Disinfecting Wells Following an Emergency

If you suspect that your well may be contaminated, contact your local or state health department for specific advice.

IMPORTANT: Fuel and other chemical releases and spills are common during flood events. If your water smells like fuel or has a chemical odor, contact your local or state health department to request a chemical analysis of your water before using it. Until you know the water is safe, use bottled water or some other safe supply of water.

Safety Precautions

You will need to clear hazards away from wells before cleaning and disinfecting wells after floods and other natural disasters. The following precautions will help you do that safely:

1. Before beginning any action, carefully inspect the area around the well for electrical and physical hazards. Those may include broken power lines on the ground or in the water; sharp metal, glass, or wood debris; open holes; and slippery conditions.
2. Wear thick rubber-soled shoes or boots to protect against electrical shock.

3. Turn off all power to the well area before clearing debris. Inspect all electrical connections for breaks in insulation and for moisture. Turn power back on only if all connections appear unbroken and dry with no opportunity for shock.
4. Do not turn on any electrical equipment if there is a persistent smell of fuel such as gasoline coming from the well head. Allow the well to vent. If the smell persists, contact your local or state health department. Do not continue with disinfection of the well until the contamination in the well has been removed
5. Before beginning work on the well, clear debris away from it to avoid inadvertently moving debris into the well.
6. When clearing debris from large-diameter wells (36 inches [approximately 90 centimeters (cm)] or greater), use grappling hooks, nets, and long-handled scoops to remove debris. Do not enter the well pit. Gases and vapors can build up in well pits, creating a hazardous environment.

Follow these additional precautions as you prepare to disinfect the wells:

- Chlorine solutions can cause chemical burns. Use rubber gloves, protective eye wear, and waterproof aprons or rain gear when working with chlorine solutions.
- When mixing and handling chlorine solutions, work in well ventilated areas and avoid breathing vapors. When working in closed spaces, use electrical fans to provide fresh air.
- Warn users not to drink or bathe in water until all the well disinfection steps have been completed and the well has been thoroughly flushed.

Here are some general instructions for disinfecting wells that may have become contaminated by harmful microorganisms in floods or other natural disasters.

Steps to Disinfect Drilled, Bored, or Dug Wells

Chlorination is a process of flushing your well water system with a chlorine solution to kill bacteria and other microorganisms. This process is recommended after floods and when a well has tested positive for bacteria. It is an effective method to eliminate germ contamination, but if problems exist with faulty well construction or groundwater contamination, chlorination is only a temporary solution. If contamination persists, further investigation may be needed to determine the problem.

The disinfection process can take from a few hours to a few days to complete. Make sure you store enough water to meet your household needs before you start this process.

Disinfection Procedure

Step 1. Scrub or hose off foreign material from the well curbing or casing. If the well cover was not properly sealed and flooding has occurred, sand and silt may have deposited in the well, requiring more cleaning.

Drilled and bored wells: Remove the well cover and thoroughly clean the well to remove all debris. Special tools or pumps may be required to remove silt and sand. Heavy deposits of silt and sand may damage well pumps if not removed before the pump is started. If sand and silt are present, remove the pump and clean it thoroughly before using.

Dug wells: Remove the well cover and thoroughly clean the well to remove all floating debris. If the well is lined, scrub the sides of the well with a brush and a strong solution of chlorine and water. Empty polluted water and debris from the well using buckets or pumps. If sand and silt are present, remove the pump and clean it thoroughly before using. Rinse well walls by pouring water along the edges. Empty polluted rinse water from the well again, then allow it to refill.

Caution: In areas without electrical power, a portable generator may be needed to operate pumps and equipment. Read the safety instructions before turning on a generator, pumps, or any electrical equipment.

Step 2. Pump or bail water out of the well until the water is clear. If you have a low-yield well, empty at a slower rate. If available, use outside faucets to drain water from the well. Do not pump contaminated water into any existing pressure tank. Instead, disconnect piping between the pressure tank and pump to allow contaminated water to flow away from the well and tank.

Step 3. Using the table that follows, calculate the amount of bleach granules or unscented liquid to use. To determine the exact amount, find the corresponding well diameter in the left

column. Then match the amount of bleach needed for the amount of time the concentration will remain in the well.

Multiply the amount of bleach needed by every 10 feet of water in the well. For example, a well 8 inches in diameter requires 3½ fluid ounces of unscented bleach (for a retention time of 8 hours at 50 parts per million [ppm]) per 10 feet of water. If the water in the well is 30 feet deep, multiply 3½ fluid ounces by 3 to determine the amount of bleach required (3½ x 3 = 11.5 fluid ounces). In a clean bucket, add this total amount of bleach to about 5 gallons of water (or mix this in 5 gallons of water).

If you are unsure about the depth of your well, check the well head and casing to see if a tag indicates the well depth. If a tag is not available, contact neighbors to see if they know the depths of their wells. Well depths are usually similar in neighborhoods. If you are still unable to determine the depth of your well, make your best educated guess, then increase the suggested amounts of chlorine by 50%.

Système International d'Unités (metric): A well 20.0 cm (8 inches) in diameter requires roughly 103.5 milliliters (mL) of unscented bleach per 3 meters of water. If the water in the well is approximately 9.1 meters deep, multiply 103.5 mL by 3 to determine the amount of bleach required (103.5 X 3 = 310.5 mL). In a clean bucket, add this total amount of bleach to about 19 liters of water.

Step 4. Pour the chlorine solution in the well in a circular pattern to ensure contact with all sides of the casing or lining of the well. If bored and dugs wells have no casing or lining, pour the solution down the center of the well hole. If possible, recirculate the water by connecting a garden hose to an outside faucet and place the other end in the well. Allow water to run for approximately 15 minutes to ensure the chlorine solution is mixed in the well.

Step 5. For wells connected to a plumbing system, open all inside and outside faucets and pump water until you notice a strong odor of chlorine at each faucet. If you do not smell chlorine after running all faucets for 15 minutes, increase the amount of chlorine by one-half of the original amount used and repeat the procedures.

Stop the pump and allow the chlorine solution to remain in the well and plumbing system. Refer to the table in the "Sampling after Disinfection" section (later in the lesson) to match amounts of chlorine solution and disinfection times. It is preferable for the solution to remain in the well for 8 hours or overnight, if possible. Do not leave chlorine in wells more than 24 hours because it may affect some pump parts.

Step 6. After the disinfectant has set in the well for the recommended period, turn on the pump, attach a hose to an outside faucet, and direct the water to a designated area away from the well. The water in the well contains high concentrations of chlorine that can be harmful to plants, septic tanks, and streams. Empty the water in an area where plants or streams will not be harmed.

Continue running the water until the chlorine odor disappears, then drain the remainder of bleach in the plumbing system from the inside faucets. With low-yield wells, empty plumbing at a slower rate to avoid over pumping. Some wells may require that you stop for periods to allow the well to refill. Depending on the depth and size of the well, this process may take hours to a day or longer.

Water from wells with no plumbing system can simply be pumped or removed in buckets until the chlorine odor disappears.

Sampling after Disinfection

Until water has been tested, any water for human consumption should be boiled (roiling boil for 1 minute), or an alternative water source used. Wait at least 2 days after disinfection to ensure that the chlorine has been thoroughly flushed from the system. Then sample the water for total coliform and either E. coli or fecal coliform bacteria to confirm that the water is safe to drink. Contact the local health department to have your water sampled and tested or contact your state laboratory certification officer to find a certified lab near you. You can also get this number from the U.S. Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791 or www.epa.gov/safewater/labs/index.html).

If the sample results show no presence of both total coliform and E. coli or fecal coliforms, the water can be considered safe to drink from a microbial standpoint. Follow up with two additional samples, one in the next 2 to 4 weeks and another in 3 to 4 months. To check the safety of your water over the long term, continue to monitor bacterial quality at least twice per year or more often if you suspect any changes in your water quality.

If sample results indicate the presence of total coliform and E. coli or fecal coliforms, repeat the well disinfection process and resample. If tests continue to show the presence of bacteria, contact your local health department for assistance.

Amount of Chlorine Needed Per 10 Feet (3.1 Meters) of Water in Well*						
Inside Diameter of Well Casing (Standard/SI)	**Amount of 5.25% Sodium hypochlorite (Unscented Laundry Bleach) Standard/SI**			**Amount of 65% Calcium Hypochlorite (Chlorine Granules) Standard/SI**		
	Disinfection time for concentration of disinfectant					
	100 ppm for 2 hours	50 ppm for 8 hours	25 ppm for 24 hours	100 ppm for 2 hours	50 ppm for 8 hours	25 ppm for 24 hours
1¼ inches or 3.18 cm	⅛ fluid ounces or 3.7 mL	¾ teaspoon or 3.7 mL	1/3 teaspoon or 3 mL	Not practical to use chlorine granules for these small-diameter well casings		
2 inches or 5.08 cm	½ fluid ounces or 14.79 mL	¼ fluid ounces or 7. 39 mL	⅛ fluid ounces or 3.7 mL			
3 inches or 7.62 cm	1 fluid ounces or 29.57 mL	½ fluid ounces or 14.79 mL	¼ fluid ounces or 7.39 mL			
4 inches or 10.16 cm	1½ fluid ounces or 44.36 mL	¾ fluid ounces or 22.18 mL	⅜ fluid ounces or 11.09 mL			
6 inches or 15.24 cm	4 fluid ounces or 118.29 mL	2 fluid ounces or 59.15 mL	1 fluid ounces or 29.57 mL	¼ ounce or 7.09 grams	⅛ ounce or 3.54 grams	1/16 ounce or 1.77 grams
8 inches or 20.32 cm	7 fluid ounces or 118.29 mL	3½ fluid ounces or 103.51 mL	1¾ fluid ounces or 51.75 mL	½ ounce or 14.17 grams	¼ ounce or 7.09 grams	⅛ ounce or 3.54 grams
10 inches or 25.40 cm	10 fluid ounces or 295.74 mL	5 fluid ounces or 146.87 mL	2 fluid ounces or 59.15 mL	¾ ounce or 21.26 grams	⅜ ounce or 10.63 grams	3/16 ounce or 5.32 grams
12 inches or 30.48 cm	2 cups or 473.18 mL	1 cup or 236.59 mL	½ cup or 118.29	1 ounce or 28.35 grams	½ ounce or 14.17 grams	¼ ounce or 7.09 grams
18 inches or 25.72 cm	4½ cups or 1.06 L	2¼ cups or 532.32 mL	1⅛ cups or 266.16 mL	2½ ounces or 70.87 grams	1¼ ounces or 35.44 grams	¾ ounces or 21.26 grams
2 feet or 60.96 cm	7½ cups or 1.77 L	3¾ cups or 887.21 mL	1⅞ cups or 443.60 mL	4½ ounces or 127.57 grams	2¼ ounces or 63.79 grams	1⅛ ounces or 31.89 grams
3 feet or 91.44 cm	17½ cups or 4.14 L	8¾ cups or 7.01 L	4⅜ cups or 1.04 L	10 ounces or 283.5 grams	5 ounces or 141.75 grams	2½ ounces or 70.87 grams

Disinfection Issues and Concerns

Bored and dug wells can be difficult to disinfect because of how they are constructed. Many are shallow and have no lining or casing, which can allow contaminants to enter the well hole from upper soil levels. If contamination problems continue, consider upgrading the existing well or drilling a new well.

Water softeners may be damaged by the disinfection process because of the large amounts of chlorine used. Follow your manufacturers' instructions for appropriate methods to disinfect your softener unit. You may need to bypass the unit until the disinfection process is complete.

Water Storage Tips to Assist in Emergency Preparedness

The Water Quality & Health Council offers important tips for storing water to help families and individuals prepare for emergency situations. In addition to ensuring safe water during periods of elevated terrorist alerts, home water storage is an important measure in preparing for natural disasters, such as floods, hurricanes and ice storms.

While many individuals rush to purchase bottled or distilled water during times of crises, another viable option for securing a supply of safe water is the storage of tap water for future use.

Following are easy-to-implement guidelines to ensure that tap water remains potable while in storage:

1. Store at least one gallon of water per person, per day in a cool, dark place.

   The average individual must drink at least two quarts of water every day. Children, nursing mothers, the elderly and people in warmer climates need more. Additional water should be reserved for personal hygiene and food preparation. The U.S. Department of Homeland Security encourages individuals to store enough water to last a minimum of three days - bearing in mind that water is needed for drinking as well as for personal hygiene. Water should be collected on days when it appears free of sediment or color. On certain days, particularly after a hard rain or heavy snowmelt, some tap water may have a brownish color and contain sediment.

2. Choose appropriate containers for water storage; disinfect before use.

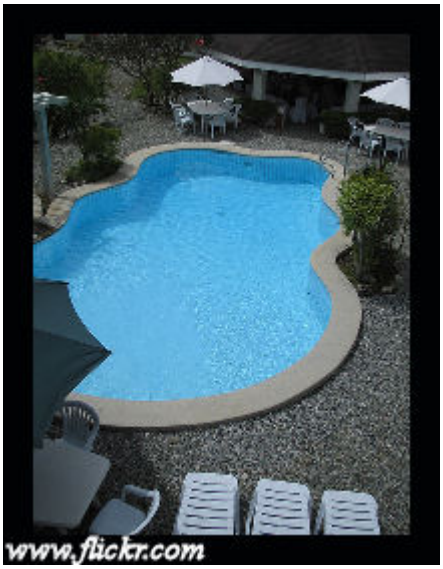
   Clear food-grade plastic containers, such as soft drink bottles, are ideal. Other options include fiberglass or enamel-lined metal containers. Never use a container that has previously held toxic substances. Containers for water should be rinsed with a diluted chlorine bleach solution (one part bleach to ten parts water) before use.

3. If necessary, treat water with a chlorine bleach solution prior to storage to prevent buildup of harmful bacteria or pathogens. Replace water every six months.

If your water is treated commercially by a water utility, it is not necessary to treat water before storing it. If you have a well or public water that has not been treated, disinfect the water prior to storage using liquid household bleach containing 5.25 percent sodium hypochlorite. Do not use scented or color-safe bleaches or bleaches containing soaps. The American Red Cross and the U.S. Federal Emergency Management Agency recommend the following procedure for treating water for storage:

- Add six drops (1/8 teaspoon) of unscented bleach per gallon of water.
- Stir and let stand for 30 minutes.
- If the water does not taste and smell of chlorine after 30 minutes, add another dose of 1/8 teaspoon and let stand another 15 minutes.
- Seal the containers and label with contents and date of preparation.

4. Identify additional sources of water.



In addition to stored water, other sources include melted ice cubes, water drained from the water heater faucet (if the water heater has not been damaged), water dipped from the flush tanks (not the bowls) of home toilets, and liquids from canned goods such as fruit and vegetable juices. Unsafe water sources include radiators, hot water boilers, waterbeds, and swimming pools and spas.