GROUNDWATER QUALITY FROM private wells in montana

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When talking about water quality, I like to say that water has a memory. It remembers where it has been, meaning, it has characteristics based on the path it has taken. So, to understand the quality of groundwater, we need a basic understanding of where groundwater originates. Ultimately, it comes from precipitation, which is as close to distilled water as we will find in nature. If the amount of liquid water on the land surface is greater than the amount of evaporation at any given time and place, the water can infiltrate into the ground to recharge groundwater. The mountainous parts of Montana get a lot more precipitation (20 to >70 inches per year) than lowlands and largely in the form of snow. As snow melts in the mountains, most of it runs off in streams and rivers and/or infiltrates into groundwater at the mountain/valley edge.

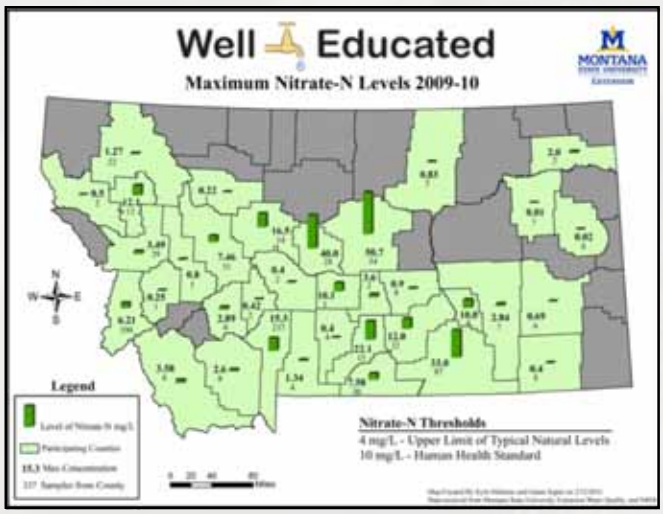
In contrast, the non-mountainous portions of Montana receive less precipitation (roughly 10 to 18 inches per year) and most of it is lost back to the atmosphere out of plants or from the land surface (evapotranspiration). However, things looked very different across much of Montana in the spring of 2011. At the Moccasin Agricultural Experiment Station in central Montana, more than 12 inches of rain fell between April and June, which was twice what fell during those months in 2010. Similar heavy spring precipitation across the state resulted in more water infiltrating and an associated movement of soluble materials such as salts and nitrate from soils down into groundwater.

After spring runoff in 2011, reports of elevated nitrate concentrations came in through the MSU Extension private well testing program (Well Educated) from a number of locations. A few of these values were greater than any results seen since the program started in 2005. The most extreme numbers were from the eastern half of the state in areas dominated by agricultural land uses. The wells with the highest concentrations were relatively shallow which makes them more susceptible to water quality impairments from surface land use than deeper wells. These results highlight the fact that it is the responsibility of private well owners to monitor the quality of their well water.

A well owner should test their water quality if the well has been flooded or if they notice a change in the quality of their water. Annual testing is recommended for nitrate and bacteria. It is also a good idea to check with your local health department, water quality district, or Extension agent to find out if there are other constituents of concern in your area. The "Well Educated" program is an MSU Extension program that guides well owners through the process of testing and understanding their water quality. Below is some basic information on a few parameters of interest for private well testing along with some insights based on results from the Well Educated program. For more information on private wells and septic systems or for information about participating in the Well Educated program, contact your local Extension agent or see the website referenced at the end of this article.

Nitrate

Nitrate is the chemical constituent that probably gets the most widespread attention in groundwater. Nitrate-N is a concern because at concentrations greater than 10 mg/L* it can cause blue baby syndrome (methemoglobinemia) and there is some evidence that at high concentrations it causes increased risk of cancer. It is also of interest because natural concentrations in groundwater rarely exceed 2 mg/L* but nitrate can come from human waste, animal waste, or fertilizer. Nitrate-N is very



soluble and moves readily in groundwater, so a concentration above 2 mg/L or a concentration that increases through time may be evidence that human activity is influencing a well water supply. Annual nitrate testing is a good idea, especially if the area up-gradient from the well includes a lot of septic systems or agriculture. The maximum nitrate concentrations for the counties shown on the Well Educated summary map likely have different explanations ranging from high septic densities in some areas to probable agricultural sources in other farming-dominated areas.

Bacteria

Bacteria can be found everywhere on Earth, including groundwater. However, coliform is a specific group of bacteria not typically found in groundwater. Presence of coliform bacteria in groundwater is not an immediate indication of a health risk but is an indicator that groundwater is being influenced by surface activities. *E. coli* is a specific type of coliform bacteria found in the waste of warm-blooded animals and its presence is an indicator of fecal contamination. Presence of *E. coli* in a well is associated with risk of waterborne disease and use of *E. coli*-contaminated water should be discontinued immediately. Coliform or *E. coli* in a well may come from a poorly capped well or from surface water or waste water reaching the water supply without adequate filtration through soil. Shallower wells are more susceptible to contamination from surface water, but any well is subject to contamination if the wellhead is not protected. For this reason, every well owner should conduct annual bacteria testing.

Arsenic

Arsenic occurs naturally in the Earth's crust at an average concentration of 2-5 parts per million (ppm) or 2-5 grains in a cup of sugar. Higher concentrations are often found around hot springs and other geothermal sources; mined ores like copper, gold, and zinc; and also in some areas with glacial geologic deposits. When groundwater flows through mineral deposits high in arsenic, the minerals can break down and release arsenic into the water. The arsenic concentration flowing out of Yellowstone National Park in the Madison River ranges up to more than 10 times the drinking water standard as a result of natural geothermal sources. As a result, the aquifers adjacent to the Madison River often have elevated arsenic. Arsenic concentrations above the 0.01 ppm drinking water standard have been detected through the Well Educated program in Big Horn, Cascade, Gallatin, Jefferson, Lewis and Clark, Madison and Missoula Counties.

Uranium

Uranium is a naturally occurring mineral in many glacial and volcanic geologic formations and can be dissolved into groundwater. Uranium is commonly associated with minerals targeted for mining, so testing for uranium may be a good idea in areas with a mining legacy. Notably in Montana, elevated uranium concentrations have been found in private wells within and in areas surrounding the Boulder Batholith geologic formation which primarily underlays portions of Beaverhead, Deer Lodge, Granite, Jefferson, Lewis and Clark, Madison, and Silver Bow Counties.

*Nitrate (NO_3) concentrations can be reported as nitrate or as nitrate-N (nitrate as nitrogen). Nitrate-N concentrations only account for the nitrogen atom in the molecule while nitrate concentrations account for the nitrogen and the oxygen which is a 4.4 times larger number. Example: 10 mg/L nitrate-N = 44 mg/L nitrate.

For additional information visit MSU Extension Water Quality website: http://waterquality.montana.edu/ ■