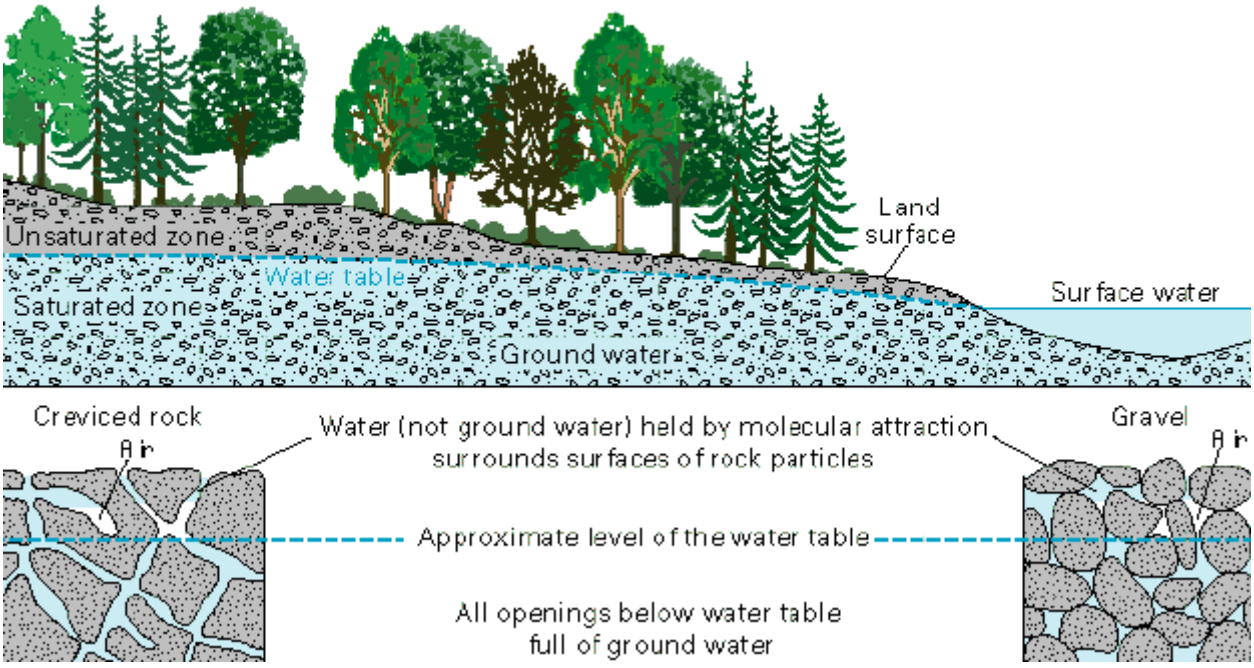
What You Need to Know About Groundwater

What is groundwater?

Groundwater is the water that lies beneath the surface of the earth, filling the open spaces between the grains of soils, sands, gravels, or other materials. Every time it rains, some of the water seeps into the ground, percolating downward until it becomes a part of the groundwater reservoir. A close view of the formations that lie beneath the surface of the earth can help you to understand how groundwater works.

The upper layer, or unsaturated zone, is fairly dry, and carries tiny droplets of water that are slowly moving downward to the water table, because of gravity. As it reaches the border between the water table and the unsaturated zone, it enters an area called the capillary fringe. This area acts as an exchange between the unsaturated zone and the saturated zone, or the area beneath the water table. Water droplets can be pulled up from the water table to supply plants with water, or water can be drawn down into the water table. The zone or line where the groundwater completely saturates the soils, sands and gravels, or bedrock, is called the water table. The picture below shows how ground water fills the spaces between the soil, sand and gravel, or rock particles.



How does groundwater and surface water interact?

Many times, the surface of the water table is equal to the level of ponds or streams. If it rains, and the level of the water in the pond or stream becomes higher than the water table, groundwater moves from the pond or stream back into the aquifer. If it is dry for a period of time and evaporation or transpiration from plants causes the level of water in the pond or stream to drop, the water in the aquifer moves into the pond or stream to recharge that area. It is a give and take between groundwater and surface water.

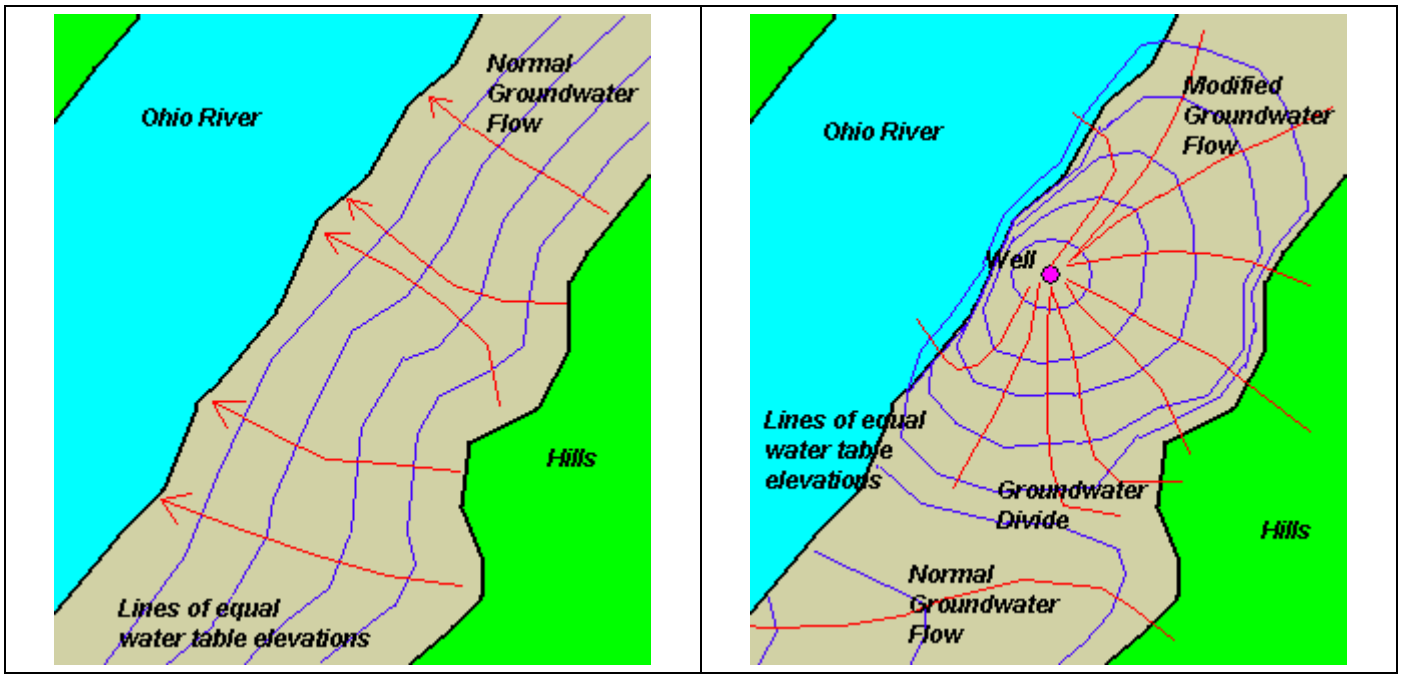
The interaction between groundwater and surface water takes place here in Louisville, as well. In the spring, when it rains, the Ohio River and its tributaries become swollen with runoff, and the level of water in the stream bed is higher than that of the water table. When this happens, the stream recharges the aquifer,

raising the water table higher than normal. In the late summer and fall, evaporation and transpiration rates are at their highest, and the level of water in the Ohio River and its tributaries drop below normal levels. At this time, the water table is higher than the level of water in the stream, and groundwater moves into the stream to recharge the stream. Did you know that after the 1937 flood, water levels in wells rose about four feet? Many basements and cellars were flooded for months after the floodwaters receded, because the water table had risen from recharge.

Most of the time, groundwater moves from higher hills to lower areas, so normal groundwater flow is from the hills down to the river or down slope to a nearby stream. Also, in general, the water table follows the general shape of the landscape, although there are many exceptions to this 'rule'.

How can you change the shape of the water table? Can you increase normal groundwater flow?

The most common way to change the water table is to install a well and pump water from the well. This changes the direction of flow in some areas, and increases the speed of groundwater flow around the well. When a well is pumped, it depresses the water table around the well. This causes more groundwater to flow toward the well from all directions, and it causes the groundwater to move at a higher than normal speed through the formations.



The picture on the left depicts normal groundwater flow from the hills to the Ohio River. Lines of equal water table elevation (called the piezometric surface) are drawn (in blue) to show where the water elevation would be the same in the area. Flow lines (in red) depict normal groundwater flow toward the river.

The picture on the right depicts groundwater flow as modified by pumping. As shown, groundwater flows into the well from all directions. Between the Ohio River and the well, the flow of groundwater is reversed, showing that the formations beneath the river actually contribute to the flow of the well. At the bottom of the picture, you can see where the flow is reverting back to more normal flow along a groundwater divide.

The circular pattern of the water elevations around the well is called the *Cone of Depression*, and represents the total area that the well uses for the groundwater supply. The Louisville Water Company (LWC) has measured water levels in wells drilled into the river bottom and into the aquifer. These wells show a decline in the level of the water in the well, indicating the 'pulling' pressure the well is exerting on the formations below the Ohio River and the aquifer.

Groundwater flowing into the well is flowing at a higher speed than groundwater flow under normal conditions. This speed can be measured by a series of formulas that take into account the ability of the sands and gravels (aquifer) to transmit water to the well, the slope of the water table, and distance the water must travel to enter the well.

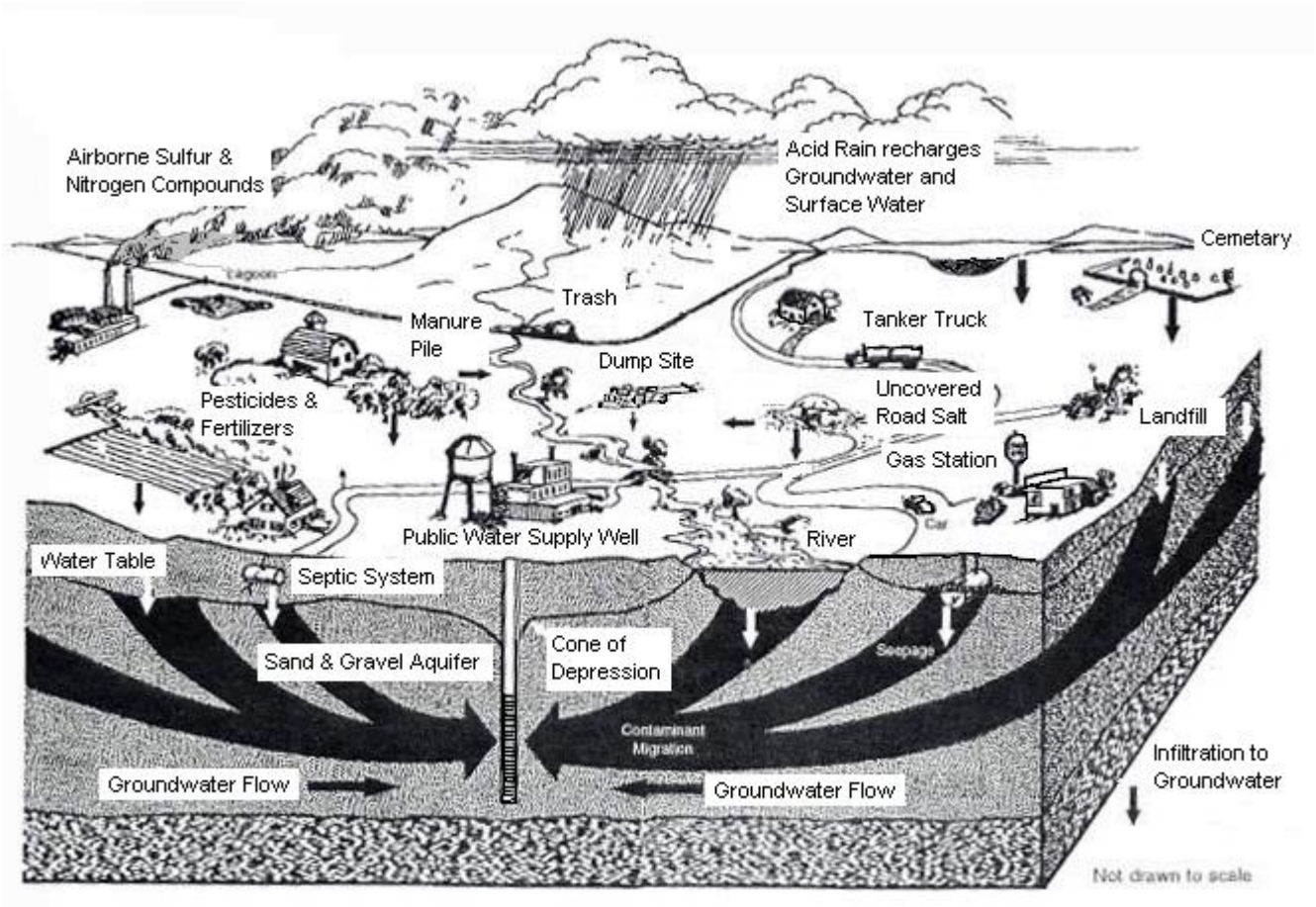
Remember that the well depicted above is a municipal well and pumps at a higher rate than most domestic or household wells. The same effect occurs with domestic wells, but on a much smaller scale.

How Does Contamination of Groundwater Occur?

There are literally hundreds of ways to contaminate groundwater, but every way relies on a few simple concepts that are easily understood. First and foremost: Almost e*verything that is put on the ground or in the ground will eventually end up in the groundwater in some form or another. Many things that are put into the air will also end up in the groundwater in some form or another.*

- A percentage of fertilizers sprayed on the lawn or crops will be partially used by the plant for growth. Some of it will travel overland with rainfall, and become a part of the surface water. The amount of fertilizers that infiltrates the soil that is not used by plants or runoff will enter the groundwater.
- A percentage of any pesticides that are applied to plants or the ground, around the edges of driveways, around the outside of your house, or in the air—even if it is bio-degradable and changes into a more harmless substance with time—will enter the groundwater.
- Forty-nine percent of salt used to de-ice roads, driveways, porches, or other walkways will enter the groundwater-- the rest usually becomes surface water runoff.
- A percentage of any automotive product that drips or spills from your car, as well as particulate matter from automotive exhaust, will at eventually enter the groundwater.
- Fluids from septic systems, buried heating oil tanks, waste lagoons, leaking cemetery vaults, and a variety of other buried items will eventually percolate into the groundwater.
- A percentage of contaminated storm water runoff, contaminated water bodies, landfills, manure piles, dump sites, and trash piles will enter the groundwater reservoir at some point.
- A percentage of the particulate matter that enters the air will also enter the groundwater reservoir.

The picture below depicts a few methods of groundwater contamination:



Why Is It Important to Prevent the Contamination of Groundwater?

Groundwater acts as a drinking water supply for many domestic wells in Jefferson County, and as the source of drinking water for the LWC Riverbank Filtration Wells at the B. E. Payne Plant in Prospect, Kentucky. The discovery, clean-up, and added treatment processes required to treat and use contaminated groundwater as a drinking water source is very costly. It can take up to 200 times the amount of money to clean up a drinking water supply as it is to normally treat and use the un-contaminated supply. *Prevention is the key*. Not only does it save money in the long run, but the drinking water supply remains safe for long-term use.

The LWC Wellhead Protection Plan (WHPP) is designed to prevent contamination before it occurs. By implementing and following the WHPP, LWC hopes to maintain the integrity of the groundwater supply at the B. E. Payne Plant, which will lower future operating costs while insuring a safe, healthy drinking water supply for our service area.

Get Involved!

LWC must rely on you, the consumer, to help prevent groundwater contamination. For people living within the Wellhead Protection Area in Prospect, Kentucky, the responsibility of protecting the groundwater is the greatest.

However, throughout Jefferson County, protecting the groundwater supply is a natural step toward maintaining un-contaminated surface water bodies, such as ditches, streams, creeks, lakes, and ponds. It is also a natural step in protecting our environment, and ensuring that all who live here may do so healthfully.

Remember that groundwater and surface water interact with one another, and that nearly anything that lies on top of the ground, or is buried underground will eventually end up in the groundwater. By maintaining a cleaner environment, by reducing the amount of pesticides and fertilizers, and by becoming more aware of the processes working around you—YOU can help to protect the groundwater used as a drinking water supply.

*picture from USEPA web site

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