Environment Canada Environnement Canada

www.ec.gc.ca

Data Sources and Methods for the Water Quantity Indicator

December 2012

Canada

ISBN : En4-144/29-2012E-PDF
Cat. No.: 978-1-100-21565-5

Aussi disponible en français

1 Introduction

The Water Quantity indicator forms part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

2 Description and rationale of the Water Quantity indicator

2.1 Description

The national indicator classifies yearly water quantity for Canada's 25 drainage regions as high, normal or low for 2001–2010. Water quantity classifications are determined by comparing daily water levels or flows to daily normal values for 1978–2007 for each water quantity monitoring station in a drainage region.

2.2 Rationale

Canada has only 0.5% of the world's population but its landmass contains approximately 7% of the world's renewable water supply. The Water Quantity indicator highlights issues around water quantity in Canada. It provides information about the state of and changes in current surface water supply in order to inform proper management of water resources.

3 Data

3.1 Data source

The Water Survey of Canada collects and publishes data for 2792 hydrometric stations across Canada, through different partnerships. The utilized daily water levels and flows were taken directly from the Water Survey of Canada's hydrological database (HYDAT) (http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=9018B5EC-1).

3.2 Spatial coverage

Water quantity monitoring stations active from 1978–2010 were chosen for this analysis. To ensure an adequate number of stations with data of a sufficient time span, both natural and regulated rivers and all basin sizes were included. These criteria resulted in the selection of 1196 stations across Canada. There are more stations in the more heavily populated southern portion of the country.

Water levels for the Great Lakes were not included in the analysis, as they are tracked through a separate Environment Canada program.[1] The Great Lakes regional data include water quantity monitoring stations on rivers draining into the Great Lakes.

[1] Environment Canada (2010) Great Lakes Water Levels and Related Data. Retrieved on 24 July, 2012. Available from: (http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=79962112-1)

Locations of 1196 water quantity monitoring stations used in the Water Quantity indicator

Note: Natural stations are those where human activity upstream of the station has little impact on water levels and flows. Regulated stations have water withdrawals, dams, diversions or other structures upstream that may change the water quantity in the river. Water quantity data for seasonal stations are only collected for part of the year.

Source: Water Survey of Canada, Environment Canada (2012)

3.3 Temporal coverage

The national Water Quantity indicator shows results for 2001 to 2010, while the regional and local Water Quantity indicators place emphasis on 2010 as it is the latest year for which quality-assured data are available. Normal, low or high water quantity is defined based on the amount of water observed at water quantity monitoring stations from 1978–2007. Both continuous and seasonal stations were included in the calculation of the indicator. At continuous stations, water level or flow data are collected 365 days per year. In general, seasonal stations operate for six months of the year.

3.4 Data completeness

Water level and flow data from each monitoring station are managed by their respective Environment Canada regional offices and are stored in the federal HYDAT database (http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=9018B5EC-1). The data used in this report were subject to quality assurance and quality control procedures to ensure they adhere to Environment Canada's national standards.

Basic station information (e.g., name and location) and water level or flow data were extracted from HYDAT. The HYDAT database allows for station selection according to input parameters, such as the record length, data type, drainage area, etc. (http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=9018B5EC-1). The data were transferred to a Microsoft Office Access database designed to calculate the percentiles used to define reference conditions for this indicator.

There are gaps in the water level and flow datasets due to periodic instrument failure. Where possible, regional offices use standardized protocols to estimate missing flow data. Estimated flow values are considered to be reliable and are included in the water quantity indicator calculations. When missing data cannot be estimated, a complete data set was defined as missing no more than 20% of the year (73 days out of 365) for yearly stations and 43 days out of 217 for seasonal stations. Stations not meeting these criteria for a year were not included in the indicator calculation.

Final, approved data for the North-Shore Gaspé drainage region in southern Quebec were not available in time for this publication. No results for 2008 to 2010 for this region are included in this publication.

3.5 Data timeliness

There is a time lag of two years between 2010, the last year reported, and the publication of this indicator. This time lag is due to several factors that intertwine with each other, including the time required to verify the raw data, compile the data at the national level from all partners, and analyze, review and report the data. The time period also aligns with 2008–10, the time period used to calculate the CESI Water Quality indicator.

4 Methods

Water quantity at a monitoring station is defined based on historical data recorded for Water Survey of Canada hydrometric stations. Percentiles for each day of the year were calculated using water level or flow data collected at each monitoring station between 1978 and 2007. This normal period was chosen to correspond to the type of normal period used to report on climate while maximizing the number of stations to be included in the indicator. Many stations do not have records going back prior to 1978 because of changes to the monitoring network. A 30-year period is used to provide a picture of the hydrologic characteristics of a station. Water quantity categories were defined as:

$$\text{Low} < 25^{\text{th}} \text{ percentile}$$
$$25^{\text{th}} \text{ percentile} \geq \text{Normal} \leq 75^{\text{th}} \text{ percentile}$$
$$\text{High} > 75^{\text{th}} \text{ percentile}$$

Daily water quantity records for 2000–2010 were categorized as low, normal or high by comparing the measured value to the percentiles calculated for the corresponding station and day of the year. Thus, a station described as having a “low” water level on a specific day had a measured value ranking among the lowest 25% of values observed for that same day between 1978 and 2007.

A station’s status for a year was the category observed most often, i.e., the mode, for a given station in a given year. Thus, a low classification does not mean that water quantity was consistently low throughout the year; it only means that low water was observed most often.

Using the 25 drainage regions defined by Pearse et al. (1985)[2] allows generalization of water quantity across Canada. Hydrometric stations were identified in each drainage region, and the historical water level and flow data were used to determine the category. The number of stations within each category (low, normal, high) was calculated for each drainage region (Table 1). The mode was used to categorize each drainage region.

Table 1. The number of water quantity monitoring stations for 2010 in each drainage region.

Drainage region	Number of stations
Pacific Coastal (1)	71
Fraser – Lower Mainland (2)	93
Okanagan – Similkameen (3)	27
Columbia (4)	61
Yukon (5)	21
Peace – Athabasca (6)	108
Lower Mackenzie (7)	44
Arctic Coastal – Islands (8)	7
Missouri (9)	49
North Saskatchewan (10)	46
South Saskatchewan (11)	132
Assiniboine – Red (12)	75
Winnipeg (13)	32
Lower Saskatchewan – Nelson (14)	60
Churchill (15)	29
Keewatin – Southern Baffin (16)	3
Northern Ontario (17)	16
Northern Quebec (18)	0
Great Lakes (19)	177
Ottawa (20)	16
St. Lawrence (21)	17
North Shore – Gaspé (22)	1
Saint John – St. Croix (23)	33
Maritime Coastal (24)	34
Newfoundland and Labrador (25)	44

Note: Results for Arctic Coastal – Islands (8), Keewatin – Southern Baffin (16) were not included because there were not enough stations to describe the land area. There were not enough data to calculate the indicator for Northern Quebec (18) and North Shore – Gaspé (22).

This report includes results for 1196 water quantity monitoring stations, compared to 1179 stations in the last report. This change reflects the fact that additional stations met data completeness criteria and verifications for 2000 to 2010 data.

5 Caveats and limitations

All monitoring instruments used in the collection of data for calculation of this indicator undergo standard quality-control and quality-assurance procedures to ensure sources of measurement error are controlled and minimized. There is reduced certainty in water flow data when ice cover is present.

Percentiles for a specific day of the year and station were computed only for stations for which 25 or more years of data were available, except unmonitored periods at seasonal stations.

[2] Pearse PH *et al.* (1985) Currents of Change: Final Report of the Inquiry on Federal Water Policy. Environment Canada.

The number of stations included in this indicator fluctuates from year to year, as stations are closed when monitoring networks are optimized. Whether or not the data have been verified and uploaded into HYDAT by the time the data are pulled to calculate the indicator influences whether the station is included in the calculation that year.

While 30 years represents a long time series for water quantity data, it represents a relatively short historical time frame for a given river and does not account for all natural variability in a river system. The status of water levels and flows assessed by the present indicator is a reflection of its time period and does not necessarily reflect longer-term trends at the station. Most water quantity monitoring stations in Canada are located in populated areas and do not represent the country's entire geographic extent or all its watersheds. More stations are needed in areas such as the North to compute complete, nationally representative indicators.

The data used to calculate the indicators originate from local hydrometric stations, which may not be representative of their entire drainage region. For example, most hydrometric stations are located on the main stem of the largest river in the region. The water quantity in tributaries may differ from that described by the indicator. Also, variability within a drainage region is not necessarily reflected. For example, the headwaters of a river may have very different hydrological characteristics than downstream sections. Professional judgement was used to determine whether there were sufficient stations to describe a drainage region. For example, the nine stations in the Arctic Coast–Islands basin region were deemed insufficient to categorize water quantity for the region in 2010.

Water levels and flows generally follow a predictable seasonal pattern; however, there is natural, year-to-year variability. The indicators compare daily values to the 30-year normal, and assume that water quantity is approximately the same from one year to the next for the same calendar day. A shift in the predictable seasonal pattern (the hydrograph) one year will influence the results. Some of this variability is accounted for by the large range of percentiles used to define normal conditions.

6 References and further reading

Environment Canada (2011) Water Survey of Canada. Retrieved on 24 July, 2012. Available from: http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=4EED50F1-1

Environment Canada - Water Office (2012) Real-time Hydrometric Data. Retrieved on 24 July, Available from: 2012. http://www.wateroffice.ec.gc.ca/index_e.html

www.ec.gc.ca

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