Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

Environment Canada
Environnement Canada

THE NATIONAL ATLAS OF CANADA 5th EDITION

CANADA
STREAMFLOW

Produced by the **National Atlas Information Service,** Canada Centre for Mapping, Energy, Mines and Resources Canada, and the **Surveys and Information Systems Division,** Ecosystem Sciences and Evaluation Directorate, Environment Canada. Printed 1993.

Copies of this map may be obtained from the Canada Map Office, Energy, Mines and Resources Canada, Ottawa, or your nearest map dealer. Quote MCR 4178.

Cette carte est aussi publiée en français. Demander le numéro MCR 4178F.

Scale 1:7 500 000 or 1 centimetre represents 75 kilometres

kilometres 75 0 75 150 225 300 375 450 kilometres

Lambert Conformal Conic Projection, Standard Parallels at 49°N and 77°N.
Modified Polyconic Projection, North of Latitude 80°.

AVERAGE ANNUAL 7-DAY LOW FLOW
(m³/s)

- <0.6
- 0.6 - 1.0
- 1.1 - 2.0
- 2.1 - 4.0
- 4.1 - 6.0
- 6.1 - 8.0
- 8.1 - 10.0
- >10.0
- Limit of continuous permafrost

(The average annual 7-day low flow is assumed to be zero above this limit.)

Average annual 7-day low flow is the minimum 7-day mean flow occurring in an average year. The map is based on flow data for rivers with a drainage basin area of approximately 1 000 km².

Scale 1:30 000 000

AVERAGE ANNUAL PEAK FLOW
(m³/s)

- Insufficient data
- <10
- 10 - 49
- 50 - 99
- 100 - 199
- 200 - 299
- 300 - 399
- 400 - 499
- 500 - 599
- >600

Average annual peak flow is the maximum flow occurring in an average year. The map is based on flow data for rivers with a drainage basin area of approximately 1 000 km².

Scale 1:30 000 000

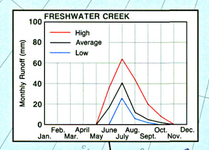
AVERAGE ANNUAL RUNOFF
(mm)

- Insufficient data
- <50
- 50 - 99
- 100 - 199
- 200 - 399
- 400 - 599
- 600 - 799
- 800 - 999
- 1 000 - 1 999
- 2 000 - 2 999
- > 3 000

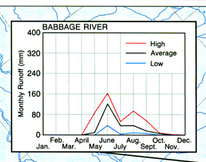
Average annual runoff is the total surface runoff occurring in an average year.

Scale 1:30 000 000

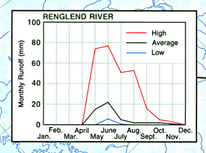
FRESHWATER CREEK



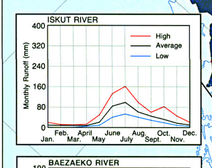
BABBAGE RIVER



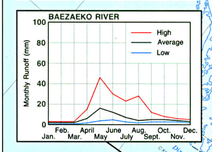
RENGLEND RIVER



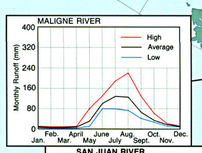
ISKUT RIVER



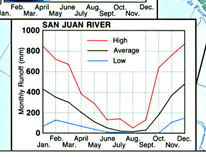
BAEZEKO RIVER



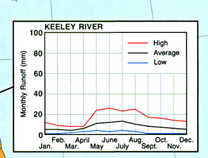
MALIGNE RIVER



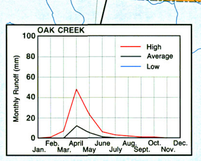
SAN JUAN RIVER



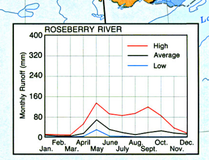
KEELEY RIVER



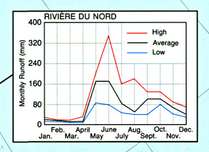
OAK CREEK



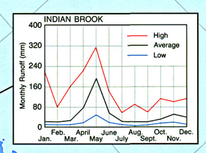
ROSEBERRY RIVER



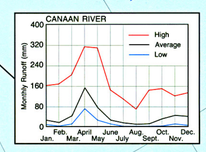
RIVIÈRE DU NORD



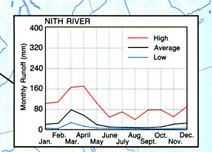
INDIAN BROOK



CANAAN RIVER



NITH RIVER



ANNUAL SURFACE WATER YIELD FROM OCEAN DRAINAGE AREAS

OCEAN DRAINAGE BASIN	AREA (thousands of square kilometres)	ANNUAL FLOW RATES[1] (cubic metres per second) Low[2]	Mean	High[3]
Pacific	1 018	19 095	24 951	30 795
Arctic	3 812	13 896	20 491	27 089
Gulf of Mexico	26	3	12	41
Hudson Bay	3 607	21 634	30 594	39 794
Atlantic	1 511	21 228	29 087	36 954
CANADA	**9 974**	**75 856**	**105 135**	**134 673**

[1] Derived from recorded flows except in Prairie basins where natural flows have been estimated.
[2] Flow equalled or exceeded in 19 years out of 20.
[3] Flow equalled or exceeded in 1 year out of 20.

AVERAGE ANNUAL RIVER FLOW

The magnitude of flow is shown for rivers with an average annual discharge at the mouth exceeding 350 cubic metres per second and is represented in those reaches where the flow exceeds 85 cubic metres per second.

cubic metres per second

85 500 1 000 2 500 5 000 7 500 10 000 12 500

HYDROGRAPHS OF MONTHLY RUNOFF

Hydrographs show the mean monthly lowest, highest and average runoff for selected drainage basins (●) ranging in size from 500 1 000 km². Vertical scale differences of graphs are indicated by type style.

DRAINAGE BASINS

DRAINAGE DIVIDE

- Ocean Drainage Area
- Major River Basin
- Diverted or Internal Drainage Area

OCEAN DRAINAGE AREA

- Atlantic Ocean
- Hudson Bay
- Arctic Ocean
- Pacific Ocean
- Gulf of Mexico
- Internal Drainage Area
- Diverted Drainage Area (Diverted flow >28 m³/s)
- Direction of Flow
- Glaciers

RUNOFF AND STREAMFLOW

Water is one of Canada's most precious resources. Without it no living organism can survive; it is the lifeblood of our environment, and its availability underpins our whole economy. This resource exists in limited supply and is in constant demand for many competing uses. In addition to domestic consumption, water is essential in the pulp and paper and agricultural industries; it is the source of hydroelectric energy; it serves as a medium for transportation; it is the basis of several recreational and tourism activities; and it constitutes an aesthetic asset.

Canada has a large natural endowment of renewable freshwater—9% of the earth's supply on 7% of the earth's landmass. But this resource is not uniformly distributed and the supply does not always meet the demand. Approximately 60% of Canada's freshwater drains to the north, while 85% of the population lives within 300 kilometres of the southern border.

The spatial and temporal variability of freshwater are represented on this map by two surface water variables, **runoff** and **streamflow**. Surface water is defined as the water in streams, rivers, lakes and wetlands. It does not include water from the oceans and glaciers, nor does it include groundwater.

Surface runoff is the depth of water on the land surface resulting from the interaction of the many components of the hydrologic cycle. The main source of runoff is precipitation, in the form of rain or snow. The complex processes of interception, infiltration, evaporation and transpiration act to reduce the amount of water available for runoff at any one time and location. These processes are influenced by various climatic factors such as precipitation, temperature, wind and solar radiation, by physiographic factors related to geology, topography and soils, and by vegetation.

The amount of runoff integrated over a year is known as annual runoff. An inset map of *average annual runoff* appears on this map sheet and shows the spatial variability of runoff across Canada. In addition, monthly hydrographs for the drainage areas of selected small rivers with regimes typifying broad hydrologic regions depict *lowest, highest* and *average monthly runoff*. The monthly hydrographs give some indication of the temporal availability of surface water including the occurrence of high runoff in spring and early summer caused by melting snow and ice.

Once surface water collects in a stream or river channel, it becomes streamflow. Several streamflow characteristics are represented on this sheet. The main map shows the *average annual flow* for rivers with a magnitude of flow at the mouth greater than 350 cubic metres per second. Where drainage diversions have reduced the original discharge of a river below this threshold, the residual flow is also shown.

Two inset maps show extreme flows, namely *average annual 7-day low flow* and *average annual peak flow*. Like runoff, these characteristics are influenced by climatic and physiographic factors and also depend on river basin size. (For reasons of comparability, a constant basin area of approximately 1 000 square kilometres was used for this analysis.) The average annual 7-day low flow is a useful indicator of a river's low flow regime. It is the 7-day mean minimum flow that is equalled or exceeded, on average, in one out of two years. Throughout most of Canada, streamflow minima occur in winter when rivers, lakes and groundwater resources are frozen. The east and west coastal areas and southern Ontario are exceptions to this general pattern. Minimum flow in these areas occurs between the months of May and September.

The water level of a stream, river or lake is constantly rising or falling in response to changing hydrologic conditions in the drainage basin. Each year, it peaks at some maximum level, which may cause flooding of adjacent lands. More often than not, however, the maximum water level is contained by the banks of a river, and no flooding occurs. The annual peak flow of a river occurs each year when the water level is highest. A river can be characterized by its average annual peak flow, that is, the maximum flow that is equalled or exceeded, on average, in one out of two years. Since climatic and physiographic factors influence the flow of a river, its *geographic* location is important. For example, a river on the rugged humid West Coast can have an average annual peak flow hundreds of times greater than that of a river in the relatively dry Prairie region.

The timing of peak flow also shows characteristic spatial patterns. The simultaneous release of water stored as snow and that held frozen in rivers, is often responsible for the characteristic heavy flow conditions and frequent flooding experienced in spring and early summer. Rainfall and ice jamming also contribute to flooding. As the monthly hydrographs indicate, the month of peak flow generally varies with latitude in response to the northward progression of snow melt and the break-up of lake and river ice. In contrast to the rest of Canada, the Pacific coast region experiences winter flow maxima in response to a mild, wet winter climate.

Finally, average flow rates characteristic of each ocean drainage basin are presented in a table of *annual surface water yield*. The proportion of flow contributed by the Pacific drainage area is of particular note: it yields almost one quarter of Canada's mean annual flow while occupying only 10% of its surface area. This table also reflects the annual variability of river flow which similarly has a characteristic spatial distribution. Rivers in the coastal mountain areas of British Columbia, for example, have relatively small variations in flow from year to year; in the southern Prairie Provinces, however, variations are large and the flow is undependable.

Canada began monitoring its rivers and lakes in 1884. Today, there are approximately 3 300 hydrometric stations in operation, gathering information on water levels and streamflow. This information is stored in the HYDAT database available from the Surveys and Information Systems Division, Environment Canada. The main map was compiled using streamflow data from this database, current to 1991, and measured at various locations on each of the rivers represented. The inset maps, table, and hydrographs were also derived from this database. The hydrographs are based on at least 20 years of record.

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Digital technologies were used in part for the production and publication of this map.

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