

***Division of Science, Research and
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A Homeowner's Guide to Arsenic in Drinking Water



Prepared by the Division of Science, Research and Technology and the
Bureau of Safe Drinking Water

What is Arsenic?

Arsenic (As) is a naturally-occurring element in the earth's crust, and traces of arsenic can be found throughout the environment. Arsenic in soil may originate naturally, and past human activities may have added to these levels in some areas. Historically, the heaviest use of arsenic in this country has been as a pesticide. The current predominant use of arsenic is as a wood preservative. In ground water, arsenic occurs primarily in two forms, As+3 (arsenite) and As+5 (arsenate). Organic arsenicals are not known to occur at significant levels in ground water. Arsenic may change chemical form in the environment, but it does not degrade.

How Does Arsenic Get into Ground Water?

Inorganic arsenic exists naturally at various levels in all geologic formations in the state. In some of these formations, arsenic is relatively immobile despite being present at high concentrations. In other formations, the chemical and physical properties of the geologic material may enable the arsenic to become mobile. Such conditions exist in rocks formed from organic-rich, ancient lake beds in a group of geologic formations in the Piedmont Physiographic Province of the state, shown as the shaded area on the map. Results from testing conducted by the New Jersey Geological Survey indicate that elevated levels of arsenic exist in some aquifers of the Piedmont Province where arsenic has been detected at levels above 5 parts per billion (ppb), or $\mu\text{g/L}$ (micrograms per liter). Levels as high as 60-80 ppb have been detected in drinking water in this area.

Further, private well testing conducted by the South Branch Watershed Association with the Raritan and Readington Township Environmental Commissions and NJDEP in Hunterdon County show arsenic levels above 5 ppb in 49 out of 238 wells, or 20%, with the highest concentration being 35 ppb. Beginning in September 2002, all private wells were required to test for arsenic if they were located in the 10 counties located in the Piedmont Region of the state. Of the 1,928 wells sampled for arsenic between September 2002 and March 2003, 72 wells (3.7%) exceeded the federal drinking water standard of 10 ppb with the highest level reported at 216 ppb (data on levels above 5 ppb, the NJ arsenic MCL, have not been publicly reported). Arsenic may reach ground water from human activities. The primary use of arsenic, historically, has been as an ingredient in pesticides. Before synthetic organic pesticides were available, arsenic-based pesticides were widely used throughout the state to combat insects on a variety of crops. Lead and calcium arsenates were

the forms used most commonly, although there were additional types of arsenical pesticides, including organic arsenicals. Although arsenic is not considered to be highly mobile, certain factors, such as the use of fertilizers, can mobilize it and enable it to reach ground water. Thus, arsenic present in an aquifer may be due to natural formations, past use of arsenical pesticides or both.

What are the health risks associated with ingesting arsenic in drinking water?

Arsenic is one of a relatively small number of chemicals that has been classified by USEPA as a known human carcinogen, based on human epidemiological data. The carcinogenicity (or cancer-causing characteristics) of arsenic is difficult to study because it does not consistently induce cancer in laboratory animals, yet it is a known human carcinogen. Unlike most other carcinogens of environmental concern, arsenic does not induce cancer in the animal models in which it has been tested, perhaps due to differences in metabolism between the test animals and humans. Quantitative estimates of risks of arsenic in drinking water come from human epidemiological studies, rather than studies in laboratory animals. The exposures to arsenic in these individuals are not controlled, as in laboratory studies, but must be estimated from information on drinking water arsenic levels and water consumption data in the populations of interest.

Ingestion of large amounts of inorganic arsenic is associated with increased risk of several types of cancer in humans including skin, lung, liver, kidney and urinary bladder. The evidence for cancers comes from studies in Taiwan, Bangladesh, Chile and Argentina where human populations were exposed to very high levels of naturally-occurring inorganic arsenic in drinking water.

The National Academy of Sciences (2001) has estimated, based on lung and bladder cancer data, that the additional lifetime cancer risk associated with drinking water that contains 5 µg/L of arsenic is about 2 in 1000. This means that if 1000 people were to consume two liters of this water per day for 70 years, we would expect to see no more than 2 additional cancers in the 1000 people exposed over a lifetime.

Other potential effects of ingestion of elevated arsenic include gastrointestinal ailments, such as diarrhea and cramping, thickening and/or discoloration of the skin, increased risk of diabetes and cardiovascular impacts. Only a small amount of arsenic is found in breast milk even when mothers have ingested elevated levels of arsenic in their diet.

What is the drinking water standard for arsenic?

The Department of Environmental Protection (NJDEP) adopted a new maximum contaminant level(MCL)of 5 ug/L which becomes effective on January 23, 2006 that applies to all New Jersey drinking water supplies (private and public water supplies). New Jersey now has the most protective arsenic drinking water standard in the nation.

New Jersey requires monitoring for arsenic at more than 600 public community water systems and 900 non-transient, non-community systems, which combined serve around 85 percent of the state's population. Based on past data, NJDEP predicts approximately 34 community and 101 non-community systems may have arsenic levels exceeding the new 5 $\mu\text{g/L}$ standard. In addition, the new standard also would apply to private well owners regulated under New Jersey's Private Well Testing Act, requiring notification of consumers about arsenic concentrations during a real estate transaction and when renting property.

Who should test?

If your drinking water comes from a public community water supply (i.e., you get a water bill), your water supplier is required by law to test it to ensure that it meets the MCL for arsenic. In this case, you do not need to test your water. You can get the most recent test results for your water system by contacting your water supplier or the NJDEP's Bureau of Safe Drinking Water at (609) 292-5550.

There are no federal or state requirements for private well owners to test their well water for arsenic, although the state does require testing for various contaminants, which may or may not include arsenic, during real estate transfers under the Private Well Testing Act (www.state.nj.us/dep/pwta). Given the elevated levels of arsenic that have been found in ground water in certain parts of the state and the lower MCL for arsenic in NJ, the NJDEP recommends that private well owners who live in the Piedmont Physiographic Province test their well water for arsenic. See the map on the first page of this guide to find out if your home is in this area. Arsenic has been found in the water from some wells in other parts of the state, but not at the frequency or concentrations found in the Piedmont. Additional study is needed in those other areas of the state. Anyone who is concerned about possible arsenic contamination of their well water should test.

How can I find out if arsenic is in my drinking water?

Arsenic in drinking water is odorless, tasteless and colorless. The only way to tell if arsenic is present is to test for it. If you decide to test your well, the DEP recommends that you use a laboratory that is DEP-certified to conduct low level arsenic analyses. There are a number of commercial labs in NJ and other states that can measure arsenic as low as 1-2 µg/L in drinking water samples. Additional laboratories in the state are NJDEP-certified to conduct arsenic tests using other analytical techniques that measure arsenic from above 2 µg/L. You can call NJDEP's Office of Quality Assurance at (609) 292-3950 for more information on laboratories certified to test for arsenic in drinking water. Arsenic testing in drinking water generally costs less than \$50 per sample. The laboratory will instruct you as to how to collect the water sample, or they will collect it themselves.

It is recommended that you conduct two tests to confirm the concentrations. Even if the initial test is low, it is useful to conduct the second test to confirm the results.

Should I continue to use my water if arsenic is found?

For drinking?

If arsenic is detected above the new MCL of 5 µg/L, do not use it for drinking, cooking, mixing baby formula, or in other consumptive ways. It is recommended that methods of arsenic removal be explored in these instances.

At this time, NJDEP recommends arsenic removal for residences whose well water contains arsenic above 5 µg/L. Any corrective action on water with arsenic levels at or below 5 µg/L is considered a personal decision at this time.

Do not boil your water as a method of treatment. This will result in increased arsenic concentrations in your water. Water evaporates but arsenic does not, so boiling results in a higher concentration of arsenic in your water.

For bathing and other uses?

Arsenic does not evaporate readily from drinking water. Therefore, even at relatively high levels, arsenic does not pose an inhalation risk from drinking water. At the arsenic levels found in NJ ground water, exposure through skin absorption and inhalation are not considered to be significant. Showering, bathing and other uses, therefore, do not need to stop if arsenic levels are elevated.

How can I reduce arsenic levels in my water?

If you choose to reduce the arsenic concentration in your drinking water, there are several short-term and long-term solutions. Purchasing bottled water for drinking and cooking is a viable short-term solution until a more permanent one is established.

If your arsenic levels are above 5 µg/L, connection to a public water system may be your best option, if possible. However, in many areas of the state, it is not possible or cost-effective. Well replacement may be an option, but, unless the local geology and sources of arsenic are fully understood, deepening your existing well or drilling a new one may not necessarily provide better quality water. In cases where connection to a community water system or installation of a new well are not possible, water treatment systems can be installed. There are two types that can be used for arsenic removal:

- 1) point-of-entry treatment (POET) systems treat the water for the entire household; and
- 2) point-of-use (POU) systems treat the water at the kitchen tap.

A granular ferric adsorption system is the preferred treatment technology. This system effectively removes arsenic from water, it is easy to operate and maintain, and the arsenic is not returned to the environment via regeneration.

For a family of three, with typical water use, a granular ferric POET system can operate with minimal maintenance for two to three years, depending on the arsenic concentration. Based on a NJDEP cost survey, the average cost of installing this type of system is approximately \$3,000 and the annual cost of maintaining it is estimated at to be about \$350.

Another option is a granular ferric POU cartridge system that removes arsenic from a single tap in the home, usually at the kitchen sink. The cartridges contain the same media as the whole-house system. These systems typically produce two quarts per minute and are used to provide treated water for drinking and cooking only. Cartridges are typically changed once per year. Based on a NJDEP cost survey, the average cost of installing this system is \$400 and the annual cost of maintaining it is estimated at \$120.

Other technologies to remove arsenic from water include anion exchange and reverse osmosis. Homeowners should work with their local health officers to determine which system is best for removing arsenic, given the geology, water chemistry and use of the water.

For further information on removal units, contact your local health officer and/or a water treatment company specializing in residential water treatment to determine which type works best in your area. Also, you should find out if a local health department permit is required. If you install a system, be sure to conduct another arsenic test after the water has been treated to verify that the system is working effectively to reduce arsenic to an acceptable level.

Where can I go for more information?

If you have any questions or wish to discuss the results of your water test with a knowledgeable professional, please contact your local or county health department or the DEP Bureau of Safe Drinking Water at (609) 292-5550. Consult the blue pages of your phone book for the numbers of your local or county health department. You can also contact the NJ Department of Health and Senior Services, Consumer and Environmental Health Services at (609) 588-3120. For information about the Private Well Testing Program, see www.state.nj.us/dep/pwta or call (866) 479-8378.

