Aquifers

An aquifer is a large underground storage space for water. They can be located either right at the ground surface or very deep underground and they are not easy to access. They can be very large (e.g. some aquifers can cover a large region or province) or relatively small. Aquifers have high permeability that allows the water to flow easily in this layer. There is always a barrier below an aquifer that will not allow water to pass through lower layers, called an *aquitard.* An aquitard has very low permeability. It is very difficult for water to pass through an aquitard, so it helps the aquifer to contain the water. Every aquifer has an aquitard below it, but in many cases, an aquitard at the above is also present. When an aquifer has an aquitard on top of it, called a *confined aquifer.* If an aquifer only has an aquitard below it and does not have an aquitard above then it is called an *unconfined aquifer.*

Unconfined aquifers are directly linked to the land surface. They recharge quickly and are prone to contamination. Therefore the water quality of this aquifer is very low. On the other hand confined aquifers are confined because they are located between the above and below aquitard. confined aquifers do not recharge quickly because it takes a long time for water to pass through the top aquitard. As a result, confined aquifers contain high-quality water because they are not directly impacted by human activity on the surface. Confined aquifers can contain very old groundwater and water can stay for several millennia in a confined aquifer.

Types of Aquifers

Based on their location in the earth and the material of which they are comprised, aquifers are classified into three types: a) unconsolidated deposit aquifers*, b)* bedrock aquifers and c) quaternary aquifers.

a) *Unconsolidated Deposit Aquifers*

An unconsolidated deposit aquifer is an aquifer that is made up of loose sediments such as gravel and sand. These aquifers are close to the surface and are unconfined. This type of aquifer is commonly found near rivers in a floodplain area. Unconsolidated deposit aquifers are formed as the result of old rivers that no longer exist, by glaciers that have moved the sediment, or by deposition at the bottom of a lake. The water in an unconsolidated deposit aquifer is directly connected to the surface water system

b) *Bedrock aquifers*:
Bedrock is the hard rock that lies below all the sand, gravel, and soil near the ground surface. A bedrock aquifer is an aquifer that is confined within hard bedrock layers. Water can travel through porous bedrock, or cracks, fractures, and crevasses in the hard bedrock. These kinds of aquifers are easily accessible in areas where the bedrock is near the earth's surface. Bedrock aquifers are of three types- *carbonate aquifers, sandstone aquifers, and fractured shale aquifers.* Carbonate aquifers are made of rocks such as

limestone and usually contain saline water. Sandstone aquifers are made of sandstone, a highly permeable rock, and can contain either saline or freshwater. Shale is a rock that is similar to sandstone but is less permeable. For shale to be an aquifer, it must be fractured, or cracked, so water can flow into it. Fractured shale aquifers are relatively rare. The wells that draw from this type of aquifer do not produce as much water.

c) *Quaternary Aquifers*

Quaternary aquifers are created by glaciers. They are located between bedrock and the earth's surface. These aquifers can be either confined or unconfined. There are two types of quaternary aquifers: *buried valley aquifers* and *alluvial aquifers*. Buried valley aquifers are confined aquifers that can be directly above bedrock or higher up in the rock layers. These are ancient valleys that are filled with permeable sand and gravel. Unconfined sand and gravel aquifers are located at the surface or near the surface. On the other hand, an alluvial aquifer is a specific type of unconfined aquifer that has a river flowing through it. The river is the main source of recharge. Quaternary aquifers generally contain freshwater.