Arsenic Water Treatment for Private Wells in New Jersey
Frequently Asked Questions

This is a companion document to the New Jersey Geological & Water Survey Information Circular "Arsenic Water Treatment for Private Wells in New Jersey", which is available at njgeology.org.

The following frequently asked questions were adapted from the New Jersey Arsenic Awareness Initiative website under a Creative Commons Attribution-Non-Commercial 4.0 International License. The New Jersey Arsenic Awareness Initiative reflects the combined efforts of the Barnard College 2011, 2012 and 2014 Workshops in Sustainable Development, the Barnard Instructional Media and Technology Services Department, the Hunterdon County Department of Health, the New Jersey Department of Environmental Protection Division of Science and Research, the New Jersey Geological and Water Survey, the Columbia University Superfund Research Program Research Translation group, and a group of New Jersey environmental and health professionals, and concerned citizens.

Arsenic Basics

What is arsenic?

- Arsenic is a toxic element. It occurs naturally in rocks and soils, and commonly occurs in groundwater and well water.
- The main toxic form of arsenic is inorganic arsenic. Arsenic compounds found in water are inorganic and toxic.
- Some food, like rice, can contain inorganic arsenic (Davis and others, 2017). There are also organic forms of arsenic in seafood. Seafood arsenic compounds are generally not toxic.

Why is there arsenic in my well water?

- Arsenic in New Jersey well water is predominantly naturally occurring. It dissolves into groundwater from arsenic-bearing minerals, most commonly in many of the bedrock aquifers of Central and Northern New Jersey (NJDEP, 2004; Serfes and others, 2010). No association between arsenic in private wells and known contaminated sites has been identified in New Jersey. Figure 1 shows the percentage of tested private wells exceeding for the arsenic drinking water standard by New Jersey physiographic provinces.

How can people reduce their exposure to arsenic?

- The most immediate option is to switch to bottled water for all drinking and cooking. Note that simple water filters (such as activated carbon filters) available in the hardware store are NOT effective for arsenic removal. Also note that boiling water DOES NOT remove arsenic from water, but rather increases its concentration as water is evaporated.
- If your water has elevated arsenic, information on treatment options and providers is available at: tinyurl.com/arsenichelp.

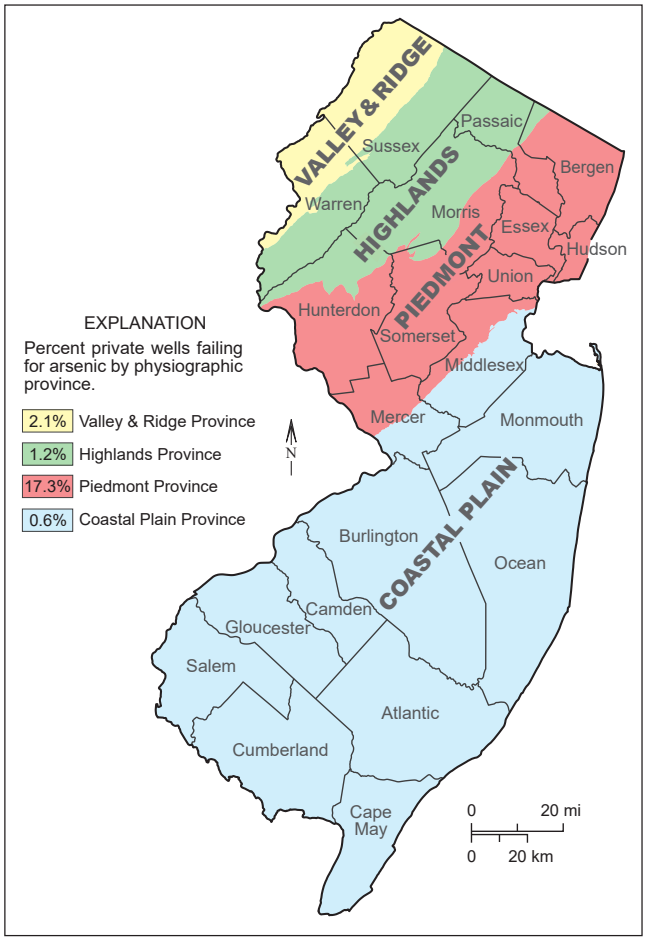

Figure 1. Arsenic exceedance in private wells by physiographic province.

- Long term, if unable to connect to a public water system, families should strongly consider either installing an appropriate treatment system. If a treatment system is installed, water should be tested for arsenic annually to ensure the water is safe to drink and the system is working properly.
- Currently the New Jersey Housing and Mortgage Finance Agency has a 0% interest 10-year loan program to help homeowners spread the initial cost of buying and installing water treatment units. Information on the program is available at: state.nj.us/dca/hmfa/consumers/homeowners/and state.nj.us/dca/hmfa/consumers/docs/ho_potablewater_fs.pdf

Testing Your Well Water and Understanding the Results

Why should we have our well tested for arsenic?

- Arsenic is a known carcinogen via ingestion of drinking water.
- Arsenic has no smell, taste, or color when dissolved in water, even in high concentrations. These properties have made arsenic an excellent poison for centuries.
- Testing a water sample is the only way to know how much arsenic is present in a well.
- United States Environmental Protection Agency (USEPA) regulations and testing are limited to public water sources and do not cover private wells. If your family gets their water from a private well, you should have your water tested for arsenic.

How often should we get our well tested?

- Based on a recent study (Mailloux and others, 2020), the New Jersey Department of Environmental Protection (NJDEP) encourages testing your well for arsenic as follows:
  - If your arsenic level is above 2.5 µg/L you should test annually.
  - If your arsenic level is below 2.5 µg/L you should test at least once every five years (Mailloux and others, 2020).

Where can we get our well water tested?

- The New Jersey Arsenic Awareness Initiative recommends that homeowners buy a home test kit to check arsenic levels in their water.
- A list of certified labs can be obtained via the NJDEP DataMiner (njems.nj.gov/DataMiner/Search/SearchByCategory)
- NJDEP's Office of Quality Assurance provides lists of certified labs, and they can be reached by phone at 609-292-3950.

Should we test for anything else besides arsenic?

- The New Jersey Department of Health encourages well owners to test as follows (NJDOH, 2019):
  - Once per year for total coliform, nitrates, and pH.
  - Once every five years for arsenic, lead, iron, manganese, and volatile organic chemicals.
  - At least once for mercury (in Southern New Jersey), gross alpha (statewide), and uranium (in Northern New Jersey).
- If your well water has not yet been tested for the full set of Private Well Testing Act contaminants now is a good time (see more information on this below).
- If your well water has ever exceeded state standards for any of the contaminants, it should be tested yearly for those contaminants, including after treatment systems have been installed to make sure the treatment system is working effectively.

What do my test results mean?

- In New Jersey, the standard for arsenic is 5 micrograms per liter (µg/L). Some labs report arsenic results in milligrams per liter (mg/L) and in these units the arsenic standard is 0.005 mg/L
- If arsenic levels are greater than 5 µg/L, DEP encourage the temporary use of bottled and/or properly treated water for drinking and cooking and encourage the installation of an effective arsenic water treatment system, or connection to a public water supply (NJDEP, 2022).
- A "not detected" test for arsenic does not mean that your water is safe with respect to other contaminants that have not been tested.

What does Maximum Contaminant Level (MCL) mean?

- The MCL is an enforceable standard for public water systems regulated under the Safe Drinking Water Act. Private well owners are responsible for managing the safety of their own drinking water and the MCL is the best available guidance.
- The Federal MCL for arsenic is 10 µg/L, established in 2001 by the USEPA using discretionary authority to consider the costs of treating publicly supplied water to meet this standard.
- New Jersey and New Hampshire have adopted a lower MCL of 5 µg/L, the most protective in the nation.
- Arsenic is a known human carcinogen via drinking water, and the USEPA has also set a maximum contaminant level goal for arsenic of 0 µg/L.

What does it mean that the "maximum contaminant level goal" for arsenic is 0 µg/L in drinking water?

- The maximum contaminant level goal (MCLG) is defined by USEPA as the level of contaminant in drinking water below which there is no known or expected risk to health and which allows a margin of safety.
- Because arsenic is a known human carcinogen via drinking water, the USEPA has determined that the MCLG for arsenic is zero in drinking water.
- The MCLG is usually lower than the Maximum Contaminant Level (MCL). The MCL is the highest level of a contaminant that is legally allowed in public drinking water systems. MCLs are set as close as feasible to the MCLGs. For arsenic, the New Jersey MCL is 5 µg/L.

What forms of arsenic are found in New Jersey well water?

- Arsenic in New Jersey well water occurs in two species arsenite (the reduced species - also referred to as As^{III}) and arsenate (the oxidized species - also referred to as As^{V}).
- Arsenite, due to its neutral charge, is much more difficult to remove from water than arsenate which is an anion (negatively charged).
- The New Jersey Geological and Water Survey (NJGWS) estimates that approximately 20% of New Jersey wells with arsenic above the MCL of 5 µg/L have significant concentrations of arsenite (Serfes and others, 2010).
- The tests to determine these species are not widely available from commercial labs, and arsenic is usually reported as total arsenic.
- There is a rule-of-thumb that can help determine the arsenic species (See next FAQ).

Is there any way to determine which arsenic species (arsenite or arsenate) is in my water?

- There is no simple and affordable test commercially available to determine which arsenic species is present, so the species of arsenic present is usually unknown.
- There is an arsenic speciation "Rule-of-Thumb" developed by the New Jersey Geological and Water Survey and Rutgers University that can be used to determine if arsenite may be a factor or not.
- The Arsenic Speciation Rule-of-Thumb is as follows: if the water has any of the following, it is likely the water is reduced

and arsenite is the predominant arsenic species:
  - dissolved concentration of iron greater than 100 µg/L (0.1 mg/L),
  - dissolved concentration of manganese greater than 50 µg/L (0.05 mg/L),
  - sulfur odor, or
  - negative oxidation reduction potential.
- The likelihood of having a significant portion of arsenite in your water increases as the number of the above items present in your water increases.
- If your water does not have the above items, it is very unlikely that the water contains a significant concentration of arsenite.
- See the section on Arsenic Species in the companion document for more information.

New Jersey Private Well Testing Act

Where can I get information on the New Jersey Private Well Testing Act (PWTA)?

- Go to the PWTA website at the NJDEP.

Arsenic Water Treatment Methods

What are my arsenic water treatment system options?

- Surveyed treatment providers in New Jersey and the NJDEP recommend adsorption systems to treat arsenic in private wells. In an adsorption system the arsenic in the water becomes attached to the surface of the arsenic treatment media inside the treatment tank. One of the biggest decision buyers are faced with is whether to treat all the water in the house or a single tap in the kitchen.
- A Whole-House treatment system with two adsorption tanks in series, which is often called "Point-of-Entry" (POE) because it treats all water in the home near the point where the water enters the home.
- The other type of treatment is single tap treatment, which is often called "Point-of-Use" (POU) because the treatment unit is usually near the single tap used for drinking and cooking water.

What would the recommended arsenic treatment system include?

- The recommended arsenic treatment system is a Whole-House two-tank adsorption system as shown in Figure 2. The system consists of:
  - a shut-off valve,
  - a 5-micron sediment pre-filter,
  - a raw water sample tap,
  - two 10x40 inch or 9x48 inch tanks each containing at least one cubic foot of adsorption media (if arsenic concentrations are greater than 50 µg/L, larger tanks and a greater volume of media should be considered in consultation with your water treatment professional),
  - automatic backwash control valves on each tank,
  - a sample tap between the tanks,
  - a 5-micron post-treatment sediment filter,
  - a shut-off valve after the system, and
  - a water meter (beneficial but optional in most areas).
- An effective system also needs to be maintained. To qualify as a well-maintained system, a water test must be conducted yearly from the kitchen sink and the sampling port between the two arsenic tanks. If the arsenic between the tanks is greater than 5 µg/L, your water treatment professional should remove the worker tank, replace it with the safety tank and install a new safety tank.

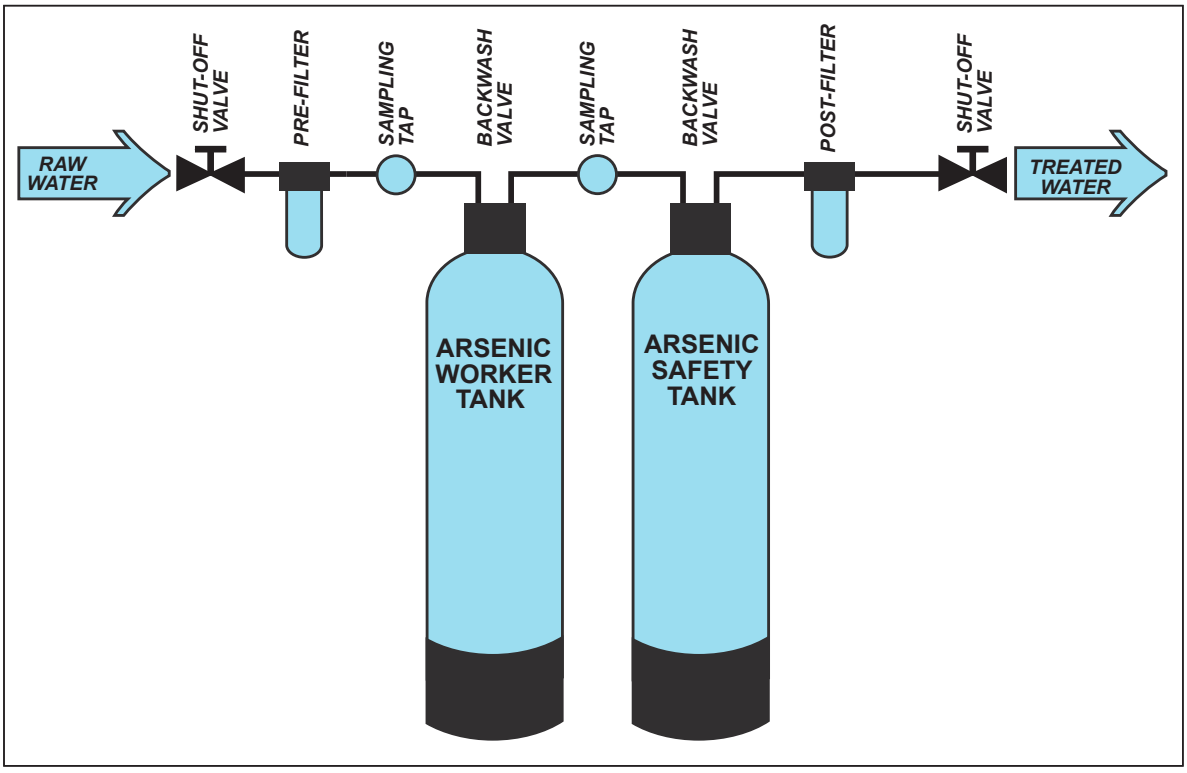

Figure 2. Arsenic water treatment system schematic.

Some vendors offer a one-tank Point-of-Entry system. What are the advantages and disadvantages of a one-tank system compared to the more common and recommended two-tank system?

- Advantages: Less expensive in the short term
- Disadvantages: With no back-up/safety tank, homeowners are at risk of drinking water with unhealthy levels of arsenic during the period after the arsenic begins to break through the treatment media and before the next water testing.

Why is the two-tank Whole House Point-of-Entry (POE) system significantly better than a one-tank POE system?

- A one-tank POE system is less expensive in the short term, but the absence of a back-up/safety tank puts the homeowners at risk of drinking water with unhealthy levels of arsenic during the period after the arsenic begins to break through and before the next testing event.
- The water goes through the first tank and then through the second tank. We call the first tank the "worker tank" because it performs most of the work removing arsenic. When the worker tank is new it will remove all the arsenic, but after about one year (depending on the arsenic level and how much water is used) the worker tank's arsenic removal efficiency will start to decline. When this occurs, some arsenic will start to break through the worker tank. With a two-tank system the second tank will remove the arsenic, and this is why the second tank is called the "safety tank".
- Without the safety tank, you would be exposed to the arsenic breaking through the worker tank. With only a one-tank system you won't know you're being exposed to arsenic until the next water test is obtained.
- A properly installed and maintained two-tank Whole House POE system will reduce your water arsenic exposure to zero, which is the USEPA maximum contaminant level goal for arsenic.
- A two-tank POE system is also more economical over the life of the system. With one tank you'll need to change the tank as soon as the concentration gets near 5 µg/L. Otherwise you will be exposed to arsenic levels above the state standard. However, with a two-tank Whole-House POE system, you could safely conduct once per year sampling and would not need to replace the worker tank until the concentration after the worker tank goes up to 10 or 20 µg/L, the safety tank will remove all the arsenic before it reaches the taps in your home.

How much space is required for a two-tank POE arsenic water treatment system?

- The typical two-tank POE arsenic water treatment system is 4-5 feet tall and requires a floor area of about 2 feet by 3 feet.
- Most homeowners find space for these systems in their basement near the well water pressure tank.

Are there any important differences between arsenic treatment media that are offered by treatment providers to filter out arsenic in adsorption systems?

- It's important to realize that if you choose a less expensive arsenic treatment media it may have a lower capacity to adsorb arsenic. This means you may need to replace the tanks more often and the system will likely cost you more over the long term. See the section on Treatment Media Performance in the companion document for more information.

Are pre-treatment sediment filters required in an arsenic treatment system?

- NJDEP strongly recommends a 5-micron pre-treatment sediment filter to prevent any dirt or geologic materials coming up from the well from clogging or fouling the arsenic water treatment equipment.

Why is it essential to have a post-treatment sediment filter?

- A 5-micron post-treatment sediment filter is essential to prevent any particles of treatment media, which may be highly enriched in arsenic, from getting into your drinking water supply. NJGWS staff have observed many cases of arsenic treatment media breaking through and getting into the drinking water.

What water treatment options are only effective at removing arsenate?

- Reverse Osmosis
  - Reverse osmosis is only effective at removing arsenate.
  - Reverse osmosis is **not** effective at removing arsenite.
  - Reverse osmosis can be an effective Point-of-Use (POU) treatment system for drinking and cooking water when only arsenate is present.
  - POU reverse osmosis has been found to be a good backup in combination with a Whole-House POE arsenic removal system when only arsenate is present (Rockafellow-Baldoni, 2016).
  - Whole-House reverse osmosis is **not** recommended due to cost, size of system, and the fact that reverse osmosis treated water should not be running through copper or other metal plumbing.

- Anion Exchange Systems
  - Anion exchange systems are only effective at removing arsenate.
  - Anion exchange systems are not effective at removing arsenite.
  - The anion exchange system requires regular maintenance that involves purchasing water softener salt to keep the brine tank filled. If the salt level is not maintained, the system will eventually stop removing arsenic and will dump the previously removed arsenic into the home's water at a very elevated concentration.
  - When an anion exchange system runs through a regeneration cycle, all the arsenic captured by the system will be flushed out of the tank and discharged somewhere near the home. The best place to route this discharge is the public sewer system or the home's septic system.
  - For the above reasons, we strongly recommend against using anion exchange for arsenic removal even if only arsenate is present.
  - However, for well water with a high pH (pH > 8.0), anion exchange can be an effective tool for lowering pH and can be used as pre-treatment in combination with a Whole-House Point-of-Entry (POE) arsenic removal system.

What water treatment options are NOT effective at removing arsenic?

The following treatments are not effective for removing any arsenic species:

- Boiling water (this will increase the arsenic concentration as water evaporates)
- Ultraviolet (UV) light
- Cation exchange (commonly called a water softener)
- Granular activated carbon (GAC)
- Aeration
- Magnetic water conditioners
- Pour-through water filtration pitchers
- Water filtration from the refrigerator
- Sediment filter

What are the advantages and disadvantages of Whole-House or Point-of-Entry (POE) systems?

- POE Advantages:
  - All water in the house is treated
  - Can drink water safely from any tap
  - Arsenic-free shower, bath, and laundry water
  - Can easily size system to maintain flows the same as before the treatment system was installed

- POE Disadvantages:
  - Initial installation cost
  - Estimated maintenance cost (about $1 a day as of 2014)

Why is the Whole-House Point-of-Entry (POE) system strongly recommended in New Jersey?

- The POE system is the most protective for you and your family's health.
- All water in the house is treated so any tap in the home can be used safely for drinking water.
- Water for bathing, showering, brushing teeth, and laundry will also be arsenic-free.
- A New Jersey study found that Whole-House arsenic water treatment provided more effective exposure reduction than Point-of-Use treatment (Spayd and others, 2015).

Are there any disadvantages of the Point-of-Entry (POE) system compared to the Point-of-Use (POU) system?

- The POE system has a higher initial cost.
- The POE system requires approximately 6 square feet of floor space in the basement, though it does not take up any space under the kitchen sink like a POU system would.

What are the advantages and disadvantages of the Point of Use (POU) System?

- POU advantages:
  - When POU is used for a single tap, installation cost is less for POU than for POE.
  - When POU is used for a single tap, maintenance cost is less for POU than for POE.
- POU disadvantages:
  - Water from untreated taps still contains unhealthy levels of arsenic.
  - Once the under the sink storage reservoir (for Reverse Osmosis) is depleted the flow volume will be down to a trickle until the storage reservoir fills back up with treated water, and this may take a couple of hours.
  - Some POU systems (reverse osmosis) only remove arsenate.
  - POU systems usually do not have a safety tank so users will be exposed to arsenic after the capacity is reached and before testing indicates the need for a replacement.
  - Studies have shown that in homes with a single tap arsenic POU water treatment system, or in homes using bottled water, it is not uncommon for people to occasionally drink from untreated taps, and when they do, arsenic levels increase in their urine (Spayd and others, 2015; Smith and others, 2016).
  - If POU treatment at the kitchen sink is used, the kitchen tap should be the only source of water used for drinking or cooking. If water may be used for drinking in other rooms of the home, such as a bathroom sink, either a POU unit should be installed at each potential drinking water tap in the home or a Whole-House Point-of-Entry (POE) system should be used.
  - When the cost of multiple POU systems is considered, it often becomes more economical to install a Whole-House POE system.
  - Some local health departments require Whole-House POE arsenic water treatment to ensure the health of current and future homeowners.

In the case of a home sale, who should choose the type of arsenic treatment system to install?

- In the case of a home sale, it is preferable that the buyer of the home choose the type of water treatment system and who will install it. The buyer will be drinking the water and living with the system, so it is important that they know what type of system they have, how to monitor and maintain it, and who to call for service.

Who should install my arsenic water treatment system?

- Contact a water treatment professional (NJDEP, 2022).
- However, the water treatment industry in New Jersey is not regulated and there is no state license, certification, or continuing education requirement to become a water treatment system designer or installer. The Water Quality Association, American Society of Civil Engineers, American Water College, among others, provide education and a voluntary professional certification programs for water treatment professionals.
- Checking reviews and references is recommended.
- Plumbing can be performed by the home owner, however it is preferable the work is completed by a company licensed for plumbing in New Jersey.

Using and Maintaining Your Arsenic Treatment System

How do I know the arsenic levels are safe once I've installed a treatment system?

- Test the treated water within two weeks of installation. This is very important. Even the best water treatment professionals can make a mistake and your system may not be working due to an error. NJGWS staff have seen homes with the wrong

Figure 3. Run water for 10 minutes before collecting a water sample. *Photo by S. Spayd*

media installed in the treatment tanks (pH adjustment media instead of arsenic treatment media). Good installations have been observed to not remove any arsenic for an entire year because of incorrect settings on the bypass valves. Hence the importance of the initial after-installation test.
- After the initial testing shows the system is working, you should test the water at the kitchen sink and between the worker and the safety tanks (on a POE system) once every year.

I heard that pH can be a problem. Do you ever need to adjust the pH for the arsenic treatment system to work well?

- It is much harder for arsenic treatment systems to remove arsenic when the pH of the water is greater than 8.0, and at higher pH (> 8.5), the life of the arsenic treatment media is greatly reduced.
- In New Jersey, wells with arsenic and a pH greater than 8.5, should have pH adjustment included in their system. This can be accomplished by installing an anion exchange system before the arsenic tanks. The anion exchange system will reduce the pH one or two units. The anion exchange system may also remove some arsenic which will also help increase the life expectancy of the arsenic treatment media, but we strongly recommend against relying on an anion exchange system to remove arsenic.
- Well water with arsenic and pH greater than 9.5 is a more difficult situation that will require the attention and recommendation of your water treatment professional. Injection of acetic acid or citric acid into the water before it goes into the arsenic tanks is one example of an approach for dealing with very high pH water.

What are the options for testing my water once the arsenic treatment system is installed?

- There are three main options for arsenic water testing:
- Lab Sampling - Lab Testing: Often, the most convenient option is to schedule someone from the lab to come out and collect the samples for arsenic testing.
- Water Treatment Company Sampling - Lab Testing: Some water treatment professionals will provide annual testing as part of their service. Obtaining a service contract from them will take the worry away from you and protect your family's health.
- Homeowner Sampling - Lab Testing: You can pick up the appropriate bottles from a convenient lab, collect the water samples yourself, and deliver them to the lab, but be sure to follow sampling protocols to be sure the sample is correctly collected.

Where can I find a water testing lab?

- Water testing labs can be obtained online via the DEP DataMiner website (njems.nj.gov/DataMiner/Search/SearchByCategory). Use a lab that is certified to test drinking water for arsenic and can provide a method detection limit (MDL) of 1 µg/L. The lab will report the total arsenic concentration.

Water Sampling Instructions

How should my water samples be collected?

- Stress the system: Run two cold water taps for at least ten minutes before collecting samples. This ensures the samples will not be from stale water in the plumbing (fig. 3).
- Collect the between-the-tanks treated water sample. This is the most important sample to collect when you have a two-tank Whole House system. See Figure 4 for the sampling location.
- Collect a sample of fully treated water at the kitchen sink:

What should I test my water for after the system is installed?

- If arsenic is your only water quality problem, test for arsenic every year along with nitrates and total coliform, which can change from year to year.
- You don't need to purchase the full Private Well Testing Act (PWTA) package every year but testing for all PWTA contaminants once every five years is recommended.

Should the water run for a certain length of time when collecting samples to test my water?

- Yes, the treatment system needs to be stressed to be sure it is working effectively when multiple taps are on at the same time.
- To test Whole-House POE systems, you should run two cold-water taps at 3-5 gallons per minute (simultaneously running the cold water in a bathtub and a sink is usually sufficient) for 10 minutes before and during the filling of the sample container at the tap between the tanks (fig. 4).
- The reason for stressing the system is that all water treatment systems require contact time between the water and the treatment media to remove all the arsenic. The more taps that are on at the same time in the home, the faster the water goes through the tanks, and this shortens the contact time. You want to make sure the system is removing the arsenic during high water use times in the home (for example, two showers at one time, or a shower and the dishwasher or washing machine are running at the same time).

How often should I test my water quality after I have installed a treatment system (and after I've done a post-installation test)?

- Once per year you should test the water coming from the kitchen tap.
- With a two-tank Point-of-Entry system you should also test the water between the two tanks once per year.

Figure 4. A whole house arsenic water treatment system with worker and safety tank showing location of sample tap between the tanks. *Photo by S. Spayd.*

How can I remember to test my treated water once per year?

- You can add a yearly recurring event to your electronic calendar to remind you that it is time to test your water.
- You can pick a day of the year - maybe a holiday - and always schedule your water test for that day each year. One person picked Valentine's Day for their water test reminder day saying, "My love for my family reminds me to make sure they're not being exposed to arsenic."
- If you obtain a service contract with your water treatment professional, ensure that a yearly arsenic test is included.

In addition to test results, are there any other signs that your media needs to be replaced or the treatment system is failing?

- No. Unfortunately the only way to tell if your arsenic treatment system is working is through a water test. Because arsenic is colorless, odorless, and tasteless you would not be able to tell if it is breaking through the treatment system by looking at, tasting or smelling your water.

Are there any other maintenance system requirements besides regular testing and media replacement when test results indicate the filter is no longer working?

- All treatment systems require pre-treatment sediment filters to be changed on a regular basis. The timing of sediment filter changes depends on the specific characteristics of your well and water. If the water pressure in the home gradually drops, the first thing to check for is a clogged sediment filter.
- The post-treatment sediment filters will probably only need to be changed once a year.

Is there waste from the arsenic treatment system that I'll need to dispose of safely?

- Your water treatment professional should take care of the proper disposal of used treatment media.
- Used arsenic tanks should be tightly closed and disposed of.
- Treatment installers should never "re-bed" (empty the used media and replace with new media) in your home.
- Due to the high arsenic level in the used treatment media, it should not be touched with bare hands.

Water Treatment Financing

Is there financing available for arsenic water treatment?

- The New Jersey Housing and Mortgage Finance Agency offers no-interest loans through its Potable Water Program to cover the cost of installation: state.nj.us/dca/hmfa/consumers/homeowners/ and state.nj.us/dca/hmfa/consumers/docs/ho_potablewater_fs.pdf (accessed July, 2022)

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All information current as of July, 2022.

More Information

If you have unanswered questions, see the companion document, NJGWS Informational Circular "Arsenic Water Treatment for Private Wells in New Jersey".

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2023

Comments or requests for information are welcome.
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Visit the NJGWS website @ https://www.njgeology.org/

This information circular is available upon written request or by downloading a copy from the NJGWS website.

Banner: *Photos courtesy Columbia University's New Jersey Arsenic Awareness Initiative.*