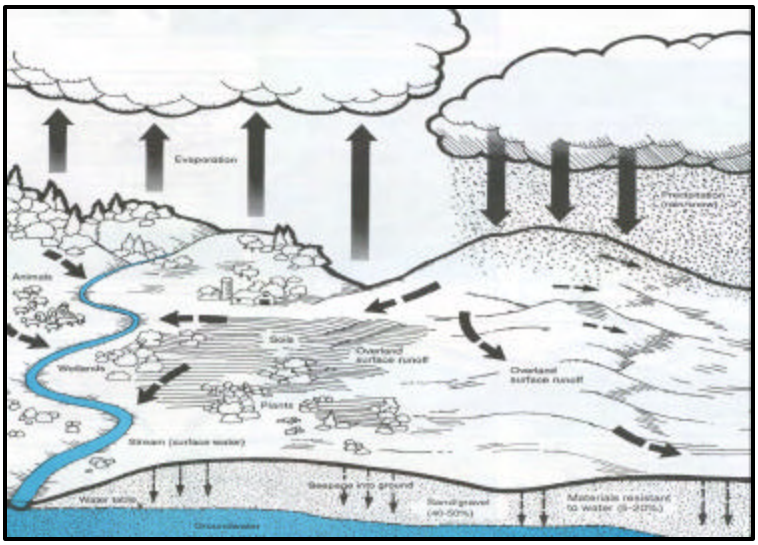
Groundwater Basics

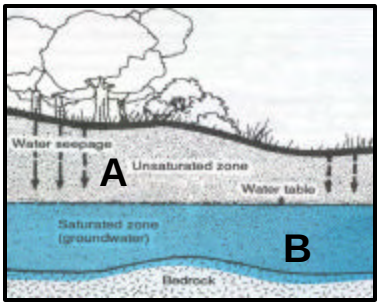
Before going into detail about the WHPP, it is important to understand the mechanics of groundwater. This section will give you the basic information you need to understand why you should participate in the WHPP.

Groundwater myth #1
Groundwater is a large underground lake or river.
Reality: Groundwater is stored in small spaces between rock or soil particles.

The Water Cycle



Groundwater begins with rain and snowmelt that seeps or infiltrates into the ground as gravity pulls it downward. The type of land surface determines how much water will infiltrate into the ground. The amount of water that infiltrates into the ground varies from 5 percent to 50 percent, with the remaining water running off the land surface into streams, rivers, and lakes or returning to the atmosphere by evaporation.

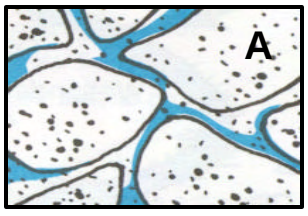


Saturated and Unsaturated Zones

Subsurface Water

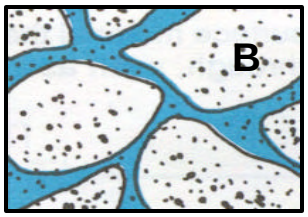
Groundwater is present in geological formations below the land surface (subsurface). The subsurface can be divided into two zones, the unsaturated zone and the saturated zone. As water infiltrates into the ground it will travel through material that has open spaces between particles called pore spaces. Pore spaces are small to microscopic in size.

The first zone that infiltrating water intercepts is the unsaturated zone (A). In the unsaturated zone the pore spaces are filled with both water and air. Plant roots can capture moisture moving through this zone but it does not contain enough water to supply a well. The movement of water through this zone is vertical.



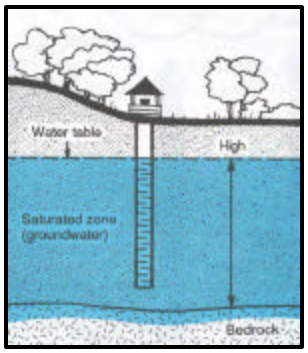
Unsaturated pore spaces

As the water infiltrates through this material it will eventually begin to build up, filling the pore spaces completely with water. The zone where pore spaces contain only water is called the saturated zone (B). Water flows both horizontally and vertically in the saturated zone. It is from the saturated zone that we can withdraw groundwater for our use.



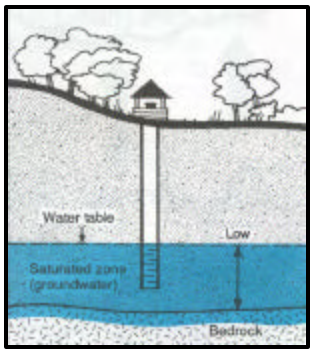
Saturated pore spaces

The Water Table



Seasonal high water table

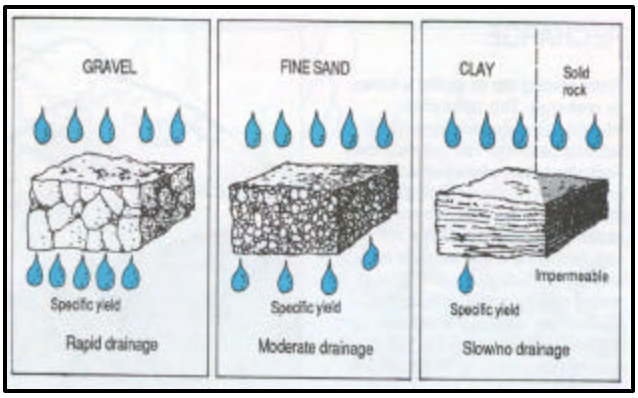
The boundary between the unsaturated and the saturated zone is called the water table. The water table is not a flat surface but a surface with high and low spots that generally follow the features of the land. The water table rises and falls according to the season of the year. Typically the water table is higher in the early spring and lower in late summer.



Seasonal low water table

Aquifers

Aquifer is the term that is used to describe a formation that stores groundwater in a usable and sustainable quantity. Drinking water comes from groundwater that is extracted from an aquifer. The aquifer can be made of a wide range of materials and may be at any depth. An aquifer's size and areal extent can vary widely. Some aquifers are found only locally where others are found throughout a region. In Michigan, aquifers are classified as confined or unconfined. The material that overlays the aquifer determines the type of aquifer.



Water travel through different materials: gravel, fine sand and clay.

Confined Aquifers

Groundwater does not move easily through layers of material that have very small, unconnected pore spaces. This layer is called an impermeable layer. When there is a thick impermeable layer it becomes a confining layer. When found between the land surface and your drinking water aquifer, it acts as a barrier that adds a natural layer of protection to your aquifer. The confining layer slows the travel of contamination from activities on the land surface to your aquifer. While the confining layer provides extra protection, contamination can still travel into your aquifer via fractures and abandoned wells.

Ground water myth #2

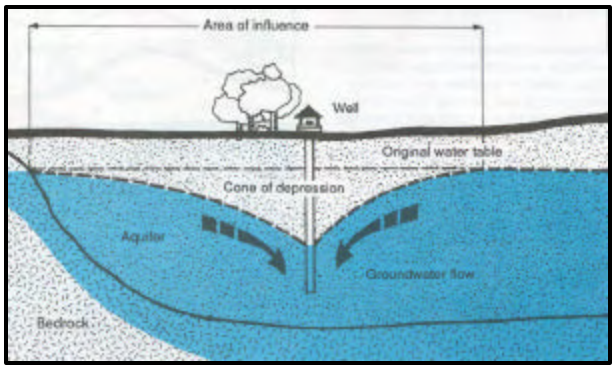
Groundwater does not move or groundwater moves very fast. Reality: Groundwater moves very slowly from a few inches to a few feet per day.

Unconfined Aquifers

Unconfined aquifers are aquifers that do not have an impermeable layer between the land surface and the aquifer. When a confining layer is not present there is no barrier to slow the travel of contamination between the surface and your aquifer. Unconfined aquifers are very sensitive to activities on the surface and are at a high risk of contamination.

The Cone of Depression

When water is pumped out of an aquifer, the water table will dip down around the well. This is called the cone of depression. Because water is being pumped out of the aquifer the speed of the water begins to increase as it approaches the pumping well. As you get farther away from the well the flow begins to decrease back to the natural flow rate.



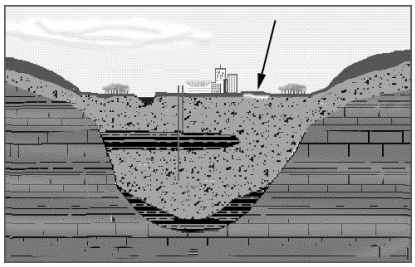
The cone of depression

Ground water myth #3
There is a lot of groundwater.
reality: Groundwater is about 0.7 percent of all the water on earth and not all of that is good for, or available for, drinking water.

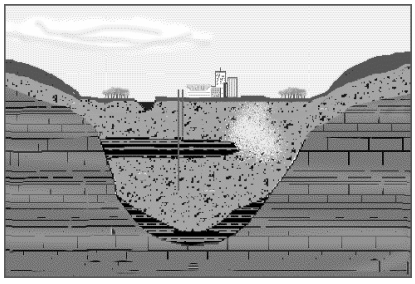
Aquifers are a complex system with many factors that influence the groundwater quality. Once an aquifer is contaminated it is very difficult and expensive to clean up and virtually impossible to return it to its original state.

Example of a Contamination Event

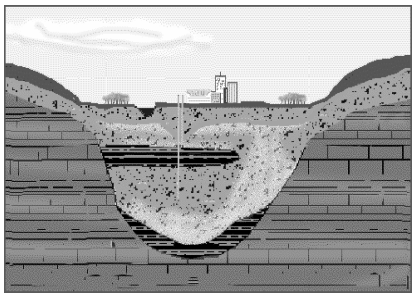
The following example will give you a visualization of how surface activities can contaminate your drinking water supply.



1) The picture is a representation of an aquifer with an incomplete confining layer (dark black bands). There are two wells, a shallow well above the partial confining layer and a deep well below the partial confining layer. The arrow points to a chemical spill that occurred on the surface.



2) One of the unique properties of water is that it can dissolve and carry many kinds of material. Because of this, chemical spills on the surface (solid or liquid) can be carried into the aquifer when water comes in contact with them. Once the contamination mixes with the water it becomes very mobile and will travel with the groundwater.



3) Once the contamination reaches the groundwater it spreads through the aquifer. Because withdrawing groundwater increases its flow or movement, it may actually cause the contamination to move more rapidly towards your drinking water well. The final outcome may be contamination being pulled into the drinking water well and ultimately into the public water supply system.