

DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY

Maine Geological Survey

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Table of Contents

1. Important Notice	1
2. Introduction	1
3. Where is arsenic found in nature?	1
4. How does arsenic get into groundwater?	2
5. How much arsenic in groundwater is too much?	2
6. Arsenic in private wells	2
7. Should I test my water?	3
8. Health effects of arsenic	5
9. More Information	5
10. References	5

Arsenic in Maine's Groundwater

Robert G. Marvinney, Maine State Geologist

1. Important Notice

The Maine Geological Survey strongly recommends that private wells used for drinking water be tested for arsenic.

2. Introduction

Arsenic is a hazard because:

- It is found in well water in all parts of the state.
- Its concentrations are not predictable from place to place.
- Long-term exposure to even low concentrations may cause health issues.

3. Where is arsenic found in nature?

Arsenic is a naturally occurring element in the earth's crust. Although typically occurring in low concentrations of only a few parts per million (ppm), some rocks and minerals can have fairly high concentrations of arsenic. In central Maine, for example, we have found concentrations ranging from less than 1 to more than 500 ppm in some rocks. Because common



Figure 1. **Left** - a rusty weathering schist in Augusta. **Right** - close-up view of fresh rock from the same outcrop shows abundant pyrite crystals (brass-colored crystals) in the rock. Although rusty rocks like these often have high arsenic, we have found arsenic in many common rock types in Maine.

minerals such as pyrite (fool's gold) may contain small amounts of arsenic, and because arsenic-containing minerals commonly occur in many different rock types, it is not possible to single out individual rock units or rock types as more or less likely to contain high concentrations of arsenic. Arsenic is present in every geologic setting in the state.

4. How does arsenic get into groundwater?

Pyrite and other minerals in rocks weather – they break down when exposed to water and the atmosphere. The amount of arsenic released into groundwater by weathering depends on many things, but one of the key factors is the time it takes water to move through the aquifer.

There are two basic types of aquifers (water-bearing units) in Maine: 1) Sand and gravel aquifers – groundwater occurs in the openings between grains in loose deposits of sand and gravel; 2) Fractured bedrock aquifer – groundwater occurs in the numerous fractures that are found nearly everywhere in the solid bedrock (ledge) that underlies the entire state. ([More information on Maine aquifers](#)). Higher arsenic concentrations are more typical in groundwater from fractured bedrock because of the length of time water is in contact with the rocks in the network of fractures. It may take years for water to move from the surface through the network of fractures in bedrock. The long contact times allow the processes that release arsenic into the water more time to act. Because groundwater travels faster in sand and gravel aquifers, arsenic concentrations in water from those aquifers are usually not as high as water from fractured bedrock aquifers. Predicting how much arsenic will be in groundwater in any area, though, is very difficult because of the complicated processes that release arsenic into the water and the complex ways in which fractures in the rocks are connected.

Compounds containing arsenic were also used by people for various purposes such as treating wood and as pesticides on various crops. Although these compounds are no longer used, some arsenic may remain in soils and eventually enter the groundwater.

5. How much arsenic in groundwater is too much?

The drinking water standard for arsenic is 10 parts per billion (ppb), also sometimes written as 10 micrograms per liter (10 µg/L). Based on studies that show health problems associated with arsenic even in low concentrations, this standard was lowered from 50 to 10 ppb in 2001.

6. Arsenic in private wells

About 40% of the people in Maine get their drinking water from a private well. The vast majority of these wells are drilled into bedrock, where water moves through fractures to the well. The only way to know if a particular well has high arsenic is to test the water. Probably 1 in 10 wells in Maine has arsenic above the drinking water standard.

The map (Figure 2), taken from a [report](#) by the U.S. Geological Survey, shows the maximum arsenic concentrations in well water in Maine towns. The map shows the results of well tests done by the Maine Health and Environmental Testing Laboratory only and does not show information on water tests by private labs. White areas in the map do not necessarily mean that there is no arsenic in those areas, but that few tests have been done on well water in those areas..

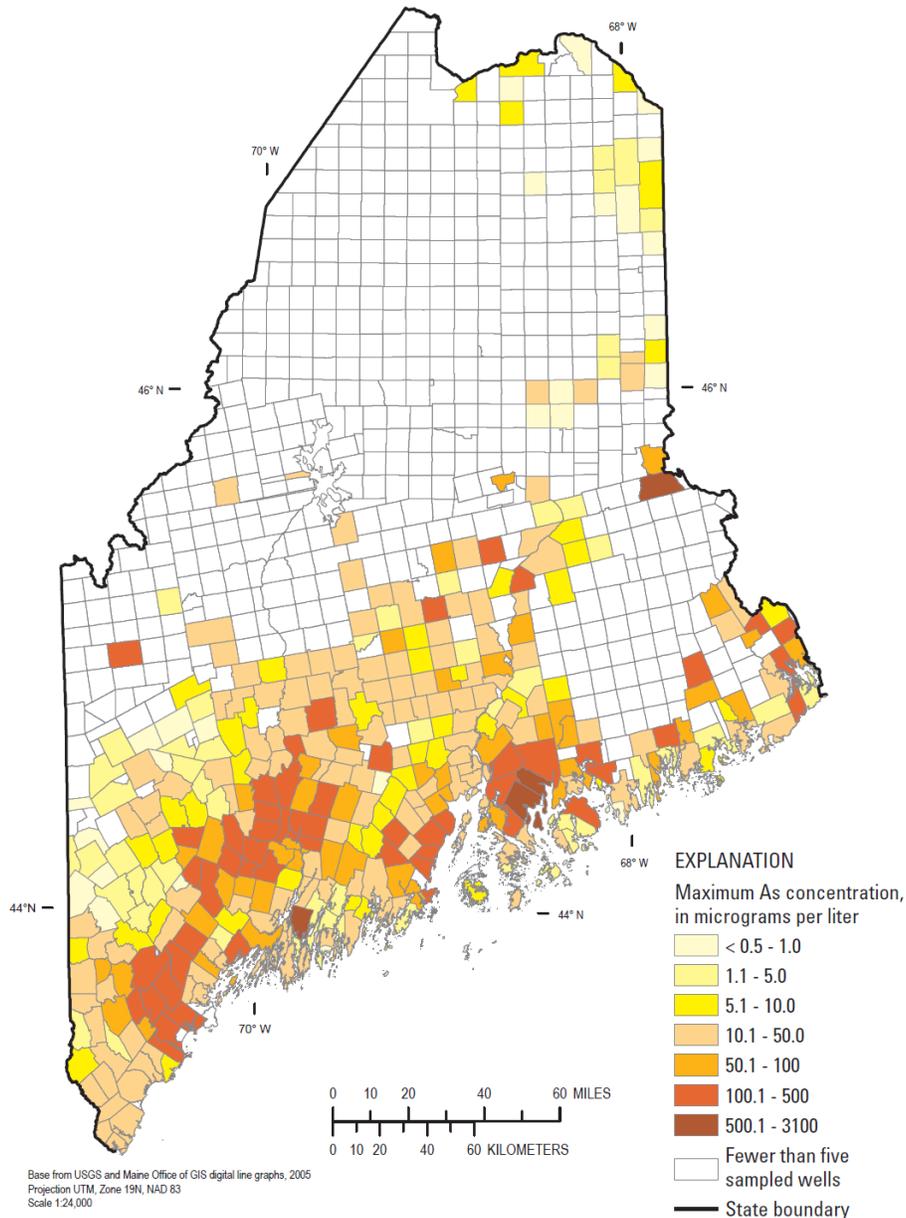


Figure 2. Maximum arsenic concentrations in towns tested by the Maine Health and Environmental Testing Laboratory.

You can review more information about arsenic in well water in your town by using the [interactive data portal](#) maintained by the Maine Center for Disease Control and Prevention. Click on “Private Well Water” and follow the instructions.

7. Should I test my water?

Arsenic in groundwater has no taste, odor, or color – the only way to know if it is there is to test the water. If the water in your home comes from a public water system, there is no need to

test; public water systems are required by law to provide water that meets the drinking water standard and regularly test for arsenic and other contaminants.

If you have a private well, you should test the water for arsenic at least once every 3 to 5 years. The [Is Your Well Water Safe to Drink? brochure](#) from the Maine Center for Disease Control and Prevention provides information on how to test your water, including a list of qualified testing laboratories.

Test your water, even if your neighbor's well has low arsenic. Arsenic concentrations in well water can be quite variable in a neighborhood, so test your well even if your neighbor's well has little arsenic (Figure 3).

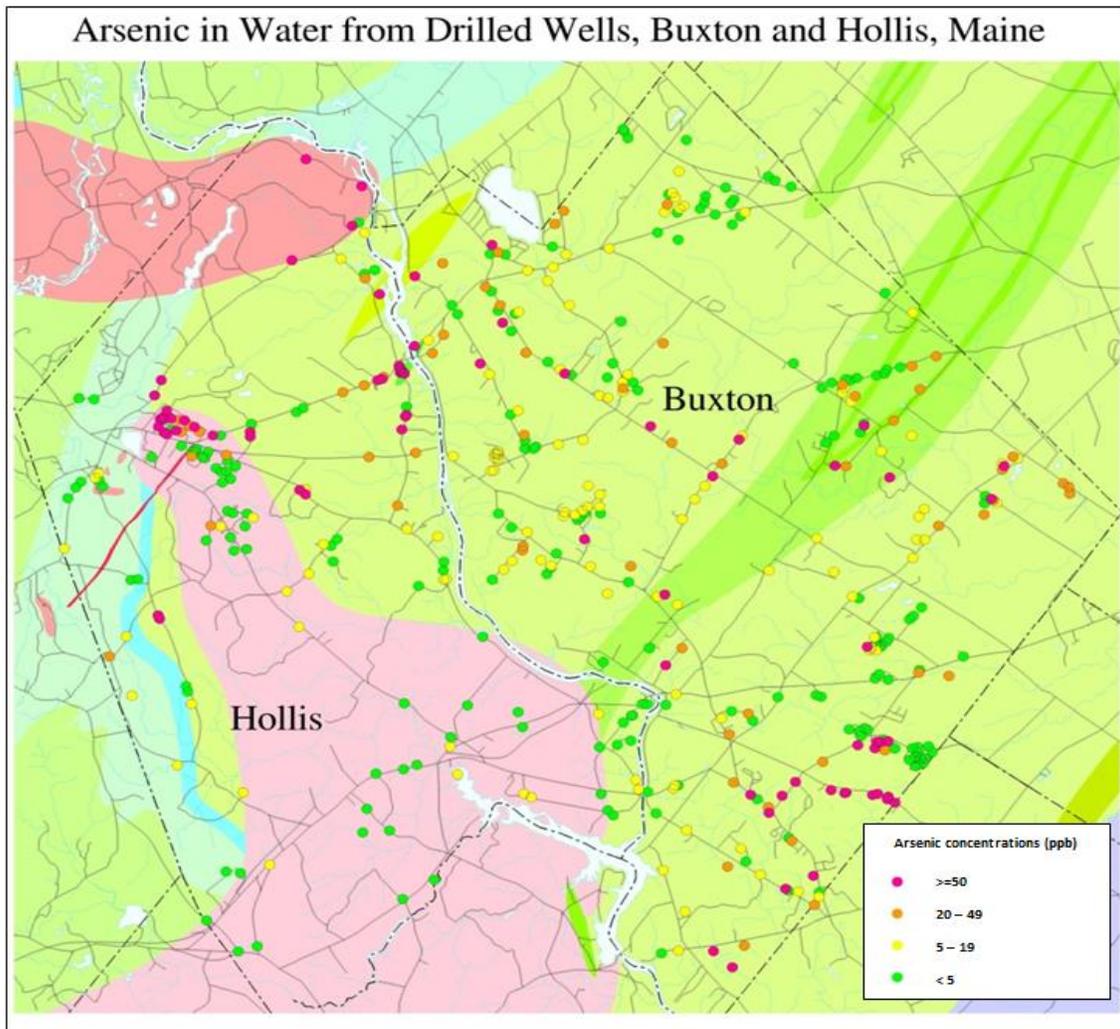


Figure 3. This geologic map of the Buxton/Hollis area of southern Maine shows wells with very high arsenic in red and wells with low arsenic (≤ 10 ppb) in green. Wells shown in yellow or orange have intermediate arsenic concentrations. In many areas, high arsenic wells are adjacent to wells with low arsenic, a pattern commonly found in other areas of the state, as well. Rock types: granite in shades of pink, metamorphic rocks in shades of green and blue.

8. Health effects of arsenic

Long-term exposure to arsenic in drinking water increases the chance of getting some types of cancer (such as skin, bladder, lung and possibly liver and kidney). Other health effects may include blood vessel damage, high blood pressure, nerve damage, anemia, stomach upsets, diabetes, and skin changes.

For more detailed information on the health effects of arsenic, please visit the [Maine CDC](#).

9. More Information

Order test kits to have your water tested.

The Maine CDC provides a useful Arsenic Fact Sheet and information on treatment systems that remove arsenic.

The Maine CDC, Environmental and Occupational Health Programs provide other useful information on arsenic in well water, including a video on how to test your well. -term exposure

10. References

- Flanagan, S.V., and others, 2015, [Influences on domestic well water testing behavior in a Central Maine area with frequent groundwater arsenic occurrence](#): Science of the Total Environment, v. 505, p. 1274-1281.
- Flanagan, S.V., and others, 2015, [Dissemination of well water arsenic results to homeowners in Central Maine: Influences on mitigation behavior and continued risks for exposure](#): Science of the Total Environment, v. 505, p. 1282-1290.
- Lipfert, G., and others, 2006, [Geochemical patterns of arsenic-enriched ground water in fractured, crystalline bedrock, Northport, Maine, USA](#): Applied Geochemistry, v. 21, no. 3, p. 528-545.
- Marvinney, R.G., and others, 1994, [Arsenic in Maine groundwater – an example from Buxton, Maine](#): Focus conference on eastern regional groundwater issues, Proceedings, Burlington, VT, p. 701-715.
- Nielsen, M.G., and others, 2010, [Assessment of arsenic concentrations in domestic well water, by town, in Maine, 2005-09](#): U.S. Geological Survey Scientific Investigation Report 2010-5199, 68 p.
- O’Shea, B., and others, 2015, [Heterogeneous arsenic enrichment in meta-sedimentary rocks in central Maine, United States](#): Science of the Total Environment, v. 505, p. 1308-1319.
- Wasserman, G.A., and others, 2014, [A cross-sectional study of well water arsenic and child IQ in Maine schoolchildren](#): Environmental Health, V. 13.
- Yang, Q., and others, 2009, [Spatial Pattern of Groundwater Arsenic Occurrence and Association with Bedrock Geology in Greater Augusta, Maine](#): Environmental Science & Technology, V. 43, p. 2714-2719.

- Yang, Q., and others, 2012, [Can Arsenic Occurrence Rates in Bedrock Aquifers Be Predicted?](#): Environmental Science & Technology, v. 46, p. 2080–2087.
- Yang, Q., and others, 2015, [Flow and sorption controls of groundwater arsenic in individual boreholes from bedrock aquifers in central Maine, USA](#): Science of the Total Environment, v. 505, p. 1291-1307.
- Zheng, Y., and Ayotte, J.D., 2015, [At the crossroads: Hazard assessment and reduction of health risks from arsenic in private well waters of the northeastern United States and Atlantic Canada](#): Science of the Total Environment, v. 505, p. 1237-1247.