Private Well Water Manual:
A Guide for Residents

DURHAM REGION
HEALTH DEPARTMENT

durham.ca/privatewells

Adapted with permission from Middlesex-London Health Unit

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Photos, unless otherwise noted, are courtesy of Zak Viljevac or Anne Maria Quin. Additional photos used in this adapted version are courtesy of Rashed Khoshnood, Craig McIlmoyle and Jordan Spear.

This version was prepared by the Durham Region Health Department for local use.

DISCLAIMER

This guide provides general information for residents who obtain their drinking water from a private well. It is intended for educational purposes and does not replace professional advice or legal requirements.

Provincial legislation, standards, and best practices related to wells may change over time. Residents, property owners, and well owners are responsible for ensuring that their well is constructed, maintained, upgraded, and operated in accordance with current provincial legislation and guidelines.

This guide is not comprehensive and may not cover all situations. For the most up to date requirements or for information specific to your well, consult current provincial legislation or a qualified professional.

NOTE:

Some documents referenced in this guide were published under former Ontario ministry names. The Ministry of the Environment and Climate Change (MOECC) and the Ministry of Environment and Energy (MOEE) is now the Ministry of the Environment, Conservation and Parks (MECP). The Ministry of Agriculture, Food and Rural Affairs (OMAFRA) is now part of the Ministry of Agriculture, Food and Agribusiness.

INTRODUCTION

If you are installing a new well or have questions about an existing well, this guide is for you. It is intended for residents who rely on well water for their drinking water supply.
Whether you have recently moved into a home that is not connected to a municipal water system, are installing a new well, repairing an existing well, or sealing an old well, it is important to understand where your water comes from, what type of well or equipment you have (or may need), and how to properly maintain your well.

Drinking or using contaminated water can cause illness, such as stomach cramps, diarrhea, or vomiting. Young children, older adults, and people with weakened immune systems may be more seriously affected.

A well can be thought of as a straw placed into the ground. If the well is not properly installed or maintained, or has cracks or openings, surface water containing contaminants can enter the well and the aquifer below. Once an aquifer becomes contaminated, it can affect other wells that draw water from the same aquifer.

It is important to conserve water by using it responsibly. Everyone has a role to play in protecting our water sources. This guide provides basic information to help you get started.

SOURCES OF WATER

In Ontario, we get our drinking water from two sources: Surface water (lakes, streams, or rivers) or Groundwater

Groundwater is water found beneath the earth's surface. It moves slowly through small spaces between soil, sand, gravel, and rock, similar to how water soaks into a sponge (Alberta Environment, 2010). Wells draw groundwater from underground to supply homes with drinking water.

Groundwater begins as precipitation, such as rain or snow. As it falls to the ground, some of the water soaks into the soil layers below the surface. This area is called the unsaturated zone, where both air and water fill the small spaces between soil and rock particles (Alberta Environment, 2010).

Some of this water continues to seep downward through the soil and rock. It can travel many metres into the earth until it reaches the saturated zone. The saturated zone is the area where only water fills the spaces between soil and rock particles (Alberta Environment, 2010).

The water table is the upper surface of this saturated zone. The level of the water table can rise or fall depending on how much rain or snow has fallen in an area (Alberta Environment, 2010). The depth of the water table can vary from less than 1 metre to 50 metres or more (Ministry of Environment and Energy [MOEE], n.d.). In general, the water table is highest in the spring and fall and lowest in the summer and winter (Ontario Ministry of Agriculture and Agri Food [OMAFRA], 2003).

Where do you find Groundwater?
Groundwater is contained underground in areas called aquifers**.** An aquifer is a layer of sand, gravel, or rock that holds water beneath the ground. Wells draw their water from these aquifers. According to OMAFRA (2003), there are three types of aquifers in Ontario:

- **Unconfined aquifers**: Unconfined aquifers are found closer to the earth's surface. In eastern North America, this type of aquifer is usually found at a depth of between 2.5 and 14 meters (5 and 50 feet) (OMAFRA, 2003). They are usually not completely full of water. Surface water can easily seep into these unconfined aquifers, bringing contaminants

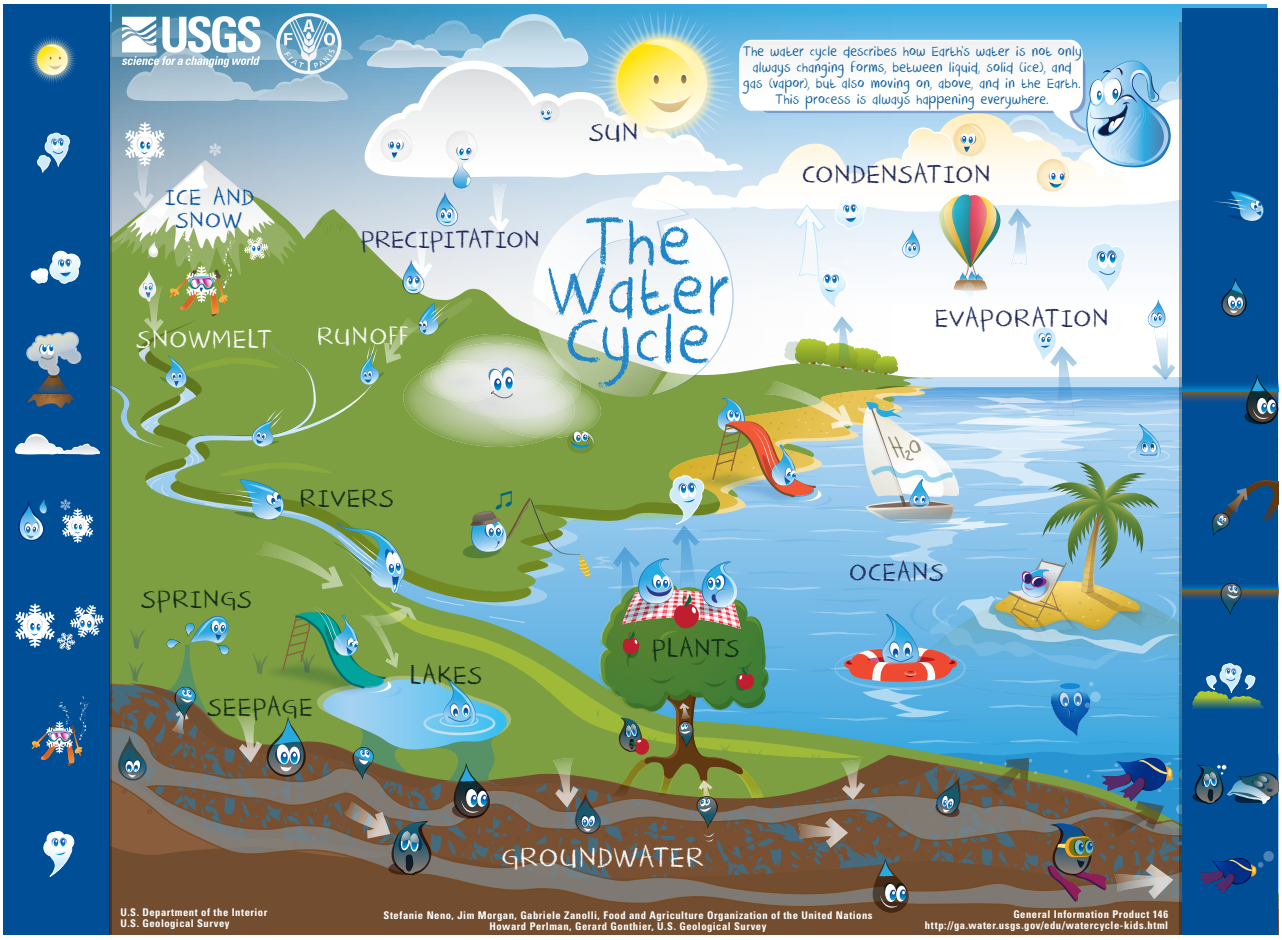
into the water (Alberta Environment, 2010). These contaminants can include bacteria, viruses, parasites, and chemicals, etc.

- **Confined aquifers:** Confined aquifers are found deeper below the ground surface. They are covered by layers of soil or rock that help limit the movement of surface water into the aquifer. This protective layer reduces the risk of contaminated water reaching the groundwater below. (Alberta Environment, 2010).
- **Semi-confined aquifers:** Semi-confined aquifers occur when a layer that normally limits water movement, called an aquitard (such as clay or shale bedrock), allows some water from above to slowly leak downward into the aquifer below. Drilling a well can also create pathways that allow water to move between layers (OMAFRA, 2003).

THE WATER CYCLE

Groundwater moves slowly through the earth's crust. In some areas, it can reach the surface and become surface water, such as streams, rivers, ponds, or lakes.

Water that is drawn from the ground may have been there for a very short time or a very long time. In shallow wells, such as dug or sand point wells, the water has usually been in the ground for a short period of time. In comparison, water from a deep drilled well in a confined aquifer may have been underground for a much longer time.



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GROUNDWATER QUALITY

Both the natural environment and human activities can affect the quality of groundwater. Natural conditions may improve or reduce groundwater quality, depending on the type of soil and rock the water moves through. Human activities can also affect groundwater quality and are often a source of contamination. According to the Ontario Ministry of Food and Rural Affairs (OMAFRA,2003), as water moves downwards through the soil, several things can happen:

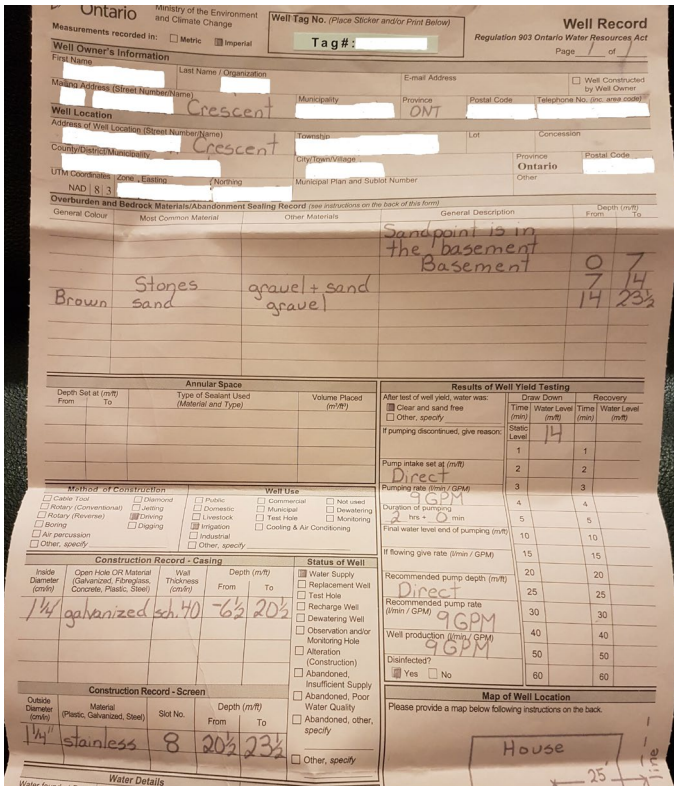
- Water can dissolve minerals from the soil or rock it passes through.
- Germs such as bacteria, viruses, and parasites that may be present at the surface can be filtered out by the soil or may die off as the water moves downwards.
- Some substances in the water may attach to soil particles and be removed from the water.

In general ground water quality depends on the type of soil or rock the water moves through, how long the water is in contact with these materials, and whether contaminants are present. The quality well water can also change with the seasons or if conditions within the aquifer change (OMAFRA, 2003).

LEGISLATION

In Ontario, several acts, regulations, and guidelines are in place to protect water quality and guide how water is used. The Ontario Ministry of the Environment, Conservation and Parks (MECP) set the minimum standards for the construction of wells. The legislation includes requirements for:

- Who is qualified to construct a well or install well pumps
- Where wells can be constructed, including required set-back distances from potential sources of contamination such as septic systems, chemicals


Ontario Ministry of the Environment and Climate Change

Well Record

Regulation 903 Ontario Water Resources Act

Well Tag No. (Place Sticker and/or Print Below) Tag #:

Well Owner's Information

Well Location

Overburden and Bedrock Materials/Abandonment Sealing Record

Brown Stones sand gravel + sand gravel

Sandpoint is in the basement Basement

0 7 / 7 14 / 14 23½

Annular Space

Results of Well Yield Testing

Method of Construction

Well Use

Construction Record - Casing

1¼ galvanized sch. 40 -6½ 20½

Status of Well

Construction Record - Screen

1¼" stainless 8 20½ 23½

Water Details

Direct

5 GPM

2 hrs + 0 min

Direct

9GPM

9GPM

Map of Well Location

Please provide a map below following instructions on the back.

House

- After a new well has been constructed, a Water Well Record must be submitted to the owner of the well and the MECP. This record will provide you with important details about your well.
- What materials may be used to construct a well
- How a well must be constructed
- The responsibilities of well owners
- When/how a well must be properly abandoned or decommissioned

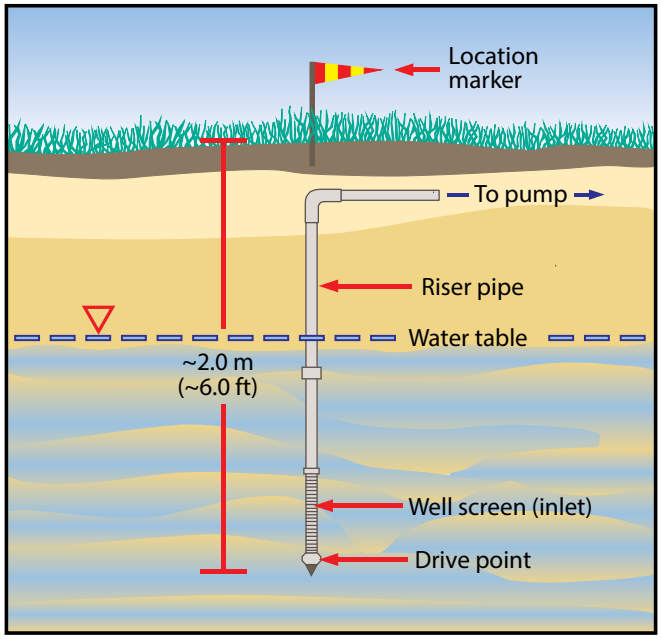
In Ontario, any well construction, repair, or upgrade involving payment must be completed by a licensed well contractor or well technician. The MECP is responsible for licensing contractors and technicians for activities such as drilling, boring, digging, and installing well pumps (OMAFRA, 2003).

After a new well is constructed, a Water Well Record must be submitted to the well owner and the MECP. This record contains important information about the well, including how it was constructed and details about the groundwater source.

WELL DESIGNS

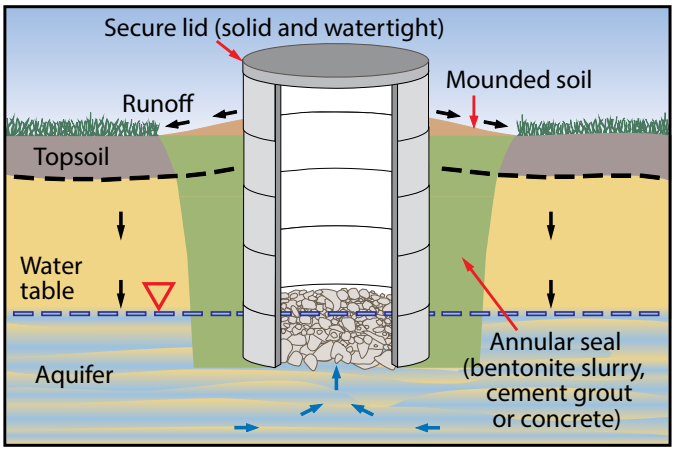
According to OMAFRA (2003), there are three main types of wells. A cross-sectional picture of each is shown below. The advantages and disadvantages of each type of well are outlined in the table on the following page.

- **Drilled Wells.** Most new wells constructed today are drilled wells. They are usually drilled using rotary or cable tool methods. These wells can be shallow or deep and are lined with a small-diameter casing, typically 10-20 cm.



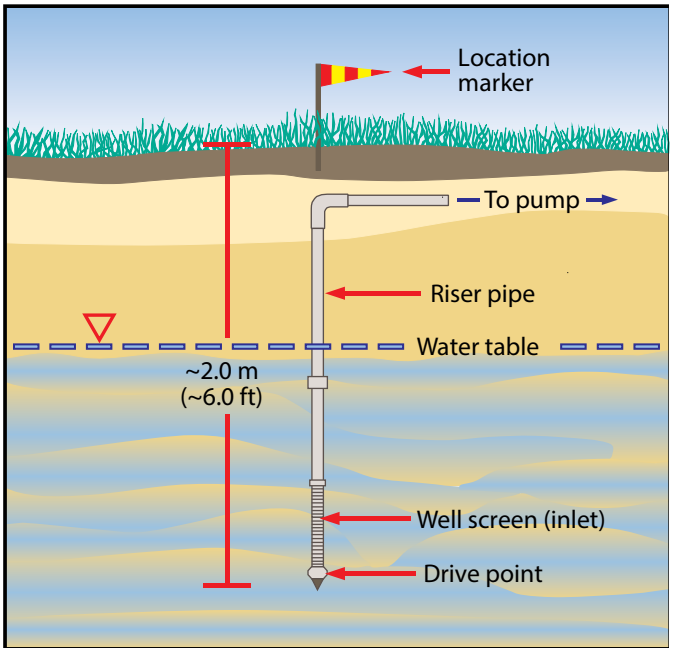
Cross-sectional illustration of a drilled well with a pitless adapter. Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

- **Dug/Bored Wells**. Dug or bored wells have a large diameter, often several feet wide. They are constructed by digging or excavating the ground until the water table is reached. Some dug wells can also be created using a boring machine. These wells can be shallow or deep, and many older wells in Ontario are of this type.



Cross-sectional illustration of a large diameter well. Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

- **Well Point (Sand Point)**. Well Point, or sand point, wells are made by driving a pointed steel pipe into the ground. The pipe has a screen throughout its length that allows water to enter. It is driven into the ground until the point of the pipe is beneath the water table. This type of well is shallow.



Cross-sectional illustration of a well point (sand point). Reproduced with permission from the Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

Each type of well has its own advantages and disadvantages, these are provided in the table below.

Table 1: The advantages and disadvantages of each type of well

ADVANTAGES

DRILLED	DUG	BORED	WELL POINT
Can enter deeper aquifers Less likely to get contaminated Easily sealed for protection Temperature is likely to remain constant Machines can get through bedrock to reach water below	Inexpensive and easy to construct Large diameter can allow for good storage of water Can be used in areas with minimal water available	Construction is more controlled than digging/ excavating Large diameter can allow for good storage of water Can be used in areas with minimal water available	Inexpensive and easy to install

DISADVANTAGES

DRILLED	DUG	BORED	WELL POINT
Susceptible to contaminants that may be present in deep aquifers Some deep aquifers may have poorer natural water quality (e.g. sulfur, iron)	Susceptible to contamination from the surface (e.g. germs, chemicals, and pests) During dry periods, insufficient water supplies may be present in shallow wells Requires large amounts of construction materials Seasonal water temperature fluctuations		Susceptible to contamination from the surface (e.g. germs, chemicals, and pests) During dry periods, insufficient water supplies may be present in shallow wells Only works in areas where the water table is high Only works when driven into permeable materials (e.g. sand and gravel)

Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016.

WELL PUMPS

There are a variety of different pumps that may be installed on a private well.

Shallow Well Pumps

Shallow well pumps can only lift water about 7 meters. These pumps are usually located at ground level, beside the well. Shallow well pumps work by creating suction in the pipe which allows water to be pushed up the pipe by the pressure differences (OMAFRA, 2003). According to the MOECC, common types of shallow well pumps include:

- **Reciprocating (piston) pumps:** These pumps use a piston that moves up and down to create a suction. This motion allows water to be drawn into the pump and moved into the discharge pipe.
- **Centrifugal pumps:** These pumps use spinning impellers to move water. The rotating motion creates centrifugal force, which pushes the water into the discharge pipe.
- **Centrifugal-jet pumps:** These pumps are similar to centrifugal pumps. Water is forced through narrow jets before entering the distribution system, which increases lifting ability.

This well point (sand point) well has a pump and pressure tank located on the ground. These wells are used in areas with a high water table because they are shallow. They are susceptible to surface contamination and to changes in the water level. This well is used during warmer months and winterized for cold weather. Plumbing can also be installed below the frost line for year-round use.

Deep Well Pumps

Deep well pumps are used when water must be lifted from greater depths. Common types of deep well pumps include:

- **Deep well jet pumps:** These pumps use a centrifugal pump located at ground level, at the top of the well. They are suitable for deeper wells because they can lift the water from depths up to about 30 meters.
- **Reciprocating (piston) pumps:** These pumps have a motor or hand-powered mechanism at the top of the well. They can be used for deep wells and are capable of liftin water from depths of approximately 122-152 meters.
- **Deep well submersible pumps:** In this type of system, both the pump and motor are submerged below the water level in the well. Submersible pumps are used in deep wells and can lift water from depths up to 300 meters.

A submersible pump in a drilled well casing model.

This is the most common type of pump used in deep wells in Ontario.

WELL LOCATION

The location of a well is very important. Wells must be placed far enough away from possible sources of contamination to meet required minimum separation distances. These sources may include utilities, existing buildings, manure piles, animal enclosures, waterways and septic systems. Whenever possible, wells should be constructed at a higher elevation than nearby sources of contamination and with greater separation distances to help protect water quality (OMAFRA, 2003).

Septic systems can be a potential source of contamination.

Wells can and are used for agriculture. Depending on the type of well, it may be more or less likely to be at risk of contamination. These cows are drinking from a water trough that is fed directly from a well below it; make sure that the well is protected from potential sources of contamination.

This picture shows the gap in the concrete well cap and its location in relation to the ground and potential sources of contamination.

WELL RECORDS

After a new well has been constructed, a Water Well Record must be provided to the well owner and submitted to the MECP. The well record may include:

- The date the well was completed
- The location of the well on the property
- The name of the original well owner
- A geologic log indicting the soil and bedrock types
- The depth at which the water was found
- Materials used to construct the well
- Details about the annular space (the space between well casing and surrounding rock or soil)
- Results of any pumping tests
- The final status of the well
- The type of water use
- The well construction method
- Details about plugging or sealing, if applicable
- Information about the well contractor

It is important to keep all of the documents related to your well and well-maintenance. This makes it easy to access when they are needed.

WELL CONSTRUCTION

Only licensed well contractors or well technicians may construct, repair or upgrade wells, and install well pumps. The following information explains some of the main components of your well and the construction process.

Well Casing

Newly constructed drilled wells are lined with a steel or fibreglass pipe called a casing. These casings are typically 12-15 cm in diameter (OMAFRA, 2003). Dug or bored wells may have food grade plastic, PVC piping, or concrete casings. The casings creates a protective pathway from the ground surface to the groundwater. It helps prevent surface water from entering the well and supports the well opening to prevent collapse. The casing also keeps loose soil, sediment, rocks, and contaminants from entering the well.

Well Screen

When well water is pumped from a sand or gravel aquifer, it will require a well screen. A well screen is typically made of stainless-steel and is attached to the bottom of the well casing. It is cylindrical in shape and has small, strainer-like openings.

The well screen allows water to enter the well while keeping sand and gravel out, which helps protect the pump and other equipment. The size of the openings in the screen depends on the size of the sand or gravel particles in the aquifer and is determined on a case-by-case basis. Well screens are generally not required for wells drilled into bedrock (OMAFRA, 2003).

Well Sealing

When a well is drilled or bored, the hole created is usually wider than the well casing. This creates a space between the soil or rock and the outside of the casing, called the annular space (OMAFRA, 2003). The annular space must be properly sealed to stop surface water and other contaminants from entering the well. Materials such as grout, bentonite slurry, cement, or concrete are commonly used for this purpose. Surface water contamination problems associated with drilled or bored wells can occur when the annular space is not properly sealed, allowing contaminants to enter the aquifer (OMAFRA, 2003).

A properly constructed drilled well. The well cap should be upgraded to make the well more secure (pictured at left).

Developing a well

After a well is installed, construction materials and loose sediments must be removed from the bottom of the well. This process is called well development. During well development, fine particles are removed from the area around the screen to allow water to move more freely into the well (MOEE, n.d.).

There are two common well development methods: In one method, the water or air is forced down into the well and out through the well screen. In the other method, water is pumped out of the well at higher- than-normal speeds (OMAFRA, 2003). Well development continues until the water coming from the well is clear and colourless (MOEE, n.d.).

A dug well that is over 100 years old. Moisture seen on the concrete and tile casings indicates that surface water is getting into the well. Ensure that the well is constructed and maintained properly to reduce potential contamination from entering the well.

WELL MAINTENANCE

All wells require routine maintenance to keep your drinking water safe. As a responsible well owner, you should ensure that:

- Your well is easy access.
- No plants or landscaping should grow around the well.
- You should be able to check the well cap and, look inside of the well at least once a year.
- Your water is tested regularly and more often if contamination is suspected.
- Chemical testing should be done if you have any concerns. For example, test for nitrates if there are infants under six (6) months of age in the home, or for other chemicals if a chemical spill occurs nearby.

Wells require regular maintenance. Your well should be routinely tested, easily accessible, maintained, repaired, upgraded, or properly decommissioned when needed. Keep records of any work done on your well, including who did the work, when it was done, and why.

- You watch for changes in the colour, taste, or odour of your water, as these changes may indicate a problem with your well water.

This image shows a properly constructed drilled well with a vented and vermin proof well cap, electrical conduit for submerged pump (to left of well casing), identification tag (linked to Water Well Record), casing extends at least 40 cm above the ground, and ground around the well that is sloped away from well casing to help direct water away from the well.

- Required set back distances are always maintained.
- The well cap is at least 40 cm above the ground level The well cap is tightly sealed and in good condition.
- The air vent in the well cap is screened and not blocked or damaged.

An inadequate well cap can allow pests and other contaminants to enter into the well and may also prevent proper ventilation.

- The ground around the well casing is grassed and sloped so that surface water drains away from the well.
- No debris is piled around your well, such as snow, leaves, or other materials.
- There is no debris floating inside the well. If debris is present, take steps to correct the problem.
- Chemicals such as fertilizers, pesticides, or motor oil are not stored or handled near the well.

Hazardous materials/solvents should not be used or stored near a well (e.g. fertilizers, pesticides, gasoline, etc.).

- There are no cracks or openings in the well casing. Check for water seepage or staining on the inside of the casing.
- Where discharge pipe or electrical lines enter the well, the connections are properly sealed and water-tight, with no signs of water entering.
- The annular space around the well casing is properly sealed.
- Anti-backflow devices are installed where necessary. Back-siphonage of dirty water can occur when a tap or hose is submerged into water, allowing contamination to flow back into the well.
- The well is properly plugged and sealed if it is no longer being used.

GENERAL HEALTH CONCERNS

Groundwater is generally clean and safe to drink. The soil above groundwater acts as a natural filter that helps remove contaminants. However, if a well is not properly installed or maintained, contaminants can enter the well and affect water quality. Contaminated groundwater can also be found in aquifers that do not have enough protective soil layers above them (Health Canada, 2008). Some common contaminants that may be present in well water are described in more detail throughout this guide.

WHAT MIGHT BE IN

Know where your well is located and make sure it is easy to access for regular inspection and maintenance. Maintain your well properly to help reduce the risk of contamination.

YOUR WELL WATER

Some things found in your well water can be harmful to health, while others may only cause aesthetic concerns, such as unpleasant tastes, odours, or staining. Below are some common water quality issues that well owners may experience:

Coliforms

Coliforms are a group of bacteria that are commonly found in the environment. The presence of coliforms in well water indicates that surface water has likely contaminated the well. Coliforms are routinely tested because the tests are simple and inexpensive. While most coliform bacteria do cause illness themselves, their presence can indicate that other harmful bacteria or contaminants may also be present. For this reason, we call them indicator organisms (Health Canada, 2008). If more than 5 coliform units per 100 ml of water are found in a well water sample, the water is considered contaminated (OMAFRA, 2003).

Escherichia coli (E. coli)

E. coli bacteria are a type of coliform bacteria that are commonly found in animal and human feces. If E. coli is found in your water in any amount, it means there has been a recent fecal contamination of the well. The presence of E. coli also suggests that other harmful organisms may be in the water, such as disease-causing bacteria, viruses, or parasites. Water that contains E. coli is not safe to drink, and steps to correct the problem should be taken immediately.

Nitrates

Nitrates can enter well water from sources such as plant fertilizers, decomposing plants, and animal wastes. If both E. coli and nitrates are found in well water, the contamination is likely coming from a malfunctioning septic system (MOEE, n.d.). High nitrate levels are a serious health concern for infants under six (6) months of age. Nitrate levels above 10 milligrams per litre (mg/L) can cause a condition called methemoglobinemia, also known as blue baby syndrome. This condition reduces the amount of oxygen in an infant's blood and can cause them to have shortness of breath and a bluish colour to the skin, lips or nails. If nitrate levels in your well water is above 10 mg/L, the water should not be used for drinking or for preparing infant formula for babies under six (6) months of age, if you have made an informed decision to formula feed your infant.

Iron & Iron Bacteria

Iron and iron bacteria are naturally found in groundwater. When iron is dissolved in water, it is colourless. When the water comes in contact with air, the iron can separate out and cause reddish-brown staining on laundry, sinks, toilets, and other

plumbing fixtures (MOEE, n.d.). Iron bacteria can also grow in well water systems. These bacteria may produce a slimy, unpleasant- smelling film that can clog pipes, pumps, and well screens. It is important to note that iron and iron bacteria are not a health concern (OMAFRA, 2003). They may affect the appearance, taste, or smell of the water, but they do not cause illness.

Sulphate & Sulphur Bacteria

Sulphate is a naturally occurring substance that may be present in groundwater (OMAFRA, 2003). High levels of sulphate, above 500 milligrams per litre (mg/L), may cause a laxative effect and can lead to dehydration (Health Canada, 2014). Sulphur bacteria may also be present in groundwater. These bacteria produce hydrogen sulfide gas, which causes a strong "rotten egg" smell in the water (OMAFRA, 2003).

Fluoride

Fluoride may naturally occur in groundwater. At levels above 1.5 milligrams per litre (mg/L), fluoride can help the formation of teeth and reduce the risk of cavities (Health Canada, 2014).

Hardness

Water hardness is usually caused by calcium and magnesium in the water, but it may also be caused by iron and manganese. Hard water can lead to scale buildup on appliances, plumbing fixtures and pipes (OMAFRA, 2003). The harder the water, the more soap is needed to create lather. This can result in poor laundry cleaning and the buildup of soap scum. Hard water is not a health concern (OMAFRA, 2003).

It is important to regularly inspect and maintain your well and to test your well water. The image shown is a drilled well located in a pit. Well pits are no longer permitted to be constructed. If your well is located in a pit, it could be upgraded so that the well casing extends at least 40 cm above ground level. NEVER ENTER A WELL PIT.

WELL MONITORING AND TESTING

Even if your well water looks fine, it may still have harmful bacteria and other contaminants that cannot be seen, tasted or smelled. The only way to know for sure if your water is safe is to have it tested. In Ontario, testing for total coliforms and E. coli bacteria is available year-round at no cost to private residences that use well water. Other types of water tests can be done through certified laboratories for a fee.

Well water should be tested regularly to monitor water quality. Water from deep aquifers usually shows little seasonal change, while water from shallow wells is more likely to change throughout the year. (OMAFRA, 2003).

According to the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA,2003), there are three ways to monitor well water quality:

- **Physical monitoring**: Physical changes in the water can sometimes warn you of possible contamination. Pay attention to the water's odour, taste, colour, and clarity (turbidity). If you notice any changes you should investigate the cause and consider taking a water sample for testing.
- **Biological monitoring**: Biological monitoring involves testing well water for bacteria, viruses, and parasites. Even if your water looks clear, it may still contain harmful microorganisms and other contaminants that cannot be seen, tasted or smelled. The only way to know for sure is to have the water tested. The most commonly used tests for total coliform and *E. coli* bacteria. These tests should be done regularly. More frequent testing may be needed depending on:
- the type of well (e.g. dug wells are typically more prone to contamination than drilled wells)
- Whether the well has been opened or repaired

- **Chemical Monitoring**: Chemical monitoring involves testing for substances such as nitrates, fluoride, iron, or other naturally occurring or chemicals. Chemical testing is usually recommended when a concern is identified, such as changes in land use, chemical spills, or health concerns.

Chemical testing should also be done whenever you are concerned that unwanted chemicals may be present in your well water. Depending on the situation, you may wish to test for nutrients (such as nitrates), water hardness, gasoline or oil, or other chemicals.

Chemical tests are usually done by private laboratories, and the cost of testing will vary depending on the substance being tested.

The soil is cracked, evidence that water has entered the well pit (not to be constructed this way anymore) and dried. One way to prevent this from happening is to upgrade the well by installing a pit-less adapter and extending the well casing at least 40 cm above the ground; and ensuring that construction/ maintenance is conducted properly. New construction wells cannot be located in well pits. NEVER ENTER A PIT.

A drilled well located in a well pit (these are not to be newly constructed anymore) can be contaminated when the pit is exposed to surface water (that comes through the casing or through gaps in the cap). These wells can be upgraded to have a pit-less adapter that makes the well more secure and less likely to be contaminated. You can see evidence of water entering the well around the concrete casing joints. New construction wells cannot be located in well pits. NEVER ENTER A WELL PIT.

Wells located near the road or parking lots may be at risk of salt (sodium) and vehicle-related contamination. Know what can get into your well and take measures to minimize the potential contamination and the risks.

RESULT INTERPRETATION

Biological water samples are taken in 200 milliliter (mL) bottles. The lab will test 100 mL of the sample and counts the number of bacteria reported as colony-forming units (CFU)

Table 2: Understanding your water sample test results for total coliforms and *E. coli*

E. COLI (CFU/100 ML)	TOTAL COLIFORM (CFU/100 ML)	WHAT DOES THIS MEAN?	WHAT SHOULD YOU DO?
0	5 or less	No significant bacterial contamination was found	Continue to test your drinking water on a regular basis to determine if there are any changes in your drinking water quality
0	More than 5	Indicates bacterial contamination	Do not drink your well water Contact your local health unit for further assistance
1 or more	1 or more	Indicates contamination from animal or human fecal waste	Do not drink your well water Contact your local health unit for further assistance
NO DATA: OVERGROWN		**WHAT DOES THIS MEAN?**	**WHAT SHOULD YOU DO?**
No data: Overgrown with Non-target		Indicates heavy bacterial contamination	Do not drink your well water Contact your local health unit for further assistance
No data: Overgrown with target		Indicates heavy bacterial contamination and total coliforms and/or *E. coli* (indicator organisms) are present.	Do not drink your well water Contact your local health unit for further assistance

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A dug well. In this example, the well cap is located close to the ground, which makes it prone to contamination. It is important to know where your well is located, how it was constructed, how it is maintained, and how susceptible it is to contamination.

WELL WATER TREATMENT SYSTEMS

There are many different treatment systems available that can be installed to improve well water quality. Because different water quality problems require different treatment methods, it is important to choose a system that meets your specific needs.

A water treatment filter. Equipment requires regular inspection and maintenance. This filter needs to be replaced.

Table 3: Common types of treatment systems

TREATMENT SYSTEMS	ADVANTAGES	DISADVANTAGES
Chlorine	Kills bacteria and viruses Inexpensive	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Needs careful handling (ensure that appropriate personal protective equipment is used) Must test chlorine levels Dosing pump requires regular maintenance
Ultraviolet (UV) Light	Kills bacteria and viruses Inexpensive	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Needs a slow water flow UV lamp and sleeve must be clean to work properly UV light bulbs must be replaced regularly
Ozonation	Kills most microbes Removes organic compounds (e.g. pesticides)	Needs filtration (to remove microbes and parasites that are hiding in dirt particles) Varies in how effective it is depending on how it is used and the manufacturer
Reverse Osmosis	Removes most microbes, nitrates, sulphates, hardness, dirt particles, and small amounts of some pesticides	Hard water may cause plugged membranes Expensive Membranes need to be replaced Needs pre-filtration and pre-softening of hard water

Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016

An example of a filter and ultraviolet disinfection system.

Make sure that the ultraviolet light bulb sleeve is cleaned on a regular basis. If the sleeve becomes dirty, the UV light cannot properly inactivate germs, allowing contaminated water to flow through untreated.

WELL ABANDONMENT AND SEALING

It is the responsibility of the well owner to ensure that a well is properly sealed when it is no longer in use (OMAFRA, 2003). A well may be sealed by a licensed well contractor, or by the property owner where the well is located (Ontario Ministry of the Environment and Climate Change [MOECC], 2011).

Unsealed or poorly sealed wells can become a source of contamination. Cracks in the well casing or well cap can allow for surface water, pests, or other contaminants to enter the well. Unsealed wells may also pose a safety risk to children, pets, and livestock who may be able to access them.

Contaminants entering a well can reach the aquifer and may affect other wells drawing water from the same aquifer (OMAFRA, 2003).

After the well has been sealed, an updated Water Well Record must be submitted to the Ministry of the Environment, Conservation and Parks (MECP) and to the owner of the well if the owner did not carry out the sealing. This record must be submitted within 30 days after all the construction equipment has been removed from the site.

TROUBLESHOOTING

The following table shows some of the common problems that you may have with your well, and how you may be able to solve these problems.

Table 4: Troubleshooting the common problems

	WHAT MIGHT BE THE PROBLEM?	HOW DO I FIX IT?
Bacteria	● Setback distances from contamination sources are not maintained ● Well casing not properly sealed or not water tight ● Well cover is cracked or not installed properly (e.g. not 40 cm above ground, loose) ● Well not shock chlorinated after maintenance or installation ● Contaminated aquifer	● Boil water before consumption (bring water to a rolling boil for 1 minute. Do not boil water if chemical contamination is suspected) ● Remove possible contamination source(s) and then disinfect the well ● Shock chlorination of well ● Install a long-term treatment system (UV, chlorine, ozonation)
Nitrates	● Setback distances from contamination sources are not maintained ● Well casing not properly sealed or not water tight ● Contaminated aquifer	● Install a long-term treatment system (reverse osmosis) ● Use an alternative water source for infant consumption
Iron	● Naturally present in the groundwater	● Install a long-term treatment system (aeration and settling, or filtration, water softeners, greensand/ potassium permanganate ion exchangers)
Sulphates	● Naturally present in the groundwater	● Install a long-term treatment system (reverse osmosis, activated carbon filtration, gravity separation system)
Iron/ Sulphur Bacteria	● Setback distances from surface water sources are not maintained (e.g. lakes and ponds) ● Well casing not properly sealed or not water tight ● Well cover is cracked or not installed properly ● Well not shock chlorinated after maintenance or installation ● Contaminated aquifer	● Install a long-term treatment system (chlorination-filtration system) ● Shock chlorination of well
Sodium*	● Naturally present in the groundwater ● Road salt is getting into the aquifer ● Water softener uses sodium	● Minimize amount of salt getting into aquifer, secure the well. ● Use water softener system that does not use sodium ● Install a long-term treatment system (reverse osmosis, ion exchange, distillation unit)
Fluoride	● High levels may be naturally present in the groundwater	● Install a long-term treatment system (reverse osmosis)
Hardness	● Naturally present in the groundwater	● Install a long-term treatment system (water softeners) ● Soluble phosphate additives

*Adapted with permission from Best Management Practices: Water Wells (2003), by Ontario Ministry of Agriculture, Food and Rural Affairs, 2016; and *from Sodium in Drinking Water Factsheet (2013), by Elgin Area Primary Water Supply System, Elgin St. Thomas Public Health, and the Middlesex-London Health Unit.*

SHOCK CHLORINATION

Shock chlorination is a process that uses a high concentration of chlorine to disinfect a well and household plumbing system. This is done by adding chlorine (household bleach containing 5.0 – 5.25% sodium hypochlorite) to the well water. Use unscented bleach only and avoid products with added fragrances such as lemon scent. Make sure that the bleach is fresh, as it loses its strength over time. After the chlorine is added, water is pumped through the plumbing system and left in the pipes long enough to allow proper disinfection. Detailed instructions are provided in the next section titled 'How to Shock Chlorinate Your Well' .

According to the Ontario Ministry of Agriculture, Food and Rural Affairs OMAFRA (2003), shock chlorination of well water is recommended:

- Immediately after any construction, maintenance, repair, inspection, or upgrade.
- When your water test results show 0 *E. coli,* but more than 5 total coliforms. If this is the case, take another water sample again 3-4 days after shock chlorinating, once all the chlorine is flushed out of the system to avoid a false test result.
- When the water test results show any E.coli, **Do Not Drink** the water. Collect a new water sample and then shock chlorinate the well. If the repeat test still shows any 0 E. coli or total coliforms, inspect the well or hire a licensed well contractor. Remember to shock chlorinate again after the inspection or any repairs.

When you are inspecting your well, keep possible sources of contamination in mind.

Not all wells are the same size or diameter, so they do not all need the same amount of chlorine (bleach) for shock chlorination. Use the following steps to determine how much chlorine your well needs.

What you will need:

- Measuring tape
- Long piece of non-stretchy string
- Small, fairly heavy weight securely attached to the string

Measuring the well:
First, you will have to determine the diameter and the depth of your well. You may be able to find this information in your well record, but if not, you will need to measure your well yourself.

- To find the diameter, measure across the widest part of the well casing.

- To find the depth of the well, attach the weight securely to the string. Slowly lower the weight into the well until you feel it reach the bottom. Carefully remove the string and weight from the well. Measure the length of the string that is wet. This shows how deep the water is in the well. Do not use stretchy or plastic string, such as fishing line, as this can give inaccurate results.

Now that you know the diameter and depth of your well, you can use the table below to determine how much bleach is needed for shock chlorination. Then follow the steps in the next section titled 'How to Shock Chlorinate Your Well'.

Table 5: Amount of bleach required for the shock chlorination of your well depending on the depth of your well.

Volume of unscented bleach added for every 3 meters (10 ft.) of water in the well		
DIAMETER OF CASING		**BLEACH VOLUME (5.0-5.25%)**
millimeters (mm)	inches (”)	milliliters (mL)
50	2	6
100	4	30
150	6	60
200	8	100
250	10	200
300	12	250
400	16	400
500	20	650
600	24	900
900	36	2000 (2 liters)
1200	48	3600 (3.6 liters)

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HOW TO SHOCK CHLORINATE YOUR WELL (AS ADAPTED FROM OMAFRA (2003))

After you have added the required amount of bleach to your well, follow the last few steps below as per the recommendations by OMAFRA, 2003:

1. Continue using a safe alternate water supply for drinking, cooking, brushing teeth, and food preparation until test results confirm that your well water is safe.
2. Add the calculated amount of bleach to the well.
3. Remove any carbon filters from the well system, as these filters remove chlorine. Replace them with new filters after shock chlorination so that the old filters do not re-contaminate the system.
4. Run the water at every faucet supplied by the well until you can smell a strong chlorine odour. If your sense of smell is not reliable, a pool test kit can be used to confirm the presence of chlorine.
5. If you cannot smell chlorine, or the smell is weak, add more bleach to the well.
6. Drain your hot water heater and allow it to fill it with the chlorinated water.
7. Backwash any water softeners or filters in your treatment system, except carbon filters.
8. Let the chlorinated water sit in your plumbing system for at least 12 hours, preferably overnight.
9. Flush the chlorinated water from the well by running water from a hose outside until chlorine can longer be smelled or detected.

Note:

- Make sure that you do not run the water through indoor taps in your home into your septic system.
- Do not discharge water over the septic bed, as chlorine can kill beneficial bacteria needed for proper septic system operation. Ideally, discharge water onto the ground surface away from the house or into a nearby ditch.

- Do not discharge the water into storm sewers, as these may drain into natural waterways.
- Be aware of any local by-laws regarding the discharge of chlorinated water to the environment.

10. Take a bacteriological water sample 3-4 days after shock chlorinate.
11. If the test shows that your water is safe, wait one week and test it again. Two safe test results in a row show that the shock chlorination was successful.
12. If bacteria are still present:
    - Shock chlorinate the well again and re-test
    - Inspect the well, equipment, and surrounding area and correct any problems if possible
    - You may need to contact a licensed well contractor, install a continuous treatment system, or construct a new well (and properly plug the old one).

Let's take a look at Bob's well:

Bob's well is 300 mm in diameter. Using the string method he found out that his well is 6 m deep.

- Since Bob's well is 300 mm in diameter, he will need to add 250 mL of bleach for every 3 m of water in his well.
- Since his well is 6 m deep in total, he will need to divide the 6 m by 3. This equals 2.
- He must then multiply the 250 mL of bleach by 2, which will equal 500 mL of bleach.
- So, Bob will need to add 500 mL of bleach for the adequate shock chlorination of his well.

Let's take a look at Judy's well:

Judy's well is 500 mm in diameter. Her well is 40 m deep.

- Since Judy's well is 500 mm wide in diameter, she will need to add 650 mL of bleach for every 3 m of water in her well.
- She takes the 40 m depth and divides by 3. This equals 13.33.
- She then multiplies the 650 mL of bleach by 13.33, which equals 8664.50 mL of bleach.
- Rounding up, Judy will need to add 8665 mL (or 8.665 L) of bleach for the adequate shock chlorination of her well.

Bored wells with proper casings and sturdy well caps will help prevent accidental falls into the well and reduce the amount of contamination that can enter. Like all types of wells, bored wells must be properly constructed and maintained to reduce the risk of contamination and injury.

A dug well with an upgraded, sturdy lid that is properly vented, and vermin proof helps reduce the amount of contamination that can enter the well. Many older wells of this type have been constructed using stones, bricks, or other materials. The coloured portion of this well lid allows for observation of the well without having to remove the heavy concrete lid. The concrete lid can still be removed when maintenance or inspection is required.

In this properly installed septic system, the access riser (green lid) to the septic tank is the only visible component. The septic tank is where heavier solids settle and begin to break down. The distribution box and leach field (also called a drain field) are located farther away, toward the tree line. This is where wastewater is further treated as it moves through the soil and is broken down by bacteria.
It is important to properly install, regularly inspect, and maintain your septic system to help prevent groundwater contamination. Signs of septic system problems may include sewage backing up into plumbing fixtures or areas of wet or "ponding" grass where the septic system is located.

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Durham Region Health Department - Health Protection Division
101 Consumers Drive, Whitby Ontario L1N 1C4
905-668-2020/1-800-841-2729 Dial 311 (within regional limit)
durham.ca/privatewells