



Contractor procedures for cleaning and disinfecting private water wells

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Research and down-hole camera investigations show that all wells will have some degree of bacterial growth, sediment build-up, encrustation, scaling and deterioration. While disinfection of wells is required as part of the construction and alteration process, the following cleaning and disinfecting procedures are to be performed when there is a problem with continual positive or high bacterial colony counts, when a well that has not been in use for an extended period is being brought back into service, or when the integrity of the well has been compromised by flooding or physical damage to the well casing. The following procedure is intended to supplement and act as an instructive guide to performing the enhanced disinfectant process cited in rule 3701-28-11(H) of the Private Water Systems Rules, Chapter 3701-28 of the Ohio Administrative Code.

The following private water well cleaning and disinfection procedures must be performed by a registered private water system contractor due to the equipment required and the chemicals used.

DISINFECTION OF EXISTING PRIVATE WATER SYSTEMS

Step One: Find the Well Log

Obtain the well log if it is available. This information will be used to determine the total depth of the well, the type and length of casing, and the original static water level in the well. The well log will also identify any unusual or unique well construction conditions the contractor should be aware of prior to beginning the disinfection process. The well log can be obtained by contacting the Ohio Department of Natural Resources, Division of Water at (614) 265-6740 or through the website at <http://www.dnr.state.oh.us/water/maptechs/wellogs/app/>.

Step Two: Pump the well

The water column in the private water system must be “moved” or circulated. Movement of the water column by pumping will draw out formation fragments and other debris present in the aquifer or in the bottom of the well; some debris will be from the initial drilling process. The water should run for several hours (24 hours if possible). The water should be drained onto the ground, away from all septic system components within proximity of the private water system, or to a drainage way. The water should not be discharged to a septic system, as it may cause the system to overload and possibly cause early septic system failure.

If a long period of pumping and circulation is not possible, the system should be pumped long enough to flush out the water well and replace the water column.

Step Three: Physical cleaning

Previous disinfection procedures distributed by the Ohio Department of Health (ODH) and local health districts did not include physical cleaning of the casing and borehole. However, the physical cleaning of the well is a very important step in the cleaning process, as it removes bio-slimes, other microbial growths and deposited minerals from the casing and borehole walls. Removing these growths will increase the chance of chlorine reaching all the bacteria and the surfaces in the casing and borehole when chlorination is performed.

All sections of the well casing and open borehole should be physically cleaned with a brush to scrub away all biological growth/slime formations and break up deposited minerals. The brush should be vigorously moved up and down the casing several times to break up and remove slime and deposits. The brush alone will not completely clean the casing, thus requiring a second process, swabbing.



Well scrub brush

Swabbing the casing, not the bore hole, involves the brush being covered with a terry cloth fabric and the swab being pushed into the casing to remove all left over biological growth. The swab must be pushed down to the bottom of the casing. Swabbing should be done long enough to sufficiently clean the casing. If the well includes a screen at the bottom, the size of the brush and swab will need to be reduced to eliminate the

possibility of entrapment of the brush in the screen. Care must be taken during this step to prevent damage to the casing, especially those constructed of PVC.



Swab around brush



Step Four: Re-development

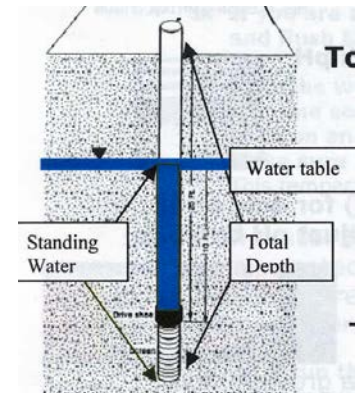
Once the physical cleaning is complete, all of the material removed from the casing and borehole walls must be removed from the well. The well must then be re-developed.

Re-development may be accomplished by initial surging and agitation of the water in the well followed by pumping with a high capacity pump or through an air method that will sufficiently remove all of the debris present in the private water system. The re-development should be done for an amount of time that is sufficient to minimize the turbidity in the water.

Step Five : Determine the volume of chlorine to be used for disinfection.

The volume of the chlorine disinfectant solution depends on the total volume of the water stored in the private water system, which includes the well and all distribution lines. The well log, in addition to on-site measuring, should be used to determine the water volume in the well. On-site measurement of the static water level is necessary to determine the actual volume of water in the well.

Once the depth to the static water level is measured, the volume of water stored in the well can be calculated. To calculate the total volume of water stored in the well, the total depth (found on the well log) must be subtracted by the static water level (measured on site); this will give you the total feet of water stored in the well (casing and borehole). The volume is calculated by taking the total feet of water stored in the well and multiplying by the gallons per foot corresponding to the casing diameter.



The following table (Table 1) shows the volume per foot for different casing diameters. This table can be found in the Ohio Administrative Code Rule 3701-28-17.

Example:

Total well depth is 120 feet; the static water level is 20 feet; and the well casing diameter is 6 inches.

The feet of water stored in the well equals: 120 – 20 = 100 (feet of water in the well).

From Table 1, a six inch well casing holds 1.5 gallons of water per foot.

100 feet of water in the well x 1.5 gallons per foot = 150 gallons (total volume of water in the well).

Diameter of well (inches)	Gallons per foot of water
3	0.37
4	0.65
5	1.0
6	1.5
8	2.6

In the past, when the well volume was not known, it was standard practice to use two gallons of 5.25% liquid bleach in a chlorine and vinegar solution. With the new disinfection procedure, the total well volume must be calculated. The measurements can be taken at the start of the physical cleaning of the well.

Step Six. Precautions to take before disinfecting the well.

Make sure that the property owner and residents of the home are aware that the water should not be used or consumed during the disinfection treatment process. This disinfection treatment process should be only

performed by a registered private water systems contractor. If the home has a treatment device, such as a water softener, have the property owner consult with the water treatment company before beginning the disinfection treatment process to determine if bypassing the treatment device is required before disinfection.

Always use rubber gloves, eye protection, and protective clothing when handling mild acids and chlorine products (such as bleach). Avoid contact with the mild acids and chlorine product. If you should splash chlorine solution on your person or clothing, immediately rinse thoroughly with water. If you are using purchased well cleaning products, be sure to follow the manufacturer's recommendations for personal protection and safety.

Step Seven: Mixing the chlorine disinfectant solution.

Simply pouring a bottle of chlorine bleach or dropping tablets into the well will not produce good disinfection results because the chlorine does not get evenly distributed in the casing and borehole, and can actually cause certain bacteria to generate more protective slime, thus preventing effective disinfection. A disinfectant solution should be introduced during the development of the well.

Chlorine products to be used for disinfection should be sodium hypochlorite at 5% strength or greater. Laundry bleach loses its effectiveness the longer it sits on the shelf in the store or in your home. Do not use bleach with fragrance additives. Calcium hypochlorite products should not be used in limestone formations, or water with a high calcium content because they will contribute to additional calcium in the water and may cause clogging or the formation of sludge in the well. Chlorine tablets, swimming pool disinfectants or other chemicals that are not approved for contact with drinking water are prohibited for use in water wells and may adversely interact with other chemicals.

Prior disinfection procedures allowed the chlorine disinfectant solution to be "mixed" in the well, not on the surface in a tank. This practice does not allow for even mixing of the chemicals with the water and severely limits the effectiveness of the disinfection process.

When sodium or calcium hypochlorite is used, an initial chlorine concentration of 100 to 150 mg/l of chlorine is required for proper disinfection. The table below can be used to help determine the quantity of chlorine required based on the volume of disinfectant solution required:

Table 2. Amount of chlorine added to 100 gallons of water for disinfection			
Chlorine concentration (parts per million)	Gallons of 5.25% sodium hypochlorite - liquid bleach	Pounds of dry calcium hypochlorite	Minimum contact time
100	0.25 gallons (4 cups)	0.2	8 hours
150 ppm	.4 gallons (6.5 cups)	0.4 pounds	8 hours

Adding more chlorine to produce higher initial concentrations of disinfecting solution will not improve the success of the disinfection process. Many bacteria react to chlorine by forming a protective slime, which the chlorine cannot penetrate. Controlling pH below 6.0 will make the chlorine more effective at disinfection.

On the surface, mix the chlorine disinfectant solution in a water container or tank large enough to hold the total water volume of the well (calculated in step 5). For proper disinfection a chlorine disinfectant solution equal to three (3) times the total water volume of the well should be utilized. For ease of transport, this volume may be split into two or at the most three parts.

For proper mixing and to optimize the disinfecting ability of the solution, the correct pH must be maintained. Fill the container/tank with water and then add an acid solution to lower the pH to approximately 3.5. Test strips, kits or probes can be used to measure the pH of the disinfecting solution. Use a mild acid, such as vinegar or one of the proprietary products available on the market to lower the pH of the disinfectant water. **Do not use a highly concentrated form of acid to lower the pH of the disinfectant water. Using one of the highly concentrated forms of acid such as hydrochloric acid (commercially available as muriatic acid) introduces the unwarranted risk of accidental exposure from spillage or inhalation.** Any product used in the disinfection of a private water supply must comply with ANSI/NSF standard sixty (60). Once at the preferred pH, add the chlorine, at a slow rate, to the water/acid solution until the pH raises to approximately 6.0. The solution must be stirred with either a plastic or wood rod to ensure proper mixture.

Step Eight: Adding the chlorine disinfectant solution

Once the chlorine disinfectant solution has reached a pH of 6.0, inject the solution into the well through a tremie pipe. The tremie pipe must be placed near the bottom of the well; this will ensure that the water is evenly distributed from the bottom and stirred enough for the chlorine to reach all the bacteria in the well. Gravity feeding, through a tremie pipe, should be sufficient for the disinfection process. Deeper or larger diameter wells may need the chlorine disinfectant solution pumped under pressure down the tremie pipe.

Note: Pouring the solution in from the top will not create sufficient turbulence for the chlorine disinfectant solution to contact the bacteria at the bottom of the well and reach small areas and crevices in the borehole.

Step Nine: Contact time

Once the chlorine disinfectant solution has been introduced into the well, **all** the plumbing fixtures should be turned on, including the hot water faucets. Be sure to run chlorinated water through all service lines including the washing machine, dishwasher, toilets and yard hydrants. Turn all the faucets off at the first odor of chlorine. Optimum contact time is 24 hours; the minimum contact time is 8 hours. Once the chlorine disinfectant solution has sufficient contact time in the system it must be flushed out. Discharge the water from all faucets until the smell of chlorine has disappeared. Do not discharge or drain the water into the sewage treatment system. The water sample should be taken no sooner than 48 hours after the chlorine has been removed from the water system and plumbing. The water sample must be taken by the local health department if it is associated with the permit process as required by OAC Rule 3701-28-03. The water sample will be checked for the presence of chlorine by the local health district during the sample collection process.

Positive test after the disinfection

The disinfection procedure does not guarantee the preferred results, but it will create the best environment for bacterial disinfection and help ensure the water is free of pathogenic (illness causing) bacteria. If the disinfection process, as described in this fact sheet, is carried out and the water sample is still positive for total coliform, then additional investigative steps may be necessary. A continuous disinfection unit may **NOT** be installed on a well until the investigation is concluded. Also, continuous disinfection units shall **NOT** be installed on wells that have construction violations or are not approvable. Further water testing (such as bacterial identification) or down-hole camera investigations may be performed to determine the type of bacteria in the well or possible causes or sources of contamination.

NEW CONSTRUCTION DISINFECTION

The procedures outlined in this fact sheet should be followed for the disinfection of newly constructed wells. If you know time will elapse between the completion of the drilling phase and the installation of the pitless adapter and the connection of the water supply to the residence, the addition of disinfectant to the well will protect against the growth of bacteria. As a reminder, solid forms of calcium hypochlorite must be completely dissolved when used for disinfection. Using liquid chlorine (sodium hypochlorite of at least 5% strength) will be a more efficient method of disinfecting newly constructed and existing wells. The chlorine disinfectant solution must be mixed in a tank at the surface and **NOT** in the well. The pH of the solution must be stabilized as in the disinfection procedure for an existing well. At least one total well volume of chlorine disinfectant solution must be pumped to the bottom of the well. The pumping will create turbulence and allow the even distribution of the chlorine disinfectant solution to ensure disinfection of bacteria in the bottom of the well and throughout the borehole column.

Note: Good drilling practice includes using potable water when mixing fluids and grouts and using clean drilling equipment before and during the drilling process to reduce the potential of contaminating the aquifer.

Registered Private Water Systems Contractors:

The cleaning and disinfection of private water wells for new construction and alterations must be performed by a registered private water systems contractor. Contractors must register annually with the ODH. For more information about how to become a registered private water system contractor, contact the ODH Private Water Systems at (614) 644-7558 or go the Ohio Department of Health website at www.odh.ohio.gov.

Where can I get more information?

Residential Water and Sewage Program
Bureau of Environmental Health
Ohio Department of Health
246 North High Street
Columbus, Ohio 43266-0118
(614) 644-7558 Water
(614) 644-7551 Sewage
Email: BEH@odh.ohio.gov