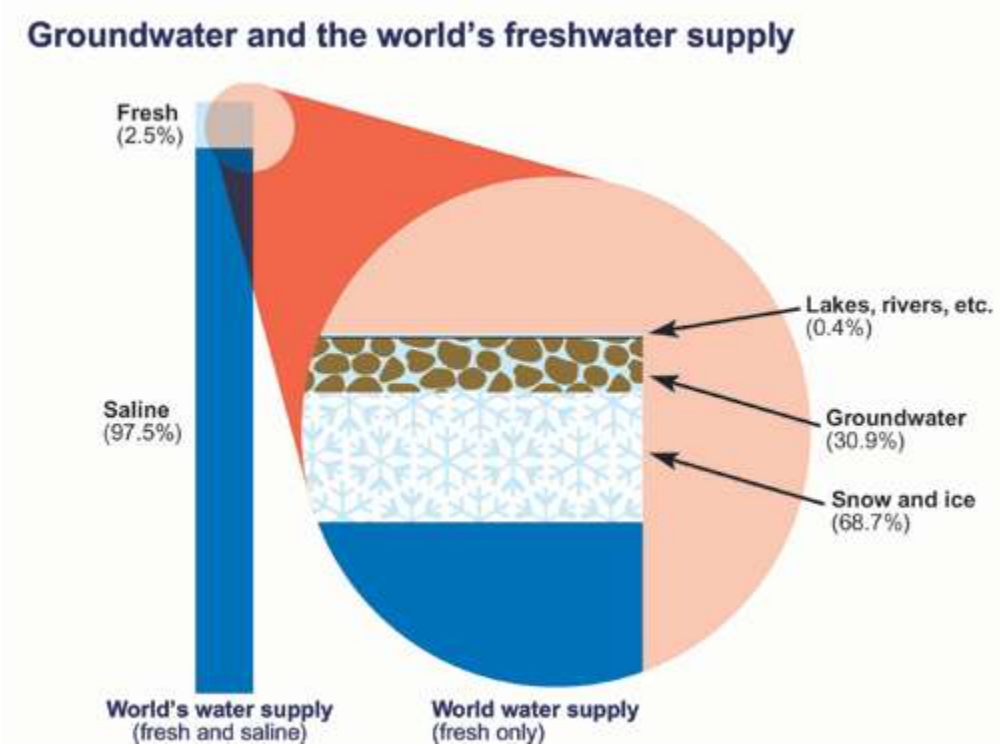
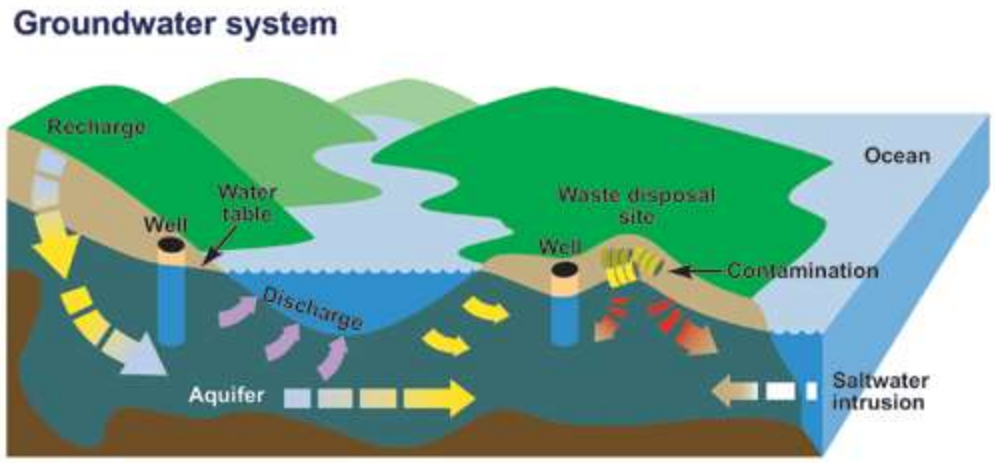
Water – Underground

What is groundwater?

A third of the world's fresh water is found underground. Even in Canada, there is more water underground than on the surface. This water is found in aquifers and appears at the surface as springs. Very often groundwater is interconnected with the lakes and rivers.



Groundwater occurs in the tiny spaces between soil particles (silt, sand, and gravel) or in cracks in bedrock, much like a sponge holds water. The underground areas of soil or rock where substantial quantities of water are found are called "aquifers". These aquifers are the source of wells and springs. It is the top of the water in these aquifers that forms the "water table".



The origin and composition of aquifers is varied. Many important Canadian aquifers are composed of thick deposits of sands and gravel previously laid down by glacial rivers. These types of aquifers provide most of the water supply for the Kitchener-Waterloo region in Ontario and the Fredericton area in New Brunswick. The Carberry aquifer in Manitoba is an old delta lying on what was formerly Glacial Lake Agassiz. It is well developed as a source of irrigation water. Prince Edward Island depends on sandstone aquifers for its entire water supply. A major glacial outwash sand and gravel aquifer occurs in the Fraser Valley in British Columbia. It is extensively used for municipal, domestic, and industrial water supplies. The Winnipeg and Montreal aquifers that are used for industrial water supply, are composed of fractured rocks.

To concentrate only on major (i.e., large) aquifers, however, is misleading. Many individual farms and rural homes depend on relatively small aquifers such as thin sand and gravel deposits of glacial or other origin. Although these aquifers are individually not very significant, in total they make up a very important groundwater resource.

Can an aquifer dry up completely?

Groundwater resources are depleted or "mined" when pumping from an aquifer is not matched by recharge. This can happen in two ways: by overpumping or by decreasing recharge, for example, caused by drought. The drying up of an aquifer should not be confused with the failure of individual wells in that aquifer, which happens much more frequently. Well failures can have many causes:

- A well may be too shallow, so that a temporary decline in water levels lowers the water table below the bottom of the well.
- Mineral and/or bacterial deposits can plug the screen at the opening of the pipe at the bottom of the well (very common).

Aquifer depletion is a more serious problem in the United States than in Canada. However, increased demand could potentially lead to serious problems in this country. The depletion of

deeper aquifers may be permanent where the weight of overlying sediments causes the aquifer to compress as the water is pumped out. The aquifer would therefore never again be fully recharged even if pumping ceased, because its capacity to store water has been reduced.

Are there any areas in Canada where aquifers are depleted?

In Canada, there have been no major problems with aquifer depletion because most major population centres use surface water. Where groundwater is used (for example, Prince Edward Island and Kitchener-Waterloo, Ontario), the safe yields of the aquifer have been determined and are managed accordingly. Some places, where groundwater was used for municipal supply in the early 1900s, have had to switch to surface water or augment their groundwater supplies with surface water because the increasing demand for water exceeded the safe yield of their aquifers (for example, Lloydminster, on the Alberta/Saskatchewan border, and Regina, Saskatchewan).

What is groundwater recharge?

Groundwater recharge refers to the replenishment of water in an aquifer. Much of the **natural** recharge of groundwater occurs in the spring and comes from the melting snowpack or from streams in mountainous regions. It can also occur during local heavy rainstorms. Often groundwater discharges into a river or lake, maintaining its flow in dry seasons.

What causes springs? Do they come from groundwater?

Springs are created when groundwater naturally flows to the surface. Groundwater discharged from a spring may have traveled underground many kilometres before reaching the surface. Usually, spring water discharges occur or increase when rain or snowmelt has recharged the groundwater system.

Is groundwater important to Canada's water supply?

Groundwater is extremely important in supplying fresh water to meet the needs of Canadians. The interdependency of surface water, groundwater, and atmospheric water is of great importance in the hydrologic cycle. The role of groundwater is critical. Perhaps the most significant function of groundwater is its gradual discharge to rivers to maintain streamflow during dry weather periods throughout the year.

Over four million Canadians residing in urban areas rely on groundwater for their domestic water supply. Another four million rural Canadians also use groundwater. Prince Edward Island (with no major rivers) depends almost entirely on groundwater, while the Northwest Territories uses mostly surface water. On the other hand, in the Yukon, groundwater use is seasonal. For example, the city of Whitehorse uses groundwater for 50% of its water supply during the winter months and for very little during the remainder of the year.

In addition, bottled groundwater, known as "spring water" or "mineral water", is being bought by many Canadians to replace drinking water that flows through their taps, particularly in the areas bordered by Lake Ontario and the St. Lawrence River.

As well as supplying human needs, groundwater is used for livestock watering, irrigation, aquaculture, and mineral and hydrocarbon extraction.

What is the relationship between groundwater and permafrost?

Most of the terrain in the Northwest Territories and Nunavut consists either of rugged glaciated Canadian Shield rock or of ground which is underlain by permafrost (permanently frozen ground). Both of these inhibit the flow of groundwater. The major exceptions include the Mackenzie Mountains in western Northwest Territories and the Yukon and the limestone terrain southwest of Great Slave Lake, where soils, fractured rock, and glacial debris provide material that can store and release groundwater.

On a local scale, the seasonal development of a thawed "active layer" above the permafrost can provide permeable pathways for the subsurface movement of water and contaminants.

How does groundwater become contaminated?

Groundwater becomes contaminated when anthropogenic, or people-created, substances are dissolved or mixed in waters recharging the aquifer. Examples of this are road salt, petroleum products leaking from underground storage tanks, nitrates from the overuse of chemical fertilizers or manure on farmland, excessive applications of chemical pesticides, leaching of fluids from landfills and dumpsites, and accidental spills.

Contamination also results from an overabundance of naturally occurring iron, sulphides, manganese, and substances such as arsenic. Excess iron and manganese are the most common natural contaminants. Another form of contamination results from the radioactive decay of uranium in bedrock, which creates the radioactive gas radon. Methane and other gases sometimes cause problems. Seawater can also seep into groundwater and is a common problem in coastal areas. It is referred to as "saltwater intrusion".

Compared with surface water, is groundwater safe for human consumption?

Groundwater is generally safer than surface water for drinking because of the filtration and natural purification processes that take place in the ground. These processes become ineffective, however, when sewage, fertilizers, toxic chemicals, and road salt, seep into the ground.

Household, commercial, and industrial wastes that end up in dumps, waste lagoons, or septic systems can pollute groundwater. Acid rain also threatens to recharge aquifers with contaminated water.

Generally, groundwater is not as easily contaminated as surface water, but once it is contaminated, it is much more difficult to clean up because of its relative inaccessibility.

http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=FCE12AD9-1