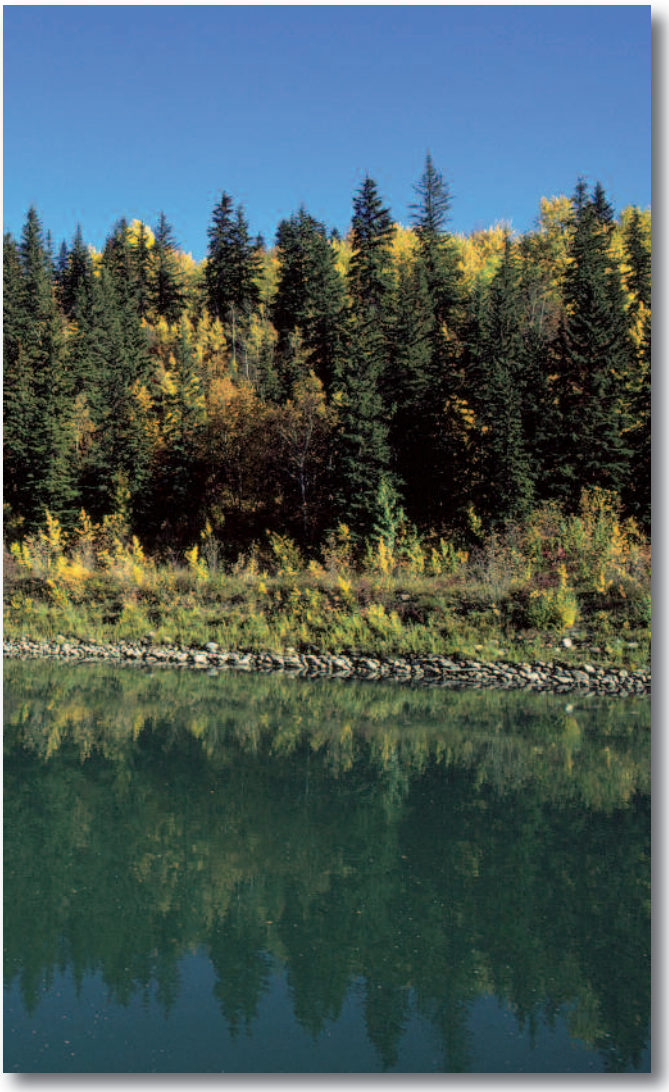
# NSWA Information Bulletin

## Groundwater

This short Bulletin provides information on groundwater in Alberta generally and in the North Saskatchewan River Basin. Much of the information is taken from the Worley Parsons report[1] on groundwater commissioned by the North Saskatchewan Watershed Alliance. Details on where groundwater is found and used and the major uses and challenges facing management of groundwater can be found in reports from Alberta Environment, the Energy Resources Conservation Board and Environment Canada.



[1] WorleyParsons. 2009. North Saskatchewan River Basin Overview of Groundwater Conditions, Issues and Challenges; available at www.nswa.ab.ca/reports/groundwater

Wagner Natural Area - rich spring fen

Photo Credit: Government of Alberta

## Interested in Learning More About Groundwater?

If the reader is interested in more background information on groundwater, there is an introductory tutorial on groundwater titled Hidden Waters which can be found at www.insideeducation.ca/Hidden_Water

# What is Groundwater?

Groundwater is water that has infiltrated through the ground surface and exists in the pore spaces, channels and fractures in soil and rock. For effective watershed management, it is necessary to understand how groundwater fits into the hydrologic cycle. The hydrologic cycle, or water cycle, describes the continuous circulation of water – precipitation; overland flow; infiltration to groundwater; transport and storage as surface water or groundwater; evaporation and transpiration (Figure 1).

Most groundwater in Alberta comes from infiltration of surface water following rainfall or snowmelt. Seasonal recharge from surface water bodies when river and lake levels are high also makes a significant contribution to restocking groundwater supplies. As water seeps into the ground it flows underground by gravity from areas of higher to lower water pressure. Along the way, groundwater may seep out of the ground into lakes and streams when water levels are low, into wetlands, and bubble-up as springs. Groundwater discharging into many rivers and streams accounts for most of the stream flow seen in late fall and throughout winter.

Only about 3% of the world's water supply is considered to be fresh water, with the remaining 97% too saline (salty) for most uses. Surface water (lakes, streams, etc.) comprises less than 0.1% of fresh water while groundwater is about 20%. The rest of the world's fresh water resource is snow and ice[2].

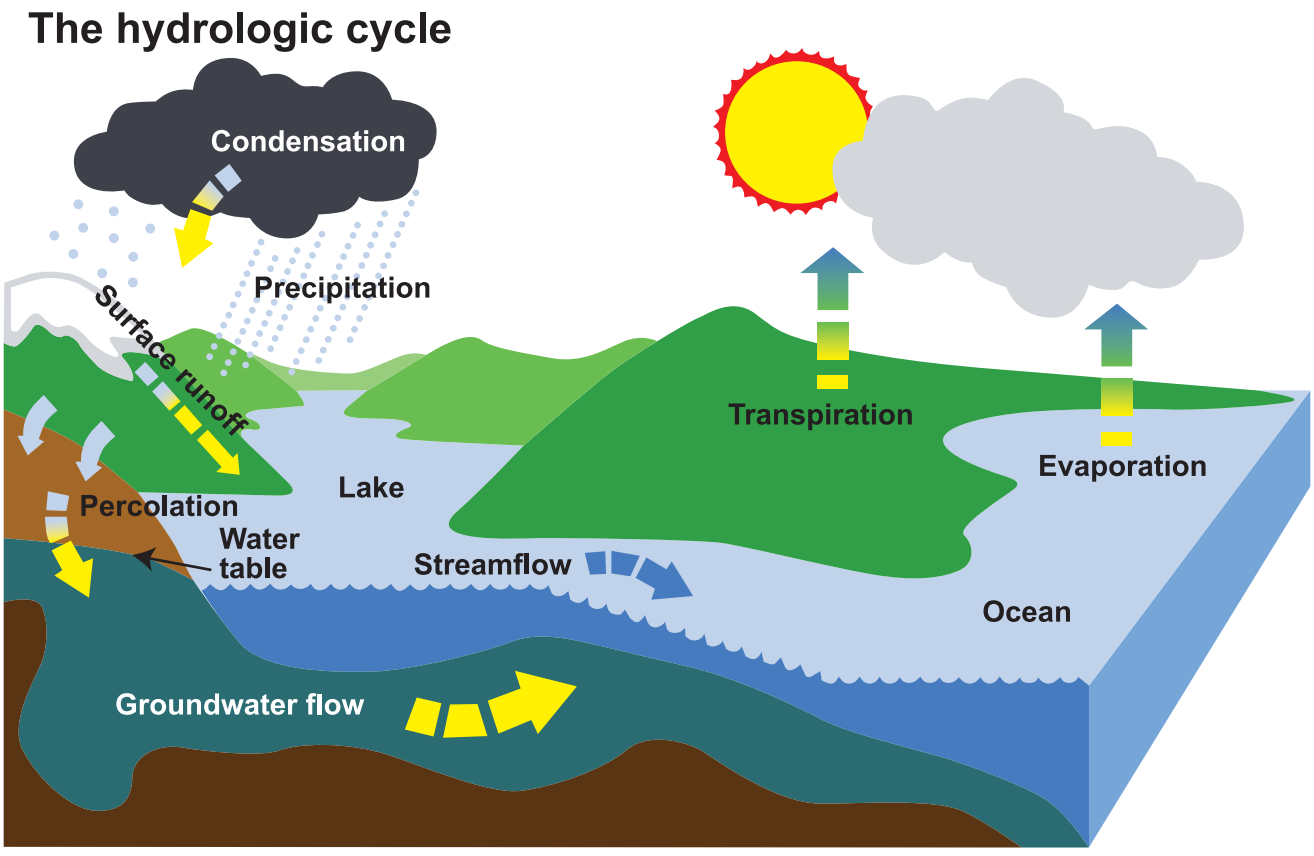



**Figure 1 Hydrologic Cycle**
From Environment Canada: Groundwater – Nature's Hidden Treasure (www.ec.gc.ca/eau-water/default.asp?lang=en&n=3F93145A-1#introduction)

[2] WorleyParsons. 2009. North Saskatchewan River Basin Overview of Groundwater Conditions, Issues and Challenges

# Where is Groundwater Found?

Infiltrating water seeps downward through the soil and rock until it reaches a point where all the pore space is filled with water. This is the saturated zone. The top of the saturated zone is commonly called the water table. The water table fluctuates up and down as recharge conditions change seasonally or from year-to-year.

Groundwater is found everywhere in Alberta, but its use may be restricted by water quality or the quantity that can be pumped from the ground. For example, although there may be abundant water held in the clayey deposits commonly found in Alberta, this water is not easily removed for use. A water-bearing soil or rock formation that yields sufficient water for human consumption or other use is called an aquifer. Most of the significant aquifers in Alberta are either sand and gravel deposits or sandstone bedrock.

Aquifers are called confined or artesian aquifers when the groundwater is trapped between impermeable rock and the water level in a well rises above the top of the aquifer itself (Figure 2). In unconfined aquifers, the water level is below the top of the aquifer. Aquifers in bedrock are usually confined while sand and gravel aquifers are usually unconfined.

Aquifer size will range from very small units providing water to a few homes or a small community to regional-scale units extending over a very large area. Aquifers may extend beyond watershed boundaries which are based on surface water drainage patterns. Managing groundwater use in some aquifers may require coordination of planning activities between two or more municipal and provincial authorities.

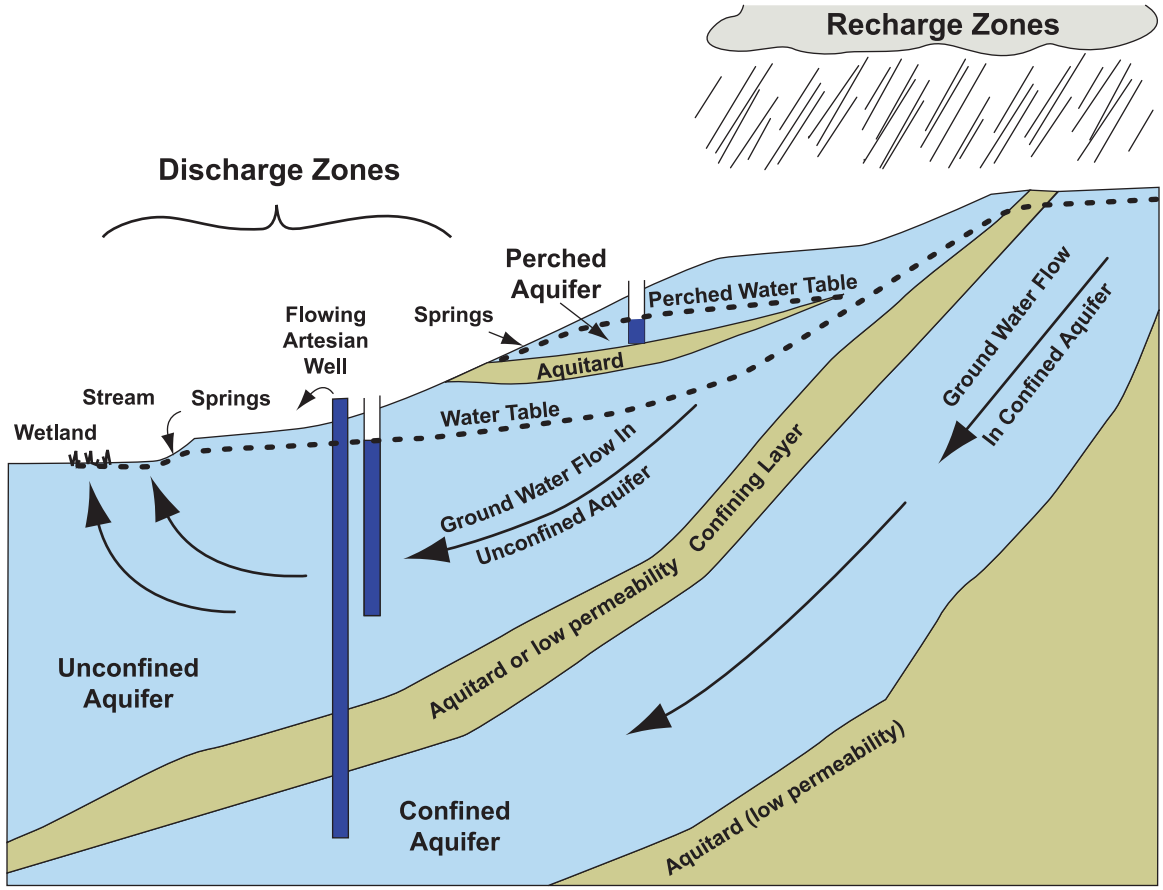



**Figure 2 Confined and Unconfined Aquifers**
From Alberta Environment: Groundwater (www.environment.alberta.ca/01601.html)

# Groundwater Use In Alberta

About 3 % of the licenced water use in Alberta comes from groundwater. Licenced use includes groundwater diverted for agriculture, municipal water supply, various commercial and industrial users and production of petroleum resources. This total does not include groundwater used by individuals for personal domestic supplies. Groundwater diverted for household use does not require a licence. About 20 % of Albertans rely on groundwater for domestic use (municipalities and private households). Figure 3 shows groundwater use and the distribution of water wells on a township basis throughout Alberta. One of the areas of greatest ground-water use and water well density is in the North Saskatchewan River Basin west of Edmonton.

Groundwater moves very slowly in comparison to water flowing in rivers and streams. In one year, groundwater may move several hundred metres through granular deposits like buried sand and gravel aquifers. This is considered to be fast. Groundwater near a well pumping from a gravel aquifer may move at a faster rate; however the rate of water production from the well will eventually be limited by the rate at which groundwater moves to replace the water pumped out. Pumping rates should be set to ensure that water is produced at sustainable rates that meet the user's long-term needs and do not deplete the aquifer.

Production rates from groundwater wells will decrease over time. Degradation of the well itself is one possible cause. Proper maintenance will extend the useful life of the well. Another cause for declining production rates could be an increase in the density of water wells in a particular area resulting in competition for a limited groundwater resource. Water well density will increase as residential and commercial/ industrial developments expand beyond urban areas served by central water distribution systems. More wells mean greater stress on the groundwater resource and possible interference between wells.

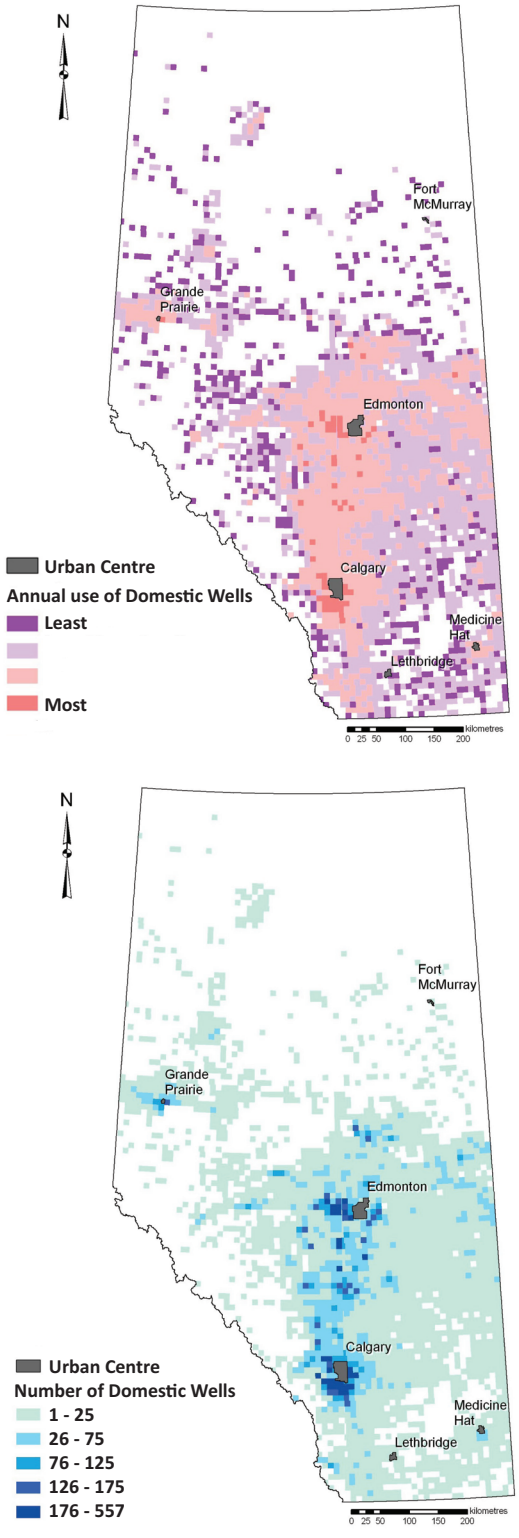



**Figure 3: Groundwater Use by Domestic Wells and Number of Domestic Wells, by Township[3]**

[3] From: Energy Resources Conservation Board. 2009. "Compilation of Alberta Groundwater Information from Existing Maps and Data Sources". ERCB/AGS Open File Report 2009-02. www.ags.gov.ab.ca/publications/OFR/PDF/OFR_2009_02.PDF