
# Groundwater Quality and Quantity

Groundwater quality and quantity may change for a variety of reasons. This fact sheet provides a brief overview of the factors that influence the quality and quantity of water in an aquifer.

## What influences groundwater quantity?

**Aquifers** are recharged, or replenished, by precipitation that seeps through the soil and rock layers, and by water contributed from surface water bodies (lakes, rivers, wetlands). Groundwater recharge is influenced by many factors including population growth and climatic variability.

As population and development increase, so does the demand for water. If groundwater is removed from an aquifer faster than nature can replenish it, the water level will drop. This is called **groundwater mining**. Unsustainable withdrawals can eventually result in aquifer depletion. Groundwater does not travel quickly, so it may take decades or even centuries for an aquifer to fully replenish.

Climatic variability, either seasonal or long term changes (e.g., droughts) may also have an impact on groundwater quantity. Groundwater provides critical stream and river **baseflow** to streams and rivers, and can often maintain surface water levels in periods of drought. A reduced flow of groundwater in **discharge areas** can result in a wetland drying up, a spring no longer flowing, or the water level in a lake decreasing.

## What influences groundwater quality?

### Natural conditions

Variations in **ion** concentration determine water quality. As water moves down through the soil, it dissolves various minerals, which increase the water's ion concentration. Water containing iron may stain plumbing fixtures and laundry. People often compare the taste of water to iron and the smell of water to rotten eggs. These characteristics are determined by the amount of iron and sulfur ions. Water can also be described as hard or soft. Hard water has high concentrations of calcium and magnesium ions. Excessive hardness will leave solid deposits in water pipes and prevent soap from lathering. Soft water usually has high concentrations of sodium ions and allows soap to lather easily.

**Aquifer**
An underground water-bearing layer, or earth formation, capable of releasing water.

**Groundwater mining**
Withdrawing water from an aquifer faster than it can be naturally replenished.

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**Baseflow**
The portion of river and stream flow that comes from groundwater rather than surface runoff.

**Discharge areas**
Lower elevation areas where groundwater surfaces, usually to a wetland or stream.

**Ion**
Electrically charged particles. Atoms or molecules, especially salts and acids, become ions in water.

**Did you know?**

In general, only groundwater within 400 metres of the surface is suitable for domestic consumption. To minimize the use of better quality groundwater, water use applicants are discouraged from using potable groundwater for industrial purposes. Whenever possible, they are to look for alternatives to potable water, such as the deeper saline groundwater.

In Alberta, groundwater quality can be linked to the type of aquifer that water originates in. Unconfined aquifers are exposed to the atmosphere through spaces in the soil. Primarily composed of sand or gravel, these aquifers have hard water with higher iron concentrations. Confined aquifers are deeper, and trapped below an impermeable upper layer such as clay or shale. These aquifers have soft water with limited iron concentrations and higher levels of total dissolved solids.

As groundwater flows through an aquifer it is naturally filtered. This natural filtering process creates water that is usually free from disease causing bacteria and lower in suspended solids than surface water. The longer water remains in an aquifer, the longer it has to dissolve minerals and filter contaminants. Groundwater in deeper aquifers and the discharge areas of aquifers have increased concentrations of salts dissolved from the rocks the groundwater has passed through.

## Human activities

Human activities influence groundwater quality primarily through contamination. Groundwater contamination occurs when products such as road salts, gasoline, oil and chemicals get into the groundwater making it unsuitable for human use. Major sources of groundwater contaminants include landfills, septic systems, abandoned water wells and excessive fertilizer use.

Aquifers vary in their susceptibility to contamination. Shallow aquifers consisting of permeable sediments are extremely vulnerable, as contaminated surface water can enter them very quickly. In contrast, deep aquifers or those of less permeable materials are less vulnerable either because of the longer travel and filtering time or the overlying protective confining layers of rock preventing the downward migration of contaminants.

Contamination of groundwater is difficult to detect in early stages. By the time contamination is realized, its effects are often significant and costly to clean up. If contaminated groundwater migrates to a surface water body such as a wetland or lake, those supplies can also be affected. Preventing groundwater contamination is the most effective and practical solution. Prevention is achievable through a combination of actions including:

- Public awareness programs
- Groundwater monitoring
- Identifying highly susceptible aquifers
- Developing and following best management practices
- Proper site selection for activities and industries using hazardous chemicals
- Enhanced containment for storage of wastes and chemicals on vulnerable soils
- Reducing chemical use wherever possible
- Responding quickly to spills
- Proper construction, maintenance and plugging of water wells

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