Health Canada Santé Canada

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Environmental and Workplace Health

What's In Your Well? - A Guide To Well Water Treatment And Maintenance

Introduction

Typically, groundwater is naturally clean and safe for consumption. Because the overlying soil acts as a filter, groundwater is usually free of disease-causing microorganisms. However, contamination may occur following improper installation of well casings or caps, after a break in the casing or as a result of contaminated surface water entering the well. Contamination can also occur if wells are drilled in fractured bedrock without an adequate layer of protective soil and with less than the recommended minimum casing length.

In order to prevent illness, wells should be properly maintained and the water regularly tested for the presence of microbial contaminants. Well water should also be tested occasionally for possible inorganic and organic chemical contaminants.

Well Maintenance

Proper siting, location, construction and maintenance of your well will help to minimize the likelihood of contamination. The well cap should be checked regularly to ensure that it is securely in place and watertight. Joints, cracks and connections in the well casing should be sealed. Pumps and pipes should also be checked on a regular basis, and any changes in water quality should be investigated.

Surface drainage should be directed away from the well casing, and surface water should not collect near the well. The well itself should not be located downhill from any source of pollution.

Well water should be tested for bacteriological quality regularly and for chemical contamination if it is suspected. In addition to regular tests, well water should be tested immediately if there is any change in its clarity, colour, odour or taste, or if there has been a change in the surrounding land use. Through regular assessment and testing of drinking water, the microbial and chemical safety of your well water can be verified.

Testing Well Water for Microbiological Contamination

New wells should be disinfected by the well driller at the time of construction to eliminate any microbiological contamination that may have occurred during drilling. This should be done **before** collecting a sample for microbiological testing. Existing wells should be tested two or three times a year. The best time to sample your well water is when the probability of contamination is greatest. This is likely to be in early spring just after the thaw, after an extended dry spell, following heavy rains or after lengthy periods of non-use.

Depending on the province, bacteriological testing of well water is done either by the provincial health laboratory in your area or by a certified private laboratory. They will supply you with a clean, sterile sample bottle and the necessary instructions. Samples collected in any other container will not yield meaningful results and will not be accepted by the laboratory. In all instances, samples should be refrigerated immediately and transported to the laboratory within 24 hours.

If you have experienced gastrointestinal illness and suspect that it might be associated with your well

water, consult your physician and local health unit.

Interpreting the Results of Testing

The microbiological quality of your water is determined by looking for the presence of bacteria indicative of faecal (sewage) contamination - namely, total coliforms and *Escherichia coli*. Total coliforms occur naturally in soil and in the gut of humans and animals. Thus, their presence in water *may* indicate faecal contamination. *E. coli* are present only in the gut of humans and animals. Their presence therefore indicates *definite* faecal (sewage) pollution.

Total Coliforms

The presence of total coliform bacteria in well water is a result of surface water infiltration or seepage from a septic system. According to Health Canada's *Guidelines for Canadian Drinking Water Quality* (Sixth Edition, 1996), drinking water should not contain more than 10 total coliform bacteria per 100 mL of water. Any water containing more than this amount should be resampled. If the repeat sample contains more than 10 total coliform bacteria per 100 mL, corrective action should be taken immediately.

Water containing fewer than 10 total coliform bacteria per 100 mL is considered marginally safe to drink. Nevertheless, the water should be resampled. If fewer than 10 total coliform bacteria per 100 mL are detected, the cause of contamination should be determined if possible and corrective action taken as appropriate.

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E. coli

E. coli appear in water samples recently contaminated by faecal matter; thus, they indicate the possible presence of disease-causing bacteria, viruses or protozoa. Water containing *E. coli* is not safe to drink. Corrective action should be taken immediately.

The maximum acceptable concentration of *E. coli* is "0" per 100 mL of water.

Corrective Action for Water that Does Not Meet the Recommended Guidelines

If test results show an unacceptable level of total coliforms or *E. coli*, it is necessary to shock treat the well and, if possible, find and eliminate the source of contamination. Disinfection can be done using unscented household bleach. Table 1 outlines the quantity of bleach required to properly disinfect new and existing wells. If the source of contamination cannot be found and eliminated, the water should subsequently receive continuous disinfection.

Table 1: Disinfection of Well Water with Unscented Household Bleach (Approximately 5.2% Hypochlorite)

Depth of water in well	Volume of bleach added			
	Casing diameter 15 cm (drilled)		Casing diameter 90 cm (dug)	
	New well*	Existing well*	New well*	Existing well*
1.0 m	100 mL	20 mL	3.2 L	0.6 L
3.0 m	300 mL	60 mL	9.8 L	2.0 L
5.0 m	500 mL	100 mL	16.5 L	3.0 L
10.0 m	1000 mL	200 mL	32.0 L	6.5 L

* New wells require a chlorine concentration of 250 parts per million (ppm) for effective disinfection, whereas existing wells require 50 ppm chlorine.

Steps for Chlorine Disinfection

1. Add the amount of unscented bleach determined in Table 1 to the bottom of the well and then agitate the water. Connect a garden hose to a nearby tap and wash down the inside wall of the well. This will ensure thorough mixing of the chlorine and the water throughout the well.

2. Start the pump and bleed air from the pressure tank. Open each tap and allow the water to run through all taps until a smell of chlorine is detected, then turn off the taps. If a strong smell is not detected, add more bleach to the well.

3. Allow the water to sit in the system for 12-24 hours.

4. Start the pump and run water through the outside hose away from grass and shrubbery until the strong smell of chlorine disappears. Make certain that the water does not enter any watercourse. Finally, open the indoor taps until the system is completely flushed.

5. Wait 48 hours, then sample the water using the instructions and bottle provided by the laboratory. In the meantime, find another source of water, or boil the water for one minute before drinking it. Two consecutive "safe" tests, performed on samples obtained over a period of one to three weeks, will probably indicate that the treatment has been effective.

6. If the shock treatment solves the problem, repeat bacteriological testing in three to four months.

7. If the above steps do not alleviate the problem, it is recommended that the source of the ongoing contamination be determined and corrected, possibly with professional help. If remediation is not possible, a permanent alternative solution, such as a new well or a drinking water disinfection device, should be considered.

Water Treatment Devices for Home Use

The water quality problems described in this fact sheet may be resolved by use of a drinking water treatment unit. There are a wide variety of such devices available for home use. Health Canada works closely with NSF International to develop performance standards for water treatment devices. Consumers are encouraged to purchase products that have been certified to these standards.

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Microbiological Contaminants

If elimination of the source of contamination is not possible after shock chlorine disinfection, consider the installation of a batch or continuous disinfection system or a new water supply. Some suitable devices are described in Table 2.

Table 2: Household Drinking Water Disinfection Devices

Water treatment method	Uses

Distillation	Kills all microorganisms.
Ultraviolet light	Kills all microorganisms. Use in conjunction with microfiltration to improve inactivation and remove particulate matter, including parasites.
Chlorination	Kills bacteria and viruses. Use in conjunction with microfiltration to improve inactivation and remove particulate matter, including parasites.
Ozonation	Kills harmful microorganisms. Use in conjunction with microfiltration to improve inactivation and remove particulate matter, including parasites.
Ceramic candle filtration	Removes parasites and bacteria. Use in conjunction with chlorination to kill viruses.

Chemical Contaminants

Well water should also be tested for hazardous chemicals whenever contamination is suspected. Chemical analysis of water samples can be provided by commercial testing laboratories. Some provincial health laboratories will analyse water for nitrate, which typically originates from farming activities and seepage from septic tanks. High concentrations of nitrate may cause "blue baby syndrome" (methaemoglobinaemia), a condition in which methaemoglobin cannot release oxygen to body tissues, and which mostly affects infants under three months of age. Other chemical contaminants of concern include pesticides, heavy metals and volatile organic compounds. Guidelines for Canadian Drinking Water Quality provides a list of maximum acceptable concentrations for these chemicals. If hazardous chemical contaminants are detected, you should consider the installation of a treatment device or a new water supply. Some suitable units are listed in Table 3.

Table 3: Chemical Removal Devices

Water treatment method	Uses
Activated carbon filtration*	Removes organic compounds, including pesticides.
Reverse osmosis*	Removes heavy metals and nitrates; often used in combination with activated carbon filters.
Distillation	Removes heavy metals and nitrates; often used in combination with activated carbon filters.
Ozonation	Removes organic compounds, including pesticides; often used in combination with activated carbon filters.

* Should not be used with microbiologically unsafe waters or water of unknown microbiological quality.

Hardness, Taste, Odour and Colour

Well water contains naturally occurring minerals, such as calcium, iron and sulphur. Although these minerals are not hazardous to human health, they can alter the hardness, taste, odour or colour of the water when present in excess quantities. Groundwaters may also contain natural organic materials (tannins). Table 4 describes some signs that may indicate the presence of these substances in your well water and some solutions. In order to select the best treatment method, a full testing of the suite of minerals should be conducted prior to the purchase of a device.

Table 4: Common Aesthetic Water Quality Problems and Solutions

Problem	Cause	Solutions
Hard water (scales/deposits in kettles and water heaters)	Excess calcium	Water softeners* Reverse osmosis Distillation
Rusty (red to brown) staining of fixtures and laundry and/or metallic taste	Excess iron	Chlorination-filtration Greensand filtration Aeration-filtration Distillation
Black staining of fixtures and laundry and/or metallic taste	Excess manganese	Chlorination-filtration Greensand filtration Aeration-filtration Distillation
Rotten egg smell	Hydrogen sulphide	Chlorination-filtration Greensand filtration Aeration-filtration
Water has laxative effect	Excess sulphates	Reverse osmosis Distillation
Turbidity/grittiness	Mud/silt/clay/sediment in water	Sediment filters
Organic (tea) colour	Tannins	Chlorination-filtration Ozonation-filtration

* Individuals on sodium-restricted diets should consult their physician before drinking artificially softened water. Iron and manganese can also be removed by a softener, provided the water is not too hard.

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