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Ontario

Best practices for source water protection

Learn how to manage risks and identify actions that you can take to protect your drinking water source.

Take our survey to share your feedback on our best practices to protect sources of drinking water.

Get started

We want to help you protect water sources and drinking water systems that are not included in a source protection plan or aren't regulated by the *Clean Water Act*.

Protecting sources of drinking water is one part of Ontario's strategy to ensure drinking water safety, sustainable water use and water security for future generations. You can tailor an approach that works for you.

By proactively protecting drinking water sources you:

- protect human health and the environment
- avoid the high costs of either cleaning up a contaminated drinking water source or having to find a new source of drinking water
- reduce the cost of water treatment for some contaminants
- extend the life of your system's infrastructure
- make informed land use planning decisions
- increase public awareness and accountability of drinking water stewardship

Decide if you need to take action

Drinking water can come from surface water (an intake pipe or a shore well that draws water from a lake or river) and groundwater (a drilled or dug well) sources.

Certain activities can pose a risk to drinking water if pollutants are released to the environment. Pollutants, also called contaminants, are either:

- **chemicals**, such as fuels, solvents, metals and pesticides
- **biological pathogens,** such as bacteria and viruses

Soil can sometimes act as a natural filter for pathogens so some private well owners do not treat the water in their wells. But groundwater can become contaminated when chemicals or pathogens are released on or into the ground from human activity.

Example: Bacteria in private wells can come from on-site sewage systems and fuel can leak from heating oil tanks. Your well can become contaminated if these contaminants move through the soil into the groundwater.

Surface water bodies have no natural filter for contaminants like pathogens. Surface water can become contaminated when:

- chemicals or pathogens are released directly into surface water bodies
- surface water run off carries contaminants across land that drains into surface water bodies

As a result, surface water always needs some form of treatment before it is safe to drink.

Source protection adds another layer of protection by managing activities that may pose a risk before they become a problem.

If your drinking water source is not currently included in a provincially approved source protection plan, you may want to consider whether actions are needed to protect your drinking water source. You can learn more about how to identify areas where drinking water sources could be at risk and how to manage risks to drinking water sources.

Two things you'll want to consider:

- if your drinking water source is vulnerable to contamination
- if other risk factors exist

Vulnerable drinking water sources

Some drinking water sources are more vulnerable to contamination than others, which means that you may need to take stronger action to protect them. Generally, the more vulnerable your source is, the more important it is to take action to protect the source.

Protecting the ground surface above vulnerable groundwater from potential contaminants will improve the protection of groundwater sources at deeper depths. Similarly, protecting the land that drains into surface water bodies from potential contaminants will improve the protection of the surface water source. If you determine your drinking water source is vulnerable to contamination, you may decide to take action to protect it.

The vulnerability of a drinking water source is based on the characteristics of the natural environment.

For groundwater sources, these characteristics include the type of soil and rock in the area and how quickly water (and contaminants) can travel through it.

For surface water sources, these characteristics include the type of source (lake or river), water flow and wind conditions, rainfall, the slope of the land, presence of vegetated or paved surfaces, and the soil type.

To help figure out how vulnerable your drinking water source is, you can look at:

- Highly Vulnerable Aquifer mapping
- your local setting
- preferential pathways
- other resources
- hiring a professional

Highly Vulnerable Aquifers

Your aquifer is the layer of soil where your well gets its groundwater. Some aquifers are more vulnerable to contamination than others.

Municipal groundwater studies and source water protection studies have been completed across much of Ontario. Highly Vulnerable Aquifers were delineated as part of the technical work in support of the development of source protection plans under the *Clean Water Act*. They are aquifers that can easily be contaminated because overlying soil layers are thin or permeable. They may or may not represent drinking water sources. Local source protection assessment reports will provide more information about how local Highly Vulnerable Aquifers were delineated and which aquifers are presented in the Highly Vulnerable Aquifer mapping. You can view Highly Vulnerable Aquifer mapping on the Source Protection Information Atlas. These maps can tell you where you may want to take action to protect your drinking water source.

Assess your local setting

Your local setting can tell you about the vulnerability of your drinking water source.

Groundwater sources

Take a look at the type of soil you have and how well the soil transmits water, also called the permeability of the soil. This relates to how quickly contaminants can reach your well from where they may have been released to the environment.

Soil is made up of particles of rock that can vary in size. The particles of rock that make up sand and gravel soil are larger than the particles of rock that make up silt and clay soil. Larger particles don't pack together as well as small particles so there is more space between sand and gravel particles than silt and clay particles. Groundwater travels faster through sand and gravel than through silt and clay because there is more space between the larger soil particles to allow water to flow.

Look at infiltration for a very basic way to assess whether your surface soil is permeable. When it rains, does water pond on your property or absorb quickly into the ground? The answer can give you a sense of the type of soil in your area and how vulnerable your groundwater source may be.

Soil thickness can also help you determine how vulnerable your groundwater is. If you can see rock outcrops on your property or can't dig very far before you hit rock, you have thin soil layers, which are usually more vulnerable than thicker layers.

You can get a rough idea of the vulnerability of your groundwater source as shown in the table below.

Local setting	Vulnerability
Highly permeable surface sand and gravel, loose, mixed soil types over bedrock or shallow, fractured bedrock	High
Lower permeable surface silt and clay or where impermeable soil is both above and below the aquifer as shown in your well log or geological maps	Low

Surface water sources

You can look at the movement and circulation of the water in your lake, river or stream to assess the vulnerability of surface water sources. Gravity and wind action also both contribute to the movement and circulation of surface water bodies. For streams and rivers, the steeper the slope of the land, the faster the water moves downstream. Strong wind action can circulate water in a pond or lake.

You can get a rough idea of the vulnerability of your surface water source as shown in the table below.

Local setting	Vulnerability

Local setting	Vulnerability
Slower moving water with less water circulation or mixing	High
Faster moving water with more water circulation or mixing	Low

Other factors affecting vulnerability

Preferential pathways, also called transport pathways, are human-made shortcuts that allow water to get to a drinking water source faster than under natural conditions. They can include things such as:

- improperly constructed or abandoned wells
- tile drains
- pits and quarries
- other excavations such as trenches for utilities and sewers

If you know these features are present, they can add to the vulnerability of your groundwater and/or surface water sources.

Preferential water flow also occurs through natural fractures in the soil and bedrock. These also impact vulnerability, especially when there is little soil overlying the bedrock.

Vulnerability resources

Learning about the physical characteristics of your area can help with your assessment of vulnerability. These maps and resources provide information about soil types, aquifers and the steepness of the land. Through the Ministry of the Environment, Conservation and Parks, the Ministry of Natural Resources and Forestry and the Ministry of Energy, Northern Development and Mines' OGSEarth website you can access:

- water well records and other borehole records
- quaternary geology and bedrock geology maps
- aquifer maps
- depth to water table maps
- maps of the thickness of the soil layers above aquifers
- geological cross-sections
- topographic surface and surface water feature maps (topographic maps show the locations of hills, mountains and valleys using lines, called contour lines, to represent different elevations)

If you are located within a source protection area, the watershed characterization and assessment report within the local source protection plan are also good resources to learn more about vulnerability.

Hire a professional

You may need to do some further assessment work to determine how vulnerable your source is to contamination if you need more information than the simple techniques presented above. A basic hydrogeological assessment or advanced modelling techniques can be used to determine the vulnerability of your drinking water source. Hydrogeology, or the study of water underground, is an area of geoscience. Geoscience is a regulated profession in Ontario under the Professional Geoscientists Act. Hire a Professional Geoscientist or Professional Engineer who is qualified to conduct hydrogeological assessments to do this work for you.

Professionals can be found through local listings in your area. You can also view public registers of Professional Geoscientists on the Professional Geoscientists Ontario website and Professional Engineers on the Professional Engineers Ontario website.

Consider a risk-based approach

There may be other factors beyond vulnerability that are important for you to consider. A risk-based approach can help you decide whether it's a priority for you to take action to protect your drinking water source. Municipalities and various communities may want to consider using this approach where information and resources are available.

The general concept of risk is the product of how likely something is to happen and how severe it would be if it happened. Risk is subjective, and your assessment of it may vary depending on your tolerance or comfort with accepting risk. Some level of risk is generally acceptable; however, it's a value judgement often based on local circumstances. The risk of a drinking water source being contaminated or depleted can be determined by looking at risk factors.

Assess your risk factors

Think about your local situation and using the provided table, ask yourself some general questions to rank (low, moderate or high) how 'at risk' your drinking water source may be. High risk sources may warrant action to protect the source.

There is no right or wrong way to assess risk and no one factor is more (or less) important than another.

> **Example**: Just because there are many wells in an area, doesn't necessarily mean those wells are at risk.

You can look at many factors together to assess the overall risk and look at the importance of each risk question compared to each other. This relationship should be based on local knowledge and the reliability of the data you used to rank the risk. Assigning importance or weighting to each risk question can help determine an overall risk ranking.

> **Example:** Confirmed water quality issues may be the driving factor where the system serves fewer users, whereas a system that serves many people where there are no known issues may still be at risk and require further protective actions.

You may also want to look at specific activities to determine the risk ranking.

> **Example:** Residential septic systems may be a nearby activity that could pose a risk to the drinking water source. If these systems are not properly maintained, they may pose a higher risk due to potential contaminants being able to get into drinking water sources, even though residential activities are generally considered lower risk than commercial or industrial activities.

Risk questions	Low risk	Moderate risk	High risk
How many wells or intakes are located in your area?	A few	Some	Many
How deep are the wells and are they drilled or dug?	Deep, drilled	Intermediate	Shallow, dug

Risk questions	Low risk	Moderate risk	High risk
How deep is the intake and how far is it located from shore?	Deep, far	Intermediate	Shallow, nearshore
What is the vulnerability of your area?	Low vulnerability setting	Moderate vulnerability setting	High vulnerability setting
How sensitive is the population?	Healthy adults only	Typical family or mixed range of ages	Vulnerable populations like the elderly, youth or infants
How many people does the system serve?	A few	Some	Many
How often is the system used?	Occasional	Seasonal or part time (work hours)	Every day or only source
What types of activities are located nearby?	Residential	Agricultural	Industrial or commercial
Do you have water quality issues? For example, algal booms or a boil water advisory.	Confirmed none	Possible / unknown	Confirmed present
Are you located in an area where there is pressure for growth? Or are there other water supply and demand issues?	No	Maybe / unknown	Yes
Is there oversight of the well(s) or intake(s)? For example, licencing, inspections, testing, compliance, and qualified operators.	Yes	Some	None

Risk resources

The following data sources can help inform your risk factors and assessment of risk.

- Property/lot fabric can give you a sense of how many people are located in your area based on township lot mapping but note that many vacant lots may be present in rural areas, which won't be a good indicator of population density.
- Development/building approval records, land use and zoning maps, official plans from your local municipality can help you determine the types of land use in your area.
- Water Well Information System records can help with the assessment of the number and construction details of wells in your area.
- Permit to Take Water records can be used to assess how much water is approved for use by permit holders (actual amounts used may be less).
- Environmental Compliance Approval records through Access Environment can provide information on activities in your area that are regulated by the Ministry of the Environment, Conservation and Parks.
- Vulnerability mapping from the Source Protection Information Atlas can give you vulnerability scores for locations within established source protection areas.
- For information on water quality, drinking water quality and enforcement records, local health department records on water quality, hydrological/hydrogeological studies conducted by municipalities, conservation authorities or consultants, and available monitoring data from the Provincial Groundwater Monitoring Network or surface water monitoring stations can be accessed.

For municipalities

You can assess risk on a broader regional scale where multiple drinking water systems are present. For multiple systems, you can use risk factors to create a list of risk rankings for each system. Comparing risk rankings in a list may be useful to prioritize and justify deciding which systems need further actions to protect the source.

You can also consider the potential for future risk associated with potential future development.

Regardless of the assessment of vulnerability or risk, you may decide that further action is needed to protect the source.

> **Example**: Even if a drinking water source is assessed to have low vulnerability and low risk based on current land uses, you can require technical work (or financial assurance to conduct such work) as a condition of development approvals with communal drinking water systems should the system become your responsibility in the future. You can learn more about managing risks to drinking water sources.

Work together

Protecting sources of drinking water is a shared responsibility. Think about your local situation and ask yourself "Is there a willingness in my community to protect the area around our wells or intakes?" Community/private drinking water may be from a shared source, and taking action in some circumstances might prove to be controversial.

> **Example**: To manage risks from private septic systems, a septic inspection program could be implemented; however, this could impact property owners who have to pay for the cost of the inspections. Collaborating with neighbours at a larger scale can be even more effective than at a smaller/private property scale.

Setting up community meetings or social media platforms to discuss issues are some ways to engage various participants. Remember to include and be respectful of differing opinions and priorities. Various resources are available online to help with building partnerships and conflict resolution.

Coordination of actions to protect drinking water sources between different jurisdictions can also improve protection of drinking water sources. Many partnerships have already been established through implementation of source protection planning in Ontario under the *Clean Water Act*. Local expertise can help with implementation of the actions you want to take to protect your drinking water source. You can connect with the following groups to find out more:

- municipalities
- Conservation Ontario
- conservation authorities
- source protection authorities and committees
- Risk Management Officials
- Indigenous communities and organizations
- environmental emergency response personnel
- small businesses
- agricultural operations
- local and neighbouring watershed experts
- environmental groups
- other community partners

In addition, collaborating with others may yield information and data that you may otherwise not be aware of or have access to. Using existing source protection information along with other information sources can help inform local decisions and actions at all levels from individual to communal systems. The following resources can help you do this:

- Source Protection Information Atlas
- Threats Tool
- Risk Management Measures Catalogue
- water quantity maps, or water budgets (now in the Source Protection Information Atlas)
- hydrogeological and hydrological studies (visit your local conservation authority website for these or Conservation Ontario for links to assessment reports and source protection plans)

Having a clear project plan and collaborating with your community can ensure your actions to protect your drinking water source are successful.

Next steps

If you decide that you need to take action to protect your drinking water source, you can learn more about identifying areas where drinking water sources could be at risk, managing risks to drinking water sources, reviewing and evaluating your actions, and exploring your options to include your drinking water source in a source protection plan under the *Clean Water Act*.

If you decide that you do not need to take action, you may still want to consider some best practices to protect the environment, such as spill prevention measures, septic system inspections or outreach and education on proper well maintenance and annual fuel tank inspections. You can find resources in the manage risks to drinking water sources page.

Identify areas where drinking water sources could be at risk

> Take our survey to share your feedback on our best practices to protect sources of drinking water.

Overview

Drinking water protection zones are areas of land where drinking water sources could be at risk of contamination from certain activities. This is the area where your management efforts should be focused to protect your source. You can create a protection zone by using:

- land use information
- information about the vulnerability of your area
- a scientific method to create protection zones around your drinking water well or intake

If you are thinking about establishing a new municipal residential drinking water system within a source protection area or adding new wells or intakes to an existing municipal residential drinking water system within a source protection area, there are rules under the *Clean Water Act* for creating protection zones. Use the Source Protection Information Atlas to find out if you are located in an established source protection area.

It's important to know the specific areas of land where certain activities may pose a risk to your drinking water source. You can also learn more about the different approaches to manage these activities.

Use land use information

Drinking water sources can be contaminated by nearby activities that are associated with various land uses. You can look at current and future land use to determine which areas you need to protect and base the protection zone on property lines (lots and concessions or parcels of land). You can use this approach when you have information about land use activities that may pose a risk to your drinking water source. It is a cost effective and easy way to identify a protection zone with minimal effort. However, its limited scientific basis could lead to overprotecting some areas or not protecting others.

For municipalities and planning authorities

Where there is little or no development around your well or intake, you may want to designate that area for protection and direct some or all development to other areas.

Where there is an activity near your well or intake that is causing or could cause a problem with your drinking water, you may want to focus protective action in those areas where the activities are occurring.

You can also protect shared drinking water sources.

> **Example**: If all the wells in a hamlet draw water from the same source, you can designate a block or combined lots where certain activities would be managed or restricted.

Use vulnerable area information

Vulnerability is a way to describe how easily a drinking water source could be contaminated by nearby activities. The vulnerability of a drinking water source is based on the natural characteristics of the environment that determine how easily contaminants move. For groundwater sources, these characteristics include the type of soil and rock in the area and how quickly water can travel through it. For surface water sources, these characteristics include the type of source (lake or river), water flow and wind conditions, rainfall, the slope of the land, presence of vegetated or paved surfaces, and the soil type.

A vulnerable area under the *Clean Water Act* is a protection zone where activities that may pose a risk to drinking water are managed or restricted. Vulnerability assessments were conducted as part of the technical work in support of the development of source protection plans under the *Clean Water Act*. Vulnerable areas are assigned a number score (2 to 10) that indicates how vulnerable (i.e., sensitive) the drinking water source is to contamination. Generally, the higher the assigned vulnerability score within a vulnerable area, the more vulnerable the drinking water source. The Source Protection Information Atlas displays vulnerability scoring and has links to local source protection plans to help you learn more about the policies that affect activities and land use planning decisions in vulnerable areas.

Highly Vulnerable Aquifers

If you are located in an established source protection area under the *Clean Water Act*, you can view Highly Vulnerable Aquifer mapping for your area in the Source Protection Information Atlas. You may also be able to see aquifer mapping for areas outside source protection areas as a result of municipal groundwater studies.

Highly Vulnerable Aquifers are aquifers that can easily be contaminated because overlying soil layers are thin or permeable. They may or may not represent drinking water sources. Local source protection assessment reports will provide more information about how local Highly Vulnerable Aquifers were delineated and which aquifers are presented in the Highly Vulnerable Aquifer mapping. Highly Vulnerable Aquifer mapping and scoring helps delineate other vulnerable areas where source protection plan policies may apply.

Highly Vulnerable Aquifer mapping can help you create a protection zone where you can take action to protect your drinking water source.

Use a scientific method

Protection zones can be created around a drinking water well or intake. These protection zones can be determined using scientific methods and information about the ground and water around the well or intake. There are two approaches to creating protection zones:

- Use a set distance from the well or intake to determine the boundary of the protection zone, also known as a **fixed radius**.
- Base the distance to the boundary of the protection zone on the time it would take for contaminants to get to the well or intake, also known as the **time of travel**.

There are several methods available to calculate the distance to the boundary of the protection zone from the well for a groundwater source and from the intake for a surface water source. A map is helpful to display the protection zone you create around the well or intake.

Time of travel calculations may constitute geoscience work. Geoscience is a regulated profession in Ontario under the Professional Geoscientists Act. Hydrogeology, or the study of water underground, is an area of geoscience. Professional Geoscientists, and Professional Engineers who are both competent and qualified, conduct hydrogeological work.

> Sometimes there is a connection between groundwater and surface water in drinking water wells. You might see this in wells that are located close to surface water bodies or when wells are improperly constructed, maintained or abandoned. This connection often results in surface water pathogens getting into groundwater. Protection zones for these groundwater systems may be established by groundwater methods or combined with surface water methods. Professional Geoscientists and Professional Engineers can determine an appropriate method for delineating these protection zones.

Groundwater protection zones

Groundwater protection zones represent the area of land at the ground surface where water is captured by the well. Within this area, certain activities may pose a risk of contamination to the water used for drinking. Outside of these areas, groundwater does not move toward the well and does not need to be considered when determining protection zones.

Your well's water supply comes from the **capture zone** of the well, which includes upland recharge areas and the zone of influence.

Recharge areas are where rain and melting snow infiltrate directly into the ground rather than flowing over the land.

The water table is the location below the ground where the spaces in soil or cracks in rock are filled with water. Groundwater does not move in underground rivers, but rather flows under the influence of gravity along a gradient from areas of higher water table elevation (upgradient) to areas of lower water table elevation (downgradient).

The zone of influence is the area that contributes water to the pumping well. When groundwater is pumped from a well, it is pulled towards the well from every direction. This action is strongest at the well and decreases as you move away from the well.

You can use one or more scientific methods to create one or more protection zones around your drinking water well to protect the source.

Where several wells have overlapping protection zones, you can combine the zones of the individual wells into a larger single zone for protective action. Similarly, if narrow strips of land exist between protection zones of neighbouring wells, you can incorporate the area in between, and protect the whole area as a single zone.

Method	Cost and complexity	Accuracy	Resources needed
Arbitrary fixed radius – groundwater	Low cost, quick and easy	Not the most accurate	Very few
Calculated fixed radius	Low cost, easy to apply	Somewhat accurate	Few
Uniform flow method	Moderate cost, moderately complex	Accurate	Some
Two-dimensional analytical model	Moderate cost, moderately complex	Accurate	Some
Computer based three-dimensional model	High cost, very complex	Can be very accurate	Many

Arbitrary fixed radius – groundwater

This method is as simple as drawing a circle around your well. You can use it when data and information resources are limited or when you want to quickly create a protection zone with little technical expertise. It is a cost effective and easy way to identify a protection zone with minimal effort. However, its limited scientific basis could lead to overprotecting some areas or not protecting others.

You will need to know the location of the well and the distance you want to protect. You can base the distance on very generalized considerations of soil and groundwater and/or professional judgement.

Example: The fixed radius could be based on averaging the distances that correspond to a time of travel for various soil types, such as in the state of California, which uses a minimum radius of 300 metres and 450 metres to represent the 5- and 10-year time of travel zones, respectively, for highly permeable sand and gravel aquifers. For fractured rock aquifers, they increase the radius of each protection zone by 50 percent.

Or you may also want to consider:

- The Director's Technical Rules under the *Clean Water Act*, which uses a fixed radius of 100 metres to protect the most vulnerable area next to a well.
- Ontario Regulation 267/03 under the Nutrient Management Act also protects municipal wells with a 100-metre buffer.
- In British Columbia, an arbitrary fixed radius of 300 metres is often used.

Choosing a large fixed radius can increase protection but may also mean that more people living and working in the protection zone would be affected than is necessary. It also might make it more difficult to defend the protection zone boundaries if they are challenged later. Public support for using this method is an important consideration.

You may want to establish multiple protection zones. With this strategy, you can use more stringent tools to manage activities that could pose a risk to drinking water in the protection zones closer to the well and softer tools to manage activities in the protection zones farther from the well.

Suggested arbitrary fixed radiuses

These are based on averages in provincially approved source protection plans.

- 100 metres to protect the most vulnerable area next to the well.
- 500 to 900 metres to protect against pathogens like bacteria and viruses that usually die off within about 2 years of travel time before getting to the well.
- 1,000 to 1,600 metres to protect against chemical contaminants and pathogens that usually break down within about 10 years of travel time before getting to the well.
- 1,700 to 3,000 metres to protect against persistent and hazardous chemicals that usually persist in the environment for about 25 years of travel time before getting to the well.

If you know which contaminants you want to protect against, you can choose to delineate protection zones that correlate with the times of travel above.

> Example: If pathogens from agricultural activities near your well are the only concern, you may not need to delineate a zone to protect against persistent and hazardous chemical contaminants.

Calculated fixed radius

This method, also known as the “cylinder method,” creates a circular protection zone. The radius of the circle is calculated using either:

- the volume of water pumped by the well over a specified period of time
- calculating the speed of the groundwater and multiplying by a chosen time of travel.

It is based on simple hydrogeologic principles and requires limited technical expertise.

You will need data on the pumping rate and/or water use, the thickness of the aquifer or well screen length, and the porosity of the aquifer. Porosity represents the amount of spaces between grains of soil, estimated as a percentage of the total volume of pore space held by water, for different soil types.

> Example: Sand and gravel can have a porosity percentage as high as 25%-50%, while for dense, solid bedrock it may be less than 0.1%.

You can delineate multiple zones using this method and take a similar management approach to that presented in the arbitrary fixed radius method.

Modified calculated fixed radius method

The calculated fixed radius method does not account for the direction that groundwater is flowing. Therefore, this method may over-protect the zone downgradient of the well (where the groundwater has already moved past your well) and under-protect the zone upgradient of the well (where the groundwater is coming from). You can apply a modified calculated fixed radius method if you know the groundwater flow direction. This shifts the circle upgradient and may provide better protection of upgradient activities that can pose a risk to your drinking water source.

To use this modified method, first calculate the fixed radius. The upgradient portion of the protection zone is estimated as one and a half times the calculated radius. The downgradient extent of the protection zone is one half of the calculated radius. The resulting shape is a circle with a radius of R, shifted upgradient by a distance of 0.5R.

To determine the groundwater flow direction, you will need advice from a Professional Geoscientist or Professional Engineer who is both competent and qualified to undertake such activities. Professionals can be found through local listings in your area. You can also view public registers of Professional Geoscientists on the Professional Geoscientists Ontario website and Professional Engineers on the Professional Engineers Ontario website.

Half circle calculated fixed radius method

The half circle calculated fixed radius method incorporates flow direction by replacing the circular shape of the protection zone with a half circle that has the same area. This method results in a protection zone that more closely resembles shapes derived from the uniform flow method. The half circle is oriented in the upgradient direction of groundwater flow.

To provide protection for the downgradient zone of influence, a small circle is delineated around the well. Lines are drawn out from the smaller circle to the boundary of the half circle. The radius of the small circle is dependent on the pumping rate of the well. Generally, if the pumping rate is 9.5 cubic metres per day or less, the radius of the small circle is 15 metres.

Uniform flow method

This method calculates the distance to the protection zone boundary by solving analytical equations using a known time of travel. It assumes groundwater moves at a steady state and that the natural conditions are fairly uniform. The uniform flow method can be done with hand calculations or with the help of relatively simple computer programs. Hire a Professional Geoscientist or Professional Engineer who is qualified to conduct hydrogeological assessments to do this work for you. Professionals can be found through local listings in your area. You can also view public registers of Professional Geoscientists on the Professional Geoscientists Ontario website and Professional Engineers on the Professional Engineers Ontario website.

You will need to have data on the geology of the area and the hydrogeology of the aquifer. The uniform flow method is more flexible than standard analytical equations since it can adjust to changes in flow direction. The disadvantage is that this method generally does not take into account hydrogeological boundaries like streams, lakes, recharge areas, etc. or variability in hydrogeology.

Two-dimensional analytical model

This method calculates the distance to the protection zone boundary by solving analytical equations (such as the uniform flow method) using a known time of travel. The model equations map protection zones in plan view (two dimensions). It's reasonably easy to apply with some technical expertise. Hire a Professional Geoscientist or Professional Engineer who is qualified to conduct hydrogeological assessments to do this work for you. Professionals can be found through local listings in your area. You can also view public registers of Professional

Geoscientists on the Professional Geoscientists Ontario website and Professional Engineers on the Professional Engineers Ontario website.

You will need to have data on the geology of the area and the hydrogeology of the aquifer. Computerized two-dimensional analytical models, such as the Wellhead Protection Area (WHPA) Model and the Wellhead Analytic Element Model (WhAEM), are available free of charge from the United States Environmental Protection Agency, or other computer programs can be used.

An analytical model can often provide a good approximation of the time of travel boundaries. However, locations with variable natural features may require more sophisticated methods, such as detailed hydrogeological mapping or numerical modeling.

Computer based three-dimensional model

This method uses a computer to solve mathematical equations to simulate or 'model' how water and contaminants move in groundwater. Essentially, the computer program creates a three-dimensional grid that simulates the aquifer. At each grid node, hydrogeological information is input into the program, allowing the model to predict groundwater flow and the movement of contaminants. When properly set-up and calibrated, these models produce more realistic time of travel estimates than the analytical or semi-analytical approaches.

You will need a lot of good quality data on:

- the geology of the area
- hydrogeology of the aquifer
- water quality

Computer based three-dimensional models account for local information and complex natural features for better accuracy but poor data quality can impact model predictions.

Running computer based three-dimensional models requires specialized technical expertise. Hire a Professional Geoscientist or Professional Engineer who is qualified to conduct hydrogeological assessments to do this work for you. Professionals can be found through local listings in your area. You can also view public registers of Professional Geoscientists on the Professional Geoscientists Ontario website and Professional Engineers on the Professional Engineers Ontario website.

Surface water protection zones

Drinking water from a surface water source is transported through a pipe directly from the lake, river or stream. The entry point of your raw water supply is called the intake. Surface water protection zones are made up of the land and water near the location of the intake. The land portion of the protection zone is called the setback. In these areas, certain activities and land uses can pose a risk to drinking water sources.

Setbacks are areas of land that drain into the surface water source. This part of the land next to a surface water source helps to control the runoff flow (slow down the water speed) and to allow enough time to let water infiltrate into the ground. When it rains a lot or snow melts, some streams and rivers overflow into a flat low-lying area called a **floodplain**. When the stream or river is just about to spill onto its floodplain, the water level in the channel is called the **high water mark**. Setbacks can be measured from the **high water mark** or you can use the area of land within **floodplain** mapping for a 100-year **flood event**, similar to the conservation authority regulation limit. The high water mark can be measured using a physical marker or observed as a natural line on the landscape.

Floods and floodplains are rated statistically for the expected time between **flood events**.

Example: A 100-year flood is a flood that is expected to occur once every 100 years. In other words, it has a 1 percent chance of occurring in any one year.

Generally, 120 metres measured from the high water mark is an adequate setback. This distance (or the conservation authority regulation limits, whichever is greater) is used in the Director's Technical Rules under the *Clean Water Act* to develop protection zones. You can also use this distance in the absence of data or technical resources.

Setbacks can also be extended to consider local information such as the type of surface soil, local topography of the land, size of the water course, preferential pathways and land use. Smaller setbacks can be used if the area within 120 metres does not drain into the protection zone associated with the water course.

The provincial land use planning framework generally suggests that if there is a proposed land use within 120 metres of a surface water feature (such as a lake, river or stream), a hydrological evaluation is required to establish a vegetative protection zone around the feature. This is consistent with Policy 4.2.4 in the Growth Plan and the Oak Ridges Moraine Conservation Plan, which use the terminology "key hydrologic features" instead of the more general "surface water" and can help protect the feature and its function, provided a minimum 30-metre setback be maintained.

Conservation authorities have flood maps that show their regulation limits. Where floodplain mapping isn't available within the conservation authority watershed, other mapping such as fill regulation mapping or regulated areas mapping may be available. Floodplain and other mapping resources can be found on Conservation Ontario's website. In areas where there are no conservation authorities, the Ministry of Natural Resources and Forestry has published technical guides on natural hazards to support municipal implementation of the natural hazard policies in the Provincial Policy Statement. These can be ordered directly from the Ministry of Natural Resources and Forestry to assist with flood mapping when needed.

You can use one or more scientific methods to create one or more protection zones around your drinking water intake to protect the source.

Method	Cost and complexity	Accuracy	Resources needed
Arbitrary fixed radius – surface water	Low cost, quick and easy	Not the most accurate	Very few
Analytical approach	Moderate cost, varying complexity	Accurate	Some
Numerical model	High cost, very complex	Can be very accurate	Many

Arbitrary fixed radius – surface water

This method involves drawing a circle or semi-circle around the intake. You can use it when data and information resources are limited or when you want to quickly create a protection zone with little technical expertise. It is a cost effective and easy way to identify a protection zone with minimal effort. However, its limited scientific basis could lead to overprotecting some areas or not protecting others.

You will need to know the type of water body (river, lake or both), the location of the intake and the distance you want to protect. The Director's Technical Rules under the *Clean Water Act* use the following fixed radiuses to protect the most vulnerable areas next to the intake:

Drinking water source	Common fixed radius distances
Lake	Full circle of 1000 metres
Large river or river connecting the Great Lakes	Semi-circle of 1000 metres upstream of the intake and a 100 metre rectangle extending downstream
Small or inland river	Semi-circle of 200 metres upstream of the intake and a 10 metre rectangle extending downstream

When the circle or semi-circle is fully in water, the protection zone does not need to include land. Where the circle or semi-circle intersects the land, a setback should be included in the protection zone. In the absence of data or technical resources, you can use 120 metres from the high water mark as the setback.

You can also establish multiple protection zones using the fixed radius method. With this strategy, you can use more stringent tools to manage activities that could pose a risk to drinking water in the protection zones closer to the intake and softer tools to manage activities in the protection zones farther from the intake. Below are some suggested arbitrary fixed radiuses you can use to establish multiple protection zones. These are rough estimates based on averages in provincially approved source protection plans.

For inland rivers and lakes:

- 200 metres to protect against contaminants that would have little to no chance for dilution before they reach the intake (where you wouldn't have time to respond to a spill)
- 500 to 1000 metres to provide about 2 hours to respond to spills
- 1500 metres or the watercourse of the entire watershed

For large water bodies like the Great Lakes and their connecting channels:

- 1000 metres to protect against contaminants that would have little to no chance for dilution before they reach the intake (where you wouldn't have time to respond to a spill)
- 2000 metres to provide about 2 hours to respond to spills
- 3000 metres

Analytical approach

This method calculates the distance along the surface water body to the protection zone boundary by solving analytical equations using a known time of travel, such as 2 hours. Distances are determined from the simple concept of speed, time and distance (Distance = Speed × Time). It is reasonably easy to apply with some technical expertise.

Three features that contribute to the source water can be included in the calculations:

- the type of water body (river, lake or both)
- storm or sewer pipeline systems (if there are any)
- a setback on the land (if needed)

You will need to have data on the size and shape of the channel, the speed of the water, and the characteristics of sewer systems if present. The Manning equation is the most common way to estimate the speed of the water **(Speed = $1/_{n} \times R^{2/3} \times S^{1/2}$),** where **n** is the Manning coefficient (friction coefficient), which varies from 0.001 to 0.03 based on the type of material along the river bottom and the flow, **R** is the hydraulic radius (in metres), which in most cases is equivalent to the depth of the water in the river, and **S** is the slope of the river.

You can use a 2 hour time of travel or increase the time of travel if you know your drinking water system's spill response time, also known as the time needed to shut down or provide treatment in the case of a spill.

Numerical model

This method uses a computer to solve mathematical equations to simulate or 'model' how water and contaminants move in rivers, streams and lakes. You will need a lot of good quality data on the size and shape of the channel, water depth and speed, wind speed, water currents and water quality parameters such as temperature and turbidity (a measure of how cloudy the water is due to sediments suspended in the water). Numerical models account for local information and complex natural features for better accuracy but poor data quality can impact model predictions.

Numerical model equations are solved for multiple locations and times under different conditions to reflect changes in the natural environment. Single (constant) values can be used for various parameters such as water depth, speed and temperature if the numerical model is being used to simulate a short period of time. If there is enough data available, models can simulate longer periods of time to reflect changes to the system from things like weather and climate. In this case, the water depth, speed and temperature cannot be assumed constant and multiple values would be needed.

Several numerical modelling codes are available and can represent the natural environment in one, two or three dimensions. The option you pick depends on the complexity of the natural environment and the data available. One- and two-dimensional numerical codes are commonly used. Three-dimensional numerical codes can be used for situations where the circulation of water is too complicated to be represented by a one- or two-dimensional model such as for the Great Lakes.

Running numerical models requires specialized technical expertise from a hydrologist or Professional Engineer. You can hire a specialist to do this work for you.

New or changing municipal residential drinking water systems

A new or changing municipal residential drinking water system within an established source protection area may not yet be included in a source protection plan.

Ontario Regulation 205/18 under the *Safe Drinking Water Act* requires municipalities within source protection areas to ensure sources of drinking water for new or changing municipal residential drinking water systems are protected before providing water to the public. In these cases, technical work to identify protection zones must follow the Director's Technical Rules under the *Clean Water Act*.

Provincially approved source protection plans generally use computer based three-dimensional modelling to delineate protection zones; however, this is not the only way to delineate these areas, and the Director's Technical Rules allow for less complicated methods. You can use the scientific methods provided above, where appropriate, to help you identify the best method to incorporate your drinking water system into your local source protection plan that meets the requirements of the Director's Technical Rules and is appropriate to local conditions and available data and resources.

For groundwater sources, where the protection zone boundaries need to be determined using a time of travel method, these include:

- a computer based three-dimensional groundwater flow model
- two-dimensional analytical method
- uniform flow method
- calculated fixed radius method

For surface water sources, you can use the analytical approach or numerical model in accordance with Part VI of the Director's Technical Rules.

For municipalities

Communal drinking water systems can end up under your care and control. Whether this is a planned transition or becomes necessary due to inadequate operation of the system by the owner, this transition can result in responsibilities that you may not have planned for, including:

- Responsibilities to incorporate the drinking water system into the local source protection plan at your expense.
- Legally binding source protection plan policies that can affect existing property owners, businesses and your municipality.

Consider the long-term ownership of any proposed communal drinking water systems. You can require that development proposals that rely on such systems be subject to conditions as part of the development approval. Conditions could include requiring the developer to complete any potentially required source protection plan technical work or financial assurance to complete such work should the system become your responsibility in the future.

Learn about how Ontario Regulation 205/18 applies to you.

Manage risks to drinking water sources

Take our survey to share your feedback on our best practices to protect sources of drinking water.

Activities that can pose a risk

Certain activities can pose a risk to drinking water if pollutants are released to the environment. Pollutants, also called contaminants, are either:

- **chemicals**, such as fuels, solvents, metals and pesticides
- **biological pathogens,** such as bacteria and viruses

If one or more of the listed activities occurs near your well or surface water intake, or within a drinking water protection zone that you have created, then there is a potential for contamination of your drinking water source. Drinking water protection zones are areas of land where drinking water sources could be at risk of contamination from certain activities.

Activity	Examples
Liquid fuel and fuel oil handling and storage	Home heating, gas stations, bulk plants and pipelines, marinas and ports, farms, public works yard, rail lines, main highways
Chemical handling and storage	Body shops, garages/repair shops, car washes and salvage yards that use paints and degreasers, dry cleaners (where chemicals are used), industrial manufacturing and processing of chemicals such as paints, fertilizers, pharmaceuticals, cosmetics, solvents and fire retardants, metal plating, furniture refinishing, tanneries, wood treating and electronic equipment
Application, handling and storage of road salt	Roads, parking lots, public works yard

Activity	Examples
Waste disposal, storage and processing	Landfills, mine tailings, snow storage and disposal, recycle processing and storage of waste where generated (for example, manufacturing)
Stormwater management	Stormwater management facilities, commercial car or truck washes, sewage treatment plant effluent discharges, sewer systems and related pipes
Septic systems	Residential systems, small- and large-scale commercial/industrial/institutional systems
Agricultural operations	Application, storage, handling and management of manure, pulp and paper biosolids and sewage biosolids, application, storage and handling of pesticides and fertilizers, livestock grazing or pasturing

Some of these activities are regulated by the province, with measures taken to protect drinking water sources. If a provincial approval or registration is already in place, you may not need to take additional management actions.

Identify local risks

If you know, or are already concerned, about specific activities that are impacting or may impact your drinking water sources in your protection zone, you can focus your efforts on managing them.

If you don't know which activities may be of concern, start by thinking about current activities, as well as future activities to prevent problems from occurring. Take into consideration local activities that may impact your drinking water source, such as those listed in the table above.

Conduct an inventory of activities to help identify activities and prioritize management actions.

Create an activity inventory form

Your activity inventory form can include:

- location of activity and contact names of the owner and/or operator
- type of activity
- age and condition of the facility
- likelihood of a spill
- whether there are any risk management measures in place
- whether the activity is managed by provincial regulations
- whether contaminants associated with the activity are biological pathogen, chemical or both
- if you know any potential contaminants associated with the activity, and whether they have been detected in your drinking water supply

Conduct the inventory

You can use any of the following methods to conduct as comprehensive an inventory as resources (staff, cost, time) allow. These methods are listed in order of increasing resources needed:

- desktop inventory
- windshield survey
- email or online survey
- mail survey

- virtual meetings
- phone survey
- door-to-door survey
- personal interviews
- field inspections

Choosing an inventory method, or combination of methods, should consider the type(s) of activity(ies), the efficiency of the inventory method and how much detail is needed to make further management decisions.

> **Example:** A farm might be best assessed by interviewing the farmer, a dry cleaner might require a site inspection, while a door-to-door, mail or online survey may be a more efficient choice for a trailer park with a septic system.

When conducting the inventory, remember that several activities may be occurring at one facility.

> **Example:** A gas station may have an underground storage tank for fuel and an onsite septic system.

As an alternative to soliciting information about activities on a property, you can make assumptions about activities and then confirm with property owners whether those activities are occurring.

> **Example:** You may assume that all buildings or residences located in your protection zone store heating/furnace oil fuel and then allow property owners to correct this assumption via a questionnaire or survey.

Desktop inventory information sources

You can use readily available information sources to make a list of activities that could pose a risk to your drinking water source, including:

- Google maps and Ontario's GeoPortal
- current and historical aerial photographs
- telephone directories
- real estate title searches
- zoning and land use maps
- waste management databases (such as Hazardous Waste Information Network)
- fire insurance plans
- environmental reports
- provincial and federal records and databases
- municipal permits and licences

Using these information sources can give you an idea of the types of businesses and other activities in your area to create a desktop inventory of activities that may pose a risk to your drinking water. These sources are available by talking to local residents, or at:

- public libraries or archives
- provincial, regional and municipal government offices

You may want to consider cross-referencing multiple information sources to verify their accuracy.

> Environmental permissions set rules for certain activities that could potentially contaminate the environment. Learn more about environmental permissions and how to find detailed information about environmental approvals and registrations in your community and locate Ontario facilities on an interactive map. This information may help inform your activity inventory.

Map activities

Mapping activities is a simplified way to assess risk and prioritize your management actions. You can use any maps you've created that show the location of your drinking water protection zones and add the location of activities in your inventory to see where they overlap.

You can map discrete activities, such as a gas station, with a point (with coordinates) on your map. Activities that extend across greater distances such as sanitary sewer lines, can be displayed as a line feature. Wide-scale activities that cover larger areas, such as application of manure on farm fields, can be represented as a polygon shape.

You can also use more advanced mapping techniques like computerized Geographic Information Systems (GIS). These systems can 'layer' data electronically using shapefiles (GIS layer) or spreadsheets with x,y values to represent spatial locations.

You can also upload your data directly into the Source Protection Information Atlas following the steps below:

1. Open the Source Protection Information Atlas, click Tools, and then click Upload Data.
2. Locate your shapefile or spreadsheet using Choose Files.
3. Give your layer a name and symbol and click Upload.
4. You should now see your layer in the Map Legend (note your layer is only temporarily available and no one else can see it).

Prioritize activities

When prioritizing which activities to manage, consider:

- The location of the activity in relation to your drinking water well or intake.
- The type of contaminants associated with the activity.

A basic understanding of common contaminants associated with the risk activity can help you identify which activities are a higher risk and should be addressed first. Identifying priorities will help you direct work to where it is most needed to protect the drinking water source.

> **Example:** Septic systems that are far away from a well may pose a lower risk than ones close to a well, in terms of potential for biological contamination. Activities such as dry cleaners may still pose a high risk far away from a well, because of the particular chemical contaminants associated with them.

You can also consider the age and condition of the facility where the activity is taking place.

Example: You may want to focus management actions on a gas station with aging infrastructure rather than a gas station with newly installed, leak-resistant tanks.

Manage local activities that may be a risk

There are many tools available to help develop local management strategies to minimize the risk that identified activities may pose to your drinking water source.

Decide on a management approach

There are several factors to consider when selecting the most appropriate tool or combined approach. Ask yourself:

- Is the activity occurring now? In the past? Predicted to occur in the future?
- How hazardous is an activity, and what is the likelihood of a negative impact from that activity?
- Is the management tool protective enough to manage the activity?
- Do you have the time, staff and resources to develop and administer the tool? Do you have the legal authority to implement the tool?
- How much time will it take to implement?
- Is there community support or opposition from landowners?
- Does the science that determined your protection zone support the type of management tool?

Management tools

Management tools can range from restrictive rules that prohibit certain activities from occurring to less restrictive strategies that help people carry out activities responsibly. The tools listed in the table below are similar to the approaches used in local source protection plan policies under the *Clean Water Act*.

Management tool	Who can use it?	Restrictiveness	Advantages and disadvantages
Land use planning (for example, official plans, zoning by-laws, site plan control)	Municipalities and planning authorities	Very restrictive	Proposed land uses are managed through rules for future development. Requires resources to establish protection zones and policies and review applications.
Municipal by-laws and Building Code	Municipalities and planning authorities	Very restrictive	Future activities are managed through rules, and fines may be imposed for non-compliance. Requires resources to establish by-laws, review applications and for enforcement.
Incentive programs	Municipalities and communities	Moderately restrictive	Benefits those who need financial support to implement risk management measures. May have restrictive terms and conditions in order to access funding. Requires resources to run program. Could also include non-financial acknowledgement programs.

Management tool	Who can use it?	Restrictiveness	Advantages and disadvantages
Best management practices	Municipalities, communities, Local Services Boards and private drinking water system owners	Less restrictive	Promotes consistency and collaboration but are not enforceable. Requires support from affected property owners to follow the best management practices.
Education and outreach	Municipalities, communities, Local Services Boards and private drinking water system owners	Less restrictive	Provides the most flexibility but tools are not enforceable.

For municipalities and local planning authorities

There are many tools available to you through Ontario's land use planning system to help you meet your obligations under the Provincial Policy Statement and other provincial plans, where applicable, to protect sources of drinking water. Land use planning tools generally only apply to future uses.

You can:

- Direct development that may pose a risk to your drinking water source away from the protection zones you identified through official plan policies and zoning by-laws.
- Restrict land uses that may be a risk to your drinking water source.
- Use planning tools, such as a community improvement plan, to provide financial assistance with rehabilitating and redeveloping land, such as brownfields, within your established protection zones to help address historical environmental issues.

The Planning Act allows for regulation of land uses, not activities. Therefore, municipal planning documents may need to identify the land use category or type of development that encompasses the activity or groups of activities in question.

> **Example**: The activities of applying untreated septage to land or landfilling of municipal waste may be included in the land use category of waste disposal, whereas the activity of storing and using organic solvents for manufacturing could be included in the industrial land use category.

Municipal official plans

The Planning Act requires that certain development applications, such as subdivision approvals, be accompanied by a set of supporting studies for a complete application. **Prescribed supporting studies** include a servicing options report and a hydrogeological report prepared by a qualified professional (Professional Geoscientist or Professional Engineer), which assesses the groundwater and surface water quality and quantity impacts of the proposed development, and how the impacts will be managed.

Municipal official plans may include policies, with mapping of drinking water protection zones to direct future development away from the drinking water source. Municipal official plans must be consistent with the Provincial Policy Statement, and are required to conform to provincial plans, where applicable, to protect drinking water sources.

You can also use official plan policies to require other studies to support development applications. Additional supporting studies may include:

- **Disclosure reports** provide details on the activities and operations of the proposed development/use.
- **Geotechnical reports** prepared by a Professional Geotechnical Engineer characterize the soil condition and the status of groundwater resources (details from this report can also be included in the hydrogeological study).
- **Spill prevention and contingency plans** outline design measures, facilities and procedures to avoid and mitigate spills of contaminants.

You can also establish specific support materials, such as a checklist identifying all the required documentation. This type of material can help municipal staff assess the risk to your drinking water source and can be a valuable tool for pre-consultation.

Communal drinking water systems can end up under your care and control. Whether this is a planned transition or becomes necessary due to inadequate operation of the system by the owner, this transition can result in responsibilities that you may not have planned for, including:

- Responsibilities to incorporate the drinking water system into the local source protection plan at your expense.
- Legally binding source protection plan policies that can affect existing property owners, businesses and your municipality.

Consider the long-term ownership of any proposed communal drinking water systems. You can require that development proposals that rely on such systems be subject to conditions as part of the development approval. Conditions could include requiring the developer to complete any potentially required source protection plan technical work or financial assurance to complete such work should the system become your responsibility in the future.

Zoning by-laws

Zoning by-laws are used to control the use of land – the type of land use and the specifications relating to that land use. You can identify zones where certain land uses are allowed. Zoning can be used to restrict uses that may pose a risk to drinking water.

> **Example:** Within an area zoned for industrial development, part of those lands may overlap with a drinking water protection zone where certain industrial activities would pose a risk to drinking water. In the zoning by-law, you could choose to specify the specific types of industry that would not be permitted in that specified portion of the land use zone. In addition, you could use an overlay or some other distinction on your zoning map schedules to show the limits of your drinking water protection zones. This approach is often used for conservation authority fill regulation mapping.

Similarly, a zoning by-law can specify certain required design standards, including the location of a connection to municipal water and wastewater servicing. This can work hand-in-hand with an official plan policy and by-law under the Municipal Act to require connection to municipal sewage servicing. Zoning by-laws also allow you to restrict development that may pose a risk to the drinking water source in areas where there is no municipal sewage servicing.

Site plan control

Site plan control, under Section 41 of the Planning Act, is an important tool in regulating development. It can be used to ensure that the proposed development is designed in a way to minimize risks to your drinking water source.

You can consider developing content in your site plan control guidance document or manual that addresses sites that are located in your identified protection zones.

The table below provides examples of site plan control requirements that you can use to address various activities. Note that zoning by-laws can apply in agricultural areas, but for farms requiring a nutrient management strategy under the Nutrient Management Act, the size of manure storage is generally dictated through nutrient management plans and separation distances under the Act for phased-in farms.

Activity	Examples of potential site plan control requirements	Examples of potential zoning by-law requirements
Storage of hazardous waste	Specify location of storage facility on parcel of land	Maximum size of storage facility Specify which types of industrial/commercial uses are permitted
Storage of non-hazardous waste	Specify location of waste storage facilities on parcel of land	Minimum separation distance of waste storage from water features
On-site septic system	Specify location of septic tank and tile bed on parcel of land	Maximum size and capacity of tank Specify location of connection to municipal sewers
Stormwater management pond	Specify lot grading Specify location of pond on parcel of land	Specify location of connection to municipal sewers
Storage of unprocessed plant waste from food processing facility	Specify location of waste storage facilities on parcel of land	Minimum separation distance between storage facility and water features Maximum size of storage facility Specify which types of industrial/commercial uses are permitted
Storage of pesticide at a manufacturing plant	Specify location of storage facilities on parcel of land	Minimum separation distance between storage facility and water features Maximum size of storage facility Specify which types of industrial/commercial uses are permitted

Activity	Examples of potential site plan control requirements	Examples of potential zoning by-law requirements
Parking lot with road salt application	Specify lot grading and layout of parking lot	Maximum impervious surface area (where water cannot infiltrate into the ground) in consideration of climate change adaptation plans or stormwater management plans Minimum separation distance between impervious surfaces (such as roads) and water features
Storage of road salt at a manufacturing plant	Specify type of storage structure	Minimum separation distance between storage from roads and water features
Snow disposal site	Specify lot grading Specify location of dedicated snow storage	Maximum total impervious surface area
Industry storing fuel	Specify lot grading Specify type of storage structure	Minimum separation distance between storage tank and water features
Dry cleaning operation	Specify type of storage structure	Maximum size of storage facility Specify which types of industrial/commercial uses are permitted
Pharmaceutical production facility	Specify type of storage facility How the release of contaminants to the environment can be prevented in the stormwater management system	Minimum separation distance between storage structure and water features Specify which types of industrial/commercial uses are permitted

Community planning permit system

The community planning permit system is a land use planning tool intended to help promote development by combining zoning, site plan and minor variance processes into one application and approval process. This gives you a greater range of options than the conventional development approval process and can help protect environmentally sensitive areas and control development, including site alteration and the removal of vegetation.

Example: You can protect water quality through the requirement of vegetative buffers and erosion control measures. In addition, you can apply conditions that need to be fulfilled either prior to or upon the issuance of a community planning permit (through a community planning permit system). These may include conditions related to ongoing monitoring requirements for the protection of the natural environment and

public health and safety. Alternately, you can include conditions for monitoring in a site plan agreement, outside of the community planning permit system.

Municipal Act authorities

Outside of land use planning, you can also consider your authority under other legislation to pass by-laws to control activities. Under the Municipal Act, you have broad powers to pass by-laws, including those that concern the economic, social and environmental well-being of your municipality and the health, safety and well-being of people. Limits apply, and by-laws cannot conflict with provincial acts and regulations. The City of Toronto has similar broad powers under the City of Toronto Act.

You can consider using these and other powers when putting local programs in place to manage certain types of activities in your drinking water protection zones or to help protect your drinking water sources.

Examples of local programs that may have taken the above powers into account include:

- The disconnection of roof downspouts from municipal sewers. This can reduce the volume of water collected by storm sewers, which can reduce municipal wastewater plant overflows, spills or bypasses during storm events.
- The collection of household hazardous waste. This can help keep hazardous substances from being released to the environment through improper disposal.

Building Code authorities

The Building Code sets requirements for the design and installation of on-site sewage (septic) systems, including minimum setbacks/clearances from wells and surface water features such as lakes and streams. Inspection programs for septic systems under the Ontario Building Code can help you identify septic systems that are not functioning properly or are poorly maintained. These may pose a risk to drinking water within a certain distance of wells and intakes. Inspection programs consist of regular inspections of the system and follow up actions to ensure septic systems are properly maintained.

Usually the property owner pays for the cost of the inspection but cost recovery through residential taxes is also an option. Funding programs are available through the Federation of Canadian Municipalities to help your residents offset the costs of replacing defective or substandard septic systems. You can choose who performs the inspections on your behalf such as municipal building inspectors/officials, health department staff, third party contractors or conservation authorities. Property owners also have the option to hire a qualified third party to conduct the inspection. You can decide how to administer and offset the costs of running the program in these cases.

Within source protection areas, the Building Code governs mandatory on-site sewage system maintenance inspection programs. You can establish areas where septic system inspections should happen and then these inspections become mandatory. The Ministry of Municipal Affairs and Housing has published a guide to help you implement a septic system inspection program. Other guides are also available to help you deliver your own program, including the Federation of Ontario Cottagers' Associations, who have published a guide for septic system re-inspection programs for lake associations.

Municipal education and outreach programs

Municipal education and outreach programs can also raise awareness of protecting drinking water sources among landowners. These programs advise on the steps landowners can take to protect their own private wells and neighbouring drinking water systems, such as ensuring their septic systems are functioning properly and any sources of contaminants on their property (such as fuel oil and pesticides) are properly stored and managed.

You can collaborate with neighbouring municipalities (or upper tier municipalities, where applicable), conservation authorities and/or health units to roll-out education and outreach programs.

An education and outreach program can include:

- written materials, such as brochures, fact sheets, internet sites, documentation of best management practices
- community outreach, such as presentations before local communities, school programs
- special activities, such as workshops, demonstrations and tours, videos, slide presentations
- media liaison, such as press releases

Local circumstances will guide specific education and outreach requirements.

Best management practices can help protect sources of drinking water by providing guidelines for businesses to follow that can help prevent contaminants from reaching source waters. Often, these guidelines have added benefits to the potential polluter, by reducing costs and liability, improving worker health and safety, and enhancing public image.

> **Example:** Best management practices for chemical handling and storage include implementing an early warning system/emergency response plan for spills and facility shutdown (includes treatment and alternate water distribution).

In addition, you can create incentive programs to help landowners offset the cost of implementing best management approaches.

Conservation Ontario has a wide variety of information and tools to help you undertake education and outreach campaigns on a number of activities that may pose a risk to your drinking water source. In addition, you can also visit local or nearby conservation authority source protection websites for local education and outreach materials.

For Local Services Boards, communities and private landowners

As a Local Services Board, community, or private landowner relying on a shared drinking water source, you have a unique opportunity to protect your drinking water source and those of your neighbours. Even though you do not have the rule-making authority that municipalities and local planning authorities have, you can make a difference by taking steps independently to manage activities that could pose a risk to drinking water.

You can:

- Ensure that septic systems are functioning properly.
- Properly store and manage any on-site sources of potential contamination (such as pesticides and fuel oil tanks).
- Choose native plants and landscaping that may require less fertilizers and pesticides to maintain.
- Ensure proper sealing and decommissioning of nearby abandoned or unused wells.
- Site your well and/or septic system using best practices.
- Self-evaluate the everyday practices and activities occurring around you and/or your community to assess the potential for on-site and off-site contaminants to your system.
- Ensure you have an action plan in place in the event of a spill or contamination.
- Talk to your neighbours and encourage good water stewardship and conservation practices in your community.

Resources are available to help you take action:

- Ontario Ministry of Agriculture, Food and Rural Affairs: Best management practices: Water Wells (Free to order)
- Ontario Well Maintenance Technical Bulletin
- Chapter 4 of the Ministry of the Environment, Conservation and Parks' Water Supply Wells: Requirements and Best Practices document and the Ministry of the Environment, Conservation and Parks Wells on Your Property webpage
- Smart about Salt
- Conservation Authority information/funding opportunities:
  - Central Lake Ontario Conservation Authority – Well Decommissioning Program
  - Lake Simcoe Region Conservation Authority – Decommissioning, rehabilitation of wells on farmland
  - Toronto and Region Conservation Authority – Rural Clean Water Program
- Source Protection Authority websites:
  - Cataraqui – Best management practices for homeowners and the groundwater protection workbook for well and septic owners
  - Trent Conservation Coalition – Landowners Roles and Responsibilities
- Public Health Units:
  - Region of Peel Health Unit – Private Wells
  - Public Health Grey Bruce – Private Drinking Water
- Risk Management Catalogue
- Septic Smart! provides provincial resources for maintaining your septic system

A watershed approach

Knowing more about your watershed will help you understand how your drinking water system fits into the bigger picture of how land use and water supply needs are managed.

A watershed, also known as a drainage basin or catchment area, is an area of land where rain and snow drains or flows into one water body such as a marsh, river or lake. The Provincial Policy Statement defines a watershed as an area that is drained by a river and its tributaries. Watersheds are generally defined by the elevation of the land, also known as topography and neighbouring watersheds are usually divided by areas of high ground. Watersheds can be divided into subwatersheds based on the size of the watershed and the number of streams contributing to the water body.

All the water that enters a watershed flows to the same place, and contamination and land use in one part of the watershed can affect other parts. Understanding your watershed, and the activities occurring within it, can help manage risks to drinking water sources.

For areas of the province with completed source protection plans, watersheds have been characterized by the following key elements:

- boundaries and subwatershed boundaries
- land uses, population and location of towns and cities
- location of drinking water systems and the areas they serve
- water bodies and types of soil and rock in the watershed
- weather conditions
- surface water and groundwater quality and quantity
- water use and potential stresses on water supply
- activities that may pose a risk to drinking water sources

Watershed resources

Many of Ontario's watersheds have already been mapped. The resources listed can help you determine your watershed's boundaries and characteristics. You can add your watershed characteristics to these maps to help you understand the impact of human use activities on your drinking water source:

- Ontario's Watershed Boundary data (Primary, Secondary, Tertiary, and Quaternary)
- Create or order topographic maps
- Geographic data can be found through the Land Information Ontario database
- Make watershed maps and calculate flow and stream characteristics using the Ontario Flow Assessment Tool
- The Source Protection Information Atlas can be used to see watershed and topographic layers for Ontario

You may also wish to contact your local or nearby Conservation Authority through Conservation Ontario for further resources and assistance.

For municipalities

Planning at the watershed scale is useful for long-term consideration of cumulative impacts of development on drinking water sources. You can use source protection information and actions as part of your strategy to protect your watershed and to provide information for understanding watershed characteristics, risks to watersheds, and threats to water quality and quantity of municipal drinking water sources.

Building on drinking water source protection, broader watershed considerations include the following:

- climate change mitigation and adaptation considerations, including the assessment of severe weather events and drought conditions
- water, wastewater and stormwater servicing needs – location and distribution of systems and potential impacts to the quality and quantity of water
- identification of water related areas, features and functions, like significant groundwater recharge areas, that are necessary for the hydrologic integrity of watersheds
- nutrient assessments and land use scenario modelling – to assist in the development of land use and water management goals and recommendations to address the impacts of growth and servicing
- types of plants and trees, wetlands, and other natural characteristics
- impervious cover, like building roofs, parking lots, and roads
- environmental monitoring
- fisheries and other aquatic habitats
- habitats of species at risk

You can incorporate this information into your management strategy to protect your drinking water sources.

Review the actions you are taking to protect drinking water sources

Take our survey to share your feedback on our best practices to protect sources of drinking water.

Review past actions

Reviewing your management actions regularly will help you identify any issues that need immediate action. It will also help you improve or revise your strategy to deal with activities that may pose a risk to your water supply.

You can conduct a simple check-in or a more thorough assessment of your management strategy.

Whoever is responsible for implementing a management action should be asked to review and report regularly on their progress. This kind of review will focus on the status or progress of management actions. Essentially, what you want to know is whether any regulatory policies you developed and put in place are being complied with, and/or whether any non-regulatory policies have been adopted. This may also include regular tracking to ensure that the management actions have not failed.

> **Example:** If you have built a fence to keep cattle away from a drinking water well or have upgraded storage facilities for fuel or other chemicals, these installations should be inspected regularly to ensure they continue to provide protection.

Environmental monitoring

Source protection is based on preventing contamination, rather than restoring a source that has already been contaminated. Tracking the implementation of the management activities, rather than sampling and testing water, may give you a better idea about whether your source of water is being protected.

Environmental monitoring, which includes taking samples and testing water in your area, may only provide beneficial information about how effective a management action is in a small number of situations.

> **Example:** Environmental monitoring may be appropriate if testing of the raw water in your drinking water system over time has shown that your current source is contaminated. For these situations, monitoring can establish a baseline, if unknown, and measure improvements in the water quality as a result of the management actions. This type of monitoring should be linked to a specific property(ies) or activity within the protection zone; otherwise it could be very difficult to show a connection between specific activities and concentrations of contaminants in the watershed.

If there is no contamination identified in the raw water, sampling raw water would not provide information about management activities.

Regulated drinking water system operators are required to test water regularly. Reviewing the data collected by the drinking water system's operating authority may help you identify whether there are any changes in the quality of your drinking water source. You can request test results from the drinking water system owner/operating authority directly. In addition, information on previous years sample results are available in the open data drinking water datasets.

For municipalities

For ideas on how to track the implementation progress of management actions, see the table below.

Management tool	Who implements	What to look for	How to find it
Land use planning (for example, official plans, zoning by-laws)	Municipalities and planning authorities	Changes to official plans or zoning by-laws to map and establish policies that recognize the drinking water source protection zones	Contact the municipal planning department or clerk

Management tool	Who implements	What to look for	How to find it
Municipal by-laws and Building Code	Municipalities and planning authorities	Changes to municipal by-laws (for example, downspout disconnection by-laws, sewer use by-laws, household hazardous waste by-laws) and septic inspection programs	Contact the municipal public works or building department, or clerk to identify any new by-laws and the results of compliance programs (for example, inspections, surveys, testing)
Education and outreach, incentive programs, best management practices	Municipalities, conservation authorities, Local Services Boards, communities, social agencies, health unit, private owners	New or revised programs created and delivered over time, number of people participating in the programs, impact of programs	Contact the municipal clerk, conservation authority communications specialist, or any other local agencies that may be involved in environmental or public health initiatives

Update your management strategy and communicate progress

Continuous improvement is an important part of taking action to protect your drinking water source.

Update your management strategy as new information, such as technical data, new activities or updated land use planning documents, becomes available. You can use new information to update your inventory, reprioritize activities, and evaluate the appropriateness of your current management tools.

If local actions are not working, you may want to consider source protection planning under the *Clean Water Act*.

For municipalities and communities

Regular progress reporting identifies implementation challenges so that they can be addressed through changes to your management strategy. A report is a good tool for tracking and communicating your progress to the people who live in your municipality or community. Annual reports, like those required under the *Clean Water Act*, may be suitable to track progress and success of local programs/policies. Local source protection authority websites have examples of annual progress reports that you can refer to. You can change the frequency of the reports depending on your local needs and resources.

To create a report, begin by listing the management actions taken. Then, identify whether the action has been completed. For each of the actions, take the time to contact the person or organization responsible, and talk with them to identify:

- whether the action has been implemented
- whether any problems were identified
- whether anything needs to change

If your municipality or community has multiple drinking water systems and you've identified several protection zones, you may decide to create a report for each zone, or one report for all. It is up to you to determine the best way to organize and present the information.

A simplified report can be formatted and graded like a school report card, listing the effectiveness of the management activities, progress, and areas for improvement. Conservation authorities use report cards to grade watershed health in order to target management actions to address specific issues.

Include optional drinking water sources in a source protection plan

Take our survey to share your feedback on our best practices to protect sources of drinking water.

Overview

The *Clean Water Act* is one of many ways to protect drinking water. The purpose of the *Clean Water Act* is to protect existing and future sources of drinking water. The *Clean Water Act* requires source protection plans to include sources of water that supply municipal residential drinking water systems within established source protection areas. The *Clean Water Act* also allows for the protection of other drinking water sources within and outside established source protection areas.

Source protection plans under the *Clean Water Act* are locally developed and provincially-approved action plans. For drinking water systems that are not included in a source protection plan under the *Clean Water Act*, the province promotes using existing municipal and provincial regulatory tools, such as the Planning Act, Municipal Act, septic inspection programs under the Building Code and provincial environmental approvals and permits, along with incentive programs, education and outreach initiatives, and other direct actions, such as setting up secondary spill containment, inspecting your own septic system routinely, choosing alternatives to road salt and putting up a fence to keep cattle out of a stream, to ensure drinking water sources are protected.

If a drinking water system is brought into a source protection plan, it is subject to all the requirements of the *Clean Water Act*. This means that the system will undergo a rigorous scientific risk assessment, policy development and source protection plan implementation. This includes:

- Technical studies of the drinking water source
- Identifying activities that may pose a risk to the drinking water source
- Developing policies that manage activities that may pose a risk to the drinking water source
- Assessing uncertainty with the information used to support decision making
- Reporting annually to track implementation of policies
- Continuous improvement updates to the source protection plan

All property owners located in any delineated protection zones in a source protection plan are subject to all applicable plan polices. In some cases, a locally-directed source protection strategy for smaller or remote drinking water systems may be more appropriate to address very specialized and local considerations, instead of including the system in a source protection plan under the *Clean Water Act*. However, if you have tried an approach outside of the *Clean Water Act* and it isn't working, you may be able to bring your drinking water system into a provincially-approved source protection plan if you are located within a source protection area, or develop a source protection plan under the *Clean Water Act* if you are located outside of a source protection area.

Source protection areas are set out in regulations under the *Clean Water Act* and largely based on conservation authority watershed boundaries, covering most of southern Ontario and several urban centres in the north. Use the interactive Source Protection Information Atlas tool to see if you are located in a source protection area.

If you are located within a source protection area

There are options available if your drinking water source is located within a source protection area, after considering an approach outside of the *Clean Water Act*.

For municipalities

Unlike municipal residential drinking water systems, you can choose to include other types of drinking water systems located in source protection areas in the source protection planning process. If you have already tried an approach using your existing tools and have determined that you need the enforcement tools under Part IV of the *Clean Water Act* or land use planning decision-making compliance, you may want to consider including other drinking water systems.

Sections 57, 58 and 59 of the *Clean Water Act* ("prohibited activities", "regulated activities" and "restricted land uses", respectively) establish regulatory tools to address activities that are, or would be, significant drinking water threats. These are sometimes called Part IV tools because their authority is established by Part IV of the *Clean Water Act*.

Subsection 39(1) of the *Clean Water Act* requires that decisions under the Planning Act or the Condominium Act must conform with applicable significant threat policies set out in the source protection plan. These policies are legally binding on decision-makers, including municipal councils, municipal planning authorities, planning boards, and the Local Planning Appeal Tribunal (formerly the Ontario Municipal Board) and cannot be appealed.

Generally, any drinking water systems that are not municipal residential drinking water systems serving or planned to serve major residential developments may be included in the source protection planning process. Other types of drinking water systems that can be included in source protection plans through municipal council resolution are prescribed in regulation. Section 4.1 of the General Regulation (Ontario Regulation 287/07 made under the *Clean Water Act*) allows for an existing non-municipal drinking water system that serves one private residence and no other facility to be included in a source protection plan if:

- the well or intake serving the system is one of a **cluster** of six or more wells or intakes,
- the system is in an area of settlement (as defined in the Planning Act), or
- the private residence is a designated facility or public facility (as defined in Ontario Regulation 170/03).

Ontario Regulation 287/07 under the *Clean Water Act* does not describe the relative distance of the wells or intakes that make up a **cluster**. The definition of a cluster is open to interpretation so that a wide variety of natural conditions can be considered.

There are two options to include other types of drinking water systems: municipal council resolution or minister's designation.

- Subsection 8(3) of the *Clean Water Act* gives municipalities the authority to pass a municipal council resolution to add other drinking water systems to the terms of reference for local source protection plans.
- Subsection 10(6) of the *Clean Water Act* grants the Minister of the Environment, Conservation and Parks the authority to require other drinking water systems to be included in the source protection planning process.

For First Nations on reserve

The *Clean Water Act* allows drinking water systems serving reserves located within or adjacent to an existing source protection area to be considered as part of the source protection planning process.

There are several opportunities for your community to participate in the drinking water source protection process under the *Clean Water Act*, including:

- participate as a member of a source protection committee (where seats are available and your community has identified a representative)
- review and comment on amendments to source protection plans
- submit a First Nation band council resolution requesting that an existing or planned drinking water system serving or planned to serve a reserve be included in a source protection plan

If protection under the *Clean Water Act* is the best choice for your community, the process of including your system would be initiated by resolution of a First Nation band council. The province would then have the authority to include (through amendment to Ontario Regulation 287/07) your drinking water system. The specific details of including your system in the source protection planning process would be determined through discussions with the source protection authority and ministry, including identifying who would conduct the technical studies (the First Nation, the source protection authority, etc.) and how traditional knowledge will be considered.

Did you know?

Three communities have included their drinking water source in local source protection plans by Lieutenant Governor in Council regulation:

- Chippewas of Rama (South Georgian Bay-Lake Simcoe Source Protection Region)
- Six Nations of the Grand River (Lake Erie Source Protection Region)
- Chippewas of Kettle and Stony Point (Thames-Sydenham Source Protection Region)

Read about their source protection plan policies in the local source protection plans listed on the Conservation Ontario website.

For local planning authorities, communities and private landowners

If you are concerned about your source water, consult with the local source protection authority to determine if the *Clean Water Act* legal framework will address your specific concerns before requesting a municipal council resolution to include the system in a provincially-approved source protection plan.

If you are located outside of a source protection area

There are options available if you are located outside of a source protection area, after considering an approach outside of the *Clean Water Act*.

The Minister of the Environment, Conservation and Parks has the authority under subsection 108(c) of the *Clean Water Act* to create a new source protection area through regulation and in doing so may also name a person or body to be the source protection authority under section 5 of the *Clean Water Act*. The Minister may also use this authority to address drinking water systems in unorganized territories.

Did you know?

There are two source protection areas (Northern Bruce Peninsula and Severn Sound) that do not have Conservation Authorities that are set out in Ontario Regulation 284/07.

For municipalities

Under section 26 of the *Clean Water Act*, you can develop a source protection plan via an agreement between your municipality, or group of municipalities, and the Minister of the Environment, Conservation and Parks. The

Minister has wide authority under this provision to include any type of drinking water system in the agreement and to specify the nature and scope of the risk assessment and source protection plan (per subsection 26(4)).

Many municipalities in northern Ontario and other locations outside source protection areas have undertaken studies to help identify threats to their sources of drinking water. These studies, coupled with existing tools and legislation, can be used together to protect these sources of drinking water.

Contact us

For more information, email the Conservation and Source Protection Branch at the Ministry of the Environment, Conservation and Parks at source.protection@ontario.ca.