focus on groundwater

Groundwater Basics

Did you know?
The residence time of groundwater (the length of time water spends in the groundwater segment of the hydrologic cycle) can vary between a couple of days to more than 10,000 years!

Unsaturated zone
The area below ground where water and air share the spaces between soil and rock.

Saturated zone
The area below ground where all open spaces are filled with water.

Water table
The upper level of the saturated zone.

The expression “out of sight - out of mind” is often accurate when considering Alberta’s groundwater. Even though groundwater is an important part of our freshwater system, many of us rarely think about it. Hidden beneath the earth's surface, water moves slowly between rocks and grains of sand.

What is groundwater?

Contrary to what some people think, groundwater in Alberta is not found in rivers or massive open spaces underground. Rather, groundwater is water that fills up the tiny spaces between particles of soil, sand, gravel or rock formations beneath the ground surface—much the way water fills a sponge.

Where does it come from?

Groundwater begins as precipitation—rain, snow, sleet or hail. Precipitation soaks into, or infiltrates, the layers of soil just below ground. In this **unsaturated zone**, water and air share the spaces between soil and rock, creating moist soil conditions for plants.

Some water continues to percolate downward—sometimes hundreds of metres below the surface. Eventually, the small spaces in these areas become saturated with groundwater. This is known as the **saturated zone.** The upper level of the saturated zone is referred to as the **water table**. The level of the water table will rise and fall depending on the amount of precipitation occurring in an area.

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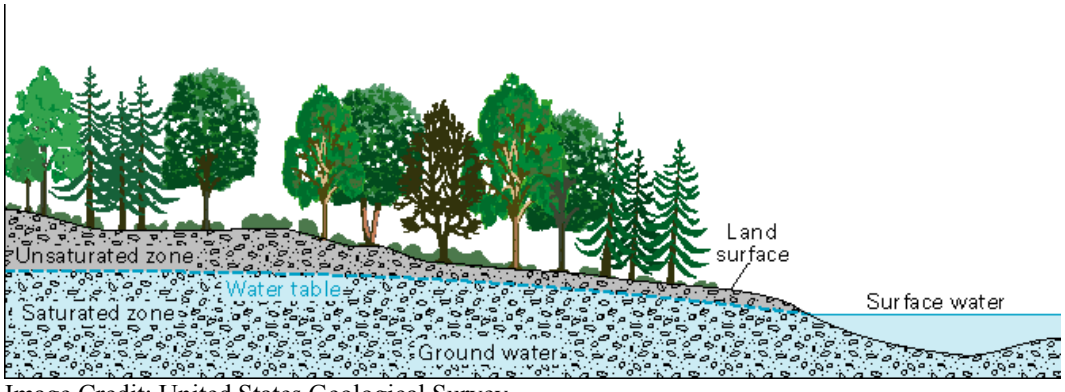

Image Credit: United States Geological Survey

Where is it located?

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

Groundwater is found in nearly every area of the province. However, for groundwater to be recoverable, it must exist in an **aquifer**. Aquifers vary in size, groundwater quantity and quality, depth from the surface, rate of flow, and the materials they are made of.

Aquifers can also be confined or unconfined. Unconfined aquifers are found right at the surface of the ground and are often not completely saturated with water. Deeper aquifers that have a confining layer of soil or rock above them are called confined aquifers**.** The confining layer is a relatively impermeable soil or rock layer that will not allow groundwater to flow easily.

Aquifers typically consist of sand, gravel, sandstone and fractured shale or limestone. For water to be extracted through a well, an aquifer must be saturated and allow groundwater to flow in enough quantity to meet the well owner's water requirement. Some aquifers are easier to extract water from than others.

Did you know?

Some aquifers can supply enough water to meet the needs of a single household while others can meet the needs of an entire city.

Some towns in Alberta that use groundwater as their primary water supply include: Bashaw, Coronation, Edson, Hardisty, Provost and Two Hills.

How does it move?

Groundwater does not often stay in one place. Because of gravity, groundwater is constantly flowing, but at a much slower rate than surface water. It could take days, weeks or hundreds of years for groundwater to flow to the surface.

Porosity
The amouny of open space between soil particles and rock in an earth formation.

Permeability
A measure of how easily a fluid flows through the connecting pore spaces of an earth formation.

Slope
A measure of the steepness or incline of land.

Groundwater movement depends on a variety of factors, including **porosity, permeability** and **slope** of the underground formation where it is found. Groundwater will move more freely where spaces (pores) in soil or rock particles are large and interconnected, such as in sand and gravel aquifers, and more slowly where spaces are small or filled with cementing material, like in clays or tills.

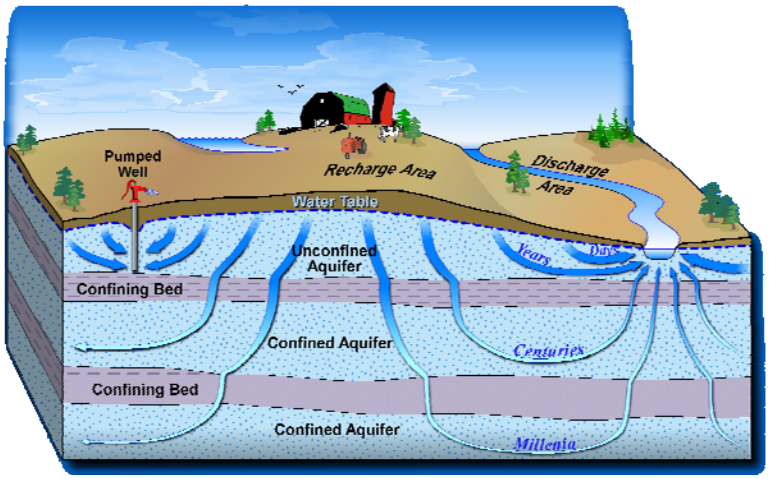

Image credit: Alberta Geological Survey

Groundwater moves from areas of recharge to areas of discharge. Groundwater recharge occurs when precipitation seeps into the ground or when a neighboring surface water body, like a wetland, contributes to groundwater flow.

Water that reaches the saturated zone will move towards sites of groundwater discharge, such as springs, streams, lakes and wetlands. Groundwater moves from areas of recharge at higher surface elevations to areas of discharge that

occur at lower surface elevations, with gravity as its driving force. In areas of flat terrain, like Alberta's prairies, there may be little or no horizontal movement of groundwater.

Groundwater is intricately connected with surface water bodies through recharge and discharge. As such, groundwater can potentially impact the volume and quality of rivers, lakes and wetlands. As aquifers exceed their capacity for storage, water flows in to surface water bodies. In periods of drought, groundwater discharge plays a role in sustaining surface water quantity for human use.

When the earth materials above an aquifer are permeable, groundwater is at risk of contamination. Hazardous materials spilled or stored improperly at the surface can seep into the soil and enter an aquifer as rainfall recharges groundwater. Landfills, septic systems, leaking petroleum tanks and overuse of fertilizers and pesticides can also contaminate groundwater. While some pollutants may be filtered out naturally by soil and rock materials, pollution can contaminate groundwater over a larger area. Polluted groundwater may then return to the surface, where cross-contamination between ground and surface waters can pollute our lakes, wetlands and rivers. Once contaminated, groundwater is very costly and time consuming to clean up. It is important for landowners, industry, communities and government to work together to protect and reduce the risk of pollution to our groundwater supplies.

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