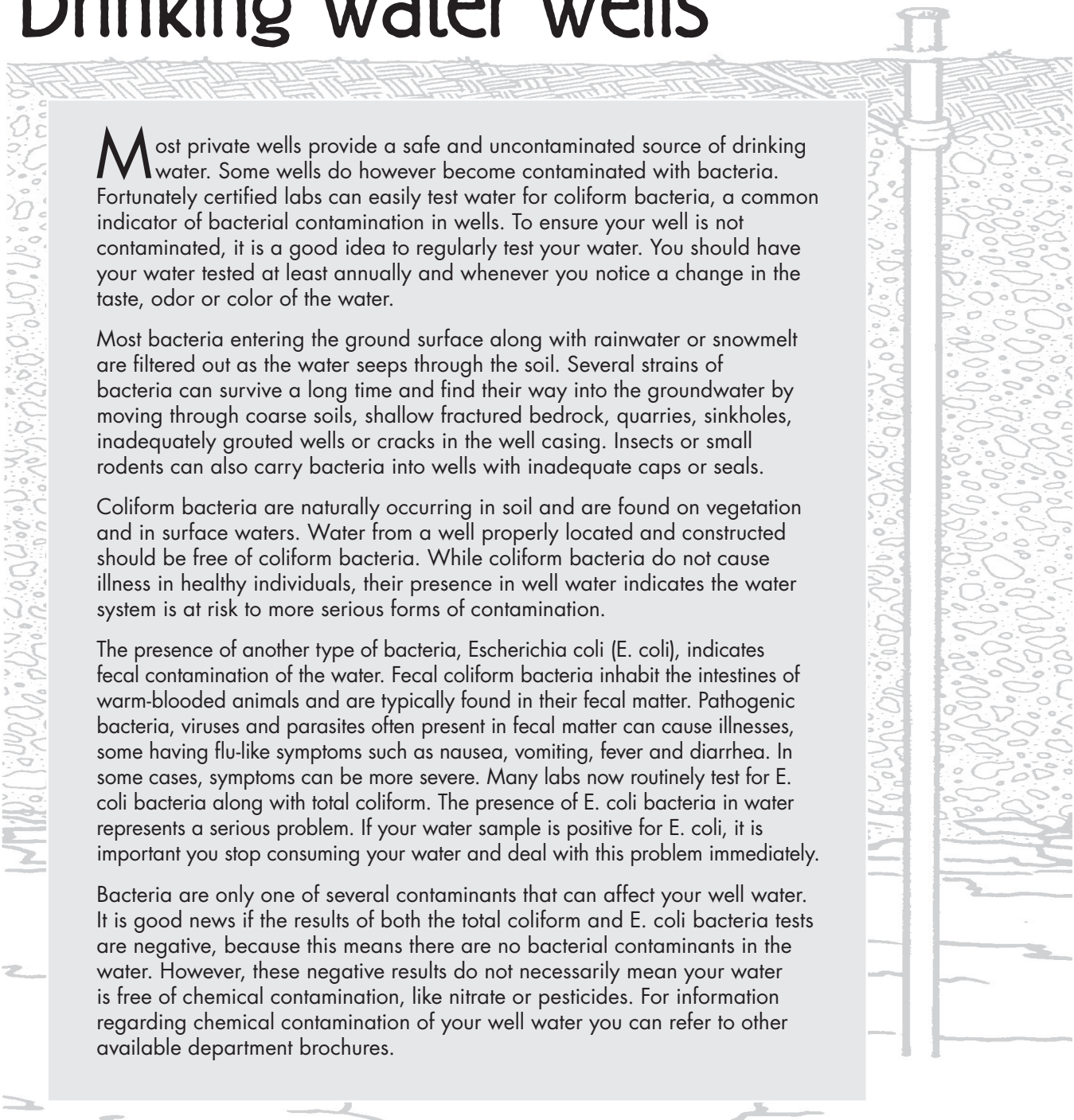
Bacteriological Contamination of Drinking Water Wells



Most private wells provide a safe and uncontaminated source of drinking water. Some wells do however become contaminated with bacteria. Fortunately certified labs can easily test water for coliform bacteria, a common indicator of bacterial contamination in wells. To ensure your well is not contaminated, it is a good idea to regularly test your water. You should have your water tested at least annually and whenever you notice a change in the taste, odor or color of the water.

Most bacteria entering the ground surface along with rainwater or snowmelt are filtered out as the water seeps through the soil. Several strains of bacteria can survive a long time and find their way into the groundwater by moving through coarse soils, shallow fractured bedrock, quarries, sinkholes, inadequately grouted wells or cracks in the well casing. Insects or small rodents can also carry bacteria into wells with inadequate caps or seals.

Coliform bacteria are naturally occurring in soil and are found on vegetation and in surface waters. Water from a well properly located and constructed should be free of coliform bacteria. While coliform bacteria do not cause illness in healthy individuals, their presence in well water indicates the water system is at risk to more serious forms of contamination.

The presence of another type of bacteria, Escherichia coli (E. coli), indicates fecal contamination of the water. Fecal coliform bacteria inhabit the intestines of warm-blooded animals and are typically found in their fecal matter. Pathogenic bacteria, viruses and parasites often present in fecal matter can cause illnesses, some having flu-like symptoms such as nausea, vomiting, fever and diarrhea. In some cases, symptoms can be more severe. Many labs now routinely test for E. coli bacteria along with total coliform. The presence of E. coli bacteria in water represents a serious problem. If your water sample is positive for E. coli, it is important you stop consuming your water and deal with this problem immediately.

Bacteria are only one of several contaminants that can affect your well water. It is good news if the results of both the total coliform and E. coli bacteria tests are negative, because this means there are no bacterial contaminants in the water. However, these negative results do not necessarily mean your water is free of chemical contamination, like nitrate or pesticides. For information regarding chemical contamination of your well water you can refer to other available department brochures.

How can my well become contaminated?

Your water supply may become bacteriologically contaminated because of one or more of the following reasons:

1. There is a source of contamination too close to the well and the casing does not extend deep enough to assure bacteria have been adequately filtered out of recharge water to the aquifer.
2. The well may have been constructed using poor sanitary practices. Wells can become contaminated during the drilling process by the improper use of contaminated drill tools, casing pipe or drilling water. The installation of the pump, its discharge piping, or any other pump or pressure system component can also be the cause of contamination if they are not assembled and installed in a sanitary manner prior to their use. The State Private Well Code (NR 812) requires disinfection of any new well, the pump, pump discharge piping and the pressure tank, prior to being placed in service.
3. Contaminated surface or near-surface water can enter a substandard or improperly constructed well in any of the following ways:
   - Dug wells lined with poorly sealed brick, stone or tile curbing, or having unsealed covers, can allow unfiltered water to get into the well.*
   - Casing improperly sealed through a shallow unconsolidated or bedrock geological formation may allow contaminated water to migrate downward into the aquifer.*
   - Surface water can enter the top of the well casing if the casing does not extend far enough above the ground surface.
   - The well casing terminates in a basement, pit or alcove subject to flooding or seepage of water.*
   - An old well casing may become badly corroded and allow water to seep into the well through holes in the casing.*
   - A well with a noncomplying casing depth setting can allow contaminated near-surface water to enter the well.*
   - A well having old, substandard 'stove-pipe' casing can allow near surface water to enter the well.*

   * **Note:** A well with the defects indicated with an asterisk cannot be easily repaired and typically needs to be replaced with a new code-complying well.
4. The aquifer may be a highly fractured bedrock formation or a coarse gravel deposit that does not adequately filter recharge water percolating down from the ground surface into the aquifer.
5. The well cap is not vermin proof, or may be loose or poorly installed allowing insects, spiders or small animals to enter the well.
6. There may be a 'cross-connection' between the well or plumbing system and the septic or sewerage system.

When should I test my well for bacteriological contamination?

The State Well Code requires all new wells to be tested for bacteriological quality. Wells must also be tested following the installation or reinstallation of a pump, or anytime a well is entered for repairing or reinstalling equipment within the well. Existing wells should be tested annually, after modifying the well in any way, or whenever there is any change in the taste, odor or appearance of the water.

The best times of the year to test your well water are when it is most likely to be unsafe. Statistically these times occur following a period of heavy snowmelt in early spring or during the hot stagnant time of late summer and early fall.

Where can I obtain a water-sampling kit for bacteriological testing?

A test kit (including sampling instructions) may be obtained from any laboratory certified to test water for bacteriological contamination. Homeowner help in locating certified bacteria labs can be found online at **dnr.wi.gov**, Search: Bacteria testing. When collecting a water sample make sure you carefully follow all instructions for sampling and handling.

What do the test results tell me?

Bacteriological analyses of water samples are completed to determine the safety of the water for drinking and preparation of food. If a sample was collected according to directions included with the kit and the lab subsequently reports the sample as bacteriologically "safe," then "total coliform bacteria" were **not** found in the water. You can then be reasonably sure the water is bacteriologically safe to drink.

On the other hand, when the lab reports the sample as either bacteriologically "at risk" or "unsafe," then total coliform and/or *E. coli* bacteria **were** found in the sample and you should **not** drink the water. Total coliform bacteria are only an indicator bacteria and are not, by themselves, usually a health concern for healthy individuals. But their presence in well water indicates an increased risk that pathogenic (disease-causing) bacteria are also present in the water.

Well water reported by the lab as being "at risk" or "unsafe" should **not** be consumed or used for preparation of food unless it is first boiled for at least one minute, at a rolling boil. If you need additional help in interpreting the results of your water analysis, contact your laboratory.

(**Note:** Boiling water for a long time reduces the volume of water and can increase the concentration of any nitrate that may be present in the water. This can make the water more hazardous for infants.)

What should I do if my well water is bacteriologically unsafe?

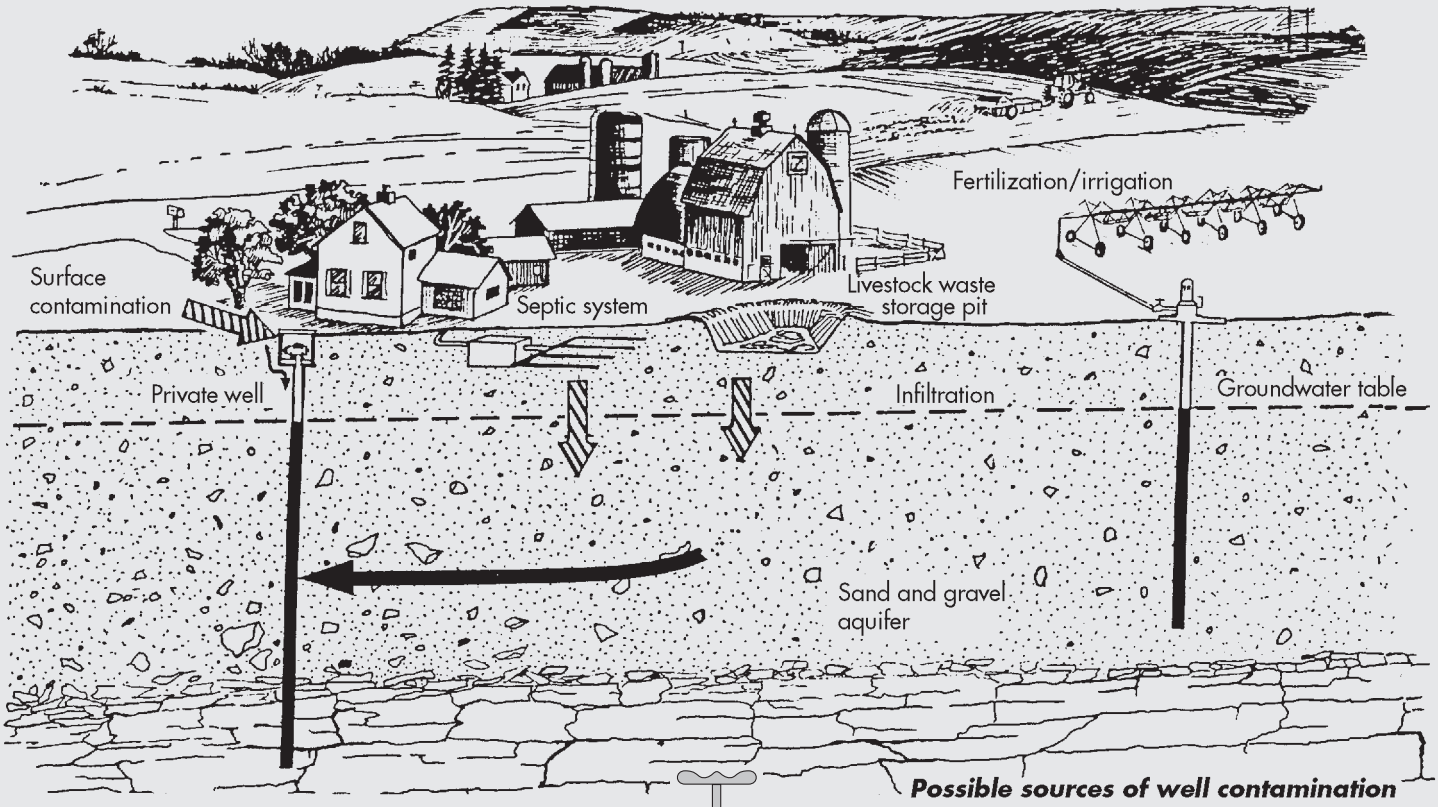
1. First resample your well. Collect another water sample and have it analyzed to confirm your first "at risk" or "unsafe" result. Be sure to use the proper sampling procedure when you collect the sample. This will help you determine if your original sample result could have simply been a result of an improper sampling technique.
2. If the second sample result is also reported as being "at risk" or "unsafe", do **not** consume the water unless you boil it, at a rolling boil, for at least 1 minute.
3. If you find no obvious sources of contamination of your well or water system, you should have your entire system inspected and disinfected by a Licensed Well Driller or Pump Installer. You can disinfect your well yourself if you follow the precautions and directions at the end of this brochure.
4. If your well does not have a Department-approved vermin-proof well cap or seal, have one installed by your Licensed Well Driller or Pump Installer.

   To find a Licensed Well Driller or Pump Installer, look in the back of your phone book under "Water Well Drilling & Service," "Pump Service & Repair" or "Water Supply Systems." Homeowner help in locating a Licensed Well Driller or Pump Installer in your area can be found online at **dnr.wi.gov**, Search: licensed drillers pump installers.

How can I find possible sources of my well contamination?

If your water is unsafe and you have ruled out sampling procedural errors, then check the area surrounding your well for possible sources of contamination, including animal yards, septic systems, sewers, abandoned or improperly filled and sealed wells, landfills, sinkholes, quarries, bedrock outcroppings, etc.

Other possible causes of an unsafe water condition include inappropriate openings in the well head, a damaged or corroded casing, an inadequate casing depth setting, faulty installation of a pitless adapter or any other component of the pump installation. If any of these items seems to be a likely cause of your well contamination, the necessary repairs should be made to your water system. You can ask a Licensed Well Driller, or Pump Installer to assist you in inspecting your well and water system and to recommend whether or not your system should be modified, upgraded or replaced.



Possible sources of well contamination

How can I disinfect my water system?

Safety: Before you begin, consider safety issues, first and foremost.

You may disinfect you water system yourself, but if you choose to do so it is very important you first heed the following important safety precautions:

Electrical: If you undertake this procedure you will be working with both water and dangerous voltages of electricity, a potentially lethal combination. Use extreme caution to protect yourself and others from electrical shock. If you are not familiar with electrical systems, seek help from a licensed professional. If you have the necessary knowledge and experience, use the following precautions before and during a disinfection procedure:

- Turn off the electrical power to the pump at the circuit breaker before removing the well cap.
- Wear rubber gloves and rubber-soled footwear.
- After removing the well cap or seal, examine the wires and connections for potential electrical safety hazards. Have any damaged features repaired or replaced.
- Keep the power off when adding the chlorinated solution into the well.

Chemical: The use of chlorine products involves the risk of chlorine gas, which is very damaging to the eyes and lungs and can be deadly in extreme cases. Take the following precautions to protect yourself:

- Wear protective goggles or a face shield when using a chlorine product.
- Never mix chlorine and ammonia products. A mixture of these two products will create a concentrated chlorine gas.
- Stay upwind of your mixing containers and the well.
- Do not mix or use a chlorine product in an enclosed space like a pumphouse, alcove or well pit. (In fact, do not enter a pit for any reason because there can be a low oxygen level or a buildup of other harmful gases in a pit.) If your well is in a pit, an alcove or in your basement, hire a licensed professional to chlorinate the well.
- Do not use more bleach for the chlorine solution than the volumes recommended below.
- Do not drink heavily chlorinated water or bathe or shower in it. Doing so can damage skin and other tissue.
- Do not leave or store bleach products where children can get to them.

Disinfection Procedure

New wells and wells that produce bacteriologically unsafe water should be disinfected according to the following instructions:

1. Close gate valves so the chlorine solution will bypass your water softener and any other water treatment equipment. A strong chlorine solution can damage this equipment. You can disinfect these devices separately using the manufacturer's instructions.
2. Calculate the volume of water standing within your well according to the following:

   Volume of water standing within a well = Length of water column multiplied by the 'Volume factor' for your well. ('Volume factors' are listed below for given well diameters).

   Note: Length of standing water column = Total well depth minus depth to the static water level.

'Volume factors' - based on well diameter:

- 2-inch diameter = ¾ quart water for each foot of water standing in the well.
- 4-inch diameter = ½ gallon water for each foot of water standing in the well.
- 5-inch diameter = 1 gallon water for each foot of water standing in the well.
- 6-inch diameter = 1½ gallons water for each foot of water standing in the well.
- 8-inch diameter = 2½ gallons water for each foot of water standing in the well.
- 10-inch diameter = 4 gallons water for each foot of water standing in the well.

Example: Calculate the volume of water standing within a **6**-inch diameter well, 80 feet deep with a static water level of 15 feet.

First there are (80'- 15') = 65 feet of water standing within the well.
The volume of the water standing within this well will then be:
['Volume factor' X (80' – 15') ➡ [1.5 gal./ft. X 65 ft.] = 97.5 gallons of water standing within well.

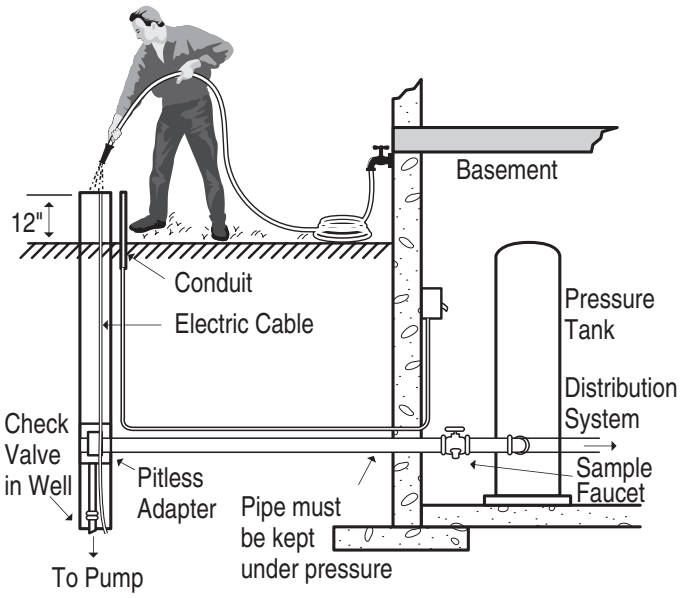
3. Using water from a known safe and uncontaminated source, add a volume of water – at least as great as the volume of water standing in the well – into clean new garbage cans or other comparable containers.
4. Using the table below calculate the volume of bleach (sodium hypochlorite) necessary to produce the desired chlorine concentration to disinfect the well and water system. Generally, for most water systems, a concentration of anywhere from 100 to 300 parts per million (ppm) will be adequate to disinfect the well and the plumbing system. (Most household bleaches contain between 5% and 6% available chlorine.) The bleach must be free of additives like 'fresh scent,' algaecides or thickening agents that can chemically contaminate your well.

   Note: For severe bacterial infestations perhaps involving a biofilm, like an iron or sulfate reducing bacterial slime, more aggressive approaches may be necessary. These approaches include a more concentrated chlorine solution, measures to control the pH of the solution, or the addition of salt (NaCl) or other department approved products. Sometimes it is also necessary to scrub the inside of the well with a chimney brush to help remove slime or mineral buildup that can harbor the bacteria. Contact a Licensed Well Driller or Pump Installer for these more difficult situations.

Volume of Bleach To Water Mix Ratio	Approximate Chlorine Concentration
¾ quart bleach per 100 gallons water	100 ppm
1½ quarts bleach per 100 gallons water	200 ppm
2 quarts bleach per 100 gallons water	300 ppm

5. Using this water and the calculated volume of bleach, prepare a chlorine solution that equals or exceeds the volume of water standing within the well. Add the bleach to the water-filled containers at a site upwind and close to the well so you are less likely to breathe the fumes and so you won't have to carry the solution too far.
6. Remove your well cap or seal and add about a half-cup to a cup of department-approved chlorine granules or tablets (calcium hypochlorite) down the well. (These products must also be free of additives.) The granules will disinfect the column of water standing within the well and prevent bacteria from being forced out into the aquifer when you add the large volume of liquid chlorine solution.

   (**Caution:** Do not use granular or tablet chlorine products in the arsenic problem areas of northeastern Wisconsin.)



7. Turn off the electrical power and, while wearing eye protection, rubber gloves and rubber-soled shoes, remove the well cap. Make sure you examine pump wires for chafed insulation or missing wire nuts. Have any necessary repairs made to the electrical system.
8. Pour or siphon the chlorine solution down the well, as rapidly as possible, in one continuous pour.
9. Connect a new clean hose to a nearby hose bib (faucet) and turn the electrical power back on. Turn the water on and recirculate the chlorinated solution through the hose and back to the well making sure you rinse the entire inside surface of the casing, all the way down to the water table.
10. Again turn off the electrical power and drain both the pressure tank and water heater. (Doing this will subsequently allow the water from these tanks to be totally replaced by the chlorinated solution.)
11. Turn the electrical power to the pump back on and let the well water refill the pressure tank and water heater.
12. Open every one of your water faucets throughout your plumbing system, both inside and outside, until you can smell the chlorine solution at each one.

    Note: For cartridge water filters, replace the cartridge after you have completed the chlorination process and completely flushed the system.
13. Turn all water taps off completely and allow the chlorine solution to remain in your well and plumbing system at least overnight, but preferably for 24 hours.
14. Flush the chlorine solution from the entire water system by using a hose connected to one of your outside faucets. Run the solution to a location away from your lawn and landscaping because it can damage them. Also make sure the chlorine solution does not get into a stream, river or lake. Chlorine, even in small doses, can kill aquatic life. Do not run the chlorinated solution into your septic system because it may kill the bacteria that

biologically breakdown the waste. The extra volume of the solution can also hydraulically overload the system. The flushing process can take a long time. Keep running the water until you can no longer notice a smell of chlorine from any of your faucets or taps.

15. After the chlorine solution has been completely flushed from the system, wait about a week and resample your water to make sure it is bacteriologically safe to drink.

Some General **DO's** and **DON'Ts**

DO check chlorine products before you use them. Chlorine concentrations vary from manufacturer to manufacturer and decrease in concentration with age. Some products contain inappropriate additives. It is also a good idea to confirm the concentration of the chlorine in the well using a test kit. This process will assure that you are adding enough, but not too much, bleach solution into the well. You may wish to confirm the pH of the chlorine solution in your well with test paper. The pH should not exceed about 7.5.

DO contact a Licensed Well Driller or Pump Installer for guidance if you do not feel confident you can safely undertake this procedure or for a situation involving a more difficult case of bacterial infestation or/or slime buildup. The professional contractor may wish to optimize the chlorine solution with pH control or by adding salt in order to obtain peak germicidal action from the chlorination process.

DO sample your well water about a week following the chlorination procedure and have it tested for coliform bacteria at a certified lab. If the sample is "safe", sample your water yearly thereafter, during early spring or late summer/early fall.

DO NOT chlorinate your well and water system as part of regular maintenance protocol unless you have recurring or persistent problems. Doing so can, in some cases, plug up the pump with sediment or damage the pump or components of the water system.

DO NOT use more bleach than necessary for the disinfection procedure. Doing so can raise the pH of the solution to a point where the effectiveness of the chlorination process is significantly reduced.

DO NOT use dry calcium hypochlorite products (granules or pellets) within the arsenic contamination areas of northeastern Wisconsin. When using a liquid bleach/water disinfection solution in these arsenic problem areas, **do not** use a chlorine concentration greater than 100 ppm or allow the solution to remain in the well for more than 30 minutes. Doing so can trigger geochemical reactions within the bedrock aquifers that can release arsenic into your well water.

Contact Us

Customer Service Staff are here to assist you 7 days a week, 7 a.m. to 10 p.m.

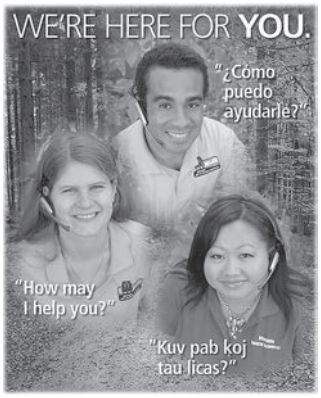
How may we help you?

Call Toll Free 1-888-WDNRINFO (1-888-936-7463)
Or, go to **dnr.wi.gov**, Search: Contact
Click on one of the following options:

Chat available from 7 a.m. to 9:45 p.m.

Call a representative 7 a.m. to 10 p.m.

Email your question.



Toll free hotlines

Violation Hotline:

1-800-TIP-WDNR or phone 1-800-847-9367
Confidentially report suspected wildlife, recreational and environmental violations.

Emergency Spill Hotline:

1-800-943-0003
phone

Bilingual Services are available

Drinking Water & Groundwater Program

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For more information, go to **dnr.wi.gov**,
Search: Drinking Water

This brochure was revised by the Wisconsin Department of Natural Resources with assistance from the Education Subcommittee of the Groundwater Coordinating Council.