

Groundwater Series

Testing and Treating Private Water Wells

H. Simpson, P.Geo., J. Myslik, P.Eng.

All Ontarians play a role in protecting groundwater quality and quantity. This is the seventh factsheet of seven in a series that will help Ontario's farmers and rural residents learn more about groundwater. This factsheet reviews water quality testing, the interpretation of water quality test results and commonly available treatment methods for private water wells.

The OMAFRA Factsheets in the Groundwater Series are:

- *Understanding Groundwater*
- *Managing the Quantity of Groundwater Supplies*
- *Protecting the Quality of Groundwater Supplies*
- *Private Rural Water Supplies*
- *Highly Vulnerable Water Sources*
- *Disinfecting Private Water Wells*
- *Testing and Treating Private Water Wells*

GROUNDWATER

Groundwater is a valuable resource for farm and rural families, farming (livestock watering, irrigation, wash water, etc.) and rural businesses — in some situations it may be the only water source. When living in a rural area, it is important to understand what actions to take to protect your water and ensure that it is suitable for potable use. More information about the presence, movement and why some subsurface materials are a better source of groundwater than others, is presented in the OMAFRA factsheet, *Understanding Groundwater*.

The terms “highly vulnerable” and “surface water” are used in a generic sense, rather than as defined under the *Clean Water Act, 2006*.

Some groundwater sources are more vulnerable than others. Factors that influence well water and groundwater quality include:

- shallow depth (less than 3 m (10 ft)) of overlying soil, which serves as a protective layer to the water below
- precipitation, including rain and snowmelt events, which may act to transport surface contaminants to the well
- wells located in areas with shallow fractured rock aquifers with little or no protective overlying soil
- well age

Wells can also be vulnerable where a defective casing allows direct entry of surface water, those located in a low area prone to ponding and/or flooding and those near or downslope (down-gradient) of a potential contaminant source. Information about more vulnerable groundwater sources is presented in the OMAFRA factsheet, *Highly Vulnerable Water Sources*.

In Ontario, [Regulation 903](#) (the Wells Regulation) prescribes requirements for the construction, maintenance and abandonment of private water wells. The Wells Regulation requires that the well owner must maintain the well in a way that prevents the entry of surface water and other foreign materials into the well. Proper construction and maintenance of a well will help prevent it from becoming a pathway for surface water and contaminants to reach the groundwater. If a well is no longer used, it must be properly abandoned (plugged and sealed). The requirements for construction change periodically, and it is recommended that well owners refer to the current requirements under the Wells Regulation.

SURFACE WATER

Although groundwater is the main source of water for most farms and rural properties, surface water is used as a water supply in some instances. Surface water sources (e.g., lakes, ponds, rivers, streams and wetlands) have no natural protective layer to filter out microorganisms or other contaminants. They can be highly vulnerable to contamination from microorganisms (e.g., bacteria, parasites, viruses) and should be considered unsuitable for human consumption without treatment. Additional information is presented in the OMAFRA factsheet, *Highly Vulnerable Water Sources*.

You can determine if your water supply is suitable for potable use (i.e., there is no significant evidence of bacterial contamination) by submitting well water samples to Public Health Ontario or to your [local public health unit](#).

TESTING YOUR WATER SUPPLY

It is important for well owners to understand how to test their water supply, interpret test results and use effective and available treatment methods for the water supply.

If your drinking water is supplied by a well on your property, you must do all you can to make sure the water is suitable for potable use, now and for years to come. Testing frequently, together with inspecting and maintaining the well, will help ensure the quality of your drinking water. These are proactive steps you can take to make sure the water supply for your home, farm or rural business is suitable for human consumption. Additional information concerning well construction and vulnerability to contamination is provided in the OMAFRA factsheets, *Protecting the Quality of Groundwater Supplies* and *Private Rural Water Supplies*.

Private well water testing is provided free of charge by Public Health Ontario (Figure 1). Public Health Ontario tests for the bacterial indicator organisms *E. coli* and total coliforms but does not test for other contaminants such as chemicals. This means that even if your results indicate that there is no bacterial contamination of your drinking water, it still may have other contaminants and may be unsafe to drink. More information regarding sample collection, submission and testing is provided to [the Public Health Ontario water testing](#) web site. Information about testing for other contaminants in groundwater is presented in the OMAFRA factsheet, *Protecting the Quality of Groundwater Supplies*.



Figure 1. A private water well sample kit available from Public Health Ontario or your local public health unit.



Figure 2. A person taking a water sample from an interior tap using the sample bottle provided in the typical private water well sample kit.

How often should you test? Regularly test wells to establish a pattern to determine how much your water quality changes and how often you should test (Figure 2). Some wells are fairly stable and won't have to be tested as often, whereas others will be more variable and should be tested frequently. Properly constructed deeper wells tend to have more stable static water levels than shallower wells. Also, more testing is required when unusual events occur, such as during the spring melt.

When your well produces water that is not potable (i.e., water tests indicate evidence of bacterial contamination), contact your local public health unit for information or advice regarding how to address the contamination issue as an alternative to immediately abandoning the well.

INTERPRETING WATER SAMPLE RESULTS

Table 1 provides information on the actions required depending upon the number of organisms identified.

"Total coliform" includes bacteria that are always present in animal waste and sewage but are also found in soil and vegetation. Their presence may indicate that surface water is entering your well. *Escherichia coli* (*E. coli*) are bacteria found in the digestive systems of people and animals. The detection of *E. coli* indicates the potential presence of animal or human waste in your well water.

Table 1. Level of organisms detected and actions to take

Indicator Organisms	Parts per 100 mL	Action
No significant evidence of bacterial contamination		
Total coliform	5 or less	<ul style="list-style-type: none"> • There is some evidence that bacteria are in the well, but it may not be significant at these low numbers. • It is important to continue to test your drinking water frequently to determine the stability of your drinking water quality. • Consult the local public health unit for additional information.
<i>E. coli</i>	0	
Significant evidence of bacterial contamination		
Total coliform	more than 5	<ul style="list-style-type: none"> • May be unsafe to drink • Consult your local public health unit for information as soon as possible.
<i>E. coli</i>	0	
Unsafe to drink — animal or human waste contamination		
<i>E. coli</i>	more than 0	<ul style="list-style-type: none"> • Unsafe to drink • Evidence of animal or human waste contamination • Consult your local public health unit for information immediately.

IMMEDIATE ACTIONS

If the indicator bacteria test result is unacceptable, stop drinking the water immediately.

Consider using alternative water sources such as bottled water or a municipal supply if available, and contact your local public health unit for advice. For the most up-to-date information regarding interpreting water test results, see the [Public Health Ontario Laboratory Customer Service](#) website.

LONGER-TERM ACTIONS

Contact your local public health unit or the Ministry of the Environment, Conservation and Parks (MECP) [Wells Help Desk](#) for more assistance.

Have the well assessed and inspected to determine reasons for the poor water quality results, such as surface water entering the top of the well or down the side of the well. Contact a licensed well contractor to help you with this task. Information on conducting an inspection of your well, including a well maintenance checklist, is presented in the OMAFRA factsheet, *Protecting the Quality of Groundwater Supplies*. Chronic, ongoing problems may mean you need to have your well and plumbing system professionally inspected to identify possible causes of contamination.

Conduct a visual inspection of your well:

- A visual above-ground inspection of a well casing can provide an indication of the state of repair below ground. If you have any concerns, it is recommended you contact a [licensed well contractor](#) for assistance.
- If you have an older well, make sure the cap and the sealant around the well casing aren't cracked or damaged. If they are, fix or replace them right away. Inspect your well regularly, for example, each time you take a water sample.
- The area around the well should be:
 - clear of any potential contaminant sources (e.g., animal droppings, lawn care products and garden)
 - mounded up immediately surrounding the outside of the well or well pit
 - sloped away from the well to prevent ponding and direct surface water drainage away from the well and prevent ponding of water

Disinfect (shock chlorinate) your well and entire household plumbing system. More information about disinfecting your well is presented in the OMAFRA factsheet, *Disinfecting Private Water Wells*.

Evaluate changes in the surrounding area on your and your neighbour's property.

Consider replacing the existing well with a new well that meets the requirements of the [Wells Regulation](#) and possibly move it to a better location.

Note that minimum separation distances between new wells and potential contaminant sources are requirements of the Wells Regulation and the [Ontario Building Code](#).

Institute long-term water treatment options, where necessary. These are discussed in the next section.

Groundwater can also contain dissolved chemicals that can make you sick or the water unpalatable. The dissolved chemicals may come from naturally occurring minerals or from spills of manufactured substances. There can also be changes in "aesthetic parameters" (e.g., taste, colour or odour) that may signal a change in water quality and should prompt you to test your water. More information about naturally occurring chemicals in groundwater is presented in the OMAFRA factsheet, *Protecting the Quality of Groundwater Supplies*.

Bacterial testing results do not give any information on the chemical or viral quality of the water supply. If you suspect that there are problems with your water that are chemical or microbiological in nature (e.g., nitrate, sulphur solvents or viruses), send a water sample to a [private accredited laboratory](#).

WATER TREATMENT OPTIONS

If disinfecting the well does not solve the problem, and water tests continue to have positive (unsafe) results or there is a chemical concern, water treatment may be necessary if an alternative water source is not available.

There are many treatment systems available. Some of these are referred to as "point-of-use" systems, where the equipment is attached to one faucet. Others are "in-line" and provide treated water for an entire home. These systems are based on different technologies, ranging from chemical treatment to mechanical treatment (e.g., filters to ultra-violet light).

Each water treatment technology is effective for a different concern, and no single option works for everything. Some technologies make water suitable for potable use, some soften water and some improve taste or smell. Before choosing an option, be sure you understand what each treatment system will do, what the associated

costs are (e.g., initial purchase and installation, replacement filters/bulbs, electricity costs), what ongoing maintenance requirements are and any other considerations.

Each water treatment option also has its benefits and limitations. Heating water to a rolling boil for at least one minute is an effective treatment method for killing harmful organisms. However, it does not remove most dissolved contaminants and it is impractical for treating large quantities of water in the long-term.

Long-term disinfection of a well with chlorine is effective against bacteria and many viruses but cannot be relied on to kill all parasites. Also, disinfection with chlorine cannot be relied on to kill microbes that are embedded inside tiny dirt particles. For water sources that may be contaminated with surface water (i.e., highly vulnerable water supplies and improperly constructed and maintained wells), effective filtration and treatment will be required.

Treatment may also be helpful in restoring the quantity of water your well can produce. Disinfection may remove iron bacteria that can plug your well. Additional information about disinfecting your well is presented in the OMAFRA factsheet, *Disinfecting Private Water Wells*.

Treatment systems can be used on water from most sources in order to make it suitable for potable use. However, treating highly vulnerable water sources such as surface water is usually expensive and difficult, and will require a great deal of your time to make sure the equipment is looked after properly. For more information, see the OMAFRA factsheet, *Highly Vulnerable Water Sources*.

Treatment systems for highly vulnerable water sources need a high level of skill and knowledge to design, construct and operate. Contact your local public health unit and/or a water treatment professional when selecting, installing and operating a treatment system.

Tables 2 and 3 provide a summary of technical information about common water quality problems and various water treatment systems. The information presented in these tables is intended to provide guidance, not recommendations, concerning home water treatment options. It's also important to realize that each water treatment system, to remain effective, must be installed, operated and maintained as directed by the manufacturer. In water treatment, there are no shortcuts!

This factsheet is consistent with, but does not reflect the full detail of, the Wells Regulation. For assistance with the Regulation, seek advice from the Ontario Ministry of the Environment, Conservation and Parks (MECP) through the Wells Help Desk. Call 1-888-396-9355 or e-mail wellshelpdesk@ontario.ca.

Table 2. Common well water quality concerns

This table is intended to provide guidance, not recommendations, concerning home water treatment options.

Concern	Cause	Consequences	Options
<i>E. coli</i> bacteria detected	<ul style="list-style-type: none"> human or animal sewage getting into well 	<ul style="list-style-type: none"> illness – of special concern to visitors, infants and seniors and other frail individuals 	<ul style="list-style-type: none"> stop using well water use alternate water supply consult local public health unit staff for advice
coliform bacteria (total coliform >5 counts)	<ul style="list-style-type: none"> surface water getting into well 	<ul style="list-style-type: none"> early warning of possible illness 	<ul style="list-style-type: none"> consult local public health unit for advice inspect and repair well shock-chlorinate well if necessary retest
fluoride	<ul style="list-style-type: none"> naturally occurring mineral in aquifer 	<ul style="list-style-type: none"> children's second teeth can be mottled in severe cases, bone defects can occur 	<ul style="list-style-type: none"> test for level avoid fluoride dental treatment and toothpaste distill water for drinking or use bottled water if level is very high

NOTE: Deep well water quality is not constant and can change over time. Iron and manganese concentrations may increase to acceptable or untreatable levels. Similarly, iron bacteria problems can become severe enough to force well abandonment.

Shallow well water quality can change seasonally. Water quality in highly susceptible wells (less than 3 m (10 ft) in depth) may change within hours or several days after rainstorms or thaws. See the OMAFRA factsheet, *Highly Vulnerable Water Sources* for more information.

Table 2. Common well water quality concerns

This table is intended to provide guidance, not recommendations, concerning home water treatment options.

Concern	Cause	Consequences	Options
iron	<ul style="list-style-type: none"> naturally occurring mineral in aquifer 	<ul style="list-style-type: none"> yellow or red cloudy water not hazardous to health can stain plumbing and laundry may increase over time making well water unusable 	<ul style="list-style-type: none"> use chlorination–filtration consider greensand treatment distill water
iron bacteria	<ul style="list-style-type: none"> growth of non-harmful bacteria creating black slime and particles 	<ul style="list-style-type: none"> well pump failure (burnout), low flow rates may increase over time 	<ul style="list-style-type: none"> disinfect the well
manganese	<ul style="list-style-type: none"> naturally occurring mineral in aquifer 	<ul style="list-style-type: none"> brown to black stains, cloudy water — not a health problem, but presence of manganese may increase over time 	<ul style="list-style-type: none"> distill or use softener if at less than 0.1 ppm over 0.1 ppm, consult experts over 1 ppm, find another water source
pesticides	<ul style="list-style-type: none"> local spraying, spills 	<ul style="list-style-type: none"> long-term health risk 	<ul style="list-style-type: none"> stop using well water use alternate water supply consult local Ministry of the Environment, Conservation and Parks and public health unit staff about treatment options
fuels (gasoline, diesel fuel, heating oil)	<ul style="list-style-type: none"> leaking old storage tank, spills 	<ul style="list-style-type: none"> long-term health risk 	<ul style="list-style-type: none"> stop using well water use alternate water supply consult local Ministry of the Environment, Conservation and Parks and public health unit staff about treatment options
nitrate	<ul style="list-style-type: none"> nutrient application and septic systems 	<ul style="list-style-type: none"> health risk for infants when nitrate is above 10 ppm 	<ul style="list-style-type: none"> use reverse osmosis or distillation
arsenic, uranium, radium	<ul style="list-style-type: none"> naturally occurring minerals in aquifer spill of industrial chemicals 	<ul style="list-style-type: none"> long-term health risk 	<ul style="list-style-type: none"> stop using well water use alternate water supply consult local Ministry of the Environment, Conservation and Parks and public health unit staff about treatment options
salt	<ul style="list-style-type: none"> naturally occurring minerals in aquifer road salt 	<ul style="list-style-type: none"> unpalatable taste 	<ul style="list-style-type: none"> use reverse osmosis use alternate water supply
methane	<ul style="list-style-type: none"> decaying, naturally occurring organic matter 	<ul style="list-style-type: none"> not a health hazard explosion hazard if high amounts in confined areas 	<ul style="list-style-type: none"> ventilate house well consult a professional to avoid hazards
sulphate	<ul style="list-style-type: none"> naturally occurring mineral in aquifer 	<ul style="list-style-type: none"> upset stomach, diarrhea (visitors may be more prone) 	<ul style="list-style-type: none"> use reverse osmosis or distillation
hydrogen sulphide	<ul style="list-style-type: none"> naturally occurring gas, or harmful bacteria that's releasing sulphate 	<ul style="list-style-type: none"> not a health hazard 	<ul style="list-style-type: none"> use chlorination–filtration use greensand treatment
solvents	<ul style="list-style-type: none"> spill of industrial chemicals 	<ul style="list-style-type: none"> long-term health risk 	<ul style="list-style-type: none"> stop using well water use alternate water supply consult local Ministry of the Environment, Conservation and Parks and public health unit staff about treatment options
hardness	<ul style="list-style-type: none"> naturally occurring minerals in aquifer 	<ul style="list-style-type: none"> not a health hazard 	<ul style="list-style-type: none"> add softener use an alternate soap and detergent for moderately hard water

NOTE: Deep well water quality is not constant and can change over time. Iron and manganese concentrations may increase to acceptable or untreatable levels. Similarly, iron bacteria problems can become severe enough to force well abandonment.

Shallow well water quality can change seasonally. Water quality in highly susceptible wells (less than 3 m (10 ft) in depth) may change within hours or several days after rainstorms or thaws. See the OMAFRA factsheet, *Highly Vulnerable Water Sources* for more information.

Table 3. Water treatment methods

This table is intended to provide guidance, not recommendations, concerning home water treatment options.

Method	Uses	Limitations	Comments
distillation	<ul style="list-style-type: none"> kills all microbes by heat removes heavy metals and nitrates, often used in combination with activated carbon filters 	<ul style="list-style-type: none"> can remove only chemicals with a lower boiling point than water (e.g., pesticides, gasoline, diesel fuel, degreasing solvents) 	<ul style="list-style-type: none"> requires regular de-scaling and weekly disinfecting with bleach or heat can concentrate chemicals (with boiling points lower than water) in distilled water (e.g., ammonia)
ultra-violet treatment	<ul style="list-style-type: none"> kills bacteria and viruses 	<ul style="list-style-type: none"> requires filtration to remove microbes embedded in dirt particles, including parasites 	<ul style="list-style-type: none"> requires very fine (5-micron pre-filter), slow water flow and UV lamp must be kept clean
chlorination	<ul style="list-style-type: none"> kills bacteria and viruses can be used to remove some forms of iron, if water is filtered after chlorination 	<ul style="list-style-type: none"> requires filtration to remove microbes shielded or embedded in dirt particles, including parasites 	<ul style="list-style-type: none"> requires careful handling of chlorine, testing of chlorine levels and maintenance of dosing pump
ozonation	<ul style="list-style-type: none"> kills most microbes, but not cryptosporidium removes organic compounds, including pesticides can be used in combination with activated carbon filters 	<ul style="list-style-type: none"> requires filtration to remove microbes embedded in dirt particles and parasites 	<ul style="list-style-type: none"> varies in effectiveness depending on application and manufacturer contact local public health unit for more information.
activated carbon contactors	<ul style="list-style-type: none"> remove small amounts of some chemicals use for removing tastes and odours and reducing trace levels of organic chemicals (e.g., pesticides) 	<ul style="list-style-type: none"> not suitable for removing minerals or larger amounts of chemicals 	<ul style="list-style-type: none"> must be replaced regularly but hard to know when contactors are exhausted can become a dangerous source of bacteria and taste and odour problems
filters	<ul style="list-style-type: none"> use ceramic candle filters to remove bacteria and parasites but not viruses use other filter types to remove sand, sediment, rust and particles use specially rated filters to remove very small particles 	<ul style="list-style-type: none"> require chlorination in addition to ceramic candle filters to remove viruses 	<ul style="list-style-type: none"> require regular maintenance and replacement for proper operation
greensand treatment	<ul style="list-style-type: none"> removes moderate amounts of iron and manganese 	<ul style="list-style-type: none"> is unsuitable for removing microbes 	<ul style="list-style-type: none"> is not easy to operate or maintain requires regular backwash and periodic reactivation with permanganate solution and/or bleach
reverse osmosis	<ul style="list-style-type: none"> removes nitrates, sulphate, hardness, most microbes, dirt particles and small amounts of some pesticides 	<ul style="list-style-type: none"> can result in plugged membranes due to hard water 	<ul style="list-style-type: none"> is costly because of need to replace membrane requires prefiltration and softening of hard water
softeners	<ul style="list-style-type: none"> reduce hardness that produces lime deposits on dish-washed items and creates a starched effect on laundry 	<ul style="list-style-type: none"> are unsuitable for removing microbes or most chemicals increases sodium concentration in treated water 	<ul style="list-style-type: none"> requires periodic replacement of softener salt and disposal of concentrated salty water

NOTE: Equipment carrying the “NSF certified” trademark has been thoroughly checked for performance, and the manufacturing facility is inspected annually. There are several NSF standards. Check for the appropriate NSF standard number for your treatment needs. Consult your local public health unit and reputable expert companies.

RESOURCES

Service	When to contact	How to locate
Public health unit	<ul style="list-style-type: none"> if you have suspected problems with your well that involve surface water, human or animal waste for a water sample bottle for indicator bacteria testing for help interpreting your water quality sample results 	public health units
Public health labs	<ul style="list-style-type: none"> for a water sample bottle for indicator bacteria testing or interpretation of water sample test results 	Public Health Ontario Laboratories
Private accredited labs	<ul style="list-style-type: none"> if you have concerns about chemicals in the well such as sulphur or nitrates 	accredited laboratories to perform water testing in Ontario
Licensed well contractors	<ul style="list-style-type: none"> if you are concerned that your well is improperly constructed, or requires upgrading or maintenance 	licensed well contractors in Ontario. See the listings under the "Water Well Drilling & Services" heading in your local yellow pages. Ensure they are licensed to provide this service.

OMAFRA Factsheets Groundwater Series

Visit ontario.ca and search for "Groundwater."

- *Understanding Groundwater*
- *Managing the Quantity of Groundwater Supplies*
- *Protecting the Quality of Groundwater Supplies*
- *Private Rural Water Supplies*
- *Highly Vulnerable Water Sources*
- *Disinfecting Private Water Wells*
- *Testing and Treating Private Water Wells*

Other Sources

Ministry of the Environment, Conservation and Parks:

- [Drinking water testing labs: accreditation and licensing](#)
- [Licensed Well Contractors](#)
- [Water Supply Wells: Requirements and Best Practices, Chapter 8, Well Disinfection](#)
- [Technical Bulletin – Well Abandonment: How to Plug and Seal a Well](#)

Public Health Ontario:

- [Public Health Unit Contact Information](#)
- Laboratory Services Contact - Provincial: (e-mail customerservicecentre@oahpp.ca or call toll free Toll Free: 1-877-604-4567) Regional (a list of [regional laboratories](#) and contact information)
- [Factsheet: Drinking Water Quality - Indicator Bacteria](#)
- [Well Water Testing \(Private Drinking Water\)](#)

Ontario Soil and Crop Association. Information on different actions that can be taken to protect the quality of groundwater and your drinking water supply is provided in the [Canada-Ontario Environmental Farm Plan](#) workbook and associated [Infosheets](#).

This factsheet was written by Dr. Hugh Simpson, Program Analyst, OMAFRA, Guelph; Jim Myslik, JPM Consulting and Brewster Conant, Jr. It was reviewed by Dr. Anna Majury, Clinical Microbiologist, Public Health Ontario, Kingston; John Warbick, Engineer, Crop Systems & Environment, OMAFRA, Vineland. Recommendations were also provided by technical experts at the Ontario Ministry of the Environment, Conservation and Parks.

Published by the Ontario Ministry of Agriculture, Food and Rural Affairs

© Queen's Printer for Ontario, 2021

ISSN 1198-712X

Également disponible en français (Fiche technique 21-024)

Agricultural Information Contact Centre:

1-877-424-1300

1-855-696-2811 (TTY)

E-mail: ag.info.omafra@ontario.ca

ontario.ca/omafra