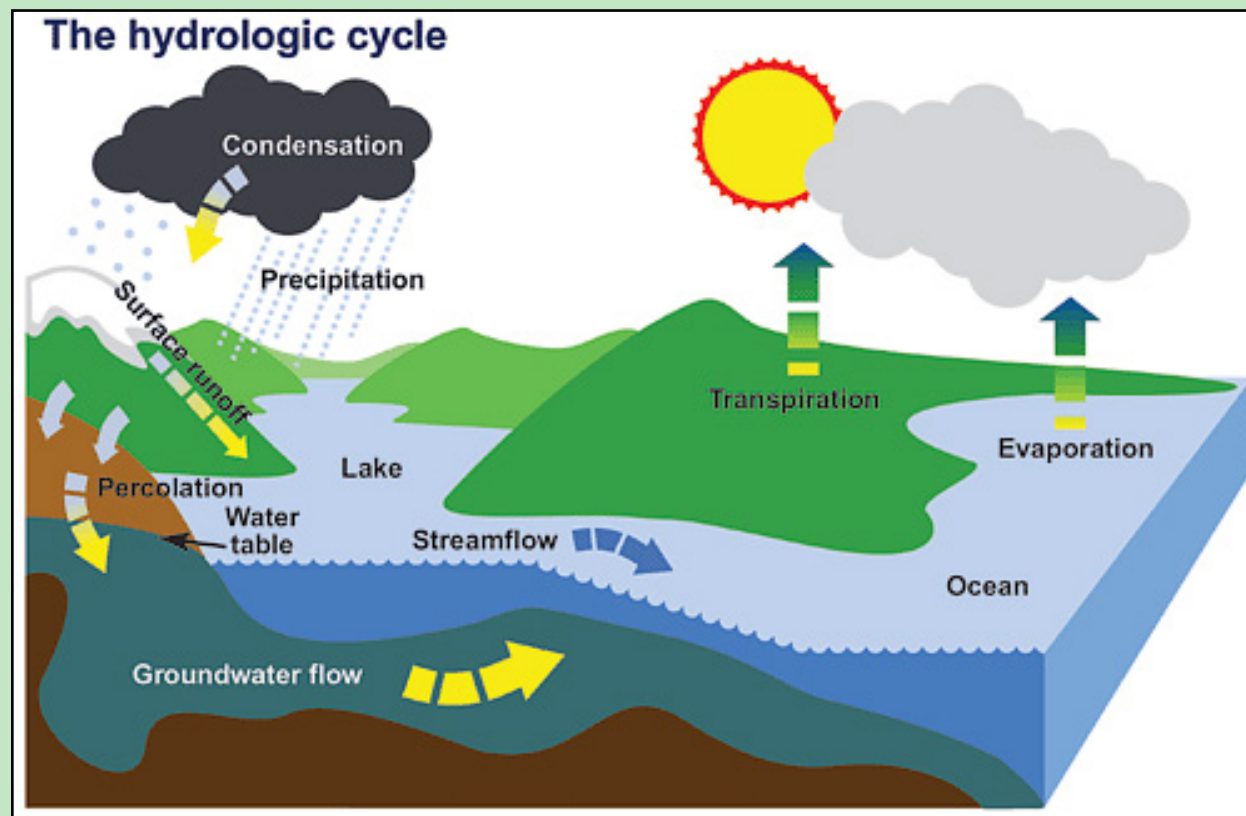
[Appendices](#): include a glossary of water terminology, methodology information, equivalences and comprehensive data tables.

The annual *Human Activity and the Environment* publications bring together data from many sources to present a statistical portrait of Canada's environment, with special emphasis on human activity and its relationship to natural elements—air, water, soil, plants and animals. Each issue provides accessible and relevant information on an environmental issue of concern to Canadians.

Textbox 1.1 What you need to know about this study

The [hydrological cycle](#) describes the continuous movement of water between the earth and the atmosphere (Figure 1.1). Water evaporates from surfaces, sublimates from snow or ice or is transpired by plants. The water vapour rises through the air, cools and condenses, forming clouds. When the water droplets in clouds combine and grow heavier, they fall to the earth as [precipitation](#)—rain, snow or hail. Water is also supplied to ecosystems as dew and fog. It is stored as snowpack and in glaciers, runs overland into streams, rivers and lakes, infiltrates into the soil where it becomes [soil moisture](#), or travels downward through the soil to the water table, becoming [groundwater](#). Groundwater flows slowly underground and is discharged back to surface water systems through wells, springs and seepage into streams, rivers, lakes and oceans. Groundwater can also be stored in [aquifers](#) for hundreds or even thousands of years.

Figure 1.1
Hydrological cycle



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Most water is found in the oceans—**freshwater** makes up less than 3% of water on earth. This freshwater is found in glaciers, ice and snow, in streams, lakes, rivers and wetlands and as groundwater and soil moisture.

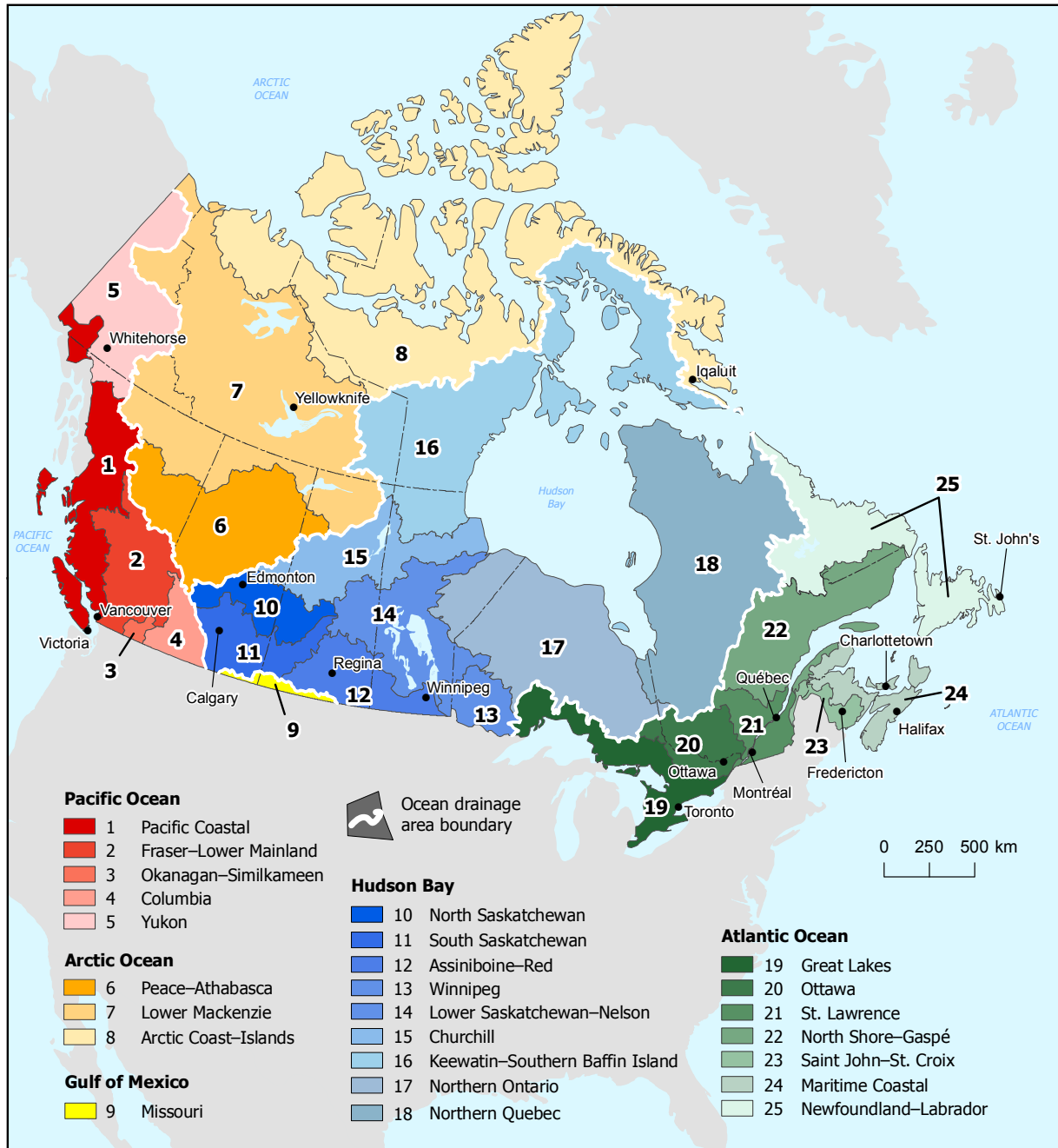
Renewable freshwater refers to the water that regularly replenishes our rivers, lakes and aquifers. Non-renewable freshwater describes water that is stored in deep aquifers, ice caps and glaciers that have a negligible rate of recharge on a human time scale. Some freshwater in the Great Lakes and other major water bodies can also be considered non-renewable since the renewal rates are very low.

The **water yield** is an estimate of renewable freshwater. It is derived from data on the **unregulated flow** of water in rivers and streams in Canada. Although the water yield provides an estimate of renewable freshwater, it can include some water that is considered non-renewable (e.g., melt water from receding glaciers).

Where possible, data are aggregated and presented by drainage region, which groups 974 sub-sub-drainage areas representing all land and interior freshwater bodies into 25 drainage regions (Map 1.1).² These drainage regions can be further grouped according to their outflow into one of five ocean drainage areas: the Pacific Ocean, Arctic Ocean, Gulf of Mexico, Hudson Bay or Atlantic Ocean. This geography is a variant of Statistics Canada's official classification of drainage areas, the Standard Drainage Area Classification (SDAC) 2003 (www.statcan.gc.ca/eng/subjects/standard/sdac/sdac).

² Spatial data files (ArcGIS®, file extension: .shp) for this map can be downloaded from the HTML version of the publication, www.statcan.gc.ca/pub/16-201-x/16-201-x2017000-eng.htm.

Map 1.1 Drainage regions of Canada



Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2009, special tabulation from Pearse, P.H., F. Bertrand and J.W. MacLaren, 1985, *Currents of Change: Final Report of the Inquiry on Federal Water Policy*, Environment Canada, Ottawa.

Section 2: Freshwater supply and demand

Canada is the second largest country in the world and has the third largest renewable freshwater supply worldwide (Table 2.1). Among developed countries, its water resources per capita are exceeded only by Iceland's.³ However, this freshwater is not always easily available for use since it is unevenly distributed across the landmass and its supply varies from month to month and year to year.

Water use per capita is also among the highest in the world—it is surpassed only by the United States. As a proportion of the total renewable freshwater resource, Canadian **water withdrawals** for industry, households and agricultural use are relatively low (1%). However, challenges in balancing supply and use can still be an issue due to the temporal and regional variation of water supply and demand.

Water use and other human activities can also have impacts on the quality of freshwater resources and the health of ecosystems. Monitoring changes in water resources, their quality and use is important, particularly given the changing demand for water resources due to demographic and economic factors, resource development, as well as ongoing changes in precipitation and temperature patterns and extreme weather events.

Table 2.1
Renewable freshwater resources, water use and gross domestic product for selected countries

	Total area, 2014	Population, 2015	Total renewable freshwater resources ¹			Total water withdrawals ²		Gross domestic product, 2014	
			Per year	Per capita	Per area	Per year	Per capita	million US dollars	US dollars per capita ³
	km ²	thousand	km ³ /year	m ³ per capita	m ³ /m ²	km ³ /year	m ³ per capita		
Algeria	2,381,740	39,667	12	294	0.005	8	225	213,518	5,383
Argentina	2,780,400	43,417	876	20,181	0.315	38	898	543,490	12,518
Australia	7,741,220	23,969	492	20,527	0.064	20	824	1,471,439	61,389
Brazil	8,515,770	207,848	8,647	41,603	1.015	75	370	2,346,523	11,290
Canada	9,978,923	35,852	3,478	103,899	0.349	38	1,078	1,785,390	49,799
China	9,600,000	1,407,306	2,840	2,018	0.296	554	411	10,430,590	7,412
Egypt	1,001,450	91,508	58	637	0.058	78	911	282,242	3,084
France	549,090	64,395	211	3,277	0.384	33	521	2,829,192	43,935
Germany	357,170	80,689	154	1,909	0.431	33	411	3,868,291	47,941
India	3,287,260	1,311,051	1,911	1,458	0.581	761	602	2,054,941	1,567
Mexico	1,964,380	127,017	462	3,637	0.235	80	658	1,294,695	10,193
Russian Federation	17,098,250	143,457	4,525	31,543	0.265	66	456	1,849,940	12,895
South Africa	1,219,090	54,490	51	936	0.042	13	270	349,819	6,420
United States	9,831,510	321,774	3,069	9,538	0.312	486	1,543	17,348,072	53,914

1. Renewable water resource data are the long-term total renewable freshwater resources (typically 1961 to 1990) listed in the United Nations AQUASTAT database for 2014, with the exception of Canada, which uses the long term average yield from 1971 to 2012 produced by Statistics Canada. The per capita values for Canada use population from the 2011 Census to be consistent with per capita water yield values by drainage region in Table 2.2.

2. Total water withdrawal volumes are for 2013 for Australia and Canada, 2012 for Algeria, 2011 for Mexico and Argentina, 2010 for France, Germany, Brazil, India, Egypt and the United States, 2005 for China, 2001 for the Russian Federation and 2000 for South Africa. Excluding Canada, total and per capita withdrawal values were taken from the AQUASTAT Main Database. Canada's total and per capita withdrawals were updated to 2013 using Statistics Canada's Physical Flow Account and population estimates.

3. Per capita gross domestic product is calculated using the 2015 population data.

Note: Countries were chosen by reason of historical comparability with *Human Activity and the Environment 2010*, availability of current data and geographic coverage. They include nine of the top ten countries by total area and six of the top ten by total volume of renewable freshwater resources.

Sources: Food and Agriculture Organization of the United Nations, 2016, AQUASTAT Main Database and country-specific factsheets, www.fao.org/nr/water/aquastat/water_res/index.stm (accessed August 15, 2016); United Nations Statistics Division, 2016, "GDP by Type of Expenditure at current prices - US dollars," *National Accounts Estimates of Main Aggregates*, http://data.un.org/Data.aspx?q=GDP+US+dollars&d=SNAAMA&f=grID:101;currID:USD;pcFlag:0&c=2,3,5,6&s=_crEngNameOrderBy:asc,yr:desc&v=1 (accessed May 18, 2016); Statistics Canada, CANSIM Tables 153-0116 and 051-0001, www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as (accessed May 17, 2016).

3 Food and Agriculture Organization of the United Nations, 2016, *AQUASTAT Main Database*, www.fao.org/nr/water/aquastat/water_res/index.stm (accessed May 17, 2016).

2.1 Renewable freshwater in Canada

Canada's many different landscapes and [climate regions](#) result in considerable challenges when measuring when, where, and how much freshwater is provided to ecosystems; how much is available for human use; and if the rate of renewal may be changing over time. As well, water quality varies naturally and can be degraded by human activities (Textbox 2.1).

Water yield

[Water yield](#)⁴ is an estimate of freshwater [runoff](#) into streams and rivers and provides information on Canada's renewable freshwater supply. The average annual water yield for Canada from 1971 to 2013⁵ was 3,478 km³ or 0.349 m³/m², equivalent to a depth of 349 mm across the extent of the country. Overall, this yield corresponds to renewable freshwater resources of 103,899 m³ per person (Table 2.2).

The distribution of water yield varies widely across the country (Map 2.1).⁶ The Pacific Coastal drainage region in British Columbia had the highest water yield per unit area in the country at 1.5 m³/m². On a per capita basis, an average of 339,002 m³ of [renewable water](#) were produced per person in this drainage region.

The lowest yields were found in the Prairies—the average annual water yield per unit area for the Missouri, Assiniboine–Red, South Saskatchewan and North Saskatchewan drainage regions was 0.05 m³/m². Average water yield per capita was also comparatively low—an average of 5,689 m³/person.

4 Water yield estimates are derived from data on the monthly volume of unregulated flows in Canada's rivers and streams. Although the water yield provides an estimate of renewable freshwater, it can include some water that is considered non-renewable (e.g., melt water from receding glaciers). A more complete discussion of the methodology for estimating water yield is presented in [Appendix D](#) and in Statistics Canada, 2009, "The Water Yield for Canada as a Thirty-year Average (1971 to 2000): Concepts, Methodology and Initial Results," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no. 16-001-M, no. 7, www.statcan.gc.ca/pub/16-001-m/16-001-m2009007-eng.htm.

5 The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

6 Spatial data files (ArcGIS®, file extension: .shp) for this map can be downloaded from the HTML version of the publication, www.statcan.gc.ca/pub/16-201-x/16-201-x2017000-eng.htm.

Human Activity and the Environment 2016: Freshwater in Canada

Table 2.2

Average annual water yield and selected statistics by drainage region, 1971 to 2013

		Total area ¹	Population, 2011	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield per capita, 1971 to 2013	Water yield variability index, 1971 to 2013 ³	Average annual evapotranspiration, 1981 to 2010 ⁴
	code	km ²	persons	km ³	m ³ /m ²	m ³ /person	monthly CV	m ³ /m ²
Canada	...	9,978,923	33,476,688	3,478.2	0.35	103,899	1.05	0.23
Pacific Coastal	1	334,455	1,505,007	510.2	1.53	339,002	0.50	0.26
Fraser–Lower Mainland	2	233,104	2,336,941	129.3	0.55	55,337	0.83	0.33
Okanagan–Similkameen	3	15,603	327,548	4.3	0.27	13,070	1.44	0.41
Columbia	4	87,323	160,896	67.9	0.78	422,042	1.04	0.41
Yukon	5	332,906	32,280	106.0	0.32	3,283,759	..	0.14
Peace–Athabasca	6	485,145	406,303	99.5	0.21	244,789	1.01	0.31
Lower Mackenzie	7	1,330,490	52,844	246.3	0.19	4,660,913	..	0.17
Arctic Coast–Islands	8	1,764,280	20,133	231.3	0.13	11,488,870	..	0.11
Missouri	9	27,096	8,439	0.5	0.02	62,660	2.14	0.33
North Saskatchewan	10	150,151	1,559,613	10.4	0.07	6,700	1.04	0.34
South Saskatchewan	11	177,623	2,168,447	10.3	0.06	4,732	1.10	0.34
Assiniboine–Red	12	190,704	1,464,936	8.4	0.04	5,702	2.49	0.39
Winnipeg	13	107,655	82,775	25.9	0.24	312,611	0.87	0.40
Lower Saskatchewan–Nelson	14	360,887	216,586	51.7	0.14	238,501	0.92	0.32
Churchill	15	313,568	94,292	51.0	0.16	541,004	0.75	0.24
Keewatin–Southern Baffin Island	16	939,569	13,968	192.0	0.20	13,745,664	..	0.13
Northern Ontario	17	691,809	134,355	199.2	0.29	1,482,638	..	0.31
Northern Quebec	18	940,193	109,239	516.3	0.55	4,726,324	..	0.18
Great Lakes	19	317,860	11,287,184	133.3	0.42	11,806	0.72	0.48
Ottawa	20	146,353	1,957,937	64.3	0.44	32,858	0.80	0.47
St. Lawrence	21	118,733	6,583,552	72.3	0.61	10,983	0.76	0.39
North Shore–Gaspé	22	369,095	508,869	290.4	0.79	570,600	0.91	0.27
Saint John–St. Croix	23	41,903	413,581	29.8	0.71	72,156	0.89	0.48
Maritime Coastal	24	122,057	1,515,262	103.6	0.85	68,343	1.03	0.47
Newfoundland–Labrador	25	380,361	515,698	324.2	0.85	628,662	..	0.23
Newfoundland (Island) ⁵	...	111,186	487,808	125.6	1.13	257,404	0.62	0.34

1. Total area includes land and water.

2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008).

3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.

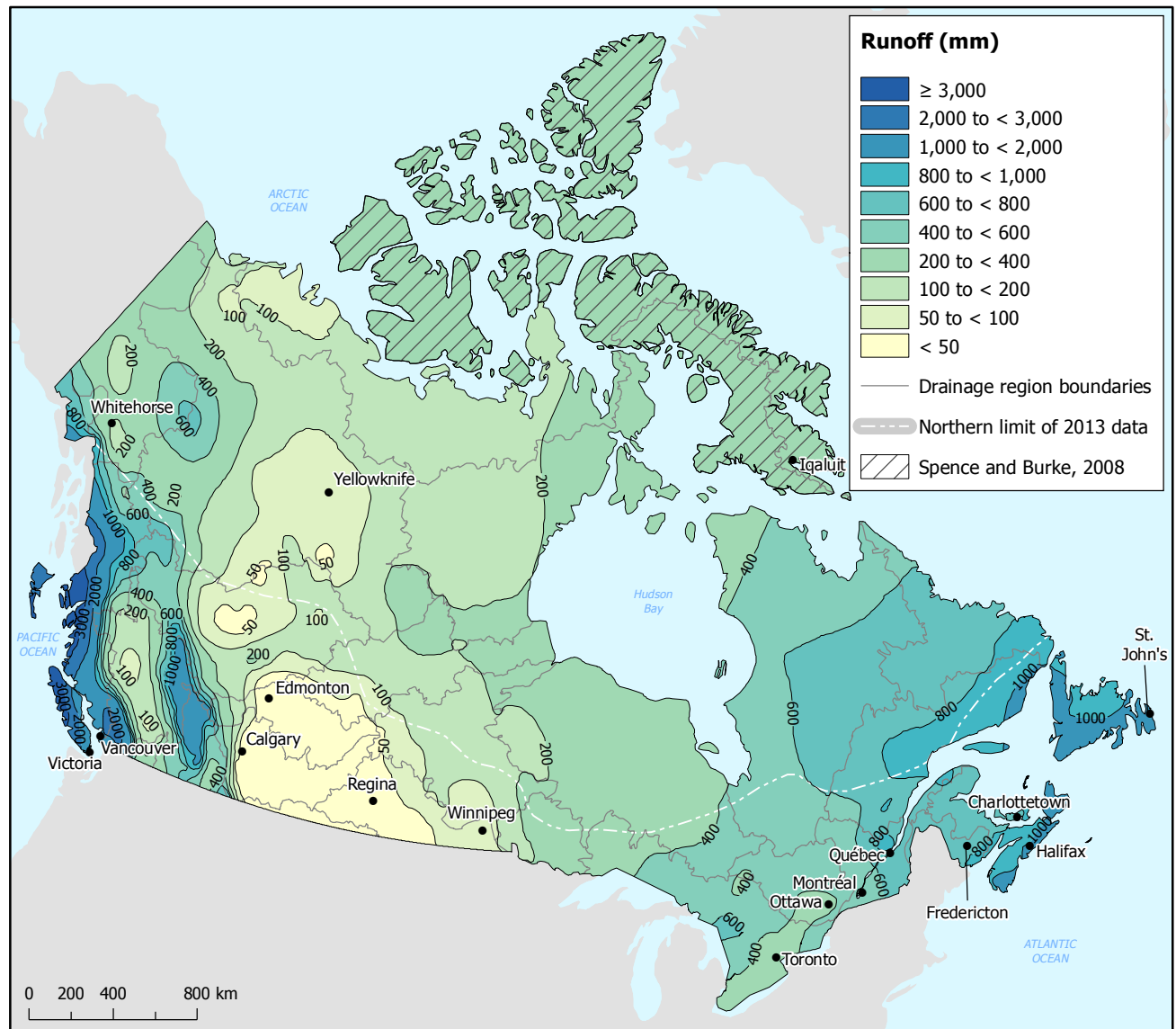
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

5. Data for Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 2011 Census of Population; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3rd, 2015); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247–259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Map 2.1 Average annual runoff in Canada, 1971 to 2013



Note: Runoff data were derived from discharge values from hydrometric stations with natural flows for the period 1971 to 2013 below the boundary delineated on the map and 1971 to 2004 above the boundary line with the exception of the Arctic Islands where estimates were taken from Spence and Burke, 2008.

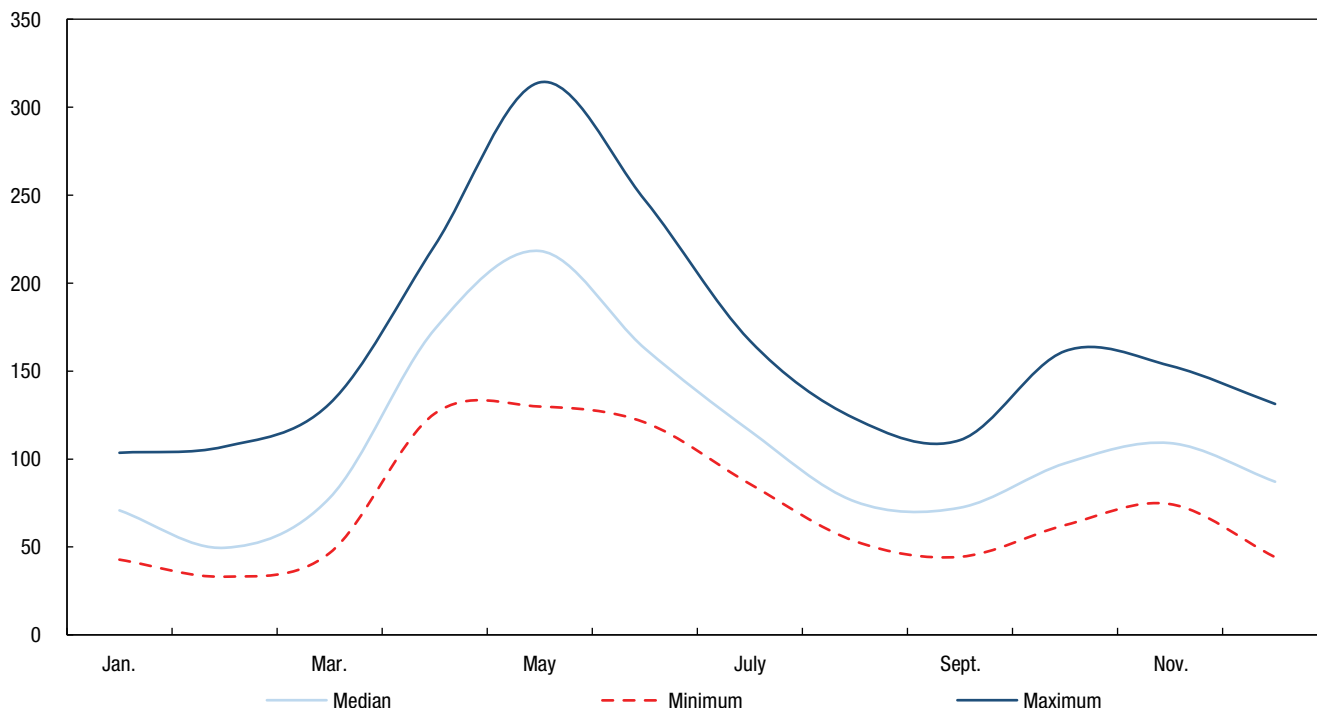
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247–259.

Monthly water yield

Water yield varies throughout the year. In a typical year, most renewable freshwater is produced in spring and early summer, with the peak occurring later in some northern and snow and glacier melt-driven systems. By late summer and fall, water yield typically decreases significantly; however, much of the country experiences the lowest yields in winter. The median monthly water yield from 1971 to 2013 in southern Canada⁷ reached a peak of 218 km³ in May, dropping to 76 km³ in August, with a low of 50 km³ in February (Chart 2.1).

Chart 2.1
Monthly water yield, southern Canada, 1971 to 2013

cubic kilometres



Notes: Southern Canada is a statistical area delineated by a boundary separating the northern from the southern portion of the country. For a map depicting the north-line see Map 2.3 Statistics Canada's North-line in relation to the land mass of Canada in Statistics Canada, 2010, "Freshwater supply and demand in Canada," *Human Activity and the Environment*, Catalogue no. 16-201-X.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division and Business Survey Methodology Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

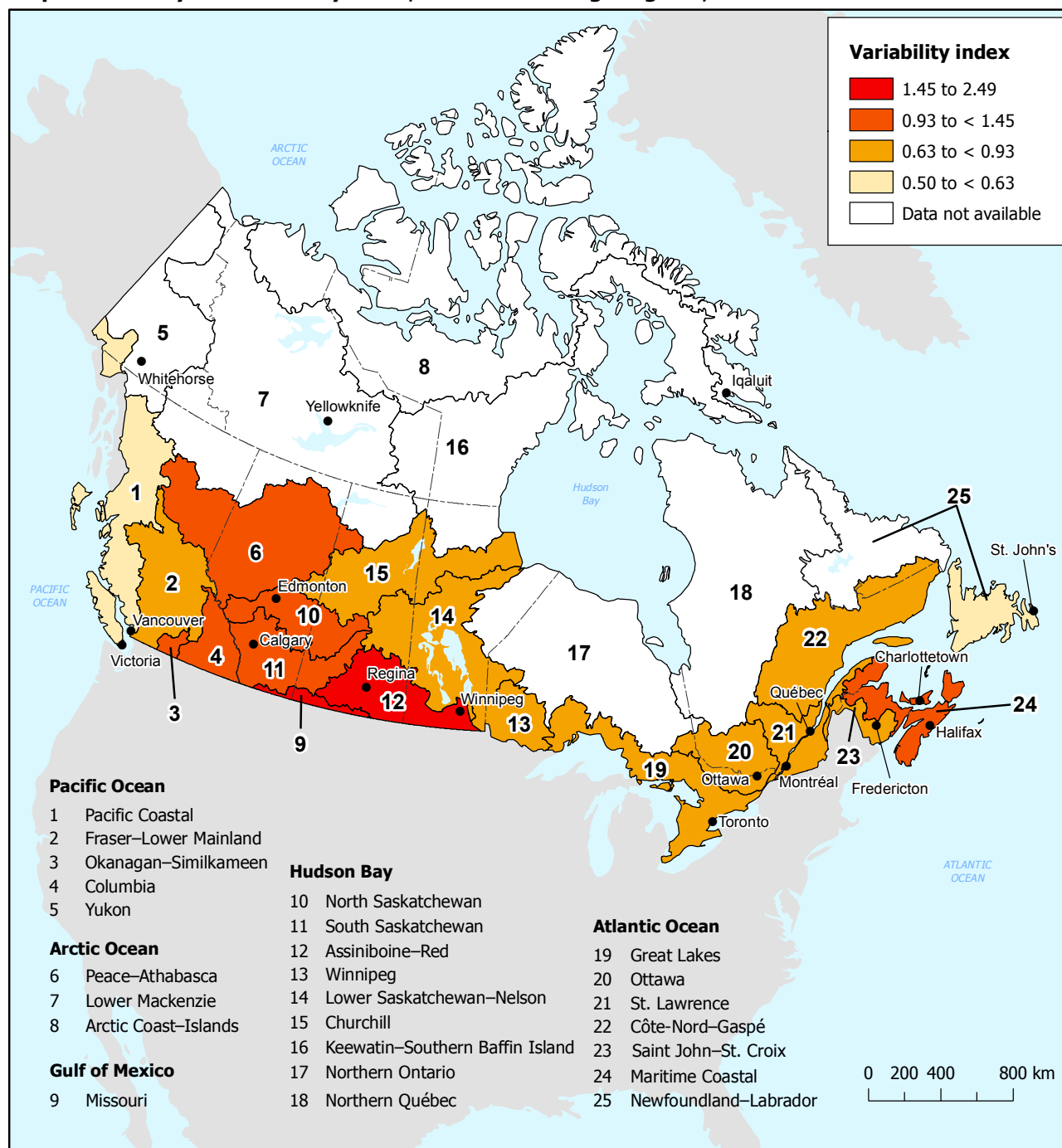
⁷ Southern Canada is a statistical area delineated by a boundary separating the northern from the southern portion of the country. For a map depicting the north-line see Map 2.3 Statistics Canada's North-line in relation to the land mass of Canada (www.statcan.gc.ca/pub/16-201-x/2010000/m018-eng.htm) in Statistics Canada, 2010, "Freshwater supply and demand in Canada," *Human Activity and the Environment*, Catalogue no. 16-201-X.

Water yields in the Okanagan–Similkameen and the Assiniboine–Red drainage regions are the most heavily dominated by spring flows—in these areas the median water yields in April, May and June accounted for 75% and 77% respectively of the annual flows over the 1971 to 2013 period (Maps 3.3.3 and 3.3.12). In contrast, peak median water yields occurred later in the year and declined more gradually in the South and North Saskatchewan drainage regions due to the contribution of snow and ice melt.

The peak water yields occurred in April in the Great Lakes and the St. Lawrence drainage regions, with spring flows in March, April and May accounting for close to half of the annual volumes. Median water yield in the drier summer months of July, August and September accounted for 10% and 14% of the annual flows in these two regions (Maps 3.3.19 and 3.3.21).

Depending on the region, the monthly water yield can also be quite variable from year to year. Water yields are the most variable in the prairie drainage regions (Map 2.2).⁸ The Assiniboine–Red has the highest variability index for monthly flows (Table 2.2) followed by the Missouri, Okanagan–Similkameen and the South Saskatchewan drainage regions. Variability of water yield in the Prairies may result in challenges in satisfying the various demands for water.

⁸ Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year.

Map 2.2 Water yield variability index, selected drainage regions, 1971 to 2013


Notes: Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013 (and 1971 to 2012 for drainage region 1). It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The monthly variability was not calculated for drainage regions 5, 7, 8, 16, 17, 18, or the Labrador portion of 25.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

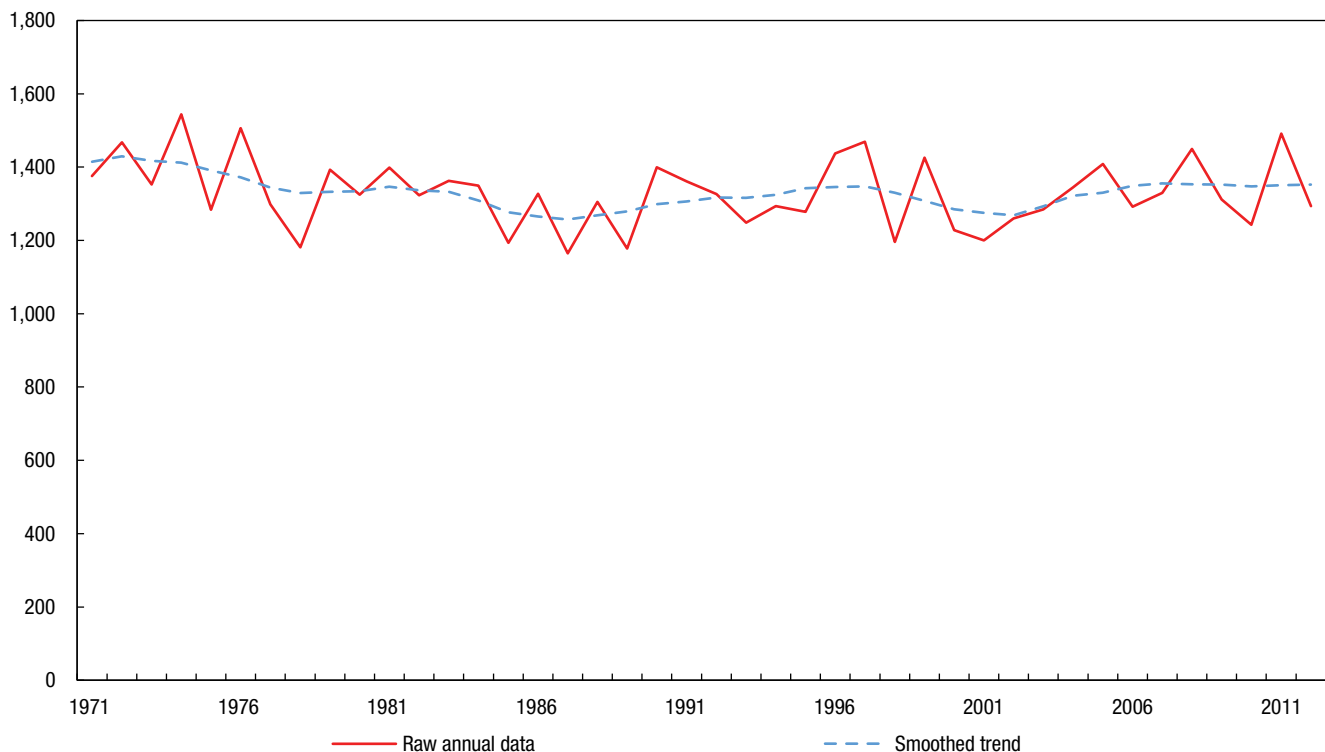
Changes in water yield over time

The water yield varies throughout the year and by geographical area. It also fluctuates over time.⁹ Climate change further alters the regional and temporal characteristics of hydrological conditions (Textbox 2.2).¹⁰

The annual water yield in southern Canada fluctuated from a high of 1,544 km³ in 1974 to a low of 1,165 km³ in 1987 (Chart 2.2). The water yield decreased from 1971 to 1987 and then began a gradual recovery to 2012, with a dip in the late 1990s to early 2000s. Similarly, annual fluctuations are common for individual drainage regions (Charts 2.3, 2.4 and 2.5).

Chart 2.2
Annual water yield, southern Canada, 1971 to 2012

cubic kilometres



Notes: Southern Canada is a statistical area delineated by a boundary separating the northern from the southern portion of the country. For a map depicting the north-line see Map 2.3 Statistics Canada's North-line in relation to the land mass of Canada in Statistics Canada, 2010, "Freshwater supply and demand in Canada," *Human Activity and the Environment*, Catalogue no. 16-201-X.

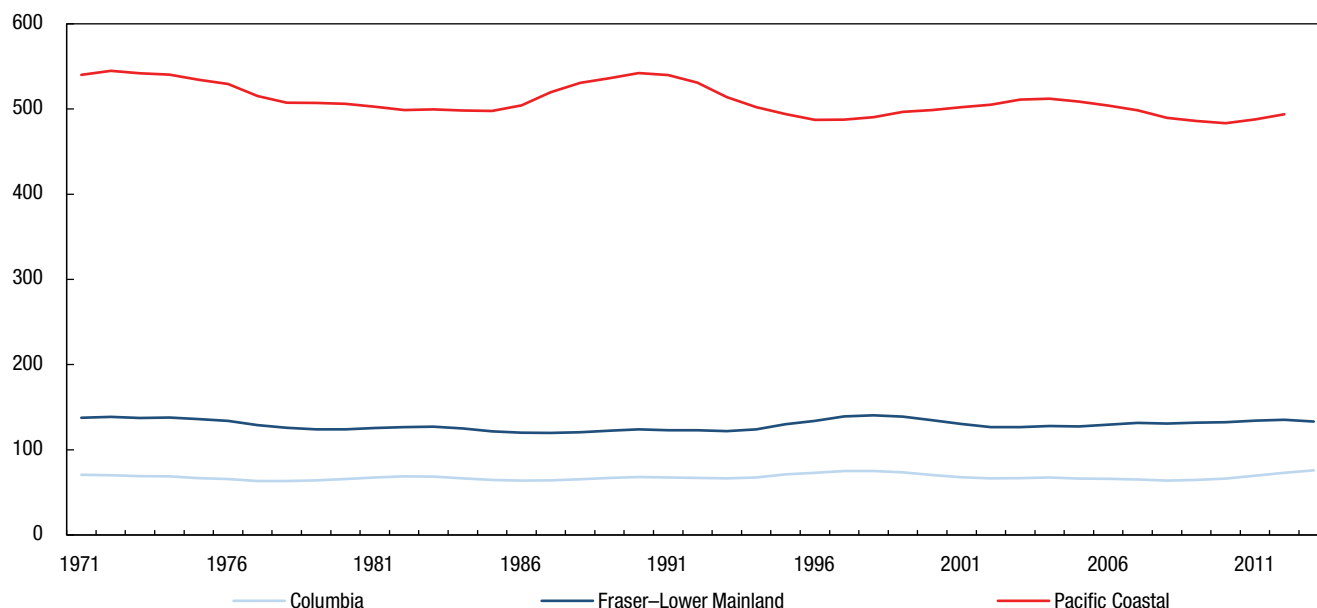
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division and Business Survey Methodology Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

⁹ Significant fluctuations can occur even in long-term average trends, and therefore any change must be interpreted with caution. Changes in the long-term linear trend are not statistically significant for most drainage regions.

¹⁰ Cisneros, J. et al., 2014, "Freshwater Resources," *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*, pp. 229–269, www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap3_FINAL.pdf (accessed August 15, 2016).

Chart 2.3
Annual water yield, Pacific Ocean drainage area, 1971 to 2013

cubic kilometres

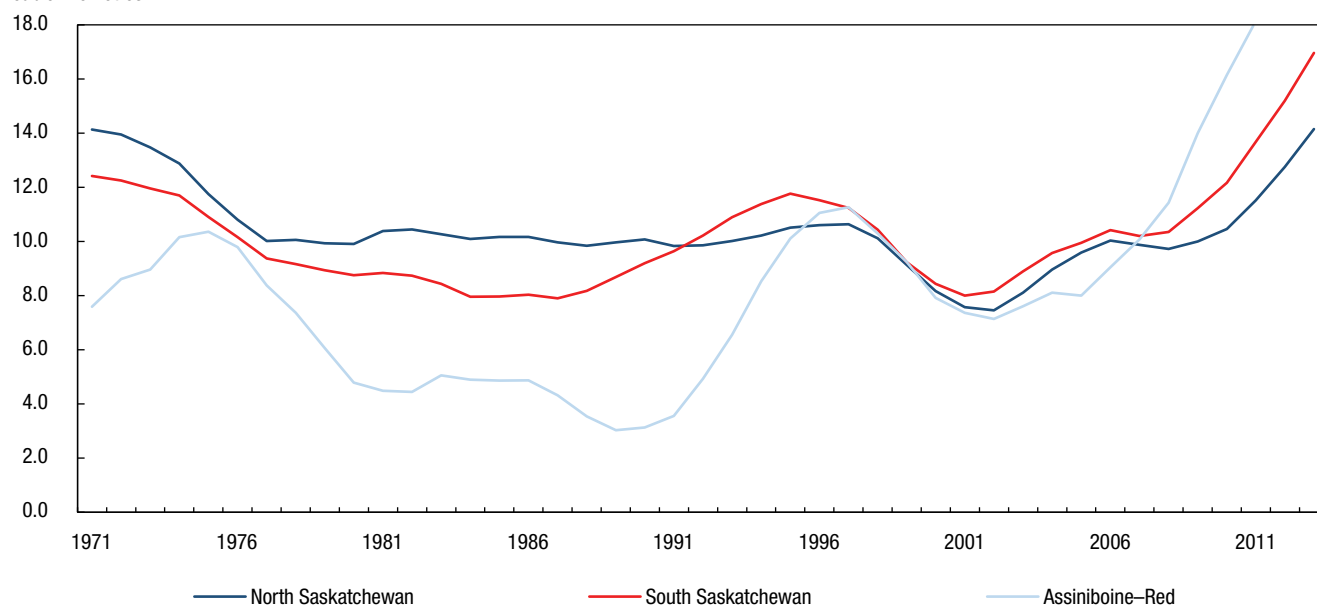


Note: Data for the Pacific Coastal drainage region were not available for 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division and Business Survey Methodology Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

Chart 2.4
Annual water yield, Hudson Bay drainage area, 1971 to 2013

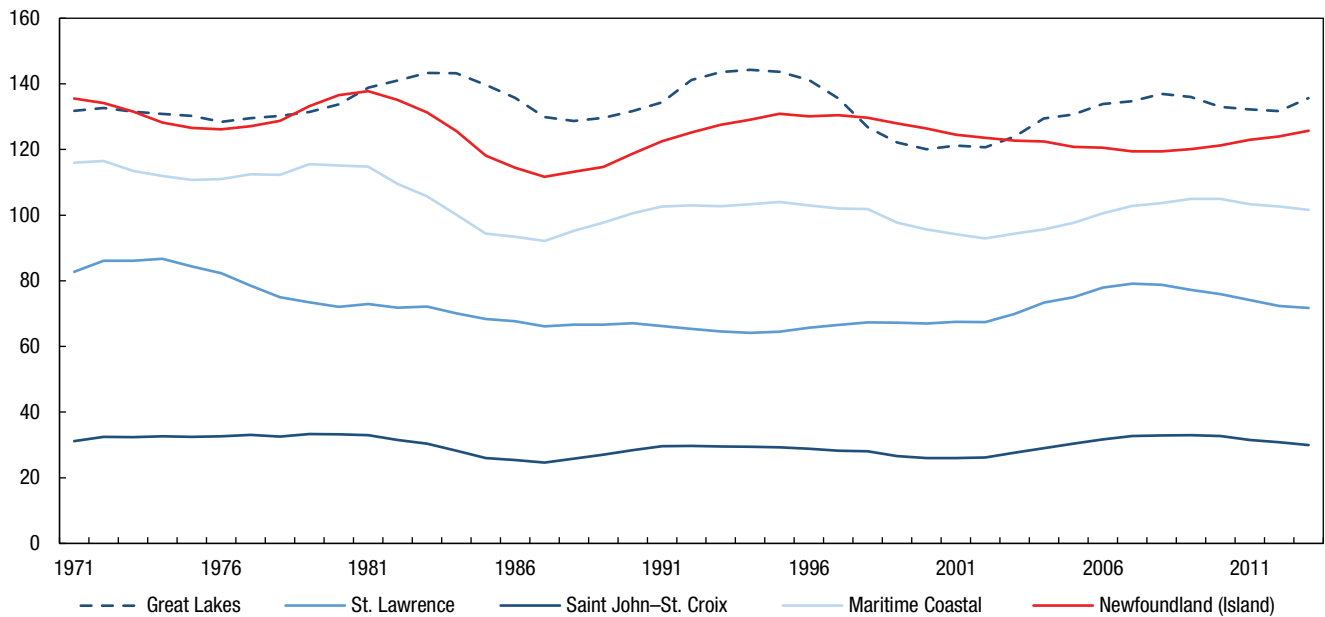
cubic kilometres



Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division and Business Survey Methodology Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

Chart 2.5
Annual water yield, Atlantic Ocean drainage area, 1971 to 2013

cubic kilometres



Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division and Business Survey Methodology Division, 2017, based on data from Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015).

Textbox 2.1 Freshwater quality and the human influence

Canada's large land mass, complex hydrological conditions, changing climate and human activities not only impact the quantities of water yielded by the environment, but also the quality of its waters. This, in turn, impacts the capacity of ecosystems to deliver the services society depends upon—for example, fish, clean water and healthy habitats.

Water quality refers to the physical, chemical and biological properties of water. These properties vary naturally according to environmental factors such as geology, soils and flow rates, which affect the type and quantity of substances dissolved or suspended in the water. Water quality can also be degraded by human activities occurring in the surrounding, upstream and even distant environments. Societies modify the land cover, dam and divert rivers changing the hydrology and emit pollutants directly into water and indirectly via air emissions.

The Freshwater quality in Canadian rivers indicator, produced as part of the Canadian Environmental Sustainability Indicators, provides information on the ability of ambient water to support aquatic life and covers selected rivers at risk of being impaired by human activity. For drainage regions with more than five sites tested, more than 70% include sites with poor or marginal quality (Table 2.3).

Table 2.3
Freshwater quality, by drainage region, 2010 to 2012

	code	Freshwater quality					Total
		Poor	Marginal	Fair	Good	Excellent	
		number of sites					
Canada	...	3	27	64	69	9	172
Pacific Coastal	1	0	0	4	2	0	6
Fraser–Lower Mainland	2	0	2	3	1	1	7
Okanagan–Similkameen	3	0	0	1	1	0	2
Columbia	4	0	0	2	5	0	7
Peace–Athabasca	6	0	1	4	0	1	6
North Saskatchewan	10	0	0	2	4	0	6
South Saskatchewan	11	0	2	2	5	2	11
Assiniboine–Red	12	0	3	9	3	0	15
Winnipeg	13	0	0	0	0	1	1
Lower Saskatchewan–Nelson	14	0	1	4	7	0	12
Great Lakes	19	0	5	6	4	1	16
Ottawa	20	0	1	2	6	1	10
St. Lawrence	21	3	8	12	5	0	28
Saint John–St. Croix	23	0	0	3	7	0	10
Maritime Coastal	24	0	2	7	8	1	18
Newfoundland–Labrador	25	0	2	3	11	1	17

Note: Freshwater quality was assessed at 172 sites using the Canadian Council of Ministers of the Environment's Water Quality Index (www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/calculators.html).

Source: Environment and Climate Change Canada, 2016, "Regional freshwater quality in Canadian rivers," *Canadian Environmental Sustainability Indicators*, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=1C71AB61-1 (accessed April 15, 2016).

Surface water sources used to produce drinking water for communities are monitored so that drinking water plants can ensure appropriate water treatment including filtration and disinfection. One important measure of the quality of source water for drinking water treatment plants is **turbidity**, which refers to the relative cloudiness of water, caused by suspended particles in the water. These particles can include clay, silts, metals, organic matter and microorganisms.¹¹

There is a considerable range in the level of suspended sediment that occurs naturally.¹² These levels vary between watersheds and seasonally within watersheds, generally increasing during spring runoff and declining during summer low-flow periods. Since turbidity can be affected by runoff and erosion, it can therefore be affected by human activities that disturb land, such as construction, logging, mining, farming, as well as many others. Sudden increases in turbidity in water bodies that are normally clear can indicate a water quality problem.

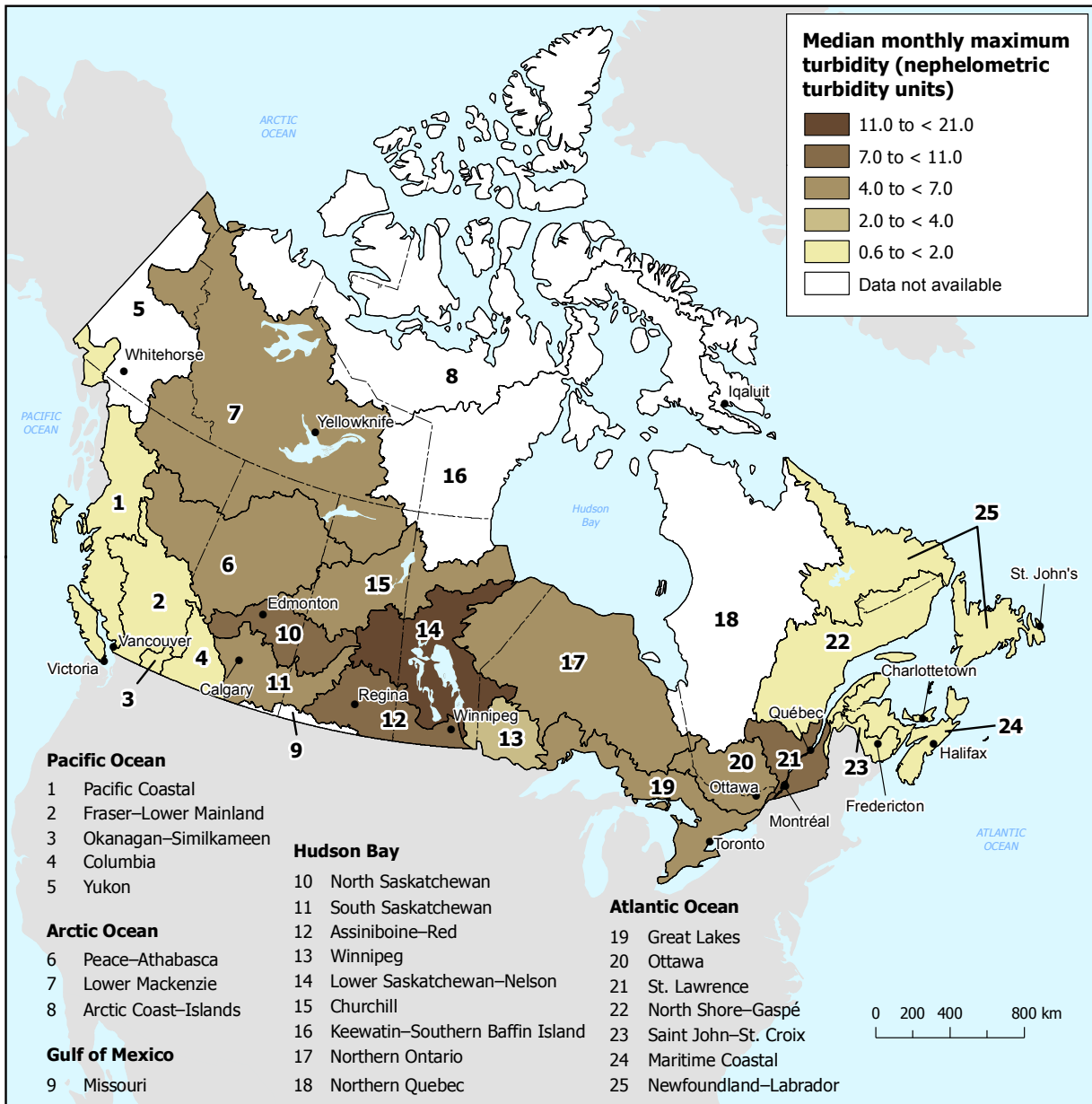
In 2013, the Survey of Drinking Water Plants collected information on monthly maximum turbidity values for surface water sources. These values were highest in the Lower Saskatchewan–Nelson, North Saskatchewan and Assiniboine–Red drainage regions in the Prairies and in the St. Lawrence drainage region, while the lowest levels were seen in drainage regions in British Columbia and the Atlantic provinces (Map 2.3).¹³ Results were similar for 2011.

11 Statistics Canada, 2015, "Source water quality, 2013," *Environment Fact Sheets*, Catalogue no. 16-508-X, www.statcan.gc.ca/pub/16-508-x/16-508-x2015009-eng.htm.

12 Environment and Climate Change Canada, 2016, "Suspended Sediment Load in Select Canadian Rivers," *Erosion & Sedimentation*, www.ec.gc.ca/eau-water/default.asp?lang=En&n=32121A74-1#sec5 (accessed August 11, 2016).

13 Statistics Canada, 2015, "Source water quality, 2013," *Environment Fact Sheets*, Catalogue no. 16-508-X, www.statcan.gc.ca/pub/16-508-x/16-508-x2015009-eng.htm.

Map 2.3 Median values of monthly maximum turbidity in raw surface water sources by drainage region, 2013



Note: Data are for raw surface water sources from facilities that reported turbidity data for at least 10 months in 2013. These facilities served 24 million people and produced 4,091 million cubic metres of potable water from surface water sources in 2013. Source water turbidity was monitored continuously at 42% of these drinking water plants in 2013, was monitored at least daily at 34% of plants and was monitored less frequently at the rest.

Source: Statistics Canada, 2015, "Source water quality, 2013," *Environment Fact Sheets*, Catalogue no. 17-508-X.

Textbox 2.2 A climate of change for the hydrological cycle

Scientific evidence indicates that the hydrological cycle is impacted by climate change.¹⁴ Impacts include increases in water temperatures and [evapotranspiration](#), and variations in precipitation patterns. These variations may include changes in the magnitude, duration, frequency and timing of events such as droughts, storms and floods, and also changes in the regular provision of water.¹⁵

The water environment of individual [biomes](#) is also impacted by these changes. For example, air temperature increases are resulting in [permafrost](#) melting, modifying the hydrology of northern areas.¹⁶ Water quality characteristics are also impacted by a changing climate, for example as a result of the influence of temperature increases on water-born nutrients or storm intensity on turbidity.¹⁷

Temperature change and evapotranspiration

A recent study of the 1948 to 2015 period demonstrates that average air temperatures have increased in all eleven [climate regions](#) of the country, with the most prominent increases occurring in some of the northern climate regions.¹⁸ These temperature increases also contribute to the warming of marine surface waters. Ocean surface temperatures have increased from 1.0°C to 2.6°C along the Atlantic Coast and 0.7°C to 1.1°C along the Pacific Coast from 1901 to 2014 (Map. 2.4). Warmer oceans further intensify climatic events.¹⁹

14 Cisneros, J. et al., 2014, "Freshwater Resources," *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*, pp. 229–269, www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap3_FINAL.pdf (accessed August 15, 2016).

15 Cisneros, J. et al., 2014, "Freshwater Resources," pp. 229–269; Kundzewicz, Z.W. et al., 2013, "Flood risk and climate change: global and regional perspectives," *Hydrological Sciences Journal*, Vol. 59, no. 1, p. 1–28.

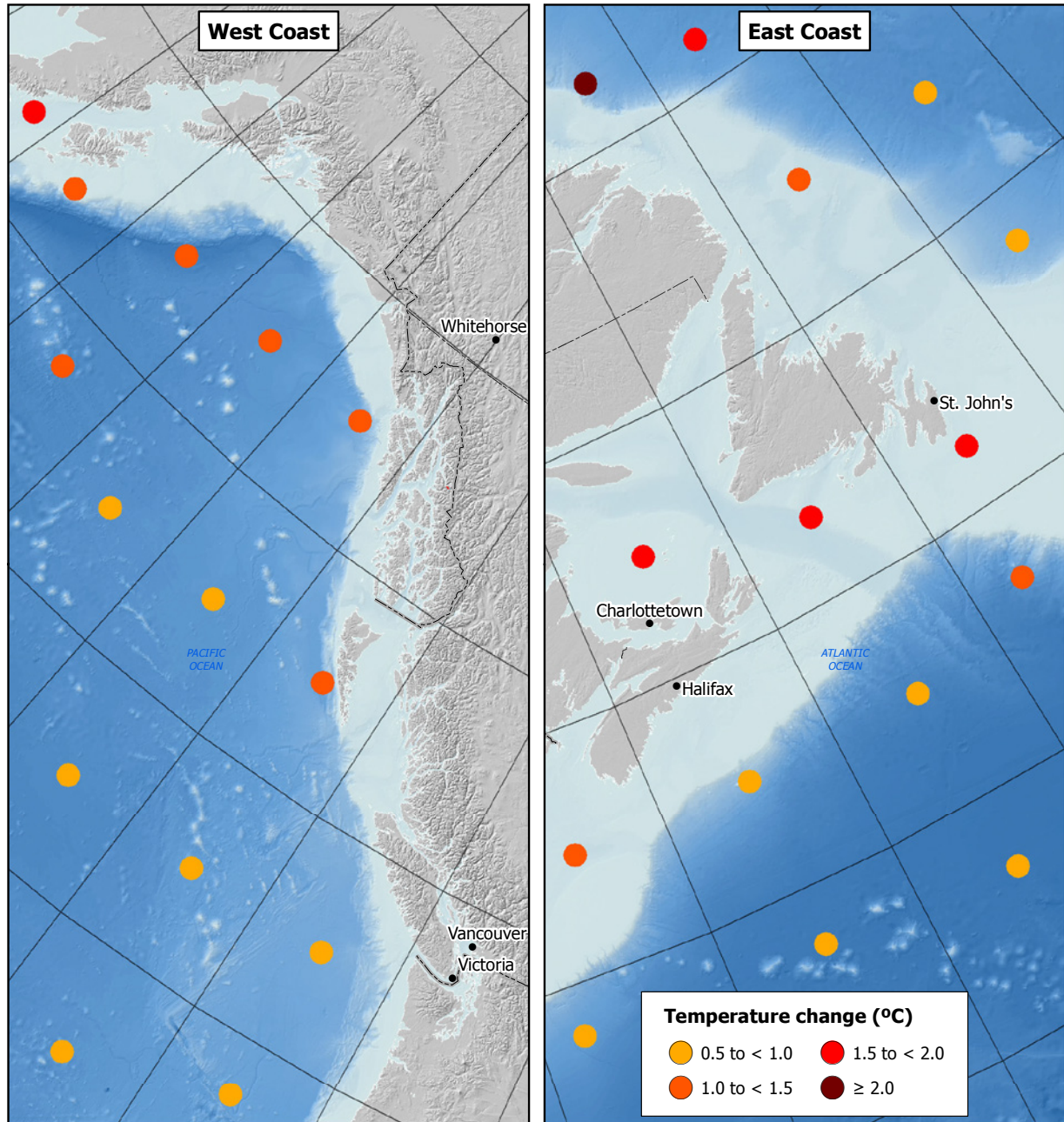
16 Cisneros, J. et al., 2014, "Freshwater Resources," pp. 229–269.

17 Cisneros, J. et al., 2014, "Freshwater Resources," pp. 229–269; Mukundan, R. et al., 2013, "Suspended sediment source areas and future climate impact on soil erosion and sediment yield in a New York City water supply watershed, USA," *Geomorphology*, Vol. 183, pp. 110–119, doi: 10.1016/j.geomorph.2012.06.021.

18 Environment and Climate Change Canada, 2016, *Climate Trends and Variability Bulletin—Annual 2015*, www.ec.gc.ca/sc-cs/default.asp?lang=En&n=7150CD6C-1 (accessed August 18, 2016).

19 United States Environmental Protection Agency, 2016, *Climate Change Indicators in the United States*, 2016, Fourth Edition, EPA 430-R-16-004, pp. 1–96, www.epa.gov/climate-indicators (accessed August 18, 2016).

Map 2.4 Average sea surface temperature change, 1901 to 2014



Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from National Oceanic and Atmospheric Administration, 2015, *Merged Land–Ocean Surface Temperature Analysis: Global gridded 5° x 5° data*, National Centers for Environmental Information, <ftp://ftp.ncdc.noaa.gov/pub/data/mlost/operational> (accessed May 16, 2016).

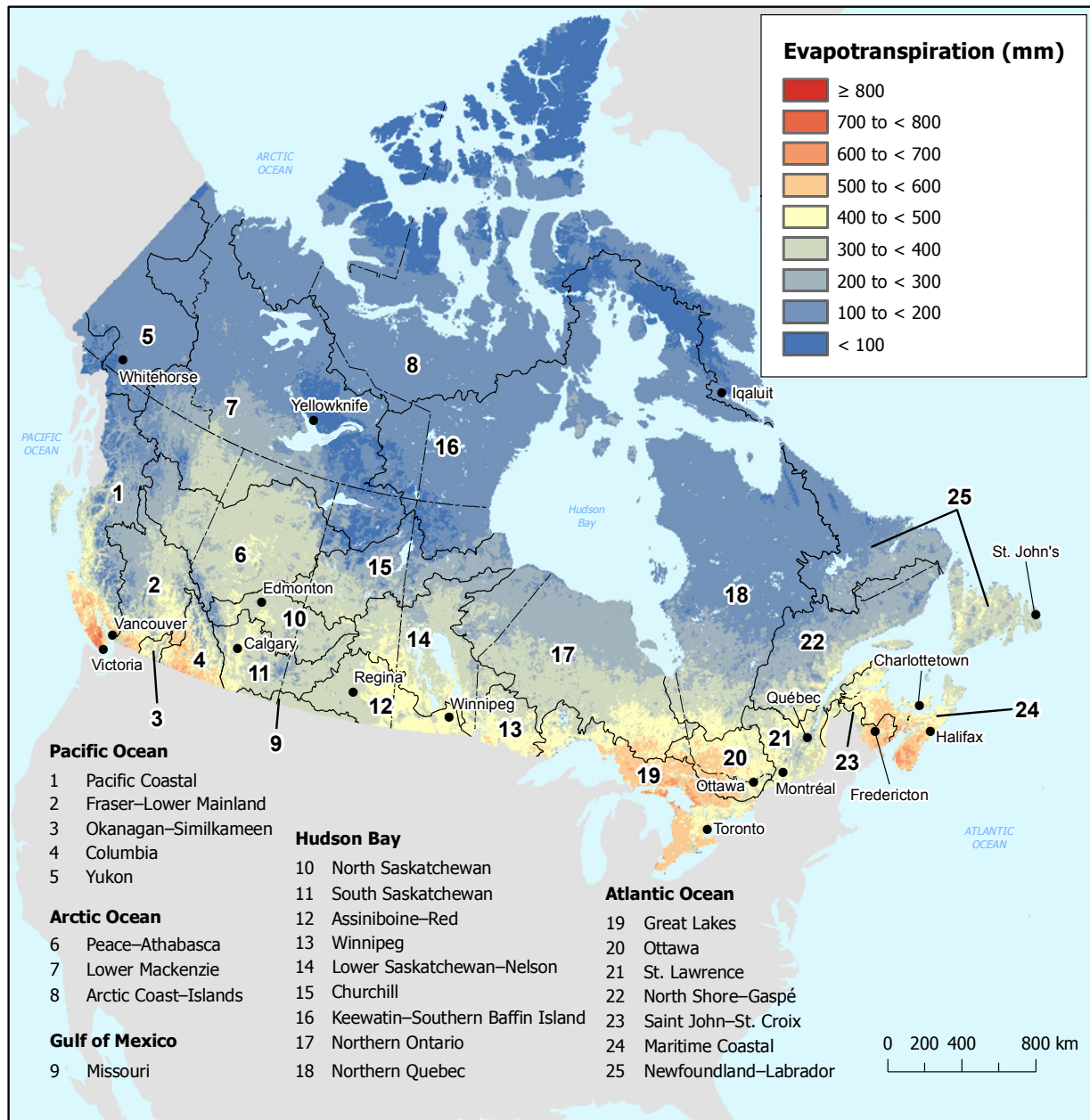
Evapotranspiration—the combined processes of evaporation from land surfaces, water bodies and transpiration from plants—provides the atmospheric water vapour required for precipitation. Solar radiation, air and water temperature, soil moisture, air humidity, wind speed, vegetative cover and root depth, among other factors, influence the amount of water transferred from the surface of the earth to the atmosphere.

Significant amounts of freshwater can be lost to evapotranspiration, particularly during the hot summer months, reducing the amount of surface runoff and the volume of water stored above ground. Subsurface water assets are also impacted with a diminished groundwater recharge and loss of soil moisture. In Canada, an estimated 2,257 km³ of water is transferred to the atmosphere each year by these two processes.²⁰

The highest average annual volumes of water lost to evapotranspiration occurred in the Great Lakes, Saint-John–St. Croix, Maritime Coastal, Ottawa, Okanagan–Similkameen, Columbia, Winnipeg, Assiniboine–Red and St. Lawrence drainage regions (Table 2.2 and Map 2.5). The lowest values occurred in the North.

²⁰ Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation of Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Map 2.5 Average annual evapotranspiration, 1981 to 2010



Note: Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface area and gridded climate data. Data exclude Great Lakes.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation of Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no.9, pp. 3561–3575, doi:10.5194/hess-17-3561-2013.

Climate change, permafrost and peatland ecosystems

One type of ecosystem already affected by climate change is peatlands. Canada has over 1.1 million square kilometres of [peatlands](#), covering 12% of its total land area.²¹ These organic wetlands provide valuable ecosystem services by storing carbon, providing unique habitats and regulating water flow. More than one-third of Canada's peatland area is frozen throughout the year as permafrost. These frozen peatlands store large quantities of water in their soils.

The Mackenzie and Northwestern Forest climate regions²² of north-central Canada contain approximately 462,117 km² of peatlands, 58% of which are permafrost (Map 2.6).²³ In these peatland-dominated climate regions, average annual temperatures have increased by 2.6°C and 1.9°C respectively from 1948 to 2015,²⁴ resulting in thawing permafrost. Temperature changes are even larger in the winter.²⁵

These changes have resulted in increased fire susceptibility;²⁶ increased emissions of greenhouse gases such as carbon dioxide, nitrous oxide²⁷ and methane;²⁸ increased [groundwater recharge](#) and surface water flow;²⁹ and modification of plant and animal habitat.³⁰

21 Tarnocai, C., 2009, "The impact of climate change on Canadian Peatlands," *Canadian Water Resources Journal*, Vol. 34, no. 4, pp. 453–466.

22 See Map 2.1 Canadian Climatic Regions in Statistics Canada, 2011, *Human Activity and the Environment: Detailed Statistics*, Catalogue no. 16-201-S, www.statcan.gc.ca/pub/16-201-s/2011001/m005-eng.htm.

23 Tarnocai, C., I.M. Kettles and B. Lacelle, 2005, *Peatlands of Canada*, Agriculture and Agri-Food Canada, Research Branch, Ottawa (digital database).

24 Environment and Climate Change Canada, 2016, *Climate Trends and Variability Bulletin—Annual 2015*, www.ec.gc.ca/sc-cs/default.asp?lang=En&n=7150CD6C-1 (accessed August 18, 2016).

25 Environment and Climate Change Canada, 2016, *Climate Trends and Variations Bulletin—Winter 2015-2016*, www.ec.gc.ca/sc-cs/default.asp?lang=En&n=55965A8C-1 (accessed August 18, 2016).

26 Flannigan, M., B. Stocks, M. Turetsky and M. Wotton, 2008, "Impacts of climate change on fire activity and fire management in the circumboreal forest," *Global Change Biology*, Vol. 14, pp. 1–13, doi: 10.1111/j.1365-2486.2008.01660.x.

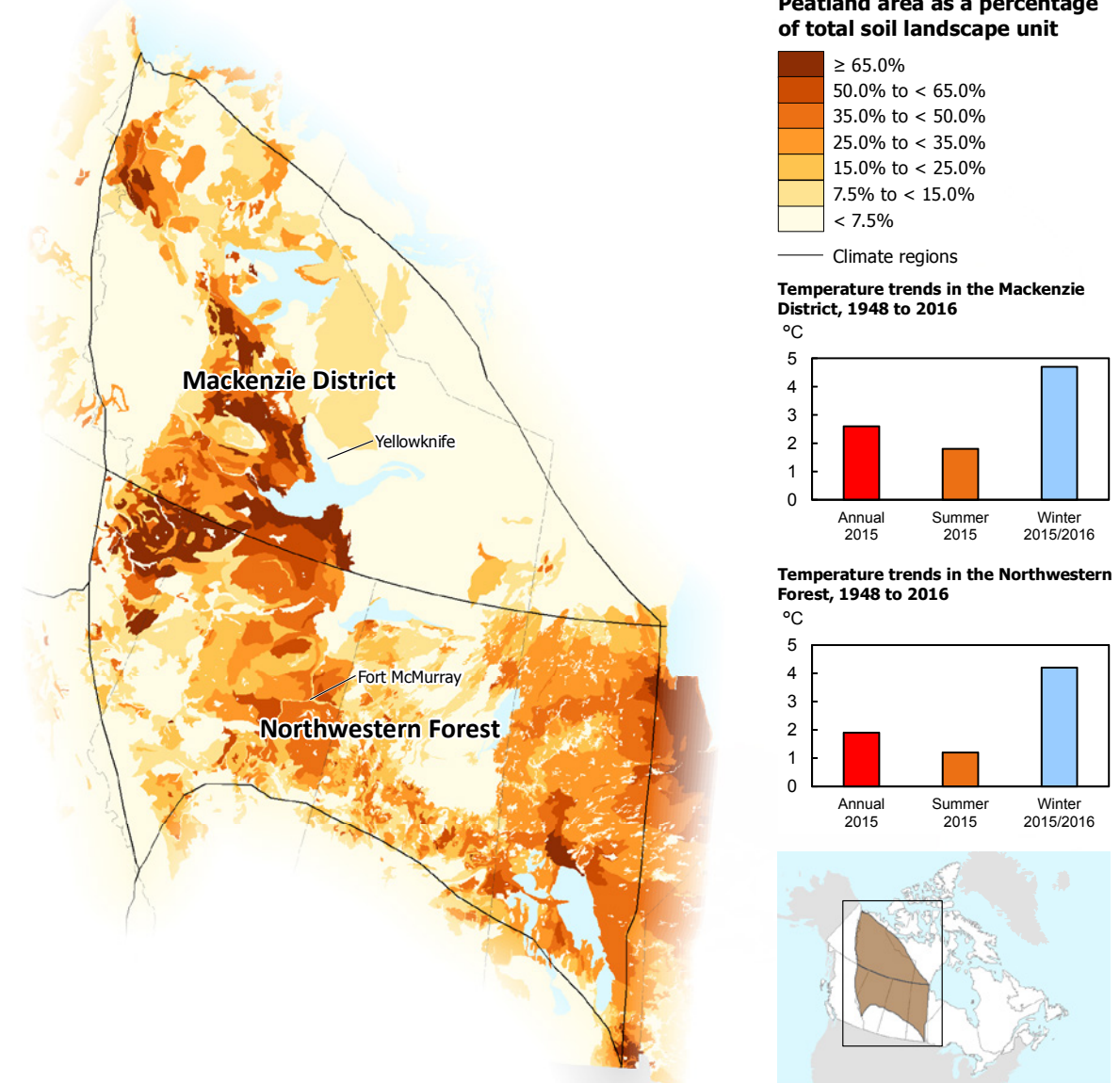
27 Elberling, B., 2010, "High nitrous oxide production from thawing permafrost," *Nature Geoscience*, Vol. 3, pp. 332–335.

28 Tarnocai, C., 2009, "Soil organic carbon pools in the northern circumpolar permafrost region," *Global Biogeochemical Cycles*, Vol. 23, GB2023, pp. 1–11, doi: 10.129/2008GB003327.

29 Bense, V.F., G. Ferguson and H. Kooi, 2009, "Evolution of shallow groundwater flow systems in areas of degrading permafrost," *Geophysical Research Letters*, Vol. 36, L22401, pp. 1–6, doi: 10.1029/2009GL039225.

30 Settele, J. et al., 2014, "Terrestrial and Inland Water Systems," *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*, pp. 271–359, www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap4_FINAL.pdf (accessed August 15, 2016).

Map 2.6 Peatland area and temperature trends, Mackenzie District and Northwestern Forest climate regions, 1948 to 2016



2.2 Water demand

Water withdrawn from water bodies provides drinking water and water for other uses around the home, but also supports economic uses including **thermal-electric power generation**, manufacturing, agriculture, mining and oil and gas extraction. Important instream water uses also include shipping, fishing and recreational activities, while water also supports **ecosystem functions**, vegetation, fish and wildlife (Textbox 2.3).

Information on the volume and timing of **water withdrawals**, the type and location of source water bodies and the amount of water returned to water systems are important in order to understand potential pressures on ecosystems and difficulties in balancing competing water demands. Understanding the contribution water users make to the economy is also helpful in understanding the value of water.

In 2013, 37,892 million m³ (37.9 km³) of water was withdrawn from the environment and used in economic and household activities in Canada.³¹ The majority of this water—87%—was self-supplied, for example by industry or households that took water directly from rivers, lakes and groundwater. The production of potable water by drinking water plants accounts for the remaining 13% of **water intake**.³²

While some of this water was consumed—for example, lost to evaporation, transpiration or included in products—the majority was returned back to the environment after use.

Textbox 2.3 Water abstraction

Although the water use data presented here focuses on water withdrawals, total water **abstraction** in the System of Environmental–Economic Accounting includes the much larger amounts of precipitation and soil water used to support agricultural and timber production, as well as the vast amounts of water flowing through turbines to generate hydro-electricity.³³

Previous estimates of water abstraction indicate that in Canada, in 2005, irrigation represented less than 2% of total water abstracted for agricultural production, forest land required more than 500 billion m³ of water to support timber production and water abstracted for hydro-electric generation was in the range of 3 trillion m³.³⁴

Estimates of water abstracted for hydro-electric power generation or rain-fed agriculture and timber production are not aggregated with other water use data presented in this report, which focus on water that is withdrawn from the environment.

Water use by industry and households

The main water users in 2013 were electric power generation, transmission and distribution;³⁵ manufacturing; households; agriculture; mining and oil and gas extraction; and natural gas distribution, water, sewage and other systems³⁶ (Chart 2.6). These industries, which use both self-supplied and publicly-supplied water, contributed 22% of total gross domestic product and 14% of employment in 2013 (Table 2.4). All other industries combined accounted for only 3% of water use in 2013.

31 Statistics Canada, CANSIM Table 153-0116 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed February 9, 2017). Water use is the amount of water withdrawn from water resources to support society in both the economic and residential sectors. Water withdrawals are also referred to as water intake. Water use estimates here include water loss and leakages through water treatment and distribution systems. They exclude the use of water for hydro-electricity production.

32 Statistics Canada, CANSIM Tables 153-0125 and 153-0116 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed February 9, 2017).

33 United Nations, 2012, *System of Environmental–Economic Accounting for Water*, unstats.un.org/unsd/envaccounting/seeaw/ (accessed May 25, 2016).

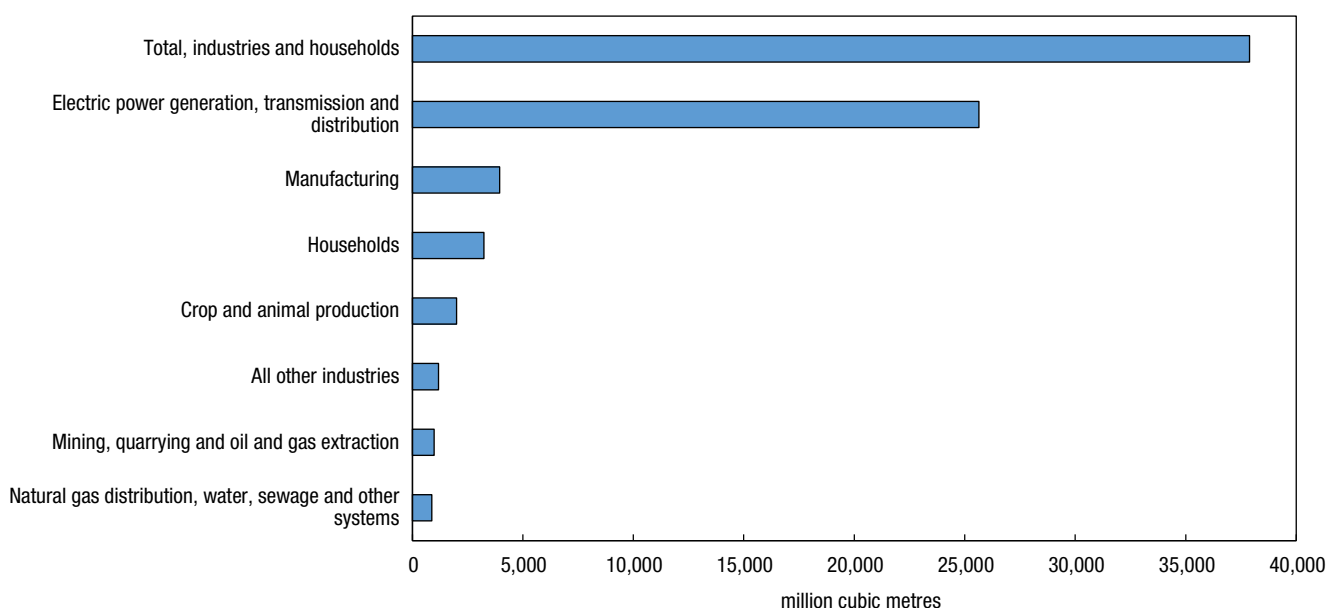
34 Statistics Canada, 2010, "Freshwater supply and demand in Canada," (www.statcan.gc.ca/pub/16-201-x/2010000/part-partie1-eng.htm) *Human Activity and the Environment*, Catalogue no. 16-201-X.

35 Data exclude hydro-electric generation. Data were derived from the Industrial Water Survey: Fossil-Fuel and Nuclear Electric Power Generating Plants biennial census of 128 thermal-electric plants in Canada.

36 Water use by the natural gas distribution, water sewage and other systems industry includes water loss and leakages through water treatment and distribution systems. This industry is included, along with the electric-power generation and distribution industry in the Utilities sector in Table 2.4.

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Chart 2.6
Water use, by sector, 2013



Note: Water use by the electric power generation, transmission and distribution industry does not include water use for hydro-electric power generation. Water use estimates for the natural gas distribution and water, sewage and other systems industries include water loss and leakages through water treatment and distribution systems. Mining and oil and gas extraction includes the coal mining, metal ore mining, non-metallic mineral mining and quarrying, oil and gas extraction and support activities for mining and oil and gas extraction industries.

Source: Statistics Canada, CANSIM Table 153-0116 (accessed February 9, 2017).

Table 2.4
Gross domestic product and employment, by province, total and selected industries, 2013

	Gross domestic product at basic prices, current dollars					Employment, age 15 and up, both sexes				
	Utilities ¹	Manufacturing	Agriculture, forestry, fishing and hunting ²	Mining, quarrying and oil and gas extraction	Total gross domestic product	Utilities ¹	Manufacturing	Agriculture, forestry, fishing and hunting ²	Mining, quarrying and oil and gas extraction	Total employment
	million dollars					thousand persons				
Canada	40,641	182,398	32,738	135,394	1,777,213	135	1,723	382	300	17,691
	percent of total									
Newfoundland and Labrador	1.8	2.8	1.6	34.2	100.0	1.1	4.8	2.2	5.5	100.0
Prince Edward Island	1.5	8.1	6.5	0.1	100.0	0.5	6.7	8.4	0.4	100.0
Nova Scotia	2.2	7.2	2.5	1.0	100.0	0.9	6.8	3.0	0.8	100.0
New Brunswick	3.2	10.1	2.5	1.4	100.0	1.0	8.0	3.2	1.6	100.0
Quebec	3.6	13.4	1.4	1.5	100.0	0.7	12.2	1.7	0.5	100.0
Ontario	2.0	12.2	0.9	1.2	100.0	0.8	11.2	1.3	0.4	100.0
Manitoba	3.3	10.7	4.6	4.1	100.0	1.2	10.0	4.1	0.9	100.0
Saskatchewan	2.2	6.2	9.9	24.2	100.0	1.0	5.2	8.0	4.5	100.0
Alberta	1.4	7.6	1.6	23.8	100.0	0.8	6.4	3.0	7.7	100.0
British Columbia	2.3	7.1	1.8	3.9	100.0	0.5	6.7	2.1	1.2	100.0

1. The utilities sector includes the following industries: electric power generation, transmission and distribution, natural gas distribution and water, sewage and other systems.

2. At the national level, crop and animal production and support activities for crop and animal production account for 81% of the sector's gross domestic product and 82% of employment.

Sources: Statistics Canada, CANSIM Tables 379-0029, 379-0028 and 282-0008 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed January 20, 2017).

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Utilities

The utilities sector, which includes the electric power generation, natural gas distribution and water, sewage and other systems industries, depends on large amounts of water. Hydro-electric power plants store vast quantities of water behind dams in reservoirs and use it to drive turbines.³⁷ Thermal power plants withdraw water from water bodies and use it mainly for cooling purposes before returning it to the environment. Together, the electric power generation industry produced 628 million megawatt hours of electricity in 2014, with hydro-electric stations accounting for 60% of electricity production, followed by thermal-electric plants at 37%. Alternative power generation sources, such as tidal, wind, solar, represented 2% of production (Table 2.5). In 2014, 91% of electric power generated was used domestically.³⁸ The remaining 9% represented 0.6% of total exports value.³⁹

Table 2.5
Electric power generation, by type and by province and territory, 2014

	Hydro generation	Thermal generation	Tidal, wind, solar and other generation	Total all types of electricity generation	Hydro generation	Thermal generation	Tidal, wind, solar and other generation	Total all types of electricity generation
	megawatt hours				percent of total			
Canada	378,786,255	234,994,151	13,904,077	627,684,483	60.3	37.4	2.2	100.0
Newfoundland and Labrador	39,047,826	1,829,179	176,963	41,053,968	95.1	4.5	0.4	100.0
Prince Edward Island	0	8,256	594,768	603,024	0.0	1.4	98.6	100.0
Nova Scotia	1,128,686	8,748,063	764,161	10,640,910	10.6	82.2	7.2	100.0
New Brunswick	2,963,114	12,571,439	785,937	16,320,490	18.2	77.0	4.8	100.0
Quebec	197,207,367	1,662,758	1,010,152	199,880,277	98.7	0.8	0.5	100.0
Ontario	39,199,464	114,146,974	3,766,189	157,112,627	24.9	72.7	2.4	100.0
Manitoba	34,494,874	170,961	911,319	35,577,154	97.0	0.5	2.6	100.0
Saskatchewan	4,706,090	16,969,148	615,264	22,290,502	21.1	76.1	2.8	100.0
Alberta	1,821,377	71,837,048	2,171,041	75,829,466	2.4	94.7	2.9	100.0
British Columbia	57,572,873	6,347,011	3,087,978	67,007,862	85.9	9.5	4.6	100.0
Yukon	410,668	22,684	334	433,686	94.7	5.2	0.1	100.0
Northwest Territories	233,916	523,032	19,971	776,919	30.1	67.3	2.6	100.0
Nunavut	0	157,598	0	157,598	0.0	100.0	0.0	100.0

Source: Statistics Canada, CANSIM Table 127-0007 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 6, 2016).

Thermal-electric power generation used 25,635 million m³ of water in 2013.⁴⁰ This represented 68% of total water use, though the majority (98%) of this water was discharged back into the environment after use, with small amounts lost to evaporation.⁴¹ Natural gas distribution and water, sewage and other systems used 885 million m³ of water—2% of total use.

The majority (88%) of water used by thermal-electric power plants was self-supplied freshwater from surface water bodies, with the rest originating from tidewater and other saline water sources.⁴² Thermal-electric power plants in Ontario were responsible for 81% of water withdrawals by the industry, followed by those in the Atlantic provinces (10%) and the Prairie provinces (9%) (Chart 2.7).⁴³

The industry's average monthly water use from 2007 to 2013 was highest in July and August⁴⁴ due to higher demand for power in summer. In 2013, total water use for thermal-electric production was down 8% from 27,834 m³ in 2007.

³⁷ Water use for hydro-electric power production is excluded from water use estimates. See Textbox 2.3 for estimates of water used in hydro-electric production.

³⁸ Statistics Canada, CANSIM Table 127-0008 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 6, 2016).

³⁹ Statistics Canada, CANSIM Table 228-0059 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 6, 2016).

⁴⁰ Statistics Canada, CANSIM Tables 153-0116 and 153-0079 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed February 9, 2017).

⁴¹ Statistics Canada, CANSIM Tables 153-0116 and 153-0079 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed February 9, 2017).

⁴² Statistics Canada, CANSIM Table 153-0082 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 4, 2016).

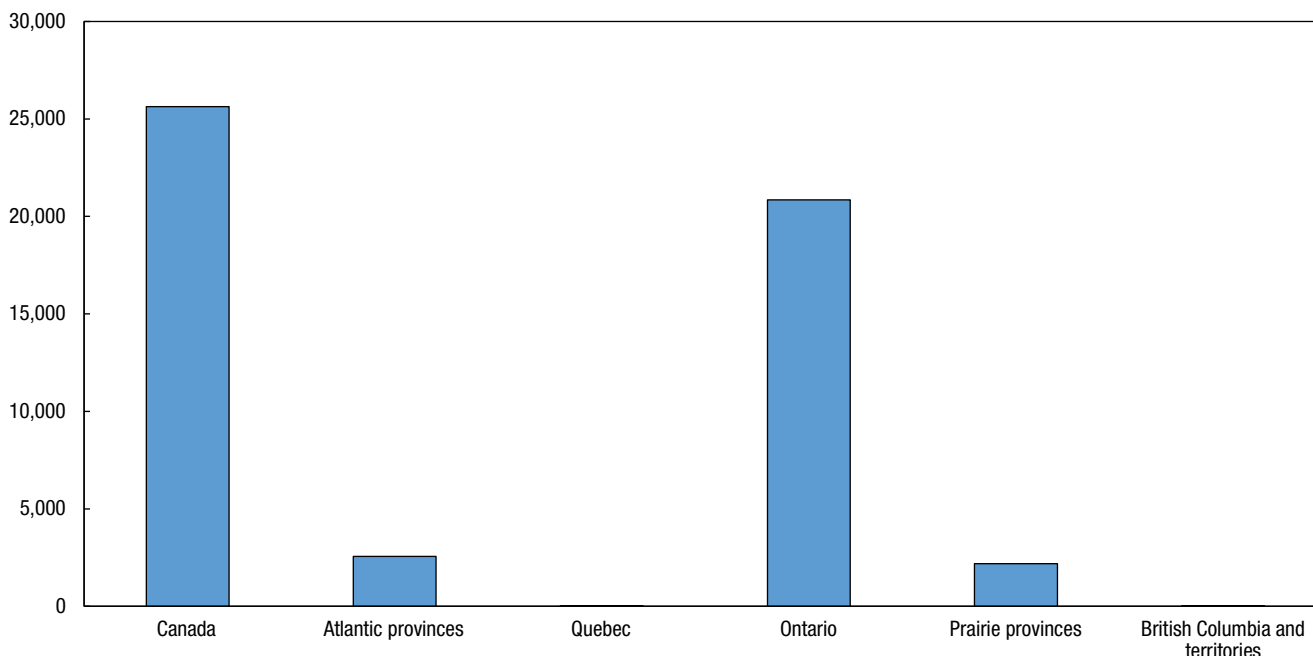
⁴³ Most electricity production in Quebec, British Columbia and Manitoba is hydro-electricity.

⁴⁴ Statistics Canada, CANSIM Table 153-0080 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 4, 2016).

The thermal-electric power generation industry spent \$172 million on water in 2013, half of which was for water acquisition, 30% was for intake water treatment and the remainder was related to water recirculation and discharge treatment.⁴⁵

Chart 2.7
Water intake, thermal-electric power generation industry, by region, 2013

million cubic metres



Source: Statistics Canada, CANSIM Table 153-0079 (accessed May 3, 2016).

Manufacturing

Overall, the manufacturing sector used 3,954 million m³ of water in 2013—10% of total water use.⁴⁶ The largest amounts were used by the paper manufacturing (1,537 million m³) and primary metal manufacturing (1,142 million m³) industries. Of manufacturing's total water intake, 90% was eventually discharged back to the environment.⁴⁷

Most (88%) water intake by manufacturing was self-supplied and 95% of the total intake was freshwater (Table 2.6). More than one-third (35%) of water intake by manufacturing industries occurred in the Great Lakes drainage region, followed by 18% in the St. Lawrence, 8% in the Pacific Coastal, 7% in the Fraser–Lower Mainland and 6% in the Maritime Coastal drainage regions (Chart 2.8).

Average water intake by the manufacturing sector was highest in summer (Chart 2.9). Overall, water intake for manufacturing has declined 13% from 4,573 million m³ since 2007. Annual sales of manufactured goods declined 11% from 2007 to 2013.⁴⁸

The manufacturing sector spent a total of \$1.2 billion on water including acquisition (\$465 million), intake treatment (\$198 million), recirculation (\$97 million) and discharge treatment (\$447 million) in 2013.⁴⁹

45 Statistics Canada, CANSIM Table 153-0097 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 9, 2016).

46 Statistics Canada, CANSIM Table 153-0116 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017).

47 Statistics Canada, CANSIM Table 153-0047 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 6, 2016).

48 Statistics Canada, CANSIM Table 377-0009 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed January 20, 2017).

49 Statistics Canada, CANSIM Table 153-0076 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 9, 2016).

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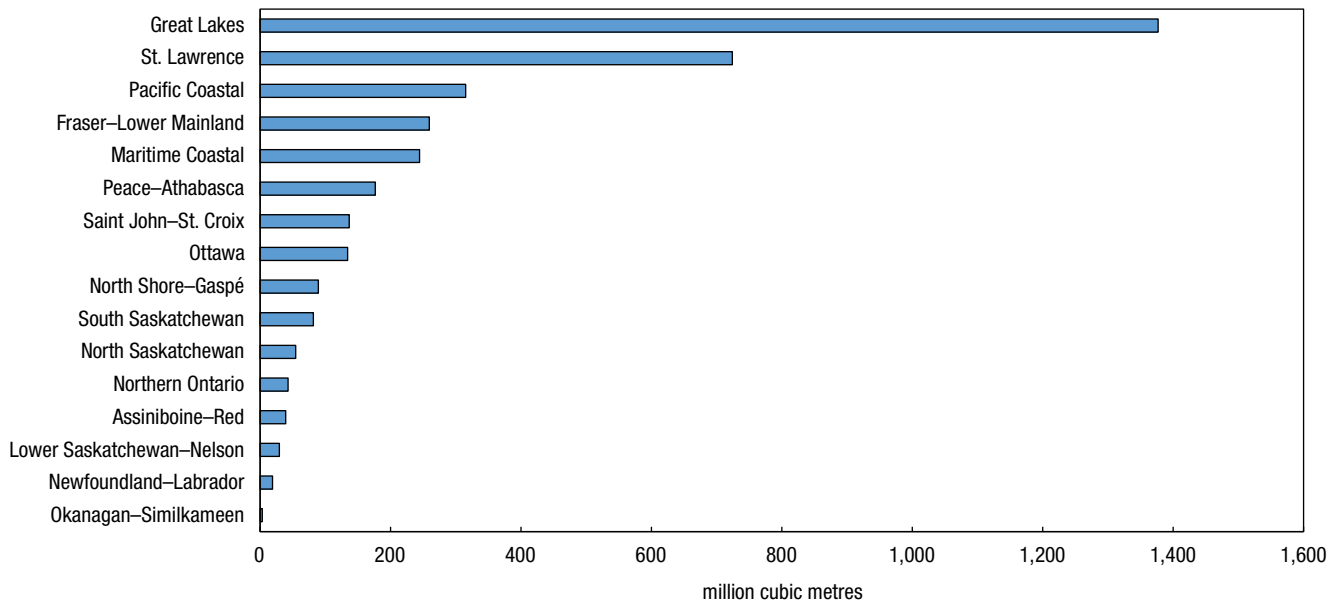
Table 2.6

Water intake in manufacturing industries, by type of supply, water source and drainage region, 2013

Water supply by type of supply, water source and drainage region, 2016										
		Publicly-supplied		Self-supplied						
		Freshwater source	Freshwater source, surface water bodies	Freshwater source, groundwater	Freshwater source, other	Saline water source, tidewater	Saline water source, groundwater and other	Total self-supplied, all sources	Total water intake, all sources	
code		million cubic metres								
Canada	...	458.5	3,062.6	137.6	104.6	190.7	x	3,497.5	3,956.0	
Pacific Coastal	1	x	233.2	x	x	46.6	0.0	x	315.4	
Fraser–Lower Mainland	2	17.4	202.6	10.9	28.7	0.0	F	242.2	259.6	
Okanagan–Similkameen	3	3.3	F	x	F	0.0	x	0.1	3.4	
Columbia	4	x	x	0.4	x	0.0	0.0	x	0.0	
Yukon	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Peace–Athabasca	6	x	142.2	x	x	0.0	x	x	176.9	
Lower Mackenzie	7	0.0	0.0	x	x	0.0	0.0	x	x	
Arctic Coast–Islands	8	x	0.0	0.0	x	0.0	0.0	x	x	
Missouri	9	x	0.0	x	0.0	0.0	0.0	x	x	
North Saskatchewan	10	14.2	38.9	x	x	0.0	0.0	0.0	54.9	
South Saskatchewan	11	26.6	49.5	F	2.8	0.0	0.0	0.0	81.9	
Assiniboine–Red	12	21.1	x	17.0	x	0.0	x	0.0	39.2	
Winnipeg	13	0.3	x	0.0	F	0.0	0.0	x	x	
Lower Saskatchewan–Nelson	14	x	27.0	1.6	x	0.0	0.0	x	29.6	
Churchill	15	0.0	x	x	x	0.0	0.0	x	x	
Keewatin–Southern Baffin Island	16	x	x	0.0	0.0	0.0	0.0	x	x	
Northern Ontario	17	x	x	F	0.0	0.0	0.0	x	42.8	
Northern Quebec	18	0.7	x	0.3	F	0.0	0.0	x	x	
Great Lakes	19	115.0	1,250.1	10.3	x	0.0	x	1,261.8	1,376.8	
Ottawa	20	5.8	127.5	0.7	0.1	0.0	0.0	128.3	134.1	
St. Lawrence	21	146.9	529.4	17.7	x	0.0	x	577.1	724.0	
North Shore–Gaspé	22	4.9	83.2	0.8	x	x	x	84.5	89.4	
Saint John–St. Croix	23	54.6	72.1	2.8	2.3	4.7	0.2	82.2	136.8	
Maritime Coastal	24	x	43.2	25.9	x	133.4	F	x	244.5	
Newfoundland–Labrador	25	11.7	x	F	x	x	0.0	7.3	19.0	

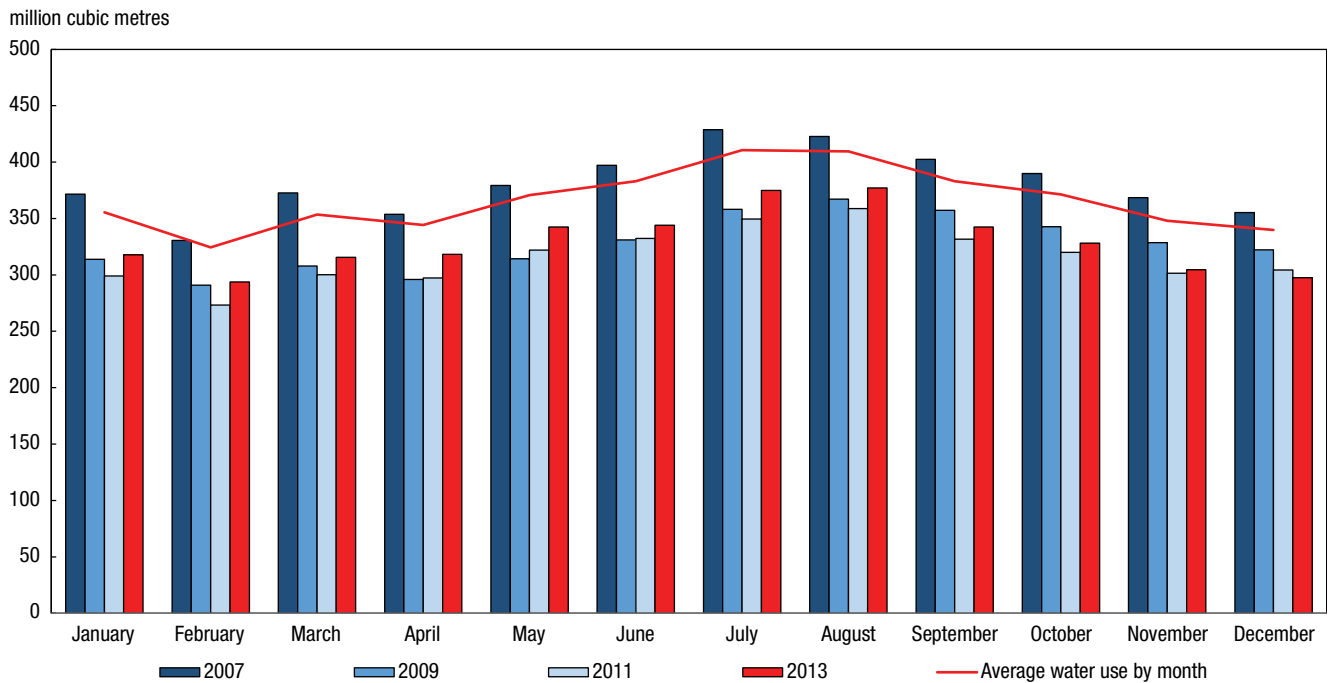
Sources: Statistics Canada, CANSIM Tables 153-0051 and 153-0050 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed May 3, 2016).

Chart 2.8
Water intake, manufacturing industries, by drainage region, 2013



Source: Statistics Canada, CANSIM Tables 153-0051 and 153-0050 (accessed May 3, 2016).

Chart 2.9
Water intake, manufacturing industries, Canada, 2007 to 2013



Source: Statistics Canada, CANSIM Table 153-0049 (accessed April 13, 2016).

Households

The household sector used 9%—or 3,239 million m³—of the country's total water use in 2013, including both publicly-supplied water and estimates for households on wells.⁵⁰ While some of these household uses of water are consumptive, an estimated 90% of water withdrawals are eventually discharged back into the environment after treatment by municipal wastewater treatment plants.⁵¹ See Textbox 2.4 for more information about household water use and conservation practices.

Drinking water plants produced 5,059 million m³ of potable water in 2013, with 39% (1,978 million m³) consumed by the residential sector (Chart 2.10).⁵² However, the sector of use was unknown for 21% of publicly-supplied water and distribution system losses accounted for another 13%.

Surface water accounted for 88% of potable water processed by drinking water plants in 2013, followed by groundwater (10%) and groundwater under the direct influence of surface water (2%).⁵³ Water withdrawals by drinking water treatment plants peak in summer (Chart 2.11) and were highest in the Great Lakes and St. Lawrence drainage regions.⁵⁴ Households spent \$3.2 billion for delivery of publicly-supplied potable water in 2013.⁵⁵

Most homes in Canada are connected to a municipal water supply. In 2015, municipal water was the main source of water for 89% of households.⁵⁶ Homes not connected to a municipal water supply most frequently had a private well as the main source of water. The proportion of households using a non-municipal supply was highest in the Maritimes—51% of dwellings in Prince Edward Island, 48% in New Brunswick and 41% in Nova Scotia relied on non-municipal water.

50 Statistics Canada, CANSIM Table 153-0116 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017).

51 Environment and Climate Change Canada, 2016, *Canadian Environmental Sustainability Indicators: Water Withdrawal and Consumption by Sector*, Catalogue no. 978-0-660-04751-5, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=5736C951-1 (accessed May 26, 2016).

52 The Survey of Drinking Water Plants is a census of drinking water plants serving 300 or more people, the majority of which are public (municipal) systems. It includes approximately 2,000 facilities that are licensed and regulated by provincial/territorial agencies (excluding First Nations communities) and that draw and process source/raw water from the environment to produce treated/potable water for consumption. Statistics Canada, CANSIM Table 153-0127 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 3, 2016).

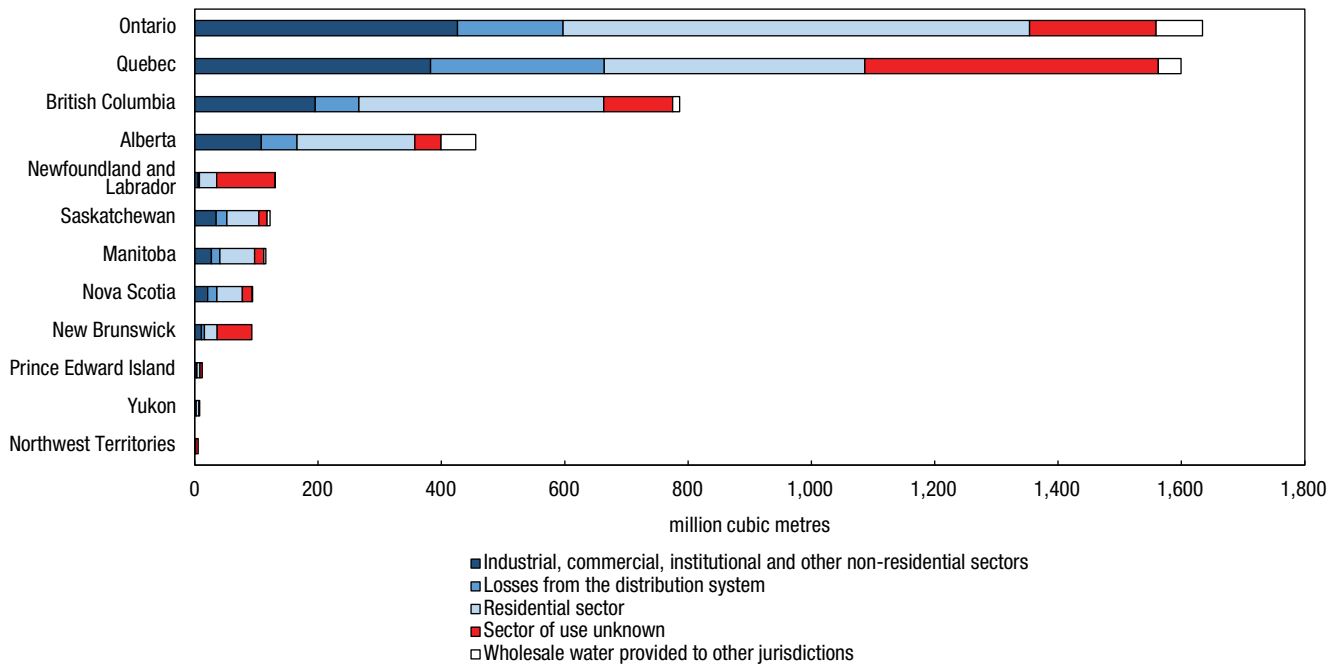
53 Statistics Canada, CANSIM Table 153-0105 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 3, 2016).

54 Statistics Canada, CANSIM Table 153-0124 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed December 12, 2016).

55 Statistics Canada, CANSIM Table 381-0034 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 9, 2016).

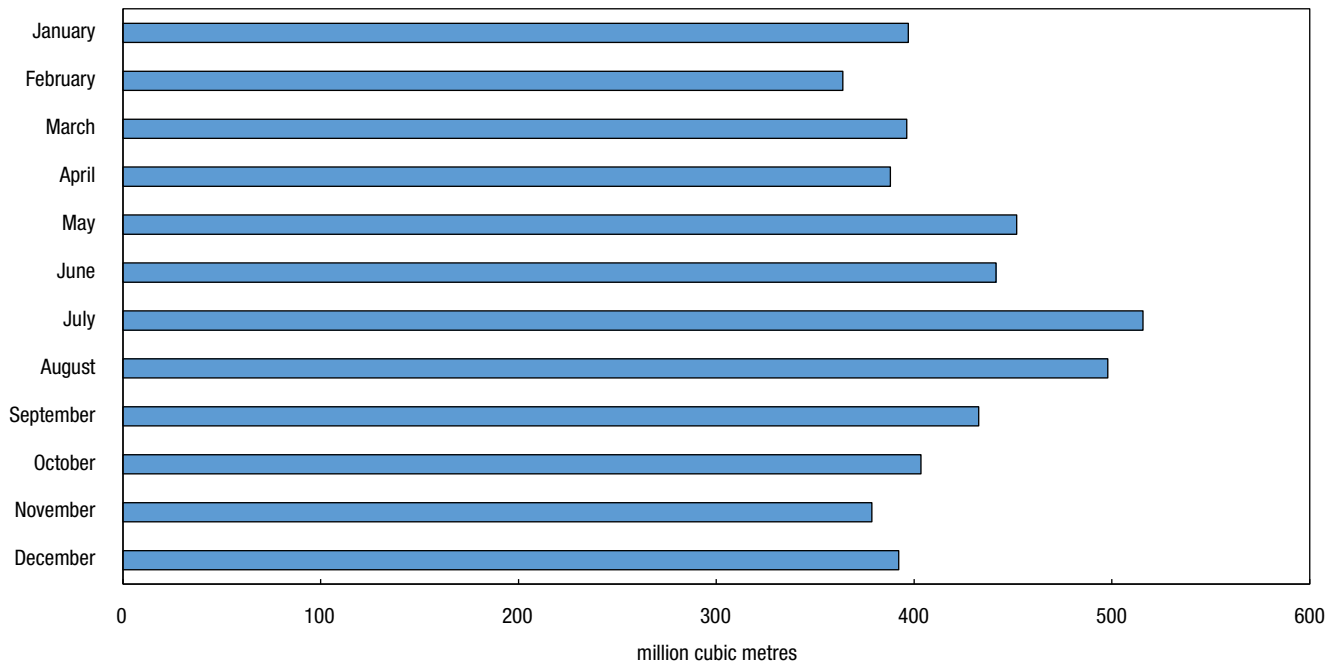
56 Statistics Canada, CANSIM Table 153-0062 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017).

Chart 2.10
Potable water use, by sector of use and province, 2013



Source: Statistics Canada, CANSIM Table 153-0127 (accessed April 1, 2016).

Chart 2.11
Potable water use, by month, Canada, 2013



Source: Statistics Canada, CANSIM Table 153-0124 (accessed May 27, 2016).

Textbox 2.4. Water conservation at home

Residential water use includes indoor water use from toilets, faucets, showers, baths, clothes washers and dishwashers, as well as seasonal outdoor use such as lawn watering. Toilet flushing, faucets and showers account for the largest proportions of indoor water use.⁵⁷ Many factors can account for differences in water use, including pricing and billing practices, conservation measures, demographics, dwelling types, economic activities, the state of infrastructure and climate. Outdoor water use is particularly variable.

Household water use in Canada has declined in recent years. Total household water use in 2013 was down 16% compared to 3,875 million m³ in 2005,⁵⁸ while on a per capita basis water use has dropped from approximately 330 L/person/day to 250 L/person/day.⁵⁹

For households served by public water utilities, per capita daily residential water use in Newfoundland and Labrador, Yukon, British Columbia, Prince Edward Island, Quebec, Northwest Territories and New Brunswick was above the Canadian average (Chart 2.12). Residents of the three Prairie Provinces and Nunavut had the lowest per capita usage.

These trends are consistent with the results of other studies, which have also found large decreases in household daily water use for many cities throughout North America.⁶⁰ These changes were attributed mainly to water use efficiencies in toilets and clothes washers. Other studies indicate that water metering and volume-based pricing tools can be used to reduce residential water use.⁶¹

According to the 2015 Households and Environment Survey, 51% of households in Canada reported having a low-volume toilet, 62% reported having a low-flow shower head, while 43% of households reported that they had a water meter.⁶² Outdoor water conservation tools include the use of water barrel or cistern to store water, used by 15% of households in 2015.⁶³ As well 32% of households using lawn sprinklers to water their lawn used a sprinkler timer.

57 Mayer, P. W. et al., 1999, *Residential End Uses of Water*, AWWA Research Foundation and American Water Works Association, www.waterrf.org/Pages/Projects.aspx?PID=241 (accessed May 30, 2016); DeOreo, W.B. et al., 2016, *Residential End Uses of Water, Version 2: Executive Report*, Water Research Foundation, www.waterrf.org/Pages/Projects.aspx?PID=4309 (accessed May 30, 2016).

58 Statistics Canada, CANSIM Tables 153-0116 and 153-0101 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017). Note that the methodology for calculating household water use changed over this period. The 2005 value was derived from Environment Canada's Municipal Water and Wastewater Survey, while the 2013 value is derived from Statistics Canada's Survey of Drinking Water Plants.

59 Statistics Canada, CANSIM Tables 153-0116, 153-0101 and 051-0001 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017); Environment and Climate Change Canada, 2014, *Canadian Environmental Sustainability Indicators: Data Sources and Methods for the Residential Water Use in Canada Indicator*, EN4-144/32-2014E-PDF, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=D43360E101 (accessed May 30, 2016).

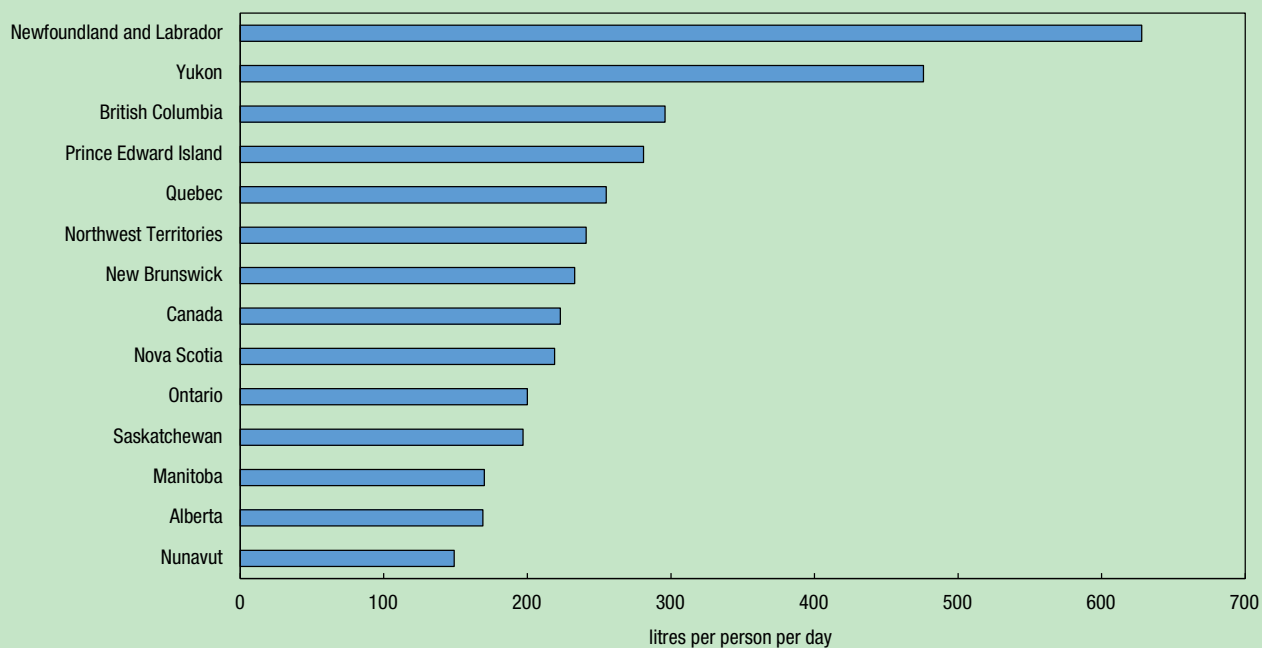
60 DeOreo, W.B. et al., 2016, *Residential End Uses of Water, Version 2: Executive Report*, www.waterrf.org/Pages/Projects.aspx?PID=4309 (accessed May 30, 2016); DeOreo, W.B. and P.W. Mayer, 2012, "Insights into declining single-family residential water demands," *American Water Works Association Journal*, Vol. 104, pp. E383–E394.

61 Howe, C.W., 2005, "The functions, impacts and effectiveness of water pricing: Evidence from the United States and Canada," *Water Resources Development*, Vol. 21, no. 1, pp. 43–53; Olmstead, S.M. and R.N. Stavins, 2008, *Comparing price and non-price approaches to urban water consumption*, no. 14147, National Bureau of Economic Research, www.nber.org/papers/w14147.pdf (accessed May 30, 2016).

62 Statistics Canada, CANSIM Table 153-0104 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017).

63 Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 2015 Households and the Environment Survey.

Chart 2.12
Per capita residential water use, 2013



Note: At the national level, the sector of water use was unknown for 21% of publicly-supplied water. The provinces and territories with the highest percentage of unknown water use were Newfoundland and Labrador (72%), Northwest Territories, (71%), New Brunswick (60%), and Québec (30%). Figures in this chart represent the results for plants that reported the percentage of potable water used by the residential sector. Higher proportions of unknown water use reduce the accuracy of average daily residential water use estimates.

Source: Statistics Canada, CANSIM Table 153-0127 (accessed April 1, 2016).

Agriculture

In 2013, the value of Canadian agricultural production was \$55.2 billion⁶⁴ and farm, fishing and intermediate food products made up 6% of exports.⁶⁵

Crop and animal production was responsible 5% of total water withdrawals in 2013—a total of 2,007 million m³. This water was used mostly for irrigation and livestock watering.⁶⁶ Crop production accounted for slightly more than half (53%) of this total.⁶⁷ While a portion of irrigation water is taken up and incorporated into plants or transpired, water is also lost to evaporation and can percolate or run off fields.⁶⁸

Farms spent \$21.1 million to purchase water or water rights for irrigation purposes in 2013.⁶⁹ The amount and timing of water used for irrigation depends on crop type, as well as local temperature and precipitation patterns.

According to the Census of Agriculture, 7% of farms in Canada irrigated their land in 2011.⁷⁰ By area, field crops including grain, oil and seed crops such as wheat, barley, corn and canola, represented the largest irrigated crop type (60%), followed by alfalfa, hay and pasture land (29%) and vegetables, fruit and other irrigated areas (11%).⁷¹

In 2014, farms in Canada used 1,679 million m³ of water to irrigate 585,870 ha of farmland.⁷² As a percent of irrigation water, the main water sources included off-farm water sources (71%), on-farm surface water (21%) and on-farm groundwater sources (7%).⁷³ The largest irrigation volumes were used in the South Saskatchewan drainage region—this drainage region accounted for 78% of the annual irrigation volume, followed by the Fraser–Lower Mainland drainage region (11%) (Table 2.7).⁷⁴ Water use for irrigation is highest in July (Chart 2.13).

64 Statistics Canada, CANSIM Table 002-0001 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed June 15, 2016).

65 Statistics Canada, CANSIM Table 228-0059 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 6, 2016).

66 Statistics Canada, CANSIM Table 153-0116 (accessed February 9, 2017). Note that Statistics Canada's Water Account develops the agricultural water use estimates published in Table 153-0116 using multiple data sources. Irrigation estimates for Alberta are taken from irrigation estimates published by the Alberta Agriculture and Rural Development, while estimates for other provinces are based on Statistics Canada's Agricultural Water Use Survey (AWUS) combined with precipitation measures for the growing season. Note that the AWUS provides irrigation estimates for even years, whereas other water survey data and the Water Account data are for odd years. Livestock numbers from Statistics Canada surveys and water use coefficients provided by Agriculture and Agri-Food Canada are used to derive water use for livestock watering and cleaning.

67 Water used for animal production includes watering and washing, but also includes the irrigation of animal forage and feed crops such as hay and alfalfa.

68 Environment and Climate Change Canada provides one estimate of water consumption for agriculture (80%) through the Water Withdrawal and Consumption by Sector indicator, part of the Canadian Environmental Sustainability Indicators. This estimate is based on returns to the river systems reported in 2013 by irrigation districts in southern Alberta. Environment and Climate Change Canada, 2016, *Canadian Environmental Sustainability Indicators: Water Withdrawal and Consumption by Sector*, Catalogue no. 978-0-660-04751-5, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=5736C951-1 (accessed May 9, 2016), citing Alberta Agriculture and Rural Development, 2013, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch.

69 Statistics Canada, CANSIM Table 002-0005 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 9, 2016). Data exclude expenses to operate or purchase irrigation equipment.

70 Statistics Canada, CANSIM Tables 004-0210 and 004-0201 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 5, 2016).

71 Statistics Canada, CANSIM Table 004-0210 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 5, 2016).

72 Statistics Canada, CANSIM Tables 153-0134 and 153-0136 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed April 4, 2016). Note that the Agricultural Water Use Survey provides irrigation estimates for even years, whereas other water survey data and the Physical Flow Account for water use data are for odd years.

73 Statistics Canada, CANSIM Table 153-0141 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed April 14, 2016).

74 Statistics Canada, CANSIM Table 153-0134 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed April 4, 2016).

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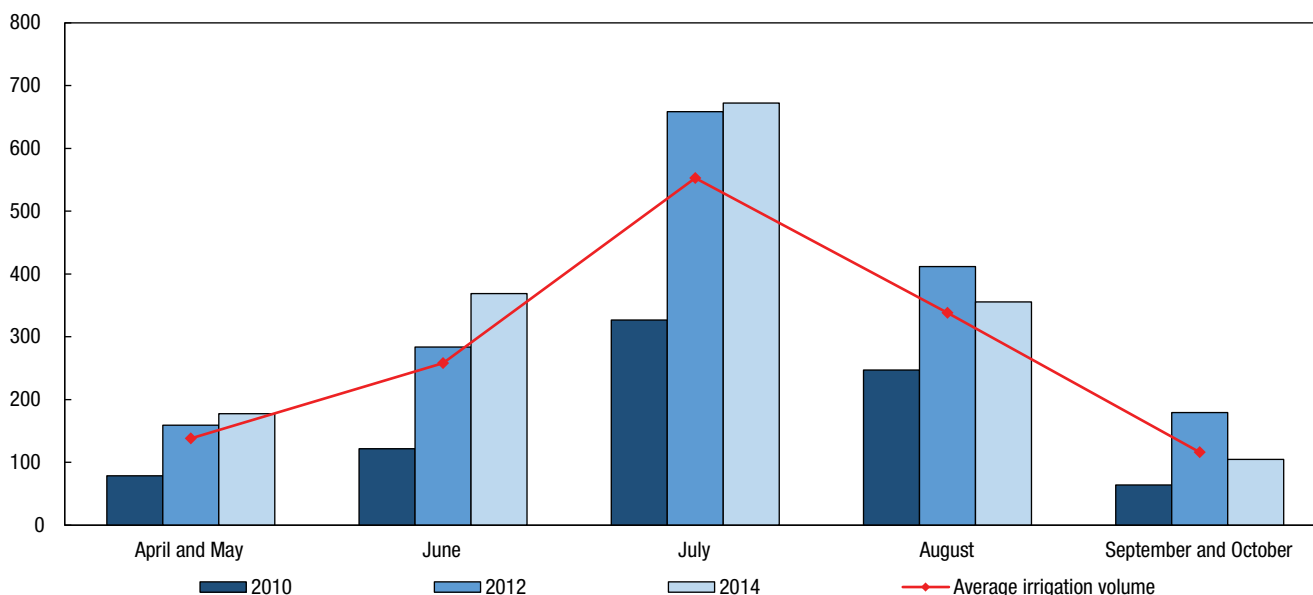
Table 2.7
Irrigation volume, by month, drainage region and province, 2014

		Irrigation volume in April and May	Irrigation volume in June	Irrigation volume in July	Irrigation volume in August	Irrigation volume in September and October	Total irrigation volume
	code	thousand cubic metres					
Canada	...	177,367	368,964	672,326	355,661	104,704	1,679,021
Drainage regions							
Pacific Coastal	1	F	3,966	F	3,563	1,294	18,796
Fraser–Lower Mainland	2	33,780	44,089	43,788	41,665	23,293	186,615
Okanagan–Similkameen	3	7,082	9,520	13,414	14,299	7,902	52,217
Columbia	4	2,839	3,938	5,398	4,646	2,440	19,260
Missouri	9	8,359	2,818	5,278	2,222	F	18,711
North Saskatchewan	10	F	x	1,224	566	x	3,154
South Saskatchewan	11	120,803	280,544	568,498	271,944	65,289	1,307,076
Assiniboine–Red	12	649	x	7,653	5,602	x	28,177
Winnipeg, Lower Saskatchewan–Nelson and Churchill	13,14,15	F	3,055	7,928	3,144	0	14,408
Great Lakes	19	1,004	3,254	3,963	x	x	x
Ottawa	20	x	60	x	x	x	x
St. Lawrence	21	995	2,953	5,111	4,111	1,502	14,673
North Shore–Gaspé, Saint John–St. Croix, Maritime Coastal and Newfoundland–Labrador	22,23,24,25	x	318	x	718	x	2,542
Provinces							
British Columbia	...	44,655	61,513	71,620	64,173	34,928	276,888
Alberta	...	116,213	272,276	551,536	262,312	63,240	1,265,576
Saskatchewan	...	13,928	13,603	26,076	14,029	2,599	70,234
Manitoba	...	353	F	12,970	7,136	F	35,716
Ontario	...	1,015	3,267	4,024	2,863	F	12,800
Quebec	...	1,018	3,084	5,500	4,628	1,716	15,947
Atlantic provinces	...	186	233	601	519	321	1,860

Source: Statistics Canada, CANSIM Table 153-0134 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed April 4, 2016).

Chart 2.13
Irrigation volume, by month, Canada, 2010 to 2014

million cubic metres



Note: Irrigation water use was low in 2010 compared to other years, due to a wetter than average growing season in some provinces.

Source: Statistics Canada, CANSIM Table 153-0135 (accessed April 4, 2016).

Mining, quarrying and oil and gas extraction

Crude oil and natural gas represented 78% of **primary energy** production in Canada in 2013,⁷⁵ with 76% of crude and 52% of natural gas production going for export.⁷⁶ Energy products excluding electricity represented 24% of exports in 2013, while metal ores and non-metallic minerals accounted for 4%.⁷⁷

Together, mining and oil and gas extraction used 982 million m³ of water in 2013—under 3% of total water use.⁷⁸ While the oil and gas industry reuses much of its water intake, the vast majority of this water use is consumptive—for example, it may be lost to steam, injected into oil reservoirs or held in tailings ponds after use.⁷⁹

For mining and quarrying (excluding oil and gas), the total water intake was 599 million m³, with the highest water use resulting from metal ore mining (373 million m³ of water or 62%), non-metallic mineral mining and quarrying (134 million m³ or 22%) and coal mining (92 million m³ or 15%).⁸⁰ Water discharges from the mineral extraction industries were 675 million m³ in 2013 with the majority (71%) released to surface water, followed by tailings ponds (13%) and groundwater (8%).⁸¹

Self-supplied surface freshwater made up 73% of total water intake for mining and quarrying, followed by groundwater (12%) and other self-supplied freshwater sources (9%).⁸² Mining and quarrying operations in the Atlantic provinces were responsible for over one-third of water intake, followed by operations in Quebec (22%) and the Prairies (21%) (Chart 2.14). The majority (71%) of water use was process water while 5% was for cooling, condensing and steam.⁸³

The mineral extraction industries spent \$179 million on water in 2013, 70% of which was paid by the metal ore mining industry. Water acquisition costs represented 19% of total costs, while discharge costs represented 45% of the total.⁸⁴

75 Statistics Canada, CANSIM Table 128-0016 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed August 25, 2016).

76 Statistics Canada, CANSIM Table 128-0016 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed August 25, 2016).

77 Statistics Canada, CANSIM Table 228-0059 (accessed May 6, 2016).

78 Statistics Canada, CANSIM Table 153-0116 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed February 9, 2017). Data for the mineral extraction industries are taken from the Industrial Water Use Survey. Water use for oil and gas extraction is provided by the Canadian Association of Petroleum Producers and includes both fresh and saline water.

79 Natural Resources Canada, 2009, *Water Use by the Natural Resources Sectors: Facts*, www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/www/pdf/com/resoress/publications/wateau/wateau-eng.pdf (accessed May 25, 2016).

80 Statistics Canada, CANSIM Table 153-0078 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 5, 2016).

81 Statistics Canada, CANSIM Tables 153-0090 and 153-0079 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 5, 2016). Water discharges for the mining and quarrying industry are higher than water intake because of the need to de-water mines—the volume of mine water was 376 million m³ in 2013. The remaining water was consumed or lost.

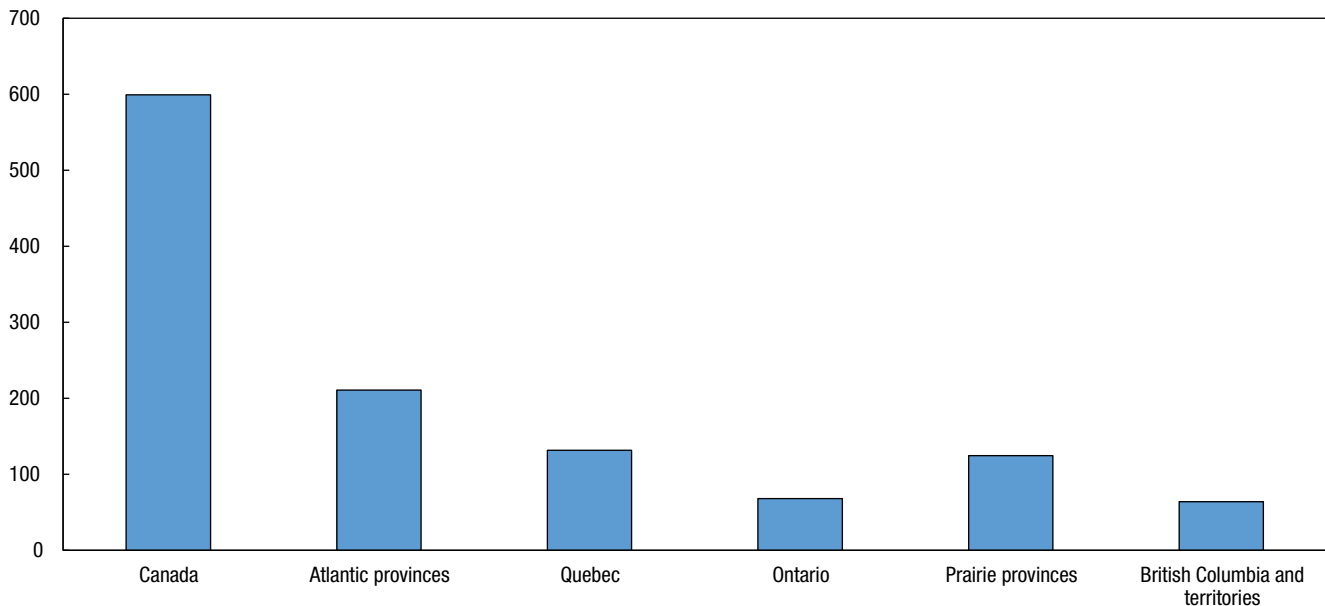
82 Statistics Canada, CANSIM Tables 153-0079 and 153-0082 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 5, 2016).

83 Statistics Canada, CANSIM Table 153-0086 (accessed May 5, 2016). Process water serves in any level of the process. It includes all water that comes in direct contact with products and/or materials, that is used in the sanitation of process equipment, that is consumed in milling and special processes, or that is included in final output. Water for cooling, condensing and steam does not come in direct contact with the products, materials or by-products of the processing operations. It includes pass-through water used in the operation of cooling or process equipment (including air conditioning), and water introduced into boilers for the production of steam for either process operations or electric power.

84 Statistics Canada, CANSIM Table 153-0096 (www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as) (accessed May 9, 2016).

Chart 2.14
Water intake, mining and quarrying industries, by region, 2013

million cubic metres



Note: Water intake data for mining and quarrying exclude intake for oil and gas extraction.

Source: Statistics Canada, CANSIM Table 153-0079 (accessed May 3, 2016).

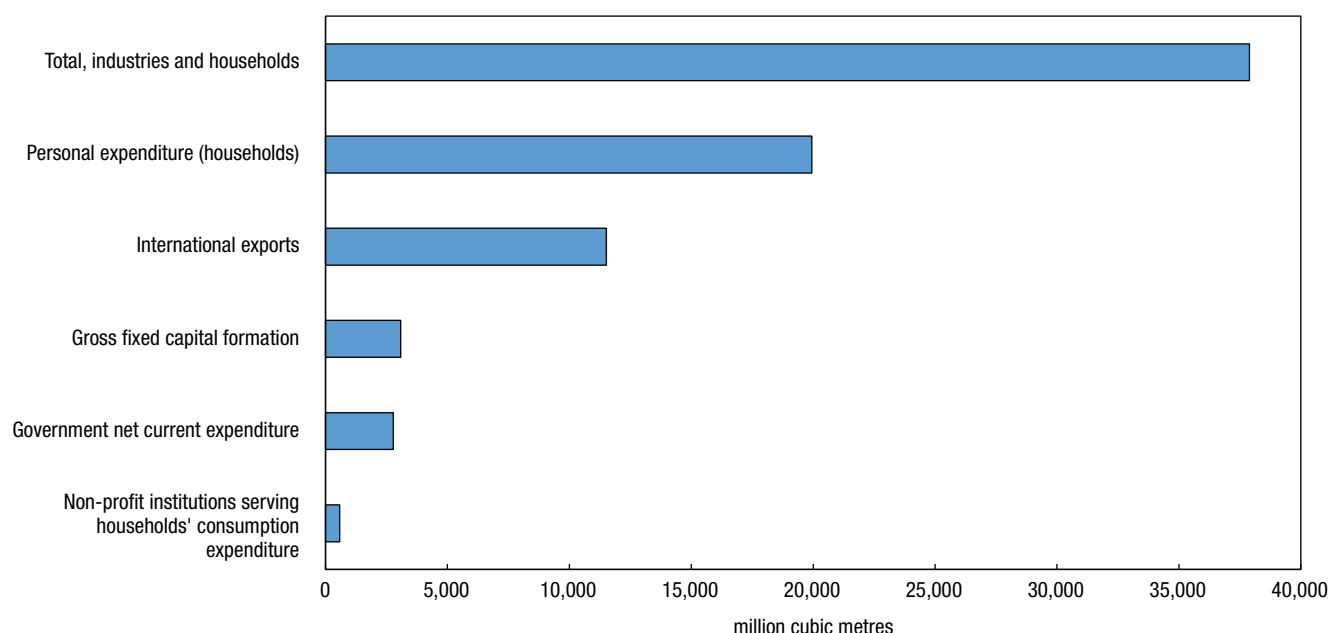
Water use by final demand

Another way to look at water use is from the final demand perspective, which attributes water use related to the production of goods and services to the end-user of that product rather than to the producer. For example, water used for power generation is attributed to the businesses or households that use electricity.

From this perspective households were the main water users in Canada. When including both direct water use in the home including cooking, drinking, cleaning and watering, as well as the indirect water use required to satisfy household demand for goods and services such as electricity and food, households were responsible for 53% of total water use in 2013 (Chart 2.15).⁸⁵ The production of goods and services for export was the second highest final demand category at 30% of water use in 2013.

⁸⁵ Statistics Canada, CANSIM Table 153-0129 (www5.statcan.gc.ca/cansim/home-accueil?&lang=eng&MM=as) (accessed February 9, 2017).

Chart 2.15
Water use by final demand category, 2013



Note: Water use by the electric power generation, transmission and distribution industry does not include water use for hydro-electric power generation. The category personal expenditure includes direct household water use in addition to the industrial amounts required to satisfy household demand for goods and services. Final demand results are derived from a hybrid input-output model that combines physical data by industry with economic data on production and consumption of goods and services. See the Methodological Guide: Canadian System of Environmental-Economic Accounting, Catalogue no. 16-509-X for more information.

Source: Statistics Canada, CANSIM Table 153-0129 (accessed February 9, 2017).

Competing water demands

In certain areas of the country, concerns have been raised about the allocation of water among competing water demands including drinking water, agriculture, manufacturing and other industries during periods of water scarcity.⁸⁶ Lower than normal streamflows can have significant economic effects on agriculture, fisheries, municipalities and industries including electricity production, while also impacting water quality, aquatic habitat and opportunities for recreation.⁸⁷

Balancing the demand for water from these different sectors may be more challenging during the summer months, which often coincide with increased demand for irrigation and municipal water, while at the same time water supplies are at a low.⁸⁸

⁸⁶ Hipel, K.W., L. Fang and L. Wang, 2013, "Fair water resources allocation with application to the South Saskatchewan river basin, *Canadian Water Resources Journal*, Vol. 38, no. 1, pp. 47–60, <http://dx.doi.org/10.1080/07011784.2013.773767> (accessed May 12, 2016).

⁸⁷ Bonsal, B. and A. Shabbar, 2008, "Impacts of large-scale circulation variability on low streamflows over Canada: A review," *Canadian Water Resources Journal*, Vol. 32, no. 2, pp. 137–154; Burn, D.H. et al., 2008, "The processes, patterns and impacts of low flows across Canada," *Canadian Water Resources Journal*, Vol. 33, no. 2, pp. 107–124.

⁸⁸ Schindler, D.W. and W.F. Donahue, 2006, "An impending water crisis in Canada's western prairie provinces, *PNAS*, Vol. 103, no. 19, pp. 7210–7216, www.pnas.org/cgi/doi/10.1073/pnas.0601568103 (accessed May 12, 2016); Essa Technologies Ltd. and Solander Ecological Research, 2009, *Instream Flow Needs Analysis for the Okanagan Water Supply & Demand Project*, www.obwb.ca/fileadmin/docs/okanagan_instream_flow_needs_analysis_essa.pdf (accessed May 9, 2016); Bradford, M.J. and J.S. Heinonen, 2008, "Low flows, instream flow needs and fish ecology in small streams, *Canadian Water Resources Journal*, Vol. 32, no. 2, pp. 165–180.

Ratios of surface freshwater withdrawals to the water yield for August 2013⁸⁹ were above 40% in the Assiniboine–Red and in the Great Lakes drainage regions, while they were between 20% and 40% in the South Saskatchewan drainage regions and Okanagan–Similkameen (Map 2.7). These higher ratios point to a higher possibility for water shortages, conflicts between competing uses and the potential for insufficient [instream flows](#) for ecosystem requirements.⁹⁰

The high intake to water yield ratios in the Great Lakes and Assiniboine–Red drainage regions were largely attributable to withdrawals for thermal-electric power production. The majority of this water was eventually released back to the water body from which it was taken.

Water withdrawals for irrigation accounted for the majority of the total water intake in the South Saskatchewan drainage region and over 40% in the Okanagan–Similkameen.⁹¹ Little water withdrawn for irrigation is returned to the water source.⁹²

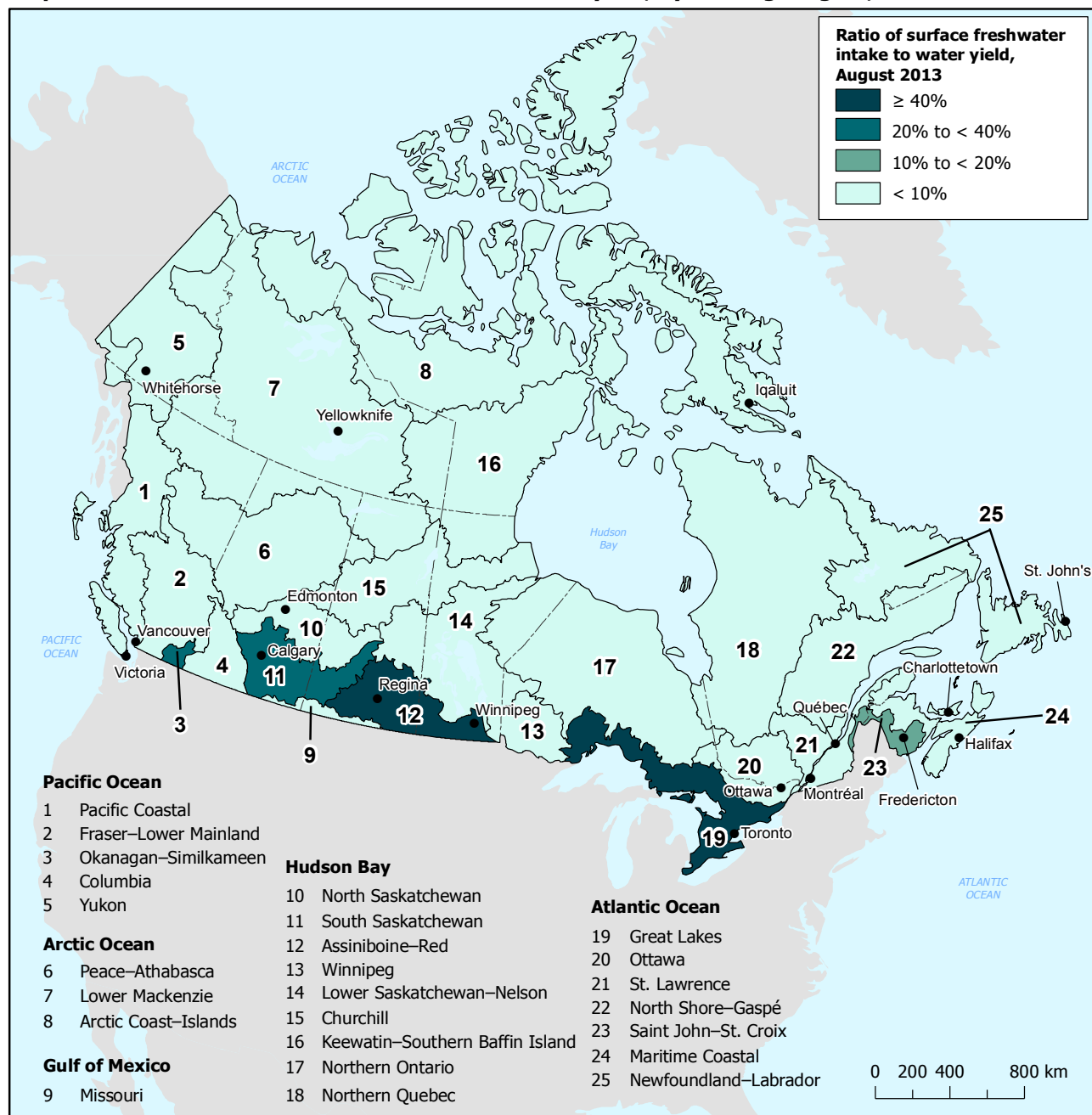
89 Water withdrawals are also referred to as water intake. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on various years of the Agricultural Water Use Survey and *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded. For more information please see [Appendix D](#).

90 Food and Agriculture Organization (FAO), 2012, "Coping with water scarcity: An action framework for Agriculture and food security," *FAO Water Reports*, Vol. 38, www.fao.org/docrep/016/i3015e/i3015e.pdf (accessed August 16, 2016).

91 Environment, Energy and Transportation Statistics Division, special tabulation.

92 Environment and Climate Change Canada, 2016, *Canadian Environmental Sustainability Indicators: Water Withdrawal and Consumption by Sector*, Catalogue no. 978-0-660-04751-5, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=5736C951-1 (accessed May 9, 2016).

Map 2.7 Ratio of surface freshwater intake to water yield, by drainage region, 2013



Notes: This map shows the ratio of surface freshwater water intake to water yield for August 2013, with the exception of drainage regions 7, 8, 16, 17, 18, which use the ratio of August intake to the long-term minimum monthly water yield. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247-259.

Section 3: Drainage region profiles

Canada's abundant freshwater is provided through a wide variety of ecosystems across a broad range of landscapes. These ecosystems can be large and complex, creating significant challenges in assessing how changes in land cover and climatological factors, among other drivers of change, affect the supply of freshwater.

This section provides maps, tables and charts on water supply and demand, land cover, population, nutrients and selected other factors influencing the provision of freshwater⁹³ for each of Canada's 25 drainage regions. Taken together, these data can help provide information on potential risks to water supply within drainage regions. See Textbox 3.1 for more information.

Textbox 3.1 Human modifications of landscapes affecting the supply of freshwater

Landscape modifications influence how ecosystems function and provide freshwater. Areas with more people, activities and infrastructure are generally more degraded from their natural state. Shorelines and waterways are modified by dams, culverts and diversions; roads, roofs, parking lots and other impermeable or disturbed surfaces increase runoff of sediment and contaminants into water bodies.⁹⁴ Some of the main factors of interest to understand this degradation include population densities, land cover and land use, and nutrient inputs.

The majority (98%) of Canada's population is concentrated in the south of the country, with large expanses of the landscape in the central and northern portions of Canada remaining virtually uninhabited.⁹⁵ The St. Lawrence and Great Lakes drainage regions have the highest population densities at 59.9 and 54.7 people per square kilometre, as well as the highest proportions of built-up area at 5.0% and 3.5% (Tables A.2 and A.1).

Landscapes in the prairie drainage regions have the largest proportions of arable land and natural land used for pasture (Table A.1). Drainage regions with the highest densities of linear infrastructure such as roads, pipelines, transmission lines and railroads include the St. Lawrence, Red-Assiniboine and Great Lakes (Table A.1).

⁹³ The suite of variables presented in this report provide context about influences on the provision of freshwater and were selected based on the availability and comparability of data at a national scale. The authors recognize that numerous other factors can have important effects at a local or regional scale.

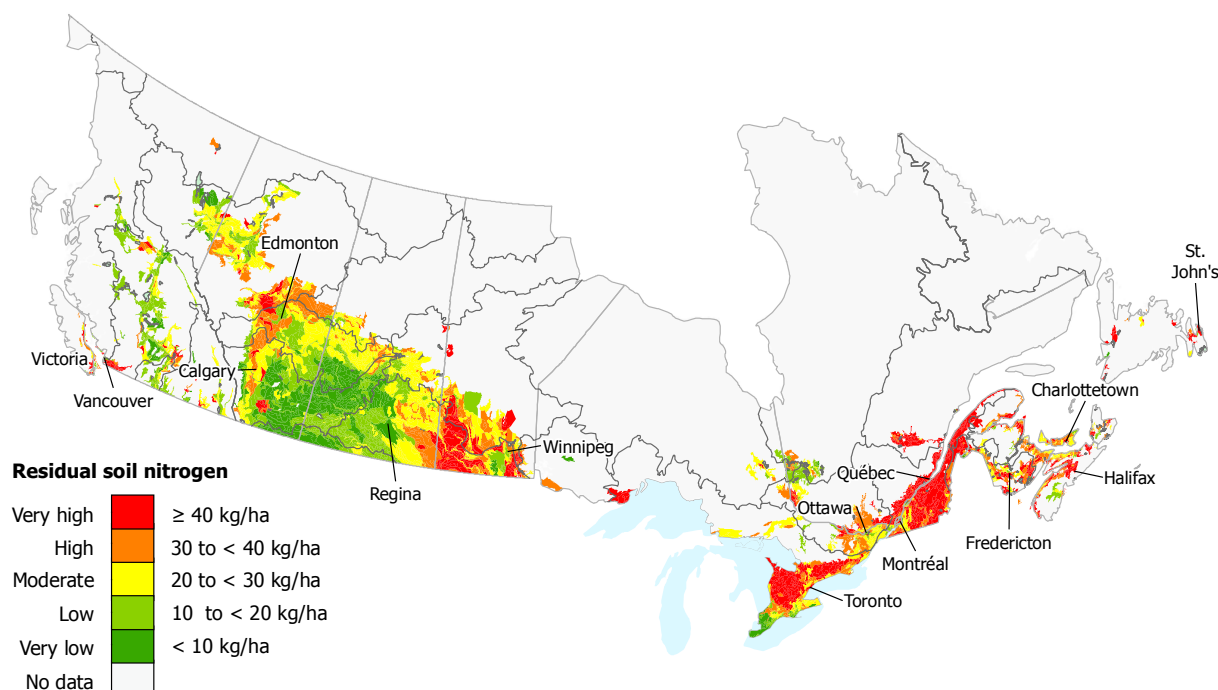
⁹⁴ Taylor, K.G. and P.N. Owens, 2009, "Sediments in urban river basins: a review of sediment-contaminant dynamics in an environmental system conditioned by human activities," *Journal of Soils and Sediments*, Vol. 9, pp. 281–303; Wong, P.P. et al., 2014, "Coastal systems and low-lying areas," *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*, pp. 361–409, www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap5_FINAL.pdf (accessed August 15, 2016); Settele, J. et al., 2014, "Terrestrial and inland water systems," *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*, pp. 271–359, www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap4_FINAL.pdf (accessed August 15, 2016).

⁹⁵ Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 2011 Census of Population. Southern Canada is a statistical area delineated by a boundary separating the northern from the southern portion of the country. For a map depicting the north-line see Map 2.3 Statistics Canada's North-line in relation to the land mass of Canada in Statistics Canada, 2010, "Freshwater supply and demand in Canada," *Human Activity and the Environment*, Catalogue no. 16-201-X, www.statcan.gc.ca/pub/16-201-x/2010000/m018-eng.htm.

While there are many different contaminants that can have an impact on water quality, nutrient pollution is one of the most widespread issues in Canada and around the world. Much of the nitrogen and phosphorus come from commercial fertilizers and manure that run off the land into water bodies or leach into groundwater, but other major sources include wastewater and stormwater, as well as nitrogen releases to air from motor vehicle use, oil and gas production, electrical power generation and other activities.⁹⁶

The largest fertilized areas were found in the Assiniboine–Red, South Saskatchewan and North Saskatchewan drainage regions (Table A.1). Some of the highest amounts of residual soil nitrogen⁹⁷ or phosphorus potentially released from agricultural soils⁹⁸ in 2011 occurred in areas that have historically had intensive agriculture, including parts of the Fraser–Lower Mainland, South Saskatchewan, Assiniboine–Red, Great Lakes, St. Lawrence and Maritime Coastal drainage regions (Maps 3.1 and 3.2, Table A.3).

Map 3.1
Residual soil nitrogen on agricultural land, 2011



Notes: The residual soil nitrogen (RSN) indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.

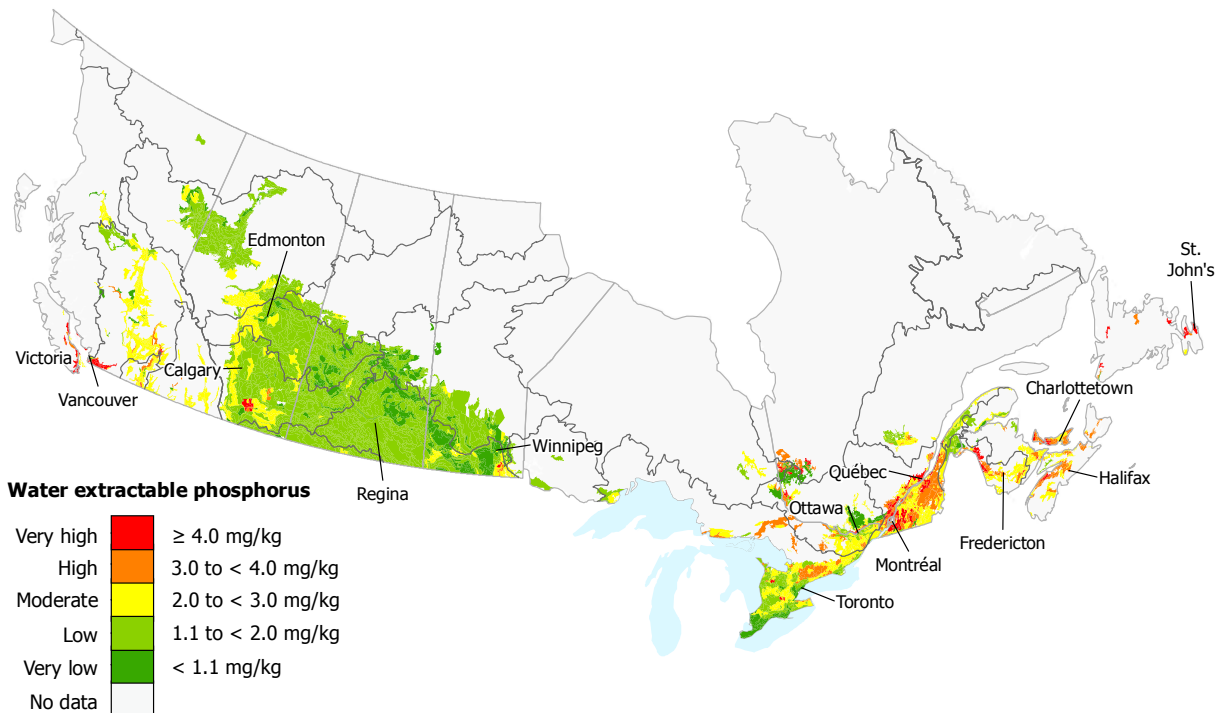
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Agri-Environmental Indicator (AEI)—Residual Soil Nitrogen (RSN), 2011*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016).

⁹⁶ Chambers, P.A. et al., 2008, "Nutrients—Nitrogen and Phosphorus," *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*, National Water Research Institute (NWRI), Environment Canada, NWRI Scientific Assessment Report Series No. 1, www.ec.gc.ca/inre-nwri/default.asp?lang=En&n=235D11EB-1&offset=7&toc=show#cur (accessed August 15, 2016); Environment and Climate Change Canada, 2016, *Canadian Environmental Sustainability Indicators: Air Pollutant Emissions*, www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=0870FFFC-1 (accessed August 15, 2016).

⁹⁷ Residual soil nitrogen (RSN) is the amount of nitrogen remaining in agriculture soils (kg/ha) in a given year after accounting for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. RSN by itself does not estimate the risk of water contamination. Surplus nitrogen can remain in the soil and be used by subsequent crops or it can be lost to the environment.

⁹⁸ This refers to the estimated amount of dissolved phosphorus potentially released from agricultural soils (P-source) (mg/kg) in a census year. P-source by itself does not estimate the risk of water contamination, which is dependent on both the P-source and a transport hydrology function.

Map 3.2
Risk of phosphorus release from agricultural soils, 2011



Notes: The risk of phosphorus release (P-source) is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Agri-Environmental Indicator (AEI)—Risk of P release in agricultural land (P-Source)*, 2011, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016).

In 2014 there were 754 thousand tonnes of nitrogen and 40 thousand tonnes of phosphorus released from industrial facilities to air, land and water across Canada (Table A.3). Wastewater discharges from industrial facilities, including wastewater treatment plants, can have varying impacts on the receiving aquatic ecosystems depending on the type of treatment, effluent quality, volume of discharge and the receiving water body. In 2012, over 3,700 wastewater systems in Canada generated an estimated 6 trillion litres of wastewater, of which over 150 billion litres may have been untreated. Of these systems, 849 were identified as needing upgrades to meet national effluent quality standards and 136 were considered high risk systems.⁹⁹

Turbidity measures of source water for drinking water production were highest in the Lower Saskatchewan–Nelson, North Saskatchewan and Assiniboine–Red drainage regions in the Prairies and in the St. Lawrence drainage region (Table A.3). Turbidity data collected by treatment plant operators help establish historical trends concerning source water conditions. Data on land cover and land use change in the surrounding and upstream environment can provide information on how people contribute to changing turbidity levels.

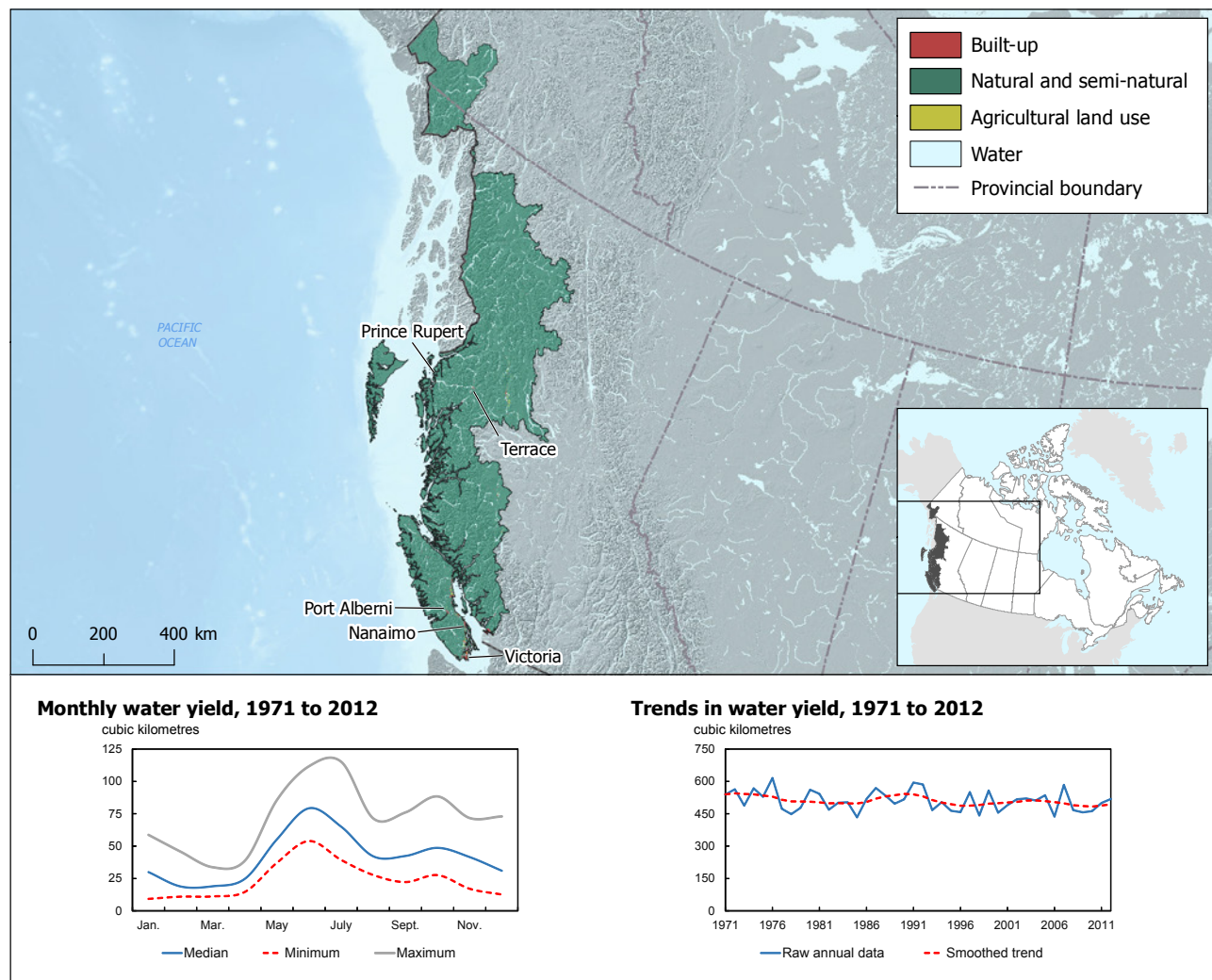
⁹⁹ Government of Canada, 2012, "Regulatory Impact Analysis Statement," *Wastewater System Effluent Regulations*, SOR/2012-139, Canada Gazette, Part II, Vol. 146, no. 15, www.gazette.gc.ca/rp-pr/p2/2012-07-18/html/sor-dors139-eng.html (accessed December 15, 2016).

3.1 Pacific Coastal drainage region

Profile highlights

- The landscape of the Pacific Coastal drainage region is dominated by natural and semi-natural areas—built-up and agricultural areas accounted for less than 1% of the region in 2011.
- The population was 1,505,007 in 2011—4% of Canada's total—with a population density of 4.7 persons/km². Population was up 65% compared to 913,522 in 1971.
- Surface freshwater intake from drinking water plants, manufacturing, irrigation, mining and thermal-electric production was 617.3 million m³ in 2013.
- The average annual water yield was 510.2 km³ over the period 1971 to 2012—the second highest after Northern Quebec. The water yield per unit area was highest at 1.53 m³/m². Monthly water flows peak in June. Compared to other drainage regions, monthly water yield varies relatively little from year to year—the variability index was lowest.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. On average the risk of phosphorus release from agricultural soils was high, with 2.9 mg/kg of water extractable phosphorus potentially released in 2011.

Map 3.3.1
Land use and water yield for the Pacific Coastal drainage region



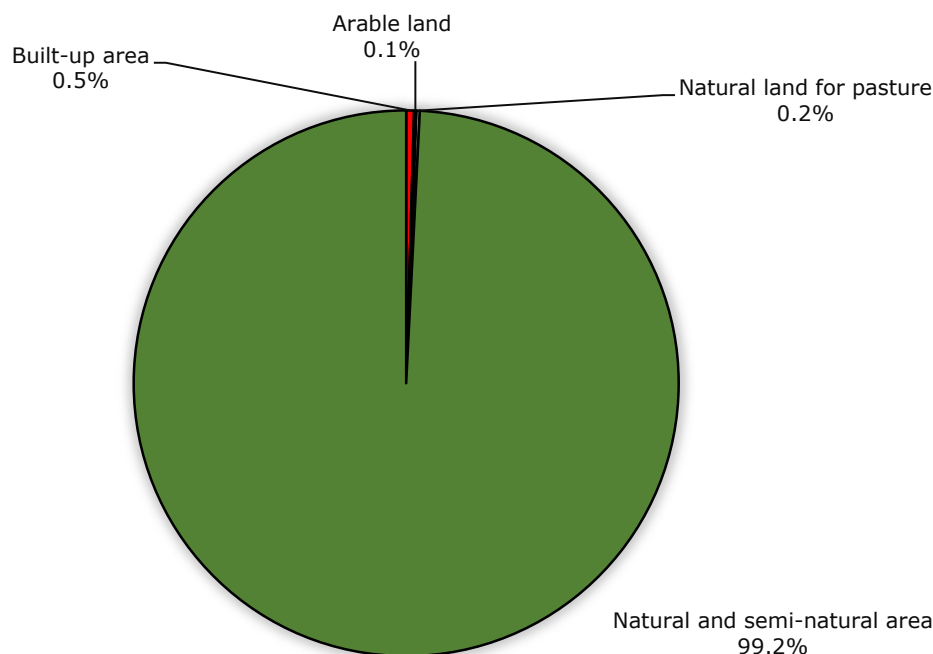
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.1

Land cover and land use, Pacific Coastal drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.1.1

Selected land cover and land use statistics, Pacific Coastal drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
		km ²			percentage			km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Pacific Coastal	334,455	14,219	320,236	0.5	0.1	0.2	99.2	183	79	141.6

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.1.2

Selected statistics on water supply and demand, Pacific Coastal drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Pacific Coastal	913,522	1,505,007	2.9	4.7	617.3	510.2	1.53	0.50	0.26

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.1.3

Selected indicators of pressures on water quality, Pacific Coastal drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Pacific Coastal	22.0	6.8	2.9	0.0	10,390	493	0.9

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.2 Fraser–Lower Mainland drainage region

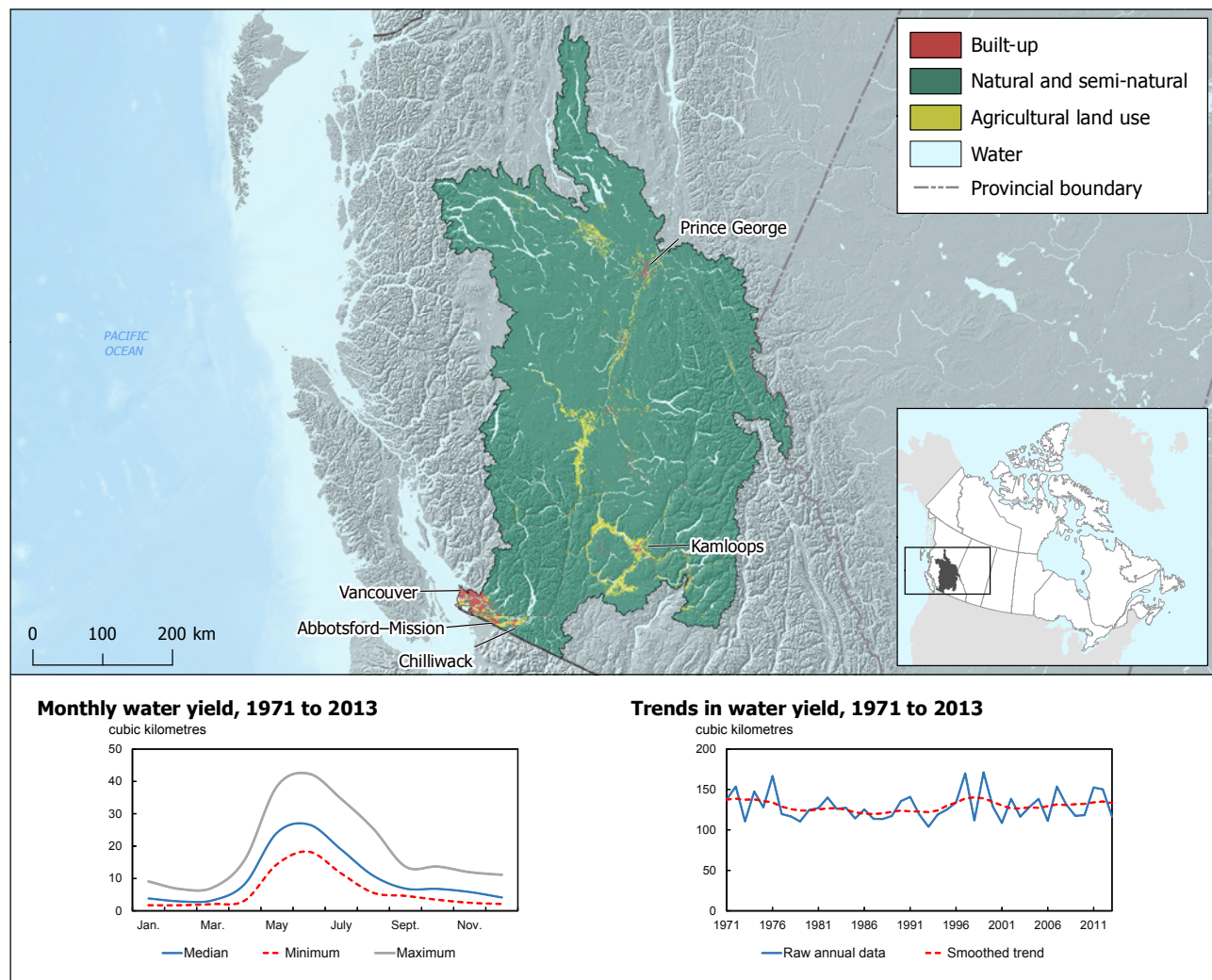
Profile highlights

- The Fraser–Lower Mainland drainage region extends across 233,104 km² from Vancouver to Prince George. The majority (94.2%) of its area was natural and semi-natural area, 4.8% was arable and natural land for pasture and 1.1% was built-up in 2011.
- The population was 2,336,941 in 2011—third highest in the country—with a population density of 10.4 persons/km². Population was up 140% compared to 971,762 in 1971.
- Surface freshwater intake for manufacturing, drinking water plants, irrigation, mining and thermal-electric production was 615.3 million m³ in 2013.
- The average annual water yield was 129.3 km³ over the period 1971 to 2013. The water yield per unit area was 0.55 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in June.
- Some sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. The risk of phosphorus release from agricultural soils was high, with 3.3 mg/kg of water extractable phosphorus potentially released in 2011. Phosphorus emitted by industrial facilities in the region directly to air, land and water in 2014 accounted for 86% of the national industrial emissions, which is largely attributable to the Mount Polley Mine disaster on August 4, 2014.¹⁰⁰

¹⁰⁰ Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016).

Map 3.3.2

Land use and water yield for the Fraser–Lower Mainland drainage region



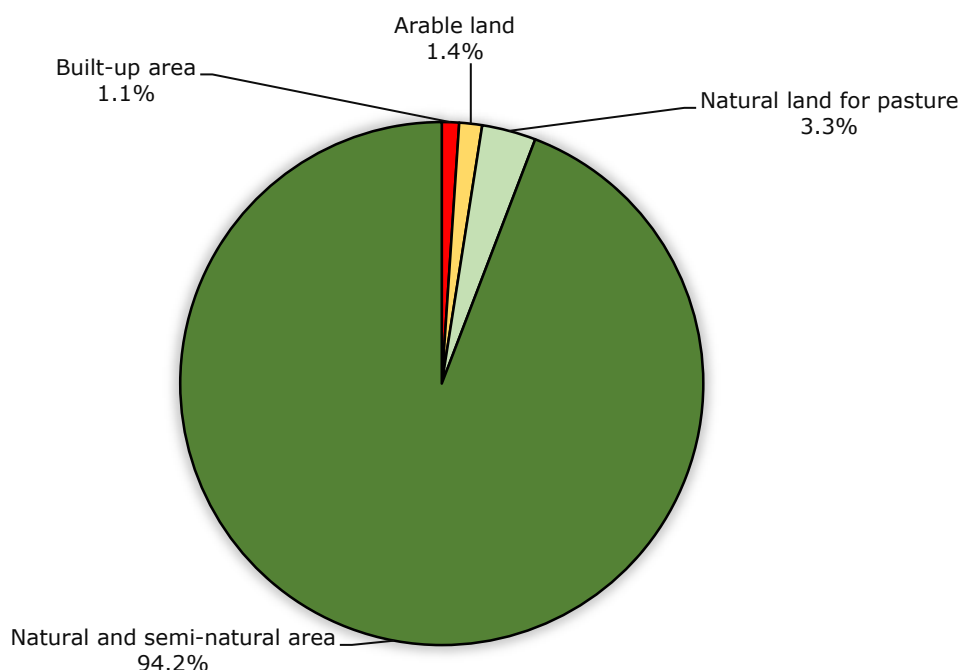
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.2

Land cover and land use, Fraser–Lower Mainland drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.2.1

Selected land cover and land use statistics, Fraser–Lower Mainland drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Fraser–Lower Mainland	233,104	8,937	224,167	1.1	1.4	3.3	94.2	1,224	725	379.1

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.2.2

Selected statistics on water supply and demand, Fraser–Lower Mainland drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Fraser–Lower Mainland	971,762	2,336,941	4.3	10.4	615.3	129.3	0.55	0.83	0.33

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.2.3

Selected indicators of pressures on water quality, Fraser–Lower Mainland drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Fraser–Lower Mainland	23.2	105.5	3.3	0.0	26,489	34,660	1.4

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

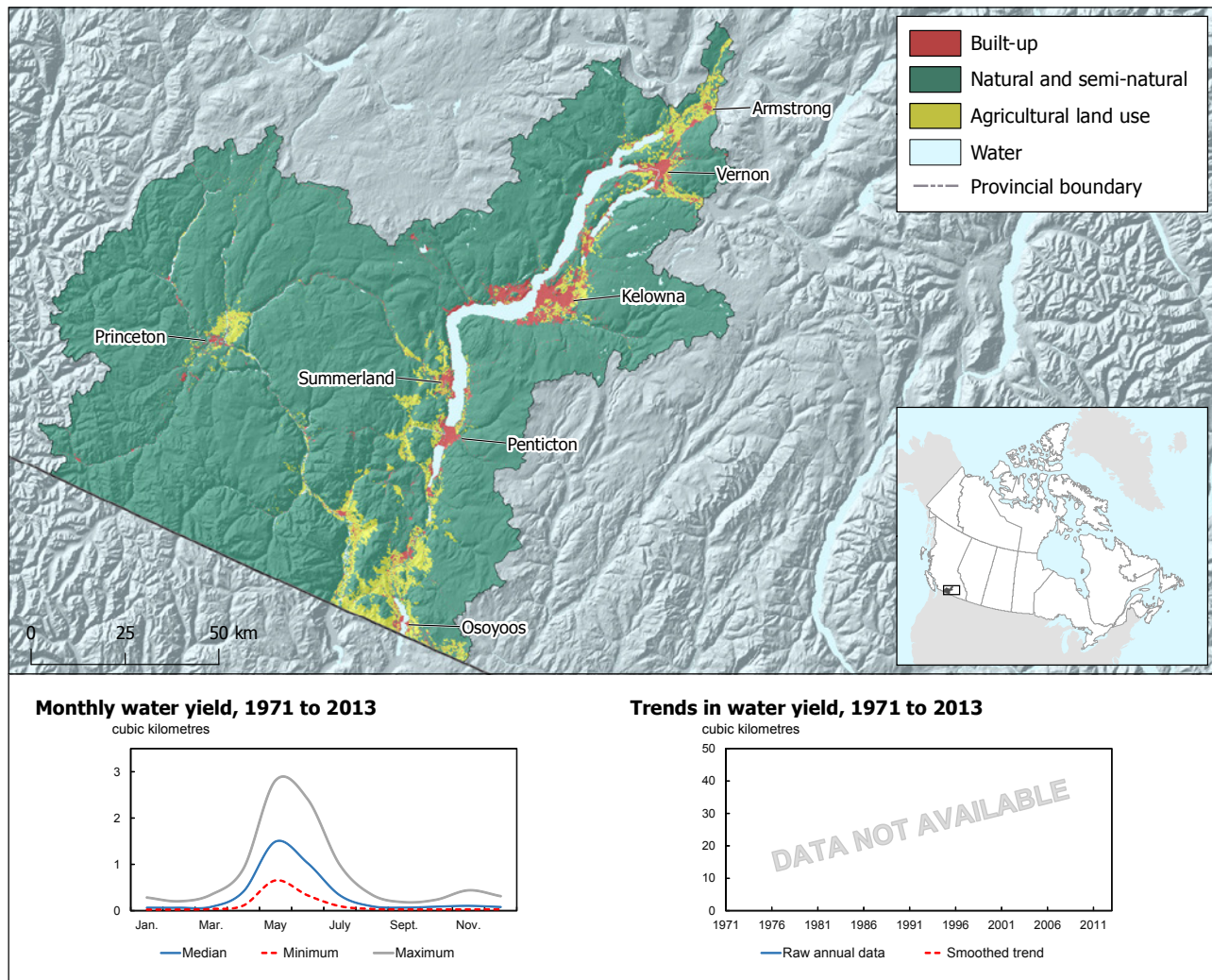
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.3 Okanagan–Similkameen drainage region

Profile highlights

- The Okanagan–Similkameen is a small and arid drainage region located in southern British Columbia near Lake Okanagan, Lake Osoyoos and the Similkameen River. In 2011, 88.2% of its total area was natural and semi-natural area, 9.0% was natural land for pasture and arable land and 2.8% was built-up area.
- The population was 327,548 in 2011, with a population density of 21.8 persons/km², the third highest in the country. Population was up 176% compared to 118,507 in 1971.
- Surface freshwater intake from drinking water plants, irrigation and manufacturing was 148.3 million m³ in 2013.
- The average annual water yield was 4.3 km³ over the period of 1971 to 2013 —the second lowest in the country. The water yield per unit area was 0.27 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in May. The monthly variability index was the third highest in the country, indicating the monthly flows can vary widely from year to year.

Map 3.3.3
Land use and water yield for the Okanagan–Similkameen drainage region



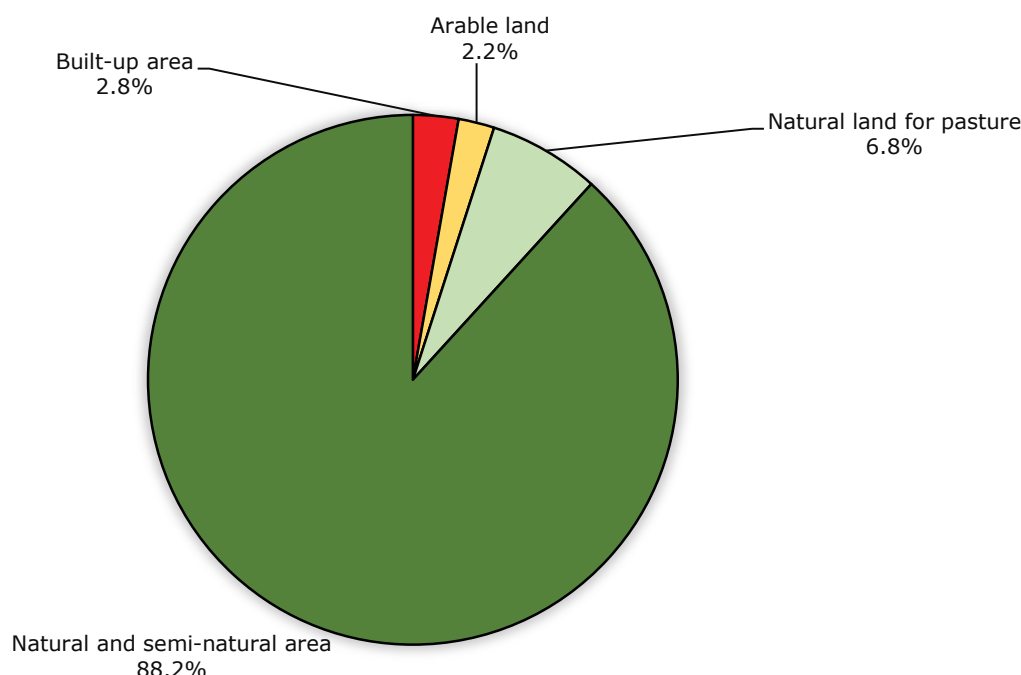
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.3

Land cover and land use, Okanagan–Similkameen drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.3.1

Selected land cover and land use statistics, Okanagan–Similkameen drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Okanagan–Similkameen	15,603	585	15,018	2.8	2.2	6.8	88.2	150	182	737.8

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's Land Use, 2010, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.3.2

Selected statistics on water supply and demand, Okanagan–Similkameen drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Okanagan–Similkameen	118,507	327,548	7.9	21.8	148.3	4.3	0.27	1.44	0.41

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.3.3

Selected indicators of pressures on water quality, Okanagan–Similkameen drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Okanagan–Similkameen	20.3	184.5	2.6	0.0	201	0	1.4

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

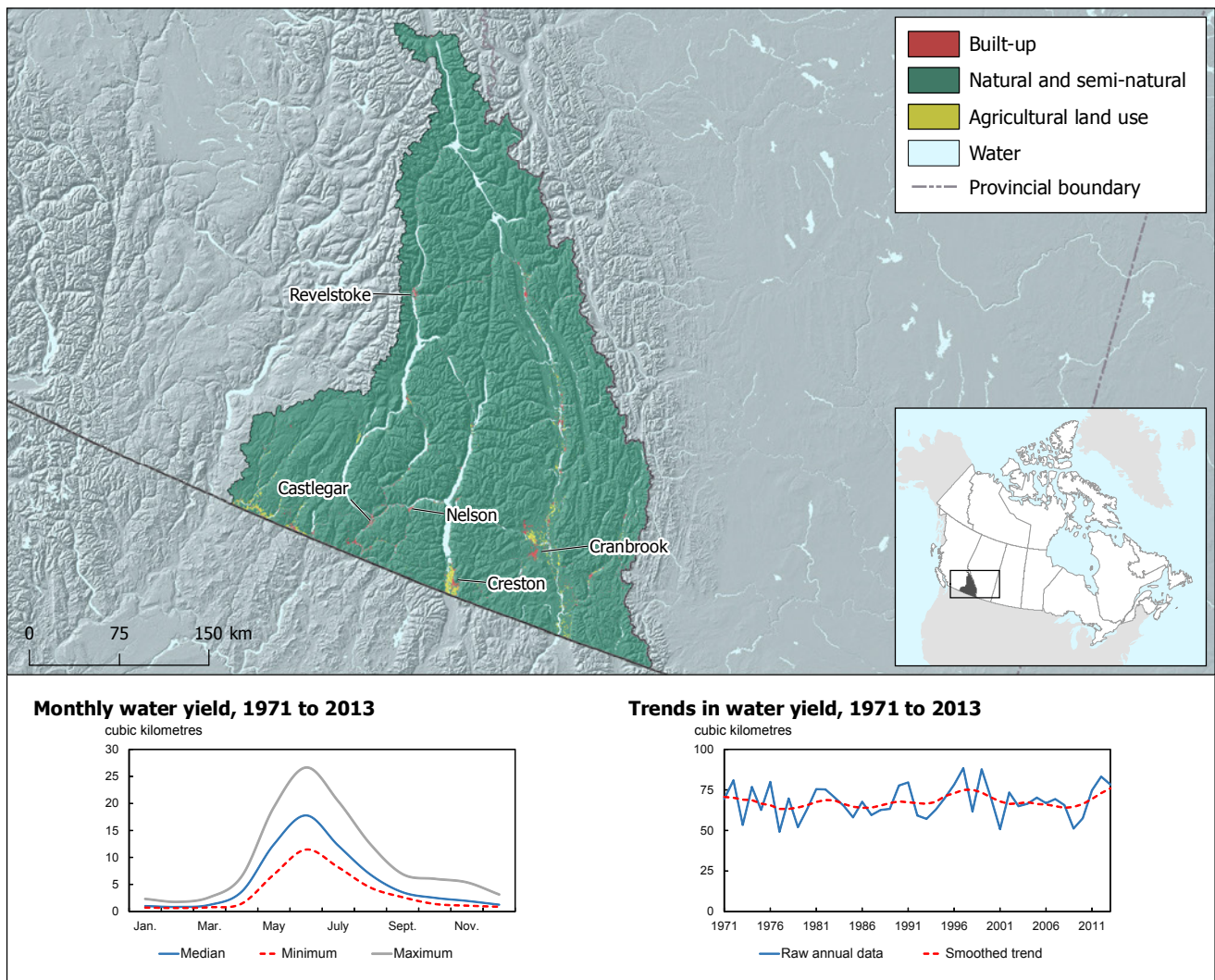
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.4 Columbia drainage region

Profile highlights

- The Columbia drainage region extends across 87,323 km² in south-eastern British Columbia. Natural and semi-natural area accounted for 97.7% of the total area in 2011, with small amounts of arable land (0.5%), natural land for pasture (1.0%) and built-up area (0.8%).
- The population was 160,896 in 2011, with a population density of 1.9 persons/km².
- Surface freshwater intake from manufacturing, drinking water plants, irrigation and mining was 190.7 million m³ in 2013.
- The average annual water yield was 67.9 km³ over the period 1971 to 2013. The water yield per unit area was 0.78 m³/m², more than double the 0.35 m³/m² at the Canada level. Monthly water flows peak in June.

Map 3.3.4
Land use and water yield for the Columbia drainage region

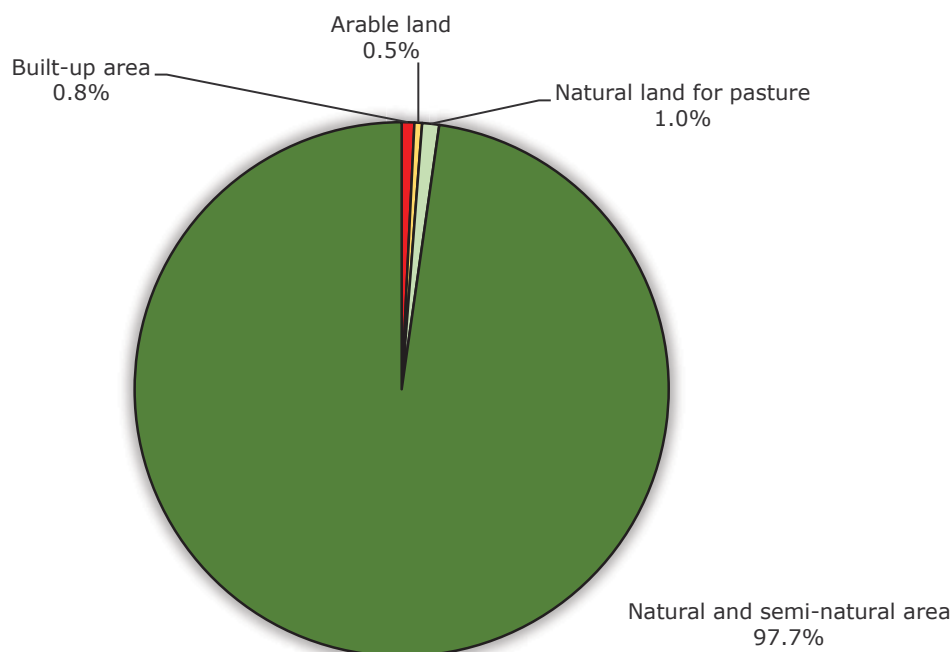


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.4
Land cover and land use, Columbia drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.4.1
Selected land cover and land use statistics, Columbia drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Columbia	87,323	2,348	84,975	0.8	0.5	1.0	97.7	148	117	351.0

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.4.2

Selected statistics on water supply and demand, Columbia drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Columbia	132,952	160,896	1.6	1.9	190.7	67.9	0.78	1.04	0.41

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.4.3

Selected indicators of pressures on water quality, Columbia drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Columbia	21.4	30.2	2.5	0.0	2,468	1,373	0.7

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

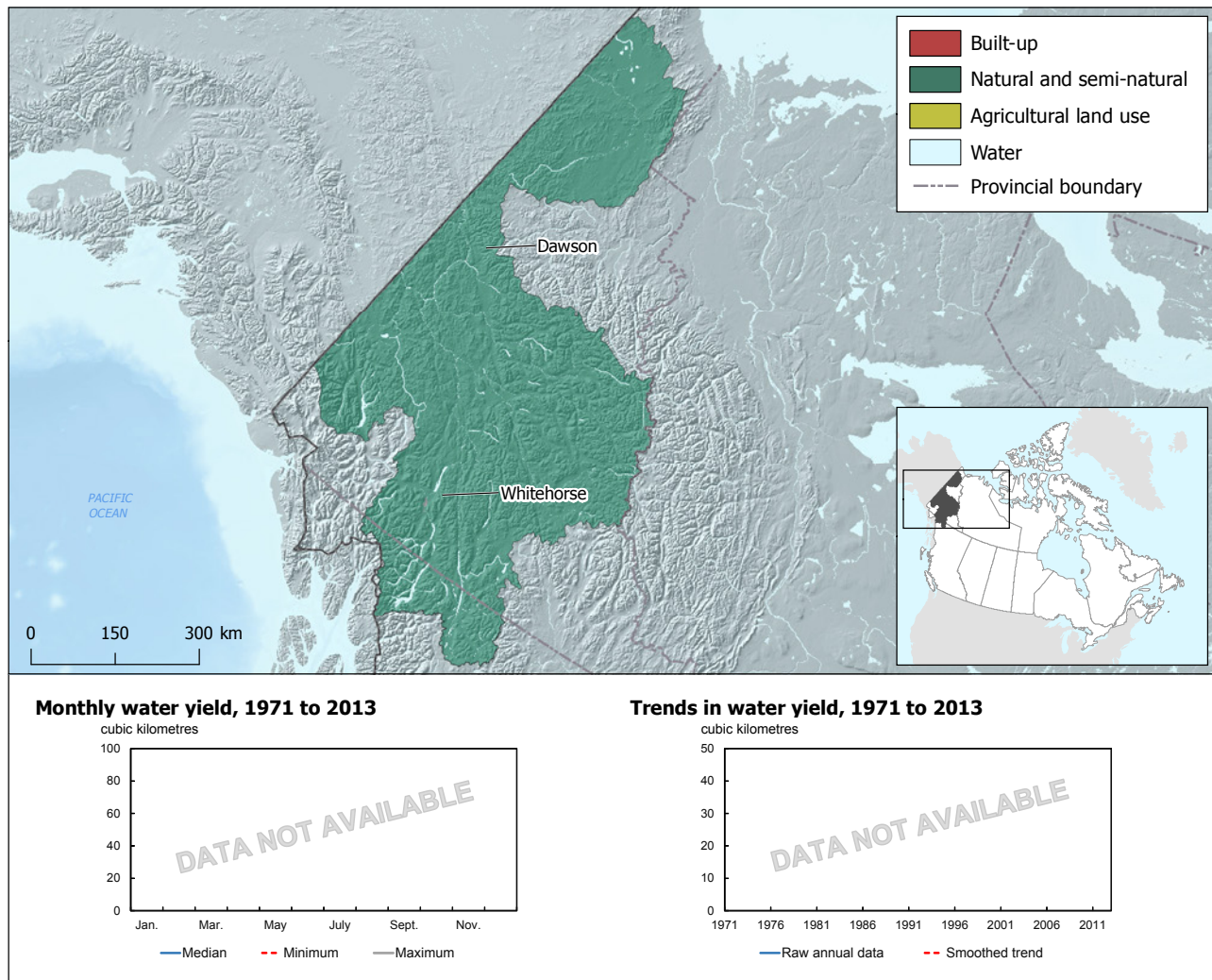
3.5 Yukon drainage region

Profile highlights

- The Yukon drainage region extends across 332,906 km² of the Yukon Territory. Natural and semi-natural area accounted for virtually all of the region in 2011.
- The population was 32,280 in 2011, with a population density of 0.1 persons/km², among the lowest in the country.
- Surface freshwater intake from mining and drinking water plants was 12.5 million m³ in 2013.
- The long-term¹⁰¹ average annual water yield was 106.0 km³. The water yield per unit area was 0.32 m³/m² compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration (0.14 m³/m²) was the third lowest among drainage regions across Canada.

¹⁰¹ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.5
Land use and water yield for the Yukon drainage region

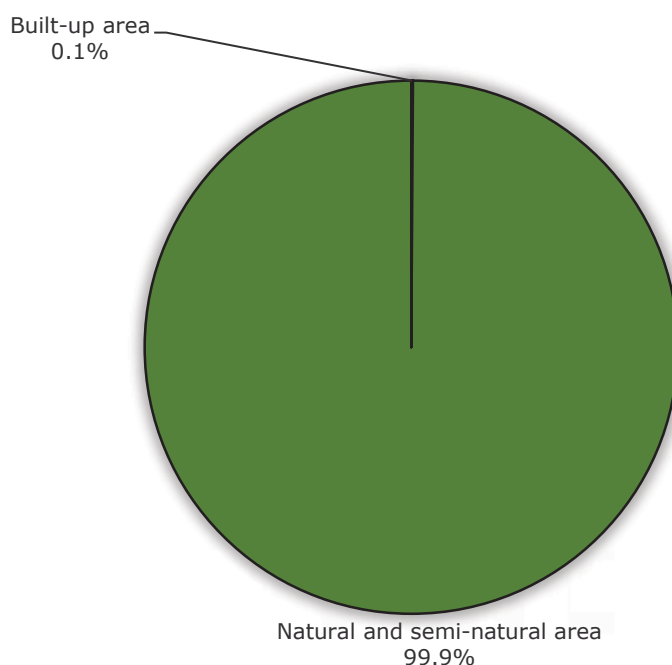


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.5
Land cover and land use, Yukon drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.5.1
Selected land cover and land use statistics, Yukon drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Yukon	332,906	9,540	323,366	0.1	0.0	0.0	99.9	0	0	41.3

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.5.2

Selected statistics on water supply and demand, Yukon drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Yukon	16,984	32,280	0.1	0.1	12.5	106.0	0.32	..	0.14

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.5.3

Selected indicators of pressures on water quality, Yukon drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Yukon	...	...	...	...	0	0	..

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

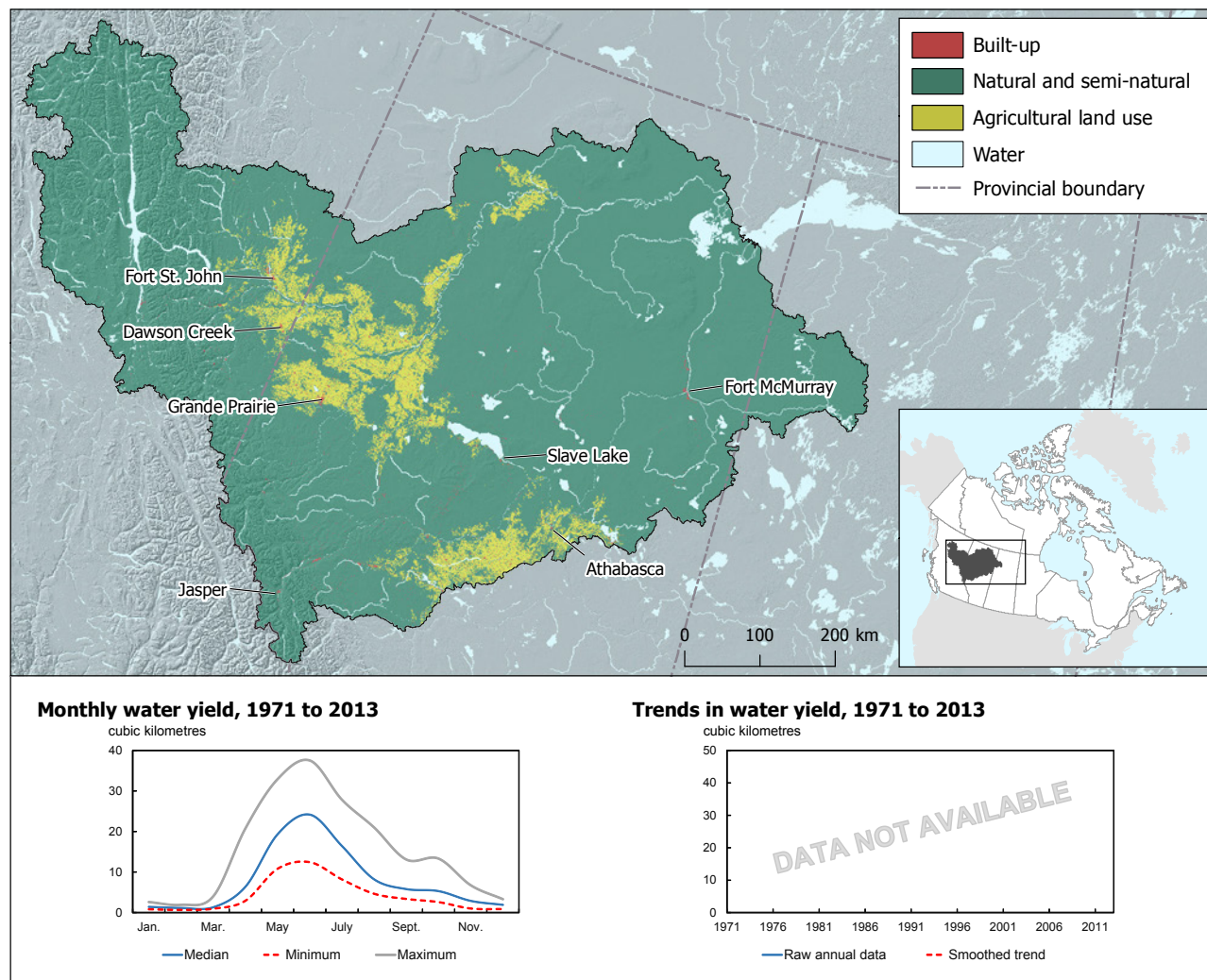
3.6 Peace–Athabasca drainage region

Profile highlights

- The Peace–Athabasca drainage region extends across 485,145 km² of northern Alberta and British Columbia. Its landscape was dominated by natural and semi-natural areas (90.9%) in 2011, although there were significant amounts of arable land (6.2%) and natural land for pasture (2.3%).
- The population was 406,303 in 2011, with a population density of 0.9 persons/km².
- Surface freshwater intake from manufacturing, mining, drinking water plants and thermal-electric production was 297.3 million m³ in 2013.
- The average annual water yield was 99.5 km³ over the period 1971 to 2013. The water yield per unit area was 0.21 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in June. Data on trends over time are not available.
- Some sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production and the 155,828 tonnes of nitrogen-containing substances emitted to air, land and water by industrial facilities in 2014. These emissions accounted for 21% of direct industrial emissions across Canada.

Map 3.3.6

Land use and water yield for the Peace–Athabasca drainage region



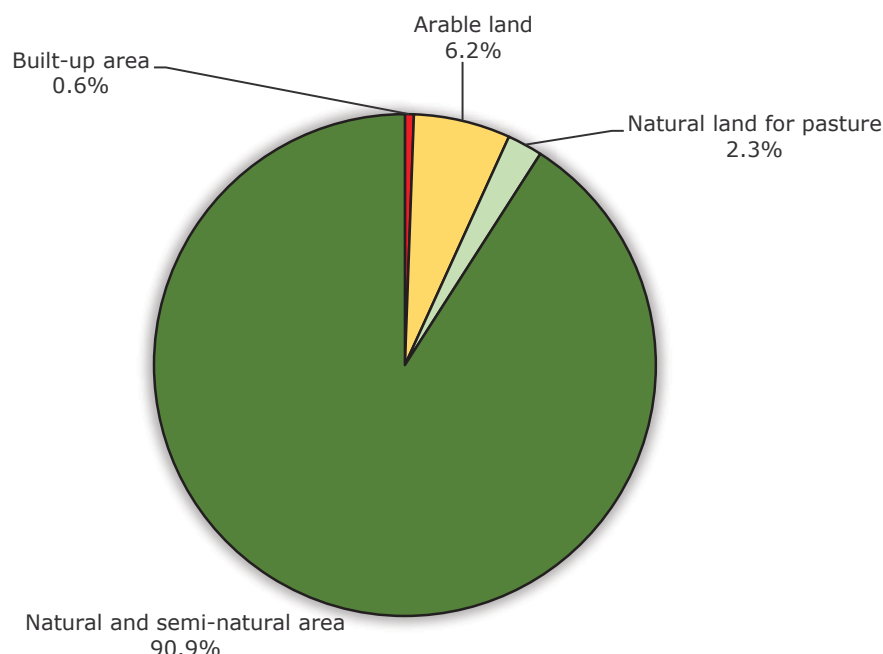
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.6

Land cover and land use, Peace–Athabasca drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.6.1

Selected land cover and land use statistics, Peace–Athabasca drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Peace–Athabasca	485,145	16,725	468,420	0.6	6.2	2.3	90.9	15,065	13	164.5

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.6.2

Selected statistics on water supply and demand, Peace–Athabasca drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Peace–Athabasca	206,361	406,303	0.4	0.9	297.3	99.5	0.21	1.01	0.31

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.6.3

Selected indicators of pressures on water quality, Peace–Athabasca drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Peace–Athabasca	25.4	215.1	1.6	0.0	155,828	133	5.0

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.7 Lower Mackenzie drainage region

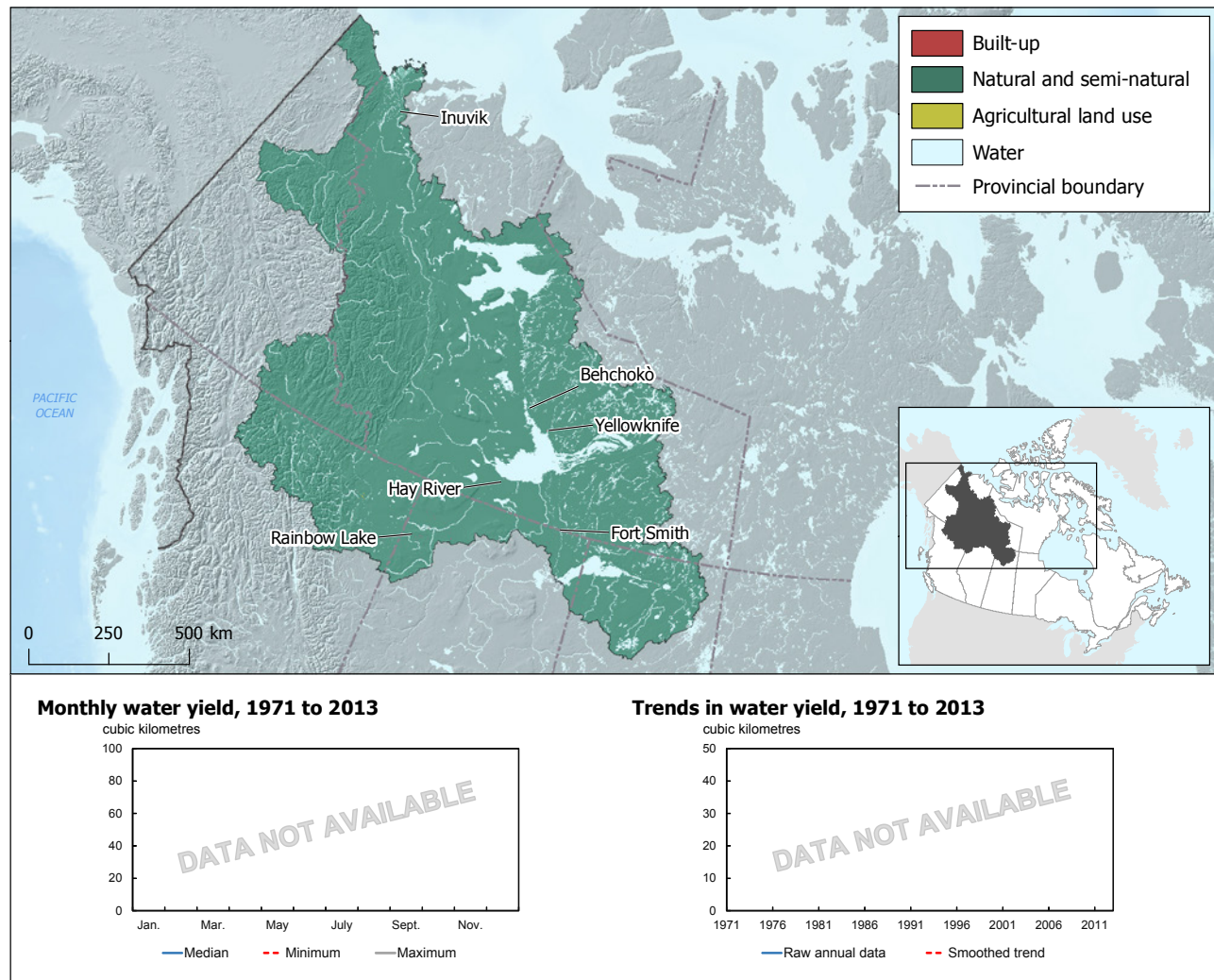
Profile highlights

- The Lower Mackenzie drainage region extends across a vast area of Canada's western provinces, Yukon and Northwest Territories. It is the second largest drainage region in Canada with total area of 1,330,490 km²—virtually all of it natural and semi-natural area.
- The population was 52,844 in 2011, with a population density of 0.05/km², the third lowest in the country.
- Surface freshwater intake from drinking water plants and mining was 10.7 million m³ in 2013.
- The long-term¹⁰² average annual water yield was 246.3 km³. The water yield per unit area was 0.19 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was relatively low at 0.17 m³/m².

¹⁰² The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.7

Land use and water yield for the Lower Mackenzie drainage region

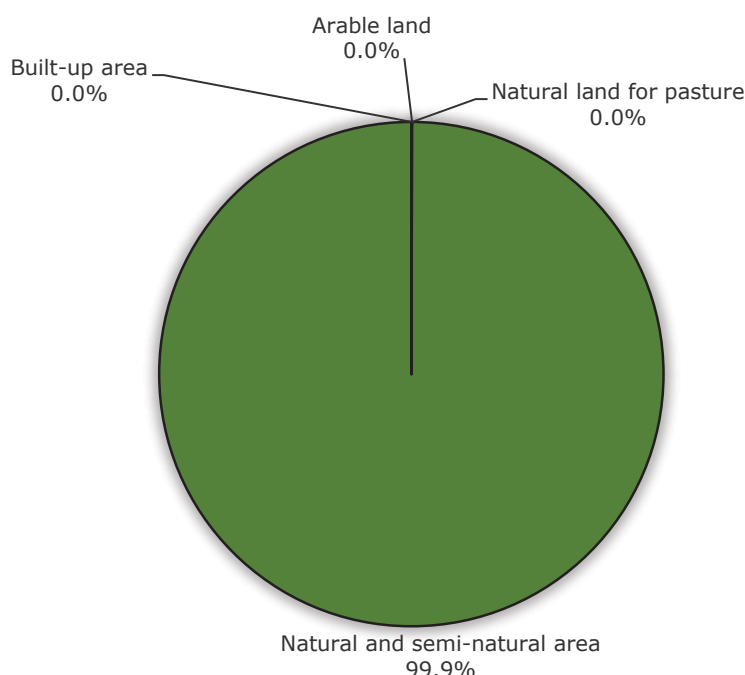


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.7
Land cover and land use, Lower Mackenzie drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.7.1
Selected land cover and land use statistics, Lower Mackenzie drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Lower Mackenzie	1,330,490	177,000	1,153,490	0.0	0.0	0.0	99.9	2	0	18.5

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.7.2

Selected statistics on water supply and demand, Lower Mackenzie drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Lower Mackenzie	34,283	52,844	0.0	0.0	10.7	246.3	0.19	..	0.17

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.7.3

Selected indicators of pressures on water quality, Lower Mackenzie drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Lower Mackenzie	26.8	0.1	1.5	0.0	22,559	0	4.6

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

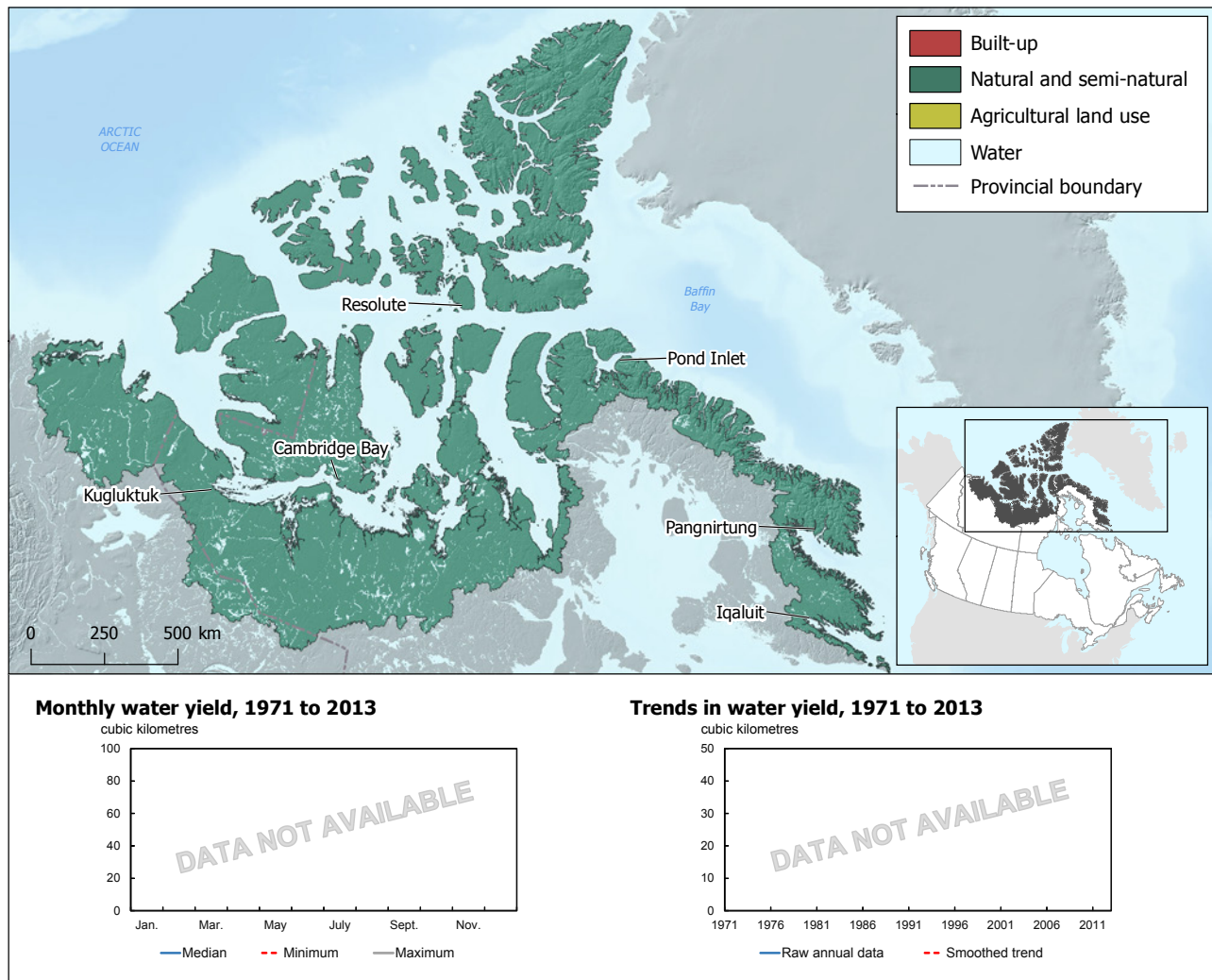
3.8 Arctic Coast–Islands drainage region

Profile highlights

- The Arctic Coast–Islands is Canada's largest drainage region, with a total area of 1,764,280 km², virtually all of it natural and semi-natural area.
- The density of linear infrastructure including roads, rail lines and transmission lines was the second lowest in the country at 1.6 m/km² in 2011.
- The population was 20,133 in 2011, with a population density of 0.01/km², the lowest in the country.
- Surface freshwater intake from drinking water plants and mining was 1.3 million m³ in 2013.
- The long-term¹⁰³ average annual water yield was 231.3 km³. The water yield per unit area was 0.13 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was the lowest in the country at 0.11 m³/m².

¹⁰³ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.8
Land use and water yield for the Arctic Coast–Islands drainage region



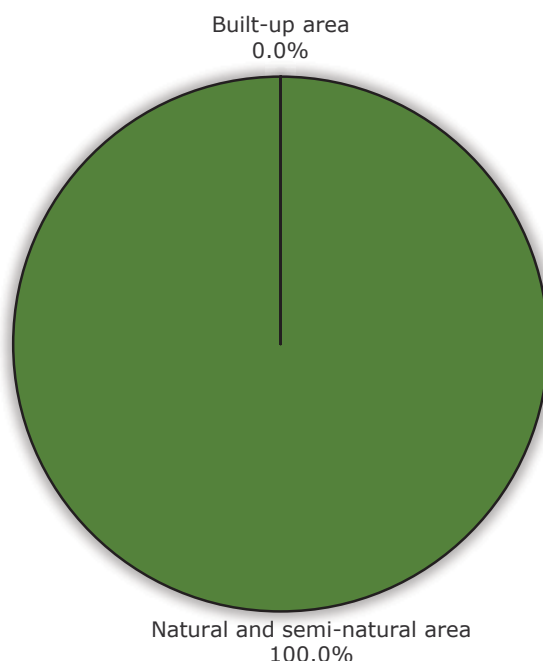
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.8

Land cover and land use, Arctic Coast–Islands drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.8.1

Selected land cover and land use statistics, Arctic–Coast Islands drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Arctic Coast–Islands	1,764,280	175,804	1,588,476	0.0	0.0	0.0	100.0	0	0	1.6

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.8.2

Selected statistics on water supply and demand, Arctic Coast–Islands drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Arctic Coast–Islands	7,655	20,133	0.0	0.0	1.3	231.3	0.13	..	0.11

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.8.3

Selected indicators of pressures on water quality, Arctic Coast–Islands drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Arctic Coast–Islands	...	...	...	...	7,607	0	F

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

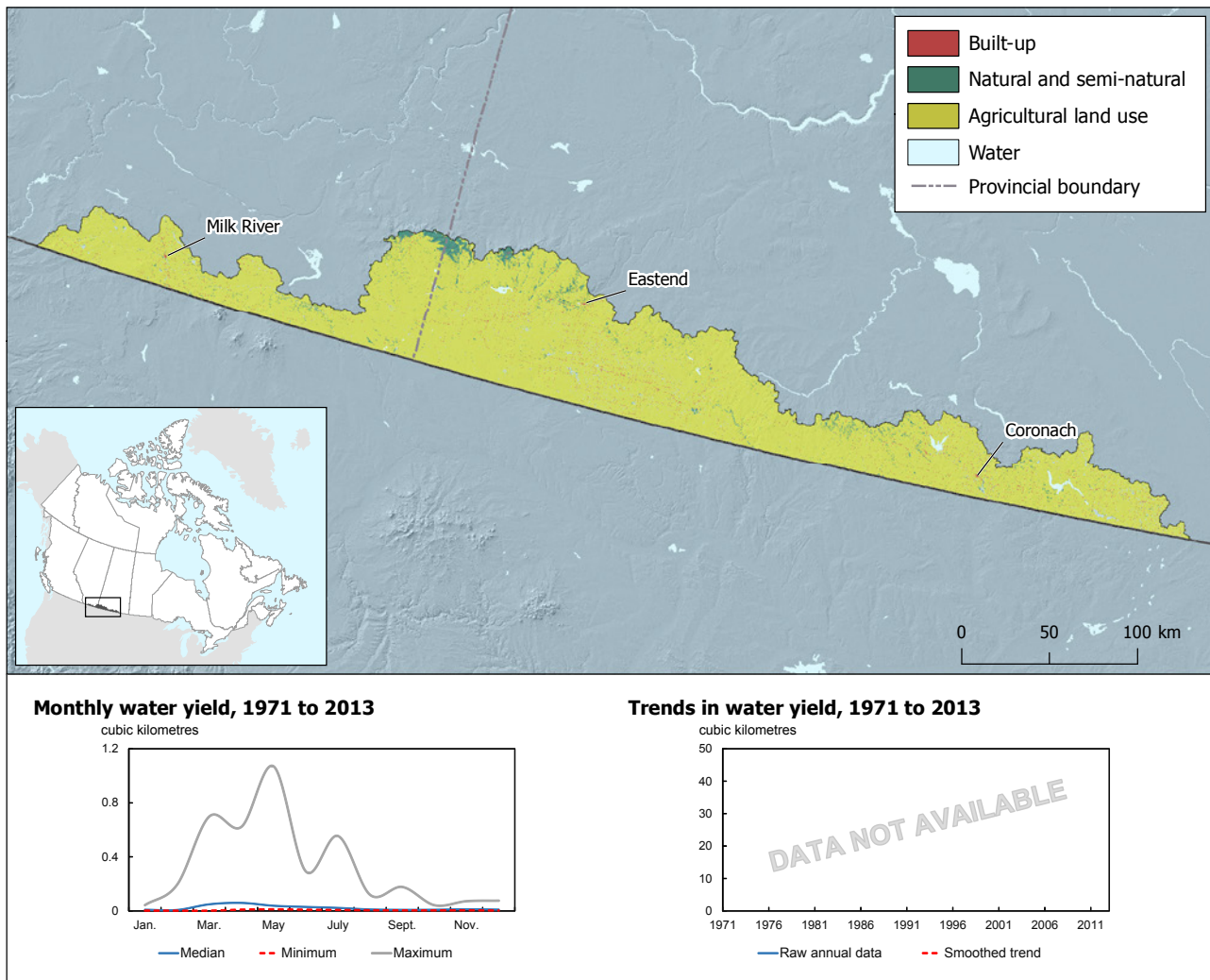
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.9 Missouri drainage region

Profile highlights

- The Missouri drainage region, located in southern Alberta and Saskatchewan, is the only region in Canada that drains into the Gulf of Mexico. This small drainage region is heavily dominated by agricultural activity, with arable land and natural land for pasture accounting for 82.7% of the total area in 2011, followed by natural and semi-natural area (16.2%) and built-up area (1.2%).
- Population and population density were relatively low at 8,439 and 0.3 persons/km² respectively in 2011.
- Surface freshwater intake from irrigation and drinking water plants was 20.2 million m³ in 2013.
- The average annual water yield (0.5 km³) and the water yield per unit area (0.02 m³/m²) over the period of 1971 to 2013, were the lowest in the country. The monthly variability index was the second highest in the country, indicating that the monthly water flows can vary widely from year to year. Monthly water flows peak in March. Data on trends over time are not available. Evapotranspiration was 0.33 m³/m², compared to 0.23 m³/m² at the Canada level.

Map 3.3.9
Land use and water yield for the Missouri drainage region

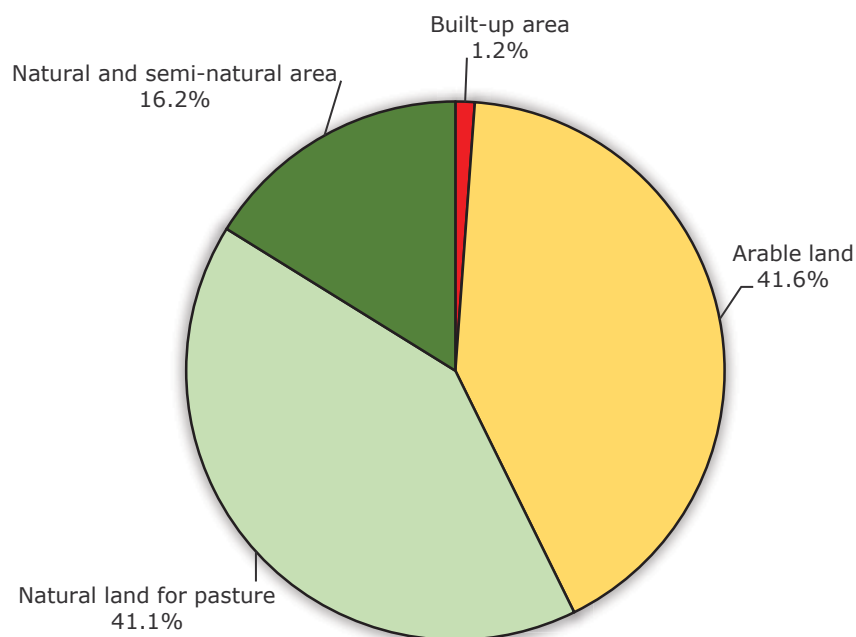


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.9
Land cover and land use, Missouri drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.9.1
Selected land cover and land use statistics, Missouri drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Missouri	27,096	915	26,181	1.2	41.6	41.1	16.2	3,931	144	586.1

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.9.2

Selected statistics on water supply and demand, Missouri drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Missouri	15,328	8,439	0.6	0.3	20.2	0.5	0.02	2.14	0.33

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.9.3

Selected indicators of pressures on water quality, Missouri drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Missouri	11.1	922.5	1.6	1.1	16,289	0	F

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

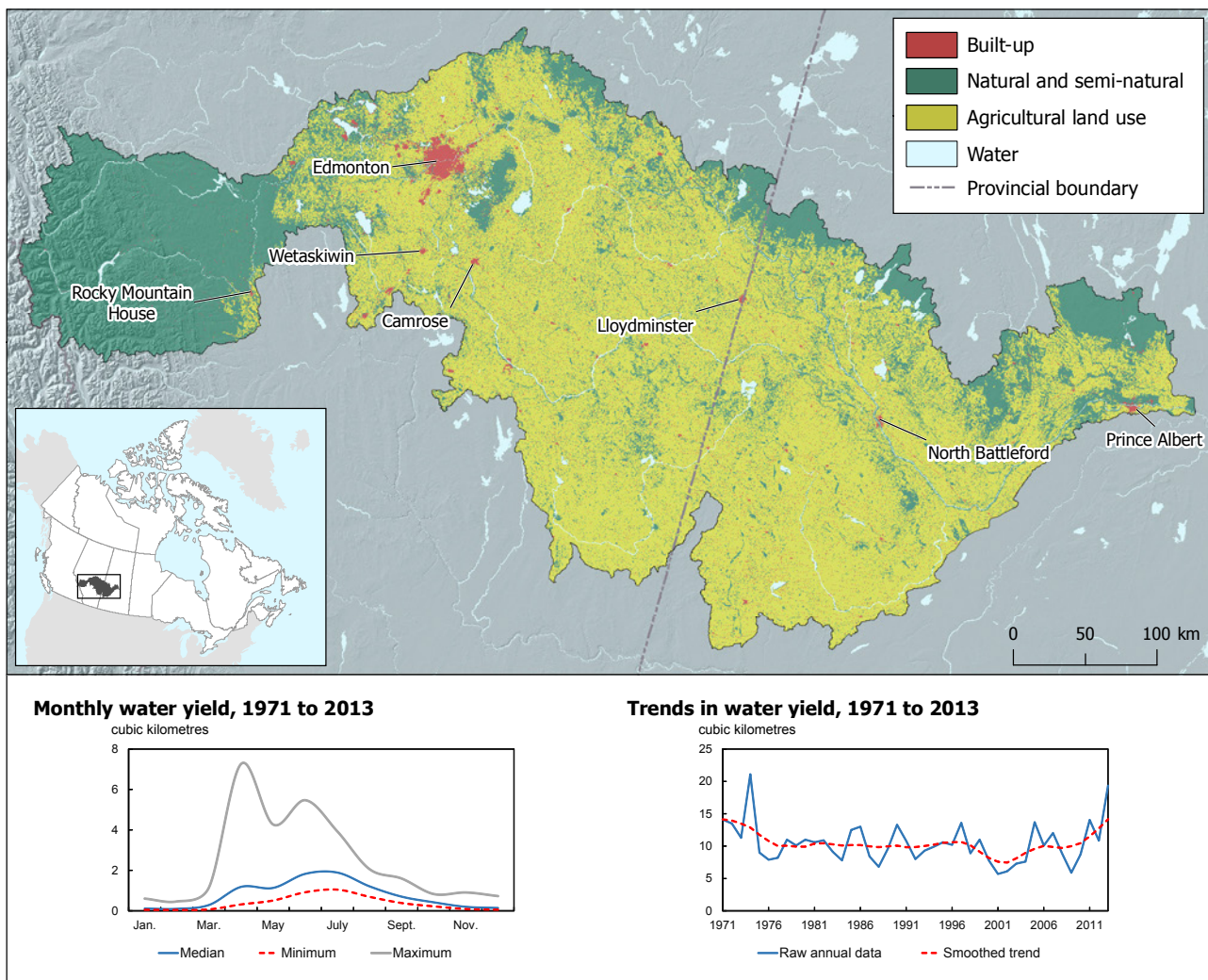
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.10 North Saskatchewan drainage region

Profile highlights

- The North Saskatchewan drainage region, which includes the City of Edmonton, is used heavily for agricultural production. Arable land and natural land for pasture made up 65.4% of the landscape in 2011, followed by natural and semi-natural area (31.5%) and built-up area (3.1%).
- The drainage region had the third highest fertilizer application area in the country at 44,992 km², accounting for 60% of the region's arable land in 2011.
- The population was 1,559,613 in 2011—5% of Canada's total—with a population density of 10.9 persons/km². Population was up 85% compared to 841,004 in 1971.
- Surface freshwater intake from thermal-electric production, drinking water plants, manufacturing, mining and irrigation was 947.4 million m³ in 2013.
- The average annual water yield was a relatively low 10.4 km³ over the period 1971 to 2013. The water yield per unit area was 0.07 m³/m², the fourth lowest in the country. Snow and ice melt contributes to summer flows—the monthly water yield peaks in July. Evapotranspiration was 0.34 m³/m², compared to 0.23 m³/m² at the Canada level.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. In 2014, 127,820 tonnes of nitrogen-containing substances were emitted to air, land and water by industrial facilities. These emissions accounted for 17% of direct industrial emissions across Canada.
- Turbidity levels of source water for drinking water plants were among the highest in the country at 9.0 nephelometric turbidity units (NTU) in 2013.

Map 3.3.10
Land use and water yield for the North Saskatchewan drainage region



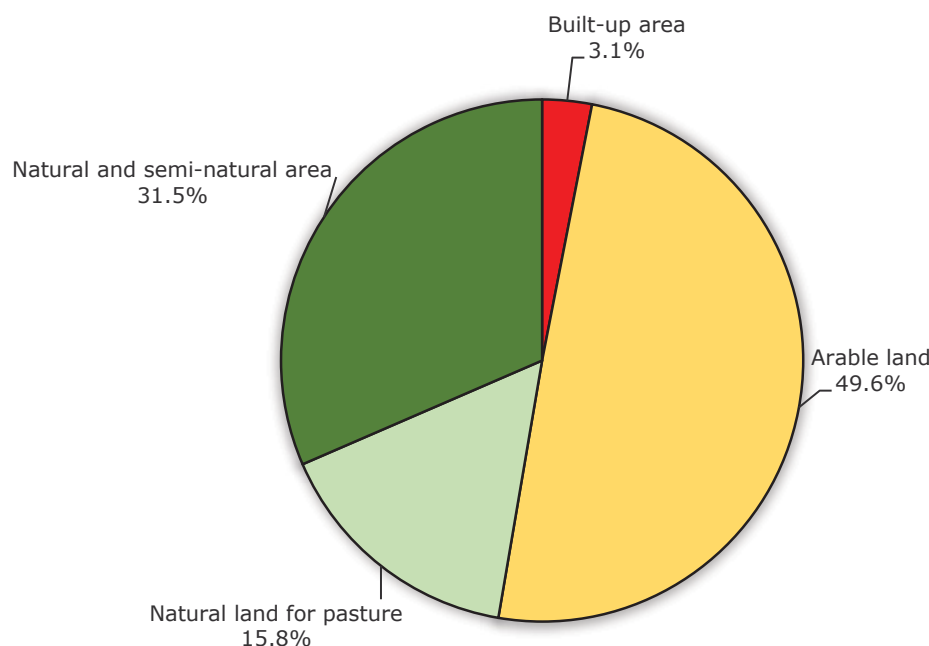
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.10

Land cover and land use, North Saskatchewan drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.10.1

Selected land cover and land use statistics, North Saskatchewan drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
North Saskatchewan	150,151	7,242	142,909	3.1	49.6	15.8	31.5	44,992	94	831.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.10.2

Selected statistics on water supply and demand, North Saskatchewan drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
North Saskatchewan	841,004	1,559,613	5.9	10.9	947.4	10.4	0.07	1.04	0.34

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.10.3

Selected indicators of pressures on water quality, North Saskatchewan drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
North Saskatchewan	20.0	1,314.5	1.5	0.6	127,820	82	9.0

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

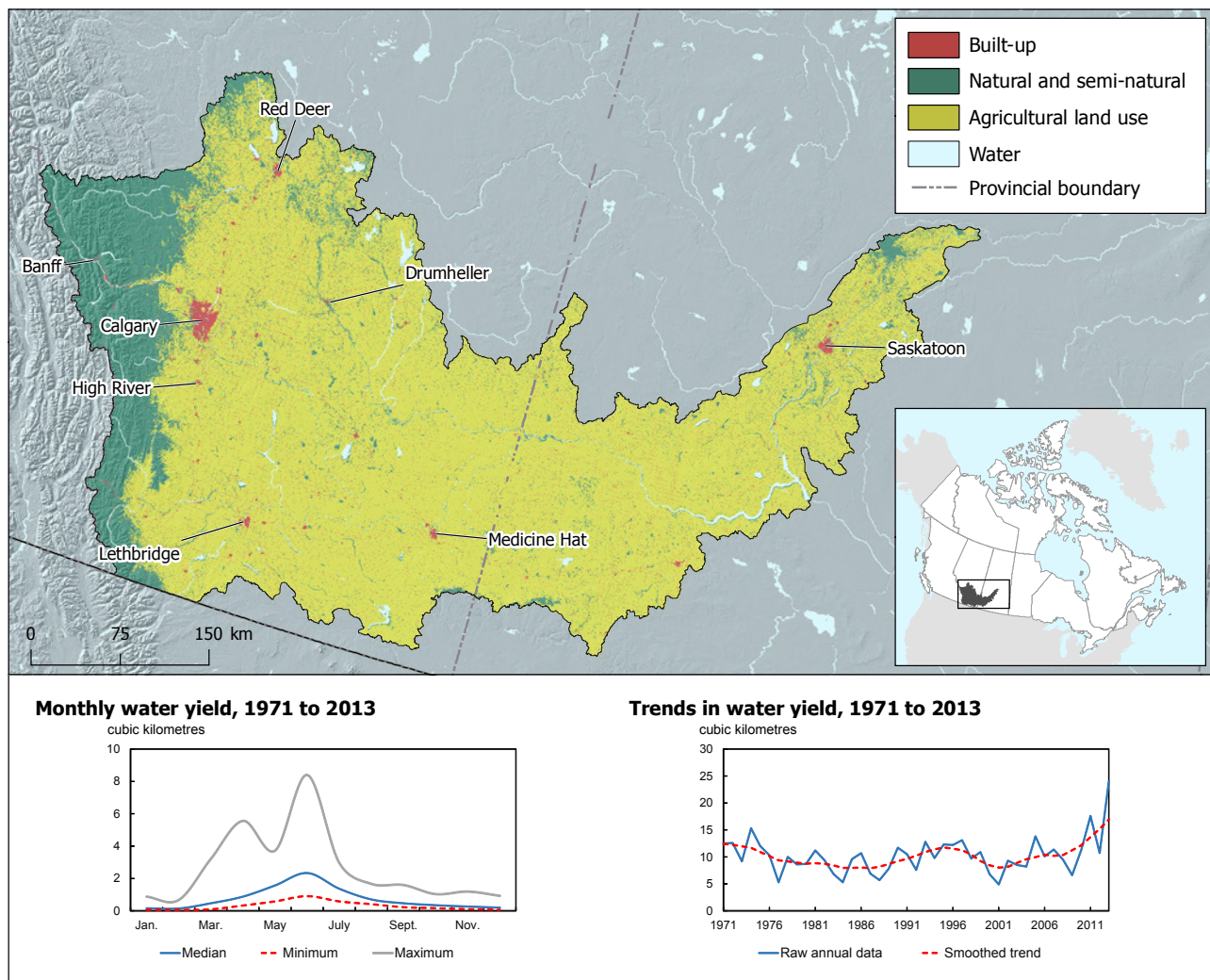
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.11 South Saskatchewan drainage region

Profile highlights

- The South Saskatchewan drainage region extends from the Rocky Mountain foothills in southern Alberta into Saskatchewan and includes Calgary, Red Deer and Saskatoon. Land used for agricultural production—arable land and natural land for pasture—accounted for 77.7% of the drainage region in 2011, the second highest proportion in Canada, followed by natural and semi-natural area (19.6%) and built-up area (2.7%).
- The drainage region had the second highest fertilizer application area in the country at 51,958 km², accounting for 58% of the region's arable land in 2011. Irrigation is an important land management practice in the region—5,236 km² of farmland in this region was irrigated, 68% of Canada's total irrigated area.
- The population was 2,168,447 in 2011—6% of Canada's total—with a population density of 12.7 persons/km². Population was up 128% compared to 949,194 in 1971.
- Surface freshwater intake from irrigation, drinking water plants, thermal-electric production, manufacturing and mining was 1,942.3 million m³ in 2013, the third highest in the country.
- The average annual water yield was a relatively low 10.3 km³ over the period 1971 to 2013. The water yield per unit area was 0.06 m³/m², the third lowest in the country. Monthly water flows peak in June. Evapotranspiration was 0.34 m³/m², compared to 0.23 m³/m² at the Canada level.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production and industrial emissions. In 2014, 107,769 tonnes of nitrogen-containing substances were emitted to air, land and water by industrial facilities. These emissions accounted for 14% of direct industrial emissions across Canada.

Map 3.3.11
Land use and water yield for the South Saskatchewan drainage region

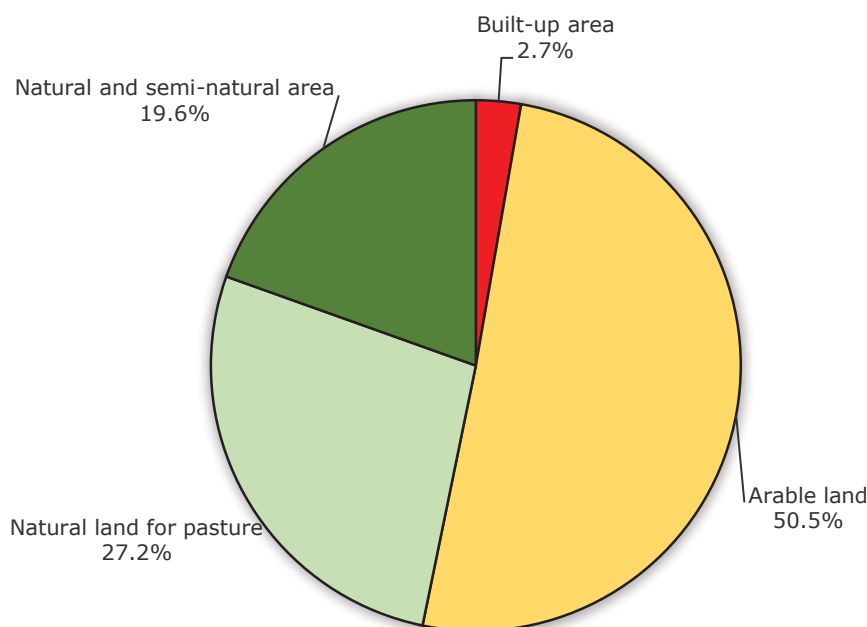


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.11
Land cover and land use, South Saskatchewan drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.11.1
Selected land cover and land use statistics, South Saskatchewan drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
South Saskatchewan	177,623	6,219	171,404	2.7	50.5	27.2	19.6	51,958	5,236	821.8

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.11.2

Selected statistics on water supply and demand, South Saskatchewan drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
South Saskatchewan	949,194	2,168,447	5.5	12.7	1,942.3	10.3	0.06	1.10	0.34

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.11.3

Selected indicators of pressures on water quality, South Saskatchewan drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
South Saskatchewan	14.2	1,099.9	1.8	1.1	107,769	331	6.3

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

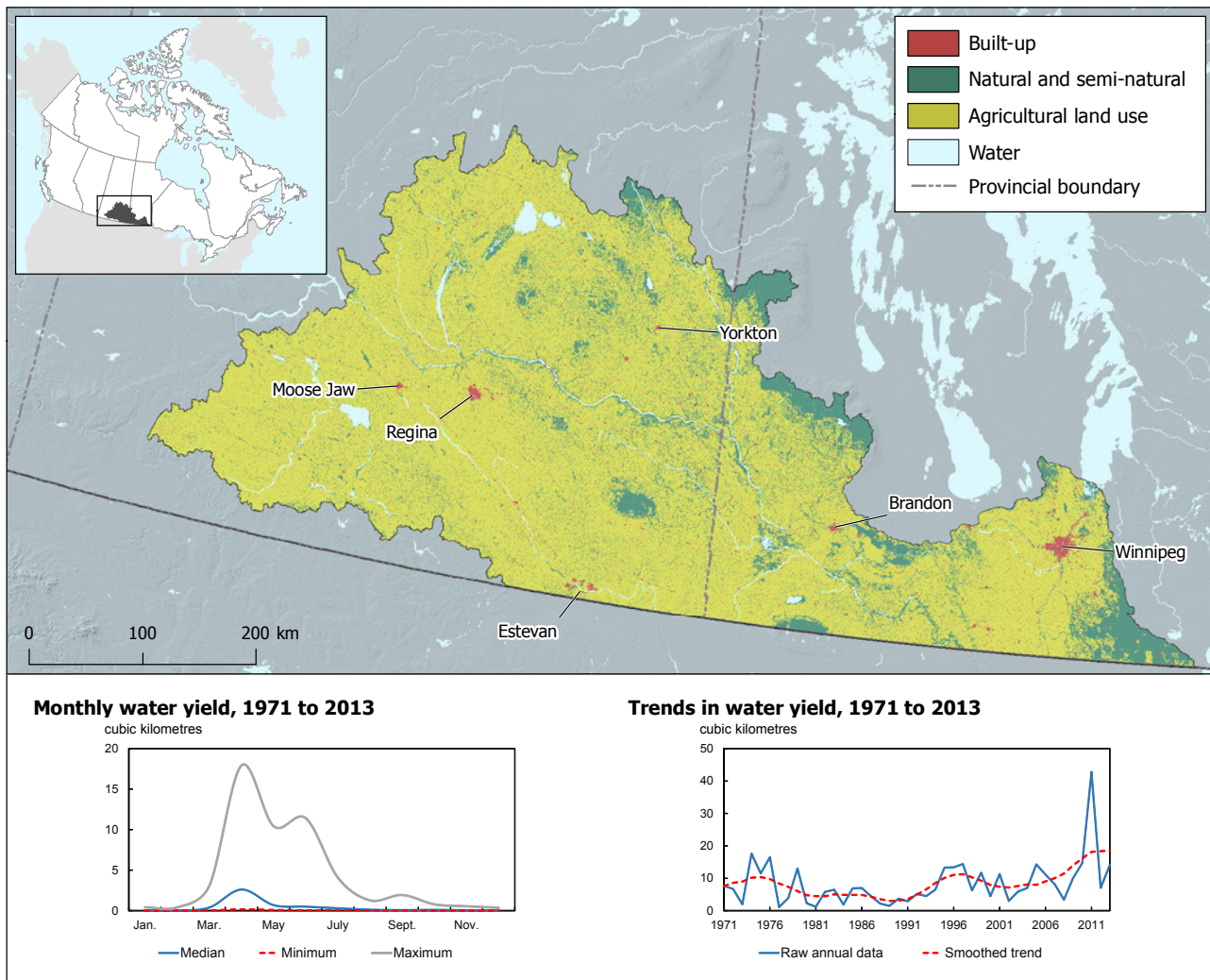
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.12 Assiniboine–Red drainage region

Profile highlights

- The Assiniboine–Red drainage region extends across southern Saskatchewan and Manitoba and includes both Regina and Winnipeg. Land used for agricultural production—arable land and natural land for pasture—accounted for 73.2% of the total area in 2011, followed by natural and semi-natural areas (23.7%) and built-up area (3.1%).
- The drainage region had the highest fertilizer application area in the country at 74,969 km², accounting for 63% of the region's arable land in 2011. This drainage region also had the second highest density of linear infrastructure including roads, rail lines and transmission lines at 997.2 m/km².
- The population was 1,464,936 in 2011, with a population density of 8.1 persons/km².
- Surface freshwater intake from thermal-electric production, drinking water plants, irrigation, manufacturing and mining was 1,522.4 million m³ in 2013.
- The average annual water yield was a relatively low 8.4 km³ over the period 1971 to 2013. The water yield per unit area was 0.04 m³/m²—the second lowest in the country. Monthly water flows peak in April. However, the monthly water variability index was the highest, meaning the volume of water supplied in each month can vary widely from year to year. Evapotranspiration was 0.39 m³/m², compared to 0.23 m³/m² at the Canada level.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. The residual nitrogen in agricultural soils normalized across the total area of the drainage region was the highest in the country at 1,822 kg/km².
- Turbidity levels of source water for drinking water plants were among the highest in the country at 7.7 nephelometric turbidity units (NTU) in 2013.

Map 3.3.12
Land use and water yield for the Assiniboine–Red drainage region



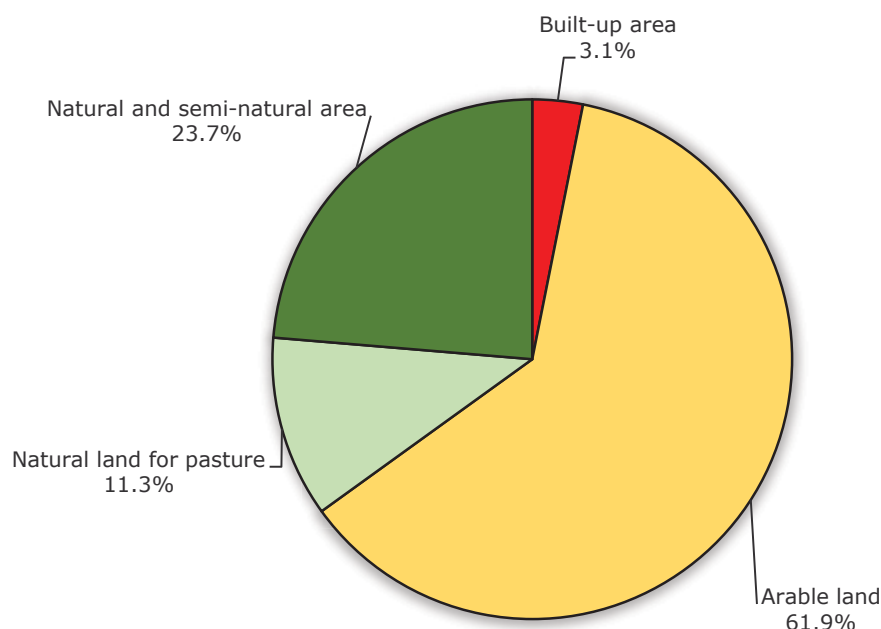
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.12

Land cover and land use, Assiniboine–Red drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.12.1

Selected land cover and land use statistics, Assiniboine–Red drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Assiniboine–Red	190,704	8,846	181,858	3.1	61.9	11.3	23.7	74,969	266	997.3

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.12.2

Selected statistics on water supply and demand, Assiniboine–Red drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Assiniboine–Red	1,248,357	1,464,936	6.9	8.1	1,522.4	8.4	0.04	2.49	0.39

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.12.3

Selected indicators of pressures on water quality, Assiniboine–Red drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Assiniboine–Red	24.7	1,822.4	1.3	0.7	30,260	524	7.7

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

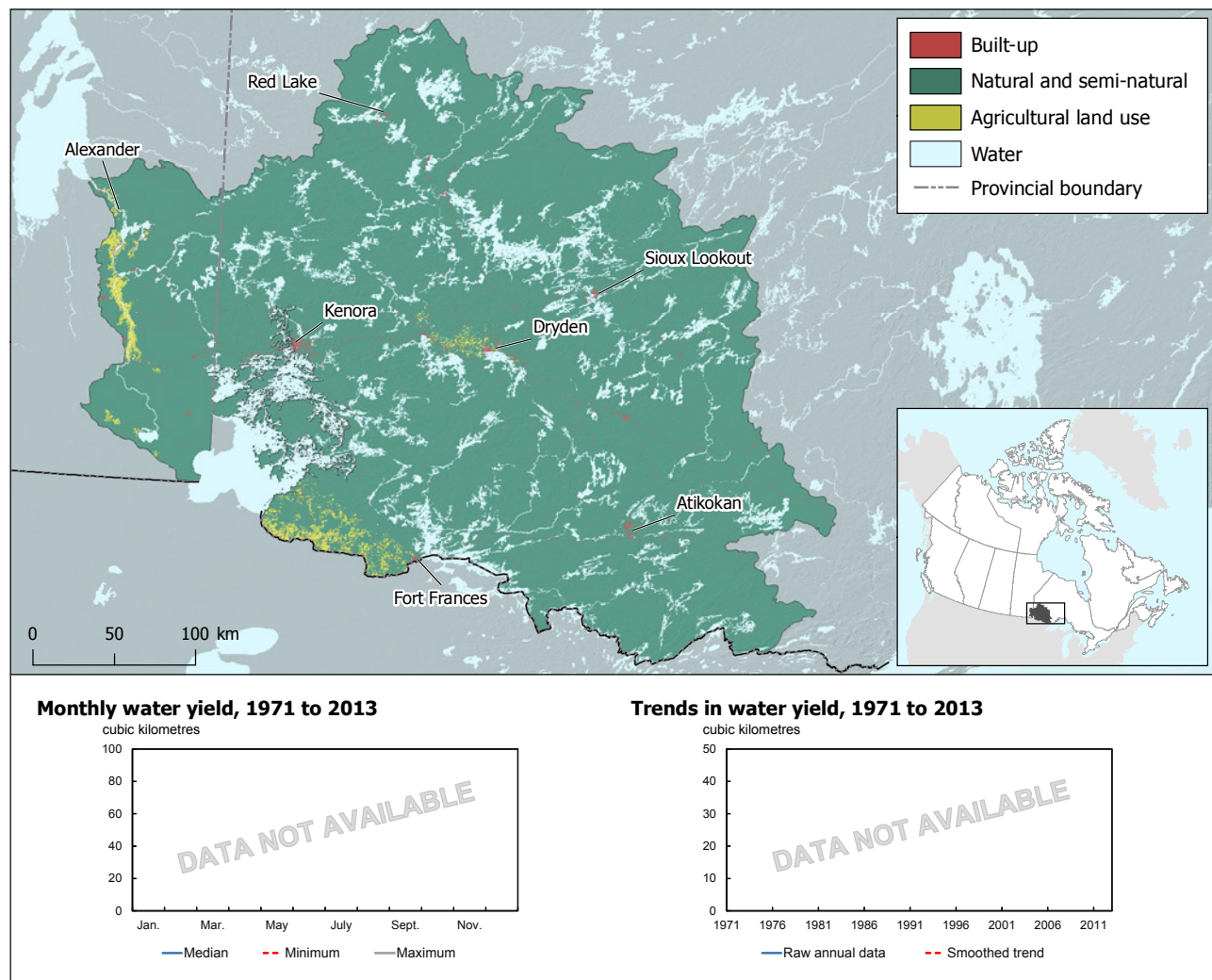
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.13 Winnipeg drainage region

Profile highlights

- The landscape of the Winnipeg drainage region, which extends from Lake Winnipeg towards Lake Superior and includes the cities of Kenora and Dryden, was dominated by natural and semi-natural areas (98.1%) in 2011. Built-up, arable land and natural land for pasture accounted for less than 2% of this drainage region.
- The population was 82,775 in 2011, with a population density of 1.0 persons/km².
- Surface freshwater intake from manufacturing, thermal-electric production, drinking water plants and mining was 131.8 million m³ in 2013.
- The average annual water yield was 25.9 km³ over the period 1971 to 2013. The water yield per unit area was 0.24 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was 0.40 m³/m², compared to 0.23 m³/m² at the Canada level.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application and livestock and poultry production. On average residual soil nitrogen on agricultural land was 31.6 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level.

Map 3.3.13
Land use and water yield for the Winnipeg drainage region



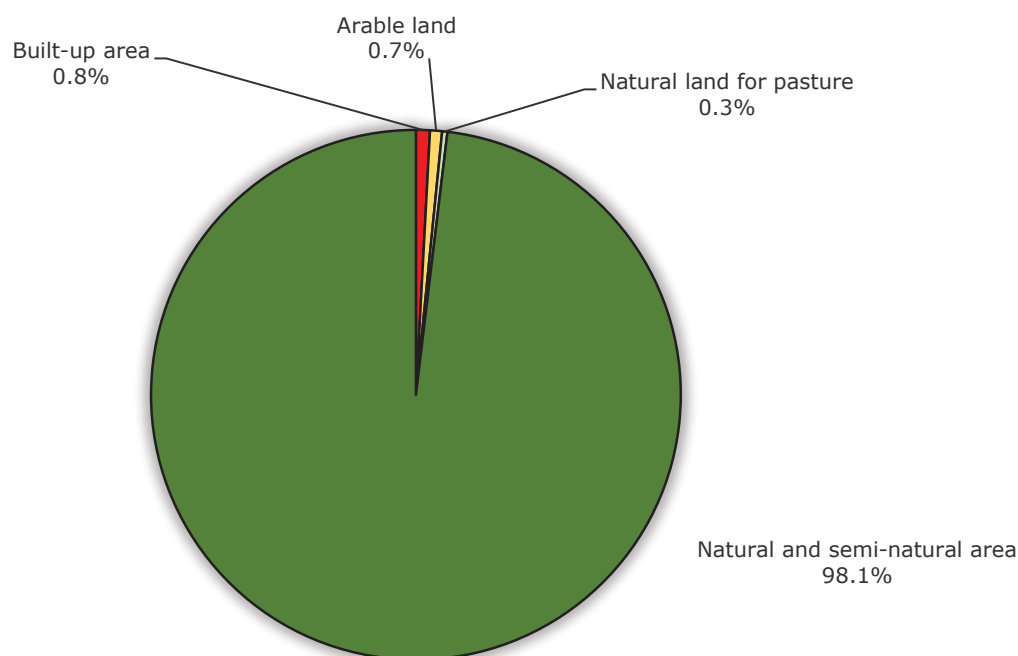
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.13

Land cover and land use, Winnipeg drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.13.1

Selected land cover and land use statistics, Winnipeg drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Winnipeg	107,655	20,525	87,130	0.8	0.7	0.3	98.1	316	1	226.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.13.2

Selected statistics on water supply and demand, Winnipeg drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Winnipeg	82,806	82,775	1.0	1.0	131.8	25.9	0.24	0.87	0.40

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.13.3

Selected indicators of pressures on water quality, Winnipeg drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Winnipeg	31.6	30.3	1.8	0.0	1,703	47	2.4

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

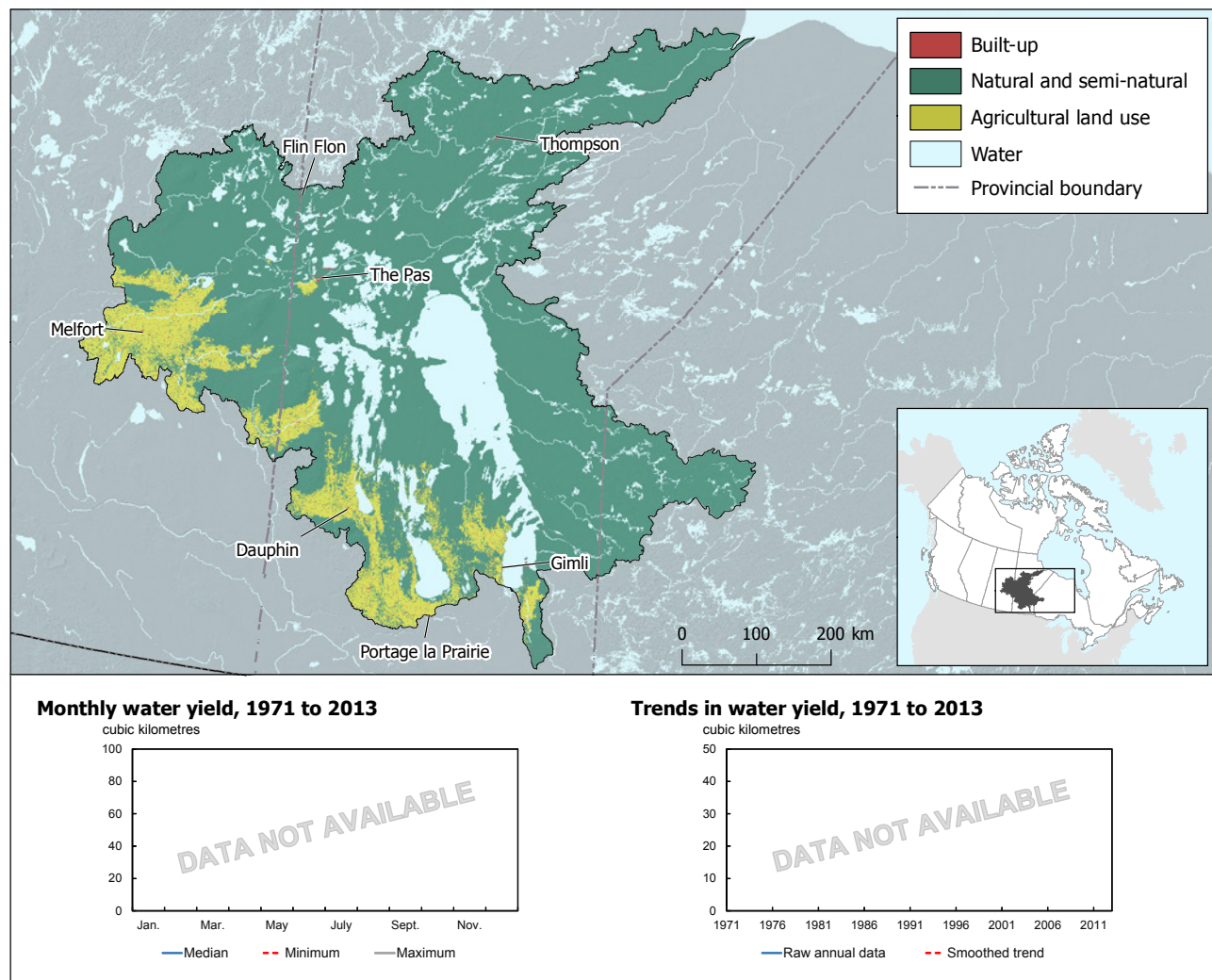
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.14 Lower Saskatchewan–Nelson drainage region

Profile highlights

- The Saskatchewan–Nelson drainage region extends across 360,887 km² of Saskatchewan, Manitoba and Ontario. In 2011, the landscape was dominated by natural and semi-natural areas (88.1%), but there was a significant amount of agricultural land use across its south-western extent. Arable land accounted for 8.6% of the total area, followed by natural land for pasture (2.7%) and built-up area (0.6%).
- Fertilizer was applied to 18,752 km² in 2011, 61% of the region's arable land.
- The population was 216,586 in 2011, with a population density of 0.7 persons/km².
- Surface freshwater intake from irrigation, manufacturing, drinking water plants and mining was 70.8 million m³ in 2013.
- The average annual water yield was 51.7 km³ over the period 1971 to 2013. The water yield per unit area was 0.14 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was 0.32 m³/m², compared to 0.23 m³/m² at the Canada level.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application and livestock and poultry production. On average residual soil nitrogen on agricultural land was 29.4 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level.
- Turbidity levels of source water for drinking water plants were the highest in the country at 20.9 nephelometric turbidity units (NTU) in 2013.

Figure 3.3.14
Land use and water yield for the Lower Saskatchewan–Nelson drainage region



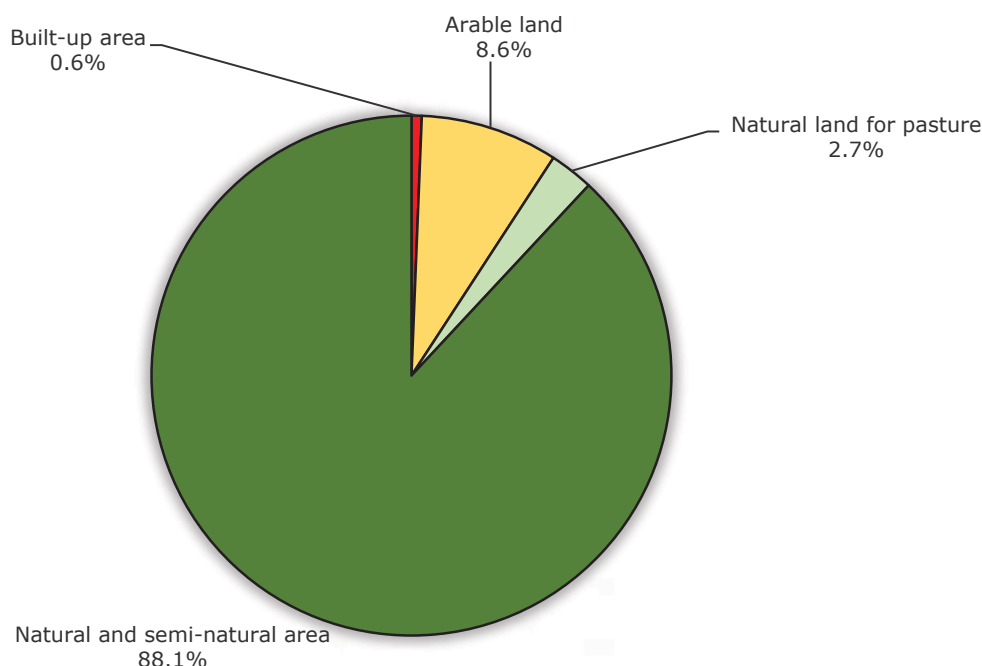
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.14

Land cover and land use, Lower Saskatchewan–Nelson drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.14.1

Selected land cover and land use statistics, Lower Saskatchewan–Nelson drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Lower Saskatchewan–Nelson	360,887	67,617	293,270	0.6	8.6	2.7	88.1	18,752	117	238.6

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.14.2

Selected statistics on water supply and demand, Lower Saskatchewan–Nelson drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Lower Saskatchewan–Nelson	238,535	216,586	0.8	0.7	70.8	51.7	0.14	0.92	0.32

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.14.3

Selected indicators of pressures on water quality, Lower Saskatchewan–Nelson drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Lower Saskatchewan–Nelson	29.4	337.0	1.3	0.0	1,427	10	20.9

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

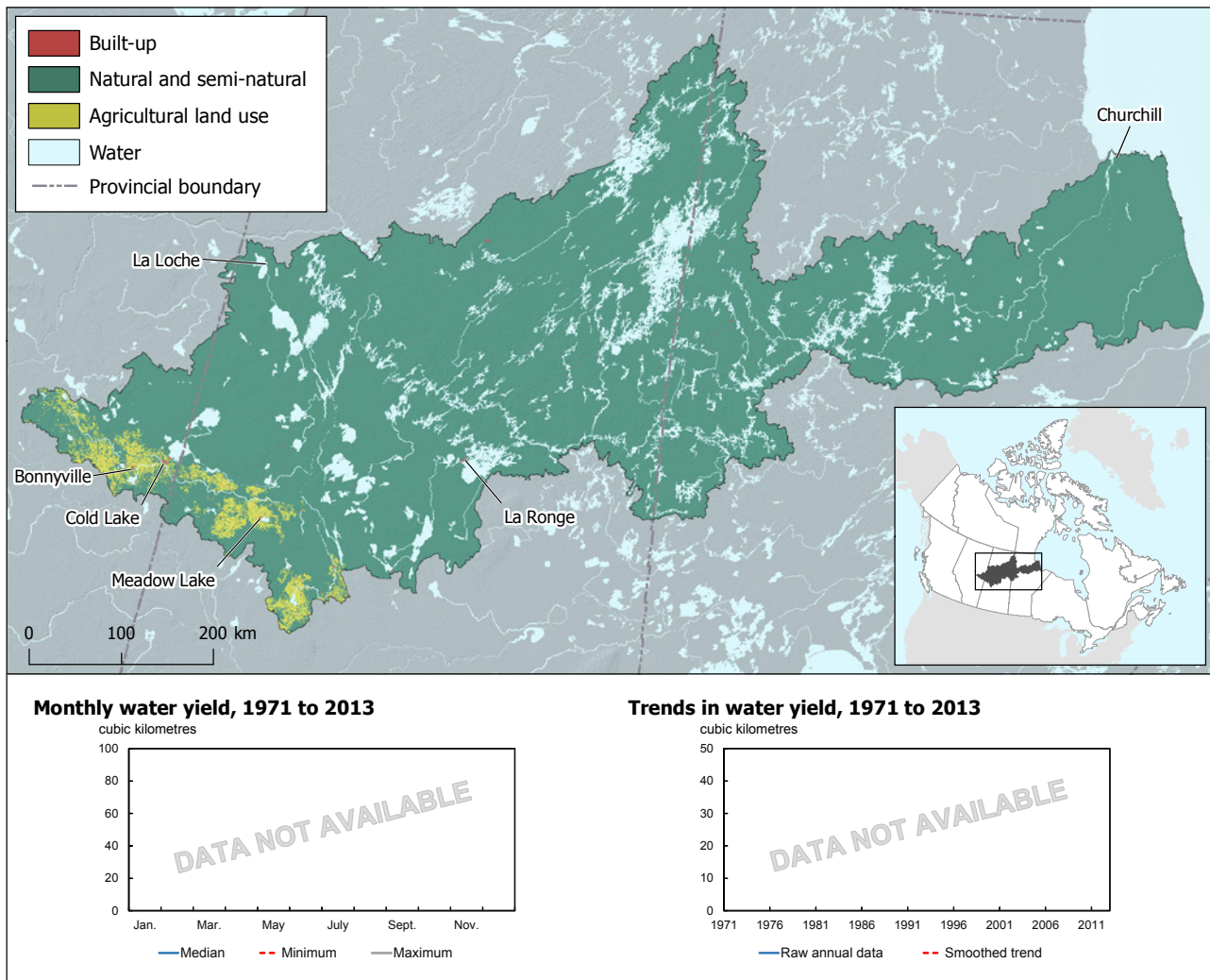
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.15 Churchill drainage region

Profile highlights

- The landscape of the Churchill drainage region was dominated by natural and semi-natural areas (96.4%), followed by arable land (1.8%), natural land for pasture (1.5%) and a small amount of built-up area (0.2%) in 2011.
- The density of linear infrastructure including roads, rail lines and transmission lines was relatively low at 70.7 m/km² in 2011.
- The population was 94,292 in 2011, with a population density of 0.4 persons/km².
- Surface freshwater intake from drinking water plants, manufacturing and mining was 7.7 million m³ in 2013.
- The average annual water yield was 51.0 km³ over the period 1971 to 2013. The water yield per unit area was 0.16 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was 0.24 m³/m²—close to the Canada level of 0.23 m³/m².

Map 3.3.15
Land use and water yield for the Churchill drainage region

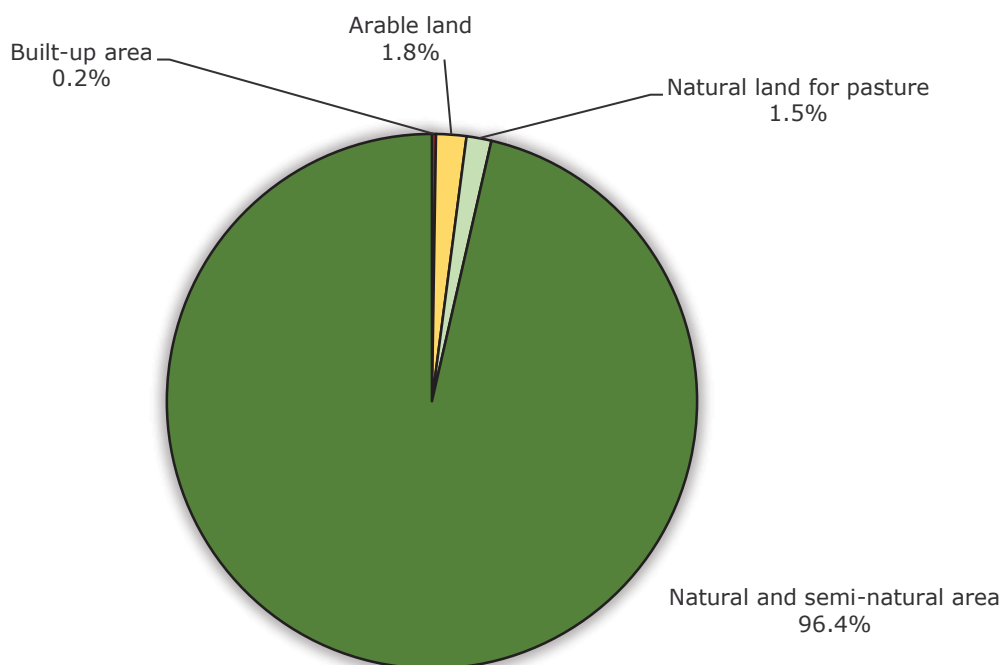


Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.15
Land cover and land use, Churchill drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.15.1
Selected land cover and land use statistics, Churchill drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Churchill	313,568	51,918	261,650	0.2	1.8	1.5	96.4	1,844	5	70.7

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.15.2

Selected statistics on water supply and demand, Churchill drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Churchill	63,418	94,292	0.2	0.4	106.0	51.0	0.16	0.75	0.24

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.15.3

Selected indicators of pressures on water quality, Churchill drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Churchill	28.0	94.9	1.6	0.0	12,724	0	4.5

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.16 Keewatin–Southern Baffin Island drainage region

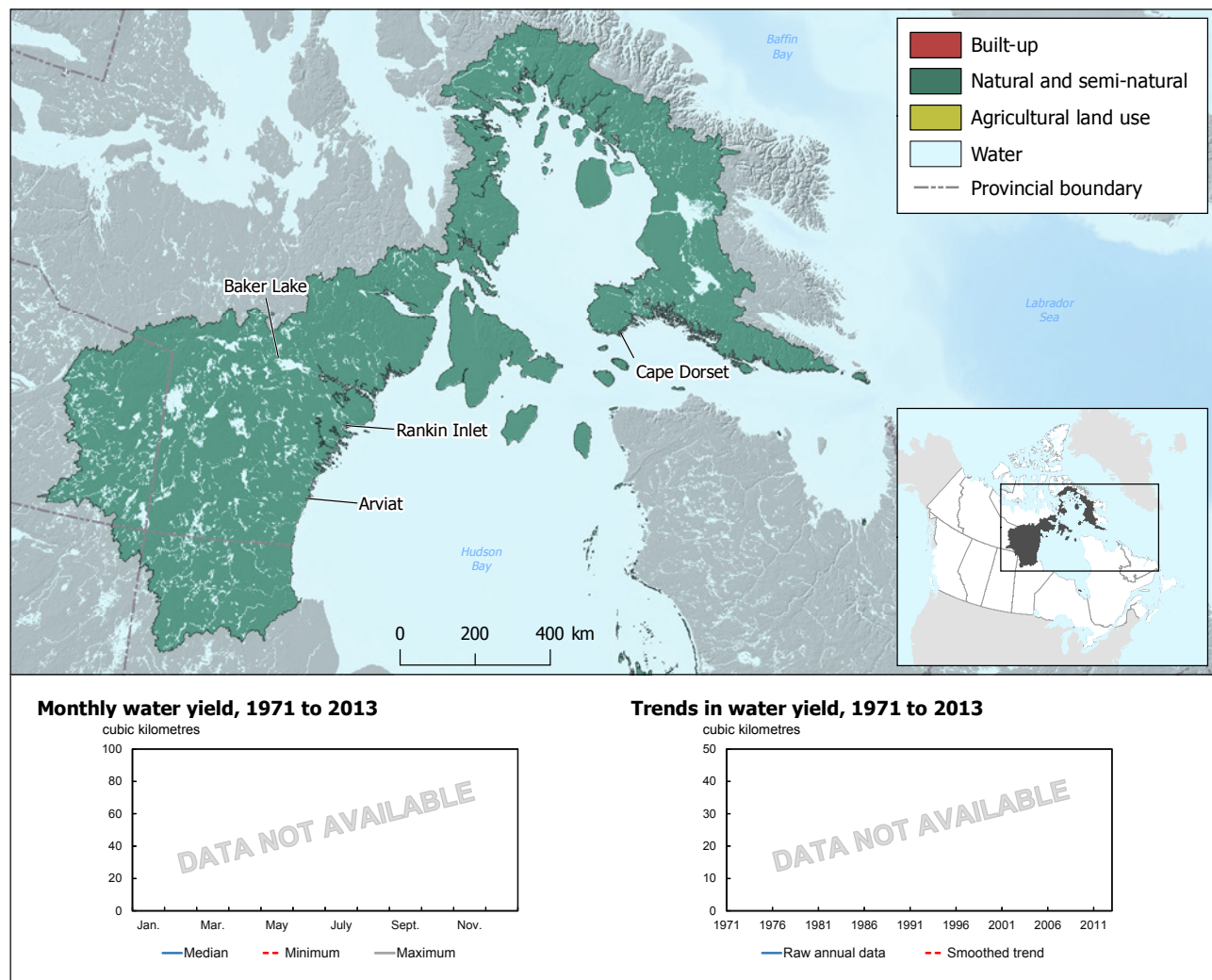
Profile highlights

- The Keewatin–Southern Baffin Island drainage region is a large region covering 939,569 km² to the west and north of Hudson Bay, virtually all of it natural and semi-natural area.
- The density of linear infrastructure including roads, rail lines and transmission lines was the lowest in the country at 0.5 m/km² in 2011.
- The population was 13,968 in 2011, with a population density 0.02 persons/km², the second lowest in the country.
- Surface freshwater intake from mining and drinking water plants was 3.2 million m³ in 2013.
- The long-term¹⁰⁴ average annual water yield was 192.0 km³. The water yield per unit area was 0.20 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available. Evapotranspiration was the second lowest in the country at 0.13 m³/m².

¹⁰⁴ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.16

Land use and water yield for the Keewatin–Southern Baffin Island drainage region



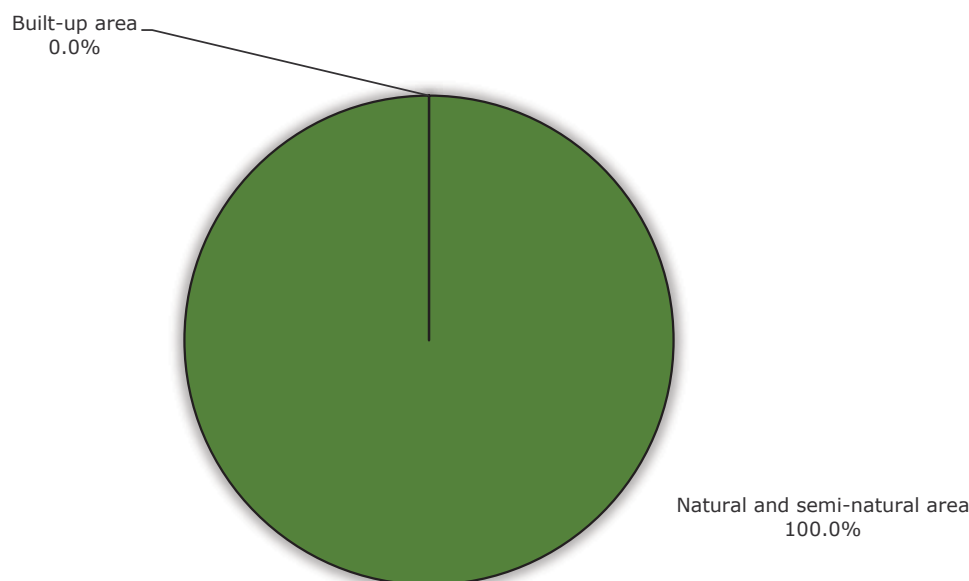
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.16

Land cover and land use, Keewatin–Southern Baffin Island drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.16.1

Selected land cover and land use statistics, Keewatin–Southern Baffin Island drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Keewatin–Southern Baffin Island	939,569	161,011	778,558	0.0	0.0	0.0	100.0	0	0	0.5

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.16.2

Selected statistics on water supply and demand, Keewatin–Southern Baffin Island drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Keewatin–Southern Baffin Island	7,034	13,968	0.0	0.0	3.2	192.0	0.20	..	0.13

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.16.3

Selected indicators of pressures on water quality, Keewatin–Southern Baffin Island drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Keewatin–Southern Baffin Island	...	...	...	...	1,327	0	F

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.17 Northern Ontario drainage region

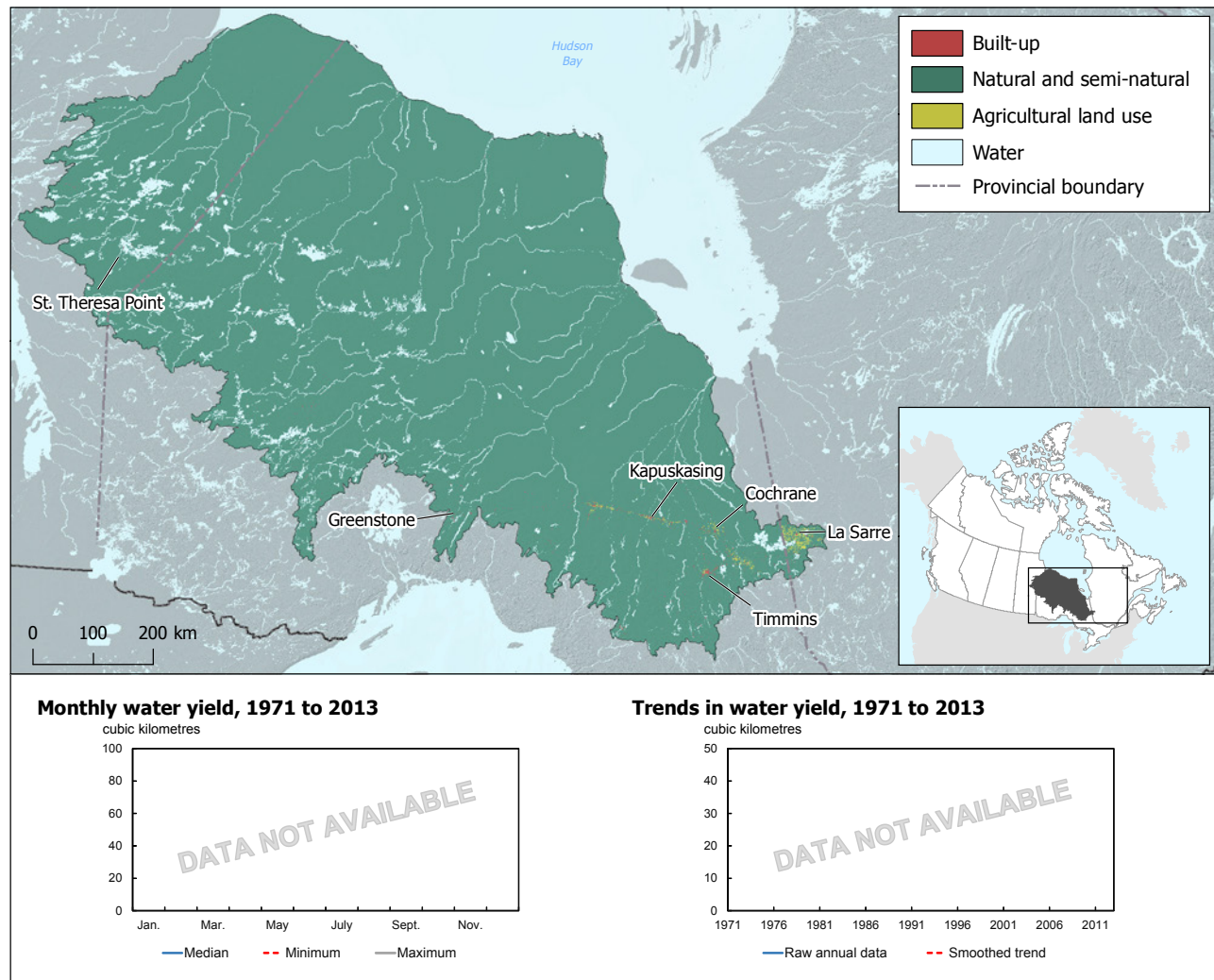
Profile highlights

- The Northern Ontario drainage region extends across 691,809 km² of Manitoba and Ontario and drains into Hudson Bay. In 2011, its landscape was almost entirely natural and semi-natural area—arable land, natural land for pasture and built-up areas combined accounted for less than 1% of the total land area.
- The population was 134,355 in 2011, with a population density of 0.2 persons/km².
- Surface freshwater intake from thermal-electric production, manufacturing, drinking water plants and mining was 106.0 million m³ in 2013.
- The long-term¹⁰⁵ average annual water yield was 199.2 km³. The water yield per unit area was 0.29 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly yield and trends over time are not available.

¹⁰⁵ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.17

Land use and water yield for the Northern Ontario drainage region



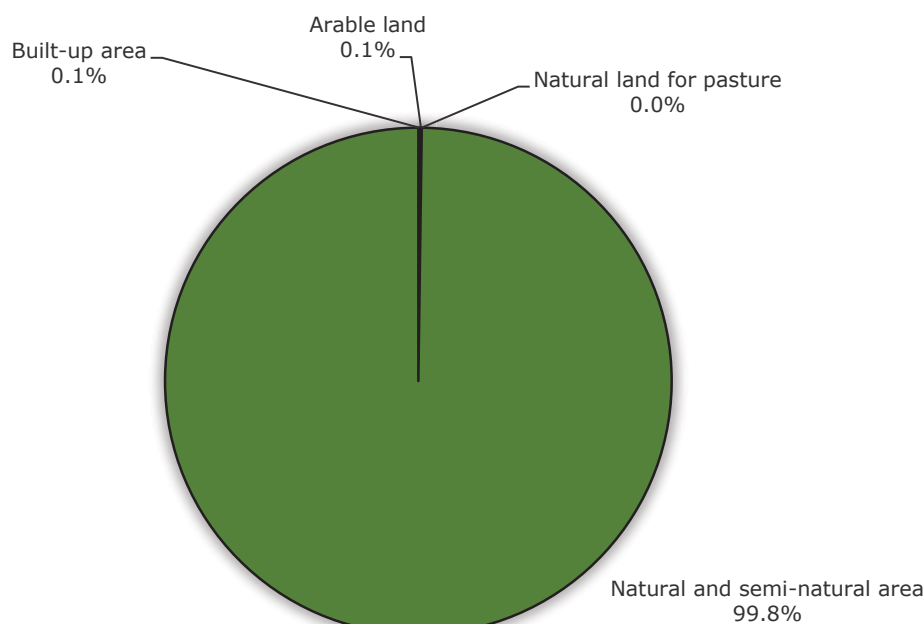
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.17

Land cover and land use, Northern Ontario drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.17.1

Selected land cover and land use statistics, Northern Ontario drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Northern Ontario	691,809	56,064	635,745	0.1	0.1	0.0	99.8	88	0	42.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.17.2

Selected statistics on water supply and demand, Northern Ontario drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Northern Ontario	148,658	134,355	0.2	0.2	106.0	199.2	0.29	..	0.31

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.17.3

Selected indicators of pressures on water quality, Northern Ontario drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Northern Ontario	25.4	1.6	2.9	0.0	6,543	19	4.9

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.18 Northern Quebec drainage region

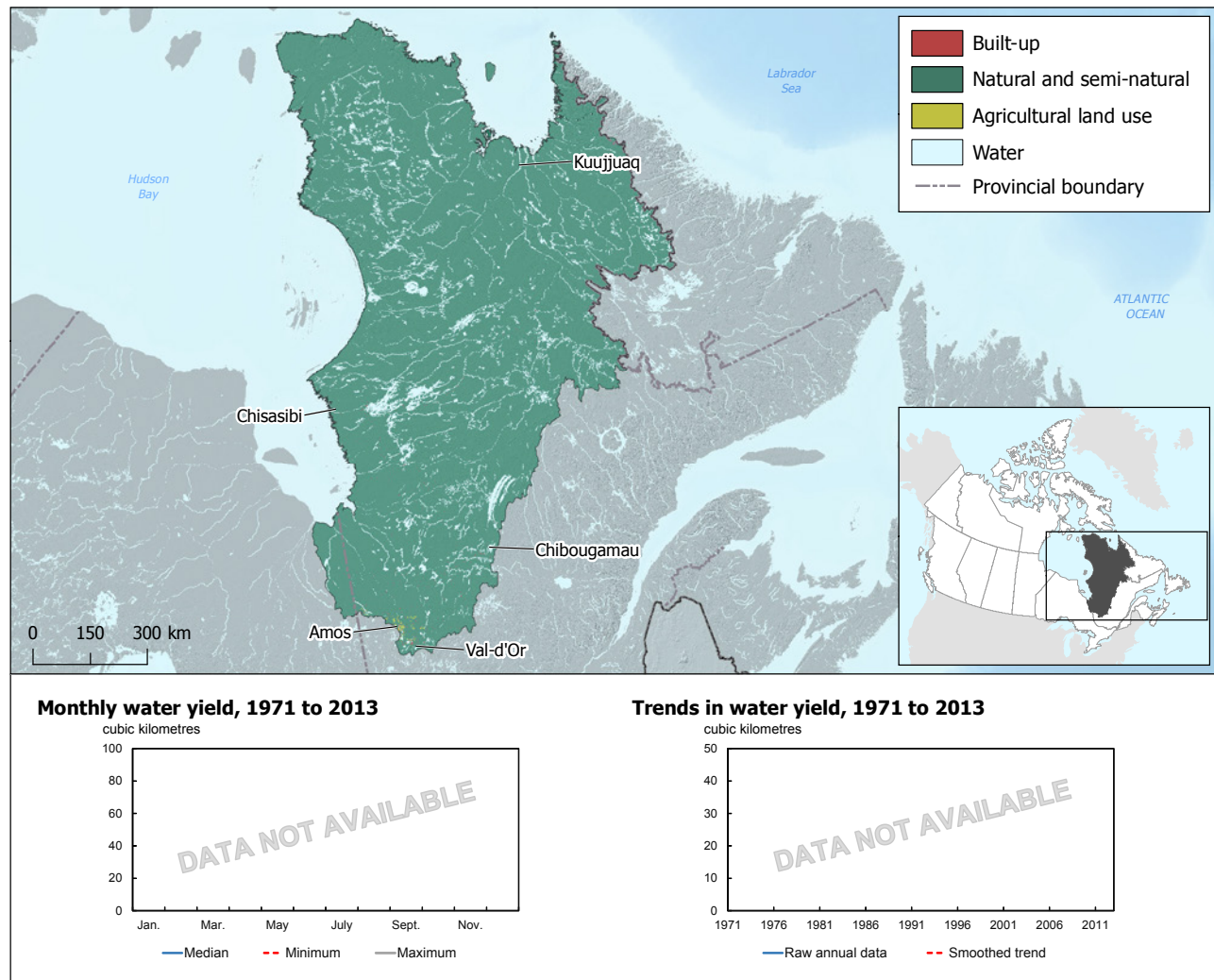
Profile highlights

- The Northern Quebec drainage region extends across 940,193 km², virtually all of it natural and semi-natural area.
- The population was 109,239 in 2011, with a population density of 0.1 persons/km².
- Surface freshwater intake from mining, manufacturing, drinking water plants and thermal-electric production was 30.1 million m³ in 2013.
- The long-term¹⁰⁶ average annual water yield was 516.3 km³—the highest in the country. The water yield per unit area was 0.55 m³/m², above the Canada level of 0.35 m³/m². Data on the monthly yield and trends over time are not available.

¹⁰⁶ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.18

Land use and water yield for the Northern Quebec drainage region



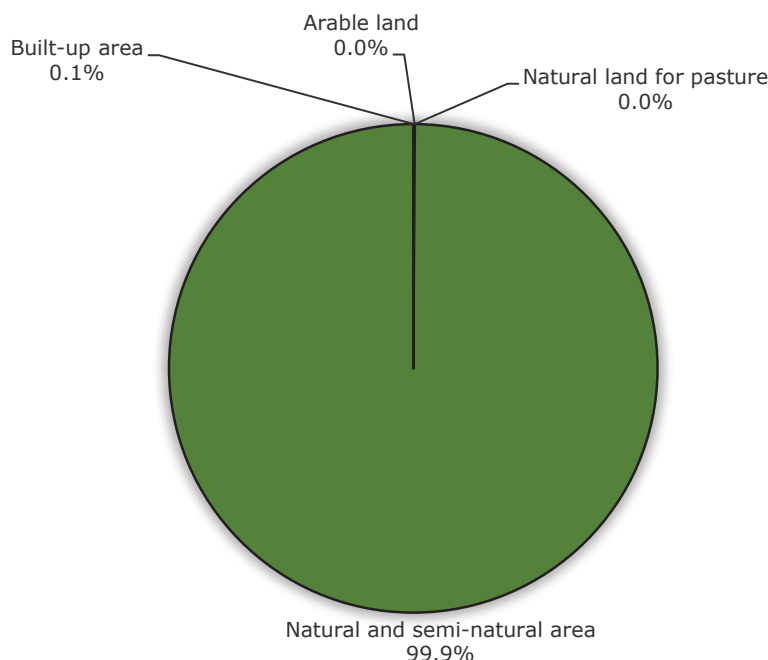
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.18

Land cover and land use, Northern Quebec drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.18.1

Selected land cover and land use statistics, Northern Quebec drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Northern Quebec	940,193	149,081	791,112	0.1	0.0	0.0	99.9	21	0	24.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.18.2

Selected statistics on water supply and demand, Northern Quebec drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Northern Quebec	90,953	109,239	0.1	0.1	30.1	516.3	0.55	..	0.18

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.18.3

Selected indicators of pressures on water quality, Northern Quebec drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Northern Quebec	25.0	1.1	3.5	0.0	5,169	13	F

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

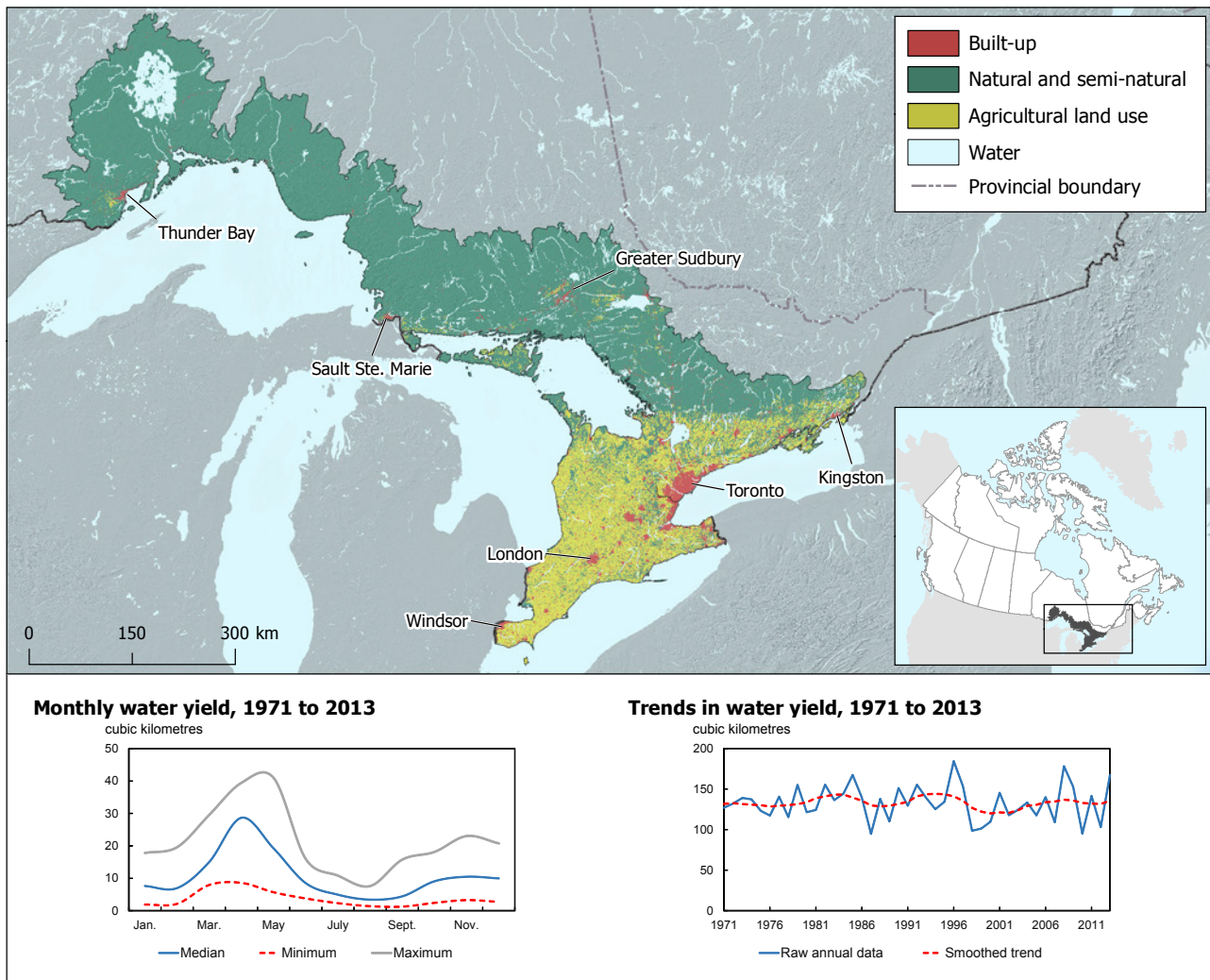
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.19 Great Lakes drainage region

Profile highlights

- The Great Lakes drainage region extends from Thunder Bay, through to Southern and Eastern Ontario. Its 10,998 km² of built-up area, accounting for 3.5% of the total area, was the highest in the country in 2011. Natural and semi-natural area accounted for 85.4% of the landscape, followed by arable land (10.3%) and smaller amounts of natural land for pasture (0.8%).
- This drainage region had the highest population in the country in 2011 at 11,287,184 in 2011, with a population density of 54.7 persons/km². Population was up 70% compared to 6,632,154 in 1971.
- Surface freshwater intake from thermal-electric production, manufacturing, drinking water plants, mining and irrigation was 23,461 million m³ in 2013, by far the highest in Canada. These withdrawals account for 70% of the water intake from the 25 drainage regions.
- The average annual water yield was 133.3 km³ over the period 1971 to 2013. The water yield per unit area was 0.42 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in April. Evapotranspiration was the highest in Canada at 0.48 m³/m².
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production and industrial emissions. On average residual soil nitrogen on agricultural land was 37.5 kg/ha compared to 23.2 kg/ha at the Canada level. In 2014, 106,099 tonnes of nitrogen-containing substances were air, land and water by industrial facilities. These emissions accounted for 14% of direct industrial emissions across Canada.

Map 3.3.19
Land use and water yield for the Great Lakes drainage region



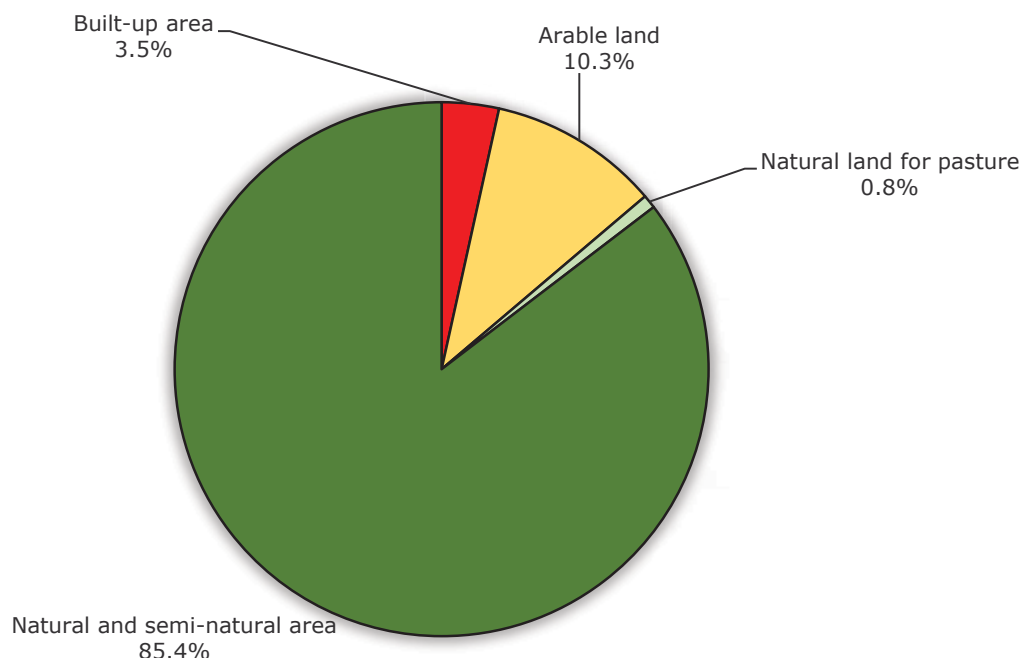
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.19

Land cover and land use, Great Lakes drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.19.1

Selected land cover and land use statistics, Great Lakes drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Great Lakes	317,860	111,577	206,283	3.5	10.3	0.8	85.4	20,631	397	898.8

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.19.2

Selected statistics on water supply and demand, Great Lakes drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Great Lakes	6,632,154	11,287,184	32.2	54.7	23,461.0	133.3	0.42	0.72	0.48

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.19.3

Selected indicators of pressures on water quality, Great Lakes drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Great Lakes	37.5	405.6	1.8	0.0	106,099	781	5.0

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

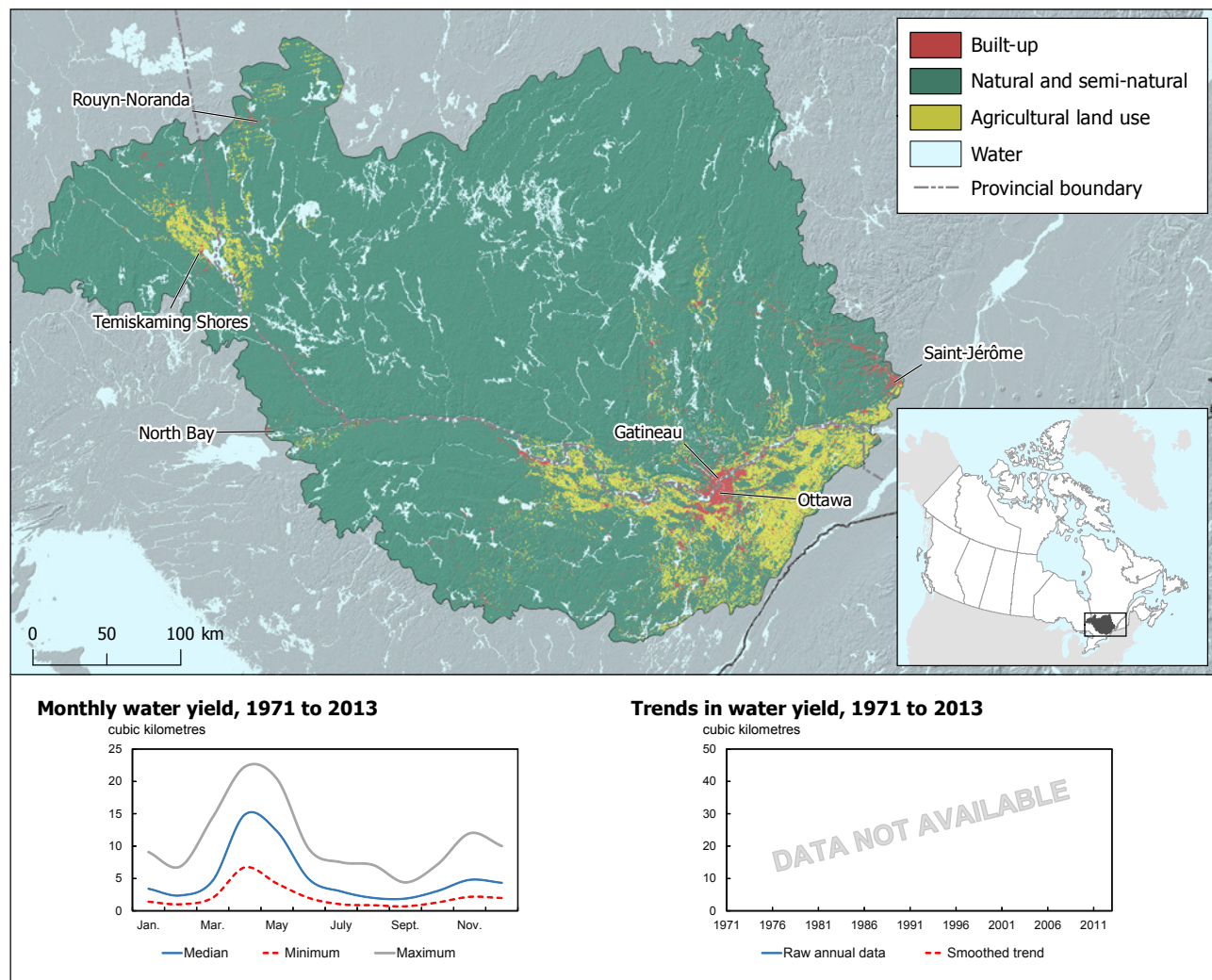
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.20 Ottawa drainage region

Profile highlights

- The Ottawa drainage region extends across 146,353 km² of Ontario and Quebec and includes Ottawa–Gatineau. In 2011, the majority (92.2%) of the total area was natural and semi-natural land, followed by arable land (4.6%), built-up area (2.4%) and natural land for pasture (0.8%).
- The population was 1,957,937 in 2011—6% of Canada's total—with a population density of 14.9 persons/km². Population was up 65% compared to 1,183,662 in 1971.
- Surface freshwater intake from drinking water plants, manufacturing, mining, thermal-electric production and irrigation was 364.9 million m³ in 2013.
- The average annual water yield was 64.3 km³ over the period 1971 to 2013. The water yield per unit area was 0.44 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in April. Data on trends over time are not available. The region had the fourth highest evapotranspiration at 0.47 m³/m².
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application and livestock and poultry production. On average residual soil nitrogen on agricultural land was 33.2 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level.

Map 3.3.20
Land use and water yield for the Ottawa drainage region



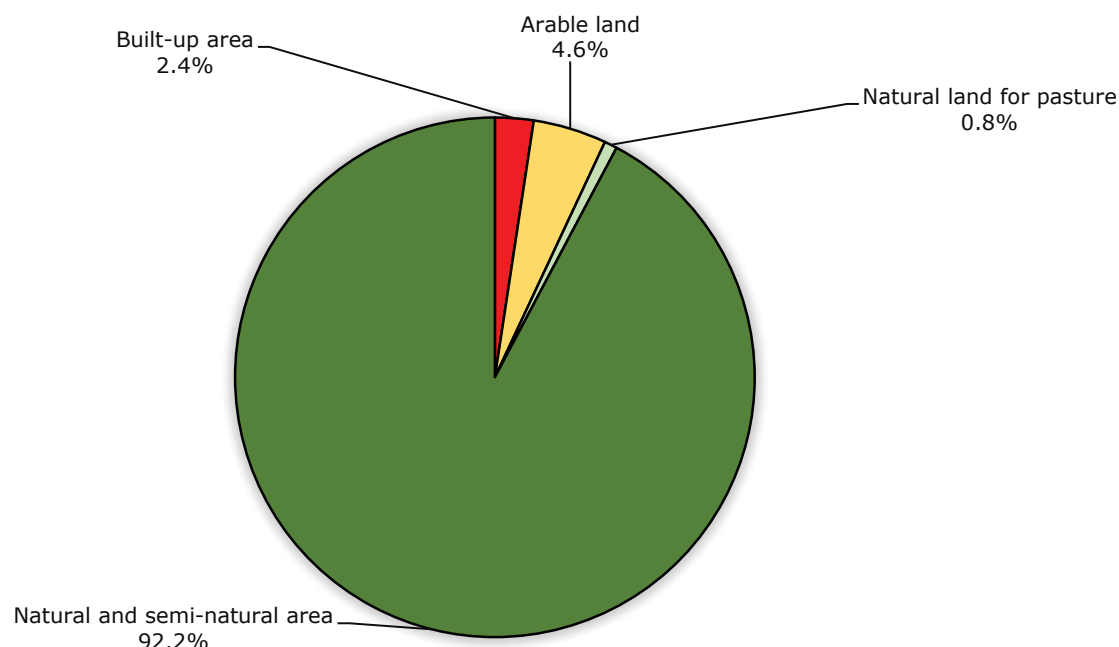
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.20

Land cover and land use, Ottawa drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.20.1

Selected land cover and land use statistics, Ottawa drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Ottawa	146,353	14,550	131,803	2.4	4.6	0.8	92.2	2,963	26	644.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.20.2
Selected statistics on water supply and demand, Ottawa drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Ottawa	1,183,662	1,957,937	9.0	14.9	364.9	64.3	0.44	0.80	0.47

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.20.3
Selected indicators of pressures on water quality, Ottawa drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Ottawa	33.2	172.6	2.2	0.0	11,648	139	4.1

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

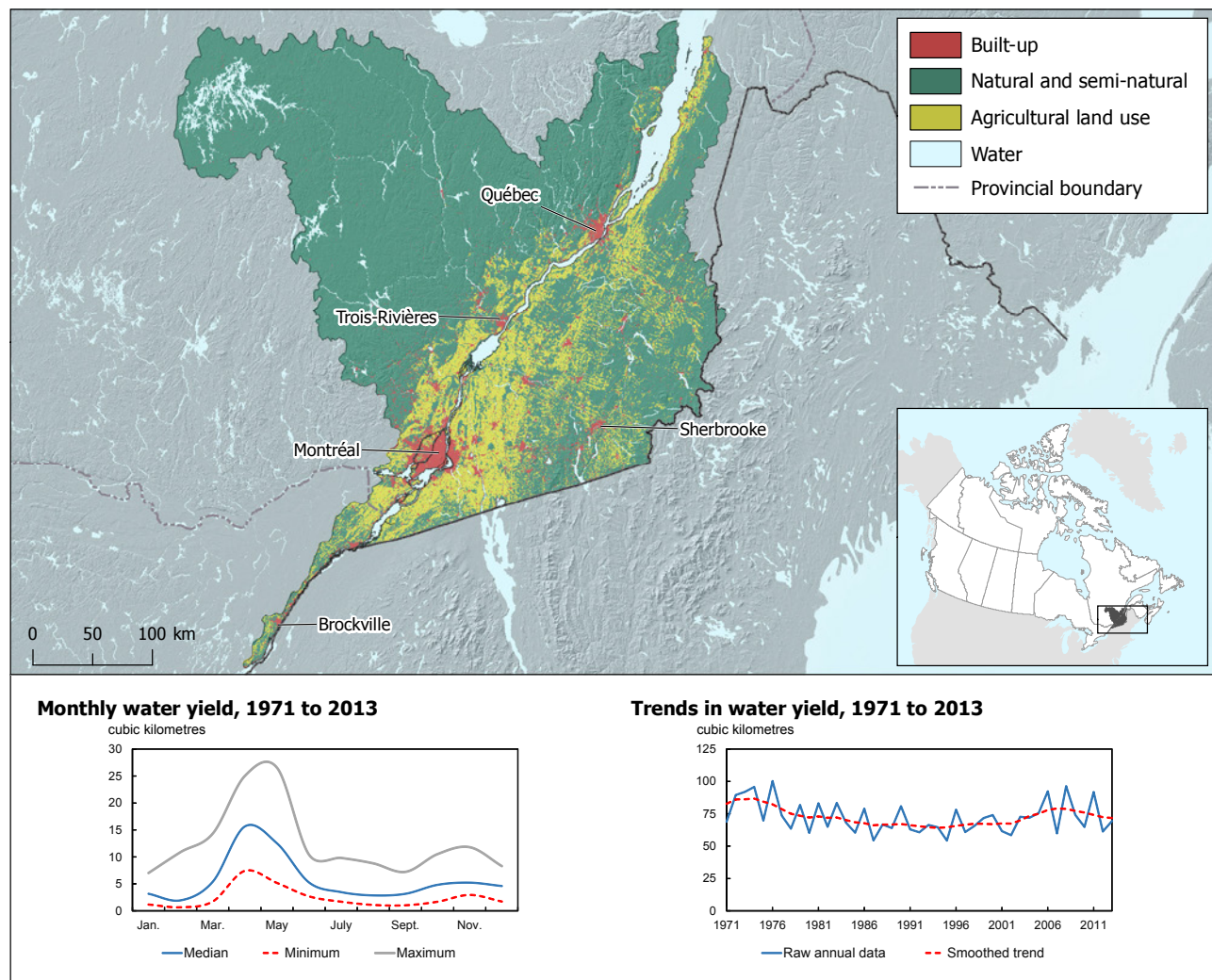
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.21 St. Lawrence drainage region

Profile highlights

- The St. Lawrence drainage region includes areas surrounding and draining into the St. Lawrence River, including the cities of Brockville, Montréal and Québec. Its 5,971 km² of built-up area, accounting for 5.0% of the total area, was the second highest in the country in 2011. Natural and semi-natural area accounted for 81.3% of the area, followed by arable land (12.8%) and smaller amounts of natural land for pasture (0.8%).
- This drainage region had the highest density of linear infrastructure including roads, rail lines and transmission lines at 1,093.9 m/km² in 2011.
- The population was 6,583,552 in 2011, with a population density of 59.9 persons/km², the highest in the country. Population was up 33% compared to 4,941,807 in 1971.
- Surface freshwater intake from drinking water plants, manufacturing, mining, irrigation and thermal-electric production was 2,045.2 million m³ in 2013, the second highest in the country.
- The average annual water yield was 72.3 km³ over the period 1971 to 2013. The water yield per unit area was 0.61 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in April.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production and industrial emissions. On average residual soil nitrogen on agricultural land was 51.8 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level. The risk of phosphorus release from agricultural soils was high, with 3.5 mg/kg of water extractable phosphorus potentially released in 2011.
- Turbidity levels of source water for drinking water plants were among the highest in the country at 9.8 nephelometric turbidity units (NTU) in 2013.

Map 3.3.21
Land use and water yield for the St. Lawrence drainage region



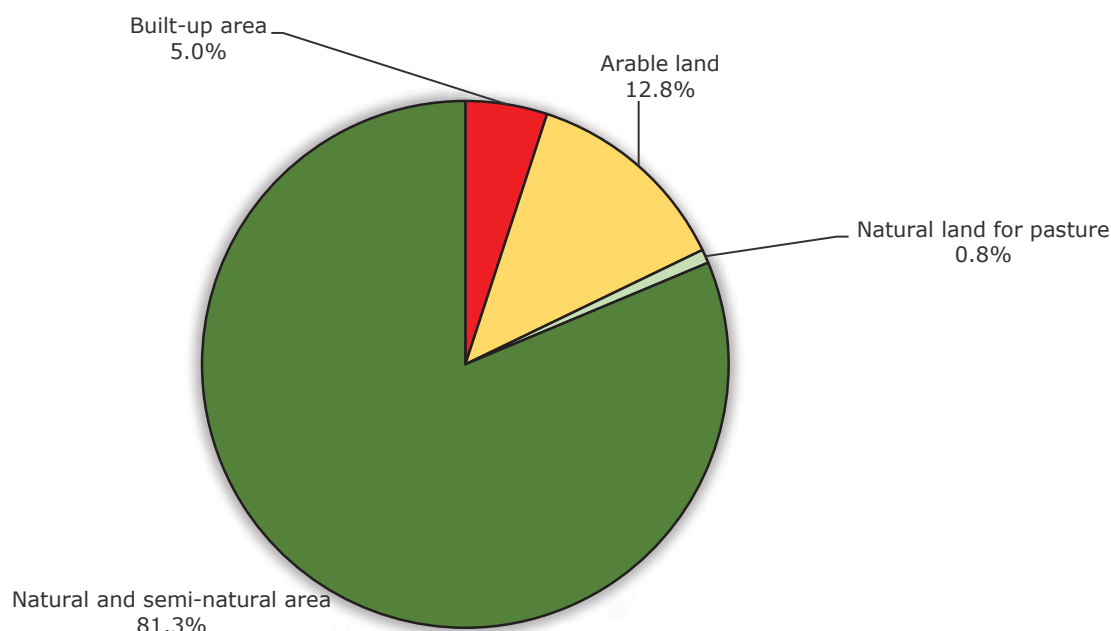
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.21

Land cover and land use, St. Lawrence drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.21.1

Selected land cover and land use statistics, St. Lawrence drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
St. Lawrence	118,733	8,801	109,932	5.0	12.8	0.8	81.3	8,451	206	1,093.9

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.21.2

Selected statistics on water supply and demand, St. Lawrence drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
St. Lawrence	4,941,807	6,583,552	45.0	59.9	2,045.2	72.3	0.61	0.76	0.39

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.21.3

Selected indicators of pressures on water quality, St. Lawrence drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
St. Lawrence	51.8	690.5	3.5	0.1	33,914	890	9.8

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

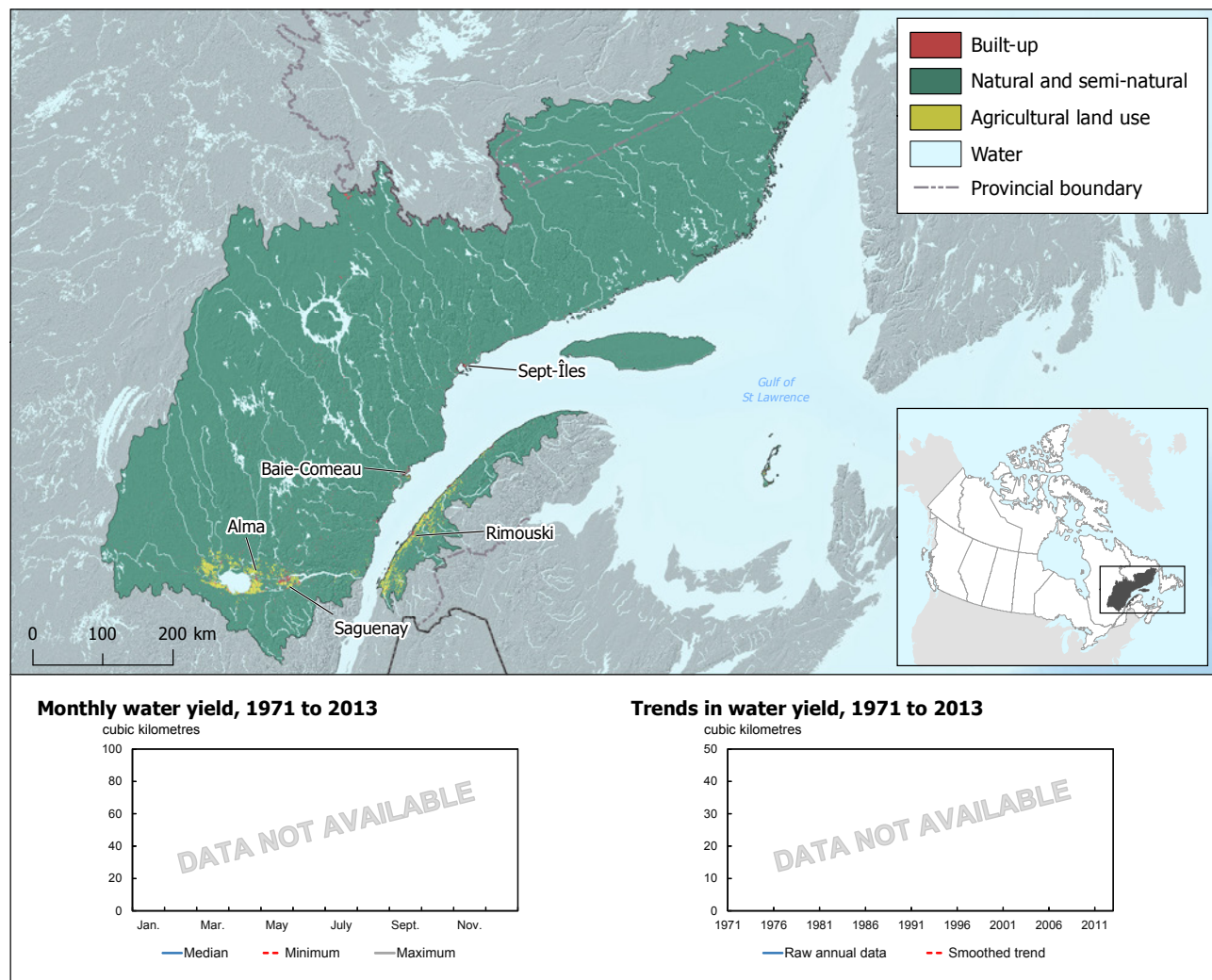
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.22 North Shore–Gaspé drainage region

Profile highlights

- The North Shore–Gaspé drainage region extends across 369,095 km² of Quebec. In 2011, the land cover was dominated by natural and semi-natural areas (98.9%), followed by arable land (0.6%) and built-up area (0.4%).
- The population was 508,869 in 2011, with a population density of 1.5 persons/km².
- Surface freshwater intake from manufacturing, mining, drinking water plants and irrigation was 203.2 million m³ in 2013.
- The average annual water yield was high at 290.4 km³ over the period 1971 to 2013, the third highest among drainage regions. The water yield per unit area was 0.79 m³/m², compared to 0.35 m³/m² at the Canada level. Data on the monthly water yield and trends over time are not available.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. On average residual soil nitrogen on agricultural land was 59.8 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level.

Map 3.3.22
Land use and water yield for the North Shore–Gaspé drainage region



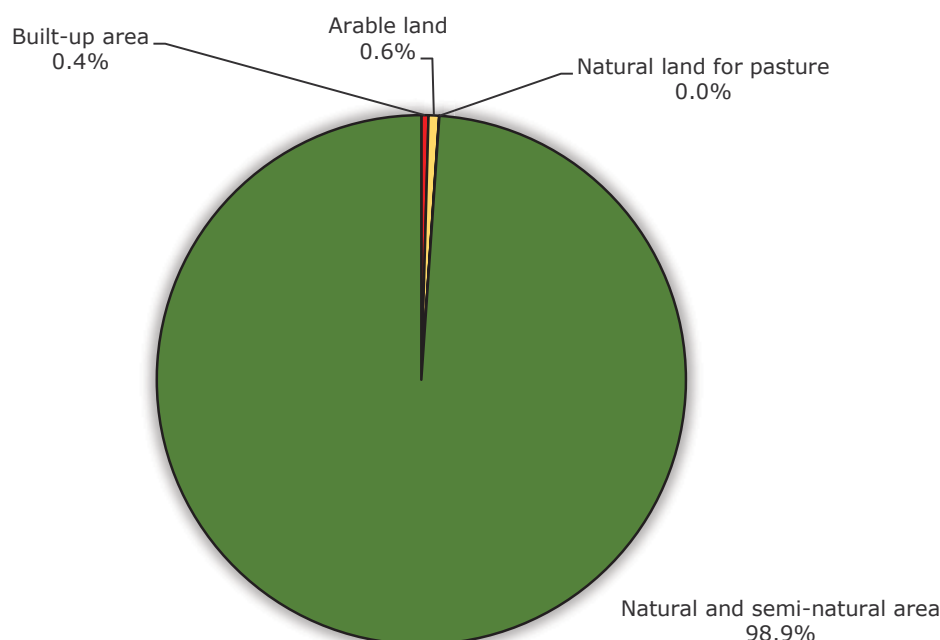
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.22

Land cover and land use, North Shore–Gaspé drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.22.1

Selected land cover and land use statistics, North Shore–Gaspé drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
North Shore–Gaspé	369,095	36,933	332,162	0.4	0.6	0.0	98.9	700	14	119.3

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.22.2

Selected statistics on water supply and demand, North Shore–Gaspé drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
North Shore–Gaspé	518,844	508,869	1.6	1.5	203.2	290.4	0.79	0.91	0.27

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.22.3

Selected indicators of pressures on water quality, North Shore–Gaspé drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
North Shore–Gaspé	59.8	38.2	2.2	0.0	14,609	195	1.5

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

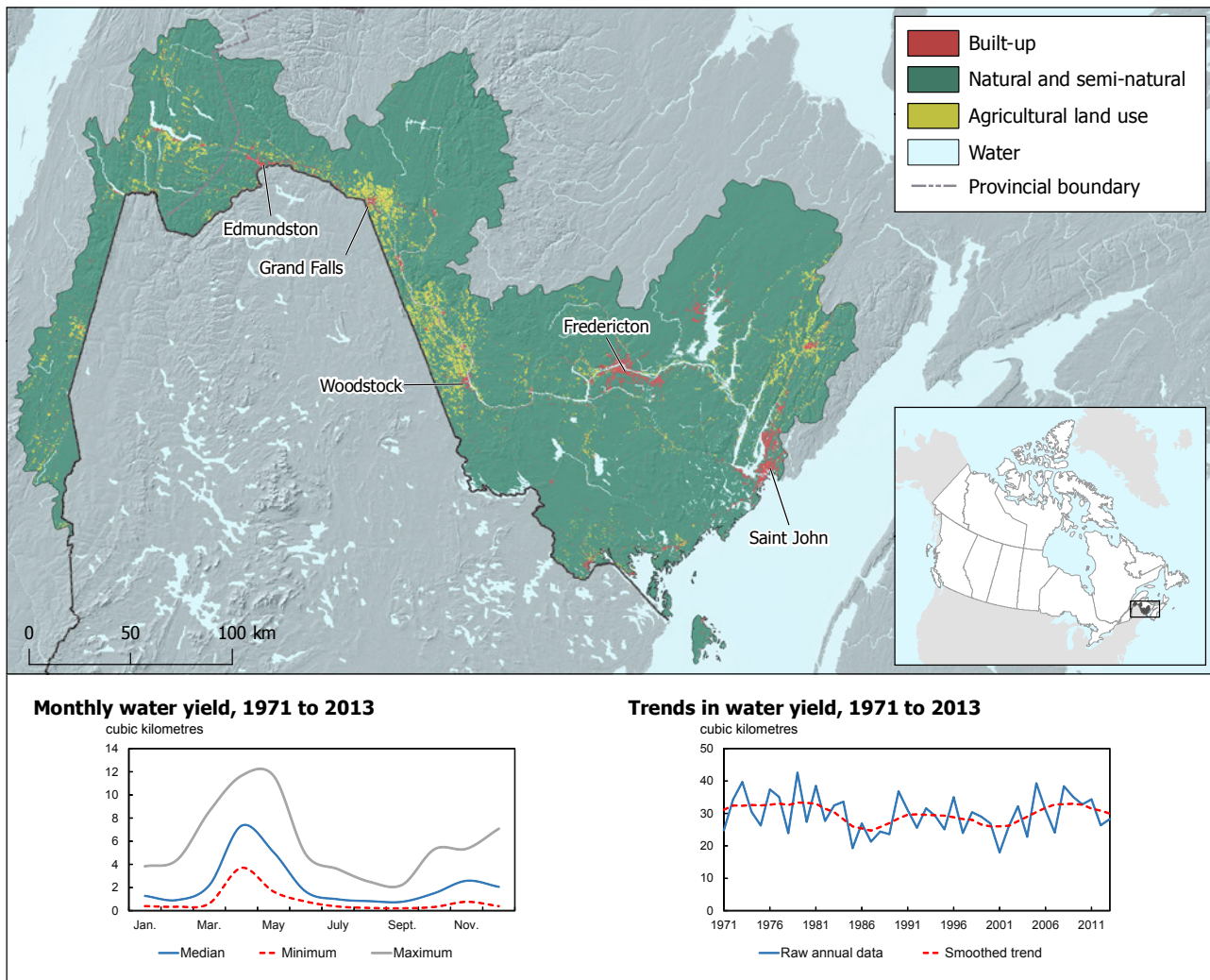
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.23 Saint John–St. Croix drainage region

Profile highlights

- The Saint John–St. Croix drainage region is a small region extending across 41,903 km² of New Brunswick and Quebec. In 2011, the majority (93.4%) of the land cover was natural and semi-natural area, followed by arable land (3.2%), built-up area (3.0%) and natural land for pasture (0.4%).
- The population was 413,581 in 2011, with a population density of 10.3 persons/km².
- Surface freshwater intake from manufacturing, drinking water plants, thermal-electric production and mining was 174.6 million m³ in 2013.
- The average annual water yield was 29.8 km³ over the period 1971 to 2013. The water yield per unit area was 0.71 m³/m², compared to 0.35 m³/m² at the Canada level. Monthly water flows peak in April. Evapotranspiration was the second highest in Canada at 0.48 m³/m².
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. On average residual soil nitrogen on agricultural land was 37.2 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level. The risk of phosphorus release from agricultural soils was high, with 3.5 mg/kg of water extractable phosphorus potentially released in 2011.

Map 3.3.23
Land use and water yield for the Saint John–St. Croix drainage region



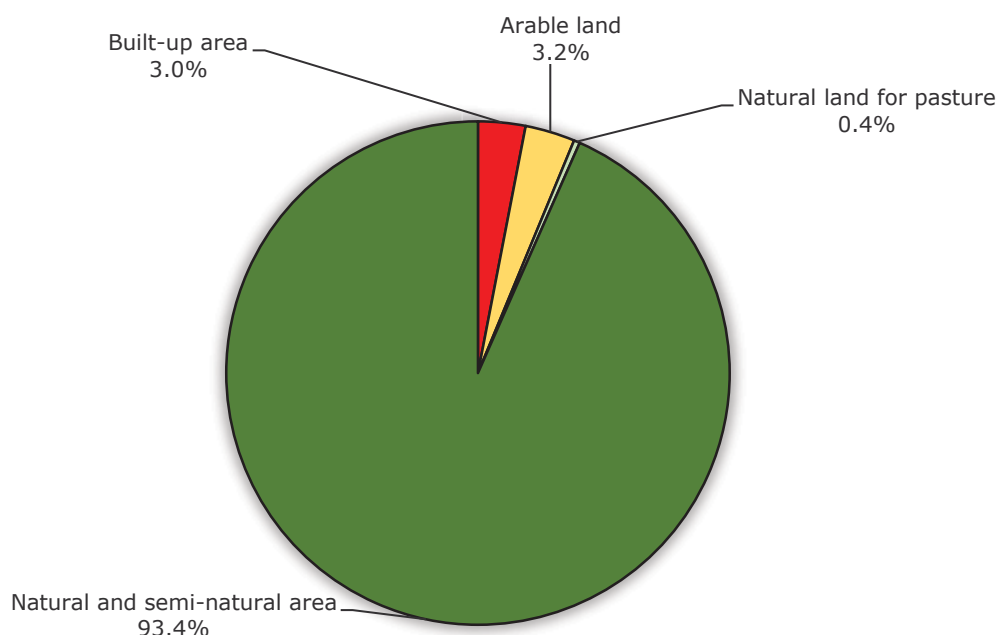
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.23

Land cover and land use, Saint John–St. Croix drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.23.1

Selected land cover and land use statistics, Saint John–St. Croix drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Saint John–St. Croix	41,903	1,716	40,187	3.0	3.2	0.4	93.4	610	3	827.4

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.23.2

Selected statistics on water supply and demand, Saint John–St. Croix drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Saint John–St. Croix	366,251	413,581	9.1	10.3	174.6	29.8	0.71	0.89	0.48

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.23.3

Selected indicators of pressures on water quality, Saint John–St. Croix drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Saint John–St. Croix	37.2	142.0	3.5	0.0	9,179	228	1.1

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

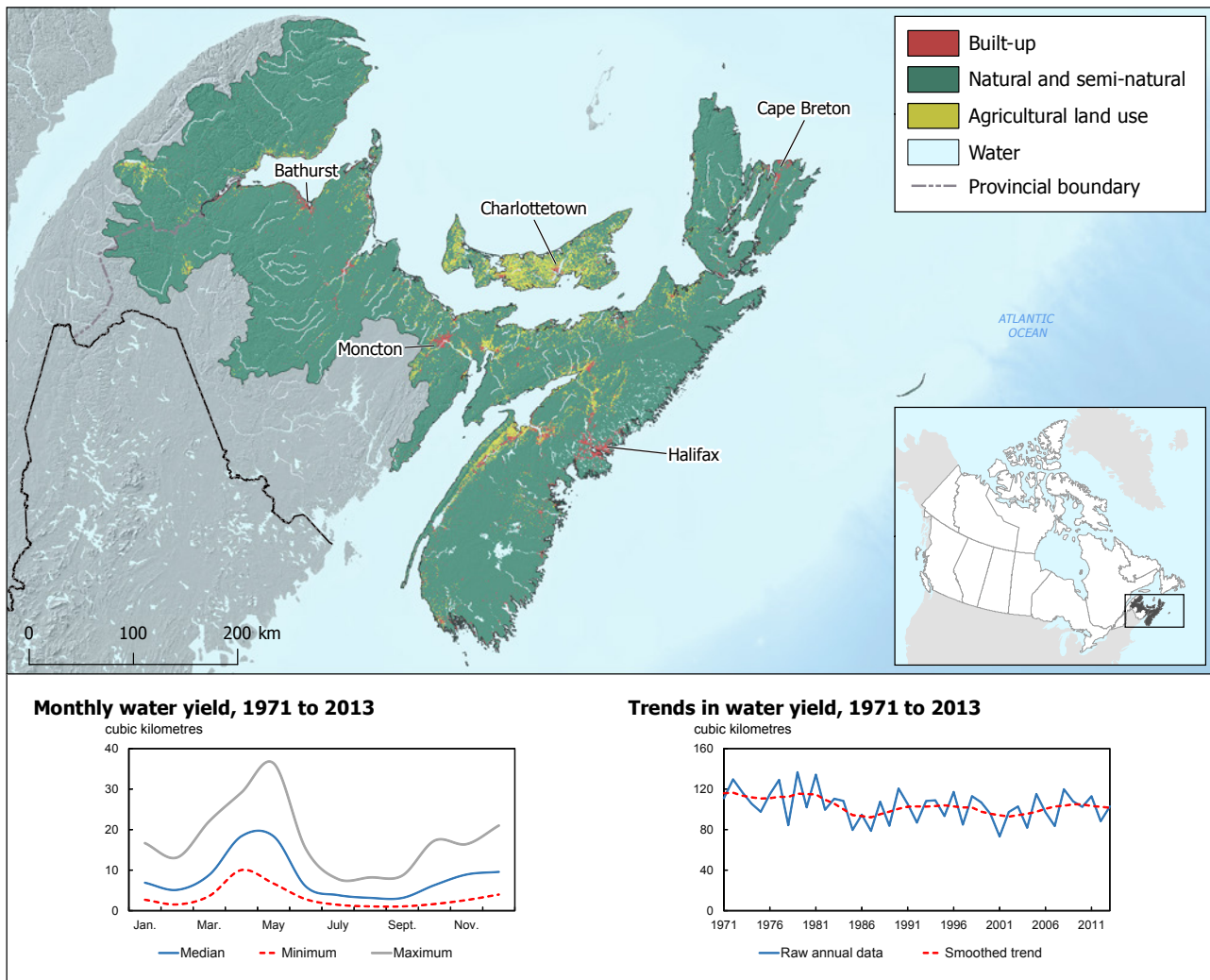
Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

3.24 Maritime Coastal drainage region

Profile highlights

- The Maritime Coastal drainage region includes Prince Edward Island, Nova Scotia and parts of New Brunswick. In 2011, the landscape was dominated by natural and semi-natural areas (93.0%), followed by built-up area (3.5%), arable land (3.2%) and natural land for pasture (0.4%).
- The density of linear infrastructure such as roads, rail lines and transmission lines was relatively high at 864.3 m/km² in 2011.
- The population was 1,515,262 in 2011—5% of Canada's total—with a population density of 13.1 persons/km².
- Surface freshwater intake from drinking water plants, manufacturing, mining and thermal-electric production was 202.5 million m³ in 2013.
- The average annual water yield was 103.6 km³ over the period 1971 to 2013. The water yield per unit area was 0.85 m³/m², compared to the 0.35 m³/m² at the Canada level. Monthly water flows peak in April. The region had the third highest evapotranspiration at 0.47 m³/m².
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application, livestock and poultry production, as well as industrial emissions. On average residual soil nitrogen on agricultural land was 37.0 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level. The risk of phosphorus release from agricultural soils was high, with 3.2 mg/kg of water extractable phosphorus potentially released in 2011.

Map 3.3.24
Land use and water yield for the Maritime Coastal drainage region



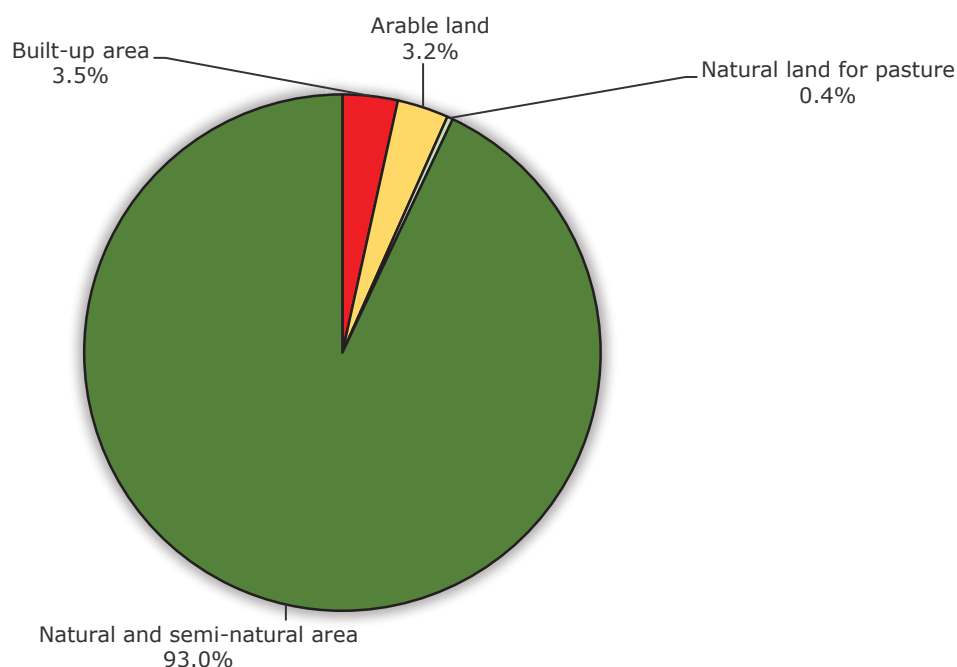
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.24

Land cover and land use, Maritime Coastal drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.24.1

Selected land cover and land use statistics, Maritime Coastal drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Maritime Coastal	122,057	6,495	115,562	3.5	3.2	0.4	93.0	2,007	40	864.3

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.24.2

Selected statistics on water supply and demand, Maritime Coastal drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Maritime Coastal	1,318,163	1,515,262	11.4	13.1	202.5	103.6	0.85	1.03	0.47

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.24.3

Selected indicators of pressures on water quality, Maritime Coastal drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Maritime Coastal	37.0	128.1	3.2	0.0	29,272	375	1.4

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

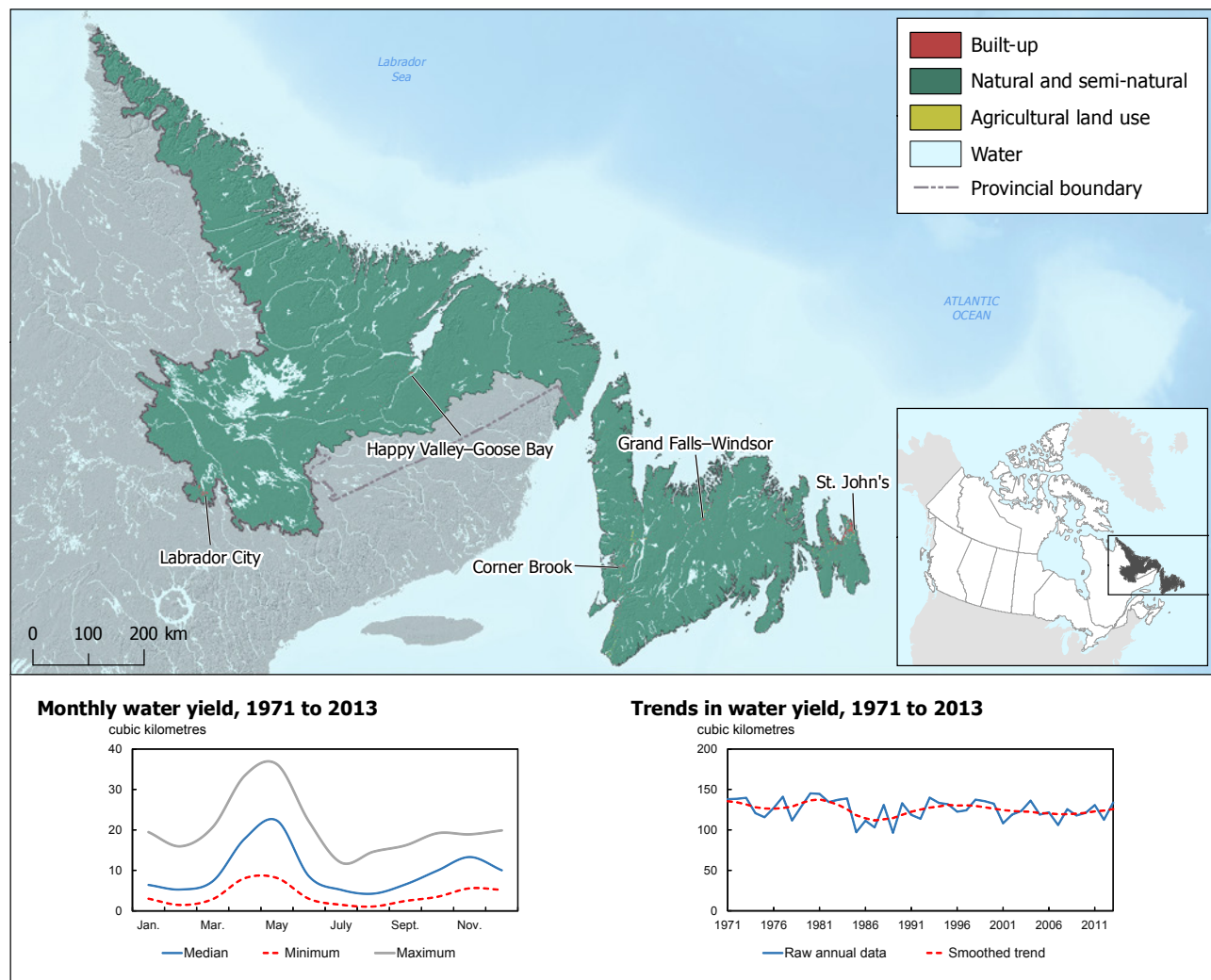
3.25 Newfoundland–Labrador drainage region

Profile highlights

- The landscape of the Newfoundland–Labrador drainage region is primarily composed of natural and semi-natural land area (99.6%)—built-up area, arable land and natural land for pasture together made up less than 0.5% of the total area in 2011.
- The population was 515,698 in 2011, with a population density of 1.6 persons/km².
- Surface freshwater intake from mining, drinking water plants, manufacturing and thermal-electric production was 338.1 million m³ in 2013.
- The long-term¹⁰⁷ average annual water yield was 324.2 km³ with a water yield per unit area of 0.85 m³/m², compared to 0.35 m³/m² at the Canada level. The average annual water yield for the Newfoundland (Island) part of the drainage region was 125.6 km³ over the period 1971 to 2013, with a water yield per unit area of 1.13 m³/m². Monthly water flows for this portion of the drainage region peak in May. Compared to other drainage regions, monthly water yield varies relatively little from year to year.
- Sources of nitrogen and phosphorus residuals in the environment include fertilizer application and livestock and poultry production. On average residual soil nitrogen on agricultural land was 56.0 kg/ha in 2011 compared to 23.2 kg/ha at the Canada level. The risk of phosphorus release from agricultural soils was high, with 6.3 mg/kg of water extractable phosphorus potentially released in 2011.

¹⁰⁷ The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). These different time periods are used due to lower availability of hydrometric data in the North. As well, because there are fewer stations in northern Canada, only the long-term average annual water yield is publishable for these regions—data quality was insufficient to derive the monthly water yield or the change over time.

Map 3.3.25
Land use and water yield for the Newfoundland–Labrador drainage region



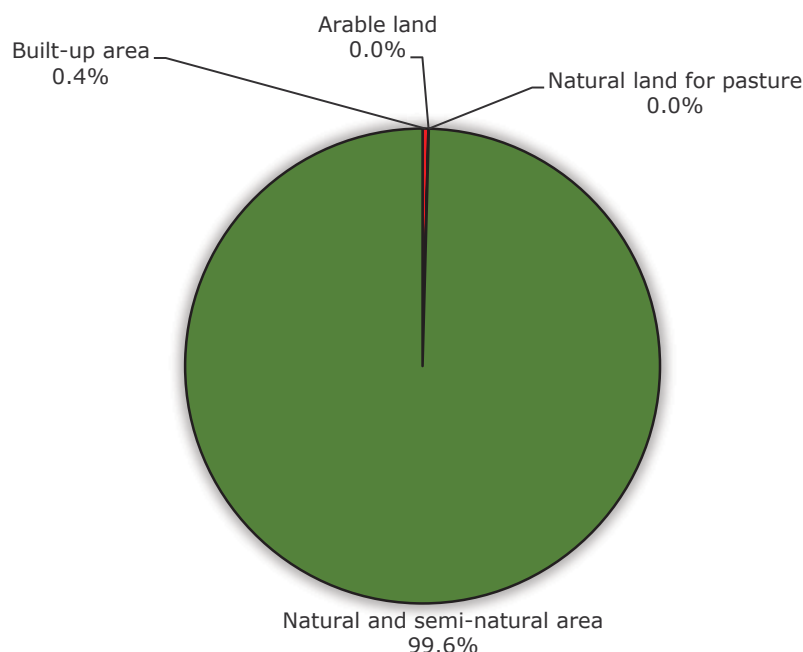
Notes: The land use map is derived from remote sensing data products and administrative data sources. Water yield data were derived from discharge values contained in Environment and Climate Change Canada's HYDAT database. The charts display water yield data for the Newfoundland (Island) portion of the drainage region only. Additional information is available in Appendix E.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada, 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); Natural Resources Canada, 2009, *Land cover, Circa 2000—Vector, Earth Sciences Sector*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2015); Statistics Canada, 2010, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no 16-001-M, no. 11; and special tabulations by Statistics Canada, Business Survey Methodology Division to calculate the smoothed trends.

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Chart 3.25

Land cover and land use, Newfoundland–Labrador drainage region, 2011



Notes: Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture. Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011.

Table 3.25.1

Selected land cover and land use statistics, Newfoundland–Labrador drainage region, 2011

	Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi-natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barrier density, 2011 ⁵
	km ²			percentage				km ²		m/km ²
Canada	9,978,923	1,169,561	8,809,362	0.6	4.3	1.5	93.6	249,056	7,665	169.7
Newfoundland–Labrador	380,361	54,893	325,468	0.4	0.0	0.0	99.6	51	0	104.0
Newfoundland (Island) ⁶	111,186	14,235	96,952	1.1	0.1	0.0	98.8	51	0	305.7

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

6. Data for the Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table 3.25.2

Selected statistics on water supply and demand, Newfoundland–Labrador drainage region

	Population, 1971	Population, 2011	Density, 1971	Density, 2011	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013 ²	Average annual evapotranspiration, 1981 to 2010 ⁴
	persons		persons/km ²		million m ³	km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	21,568,311	33,476,688	2.4	3.8	33,464.7	3,478.2	0.35	1.05	0.23
Newfoundland–Labrador	520,117	515,698	1.6	1.6	338.1	324.2	0.85	..	0.23
Newfoundland (Island) ⁵	493,938	487,808	5.1	5.0	..	125.6	1.13	0.62	0.34

1. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.
5. Data for Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247 to 259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

Table 3.25.3

Selected indicators of pressures on water quality, Newfoundland–Labrador drainage region

	Residual soil nitrogen, agricultural land, 2011 ¹	Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	kg/ha	kg/km ²	mg/kg		tonnes		nephelometric turbidity units
Canada	23.2	133.4	1.7	0.0	754,011	40,443	..
Newfoundland–Labrador	56.0	1.6	6.3	0.0	12,718	149	0.7
Newfoundland (Island) ⁴	56.0	5.5	6.3	0.0	5,573	148	..

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands, land occupied by buildings) on farms.
2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorous, substances include total phosphorous and yellow phosphorous. Substances are reported in tonnes.
3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.
4. Data for the Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," Environment Fact Sheets, Catalogue no. 16-508-X.

Appendices

A. Comprehensive data tables

Table A.1

Selected land cover and land use statistics by drainage region, 2011

		Total area ¹	Water area ¹	Land area ¹	Built-up area, 2011 ²	Arable land, 2011 ³	Natural land for pasture, 2011 ³	Natural and semi- natural area, 2011 ⁴	Fertilized area, 2011 ³	Irrigated area, 2011 ³	Barriers, 2011 ⁵	Barrier density, 2011 ⁵
	code	km ²									m	m/km ²
Canada	...	9,978,923	1,169,561	8,809,362	59,351	428,953	146,775	9,343,844	249,056	7,665	1,494,919,813	169.7
Pacific Coastal	1	334,455	14,219	320,236	1,547	493	635	331,781	183	79	45,332,602	141.6
Fraser–Lower Mainland	2	233,104	8,937	224,167	2,481	3,294	7,786	219,544	1,224	725	84,982,300	379.1
Okanagan–Similkameen	3	15,603	585	15,018	432	342	1,062	13,766	150	182	11,080,603	737.8
Columbia	4	87,323	2,348	84,975	666	403	898	85,356	148	117	29,827,848	351.0
Yukon	5	332,906	9,540	323,366	340	0	0	332,566	0	0	13,344,637	41.3
Peace–Athabasca	6	485,145	16,725	468,420	2,774	30,241	11,018	441,112	15,065	13	77,076,176	164.5
Lower Mackenzie	7	1,330,490	177,000	1,153,490	619	33	32	1,329,806	2	0	21,374,471	18.5
Arctic Coast–Islands	8	1,764,280	175,804	1,588,476	52	0	0	1,764,228	0	0	2,592,429	1.6
Missouri	9	27,096	915	26,181	313	11,264	11,139	4,380	3,931	144	15,343,911	586.1
North Saskatchewan	10	150,151	7,242	142,909	4,608	74,498	23,740	47,305	44,992	94	118,881,300	831.9
South Saskatchewan	11	177,623	6,219	171,404	4,866	89,676	48,350	34,732	51,958	5,236	140,858,590	821.8
Assiniboine–Red	12	190,704	8,846	181,858	5,987	118,065	21,505	45,146	74,969	266	181,360,534	997.3
Winnipeg	13	107,655	20,525	87,130	914	787	349	105,605	316	1	19,766,658	226.9
Lower Saskatchewan–Nelson	14	360,887	67,617	293,270	2,290	30,894	9,901	317,802	18,752	117	69,974,401	238.6
Churchill	15	313,568	51,918	261,650	763	5,786	4,753	302,267	1,844	5	18,492,635	70.7
Keewatin–Southern Baffin Island	16	939,569	161,011	778,558	25	0	0	939,544	0	0	385,997	0.5
Northern Ontario	17	691,809	56,064	635,745	878	485	134	690,311	88	0	27,268,966	42.9
Northern Quebec	18	940,193	149,081	791,112	749	214	15	939,215	21	0	19,679,873	24.9
Great Lakes	19	317,860	111,577	206,283	10,998	32,846	2,606	271,411	20,631	397	185,410,480	898.8
Ottawa	20	146,353	14,550	131,803	3,508	6,689	1,163	134,993	2,963	26	84,994,689	644.9
St. Lawrence	21	118,733	8,801	109,932	5,971	15,222	1,000	96,540	8,451	206	120,259,882	1,093.9
North Shore–Gaspé	22	369,095	36,933	332,162	1,599	2,372	48	365,076	700	14	39,638,603	119.3
Saint John–St. Croix	23	41,903	1,716	40,187	1,274	1,340	162	39,128	610	3	33,250,648	827.4
Maritime Coastal	24	122,057	6,495	115,562	4,215	3,922	441	113,480	2,007	40	99,884,596	864.3
Newfoundland–Labrador	25	380,361	54,893	325,468	1,486	87	40	378,749	51	0	33,856,985	104.0
Newfoundland (Island) ⁶	...	111,186	14,235	96,952	1,240	86	40	109,819	51	0	29,637,886	305.7

1. Total area includes land and water using the Atlas of Canada 1:1,000,000 scale hydrography base and includes the Canadian portion of the Great Lakes. Water area is calculated from the Canada-wide 1-km² gridded Water Fraction derived from National Topographic Data Base maps.

2. Built-up area estimated for 2011 combines the land use classes for settlements and roads from Agriculture and Agri-Food Canada's *Land Use, 2010*, supplemented with estimates of settlements and roads for northern areas in drainage regions 1, 5, 7, 8, 16, 18 and 25. Additional information is available in Appendix E.

3. Data for arable land, natural land for pasture, fertilized area and irrigated area are taken from the 2011 Interpolated Census of Agriculture, which aggregates data from the Census of Agriculture by soil landscape and drainage area units. Arable land is the sum of cropland, summerfallow and tame and seeded pasture. Other land on farms (e.g., land occupied by farm buildings, wetlands and woodlots) is included as built-up or natural land.

4. Natural and semi-natural land is the residual after subtracting built-up area, arable land and natural land for pasture from the total area.

5. Barriers include roads, rail lines and electrical transmission lines, but excludes other types of infrastructure such as pipelines. Barrier density refers to the density of these roads, rail line and transmission lines, measured in metres of barriers per square kilometre of land.

6. Data for Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Fernandes, R., G. Pavlic, W. Chen and R. Fraser, 2001, *1-km Water Fraction From National Topographic Data Base Maps, Canada*, Natural Resources Canada, Earth Science Sector, www.geogratis.ca/geogratis/en/option/select.do?id=8C3D34AE-5BD5-A83C-DB8C-895FB4AD86C6 (accessed April 28, 2010); Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015); AAFC and Statistics Canada, special tabulation, Census of Agriculture, Census Geographic Component Base 2011; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, 2012, *CanVec*, www.geogratis.gc.ca (accessed March 1, 2012).

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Table A.2
Selected statistics on water supply and demand by drainage region

		Population, 1971	Population, 2011	Density, 1971	Density, 2011	Water use, 2013 ¹	Surface freshwater intake, 2013 ¹	Average annual water yield, 1971 to 2013 ²	Water yield per area, 1971 to 2013 ²	Water yield variability index, ³ 1971 to 2013	Average annual evapotrans- piration, 1981 to 2010 ⁴
	code	persons		persons/km ²		million m ³		km ³	m ³ /m ²	monthly CV	m ³ /m ²
Canada	...	21,568,311	33,476,688	2.4	3.8	37,892	33,464.7	3,478.2	0.35	1.05	0.23
Pacific Coastal	1	913,522	1,505,007	2.9	4.7	.	617.3	510.2	1.53	0.50	0.26
Fraser–Lower Mainland	2	971,762	2,336,941	4.3	10.4	.	615.3	129.3	0.55	0.83	0.33
Okanagan–Similkameen	3	118,507	327,548	7.9	21.8	.	148.3	4.3	0.27	1.44	0.41
Columbia	4	132,952	160,896	1.6	1.9	.	190.7	67.9	0.78	1.04	0.41
Yukon	5	16,984	32,280	0.1	0.1	.	12.5	106.0	0.32	..	0.14
Peace–Athabasca	6	206,361	406,303	0.4	0.9	.	297.3	99.5	0.21	1.01	0.31
Lower Mackenzie	7	34,283	52,844	0.0	0.0	.	10.7	246.3	0.19	..	0.17
Arctic Coast–Islands	8	7,655	20,133	0.0	0.0	.	1.3	231.3	0.13	..	0.11
Missouri	9	15,328	8,439	0.6	0.3	.	20.2	0.5	0.02	2.14	0.33
North Saskatchewan	10	841,004	1,559,613	5.9	10.9	.	947.4	10.4	0.07	1.04	0.34
South Saskatchewan	11	949,194	2,168,447	5.5	12.7	.	1,942.3	10.3	0.06	1.10	0.34
Assiniboine–Red	12	1,248,357	1,464,936	6.9	8.1	.	1,522.4	8.4	0.04	2.49	0.39
Winnipeg	13	82,806	82,775	1.0	1.0	.	131.8	25.9	0.24	0.87	0.40
Lower Saskatchewan–Nelson	14	238,535	216,586	0.8	0.7	.	70.8	51.7	0.14	0.92	0.32
Churchill	15	63,418	94,292	0.2	0.4	.	7.7	51.0	0.16	0.75	0.24
Keewatin–Southern Baffin Island	16	7,034	13,968	0.0	0.0	.	3.2	192.0	0.20	..	0.13
Northern Ontario	17	148,658	134,355	0.2	0.2	.	106.0	199.2	0.29	..	0.31
Northern Quebec	18	90,953	109,239	0.1	0.1	.	30.1	516.3	0.55	..	0.18
Great Lakes	19	6,632,154	11,287,184	32.2	54.7	.	23,461.0	133.3	0.42	0.72	0.48
Ottawa	20	1,183,662	1,957,937	9.0	14.9	.	364.9	64.3	0.44	0.80	0.47
St. Lawrence	21	4,941,807	6,583,552	45.0	59.9	.	2,045.2	72.3	0.61	0.76	0.39
North Shore–Gaspé	22	518,844	508,869	1.6	1.5	.	203.2	290.4	0.79	0.91	0.27
Saint John–St. Croix	23	366,251	413,581	9.1	10.3	.	174.6	29.8	0.71	0.89	0.48
Maritime Coastal	24	1,318,163	1,515,262	11.4	13.1	.	202.5	103.6	0.85	1.03	0.47
Newfoundland–Labrador	25	520,117	515,698	1.6	1.6	.	338.1	324.2	0.85	..	0.23
Newfoundland (Island) ⁵	...	493,938	487,808	5.1	5.0	.	..	125.6	1.13	0.62	0.34

1. Total water use for Canada is taken from the Water Use Account. It is the amount of water withdrawn from water resources to support society in both the economic and residential sectors. Water withdrawals are also referred to as water intake. These estimates include water loss and leakages through water treatment and distribution systems. They exclude the use of water for hydro-electricity production. Surface freshwater intake aggregates data from the Survey of Drinking Water Plants, 2013 and the Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on the Agricultural Water Use Survey and the *Alberta Irrigation Information* report. Withdrawals from groundwater, groundwater under the influence of surface water and marine water sources are excluded. Data for water use by the oil and gas industry and households not supplied by a public water provider are also excluded.
2. The water yield estimates are 42-year annual averages (1971 to 2013), with the exception of estimates for drainage region 1, which is based on 41 years of data (1971 to 2012); drainage regions 5, 7, 17 and 18 and portions of 8, 16 and 25 (Labrador), which are based on 20 years of data (1976 to 1995); and portions of drainage region 8 and 16, which are based on a 23-year average (1972 to 1994) for the Arctic Archipelago (Spence and Burke, 2008). For equivalences: 1 km³ is equal to 1 billion m³.
3. Variability is measured by using a coefficient of variation (CV) that allows the comparison of all months in all years of the 42-year time period. The CV of the water yield data is a measure of the dispersion or variation in the monthly yield values over the period 1971 to 2013. It is defined as the ratio of the standard deviation of the monthly values to the mean. A higher CV indicates that the monthly data are more variable from year to year. The CV for the Pacific Coastal drainage region is for the period 1971 to 2012. The CV was not calculated for drainage regions 5, 7, 8, 16, 17, 18 and the Labrador portion of 25.
4. Evapotranspiration is taken from a dataset providing estimates of actual evapotranspiration at a 1 km resolution, which is modeled by integrating remote sensing land surface data and gridded climate data. Data exclude the Great Lakes.
5. Data for Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Note: The water yield and evapotranspiration statistics are provided to allow comparisons across regions. They are not intended to be used for the purposes of a water budget.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from the 1971 and 2011 Censuses of Population; Statistics Canada, CANSIM Table 153-0116 (<http://www5.statcan.gc.ca/cansim/home-accueil?lang=eng&MM=as>) (accessed February 9, 2017); Industrial Water Use Survey, 2013; Survey of Drinking Water Plants, 2013; Agricultural Water Use Survey, 2010, 2012 and 2014; Alberta Agriculture and Rural Development, 2014, *Alberta Irrigation Information: Facts and Figures for the Year 2013*, Basin Water Management Branch; Environment and Climate Change Canada, 2015, *Water Survey of Canada, Archived Hydrometric Data (HYDAT)*, www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1 (accessed December 3, 2016); Spence, C. and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago runoff from observed hydrometric data," *Journal of Hydrology*, Vol. 362, pp. 247–259; Wang, S., Y. Yang, Y. Luo and A. Rivera, 2013, "Spatial and seasonal variations in evapotranspiration over Canada's landmass," *Hydrology and Earth System Sciences*, Vol. 17, no. 9, pp. 3561–3575, doi: 10.5194/hess-17-3561-2013.

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Table A.3
Selected indicators of pressures on water quality by drainage region

		Residual soil nitrogen on agricultural land, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Risk of phosphorus release from agricultural soils, normalized across the total area of the drainage region, 2011 ¹	Nitrogen emissions, National Pollutant Release Inventory, 2014 ²	Phosphorus emissions, National Pollutant Release Inventory, 2014 ²	Median monthly maximum turbidity, 2013 ³
	code	kg/ha	kg/km ²	mg/kg	tonnes	nephelometric turbidity units	
Canada	...	23.2	133.4	1.7	754,011	40,443	..
Pacific Coastal	1	22.0	6.8	2.9	10,390	493	0.9
Fraser–Lower Mainland	2	23.2	105.5	3.3	26,489	34,660	1.4
Okanagan–Similkameen	3	20.3	184.5	2.6	201	0	1.4
Columbia	4	21.4	30.2	2.5	2,468	1,373	0.7
Yukon	5	...	...	...	0	0	..
Peace–Athabasca	6	25.4	215.1	1.6	155,828	133	5.0
Lower Mackenzie	7	26.8	0.1	1.5	22,559	0	4.6
Arctic Coast–Islands	8	...	...	...	7,607	0	F
Missouri	9	11.1	922.5	1.6	16,289	0	F
North Saskatchewan	10	20.0	1,314.5	1.5	127,820	82	9.0
South Saskatchewan	11	14.2	1,099.9	1.8	107,769	331	6.3
Assiniboine–Red	12	24.7	1,822.4	1.3	30,260	524	7.7
Winnipeg	13	31.6	30.3	1.8	1,703	47	2.4
Lower Saskatchewan–Nelson	14	29.4	337.0	1.3	1,427	10	20.9
Churchill	15	28.0	94.9	1.6	12,724	0	4.5
Keewatin–Southern Baffin Island	16	...	...	...	1,327	0	F
Northern Ontario	17	25.4	1.6	2.9	6,543	19	4.9
Northern Quebec	18	25.0	1.1	3.5	5,169	13	F
Great Lakes	19	37.5	405.6	1.8	106,099	781	5.0
Ottawa	20	33.2	172.6	2.2	11,648	139	4.1
St. Lawrence	21	51.8	690.5	3.5	33,914	890	9.8
North Shore–Gaspé	22	59.8	38.2	2.2	14,609	195	1.5
Saint John–St. Croix	23	37.2	142.0	3.5	9,179	228	1.1
Maritime Coastal	24	37.0	128.1	3.2	29,272	375	1.4
Newfoundland–Labrador	25	56.0	1.6	6.3	12,718	149	0.7
Newfoundland (Island) ⁴	...	56.0	5.5	6.3	5,573	148	..

1. Agriculture and Agri-Food Canada produces agri-environmental indicators on residual soil nitrogen (RSN) and the risk of phosphorus release (P-source). The RSN indicator provides an estimate of the amount of nitrogen in agricultural soils, in kilograms per hectare, in 2011. RSN accounts for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The P-source is the amount of water extractable phosphorus potentially released from agricultural soils in a given year, in milligrams per kilogram. Agricultural land is taken from the Interpolated Census of Agriculture and includes cropland, summerfallow, tame or seeded pasture and natural land for pasture. It excludes other land (e.g., woodlots, wetlands and land occupied by buildings) on farms.

2. Direct emissions from industrial facilities to air, land and water reported to the National Pollutant Release Inventory in 2014, excluding offshore facilities. For nitrogen, substances include ammonia, nitrate ion in solution, nitric acid and nitrogen oxides. For phosphorus, substances include total phosphorus and yellow phosphorus. Substances are reported in tonnes.

3. Turbidity is a measure of the relative clarity of water measured in nephelometric turbidity units (NTU). Data are for raw surface water sources from drinking water facilities that reported turbidity data for at least 10 months in 2013.

4. Data for Newfoundland (Island) are disaggregated from the Newfoundland–Labrador drainage region because data on the variability index, monthly water yield and trends in water yield over time are only available for this portion of the region.

Sources: Statistics Canada, Environment, Energy and Transportation Statistics Division, 2017, special tabulation from Agriculture and Agri-Food Canada (AAFC), 2015, *Agri-environmental Indicator—Residual Soil Nitrogen (RSN)*, <http://open.canada.ca/data/en/dataset/3f5acb7c-78e6-4127-8867-ddd70e396476> (accessed September 28, 2016); AAFC, 2015, *Agri-environmental Indicator—Risk of P release in agricultural land (P-Source)*, <http://open.canada.ca/data/en/dataset/fc9e5c73-1c1a-47c1-9de4-612569b718fd> (accessed September 28, 2016); Environment and Climate Change Canada, 2015, *National Pollutant Release Inventory, Pollution Data and Reports*, www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1 (accessed August 24, 2016); Statistics Canada, 2015, "Source water quality, 2013," *Environment Fact Sheets*, Catalogue no. 16-508-X.

B. Equivalences—units of measure

Area

$$1 \text{ ha} = 10,000 \text{ m}^2$$

$$100 \text{ ha} = 1,000,000 \text{ m}^2 = 1 \text{ km}^2$$

Volume

$$1 \text{ km}^3 = 1,000,000,000 \text{ m}^3$$

$$1 \text{ L} = 0.001 \text{ m}^3$$

Amount of water yield, runoff, evapotranspiration

$$1 \text{ mm (depth) is equivalent to } 0.001 \text{ m}^3/\text{m}^2 = 1 \text{ L}/\text{m}^2 = 10,000 \text{ L}/\text{ha}$$

C. Glossary

Abstraction: defined as the amount of water that is removed from any source, either permanently or temporarily, in a given period of time.¹⁰⁸ Wastewater discharged becomes available for re-abstraction downstream. The System of Environmental–Economic Accounting (SEEA) focuses on the inland water system, although sea or ocean water abstracted for production or consumption is included. It covers water used for the purpose of production and consumption activities and includes abstraction of soil water by plants and water used for hydro-electric-generation.

Aquatic ecosystem: An ecosystem is a community of interacting organisms and its physical environment. Aquatic ecosystems are located in a body of water. Subsets include marine and freshwater ecosystems. The latter include ecosystems in lakes, ponds, rivers, streams, wetlands and floodplains.

Aquifer: geological formation of permeable rock or material such as sand or gravel capable of holding significant quantities of water.

Biome: complex biotic community covering a large geographic area and characterized by the distinctive lifeforms of dominant species of plants and animals that are adapted to the particular conditions of the region.

Climate regions: Environment and Climate Change Canada presents climate trends and variations data for 11 climate regions across the country: Arctic Mountains and Fiords; Arctic Tundra; Atlantic Canada; Great Lakes/St. Lawrence; Mackenzie District; Northeastern Forest; Northwestern Forest; Pacific Coast; Prairies; South British Columbia Mountains and Yukon/North British Columbia Mountains. See Map 2.1 Canadian climatic regions in Statistics Canada (www.statcan.gc.ca/pub/16-201-s/2011001/m005-eng.htm), 2011, *Human Activity and the Environment: Detailed Statistics*, Catalogue no. 16-201-S.

Drainage regions: Statistics Canada groups 974 sub-sub-drainage areas representing all land and interior freshwater bodies into 25 drainage regions (Map 1.1). These drainage regions can be further grouped according to their outflow into one of 5 ocean drainage areas: the Pacific Ocean, Arctic Ocean, Gulf of Mexico, Hudson Bay or Atlantic Ocean. This geography is a variant of Statistics Canada's official classification of drainage areas, the Standard Drainage Area Classification (SDAC) 2003, www.statcan.gc.ca/eng/subjects/standard/sdac/sdac.

Ecosystem functions: the biological, geochemical and physical processes that take place within an ecosystem.

Effluent: water or wastewater discharge from a treatment plant or industrial process.

Evapotranspiration: combined processes by which water is transferred from the earth's surface to the atmosphere by evaporation from the land and ocean surfaces and by transpiration from vegetation.

Freshwater: water having a low concentration of dissolved salts.

Groundwater: water located below ground between particles of soil and fractured rock in the [saturated zone](#) below the water table (see for comparison [soil moisture](#)).

Groundwater discharge: the release of groundwater from the [saturated zone](#). Depending on the characteristics of the aquifer including the permeability and porosity of confining rocks, groundwater flows slowly from recharge areas to discharge areas at springs, streams, lakes, wetlands and oceans. Groundwater discharge is a major contributor to the flow of streams and rivers.

Groundwater recharge: inflow of water from the surface into the [saturated zone](#) of the ground.

Hydrological cycle: the natural cycle in which water evaporates from the earth's surface including the oceans to the atmosphere and returns to the earth as precipitation (see also [water cycle](#)).

Hydrometric data: data pertaining to the flow of water.

¹⁰⁸ United Nations, European Commission, Food and Agricultural Organization of the United Nations, International Monetary Fund, Organisation for the Economic Co-operation and Development, The World Bank, 2014, *System of Environmental–Economic Accounting 2012: Central Framework*, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed May 2, 2016); United Nations, 2012, *System of Environmental–Economic Accounting for Water*, <http://unstats.un.org/unsd/envaccounting/seeaw/> (accessed May 25, 2016).

Instream flows: the amount of flowing water in a stream channel. Instream flow requirements refer to the amount of water needed in a stream to sustain ecological functions, aquatic habitat and water quality, as well as other instream water uses such as recreation or navigation.

Peatlands: organic wetlands, which contain accumulations of partially decayed plant matter. They include bogs, fens and swamps and are typically found in the north.

Permafrost: soil or rock in arctic, subarctic or alpine regions at variable depth beneath the earth's surface in which a temperature below freezing has existed continuously for at least two years.

Phosphorus-source (P-source): the estimated amount of dissolved phosphorous potentially released from agricultural soils (mg/kg) in a census year. The P-source dataset provides information on the relative risk of phosphorus release and is produced as part of Agriculture and Agri-Food Canada's Agri-environmental indicators. It is based on a function of cumulative phosphorus additions and removals over a 35-year period (1976 to 2011) and the degree of soil P saturation. P-source by itself does not estimate the risk of water contamination, which is dependent on both the P-source and a transport hydrology function.

Precipitation: water, in either liquid or solid form, that falls to the earth's surface from the atmosphere. For example, rain, snow, hail or freezing rain.

Primary energy: Primary energy refers to energy in its naturally-occurring form (e.g., coal, crude oil, natural gas, primary electricity [hydro and nuclear] before conversion to end-use forms [e.g., refined petroleum products, secondary electricity]).

Renewable freshwater: refers to the water that regularly replenishes our rivers, lakes and aquifers. Non-renewable freshwater describes water that is stored in deep aquifers, ice caps and glaciers that have a negligible rate of recharge on a human time scale. Some freshwater in the Great Lakes and other major water bodies can also be considered non-renewable since the renewal rates are very low.

Residual soil nitrogen (RSN): the amount of nitrogen remaining in agriculture soils (kg/ha) in a given year after accounting for atmospheric deposition, nitrogen fixation, crop inputs (fertilizer and manure), crop removals (harvesting) and gaseous losses of ammonia, nitrous oxide and nitrogen gas. The RSN dataset produced as part of Agriculture and Agri-Food Canada's Agri-Environmental Indicator dataset provides a calculation of the amount of nitrogen in the top 60 cm of the soil at the end of the cropping season for Canadian agricultural lands. RSN by itself does not estimate the risk of water contamination. Surplus nitrogen can remain in the soil and be used by subsequent crops or it can be lost to the environment.

Runoff: the portion of precipitation and melt from snowpack and glaciers that, by a variety of paths above and below the surface of the ground, reaches the stream channel. Once it enters a stream channel, runoff becomes streamflow.

Saturated zone: the region below the water table that is saturated with water. This water is called [groundwater](#).

Soil moisture: water located in the [unsaturated zone](#) above the water table but below the surface of the earth (see for comparison [groundwater](#)).

Thermal electric power generation: refers to power generation that uses a fuel source (e.g., fossil fuels or nuclear energy) to produce heat or steam, with which to generate electricity.

Turbidity: a measure of the relative clarity or cloudiness of a liquid, caused by suspended particles (e.g. clay, silt, metals, organic matter, microorganisms), and measured in nephelometric turbidity units (NTU).

Unregulated flow: refers to natural streamflow, as opposed to controlled releases of water, in a stream or river. In a regulated river, downstream flows are regulated based on releases from a major storage or dam. Unregulated flows can occur in regulated rivers.

Unsaturated zone: subsurface zone above the water table that contains both air and [soil moisture](#).

Wastewater discharge: refers to water that is returned to the environment in its liquid state, usually close to an industrial establishment. Discharged water may be treated or untreated.

Water cycle: the natural cycle in which water evaporates from the earth's surface including the oceans to the atmosphere and returns to the earth as precipitation (see also [hydrological cycle](#)).

Water intake: the amount of water extracted from water bodies (see also [water withdrawal](#)).

Water quality: term used to describe the physical, chemical and biological characteristics of water. These characteristics can include temperature, turbidity, pH, dissolved solids, metals, oxygen, total coliforms, *e. coli*, and other parameters. Water quality is normally considered in relation to its suitability for a specific use.

Water use: Water use is the amount of water withdrawn from water resources to support society in both the economic and residential sectors. [Water withdrawals](#) are also referred to as [water intake](#). Water use estimates included in this report include water loss and leakages through water treatment and distribution systems. They exclude the use of water for hydro-electricity production.

Water withdrawal: the amount of water extracted from water bodies (see also [water intake](#)).

Water yield: is an estimate of freshwater [runoff](#) into streams and rivers and provides information on Canada's renewable freshwater supply. It is derived from data on the [unregulated flow](#) of water in rivers and streams in Canada. Although the water yield provides an estimate of renewable freshwater, it can include some water that is considered non-renewable (e.g., melt water from receding glaciers).

D. Summary of methodology for water yield and the intake to yield ratio map

Water yield methodology

Overview

Estimates of the monthly and annual water yield for Canada, southern Canada, and for the 25 drainage regions, covering the 1971 to 2013 period, are produced by Statistics Canada. These data are part of the Environmental Accounting Program and, along with other measures of natural capital such as land, timber, minerals, energy and greenhouse gas emissions, provide time series data on elements of the environment following the United Nation's statistical standard System of Environmental–Economic Accounting.¹⁰⁹ These estimates of renewable freshwater for Canada are produced using a peer-reviewed, approach and are updated regularly.

The main purpose of these estimates is to provide measures of the stock of renewable freshwater in Canada and its drainage regions, in and by themselves useful measures to track through time, but also useful denominators against which to analyze the flows of water to and from the economy such as abstraction and discharge by industry and households.

The estimates may also be used for other purposes; however, users should be aware of data limitations in instances where finer resolution or more precise data may be required.

Methodology

The water yield estimates are derived from monthly volumes of unregulated flows in Canada's rivers and streams. A database of natural streamflow data was compiled and combined with upstream basin delineations for each of the gauging stations from which observations were taken. These data cover the 1971 to 2013 time period. Streamflow values were converted to a runoff depth, geo-located at the basin centroid and then interpolated using a geospatial estimation method (ordinary kriging) to create spatial estimates of runoff. These spatial estimates were summed at the drainage region level to create various regional and temporal estimates over a 42-year period.

The methodology and results were validated using several techniques to understand the uncertainty of the estimates. For example, the data were compared against other estimates and streamflow observations and various types of analysis were performed.

Results and limitations

Results were included in this study where reasonable validation was possible. Generally, results were included where data points were denser, as seen for example in southern Canada; where mean standard error was lower; and where validation results were good.

Results were not included where uncertainty was too high as indicated by the mean standard error or a declining data density, as seen for example in many northern areas; where further validation is required because insufficient data was available for comparison; where the spatial arrangement of stations had changed over time; or where the scale was finer than what the model was originally intended to support. Few northern results were included because northern networks are sparsely populated, with fewer stations available across larger distances.

¹⁰⁹ Statistics Canada, Environment, Energy and Transportation Statistics Division, 2016, *Methodological Guide: Canadian System of Environmental–Economic Accounting*, www.statcan.gc.ca/eng/nea/list/env?fpv=1762 (accessed December 30, 2016); United Nations, European Commission, Food and Agricultural Organization of the United Nations, International Monetary Fund, Organisation for the Economic Co-operation and Development, The World Bank, 2014, *System of Environmental–Economic Accounting 2012: Central Framework*, http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed May 2, 2016); United Nations, 2012, *System of Environmental–Economic Accounting for Water*, <http://unstats.un.org/unsd/envaccounting/seeaw/> (accessed May 25, 2016).

Nationally, the number of stations gradually increased from 1971 to the late 1980s when station density peaked. The number of stations then declined to their lowest level by the late 1990s, with the steepest drop in 1993 and 1994. The overall number of stations has since remained relatively constant. Many individual drainage regions follow a similar pattern, with the exception of some drainage regions in the southern areas of the country where more consistent station densities were maintained since 1971.

For a more comprehensive review of the methodology including validation steps please refer to: Statistics Canada, 2009, "The Water Yield for Canada as a Thirty-year Average (1971 to 2000): Concepts, Methodology and Initial Results," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no. 16-001-M, no. 7, www.statcan.gc.ca/pub/16-001-m/16-001-m2009007-eng.htm.

Intake to water yield ratio map

The surface freshwater intake to water yield ratio map highlights a number of important regional relationships between the supply of and demand for surface freshwater in Canada. The indicator map divides the total surface water intake of manufacturing, mining, thermal-electric power generation, agriculture and drinking water plants by the renewable freshwater supplied (water yield) for the month of August, a month with a higher potential for stress. The results provide insight on broad regional issues such as potential pressure on the availability and accessibility of the resource, stress on aquatic ecosystems reliant on appropriate flows, and economic value of the services provided by the resource.

Consumptive use and water supplied by non-renewable water sources in some lakes and other water stocks are not the focus of this indicator. However, these issues are also important aspects to consider when assessing the supply-demand relationship.

Surface freshwater intake sums the water use data from the Survey of Drinking Water Plants, 2013 and Industrial Water Use Survey, 2013, with estimates of agricultural water use for 2013 based on various years of the Agricultural Water Use Survey and *Alberta Irrigation Information* report. Withdrawals performed by the upstream oil and gas industry, as well as withdrawals from groundwater, groundwater under the influence of surface water and marine waters are excluded from the calculations.

E. Additional information for drainage region profile maps and land cover and land use categories

Maps included in the drainage region profiles in [Section 3](#) were produced by Statistics Canada, Environment, Energy and Transportation Statistics Division. Complete reference and background information is as follows:

Land use maps

- The main data source for the land use class information is: Agriculture and Agri-Food Canada (AAFC), 2015, *Land Use, 2010*, <http://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec> (accessed September 16, 2015).
- Built-up area is based on classes 21 (Settlement) and 25 (Roads).
- Agricultural land use is based on classes 51 (Cropland) and 61 (Managed grasslands). Note that the sources used for the agricultural land use classes shown on the maps differ from those used to produce the arable and natural land for pasture statistics in the tables and charts, which are based on data from the Interpolated Census of Agriculture.
- Natural and semi-natural area is the residual area remaining after subtracting built-up and agricultural land use areas from the total area.

Water is taken from: Natural Resources Canada (NRCan), Canada Centre for Mapping and Earth Observation (CCME), 2014, *CanVec+*, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/canvec/ (accessed August 10, 2015).

For northern areas outside the agricultural ecumene, land use data has been supplemented using: NRCan, 2009, *Land cover, Circa 2000–Vector*, Earth Sciences Sector, http://ftp.geogratis.gc.ca/pub/nrcan_rncan/vector/geobase_lcc_csc/ (accessed December 15, 2016).

In addition, the built-up areas for these northern regions were estimated using data from Statistics Canada's road network files and Settlements program: Statistics Canada, 2011, *Road Network File, 2011 Census*, Catalogue no. 92-500-X; Statistics Canada, "Introducing a new concept and methodology for delineating settlement boundaries: A research project on Canadian settlements," *Environment Accounts and Statistics Analytical and Technical Paper Series*, Catalogue no. 16-001-M, no. 11, www.statcan.gc.ca/pub/16-001-m/16-001-m2010011-eng.htm.

Additional reference information for the maps (e.g., US boundaries and digital elevation models) come from United States Census Bureau, 2014, *States*, Cartographic boundary shapefile: *cb_2014_us_state_500k.zip*, www.census.gov/geo/maps-data/data/cbf/cb_f_state.html (accessed October 29, 2015); Danielson, J.J. and D.B. Gesch, 2011, *Global multi-resolution terrain elevation data 2010 (GMTED2010): U.S. Geological Survey Open-File Report 2011-1073*, 26p.

Land cover and land use charts and tables

These statistics are based on the methodology developed for *Human Activity and the Environment, 2015* ([Appendix B – Data sources and methods](#))

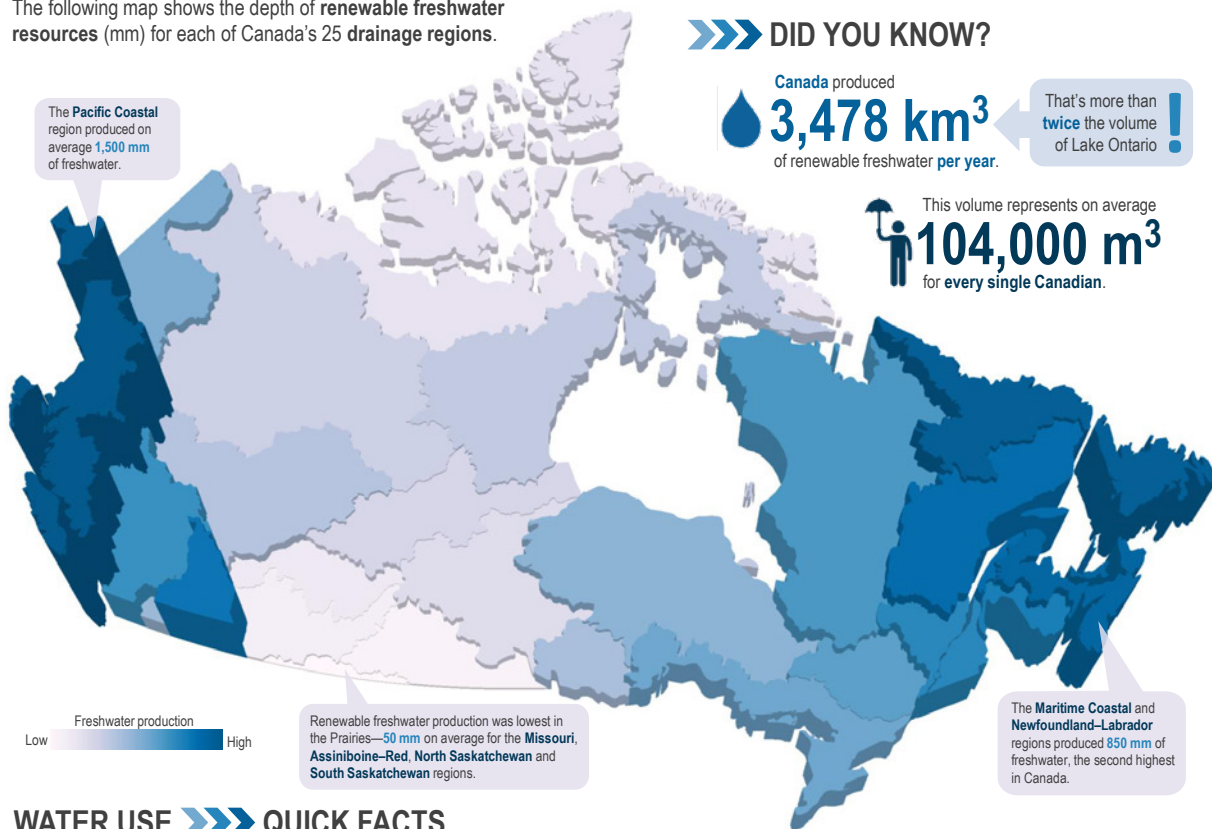
- Built-up area is based on classes 21 (Settlement) and 25 (Roads) from AAFC *Land Use, 2010*.
- Arable land is composed of the cropland, tame or seeded pasture and summerfallow land from the Interpolated Census of Agriculture.
- Natural land for pasture is taken from the Interpolated Census of Agriculture.
- Natural and semi-natural land is the residual area remaining after subtracting built-up area, arable land and natural land for pasture from the total area.

F. Infographic

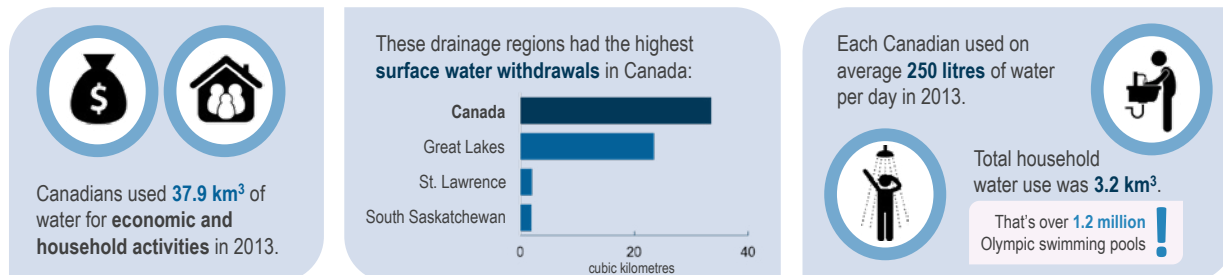
FRESHWATER IN CANADA

A look at Canada's freshwater resources from **1971 to 2013**

The following map shows the depth of **renewable freshwater resources** (mm) for each of Canada's 25 **drainage regions**.



WATER USE QUICK FACTS



Statistics Canada, 2017, "Freshwater in Canada," *Human Activity and the Environment*, Catalogue no. 16-201-X.