Ohio Department of Health

Private Water Systems

Bureau of Environmental Health

"To protect and improve the health of all Ohioans"

Private Drinking Water

Drinking Water Wells and Springs Under the Direct Influence of Surface Water Bodies

Water Treatment for Harmful Algal Bloom (HAB) Cyanotoxins

What types of Private Water Systems might be at risk from Harmful Algal Bloom (HAB) Cyanotoxins?

Algae have always been regarded as a problem for lakes and ponds of all types. However, if your drinking water well or spring is located close (within 100 feet) to a lake, pond or stream, your well or spring may be under the direct influence of those bodies of water and susceptible to contamination including harmful algal bloom (HAB) cyanotoxins. Harmful Algal Blooms (HAB) produce cyanotoxins such as microcystins, anatoxin, cylindrspermopsin, and saxiton. When present at low levels, the cyanotoxins can make water unsafe to drink. When present at higher levels, the water can be unsafe to use. Please note that not all algae produce toxins, but it's often difficult to tell the difference between a harmful algal bloom and other, harmless, algae forms.

If your well or spring is located near (within 100 feet) a lake, pond, stream, or river, consider having the water tested for algal cyanotoxins (see fact sheet Private Drinking Water – Testing for Harmful Algal Bloom (HAB) Cyanotoxins). If you are not able to test your water for cyanotoxins and are unsure about the ability of your well or spring to filter out the algae or cyanotoxins, or the capabilities of your treatment system, you should consider developing an alternative water source, such as a hauled water storage tank, or use bottled water during times of increased algal growth in nearby lakes or ponds.

How do I treat my water to reduce the risk from HAB cyanotoxins?

The water treatment system requirements for your well system are going to be dependent on the degree of influence by the nearby body of water. For example, the water treatment system for a private water system pond is designed to work in multiple stages to maximize the effectiveness of the final disinfection stage to make the water potable and safe for human consumption. If your well or spring is under the direct influence of surface water lakes, ponds, streams, or rivers you may need the same level of water treatment and disinfection.

There are several steps in the water treatment process for reducing algae and cyanotoxins from your finished water. Reduction of algae and the cyanotoxins in a private drinking water system can be done using a combination of watershed management and maintenance, filtration, oxidation with chlorine, and granular activated carbon (GAC) or powdered activated carbon (PAC).

If your well or spring is under the direct influence of a surface body of water, then protection of the watershed is the first line of defense to protect water from contamination and nutrient buildup. If you have control of the watershed, you should practice good management practices such as controlling fertilizer and other nutrient runoff to prevent HAB formations in the first place. A variety of algaecides, including copper sulfate, can be used in surface water that is a source for drinking water (ponds) or directly influences a source for drinking water, such as a well or spring. Use algaecides that meet NSF/ANSI Standard 60, Drinking Water Treatment Chemicals - Health Effects (they can be found at www.nsf.org). However, once algae have become well established in a body of water, it actually becomes more detrimental to treat the algae in the pond. This is because as the HAB cells are killed they may burst (lyse) and release more cyanotoxins into the water.

However, you may not have much control over the management of the watershed that is influencing your well or spring as many lake and pond watersheds are under the control of multiple entities. These typically do not have any management requirements and are subject to runoff from a variety of contamination sources.

A water well is usually cased with steel or plastic pipe, and when properly constructed, usually provide a significant level of protection from shallow water infiltration. Ideally, a

water well casing should extend 20 feet below the bottom elevation of the nearby body of water. Dug wells are usually lined with brick or stone, provide no protection against shallow water infiltration, and should be replaced. The overall level of protection is going to be dependent on proper well construction and the porosity of the formation. Some formations may have the ability to filter out some the algae before the water enters the well. However, if the water appears greenish or bluish-greenish, then the natural filtration through the formation is inadequate and whole-house treatment for the HAB cyanotoxins should be installed. It should be noted that in some instances wells constructed through highly permeable formation, such as porous karst limestone, may not provide adequate protection from HAB cyanotoxins *even with proper well construction*.

Step 1: Pre-Filtration

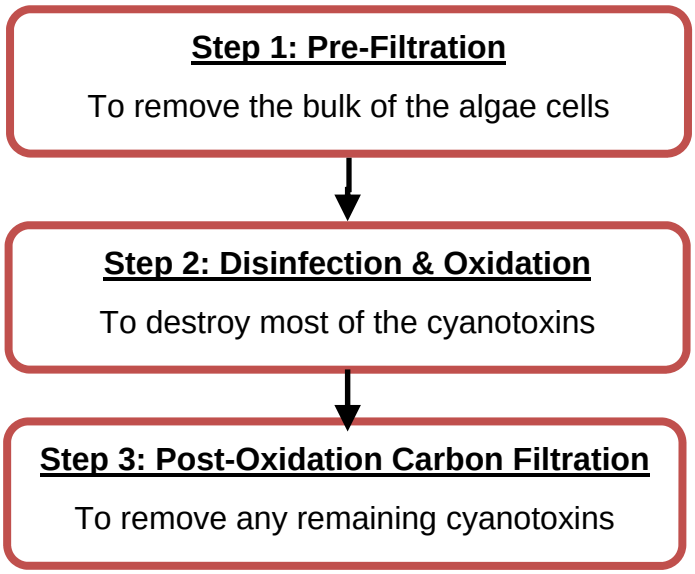
The first step in treatment to filter out as many of the algae cells as possible before the water enters the disinfection system. Typically, a sand filter is used. Sand filters do not filter cyanotoxins already in the water. Pressurized rapid sand filters are the most common filters used for drinking water. However, there is concern by some experts on the effectiveness of backwashing pressurized rapid sand filters for reducing significant levels of HAB cyanotoxins. This is because of the potential for cyanotoxins to be released during the backwash cycle as the algae cells burst. If backwashing pressurized sand filters are used in the treatment process, it *should be preceded by a coagulation step in order to reduce the amount of algae cells entering the filter.* An absolute 1 or 2-micron sized cyst reduction filter should immediately follow the pressurized rapid sand filter (An absolute filter is capable of removing 90 percent of cells or particles 1 or 2 microns in size or larger). A cyst reduction filter is designed to remove protozoans but may also remove some of the algae cells. A properly designed slow sand filter can remove algae-sized particles. Slow sand filters work by gravity and do not have a backwash cycle. However, they are large and can take up a lot of space and very few are manufactured at a size designed for individual homes.

Step 2: Disinfection and Oxidation

The next step is disinfection and oxidation. Chlorine does both. Chlorine levels for normal disinfection have to be a minimum of 0.2 ppm (parts per million) after 20 minutes of contact time with the water. However, higher chlorine doses are required to remove many of the cyanotoxins. The recommended dose of chlorine is 3 ppm for 30 minutes of contact time with the water in order remove some of the cyanotoxins. It is important to note that the oxidation stage should always be after the pre-filtration stage to remove as many algae cells as possible before the disinfection and oxidation step. If algae cells are still in the water being treated, oxidizing can cause them to burst (lyse) and release additional cyanotoxins into the water. These additional cyanotoxins that are released when the cell bursts may not have the required contact time in the oxidation stage needed to destroy them.

Some people may already have an oxidation system that uses chlorine, iodine, ozone or hydrogen peroxide to treat aesthetic water conditions. Please be aware that a water softener is *not* an oxidizing water treatment system and will *not* treat algae or cyanotoxins.

You may find some literature indicates that cyanotoxins can be removed by ultraviolet light (UV) disinfection systems. However, UV disinfection systems designed for home use do *not* generate the needed light intensity to affect the cyanotoxins. If you already have a household UV unit, you should consider adding an additional oxidation stage using chlorine, ozone or hydrogen peroxide.



Step 3: Post-Oxidation Carbon Filtration

The final treatment step following oxidation is the use of granular activated carbon (GAC) or powdered activated carbon (PAC) filter units to remove any remaining cyanotoxins. Currently activated carbon is considered the most effective method for reducing cycanotoxins. Larger whole-house activated carbon operation is recommended, but carbon filters can also be installed at frequently used taps.

Whole-house GAC or PAC filters should be installed in a tank with a bed depth of at least two feet. The three primary types of activated carbon filters are coal based, coconut hull based, and wood based. Although all activated carbon filters can remove some of the HAB cyanotoxins, wood based GAC filters have been shown to be the most effective. The activated carbon filters will also remove other chemicals like tannic acids, chlorine and chlorine by-products. The installation and sizing of an activated carbon filter treatment device for removing all contaminants should be done by a professional water treatment dealer who is registered as a private water system contractor with the Ohio Department of Health (see link at the bottom of the page). Remember that the activated carbon in these filters

is only effective at removing contaminants for a period of time and needs to be replaced. If the filters are not replaced in a timely manner the carbon will cease to work and also could release cyanotoxins that it has previously removed.

Please be aware that in years where there is increased rainfall and/or there are more and higher warm weather days than normal, HABs in a pond or lake may overwhelm disinfection and filtration treatment systems and the treatment may not be as effective at reducing higher levels of the different types of cyanotoxins. During these situations, you may *still* need to seek an alternative water supply, such as hauled water or bottled water, until cyanotoxin levels have naturally declined.

How do I get a treatment system installed?

The installation of water treatment for HAB cyanotoxins on your private water system well requires an alteration permit from the local health department prior to installation of the whole-house treatment system. If your well is under the influence of surface water, then the construction of the well should be evaluated. If your well appears to be contaminated by algae and cyanotoxins, then it is likely that well may also be contaminated with bacteria and viruses. If the surface water influence on the well can be corrected by proper well construction then you may need to have the well replaced. Any work done on a private water system and treatment system must be done by a private water system contractor registered with the Ohio Department of Health. You can review a list of registered contractors at: http://www.odh.ohio.gov/odhprograms/eh/water/PrivateWaterSystems/pwscontractors.aspx

Where can I learn more about HABs, cyanotoxins and their impacts on my water system?

- www.ohioalgaeinfo.com
- your local health department
- The Ohio Department of Health Private Water Systems program, (614) 644-7558.

Other Ohio Department of Health Factsheets related to Harmful Algal Blooms (HABs):

- Pond Water – Drinking Water Treatment of Blue Green Algae
- Harmful Algal Blooms (HABs) Disease in Animals
- Blue Green Algae / Cyanobacteria Harmful Algal Blooms (HABs)
- Harmful Algal Bloom (HABs) Ohio's Campground Operators and Privately-Owned Lakes and Ponds
- Blue Green Algae / Cyanobacteria Harmful Algal Bloom (HABs) Physician Reference
- Private Drinking Water – Testing for Harmful Algal Bloom (HAB) Cyanotoxins

Where can I get more information about my private drinking water?

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