

Arsenic in Groundwater

Gallatin Local Water Quality District
Gallatin County, Montana



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What is arsenic and where does it come from?

Arsenic (As) is a naturally occurring element that is found in rocks and soil, and is usually combined with other elements to form mineral compounds. Arsenic can be found at high levels in areas with volcanic or geothermal activity. Arsenic can enter water supplies and waterways via the erosion of rock formations, volcanic activity, agricultural runoff, mining activities, or certain types of industrial waste runoff. Industrial uses of arsenic in the U.S. include or have included wood preservatives, pesticides, and the production of lead-acid batteries and semiconductors. Elevated levels of arsenic affect groundwater in various regions throughout the world. The species, or types, in which arsenic commonly occurs in groundwater are: arsenite [also known as As(III)], and arsenate [also known as As(V)]. Both types are hazardous to human health.

How much is too much in drinking water?

Under the Safe Drinking Water Act, the United States Environmental Protection Agency (EPA) maximum contaminant level (MCL) for arsenic is **10 µg/L or ppb (also equivalent to 0.010 mg/L or ppm)** and the maximum contaminant level goal (MCLG) is 0 µg/L or ppb (0 mg/L or ppm). The Gallatin Local Water Quality District and other entities have tested wells throughout the Gallatin Valley and found that in the Amsterdam-Churchill area, many (but not all) tested wells have arsenic above this standard. The map on page 4 shows the distribution of arsenic in Gallatin County.

How does arsenic get into groundwater?

Arsenic is a natural part of the environment. As water moves through soil and rock under certain geochemical conditions, arsenic can be released into groundwater. Arsenic from geothermal waters discharging from areas such as Yellowstone National Park can migrate dozens of miles downstream, such as in the case of the Madison River in Montana. Because rivers and streams are connected to groundwater, surface water arsenic can end up in groundwater, and vice-versa. Arsenic can also enter water resources through industrial and mining surface runoff that eventually enters groundwater.

Why is arsenic a concern in groundwater?

Drinking water with elevated levels of arsenic is a primary exposure route. Skin contact, such as when bathing, is less of an exposure concern. High levels of arsenic in drinking water are associated with adverse health effects (see page 2). Of particular concern are persons using private/domestic (non-public) wells that receive little or no water quality monitoring, who may not realize they are being exposed to high levels of this odorless and tasteless element. It is important for homes that use domestic wells to test their water to determine whether it is safe to drink.

Sources of arsenic contamination:

- *Rock or soil (naturally occurring), especially in areas with sulfide mineral or volcanic rock deposits*
- *Geothermal discharge*
- *Industrial waste*
- *Previous use of pesticides with arsenic (no longer used in modern agricultural settings)*
- *Wood preservatives*
- *Smelting and mining activities*

Did you know...

Groundwater wells supply most residents of Gallatin County with their drinking water. The exception is the City of Bozeman municipal drinking water supply, which relies primarily on surface water.

What are the health effects of arsenic?

General Health Effects:

Health effects of arsenic can occur due to acute or chronic exposure. Acute toxicity often results from ingestion or inhalation of high levels of arsenic, while chronic poisoning is most commonly associated with arsenic exposure via ingestion of drinking water. High arsenic levels found in drinking water may cause a variety of health problems, including effects on the neurological, respiratory, cardiovascular, and gastrointestinal systems. It can also cause skin damage, skin lesions, anemia, and an increased risk of cancer of the lungs, skin, nasal passages, prostate, bladder, liver, and kidneys. Other non-cancerous side effects of arsenic poisoning include thickening and discoloration of the skin, stomach pain, nausea, diarrhea, numbness in the hands and feet, partial paralysis, and blindness. Other adverse health effects not listed here are possible.

Children have an increased susceptibility to arsenic toxicity due to differences in metabolism, increased sensitivity of the developing nervous system, and their decreased ability to detoxify arsenic. Children have an increased risk of exposure due to hand-to-mouth behaviors, breathing closer to the ground, and playing in potentially contaminated soil.

How and where do I test for arsenic?

The only way to know if drinking water is contaminated with arsenic is to have it tested. For homes on a private well, it is the homeowner's responsibility to have their water tested. The Gallatin Local Water Quality District recommends that homeowners test their wells for arsenic (among other parameters) on a five year basis at a minimum, and annually for nitrate and bacteria.

To pick up a well test kit, stop by the Gallatin Local Water Quality District at 215 W. Mendenhall St., Suite 300 in Bozeman. We will walk you through the water sampling procedure, and provide technical assistance to help you understand your well test results. For more information, you can visit our website at www.glwqd.org or call us at (406) 582-3168 to discuss well water testing options.

My water is high in arsenic...now what?

If the arsenic concentration in your well is at or above the MCL of 10 µg/L, find an alternative supply of water for cooking and drinking that is known to meet the standard, such as commercially bottled water. Long-term solutions include installing a water treatment system, collecting containers of water for drinking and cooking from another source, or deepening your well. However, drilling a deeper well may or may not solve the problem. See page 3 for more information on water treatment systems.

Do not boil your water in an attempt to remove arsenic! Boiling will actually increase the concentration due to evaporation of the water.

Water Treatment Systems

There are many treatment options for reducing arsenic in drinking water, each with a unique set of advantages and disadvantages related to cost, water use, chemical interferences, and maintenance. Point-of-use (POU) systems that filter enough water for drinking and cooking, such as an under-the-sink unit along with a separate tap is often more financially feasible than a higher volume system that treats all of the water entering a home (point-of-entry system). In order to treat arsenic in drinking water, knowing the species, or type, of arsenic is important. At the locations where well water has been tested for speciation in the western part of the Gallatin Valley, it is often found in the form of As(V) (arsenate).

Contact a local water treatment company to see which treatment systems they sell and which will work best for your home. Because there is no absolute way of knowing if or when the treatment system may fail, installing a home water treatment system does not mean regular water testing can be discontinued. Maintaining your treatment system per factory recommendations is crucial to keep the system functioning properly.

Reverse Osmosis: In reverse osmosis (RO) systems, pressure is used to force water through a semi-permeable membrane, filtering out most impurities. The membrane filters out arsenic, as well as nitrate, lead, iron, and chromium. According to some studies, reverse osmosis treatment can be 95% effective at removing As(V).

Anion Exchange: These systems use special anion exchange resins that exchange chloride ions for arsenic ions in the water as it passes through the resin. The level of sulfate and total dissolved solids (TDS) in the water are important factors that affect the efficiency of the ion exchange system for removing arsenic.

Distillation: The distillation process involves boiling the water, collecting the steam, and then cooling it in order to turn it back into water. Distillation removes both As(III) and As(V).

Adsorptive Filter: Adsorptive filter systems are made from activated alumina or other media, and can remove both species of arsenic. If you have As(III) in your drinking water, a pre-oxidation cartridge may be needed to increase the efficiency of the arsenic removal.

What are arsenic levels in the area?

Throughout most of the Gallatin Local Water Quality District and Gallatin County, arsenic levels are below the U.S. EPA MCL of 10 µg/L (0.010 mg/L). However, groundwater data from the Montana Bureau of Mines and Geology Groundwater Information Center and the Gallatin Local Water Quality District Groundwater Database indicate elevated arsenic is found in wells in the following areas: Camp Creek Hills, Madison Bluffs, Big Sky, Three Forks, and West Yellowstone. If you live in one of these areas, you are encouraged to test your well water for arsenic if you have not already done so. Please see page 4 for a map of the *known* distribution of arsenic levels in Gallatin County.

Recommendations if the total arsenic level exceeds 10 µg/L (0.010 mg/L) in your well:

- *Individuals, especially those with chronic health problems, should consult their doctor about consuming the water.*
- *Do not boil the water for drinking; this will actually **increase the arsenic level** by concentrating it because of evaporation.*
- *Limit your daily intake if you are concerned about the scientific uncertainty for long-term exposure.*
- *Consider installing a treatment system in your home, or find an alternative source of water for drinking and cooking.*

Gallatin County Groundwater Arsenic

For Further Reading:

National Groundwater Association-Arsenic: What You Need to Know

www.wellowner.org/water-quality/arsenic/

USGS-Arsenic in Groundwater of the US:

<http://water.usgs.gov/nawqa/trace/arsenic/>

Montana State University Extension Water Quality-Arsenic Fact Sheet:

<http://waterquality.montana.edu/well-ed/files-images/Arsenic.pdf>

World Health Organization-Arsenic Fact Sheet:

<http://www.who.int/mediacentre/factsheets/fs372/en/>

World Health Organization-Arsenic in Drinking-water:

http://www.who.int/water_sanitation_health/dwq/chemicals/arsenic.pdf?ua=1

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Oregon Health Authority. (n.d.). Drinking Water Program Fact Sheet: Recommendations for Arsenic Removal from Private Drinking Water Wells in Oregon.

U.S. EPA. (2012, March 06). *Chemical Contaminant Rule*. Retrieved October 2015, from Water: Arsenic: <http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/Basic-Information.cfm>

